FINAL

Preliminary Assessment/Site Inspection Report

August 2020

Joint Base Lewis-McChord

Pierce County, Washington

Joint Base Lewis-McChord Public Works – Environmental Division

IMLM-PWE

MS 17 Box 339500

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SIGNATURE PAGE

FINAL
Preliminary Assessment/Site Inspection Report
Joint Base Lewis-McChord, Washington

August 2020

Prepared For:

Joint Base Lewis-McChord Public Works – Environmental Division
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EXECUTIVE SUMMARY

Joint Base Lewis-McChord (JBLM) Public Works Environmental Division conducted a Preliminary Assessment (PA)/Site Inspection (SI) to assess if per- and polyfluorinated alkyl substances (PFAS) have been released to the environment at JBLM located in Pierce County, Washington. The objective of the PA was to identify locations that are areas of potential interest (AOPIs) based on whether there was use, storage or disposal of any PFAS-containing material. The objective of the SI was to identify whether there has been a release to the environment from the AOPIs identified during the PA and determine the presence or absence of perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA) and perfluorobutane sulfonate (PFBS) at or above screening levels (SLs).

The PA identified 24 generalized AOPIs, which are presented in Table ES-1. Within the 24 AOPIs, at least 52 known/potential PFAS use, storage or disposal operations were identified, including fire-fighting training, fire-fighting equipment testing/storage areas, emergency responses in hangars with aqueous film-forming foam (AFFF) fire suppression systems, AFFF storage areas, historical waterproofing operations, vehicle wash rack operations, laundry operations, and landfills.

Twenty of the AOPIs were investigated during the SI, which was conducted in three phases. Phase I, which included groundwater sample collection from 38 existing monitoring wells, sampling of influent and effluent for three groundwater pump and treat systems, and the collection of eight surface water samples, was conducted in June of 2018. The Phase II and Phase III events were performed from January through May 2019 and comprised sampling of existing monitoring wells and the installation and sampling of new monitoring wells. Samples were collected from 34 monitoring wells, 14 existing groundwater monitoring wells and 19 newly installed wells. Additionally, 13 drinking water samples were collected from off-base production wells operated by publicly owned entities or cities.

The United States (U.S.) Department of Defense has adopted a policy to retain facilities in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process based on risk-based SLs for soil and groundwater, as described in a memorandum from the Office of the Secretary of Defense (OSD) dated 15 October 2019 (Assistant Secretary of Defense, 2019). The OSD SLs established for groundwater are 40 parts per trillion (ppt) (or 40 nanograms per liter) for PFOS and PFOA, individually, and 40 micrograms per liter or parts per billion (ppb) for PFBS, as presented in Table ES-2. The SI was conducted prior to the release of the 2019 OSD memo, and as a result, soil was not evaluated during this SI. Assessment of results against other screening criteria presented in this report are considered informational in nature and serve as an indication as to whether groundwater and surface water contain or do not contain the 14 PFAS analyzed during the SI.

The geologic units underlying JBLM and the surrounding area consist primarily of Pleistocene-age glacial deposits. These units comprise a complex system of stacked aquifers and confining units, which include the following:

- Upper Vashon Aquifer (A1): Vashon Drift (Steilacoom gravel, recessional outwash). Material consists of stratified sand, silt and gravel, thickness of 35 feet to greater than 200 feet.
- Confining Unit (A2): Vashon Drift (Vashon Till, ice contact, moraine and glaciolacustrine deposits). Material consists of clay, silt, sand, and gravel; discontinuous/missing in places;

can provide a conductive pathway between Upper Vashon Aquifer and Lower Vashon Aquifer; thickness ranges from a thin veneer to 150 feet on a regional scale.

- Lower Vashon Aquifer (A3): Vashon Drift (advance outwash). Material consists of well sorted sand or sand and gravel with silt and clay lenses; average thickness is 75 feet.
- Confining Unit (B): Olympia Beds (Kitsap Formation), Lawton Clay. Material consists primarily of silts and clays; thickness of 10-20 feet where present on JBLM; discontinuous/missing in places; can provide a conductive pathway between Vashon Aquifers and lower Sea Level Aquifer.
- Sea Level Aquifer (C): Salmon Springs Drift, Penultimate Drift, Hayden Creek Drift, and Wingate Hill Drift (glacial drift). Materials consist of sand and gravel, pebble to cobble gravel, with minor lenses of silt, clay, till, and volcanic ash; thickness of 50 to 100 feet.
- Confining Unit (D): Puyallup Formation (alluvial and lacustrine deposits). Material consists of alluvial and lacustrine sand, silt, clay, and occasional volcanic ash; average thickness is 100 feet.
- Stuck Aquifer (E): Stuck Drift (glacial drift). Material consists primarily of silt, sand, and gravel with discontinuous till and lacustrine deposits; thickness ranges from a thin veneer to greater than 200 feet.
- Confining Unit (F): Alderton Formation. Consists primarily of silt and clay, with minor lenses of sand and gravel; thickness ranges from 50 feet to greater than 300 feet.
- Orting Aquifer (G): Orting Drift. Material consists primarily of stratified sand and gravel with discontinuous layers of till.

Base-wide groundwater flow has been assessed by the U.S. Geological Survey (Savoca et al. 2010). The SI component looked at the A1 (Upper Vashon), A2 (confining unit), A3 (Lower Vashon), B (Kitsap Formation), and C (Sea Level Aquifer) formations described above. Groundwater flow in the Upper and Lower Vashon Aquifers is generally to the north-northwest across the base. Groundwater flow in the Sea Level aquifer is to the north-northwest in the southern and eastern portions of the base. Groundwater in the Sea Level Aquifer flow bends to the west in the central and western portions of the base.

Seventy-seven (77) groundwater water samples were collected and analyzed for 14 PFAS compounds, along with eight duplicate samples. These samples were collected from existing and new groundwater monitoring wells, operating remediation systems, and surface water bodies on-base locations. Of these samples, 60 were collected from wells screened in the Vashon Aquifer, 16 were collected from wells screened in the Sea Level Aquifer, and 1 sample was interpreted to be collected from a well screened in the Stuck Formation.

PFOS was measured at concentration greater than the 40 ppt OSD SL in 23 of the 77 analyzed samples. PFOS concentrations greater than 40 ppt ranged from 44 ppt to 28,000 ppt. PFOA was measured at a concentration greater than 40 ppt in 12 of the 77 analyzed samples. PFOA concentrations greater than 40 ppt ranged from 44 ppt to 1,400 ppt. PFBS was not measured at a concentration greater than 40 ppb in any of the 77 analyzed samples. The highest measured PFBS concentration was 630 ppt.

In most cases, PFOS was the dominant compound compared to PFOA, with higher measured concentrations. Several monitoring wells sampled during the SI, which are positioned on the JBLM boundary, detected concentrations of PFOS above the OSD SL of 40 ppt.

Thirteen water samples were collected from off-base production wells operated by publicly owned entities or cities (Table 5-3): Six samples from the Vashon Aquifer, five samples from the Sea Level Aquifer, and two from the Stuck Formation.

The sum of PFOS and PFOA only was not measured at a concentration greater than the 70 ppt U.S. Environmental Protection Agency Health Advisory Level in any of the 13 sampled off-base production wells. These samples contained the sum of PFOS and PFOA only at concentrations ranging from a reported non-detect to 62 ppt.

The dominant compound in these samples varied between PFOS and PFOA.

Based on a comparison of SI sampling results to the OSD SLs, there are 13 remaining AOPIs. These 13 AOPIs require further evaluation. Table ES-3 presents the SI findings and summarizes which AOPIs require further investigation under CERCLA based on a comparison of SI analytical results to the OSD SLs.

Table ES-1
Summary of PA Findings

AOPI	Known/Potential PFAS Operations/Uses	General Location	Potential Concern	Approximate Years of Operation	Recommended for SI sampling based on potential concern?
AOPI 1 – McChord Airfield Runway	McChord – Aircraft Accident Responses	Along the McChord field runway, from north end to south end, and beyond in approach zones	Potential use of AFFF for firefighting, and release to surrounding environment.	1950 through 1991	Yes
	Landfill #12	McChord –south portion middle of runway	Landfill used for wastes including domestic solid waste.	1939- 1952	Yes
AOPI 2 – McChord Airfield Historical FT Area 027	FT027	McChord - located along the north end of the main runway	Historical use for firefighting practice.	1960 through 1977	Yes
AOPI 3 – McChord Airfield, North Hangar Area	Hangar 5 Building 1178	McChord - Northwestern portion	AFFF systems, and releases of AFFF to adjacent surfaces.	1967 through present day	Yes
	McChord AFFF Sump between Hangars 5 and 6	McChord – Protrudes from underground between Hangars 5 and 6	Potential release of AFFF from sump.	Unknown date through present day	Yes
	Hangar 6 Building 1160	McChord - Northwestern portion	AFFF systems, and releases of AFFF to adjacent surfaces. System activation release in 2009, foam was approximately 3 feet deep in hangar. System activation was reportedly due to freezing temperature conditions. Release from the system of an unknown volume of AFFF in 2011. Dripping to ground surface was observed from AFFF system drainage pipe on exterior wall.	1999 through present day	Yes

Table ES-1 (Continued)
Summary of PA Findings

AOPI	Known/Potential PFAS Operations/Uses	General Location	Potential Concern	Approximate Years of Operation	Recommended for SI sampling based on potential concern?
AOPI 3 – McChord Airfield, North Hangar Area (cont'd)	Hangar 7 Building 1164	McChord - Northwestern portion	AFFF systems, and releases of AFFF to adjacent surfaces. AFFF concentrate release in 2010 of approximately 5 to 10 gallons to mechanical room.	1958 through present day	Yes
	Hangar 9 Building 1166	McChord - Northwestern portion	AFFF systems, and releases of AFFF to adjacent surfaces.	1958 through present day	Yes
	McChord AFFF Sump between Hangars 9 and 10	McChord – Located underground between 9 and 10	Potential release of AFFF from sump.	Unknown date through present day	Yes
	Hangar 10 Building 1167	McChord - Northwestern portion	AFFF systems, and releases of AFFF to adjacent surfaces. Dripping to interior floor surface was observed from AFFF AST inside hangar.	1958 through present day	Yes
	McChord Flight line Infield – 4 Aviation Fuel Tanks	McChord – Four bulk fuel tanks located within infield east of Hangars 9 & 10	Potential use of AFFF for firefighting, and release to surrounding environment.	Unknown date through present day	Yes
	Hangar 13 Building 1174	McChord - Northwestern portion	AFFF systems, and releases of AFFF to adjacent surfaces. AFFF concentrate release in 2017 of approximately 50 gallons to mechanical room. AFFF concentrate release in approximately 2016 of approximately 1,500 gallons to mechanical room.	1999 through present day	Yes
	McChord AFFF Sump West of Hangar 13	McChord – Located underground West of Hangar 13	Potential release of AFFF from sump.	Unknown date through present day	Yes

Table ES-1 (Continued)
Summary of PA Findings

AOPI	Known/Potential PFAS Operations/Uses	General Location	Potential Concern	Approximate Years of Operation	Recommended for SI sampling based on potential concern?
AOPI 4 - McChord Airfield Historical FT 028, FT029, FT030	FT028	McChord - west of the perimeter road	Historical use for firefighting practice.	One to two years during the early 1960s	Yes
	FT029	McChord – Reportedly of the confluence of Clover Creek and Morey Creek	Historical use for firefighting practice.	Unknown	No, site location misidentified during historical investigations
	Historical FT Area 30	McChord – southeast of the hazardous cargo loading area	Historical use for firefighting practice.	1955 to 1960	Yes
AOPI 5 - McChord Airfield, South Hangar Area	Historic FT Area 033 Fire Station #105/ Building J00006	McChord – Area of Building J00006	Historical use for firefighting practice. Current storage of bulk AFFF, and refilling of ARFFs. Test application of AFFF spray pattern onto flight line. Dripping to interior floor surface was observed from AFFF AST inside fire station garage.	Used as FT-33 from 1940s through 1950 Fire station in use through present day	Yes
	Clover Creek	McChord – Crosses via culvert beneath middle of runway, and then flows on surface towards northwest, extending to west boundary of JBLM, many outfalls to creek that have collected storm water from McChord airfield.	Receiving storm water from hangars equipped with AFFF systems, and other historical AFFF releases.	Present day feature. AFFF systems remain in nearby hangars, therefore a potential source of PFAS	Yes
	Hangars 1 and 2 Buildings J00001 and J00002	McChord - West of central portion of runways	AFFF systems, and releases of AFFF to adjacent surfaces.	1939 through present day	Yes

Table ES-1 (Continued)
Summary of PA Findings

AOPI	Known/Potential PFAS Operations/Uses	General Location	Potential Concern	Approximate Years of Operation	Recommended for SI sampling based on potential concern?
AOPI 5 - McChord Airfield, South Hangar Area (cont'd)	Hangars 3 and 4 Buildings J00003 and J00004	McChord - West of central portion of runways	AFFF systems, and releases of AFFF to adjacent surfaces. System activation release in 2012 of approximately 3,000 gallons, foam accumulated 20 feet deep in hangar. System activations also possibly in 2008, 2010, 2012 & 2013, release volume unknown.	1939 through present day	Yes
	Hangar 301 McChord Field Runway	McChord – South end, west side of McChord Field runway	AFFF systems, and releases of AFFF to adjacent surfaces.	1957 through present day	Yes
	Historical wash rack and Taxiway D	McChord – Northwest of Hangar 2	Historical use of surfactants at Wash Rack/ARFF vehicles foam spray pattern testing at Taxiway D.	1950s through early 1970s	Yes
AOPI 6 – McChord Airfield FT031, FT032, Landfill 022, Landfill 013	FT031	McChord - East side of runway, approximately 500 feet south of Morey Creek	Historical use for firefighting practice.	1950 to 1955	Yes
	FT032	McChord - East side of runway, near Clover Creek	Historical use for firefighting practice and AFFF use.	1975 through 1990, reconstructed in 1997 to current configuration	Yes
	Landfill 013	McChord - East side of runway, approximately 800 feet south of FT 032	Disposal of soils excavated from FT032.	1950 – 1979. Soils excavated from FT032 were deposited possibly in 1990	Yes
AOPI 7 – McChord Airfield Main Bulk Fuel Tank Farm	McChord – Main Bulk Fuel Tank Farm	West of North Well	Potential use of AFFF for firefighting, and release to surrounding environment.	Unknown date to present day	Yes

Table ES-1 (Continued)
Summary of PA Findings

AOPI	Known/Potential PFAS Operations/Uses	General Location	Potential Concern	Approximate Years of Operation	Recommended for SI sampling based on potential concern?
AOPI 8 – American Lake Garden Tract Landfill 005	Landfill 005	Northeast of Logistics Center and Landfill #2	Potential leaching of PFAS compounds to groundwater.	1951 – 1961, waste oil burning 1952 - 1964.	Yes
AOPI 9 – Northwest Logistics Center	Historical waterproofing in area of Buildings 9570/9580	Logistics Center, northwest portion	Historical use of waterproofing.	Unknown	Yes
AOPI 10 – Central Logistics Center	Building 9612 Current wash rack	Northeast of Rainier Drive	Surfactants use.	Unknown date through present day	Yes
	Building 9626 Historical wash rack	North of Rainier Drive and South L Street intersection	Historical surfactants use.	Unknown	Yes
	Building 9636 Bulk “Fuel Spot"	Logistics Center, center portion	Potential release from AFFF system. This is dry system charged only during fire, so no PFAS supply remains onsite.	Unknown date through present day	Yes
	Historical waterproofing in area of Buildings 9630/9640	Logistics Center, middle northwest portion	Historical use of waterproofing.	Unknown	Yes
	Historical Laundry-Building 9060	Logistics Center	Historical use of surfactants.	Unknown	Yes
AOPI 11 – Logistics Center Landfill #2	Landfill #2	Southeast of Logistics Center	Potential leaching of PFAS compounds to groundwater.	1940s to 1970s	Yes
AOPI 12 – Lewis North Landfill #4	Lewis North - Landfill #4	North of Sequalitchew Lake	Potential leaching of PFAS compounds from landfill contents to groundwater.	1951 - 1967	Yes
AOPI 13 – Lewis North AOC 15-1 and Wash Rack	AOC 15 (1957)	Along north side of South Drive	Historical use of AFFF for firefighting practice.	At least in the 1950s	Yes
	Current wash rack	South Drive and A Street Intersection Adjacent to Lewis North AOC 15-1 and 15-2	Surfactants use.	Unknown date through present day	Yes

Table ES-1 (Continued)
Summary of PA Findings

AOPI	Known/Potential PFAS Operations/Uses	General Location	Potential Concern	Approximate Years of Operation	Recommended for SI sampling based on potential concern?
AOPI 14 – Historic Solvent Refined Coal Power Plant	SRCPP (FTLE-32)	South of Sequalitchew Lake, near drinking water production Well 12B	Unknown compounds used in coal solvent refining process, could have included PFAS, proximal to Sequalitchew Spring Well and Well 12 A/B.	1974 - 1981	Yes
AOPI 15 – Lewis North Landfill #5	Landfill #5	West side of Lewis North	Potential leaching of PFAS compounds from landfill contents to groundwater, wastewater treatment plant biosolids disposal, surface water drainage to the landfill and infiltration through landfill contents.	Primarily in 1950s through 1960s, with non-landfilling operations in more recent years	Yes
AOPI 16 – Gray Army Airfield Hangars 3106, 3146, 3101 and FTLE-17	Army National Guard Hangar 3106	Ft Lewis – Northeast corner of Gray Army Airfield	AFFF system, and releases of AFFF to adjacent surfaces. AFFF concentrate release in approximately 1985 of unknown volume to mechanical room.	1985 through present day	Yes
	FTLE-17	Ft Lewis – Within northeast portion of Gray Army Airfield flight line, approximately 600 feet northwest of Hangar 3146, beneath 10” thick concrete helicopter ramp (parking)	Historical Fire Training Area.	1962 - 1982	Yes
	Hangar 3146	Ft Lewis – Within northeast portion of Gray Army Airfield, south of larger Hangar 31010 (31010 is very new hangar)	AFFF system, and releases of AFFF to adjacent surfaces. AFFF concentrate release in 2001 of approximately 10 gallons to mechanical room.	1987 through present day	Yes
	Hangar 3101	Northeast Portion of Gray Army Airfield	AFFF system, and releases of AFFF to adjacent surfaces.	Constructed last year so not used with PFAS AFFF	No

Table ES-1 (Continued)
Summary of PA Findings

AOPI	Known/Potential PFAS Operations/Uses	General Location	Potential Concern	Approximate Years of Operation	Recommended for SI sampling based on potential concern?
AOPI 17 – Gray Army Airfield Hangar 3273 and storm drainage	Army Reserve Hangar 3273	Ft Lewis – Southeast Portion of Gray Army Airfield, East of Flight Line	AFFF system, and releases of AFFF to adjacent surfaces.	2006 through present day	Yes
	Storm water Drainage Swale near Hangar 3273	Approximately 500 feet southwest of Hangar 3273	Receives storm water from near hangar equipped with AFFF System.	Unknown date through present day	Yes
AOPI 18 – Lewis Main SWMU-47 and FLT-54 Wash Rack	SWMU-47 Historical Firefighting Training Area	Ft Lewis – Southeast of Gray Army Airfield, west of wash rack	Historical Firefighting Training Area.	Unknown date range	Yes
	FLT-54 Wash Rack Equipment 3559 - 3562	South of Gray Army Airfield - near SWMU-47	Surfactants.	Unknown date through present day	Yes
AOPI 19 – Gray Army Airfield Hangar 3063 and Fire Station 102	Hangar 3063	Gray Army Airfield – along flight line on west side	AFFF system, and releases of AFFF to adjacent surfaces. Reported AFFF release of one pint in 2009.	Unknown date through present day	Yes
	Fire Station 102 – Building 3081	Gray Army Airfield – along flight line on west side	AFFF bulk storage in adjacent outbuilding. AFFF storage and refilling.	Unknown date through present day	Yes
AOPI 20 -Gray Airfield Hangar 3098 and Buildings 3095 and 3099	Hangar 3098	West side of Gray Army Airfield	AFFF system, and releases of AFFF to adjacent surfaces. AFFF concentrate release in 2008 of approximately 250 gallons to mechanical room.	Unknown date through present day	Yes
	Building 3095	West side of Gray Army Airfield	AFFF system, and releases of AFFF to adjacent surfaces.	Unknown date through present day	Yes
	Building (Temporary) 3099	Gray Army Airfield – along flight line on west side	AFFF release reportedly occurred inside of an aircraft. Reported AFFF release of 500 gallons to the inside of an aircraft.	Unknown date through present day	Yes

Table ES-1 (Continued)
Summary of PA Findings

AOPI	Known/Potential PFAS Operations/Uses	General Location	Potential Concern	Approximate Years of Operation	Recommended for SI sampling based on potential concern?
AOPI 21 – Gray Airfield Landfill #1	Landfill #1	Approximately 1,000 feet west of southwest corner Gray Army Airfield	Potential leaching of PFAS compounds to groundwater.	1946 – 1951, or through early 1970s (sources vary)	Yes
AOPI 22 – Lewis Main Fire Station 7 Building 2014	Fire Station 7 – Building 2014	On Pendleton Avenue, between 3rd and 4th Streets	AFFF storage in, and refilling of, ARFFs, and delivery of bulk quantities of AFFF. Dry wells indicated as adjacent to building.	Unknown date through present day	Yes
AOPI 23 – Lewis Main Buildings 04074,04076, 1401, 4100, 1206 and 1210	Buildings 04074 & 04076	West part of Ft Lewis – Southwest of Traffic Circle	Historical canvas waterproofing.	Specific date range not known. Was observed active in 1990s	Yes
	Building 1401 - Formerly known as Building 1402 Historical Laundry operation since 1941	West part of Lewis Main – South of I-5 near Exit 119/ Dupont Gate	Historical use of surfactants at laundry operation.	1941 through 1999	Yes
	Fire Station 1 – Building 4100	Northwest of Intersection of West Way and Lewis Drive	AFFF storage in, and refilling of, ARFF vehicles, and delivery of bulk quantities of AFFF.	Unknown date through present day	Yes
	Buildings 1206/ 1210 Ranges	West Lewis Main (Forestry)	Storage of AFFF, and unknown area of use.	Unknown. A database of chemicals distributed to various locations, indicated AFFF was on inventory here in 2003-2004)	Yes
AOPI 24 - Lewis Main Landfill #9	Landfill #9	West part of Ft Lewis – I-5 Interchange, Exit 118, south and north of I-5	Potential leaching of PFAS compounds from landfill contents to groundwater.	1930s and 1950s	Yes

Table ES-2
OSD Screening Levels

Analyte	Tap Water (Groundwater) (ng/L)
PFOS	40
PFOA	40
PFBS	40,000

Notes:
Assistant Secretary of Defense, 2019. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS in Groundwater and Soil using U.S. Environmental Protection Agency's Regional Screening Level Calculator. Hazard Quotient=0.1. 15 October 2019.
If only one PFAS is present, a Hazard Quotient of 1 applies and the values presented would increase by a factor of ×10.

ng/L – nanogram per liter

Table ES-3
SI Findings and Recommendations

AOPI	Known/Potential PFAS Operations/Uses	SI Groundwater Samples Exceeded OSD SLs	Not Evaluated	Further Evaluation Required	Further Evaluation Not Required
AOPI 1 – McChord Airfield Runway	McChord – Aircraft Accident Responses	X		X	
	Landfill #12	X		X	
AOPI 2 - McChord Airfield Historical FT Area 027	FT027				X
AOPI 3 – McChord Airfield, North Hangar Area	Hangar 5 Building 1178	X		X	
	McChord AFFF Sump between Hangars 5 and 6	X		X	
	Hangar 6 Building 1160	X		X	
	Hangar 7 Building 1164	X		X	
	Hangar 9 Building 1166	X		X	
	McChord AFFF Sump between Hangars 9 and 10	X		X	
	Hangar 10 Building 1167	X		X	
	McChord Flight line Infield – 4 Aviation Fuel Tanks		X	X	
	Hangar 13 Building 1174	X		X	
	McChord AFFF Sump West of Hangar 13	X		X	
AOPI 4 - McChord Airfield Historical FT 028, FT029, FT030	FT028		X	X	
	FT029		X	X	
	Historical FT Area 30		X	X	
AOPI 5 - McChord Airfield, South Hangar Area	Historic FT Area 033 Fire Station #105/ Building J00006	X		X	
	Clover Creek	X		X	
	Hangars 1 and 2 Buildings J00001 and J00002	X		X	
	Hangars 3 and 4 Buildings J00003 and J00004	X		X	
	Hangar 301 McChord Field Runway	X		X	
	Historical wash rack and Taxiway D		X	X	
AOPI 6 – McChord	FT031		X	X	

Table ES-3 (Continued)
SI Findings and Recommendations

AOPI	Known/Potential PFAS Operations/Uses	SI Groundwater Samples Exceeded OSD SLs	Not Evaluated	Further Evaluation Required	Further Evaluation Not Required
Airfield FT031, FT032, Landfill 022, Landfill 013	FT032	X		X	
	Landfill 013	X		X	
	Landfill 022	X		X	
AOPI 7 – McChord Airfield Main Bulk Fuel Tank Farm	McChord – Main Bulk Fuel Tank Farm		X	X	
AOPI 8 – American Lake Garden Tract Landfill 005	Landfill 005				X
AOPI 9 – Northwest Logistics Center	Historical waterproofing in area of Buildings 9570/9580		X	X	
AOPI 10 – Central Logistics Center	Building 9612 Current wash rack		X	X	
	Building 9626 Historical wash rack		X	X	
	Building 9636 Bulk “Fuel Spot"		X	X	
	Historical waterproofing in area of Buildings 9630/9640		X	X	
	Historical Laundry-Building 9060		X	X	
AOPI 11 – Logistics Center Landfill #2	Landfill #2				X
AOPI 12 – Lewis North Landfill #4	Lewis North - Landfill #4				X
AOPI 13 – Lewis North AOC 15-1 and Wash Rack	AOC 15 (1957)		X	X	
	Current wash rack		X	X	
AOPI 14 – Historic Solvent Refined Coal Power Plant	SRCPP (FTLE-32)		X	X	
AOPI 15 – Lewis North Landfill #5	Landfill #5				X
AOPI 16 – Gray Army Airfield Hangars 3106, 3146, 3101 and FTLE-17	Army National Guard Hangar 3106	X		X	
	FTLE-17	X		X	
	Hangar 3146	X		X	
	Hangar 3101	X		X	
AOPI 17 – Gray Army Airfield Hangar 3273 and storm drainage	Army Reserve Hangar 3273	X		X	
	Storm water Drainage Swale near Hangar 3273	X		X	
AOPI 18 – Lewis Main SWMU-47 and FLT-54	SWMU-47 Historical Firefighting Training Area				X

Table ES-3 (Continued)
SI Findings and Recommendations

AOPI	Known/Potential PFAS Operations/Uses	SI Groundwater Samples Exceeded OSD SLs	Not Evaluated	Further Evaluation Required	Further Evaluation Not Required
Wash Rack	FLT-54 Wash Rack Equipment 3559 - 3562				X
AOPI 19 – Gray Army Airfield Hangar 3063 and Fire Station 102	Hangar 3063	X		X	
	Fire Station 102 – Building 3081	X		X	
AOPI 20 -Gray Airfield Hangar 3098 and Buildings 3095 and 3099	Hangar 3098	X		X	
	Building 3095	X		X	
	Building (Temporary) 3099	X		X	
AOPI 21 – Gray Airfield Landfill #1	Landfill #1				X
AOPI 22 – Lewis Main Fire Station 7 Building 2014	Fire Station 7 – Building 2014	X		X	
AOPI 23 – Lewis Main Buildings 04074,04076, 1401, 4100, 1206 and 1210	Buildings 04074 & 04076	X		X	
	Building 1401 - Formerly known as Building 1402 Historical Laundry operation since 1941	X		X	
	Fire Station 1 – Building 4100	X		X	
	Buildings 1206/ 1210 Ranges		X		
AOPI 24 - Lewis Main Landfill #9	Landfill #9				X

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1.0 INTRODUCTION

On behalf of the Joint Base Lewis-McChord (JBLM) Public Works Environmental Division, under contract to the United States (U.S.) Army Corps of Engineers (USACE), Seattle District, a Preliminary Assessment (PA)/Site Inspection (SI) was completed specifically for perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA) and perfluorobutane sulfonate (PFBS) at JBLM located in Pierce County, Washington (Figure 1-1). These compounds are part of a large family of per- and polyfluorinated alkyl substances (PFAS). The PA was conducted in early 2018 to identify locations that are areas of potential interest (AOPIs) based on whether there was use, storage or disposal of any PFAS-containing material. The SI was conducted in three phases, with Phase I performed in 2018 and Phases II and III performed in 2019. Work was completed in accordance with the Project-Specific Quality Assurance Project Plan (QAPP), PFAS Preliminary PA/SI (JBLM 2018a) and the QAPP Addendum, PFAS PA/SI (QAPP Addendum) (JBLM 2018b). This report provides the findings of the PFOS and PFOA PA/SI conducted by JBLM, following Army policy, under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) authority.

1.1. Project Background

PFAS are manufactured fluorinated organic chemicals that have been used in a wide variety of industrial and commercial products due to their valuable properties, which include fire resistance; dust suppression; and oil stain, grease, and water repellence. Examples of uses include carpets and furniture fabric, clothing, anti-stick surfaces for preparing and packaging food, dust suppression for metals plating, as well as polishes, waxes, and cleaning products. PFAS, including PFOS and PFOA, are also components of aqueous film-forming foam (AFFF), a firefighting foam used by industry, state and local governments, and the U.S. Department of Defense (DoD) since 1970 to fight petroleum fires.

PFAS is a family of many chemicals that contain chains of various lengths of fluorine-carbon bonds. Fluorine-carbon bonds are one of the strongest bonds in nature; therefore, these chemicals have distinct properties of strength, durability, heat-resistance, and stability. PFAS compounds are used in the manufacturing of intermediary products and hundreds of articles of commerce used in electronics, aerospace/defense, building/construction, alternative energy, automotive, semiconductors, military, healthcare, outdoor apparel/equipment, chemical/pharmaceutical manufacturing, and most notably in AFFF for firefighting and historically for fire training.

PFAS are persistent in the environment and have been found in surface water, soil, and groundwater. PFAS contamination is typically associated with use of products that contain PFAS, such as the use of AFFF during firefighting or fire training exercises, and with former on-site disposal practices (e.g., landfilling).

PFAS, although not currently regulated, are considered pollutants and contaminants and are being addressed under CERCLA. In May 2016, the U.S. Environmental Protection Agency (EPA) issued a Health Advisory Level (HAL) for drinking water of 70 parts per trillion (ppt) (or 70 nanograms per liter) for PFOS and PFOA (individually or combined if both are detected in drinking water). EPA's HAL is protective of the most sensitive sub-populations that drink the water over a lifetime. The EPA HAL is based on the effects of PFOS and PFOA on laboratory animals and epidemiological studies of human populations (EPA 2016a and 2016b).

As part of the Army's commitment to supplying quality drinking water to its service members, family members, and civilians and in response to the HAL released by EPA, the Army implemented a comprehensive PFOS and PFOA drinking water testing program at Army facilities that may have used AFFF or other PFOS and PFOA containing products. On June 10, 2016, the Department of Army instructed all Army installations to conduct PFAS contamination assessments for known fire training areas, AFFF storage locations, hangars/buildings with AFFF suppression systems, fire equipment maintenance areas, and areas where emergency response operations may have required AFFF use. On August 29, 2016, an Army Guidance Memo for conducting PFAS assessments was finalized and included guidance on sample design and the specific sampling and analysis methods that should be used in PFAS-related site investigations (U.S. Army 2016). On February 20, 2018, an Army Guidance Memo was issued that requires PFAS assessments to include the 14 analytes that can be identified by EPA Method 537 (U.S. Army 2018). The DoD has adopted a policy to retain facilities in the CERCLA process based on risk-based screening levels (SLs) for soil and groundwater, as described in a memorandum from the Office of the Secretary of Defense (OSD) dated October, 15 2019 (Assistant Secretary of Defense, 2019) (DoD 2019), which establish groundwater SLs of 40 ppt for PFOS and PFOA, individually, and 40 micrograms per liter or parts per billion (ppb) for PFBS. The SLs were identified to "determine if further investigation in the remedial investigation (RI) phase is warranted or if the site can proceed to site closeout." Comparisons of groundwater analytical results collected during the SI to the OSD SLs will be used to determine whether the AOPIs identified during the PA will require further evaluation.

When PFAS at Air Force installations around the country became an issue in April 2016, JBLM proactively began testing its drinking water sources for PFOS and PFOA from the 23 drinking water production wells on the installation. Testing results between January and April 2017 confirmed the presence of PFOS and PFOA in five drinking water wells on JBLM exceeding the EPA HAL of 70 ppt, which are as follows:

1. North Well, McChord Airfield – 216 ppt
2. South Well, McChord Airfield – 250 ppt
3. Well #17, Lewis Main – 71 ppt
4. Housing Well II, McChord Airfield – 72 ppt
5. Golf Course Well #22 – 78 ppt

These wells, shown on Figure 1-2, draw water from a single or multiple aquifers that underlay JBLM. Four of these wells have been isolated or taken out of service. Golf Course Well #22 remains active with point-source treatment. The current water distribution system adequately supplies JBLM McChord Airfield and Lewis Main/North using existing wells that meet the EPA HAL.

AFFF was used for firefighter training at several locations on the east side of McChord Airfield's runway, near Lewis Main's Gray Army Airfield, and at Lewis North through the early 1990's. JBLM identified up to 11 historical fire training areas that could be potential PFOS and PFOA sources of drinking water production well impacts. The AFFF fire suppression systems were also considered potential sources for PFOS and PFOA. AFFF is currently not being used for training purposes.

Four Technical Project Planning (TPP) meetings were held between December 2016 and November 2018 to develop the SI scope and QAPP. The TPP meetings were attended by the project stakeholder group, which included the JBLM Department of Public Works (DPW), Army Environmental Command (AEC), USACE Seattle District, U.S. EPA Region 10, Washington State Department of Ecology (Ecology), and Washington State Department of Health (DOH).

TPP Meeting #1 was held on December 6, 2017. The purpose of this meeting was to develop an overall approach to the PA/SI, which included 1) identifying potential PFAS use, storage, or disposal areas by interviewing JBLM staff familiar with these operations; 2) developing a project analyte list and screening criteria; 3) developing AOPIs prioritization criteria; and 4) identifying potential sampling locations for the Phase I SI sampling event. During this TPP Meeting, prior to issue of the OSD SLs, it was determined that SI samples would be analyzed for 14 PFAS, and that the sum of the full six Third Unregulated Contaminant Monitoring Rule (UCMR-3) compounds would be compared against a 70 ppt "screening level" (SL) for identifying an area as a "potential source area" needing further evaluation. This 70 ppt SL, which was developed and agreed to by the project stakeholder group, is a conservative approach to identifying potential source areas, in anticipation of Washington State DOH's issuance of state drinking water action levels, which will include numerous PFAS compounds, including PFOS, PFOA and PFBS.

TPP Meeting #2 was held on February 14, 2018. The purpose of this meeting was to develop the QAPP, which included 1) reviewing the findings of the PA activities conducted to date, including personnel interviews, research summaries, and visual site inspections; 2) establishing the QAPP questions and developing a scope of work, and 3) selecting existing groundwater monitoring wells to include in the Phase I SI sampling event. The final QAPP was approved by the stakeholder group in May 2018.

TPP Meeting #3 was held on September 18, 2018. The purpose of this meeting was to review the results of the Phase I SI sampling event. Results from the Phase I sampling event were compared against the 70 ppt SL (sum of the six UCMR-3 compounds), as specified in the approved QAPP, to identify sampling locations for the Phase II and Phase III SI sampling events. Information and feedback provided during this meeting was used to develop the QAPP Addendum, which would guide the Phase II and Phase III sampling events.

TPP Meeting #4 was held on November 27, 2018. In addition to the project stakeholder group, attendees also included representatives from Lakewood Water District, City of DuPont, City of Tacoma, and Parkland Light and Water. The purpose of this meeting was to work through the Phase II sampling QAPP Addendum and reach a consensus on Phase III sampling locations. The Final QAPP Addendum was approved in December 2018, and the Phase II and III SI sampling events were completed by the end of March.

TPP Meeting #5 was held on January 8, 2020. Attendees, including the project stakeholder group and representatives from Lakewood Water District, City of DuPont, City of Tacoma, and Parkland Light and Water, were updated on Washington State's efforts to set an action level for multiple PFAS compounds in drinking water, EPA efforts to address PFAS, and the results of the PA/SI.

As stated above, the OSD SLs for PFOA, PFOS, and PFBS were issued in October 2019. Although project screening criteria (70 ppt sum of six UCMR-3 compounds) were developed and specified in the approved QAPP, Phase I, II and III SI sample results were to be compared against the OSD SLs to determine whether the AOPIs identified during the PA will require further evaluation.

1.2. Project Objectives and Scope

This PA/SI was conducted following the CERCLA process. The purpose of the PA was to identify AOPIs based on whether there was use, storage or disposal of any PFAS-containing material that may have resulted in a release to the environment. The SI looked at sites that warranted further investigation to either identify them as AOPIs that pose a threat to drinking water, thereby needing additional investigation or remedial action, or eliminate them as AOPIs based on the collected data. PA

investigators collected readily available information and conducted a site and environs reconnaissance. The PA also identified sites that require an assessment for possible emergency response actions.

The specific objectives of this PA were:

- Identify operations/activities, both past and current, for potential PFOS, PFOA, and PFBS' contributions to drinking water production wells identified with PFAS concentrations at or exceeding the 70 ppt EPA HAL.
- Identify potential pathways of PFAS to the environment.
- Prioritize AOPIs for SI to determine if PFOS, PFOA, and PFBS are present in groundwater, both at the AOPIs and at the facility boundary, at concentrations exceeding the OSD SLs.

A SI is conducted whenever the PA indicates that there is a need for further investigation. The PA can also conclude that an SI is not required. The primary objective of the SI is to determine whether releases of hazardous substances, pollutants, or contaminants have occurred.

The specific objectives of the SI conducted at JBLM were:

- Determine whether historical waterproofing operations, vehicle wash rack operations, laundry operations, emergency responses, fire-fighting training, and landfills are sources of PFOS and PFOA in JBLM drinking water production wells.
- Determine potential PFOS and PFOA drinking pathways.
- Determine if PFOS, PFOA, and PFBS are present in groundwater, both at the AOPIs and at the facility boundary, at concentrations exceeding the OSD SLs.
- Determine if a RI is necessary to assess the nature and extent of PFOS and PFOA on the JBLM site and to evaluate the associated risks.

1.3. Project Planning

Five TPP meetings were conducted to plan and present the results of the PA/SI:

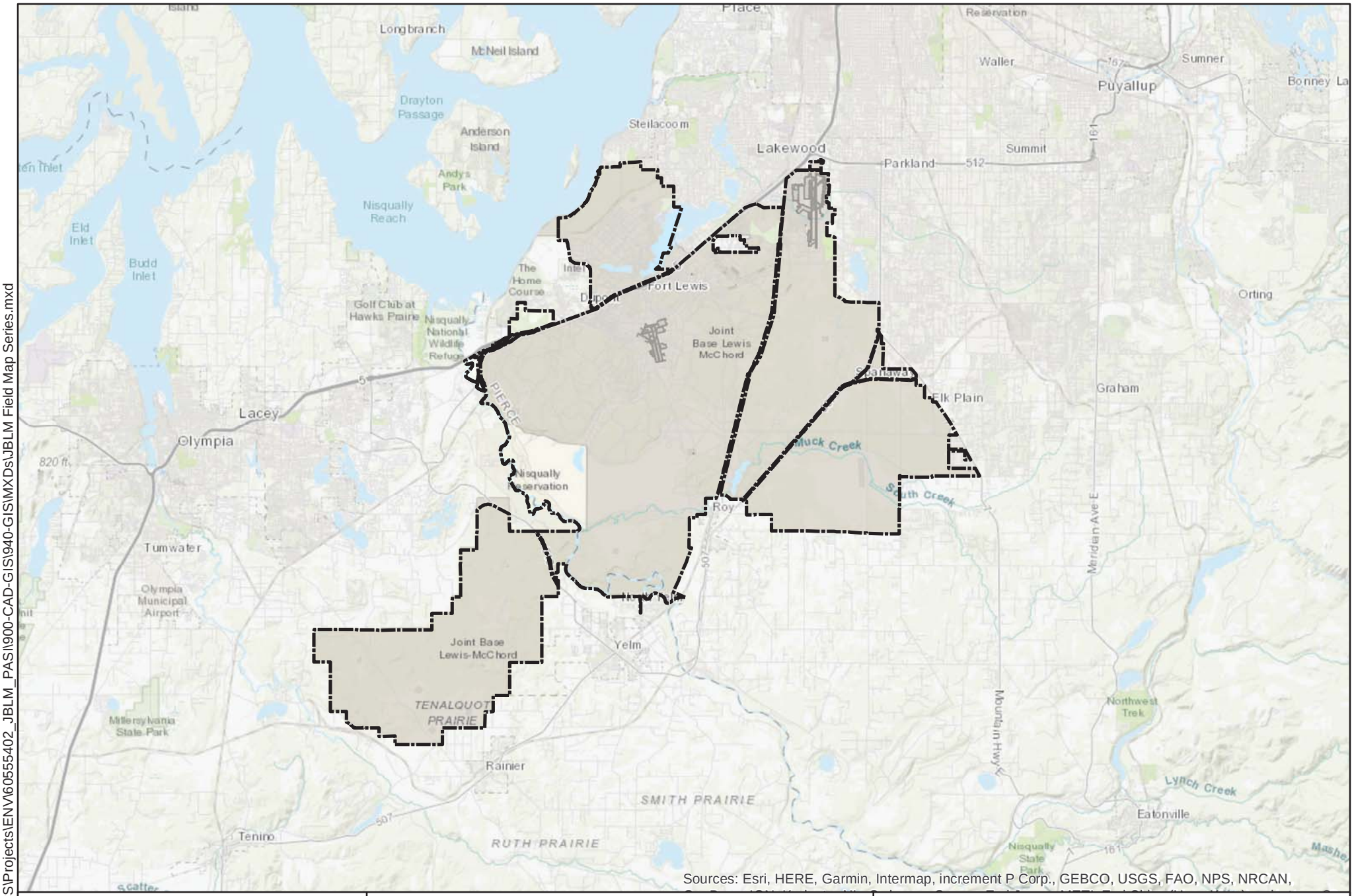
TPP Meetings were held on:

- TPP #1 - December 6, 2017
- TPP #2 - February 14, 2018
- TPP #3 - September 18, 2018
- TPP #4 – November 27, 2018
- TPP #5 – January 9, 2020

Attendees at TPP Meetings #1 through #3 included JBLM DPW environmental representatives, JBLM DPW management representatives, USACE Seattle District, U.S. EPA Region 10, Ecology, Washington State DOH, and AECOM representatives. Representatives from Lakewood Water District, City of DuPont, City of Tacoma, Parkland Light and Water were present for TPP Meetings #4 and #5.

- During TPP meeting #1, the project scope, execution plan, and project approach were presented to the TPP members.

- During TPP meeting #2, attendees were presented the findings of the PA; attendees identified potential PFAS source areas, selected Phase I existing monitoring well sampling locations, and finalized the QAPP. Potential source areas were prioritized during this meeting to maximize contract capacity of the sampling scope. The QAPP question was also developed during this meeting.
- During TPP meeting #3, attendees were presented the results of the Phase I (existing monitoring well) sampling and selected proposed Phase II monitoring well installation locations.
- During TPP meeting #4, attendees worked through finalization of the Phase II sampling QAPP addendum, and consensus was reached on the selected Phase III sampling locations.
- During TPP meeting #5, attendees were presented with an update on Washington State's efforts to set an action level for multiple PFAS compounds in drinking water, EPA efforts to address PFAS, and the results of the PA/SI.

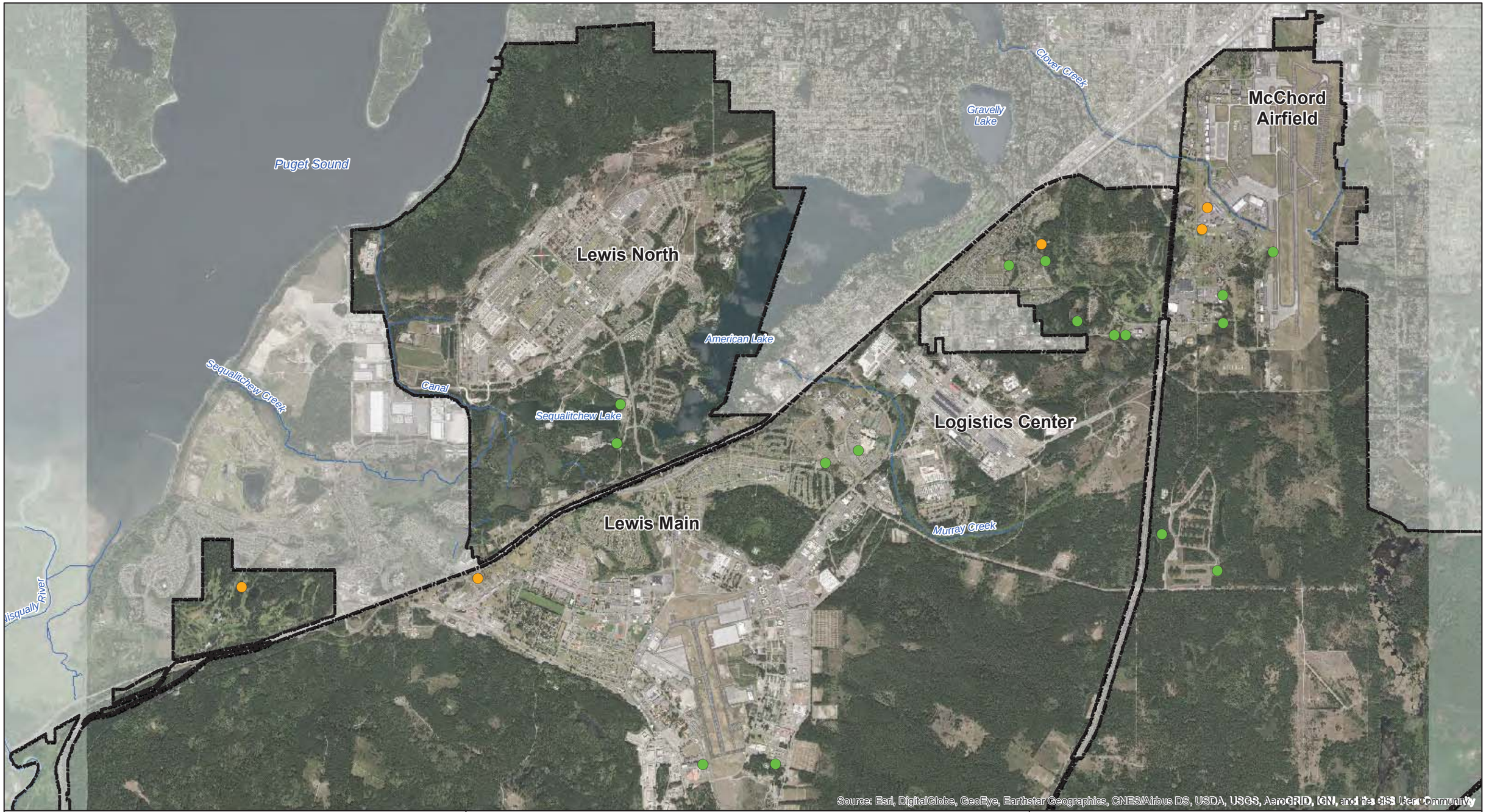


N

0 3 6 12 Miles

Figure 1-1
Site Boundary
PFAS Site Inspection
Joint Base Lewis McChord
Tacoma, WA

Document Path: J:\DCS\Projects\ENV\60555402_JBLM_PASI\900-CAD-GIS\940-GIS\MXDs\JBLM Field Map Series.mxd



PUBLIC WORKS

N

0 0.5 1

Miles

Legend

JBLM Production Wells

- ≤ 70 ppt
- > 70 ppt
- JBLM Boundary

Notes:
1. PFOS and PFOA Units are Parts Per Trillion (PPT)

2. Samples collected December 2018 through May 2019

Figure 1-2

PRODUCTION WELL PFOS + PFOA SAMPLING RESULTS COMPARED TO 70 PPT EPA HAL

PFAS Preliminary Assessment Site Inspection
Joint Base Lewis McChord
Lakewood, WA

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1

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2.0 SITE BACKGROUND

2.1. Location and Description

JBLM is located about 3 miles south of Tacoma, Washington, along Interstate 5, which bisects the installation (Figure 1-1). JBLM is surrounded by the communities of Lakewood to the north (population 58,000); Olympia, Lacey, and Tumwater to the south (population 86,000); DuPont to the west (population 7,500); and unincorporated Spanaway/Parkland to the east (population 63,000).

In 2005, Fort Lewis and McChord Air Force Base (AFB) were designated as a joint base (JBLM) under the Base Realignment and Closure program. The former McChord AFB (4,639 acres) was adjacent to the northeast boundary of the former Fort Lewis (86,198 acres). The change to JBLM took full effect in October 2010. The installation occupies 90,837 acres in Pierce and Thurston Counties, Washington. The mission of JBLM is to provide logistical support, maneuver areas, and range and facilities for I Corps and supporting units. It also provides worldwide military airlift capability. JBLM supports an on-base population and neighboring communities of more than 100,000 people, including military personnel, families, civilian and contract employees, and retirees and their families. JBLM has an Army joint base commander and an Air Force deputy commander. Base services are managed and provided by the Army.

2.2. Site Geology and Hydrogeology

The geologic units underlying JBLM and the surrounding area consist primarily of Pleistocene-age glacial deposits. These units comprise a complex system of stacked aquifers and confining units, which include the following:

- Upper Vashon Aquifer (A1): Vashon Drift (Steilacoom gravel, recessional outwash). Material consists of stratified sand, silt and gravel; thickness of 35 feet to greater than 200 feet.
- Confining Unit (A2): Vashon Drift (Vashon Till, ice contact, moraine and glaciolacustrine deposits). Material consists of clay, silt, sand, and gravel; discontinuous/missing in places; can provide a conductive pathway between Upper Vashon Aquifer and Lower Vashon Aquifer; thickness ranges from a thin veneer to 150 feet on a regional scale.
- Lower Vashon Aquifer (A3): Vashon Drift (advance outwash). Material consists of well-sorted sand or sand and gravel with silt and clay lenses; average thickness is 75 feet.
- Confining Unit (B): Olympia Beds (Kitsap Formation), Lawton Clay. Material consists primarily of silts and clays; thickness of 10-20 feet where present on JBLM; discontinuous/missing in places; can provide a conductive pathway between Vashon Aquifers and lower Sea Level Aquifer.
- Sea Level Aquifer (C): Salmon Springs Drift, Penultimate Drift, Hayden Creek Drift, and Wingate Hill Drift (glacial drift). Materials consist of sand and gravel, pebble to cobble gravel, with minor lenses of silt, clay, till, and volcanic ash; thickness of 50 to 100 feet.
- Confining Unit (D): Puyallup Formation (alluvial and lacustrine deposits). Material consists of alluvial and lacustrine sand, silt, clay, and occasional volcanic ash; average thickness is 100 feet.

- Stuck Aquifer (E): Stuck Drift (glacial drift). Material consists primarily of silt, sand, and gravel with discontinuous till and lacustrine deposits; thickness ranges from a thin veneer to greater than 200 feet.
- Confining Unit (F): Alderton Formation. Consists primarily of silt and clay, with minor lenses of sand and gravel; thickness ranges from 50 feet to greater than 300 feet.
- Orting Aquifer (G): Orting Drift. Material consists primarily of stratified sand and gravel with discontinuous layers of till.

Base-wide groundwater flow has been assessed by the U.S. Geological Survey (USGS) (Savoca et al. 2010). The SI component looked at the A1 (Upper Vashon), A2 (confining unit), A3 (Lower Vashon), B (Kitsap Formation), and C (Sea Level Aquifer) formations described above. Groundwater flow in the Upper and Lower Vashon Aquifers is generally to the north-northwest across the base. Groundwater flow in the Sea Level aquifer is to the north-northwest in the southern and eastern portions of the base. Groundwater in the Sea Level Aquifer flow bends to the west in the central and western portions of the base.

3.0 PRELIMINARY ASSESSMENT

The scope of a PA is defined in Section 300 of the National Oil and Hazardous Substances Pollution Contingency Plan (40 Code of Federal Regulations Part 420). As the first stage of investigation conducted for every site in Comprehensive Environmental Response, Compensation and Liability Information System, the PA is a compilation of existing information about the site and its surrounding area, with emphasis on obtaining comprehensive information about targets in order to distinguish between sites that pose little or no risk to human health and the environment and those that potentially pose a risk and thus require further investigation. A PA generally involves a reconnaissance of the site and its environs.

Given that PFOS and PFOA were detected in production well water samples, this PA was conducted to identify AOPIs based on whether there was use, storage or disposal of any PFAS-containing material at JBLM, and to support development of the SI. This PA included an assessment of areas within the current property boundaries of JBLM (Figure 3-1) that were inferred to be upgradient or in close proximity to water production wells with PFOS and PFOA detections at or greater than the EPA HAL. The PA focused primarily on AFFF use and storage (e.g., fire-fighting training areas, hangars fire suppression systems, crash/accident sites, accidental system releases or spills). Other potential sources of PFOS and PFOA assessed during the PA included landfills, groundwater treatment systems, waterproofing operations, historical laundries, and vehicle wash racks. The PA did not include peripheral, relatively undeveloped areas outside the main JBLM area, such as ranges used for practice military maneuvers; satellite properties under administration of JBLM; potential offsite sources of PFOS and PFOA, nor areas of JBLM outside the developed portions of the base.

The primary objectives of the PA were:

- Identify operations/activities, in both current and historical areas, for potential contributions of PFOS, PFOA, and PFBS to drinking water production wells identified with PFAS concentrations at or exceeding the 70 ppt HAL.
- Identify potential pathways of PFOS and PFOA to drinking water.
- Prioritize AOPIs for SI to determine if PFOS, PFOA, and PFBS are present in groundwater, both at the AOPIs and at the facility boundary at concentrations exceeding the OSD SLs.

Source prioritization criteria were:

- Historical/anecdotal information for the largest AFFF release volumes
- Proximity to impacted drinking water production wells
- Areas with the most direct pathway to impacted drinking water production wells

This PA identified at least 52 PFAS-related operations/uses located in 24 general AOPIs at JBLM. These generalized AOPIs areas are shown on Figure 3-1. All of these AOPIs are sources of surface or near surface releases. These AOPIs, which may be associated with current or historic use, storage or disposal of PFAS-containing material, consist of fire training areas, fire-fighting equipment testing areas, hangars with AFFF Systems, AFFF storage areas, emergency response equipment, landfills, laundry facilities, waterproofing operations and other processes that use products potentially containing PFAS compounds.

3.1. Summary of PA Activities

The research was conducted from December 2017 through February 2018. The primary sources of information utilized to develop this PA were:

- A review of installation records provided by JBLM.
- Interviews with relevant JBLM personnel.
- Site reconnaissance to document conditions where PFOS and PFOA containing products were or may have been used/stored/disposed of.

These sources of information, along with how they were used for the purpose of this PA, are discussed below.

3.1.1 Records Review

Records and reports provided by JBLM, as well as those publicly available, were reviewed to assist with identifying PFOS and PFOA AOPIs. Records reviewed during this PA included the following:

- Installation Restoration Program (IRP) reports and other available environmental records
- Historical information, such as accident responses, national historic registry information, and aerial photographs
- Installation databases and resources, including P2 Enterprise, Environmental, Safety, Occupational Health- Management Information System
- Spill Response Incident Reports
- Aircraft accident and response reports
- Installation Stormwater Pollution Prevention Plans
- Safety – AFFF system locations

3.1.2 Personnel Interviews

Interviews were conducted with JBLM personnel knowledgeable about the installation's history, including the use of PFOS and PFOA containing products. The interviews were generally conducted in-person with follow-up phone calls. The list of individuals (identified by their title/role) who were interviewed during this PA are as follows:

- IRP Manager
- Fire Chief
- Assistant Fire Chief of Training
- Assistant Fire Chief of Health and Safety
- Installation Environmental Operations Brach Chief
- Installation Historian
- Installation Drinking/Wastewater Program Manager

- P2 Database Program Support
- Installation Spills Group Manager
- McChord Airfield Hangars Manager
- Gray Army Airfield Manager
- Fuel Farm Manager

3.1.3 Site Reconnaissance

Visual surveys were conducted at many of the PFOS and PFOA AOPIs identified during the records review process and installation personnel interviews. Some areas that were not assessed visually were still been categorized as AOPIs based on historical research or installation personnel interviews. A photolog of select sites is provided in Appendix A. The results of the site reconnaissance are summarized in Section 3.3.

Site visits to locations identified for potential PFAS-related operations/activity/equipment typically began with interviewing site contacts familiar with potential PFAS-related operation(s) at a site. The interview included a review of documents pertaining to historical events, operations, and/or equipment, followed by a visual inspection of areas of potential PFAS activity. At some locations, equipment specific to potential use of PFAS (e.g., AFFF spray, deluge, pumps and nozzles, wastewater treatment systems, storage tanks, and other containers) were exhibited accompanied by an explanation of the equipment operation. The inspection team also independently looked for and identified potential PFAS-related equipment/operations, including:

- AFFF sump manhole covers
- Firefighting sprinkler system drains on sides of buildings
- AFFF reservoirs leaking

The inspection team looked at systems and equipment to assess PFAS containing materials release patterns and whether chemicals could have migrated to permeable surfaces, such as drainage swales, basins, and dry wells. The inspection team also looked for stormwater conveyance systems that may have resulted in discharge to Clover Creek, a perennial stream that runs east/west across McChord Airfield. The team collected photographs of the PFAS equipment and areas, as security limitations allowed, focusing on features such as storage tanks, reservoirs, trailers, standpipes, dispensing mechanisms (nozzles, deluge boxes), other associated equipment (e.g., pumps), and associated features such as floor and area drains or bioswales.

At locations where the PFAS was reportedly used in the past, the inspection team conducted followed the same procedures of looking for features, such as deteriorated or cracked floors, that could potentially have resulted in chemicals' leaking into groundwater. Not all suspect locations were visited, such as Logistics Center buildings 9570/9580 and 9630/9640, due to security or other access considerations.

3.2. Preliminary Assessment Findings

The following section presents the PA findings, based on the criteria specified in Section 3.1. The AOPIs identified during the PA with the highest likelihood for releases to the environment are summarized below; other AOPIs with a lower likelihood of releases to the environment are identified in Table 3-1.

Based on numerous interviews with JBLM personnel, fire extinguishing systems utilizing AFFF were identified as operations associated with the highest volume of chemicals typically containing PFOS and PFOA. Additionally, an interview conducted with a JBLM Fire Chief indicated that AFFF use was initiated at the installation in the early 1980's. Prior to that, it is believed that protein-based foams, which potentially contained fluorochemicals, were used for fire suppression and fire training. Systems associated with AFFF storage and use at JBLM included aircraft hangars equipped with fire suppression systems and emergency response equipment. Each of the aircraft hangars equipped with fire suppression systems typically included one aboveground AFFF storage tank located in a mechanical room with associated pumps and piping. Piping systems would distribute the AFFF to nozzles or deluge outlets mounted in strategic locations within the hangar interior (e.g., floor and ceiling).

The most significant discharge of AFFF directly to the environment likely was during firefighting training exercises and routine foam spray pattern adjustment for aircraft rescue and firefighting (ARFF) vehicles. The fire-fighting training exercises occurred in areas located at McChord Field to the east of the runway, at Gray Army Airfield on the northeast portion of the airfield, and approximately 0.25 miles to the southeast of Gray Army Airfield. As part of the routine adjustment of the foam spray patterns for ARFF vehicles, foam was sprayed onto flight-line areas or on and around the perimeter of runways at McChord. The resultant foam was washed to adjacent permeable surface areas.

The PA identified hangars at McChord Airfield, Gray Army Airfield, and areas at the Logistics Center that currently have or had AFFF fire extinguishing systems. The hangars include McChord Airfield Hangars 1 to 7, 9 to 10, and 13 (Figure 3-2). Gray Army Airfield hangars 3063, 3098, 3106, and 3146 and temporary building 3099 (Figure 3-4) currently have or had AFFF fire extinguishing systems. Releases were identified at several hangars based on information in a spills database, from site visits, and from interviews with JBLM staff. Personnel interviews documented that historical AFFF systems activations have occurred at McChord Airfield Hangars 4 and 6. During the site visit, an ongoing small-volume release of AFFF was observed adjacent to the individual storage tanks at McChord Airfield Hangars 6 and 10, which was subsequently addressed by JBLM personnel. The Logistics Center Bulk Fuel Spot was determined to be a possible AFFF system location (Figure 3-3).

3.3. McChord Airfield

The following subsection summarizes the findings from the PA for McChord Airfield.

3.3.1 McChord Airfield Hangars

McChord Airfield Hangars 5, 6, 7, 9, 10, and 13

Hangars 5, 6, 7, 9, 10 and 13 are located on the northern portion of McChord Airfield (Figure 3-2). During the site reconnaissance, ongoing small-scale AFFF leaks were observed; in the past, there were larger scale AFFF releases, such as hangar AFFF system activations, which have been documented. Hangar 5 was reported to have a foam storage tank with a capacity of 1,500 gallons, and the foam that was

reportedly stored was identified as Light Water FC-203CF. Hangars 6, 7, 9, 10, and 13 have foam storage capacities ranging between 450 gallons (Hangar 10) and 1,500 gallons (Hangar 13), and the foam stored was reportedly Chemguard MS C301 for all the hangars except Hangar 13, which stored Light Water FC-203CF foam.

In November 2011, the AFFF fire extinguishing system was activated and foam was released at McChord Hangar 6. The released foam accumulated on the hangar floor to a depth of approximately 3 feet; the release volume is unknown.

In June 2010, an estimated 5 to 10 gallons of AFFF concentrate was released to the floor of the mechanical room in Hangar 7. It was reported that an unknown amount of concentrate entered the sewer through a drain on the floor.

In November 2017, an estimated 50 gallons of AFFF concentrate was released to the floor in the AFFF Control Room of Hangar 13. This was attributed to a leaking gasket in the AFFF system. The AFFF concentrate was contained using absorbent pads and booms, but some of the concentrate was pushed into an overflow drain.

McChord Airfield Hangars 1, 2, 3, 4, and 301

Hangars 1, 2, 3, 4, and 301, located in the southern portion of McChord Field (Figure 3-2), currently have AFFF fire extinguishing systems. Hangars 1 and 2 share a foam storage capacity of 1,000 gallons, which contain Light Water FC-203 CF. Hangars 3 and 4 share a foam storage with an unknown volume of high expansion foam.

AFFF releases have occurred at Hangars 1 and 2, but the dates and volumes of these releases are not known. System activations may also have occurred in 2008, 2010, 2012, and 2013 at Hangars 1 and 2, but release volumes are unknown. In 2012, the AFFF fire extinguishing system activated and foam was released at McChord Hangar 4. Approximately 3,000 gallons were released with foam accumulating on the hangar floor to a depth of approximately 20 feet. The released AFFF had a high potential for migrating from the hangar to the permeable surface areas and downward into the subsurface.

Base personnel also reported that six aircraft crash incidents occurred in this area, which could have resulted in firefighting response activities (Figure 3-2). No other additional information is available.

Several ARFF vehicles are assigned to McChord Airfield. These vehicles are mobile pieces of equipment, which include trailers typically dispatched behind fire trucks, with foam tanks at volumes ranging from 200 to 420 gallons. Interviewed JBLM personnel indicated that these vehicles were tested in 2017 by the fire department and were all determined to contain PFOS and/or PFOA compounds. Usage dates and volumes have not been documented.

3.3.2 McChord Airfield Fire Training Areas

FT027

Site FT027 is a former fire training area covering less than 1/4 acre, located along the north end of the main runway (Figure 3-2). Waste Jet Petroleum (JP)-4, gasoline, and other flammable materials were used as fuels for fire training exercises at the site from 1960 to 1977. The fire training area did not have a liner, but the fuels were reportedly floated on water before being ignited. No berm was observed at the time of the site visit. Twenty-four fire training exercises were conducted each year using about 300 gallons of fuel per exercise (CH2M Hill 1982). Ecology conducted an Initial Investigation at this site in

November 1990. FT027 was included in the February 1992 Consent Decree. Petroleum impacted soil was found and approximately 6,000 cubic yards of contaminated soil was removed and treated at an on-base bioremediation/landfarming facility at Landfill 013.

Following the cleanup and post-remedial testing results, a No Further Action (NFA) determination was obtained from Ecology (USAF 1993b). However, the presence or absence of PFOS and PFOA was not evaluated under the NFA as they were not considered a part of this determination. Based on the operational timeframe of the area and the reported AFFF use timeframe, it was determined that AFFF was not used in training exercises at FT027.

FT028

Site FT028 is a former fire training area covering less than 1/4 acre located north of the hazardous cargo loading/unloading area and west of the perimeter road (Figure 3-2). No berm was observed at the time of the site visit. The site was used for helicopter fire training for approximately one to two years during the early 1960s. The IRP Records Search indicated that 40 to 50 fire training exercises were conducted each year using flammable liquids such as JP-4 (CH2M Hill 1982). Ecology conducted an Initial Investigation at this site in November 1990, and the site was listed in the February 1992 Consent Decree. However, the site was not evaluated for the presence or absence of PFOS and PFOA for this consent decree.

Air Force issued an NFA Decision Document in August 1993 (USAF 1993b). Ecology issued NFA concurrence letters on January 27, 1994, and June 28, 1995. PFOS and PFOA were not considered as part of this determination. Based on the operational timeframe of the area and the reported AFFF use timeframe, it was determined that AFFF was not used in training exercises at FT028.

FT029

Site FT029 was reportedly a fire training area located approximately 1,200 feet northeast of the confluence of Clover Creek and Morey Creek (Figure 3-2). The general area is unpaved and covered by native grasses. No berm was observed at the time of the site visit. The presence of a berm would confirm the area location and suggest that some containment was attempted. No specific information was available on the area other than a reference in old base maps. No contamination was noted in this area (CH2M Hill 1982). It is believed that the site was mis-identified on old base maps, and inspections of the site area did not indicate fire training activities. An NFA Decision Document was issued in July 1990 (USAF 1990) with Ecology concurrence in December 1990. Because this area was misidentified and fire training did not occur here, it is unlikely that AFFF was released at this location.

FT030

FT030 is a former fire training area covering less than 1/4 acre located southeast of the hazardous cargo loading/unloading area (Figure 3-2). The site was used from approximately 1955 to 1960. The IRP Records Search indicated that 35 fire training exercises were conducted each year using approximately 300 gallons of fuel per exercise. Fuel and used solvents were floated on water before being ignited. The site did not have a soil liner (CH2M Hill 1982). No berm was observed at the time of the site visit.

Ecology conducted a Model Toxics Control Act (MTCA) Initial Investigation at this site in November 1990 and requested confirmation sampling to determine whether a Site Hazard Assessment or No Further Remedial Action Planned (NFRAP) under MTCA was appropriate.

An examination of the historical information, SIs, and analytical results did not identify any adverse impact to human health or the environment from the reported release of contaminants to the site. There are no contaminant pathways connecting the site to human or environmental receptors. The Air Force concluded that the site be included in the base-wide long-term monitoring program. A Decision Document was written in August 1993 that recommended NFRAP (USAF 1993b). However, the site was not evaluated for the presence or absence of PFOS and PFOA as they were not considered a part of this determination. Based on the operational timeframe of the area and the AFFF use timeframe, it was determined that AFFF was not used in training exercises at FT030.

FT031

FT031 was a former fire training area covering less than 1/4 acre and located south of the hazardous cargo loading/unloading area on the south side of Morey Pond (Figure 3-2). No berm was observed at the time of the site visit. Fire training exercises were conducted at the site from 1950 to 1955. The IRP Records Search indicated that 30 exercises were conducted each year using approximately 300 gallons of fuel per exercise. Fuel and other flammable liquids such as solvents were floated on water before being ignited during the training exercise. The site did not contain a soil liner (CH2M Hill 1982).

A MTCA Initial Investigation was conducted at this site in 1993, and carcinogenic polynuclear aromatic hydrocarbons (PAHs) were detected above MTCA cleanup levels. The 1993 investigation concluded that there were no contaminant pathways connecting the site to human or environmental receptors. No rationale was identified for further investigation at this site. The Air Force concluded that the site should be included in the base-wide long-term monitoring program. A Decision Document was written in August 1993 recommending NFRAP for FT-31 (USAF 1993b) with Ecology concurrence in June 1995. However, the site was not evaluated for the presence or absence of PFOS and PFOA as they were not considered a part of this determination. Based on the operational timeframe of the area and the AFFF use timeframe, it was determined that AFFF was not used in training exercises at FT031.

FT032

FT032 is located 500 feet south of Morey Creek (Figure 3-2) just east of the McChord Field runway. This fire training area was built in 1975 and used until April 1990. According to an IRP Decision Document (USAF 1993a), the site was used for simulated crash fire training beginning in 1976; approximately 10 exercises were carried out each year involving floating 300 to 400 gallons of JP-4 fuel on water and then igniting the fuel. The fire training area consisted of a 130-foot-diameter diked, pit-lined area with a 1-foot-thick impermeable clay lift. The pit drained through an oil/water separator into a holding tank and discharged to the sanitary sewer connected to the JBLM Publicly Owned Treatment Works (CH2M Hill 1982).

A Site Hazard Assessment was conducted in 1993 (Ecology 1993) that included three test pits and soil sampling. Petroleum contaminated soil (6,000 cubic yards) was removed and treated at an on-base landfarming facility (USAF 1997) located at Landfill 013. During the soil excavation, an underground storage tank was discovered and removed. A fuel release occurred during the removal and the spill was cleaned up. Soils excavated during the cleanup area were reportedly relocated to Landfill 013, approximately 0.2 mile south of FT032. A Decision Document was written in August 1990, which indicated that the site should be removed from further IRP consideration (USAF 1993a).

The current fire training area was constructed in 1997 over the former FT032 area, and propane is used instead of jet fuel or other flammables/combustibles. The training area pit now drains into an adjacent

holding pond, and after inspection of the discharge and confirmation that AFFF was not used, discharges to the sanitary sewer were connected to the JBLM Publicly Owned Treatment Works.

FT033

The FT033 former fire training area is located adjacent to the current Fire Station House 105/Building 6 (Figure 3-2). No berm was observed at the time of the site visit. Fire training exercises were conducted at FT033 from the late 1940s until 1950 when the overall airfield was much smaller than the current airfield. Aviation gas was the primary fuel used during fire suppression training. Approximately 20 training exercises were conducted each year, and 100 to 200 gallons of aviation fuel were burned per exercise. The site was investigated and determined to pose no significant contamination risk (USAF 1993b). Ecology provided a NFA/NFRAP determination in June 1995. However, the site was not evaluated for the presence or absence of PFOS and PFOA as they were not considered a part of this determination. Based on the operational timeframe of this area and the AFFF use timeframe, it was determined that AFFF was not used in training exercises at FT033. However, FT033 is generally collocated with the current McChord Airfield Fire Station Building 105. Interviews with JBLM personnel indicated that AFFF spray pattern testing was conducted on the flight line adjacent to the building. Storage of bulk AFFF and refilling of ARFFs is ongoing at Fire Station 105. During the visual inspection, drips to the interior floor surface was observed from an AFFF aboveground storage tank located inside fire station garage.

3.3.3 McChord Airfield Landfills

Landfill 013

Landfill 013 is an old landfill located just south of FT032 (Figure 3-2). The site was used as a landfill from 1950 to 1979. Open burning was reported to have occurred during the 1950's (CH2M Hill 1982).

A 1990 site investigation identified trichloroethylene (TCE) and degradation products slightly above the applicable soil and groundwater cleanup levels. In 1993, the site was covered with a 40-millimeter geo-fabric and converted into a bioremediation facility for fuel-contaminated soils excavated from other locations, including soils excavated from FT027 and FT032. Petroleum impacted soil was land farmed in this area and when fully bioremediated, the facility was to be dismantled or the remediated soil seeded with grass and used as permanent cap for the landfill (USAF 1993a). Petroleum affected soils from FT032 were treated in this area; thus, PFAS containing soils may be present.

American Lakes Garden Tract - Landfill 005

Landfill 005 was placed on the EPA National Priorities List (NPL) in 1984. The Air Force, EPA, and Ecology entered into a Federal Facilities Agreement, effective October 23, 1989, and a Record of Decision (ROD), effective September 19, 1991. The NPL included AEDB-R sites: Landfill 004, Landfill 005, Landfill 006, Landfill 007, MF-OT-026, MF-RW-035, and MF-OT-039. During the subsequent RI, site Landfill 005 was determined to be the principal contributor to groundwater contamination with Landfill 007 and MF-OT-039 being potential contributors. TCE and cis-1,2-dichloroethene concentrations in groundwater exceeded cleanup levels. A groundwater pump and treat (P&T) system was installed and was in operation since February 1994. The system utilized granular activated carbon to remove the organic contaminants in groundwater emanating from Landfill 005 and MF-OT-039 sites, which are now located under the base golf course. The P&T system operated at the site for 22 years but did not remove sufficient contaminant mass to drive the site towards closure in an expedient manner. Concentration

data collected from a rebound test initiated in 2016 indicate that the plume is in a steady-state condition without the extraction system running (Tetra Tech EC 2018). Landfill 005 was a major base landfill from 1951 until 1961. A waste oil burn pit was operating at the site from 1952 to 1964. The landfill also had a concrete trench used for burning liquid wastes, which reportedly included petroleum, oil, and lubricants; solvents; and fuels. Open burning was conducted until the landfill was closed. A TCE plume that in September 2002 extended approximately 1,500 feet downgradient and was approximately 400 feet wide has been steadily shrinking as a result of groundwater treatment. In 2010 a pilot project was conducted to determine whether bioremediation was a viable alternative to reduce remaining TCE concentrations to cleanup levels. Results were favorable. In 2011 a land use control (LUC) plan was implemented that restricts excavation in site landfills and construction of water wells without state or EPA approval. Landfills are potential PFOS and PFOA sources due to the potential for disposal of PFOS and PFOA containing waste. Open burning at the site could also have resulted in AFFF use here.

3.4. Logistics Center

3.4.1 Logistics Center Fueling

Logistics Center Bulk Fuel Spot

In personnel interviews the Logistics Center Bulk Fuel Spot was identified as a possible AFFF system location (Figure 3-3). No further information is available.

3.4.2 Logistics Center Landfill #2

Landfill #2 has groundwater contamination resulting from the disposal of solvents and other industrial wastes from the 1940s to the 1970s at Landfill #2, formerly known as East Gate Disposal Yard. The primary contaminant of concern is TCE, which is present in both the Vashon and Sea Level Aquifers. In the late-1980s, impacted domestic water wells in the community of Tillicum were shut down. In 1990, a ROD was signed and the selected remedy was groundwater extraction and treatment. In accordance with the 1990 ROD, two groundwater P&T systems were installed in the Vashon Aquifer, one at the Landfill #2 source area and one downgradient near the installation boundary, began operations. Construction was completed in 1995. In 2009, a sea level Aquifer P&T system was constructed near Madigan Army Medical Center and full operation was achieved in March 2010. This system has the potential to capture and redistribute PFOS and PFOA in groundwater from potential upgradient sources. An assessment was requested by EPA to satisfy the Second Five-Year Review (U.S. Army 2017). Additionally, landfills are potential PFOS and PFOA sources due to the potential for disposal of PFOS and PFOA containing waste.

3.4.3 Logistics Center Waterproofing Operations

Historical waterproofing operations reportedly occurred in the central portion of the Logistics Center at Buildings 9630/9640 and 9570/9580. PFAS compounds may have been used in these operations due to their common occurrence in fabric and clothing treatments along with cleaning compounds. The operational timeframe is unknown.

3.4.4 Logistics Center Washracks

Vehicle washing was reported at Building 9626, and current vehicle washing occurs at Building 9612 (Figure 3-3). PFAS can be found in automotive polishes, waxes, and cleaning compounds.

3.5. Gray Army Airfield

3.5.1 Gray Army Airfield Hangars 3106, 3146, 3098, 3063 and Building 3099

Hangars 3106, 3146, 3098, and 3063 and Building 3099 located in the northern portion of the Gray Army Airfield currently have AFFF fire extinguishing systems (Figure 3-4). The AFFF system in the mechanical room of Hangar 3106 was activated in approximately 1985. The release volume is not known. An AFFF release occurred in the mechanical room of Hangar 3146 in 2001, releasing approximately 10 gallons. A 250-gallon AFFF system release occurred in a mechanical room in Hangar 3098 in 2008. A 500-gallon AFFF system activation occurred in Building 3099 on an unknown date. One “pint” of AFFF was reported to be released inside Hangar 3063 at an unknown date.

Other hangars identified on Gray Army Airfield during the PA that did not have known or suspected releases of AFFF are summarized in Table 3-1.

A current inventory of foam systems at these hangars indicates the following:

- Hangar 3106 has an unknown volume reservoir of Ansulite foam
- Hangar 3146 has four 250-gallon reservoirs and two hose reel reservoirs of 50 gallons each, all of which contain Ansulite (AFC-5) foam
- Hangar 3063 has an "open-head water deluge system" that does not utilize foam
- Hangar 3098 has a "failing-head water deluge system" that does not utilize foam
- Temporary building 3099 contains a portable AFFF trailer with an approximate 100-gallon capacity foam reservoir containing an unknown type of foam

Several ARFF vehicles are assigned to Gray Army Airfield. These vehicles are mobile pieces of equipment, which include trailers typically dispatched behind fire trucks, with foam tanks of volumes ranging from 200 to 420 gallons. These vehicles were tested in 2017 by the fire department and were all determined to contain PFOS and/or PFOA compounds.

3.5.2 Gray Army Airfield Fire Training Areas

FTLE-17 Area

Former Fort Lewis Fire Training Pit known as FTLE-17 is located adjacent to the north side of Taxiway Number 2 at Gray Army Airfield (Figure 3-4). The FTLE-17 is in a large, shallow swale approximately 6 feet below the elevation of the adjacent taxiway. A few yellow tires and remnants of a low berm (approximately 1.5 feet high) delineate the perimeter of the roughly 100-foot-diameter pit. Between 1962 and 1982, FTLE-17 was used for air-crash rescue operation training. Waste materials including duplicating fluid, alcohol, paint thinner, and Jet Propellant-4 were pumped into the pit and ignited as a fuel source. Records do not indicate whether all the fluids pumped into the pit were consumed by burning. In September of 1987, three borings were advanced to a depth of 10 feet. Eight soil samples

were collected and analyzed for semivolatile organic compounds (SVOCs), volatile organic compounds (VOCs), pesticides, polychlorinated biphenyls, and dioxins. Trace amounts of dioxins, xylenes, methylene chloride, and some SVOCs were detected in some of the samples. In 1993, three monitoring wells were installed to the depth of 40 below ground surface, and groundwater samples were analyzed for SVOCs, VOCs, pesticides, polychlorinated biphenyls, dioxins, dioxin homologs, and metals. All sample results were below their respective screening criteria, and no evidence of groundwater contamination was observed. The location of FTLE-17 is currently covered by a concrete surface as part of a multi-acre aircraft ramp. Given their use as fire training areas, these sites are potential PFAS source areas (JBLM 2019). Based on the timeframe when this area was operational, AFFF could have been used during training exercises.

South Gray Army Airfield Fire Training Pit - SWMU-47

The former fire training pit was located southeast of Gray Army Airfield, adjacent to the Southeast Vehicle Wash Rack (SWMU-52-4) (Figure 3-4). When the pit was used, waste jet fuel was pumped into the concrete-lined pit and ignited. The pit has not been in use since 1995. The fire training pit was identified during the 1986 Resource Conservation and Recovery Act (RCRA) facility assessment (RFA) with NFA recommended due to the containment. The entire system, including the concrete liner and fuel pump, was removed on November 24, 1999.

In the 1986 RFA, the site was identified as having low to moderate potential for release to soil and groundwater depending on how well the containment worked. However, SWMU-47 was left off the list of recommended RCRA corrective actions because it was mistakenly believed to have been addressed in the 1986 RFA. Although not listed in the Fort Lewis Agreed Order, this site is included in a RI work plan to confirm that the potential release cited in the 1986 RFA was not an actual release. Fire training could have involved the use of AFFF.

Former Practice Firefighting Area, AOC 15

The site consists of two areas, roughly 600 feet apart in an open field. These areas were identified as a fire training area on a 1957 map of Fort Lewis. A review of historical aerial photographs indicates that the whole area was actually two separate areas. There is no additional information available about the area. However, if fuel was placed on the ground, ignited, and extinguished, as was done at the former fire training pit (SWMU-47), there would have been the potential for the release of AFFF.

This area of concern was identified in the 1986 RFA as having low to moderate potential for release to soil and groundwater based on the assumption that fuel releases occurred. As a result, RCRA corrective action was recommended in order to determine whether any releases to the environment had occurred. Fire training could have involved the use of AFFF.

Former Practice Firefighting Area I, AOC 15-1

Area I consists of a large concrete pad in an open field. The site was identified as a potential firefighting area based on aerial photography that indicates smoke coming from this area. Chemicals of concern include total petroleum hydrocarbons (TPH), arsenic, cadmium, lead, polychlorinated biphenyls, PAHs.

Former Practice Firefighting Area II, AOC 15-2

Area II was discovered during an additional historical aerial photograph search of the site. The 1951 aerial photograph showed eight burn circles. In addition, two aboveground storage tanks were also identified from historical aerial review on the southern portion of this site. The purpose of these tanks

was not clear, but based on site use, it is believed they contained water to put out fires. Sample results indicated that TPH as heavy oil and carcinogenic PAHs were present in site soils slightly above the MTCA Method A soil cleanup levels in 7 of the 20 collected samples. The maximum detected TPH concentration was 5400 milligrams per kilogram in the heavy oil range. The type of TPH present coupled with the extractable petroleum hydrocarbons/volatile petroleum hydrocarbons results indicate that the contamination is immobile and is unlikely to impact groundwater. However, the full vertical extent of TPH contamination was not determined. Fire training could have involved the use of AFFF.

3.5.3 Landfill #1

Landfill #1 is located in the southern portion of the Cantonment Area, approximately 1/2 mile southwest of Gray Army Airfield (Figure 3-4). The site is approximately 15 acres and was reportedly used for disposal of solid waste between 1946 and the early 1970s. Past landfill operations within the main cell of the landfill reportedly consisted of trench cut-and-fill operations in the northern portion between 1946 and 1951 and overbank dumping and surface dumping of construction debris in the southern portion from 1951 until the early 1970s. In addition, burn pit/open-pit dumping likely occurred to the west of the main cell within three small areas between 1946 and 1951. The landfill has a three-foot-thick soil cover. The main cell of the landfill is currently vacant with vegetation growing on the landfill cover. The three small burn pit/open-pit dumping areas are paved. The site's primary contaminant of concern is TCE in groundwater. Landfills are potential PFOS and PFOA sources due to the potential for disposal of PFOS and PFOA containing waste. Open burning at the site could also have resulted in in AFFF use here.

3.5.4 Gray Army Airfield Wash Rack

The Gray Army Airfield Wash Rack, which is located south of Gray Army Airfield (Figure 3-4), is still operational although its start date is unknown. The site is approximately 1 acre in size with 4 wash racks, a building, and two holding ponds. Vehicles and other equipment are washed in this area. PFAS compounds can be found in automotive polishes, waxes, and cleaning products.

3.6. Lewis Main

3.6.1 Landfill #9

Landfill #9 covers approximately 15 acres and was apparently used for disposal of vegetation, municipal waste, and medical waste from about 1932 to the 1950s. Approximately 5 acres in the northwest portion of the landfill is located within an Interstate 5 easement and has already been remediated. Approximately 10 acres in the southeast portion of the landfill is located in active JBLM.

The southeast portion of the landfill is a Fort Lewis Agreed Order site as a result of a RCRA corrective action recommended in a 1997 RFA. Although no further RCRA corrective action was recommended for the landfill following the 1986 RFA, some municipal and medical wastes were discovered by the Washington State Department of Transportation (WSDOT) in the mid-1990s in the northwest portion of the landfill during construction of an interchange. Between 1995 and 1996 the WSDOT conducted an SI of the landfill. The SI included the collection and analysis of soil samples from test pits and from within the landfill boundary. Monitoring wells were also installed and sampled. Low concentrations of landfill constituents were detected in soils and low concentrations of manganese were found in the groundwater. The remedy selected by the WSDOT and approved by Ecology for the northwest portion of

the landfill included a two-foot gravel cover in locations where interchange construction had occurred or was about to occur, planting grasses and/or shrubs in locations where the cover was applied, implementing LUCs on groundwater use, and decommissioning the four monitoring wells installed during the WSDOT SI. Additional RI was conducted in 2002 for the remaining portion of the site. Soil samples were collected and analyzed from six test pits excavated within the landfill boundary. An RI/feasibility study (FS) was completed in March 2012. The maximum detected concentrations of lead and total carcinogenic polycyclic aromatic hydrocarbons were above the state cleanup levels. Remedial action capping was initiated in 2011 and completed in October 2016. Landfills are potential PFOS and PFOA sources due to the potential for disposal of PFOS and PFOA containing waste. Since municipal and medical wastes were disposed of in this landfill, PFAS compounds, which have been in use since the 1940s, could be present.

3.6.2 Lewis Main Waterproofing Operations

Historical canvas waterproofing operations were identified at Buildings 4074 and 4076 in the western portion of Lewis Main (Figure 3-3); operation dates are unknown. PFAS compounds may have been used in these operations due to their common occurrence in fabric and clothing treatments.

3.6.3 Lewis Main Historical Laundry Operations

Historical laundry operations were conducted at Building 1402, located on the western portion of Lewis Main, from 1941 through 1999 (Figure 3-3). PFAS can be found in cleaning compounds and fabric and clothing treatments.

3.6.4 Lewis Main Fire Stations

Fire Station Building 2014 is located on the western portion of Lewis Main (Figure 3-3) and stores AFFF and ARFFs. The fire station has received large deliveries of AFFF and has been used as an area to refill ARFFs.

3.7. Lewis North

3.7.1 Lewis North Landfills

Landfill #5

Landfill #5 was formerly an NPL CERCLA site and was listed on the NPL in 1988. NFA was the selected remedy in the 1992 ROD. The site was delisted from the NPL in 1995. Although the site was delisted, it is still subject to state landfill regulations (Washington Administrative Code 173-351). State requirements include 30 years of post-closure monitoring. Landfill #5 site is approximately 220 acres comprising seven cells. Five of the cells contain a cover only. Two other cells contain both a liner and a cover per the requirements of RCRA subtitle D. Primary contaminants of concern are iron and manganese. However, in accordance with Chapter 173-351 of the Washington Administrative Code, analytes that need to be monitored for post-closure include metals, VOCs, and other inorganic compounds. There is the potential for off-site migration downgradient from the landfill, such as the migration to a gravel quarry and then to Puget Sound. Landfills are potential PFAS sources due to the potential for disposal of PFAS containing waste.

Landfill #4

Landfill #4 covers approximately 52 acres and was reportedly used for the disposal of municipal solid waste between 1951 and 1967. The landfill consists of three cells, all located north of Sequalitchew Lake on JBLM-North. The site was added as an operable unit to the Logistics Center NPL site and is a CERCLA site on the NPL. Site investigation and assessment activities were conducted from 1981 through 1993. The ROD was signed in October 1993. The pre-ROD investigations concluded that the source of groundwater contamination does not appear to be the landfill per say but rather a discrete hot spot adjacent to the landfill where other activities (such as vehicle maintenance) likely occurred. Following the ROD, an air sparging and soil vapor extraction system was installed and operated for three years to remove the hot spot TCE and vinyl chloride site contaminant between October 1996 and October 1999. Post-ROD remedial action (operations) groundwater monitoring has included events conducted between 1994 and the present. Landfills are potential PFAS sources due to the potential for disposal of PFAS containing waste.

3.8. Installation Groundwater Treatment Systems

Logistics Center Groundwater Remedy

Three P&T systems are located within the JBLM Logistics Center area and are associated with the Landfill #2 TCE plume (Section 3.4.2). The three treatment systems include the Landfill #2 P&T system, Sea Level Aquifer P&T system, and the I-5 P&T system. To fulfill EPA's request for additional information to make a protectiveness determination, water samples were collected from the influent and effluent of these systems. Additionally, landfills are potential PFAS sources due to the potential for disposal of PFAS containing waste.

McChord American Lakes Garden Tract Remedy

A groundwater P&T system is associated with the American Lakes Garden Tract (ALGT) TCE plume. ALGT comprises several subsites, but the primary contributors of TCE contamination are Landfill 005 and Old Burn Trench 39 (OT-39) (Figure 3-2). Landfill 005 operated between 1951 and the mid-1960s. The landfill was used primarily for the disposal of domestic, construction, and industrial wastes, which included fuel, waste oil, and possibly solvents. OT-39 operated from 1953 to the early 1960s and consisted of an open trench for the disposal of waste oils, petroleum, fuel, and solvents.

The ALGT system was not operating when this PA/SI was conducted. To fulfill EPA's request for the additional information required to make a protectiveness determination, groundwater samples were collected from four monitoring wells associated with the ALGT landfill 005 during the SI.

3.9. Aircraft Rescue and Firefighting Vehicles

The seven ARFF vehicles are mobile pieces of equipment, which include trailers typically dispatched behind fire trucks, with foam tanks at volumes ranging from 200 to 420 gallons. These vehicles were tested in 2017 by the fire department and were all determined to contain PFOS and/or PFOA compounds.

3.10. Other Potential PFAS Source Areas at JBLM

The primary objective of the PA was to identify operations/activities, both current and historical, for potential contributions of PFOS, PFOA, and PFBS to drinking water production wells identified with PFAS concentrations at or exceeding the HAL of 70 ppt.

The PA screened for operations and areas based on whether there was use, storage or disposal of any PFAS-containing material, but focused on areas with obvious higher activity, which included fire-fighting training and response, known contaminated sites, landfills, waterproofing operations, and surfactant operations (e.g., vehicle washracks and laundry facilities).

Once a potential source was identified, it was prioritized based on the following criteria:

- Historical/anecdotal information for the largest AFFF release volumes
- Proximity to impacted drinking water production wells
- Areas with most direct pathway to impacted drinking water production wells

In addition to those described above, other potential sources of PFAS identified during the PA are summarized in Table 3-1.

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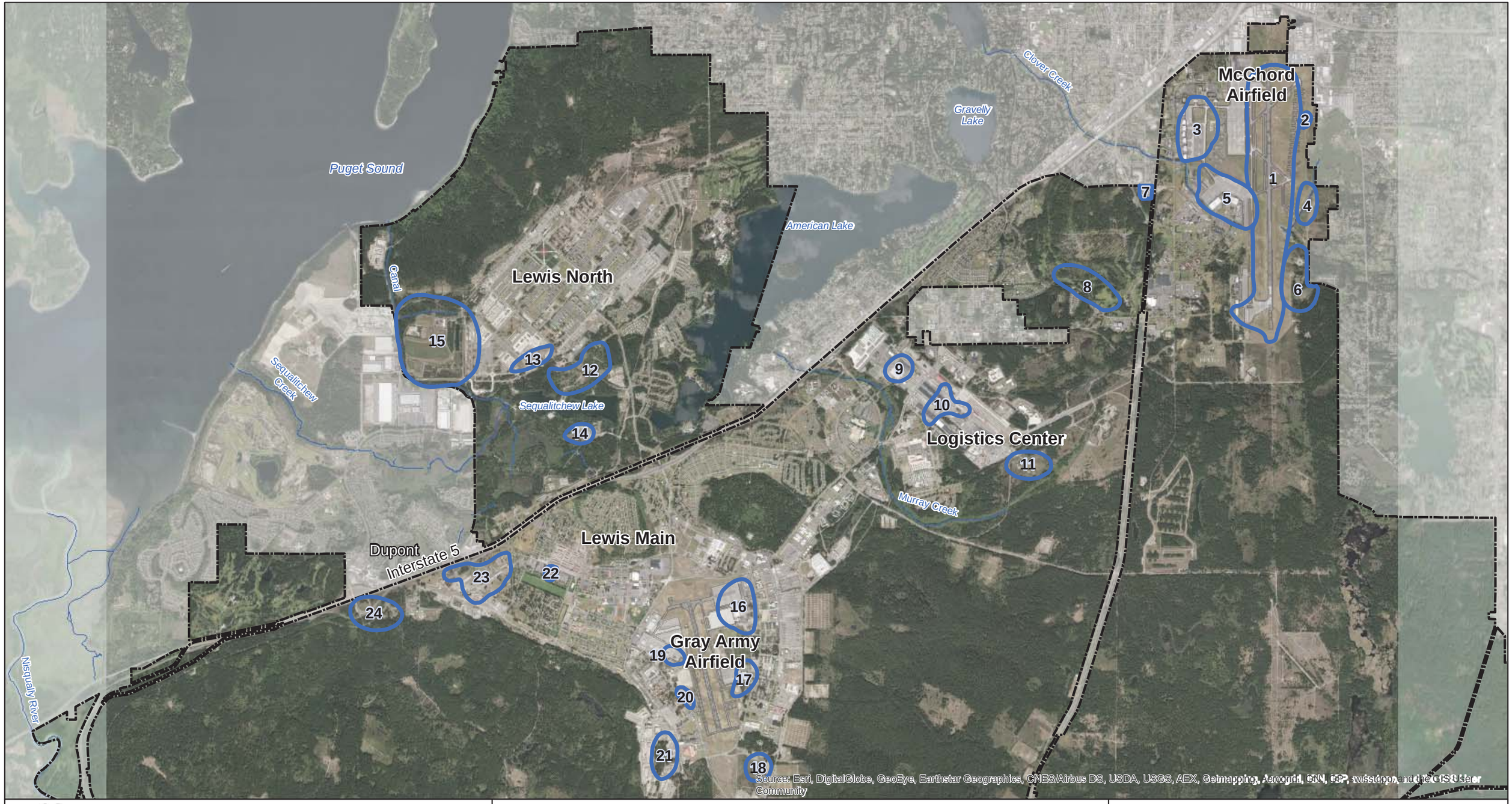

PUBLIC WORKS

N

0 0.5 1

Miles

Legend

Area of Potential Interest

JBLM Boundary

Figure 3-1
JBLM Preliminary Assessment Sites Map

PFAS Preliminary Assessment Site Inspection
Joint Base Lewis McChord
Lakewood, WA

Document Path: S:\60555402-SEA1\900-CAD-GIS\940-GIS\MXDs\PASI_Report\draft\Figure 3-1 JBLM Preliminary Assessment Sites Map1.mxd

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Landfill 019
Landfill 020
Sump
Hangar 13
Infield Bulk Fuel Tank Farm
Landfill 016
10
9
7
6
5
AFFF Sump
Hangars
3
2
FT027
McChord Airfield Runway
Clover Creek
Historic Wash Rack
Landfill 017
Taxiway D
Landfill 011
1
FT028
Hangars
7
Tank Farm
Landfill 002
3
4
2
1
5
FT033
FT033
Fire Station House 105/Building 6
4
FT029
FT030
Landfill 001
Clover Creek
Culverted Beneath Runway
Landfill 021
Landfill 012
FT031
FT032
Landfill 010
8
Landfill 022
6
Landfill 005
Landfill 007
OT039
Hangar 301
Landfill 013
Landfill 025
Landfill 006
Landfill 014

N

0 0.125 0.25
Miles

Legend

- Area of Potential Interest
- Fire Training Area - Current
- Aircraft Accident Responses
- Fire Training Area Sites-Historic
- PFAS Operations/Use
- Fire Training Restoration Sites
- Landfill
- JBLM Boundary

Figure 3-2
JBLM Preliminary Assessment Sites - McChord Area

PFAS Preliminary Assessment Site Inspection
Joint Base Lewis McChord
Lakewood, WA

Document Path: S:\60555402-SEA1\900-CAD-GIS\940-GIS\MXDs\PASI_Report\draft\Figure 3-2 McChord Area_20200309.mxd

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PUBLIC WORKS

N

0 0.25 0.5

Miles

Legend

- Area of Potential Interest
- PFAS Operations/Use
- Landfill
- JBLM Boundary

Figure 3-3
JBLM Preliminary Assessment Sites -
Log Center/ Fort Lewis/Landfill #4 and #5 Area

PFAS Preliminary Assessment Site Inspection
Joint Base Lewis McChord
Lakewood, WA

Document Path: S:\60555402-SEA1\900-CAD-GIS\940-GIS\MXDs\PASI_Report\draft\Figure 3-3 Log Center Landfill 5 6.mxd

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Hangar 3106
16
FTLE-17
Hangar 3146
Gray Army Airfield Runway
Storm Drainage
Hangar 3063
19
3081 Fire Station House 102
Hangar 3273
17
Storm Drainage
3095
20
Hangar 3098
3099
Landfill #1
21
SWMU-47
18
Ft Lewis Wash Rack

PUBLIC WORKS

N

0 0.1 0.2 Miles

Legend

- Area of Potential Interest
- Fire Training Area - Current
- Aircraft Accident Responses
- Fire Training Area Sites-Historic
- PFAS Operations/Use
- Fire Training Restoration Sites
- Landfill
- JBLM Boundary

Figure 3-4
JBLM Preliminary Assessment Sites - Gray Army Airfield Area

PFAS Preliminary Assessment Site Inspection
Joint Base Lewis McChord
Lakewood, WA

Document Path: S:\60555402-SEA1\900-CAD-GIS\940-GIS\MXDs\PASI_Report\draft\Figure 3-4 Gray Field Ft Lewis.mxd

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Table 3-1
Summary of PA Results

AOPI	Known/Potential PFAS Operations/Uses	General Location	Potential Concern	Approximate Years of Operation	Recommended for SI sampling based on potential concern?
AOPI 1 – McChord Airfield Runway	McChord – Aircraft Accident Responses	Along the McChord field runway, from north end to south end, and beyond in approach zones	Potential use of AFFF for firefighting, and release to surrounding environment.	1950 through 1991	Yes
	Landfill #12	McChord –south portion middle of runway	Landfill used for wastes including domestic solid waste.	1939- 1952	Yes
AOPI 2 – McChord Airfield Historical FT Area 027	FT027	McChord - located along the north end of the main runway	Historical use for firefighting practice.	1960 through 1977	Yes
AOPI 3 – McChord Airfield, North Hangar Area	Hangar 5 Building 1178	McChord - Northwestern portion	AFFF systems, and releases of AFFF to adjacent surfaces.	1967 through present day	Yes
	McChord AFFF Sump between Hangars 5 and 6	McChord – Protrudes from underground between Hangars 5 and 6	Potential release of AFFF from sump.	Unknown date through present day	Yes
	Hangar 6 Building 1160	McChord - Northwestern portion	AFFF systems, and releases of AFFF to adjacent surfaces. System activation release in 2009, foam was approximately 3 feet deep in hangar. System activation was reportedly due to freezing temperature conditions. Release from the system of an unknown volume of AFFF in 2011. Dripping to ground surface was observed from AFFF system drainage pipe on exterior wall.	1999 through present day	Yes

Table 3-1 (Continued)
Summary of PA Results

AOPI	Known/Potential PFAS Operations/Uses	General Location	Potential Concern	Approximate Years of Operation	Recommended for SI sampling based on potential concern?
AOPI 3 – McChord Airfield, North Hangar Area (cont'd)	Hangar 7 Building 1164	McChord - Northwestern portion	AFFF systems, and releases of AFFF to adjacent surfaces. AFFF concentrate release in 2010 of approximately 5 to 10 gallons to mechanical room.	1958 through present day	Yes
	Hangar 9 Building 1166	McChord - Northwestern portion	AFFF systems, and releases of AFFF to adjacent surfaces.	1958 through present day	Yes
	McChord AFFF Sump between Hangars 9 and 10	McChord – Located underground between 9 and 10	Potential release of AFFF from sump.	Unknown date through present day	Yes
	Hangar 10 Building 1167	McChord - Northwestern portion	AFFF systems, and releases of AFFF to adjacent surfaces. Dripping to interior floor surface was observed from AFFF AST inside hangar.	1958 through present day	Yes
	McChord Flight line Infield – 4 Aviation Fuel Tanks	McChord – Four bulk fuel tanks located within infield east of Hangars 9 & 10	Potential use of AFFF for firefighting, and release to surrounding environment.	Unknown date through present day	Yes
	Hangar 13 Building 1174	McChord - Northwestern portion	AFFF systems, and releases of AFFF to adjacent surfaces. AFFF concentrate release in 2017 of approximately 50 gallons to mechanical room. AFFF concentrate release in approximately 2016 of approximately 1,500 gallons to mechanical room.	1999 through present day	Yes
	McChord AFFF Sump West of Hangar 13	McChord – Located underground West of Hangar 13	Potential release of AFFF from sump.	Unknown date through present day	Yes

Table 3-1 (Continued)
Summary of PA Results

AOPI	Known/Potential PFAS Operations/Uses	General Location	Potential Concern	Approximate Years of Operation	Recommended for SI sampling based on potential concern?
AOPI 4 - McChord Airfield Historical FT 028, FT029, FT030	FT028	McChord - west of the perimeter road	Historical use for firefighting practice.	One to two years during the early 1960s	Yes
	FT029	McChord – Reportedly of the confluence of Clover Creek and Morey Creek	Historical use for firefighting practice.	Unknown	No, site location misidentified during historical investigations
	Historical FT Area 30	McChord – southeast of the hazardous cargo loading area	Historical use for firefighting practice.	1955 to 1960	Yes
AOPI 5 - McChord Airfield, South Hangar Area	Historic FT Area 033 Fire Station #105/ Building J00006	McChord – Area of Building J00006	Historical use for firefighting practice. Current storage of bulk AFFF, and refilling of ARFFs. Test application of AFFF spray pattern onto flight line. Dripping to interior floor surface was observed from AFFF AST inside fire station garage.	Used as FT-33 from 1940s through 1950 Fire station in use through present day	Yes
	Clover Creek	McChord – Crosses via culvert beneath middle of runway, and then flows on surface towards northwest, extending to west boundary of JBLM, many outfalls to creek that have collected storm water from McChord airfield.	Receiving storm water from hangars equipped with AFFF systems, and other historical AFFF releases.	Present day feature. AFFF systems remain in nearby hangars, therefore a potential source of PFAS	Yes
	Hangars 1 and 2 Buildings J00001 and J00002	McChord - West of central portion of runways	AFFF systems, and releases of AFFF to adjacent surfaces.	1939 through present day	Yes

Table 3-1 (Continued)
Summary of PA Results

AOPI	Known/Potential PFAS Operations/Uses	General Location	Potential Concern	Approximate Years of Operation	Recommended for SI sampling based on potential concern?
AOPI 5 - McChord Airfield, South Hangar Area	Hangars 3 and 4 Buildings J00003 and J00004	McChord - West of central portion of runways	AFFF systems, and releases of AFFF to adjacent surfaces. System activation release in 2012 of approximately 3,000 gallons, foam accumulated 20 feet deep in hangar. System activations also possibly in 2008, 2010, 2012 & 2013; release volume unknown.	1939 through present day	Yes
	Hangar 301 McChord Field Runway	McChord – South end, west side of McChord Field runway	AFFF systems, and releases of AFFF to adjacent surfaces.	1957 through present day	Yes
	Historical wash rack and Taxiway D	McChord – Northwest of Hangar 2	Historical use of surfactants at Wash Rack/ARFF vehicles foam spray pattern testing at Taxiway D.	1950s through early 1970s	Yes
AOPI 6 – McChord Airfield FT031, FT032, Landfill 013, Landfill 022	FT031	McChord - East side of runway, approximately 500 feet south of Morey Creek	Historical use for firefighting practice.	1950 to 1955	Yes
	FT032	McChord - East side of runway, near Clover Creek	Historical use for firefighting practice and AFFF use.	1975 through 1990, reconstructed in 1997 to current configuration	Yes
	Landfill 013	McChord - East side of runway, approximately 800 feet south of FT 032	Disposal of soils excavated from FT032.	1950 – 1979. Soils excavated from FT032 were deposited possibly in 1990	Yes
AOPI 7 – McChord Airfield Main Bulk Fuel Tank Farm	McChord – Main Bulk Fuel Tank Farm	West of North Well	Potential use of AFFF for firefighting, and release to surrounding environment.	Unknown date to present day	Yes

Table 3-1 (Continued)
Summary of PA Results

AOPI	Known/Potential PFAS Operations/Uses	General Location	Potential Concern	Approximate Years of Operation	Recommended for SI sampling based on potential concern?
AOPI 8 – American Lake Garden Tract Landfill 005	Landfill 005	Northeast of Logistics Center and Landfill #2	Potential leaching of PFAS compounds to groundwater.	1951 – 1961, waste oil burning 1952 - 1964.	Yes
AOPI 9 – Northwest Logistics Center	Historical waterproofing in area of Buildings 9570/9580	Logistics Center, northwest portion	Historical use of waterproofing.	Unknown	Yes
AOPI 10 – Central Logistics Center	Building 9612 Current wash rack	Northeast of Rainier Drive	Surfactants use.	Unknown date through present day	Yes
	Building 9626 Historical wash rack	North of Rainier Drive and South L Street intersection	Historical surfactants use.	Unknown	Yes
	Building 9636 Bulk “Fuel Spot"	Logistics Center, center portion	Potential release from AFFF system. This is dry system charged only during fire, so no PFAS supply remains onsite.	Unknown date through present day	Yes
	Historical waterproofing in area of Buildings 9630/9640	Logistics Center, middle northwest portion	Historical use of waterproofing.	Unknown	Yes
	Historical Laundry-Building 9060	Logistics Center	Historical use of surfactants.	Unknown	Yes
AOPI 11 – Logistics Center Landfill #2	Landfill #2	Southeast of Logistics Center	Potential leaching of PFAS compounds to groundwater.	1940s to 1970s	Yes
AOPI 12 – Lewis North Landfill #4	Lewis North - Landfill #4	North of Sequalitchew Lake	Potential leaching of PFAS compounds from landfill contents to groundwater.	1951 - 1967	Yes
AOPI 13 – Lewis North AOC 15-1 and Wash Rack	AOC 15 (1957)	Along north side of South Drive	Historical use of AFFF for firefighting practice.	At least in the 1950s	Yes
	Current wash rack	South Drive and A Street Intersection Adjacent to Lewis North AOC 15-1 and 15-2	Surfactants use.	Unknown date through present day	Yes

Table 3-1 (Continued)
Summary of PA Results

AOPI	Known/Potential PFAS Operations/Uses	General Location	Potential Concern	Approximate Years of Operation	Recommended for SI sampling based on potential concern?
AOPI 14 – Historic Solvent Refined Coal Power Plant	SRCPP (FTLE-32)	South of Sequalitchew Lake, near drinking water production Well 12B	Unknown compounds used in coal solvent refining process, could have included PFAS, proximal to Sequalitchew Spring Well and Well 12 A/B.	1974 - 1981	Yes
AOPI 15 – Lewis North Landfill #5	Landfill #5	West side of Lewis North	Potential leaching of PFAS compounds from landfill contents to groundwater, wastewater treatment plant biosolids disposal, surface water drainage to the landfill and infiltration through landfill contents.	Primarily in 1950s through 1960s, with non-landfilling operations in more recent years	Yes
AOPI 16 – Gray Army Airfield Hangars 3106, 3146, 3101 and FTLE-17	Army National Guard Hangar 3106	Ft Lewis – Northeast corner of Gray Army Airfield	AFFF system, and releases of AFFF to adjacent surfaces. AFFF concentrate release in approximately 1985 of unknown volume to mechanical room.	1985 through present day	Yes
	FTLE-17	Ft Lewis – Within northeast portion of Gray Army Airfield flight line, approximately 600 feet northwest of Hangar 3146, beneath 10” thick concrete helicopter ramp (parking)	Historical Fire Training Area.	1962 - 1982	Yes
	Hangar 3146	Ft Lewis – Within northeast portion of Gray Army Airfield, south of larger Hangar 31010 (31010 is very new hangar)	AFFF system, and releases of AFFF to adjacent surfaces. AFFF concentrate release in 2001 of approximately 10 gallons to mechanical room.	1987 through present day	Yes
	Hangar 3101	Northeast Portion of Gray Army Airfield	AFFF system, and releases of AFFF to adjacent surfaces.	Constructed last year so not used with PFAS AFFF	No

Table 3-1 (Continued)
Summary of PA Results

AOPI	Known/Potential PFAS Operations/Uses	General Location	Potential Concern	Approximate Years of Operation	Recommended for SI sampling based on potential concern?
AOPI 17 – Gray Army Airfield Hangar 3273 and storm drainage	Army Reserve Hangar 3273	Ft Lewis – Southeast Portion of Gray Army Airfield, East of Flight Line	AFFF system, and releases of AFFF to adjacent surfaces.	2006 through present day	Yes
	Storm water Drainage Swale near Hangar 3273	Approximately 500 feet southwest of Hangar 3273	Receives storm water from near hangar equipped with AFFF System.	Unknown date through present day	Yes
AOPI 18 – Lewis Main SWMU-47 and FLT-54 Wash Rack	SWMU-47 Historical Firefighting Training Area	Ft Lewis – Southeast of Gray Army Airfield, west of wash rack	Historical Firefighting Training Area.	Unknown date range	Yes
	FLT-54 Wash Rack Equipment 3559 - 3562	South of Gray Army Airfield - near SWMU-47	Surfactants.	Unknown date through present day	Yes
AOPI 19 – Gray Army Airfield Hangar 3063 and Fire Station 102	Hangar 3063	Gray Army Airfield – along flight line on west side	AFFF system, and releases of AFFF to adjacent surfaces. Reported AFFF release of one pint in 2009.	Unknown date through present day	Yes
	Fire Station 102 – Building 3081	Gray Army Airfield – along flight line on west side	AFFF bulk storage in adjacent outbuilding. AFFF storage and refilling.	Unknown date through present day	Yes
AOPI 20 -Gray Airfield Hangar 3098 and Buildings 3095 and 3099	Hangar 3098	West side of Gray Army Airfield	AFFF system, and releases of AFFF to adjacent surfaces. AFFF concentrate release in 2008 of approximately 250 gallons to mechanical room.	Unknown date through present day	Yes
	Building 3095	West side of Gray Army Airfield	AFFF system, and releases of AFFF to adjacent surfaces.	Unknown date through present day	Yes
	Building (Temporary) 3099	Gray Army Airfield – along flight line on west side	AFFF release reportedly occurred inside of an aircraft. Reported AFFF release of 500 gallons to the inside of an aircraft.	Unknown date through present day	Yes

Table 3-1 (Continued)
Summary of PA Results

AOPI	Known/Potential PFAS Operations/Uses	General Location	Potential Concern	Approximate Years of Operation	Recommended for SI sampling based on potential concern?
AOPI 21 – Gray Airfield Landfill #1	Landfill #1	Approximately 1,000 feet west of southwest corner Gray Army Airfield	Potential leaching of PFAS compounds to groundwater.	1946 – 1951, or through early 1970s (sources vary)	Yes
AOPI 22 – Lewis Main Fire Station 7 Building 2014	Fire Station 7 – Building 2014	On Pendleton Avenue, between 3rd and 4th Streets	AFFF storage in, and refilling of, ARFFs, and delivery of bulk quantities of AFFF. Dry wells indicated as adjacent to building.	Unknown date through present day	Yes
AOPI 23 – Lewis Main Buildings 04074,04076, 1401, 4100, 1206 and 1210	Buildings 04074 & 04076	West part of Ft Lewis – Southwest of Traffic Circle	Historical canvas waterproofing.	Specific date range not known. Was observed active in 1990s	Yes
	Building 1401 - Formerly known as Building 1402 Historical Laundry operation since 1941	West part of Lewis Main – South of I-5 near Exit 119/ Dupont Gate	Historical use of surfactants at laundry operation.	1941 through 1999	Yes
	Fire Station 1 – Building 4100	Northwest of Intersection of West Way and Lewis Drive	AFFF storage in, and refilling of, ARFF vehicles, and delivery of bulk quantities of AFFF.	Unknown date through present day	Yes
	Buildings 1206/ 1210 Ranges	West Lewis Main (Forestry)	Storage of AFFF, and unknown area of use.	Unknown. A database of chemicals distributed to various locations, indicated AFFF was on inventory here in 2003-2004)	Yes
AOPI 24 - Lewis Main Landfill #9	Landfill #9	West part of Ft Lewis – I-5 Interchange, Exit 118, south and north of I-5	Potential leaching of PFAS compounds from landfill contents to groundwater.	1930s and 1950s	Yes

4.0 SITE INSPECTION

The SI consisted of groundwater well installation, new and existing groundwater monitoring well sampling, surface water sampling, treatment system influent and effluent sampling, and off-base production well sampling. Surface water sampling was conducted by JBLM staff. JBLM staff or off-base water purveyors sampled off-base production wells. Sampling and sample analyses conducted by JBLM and off-base water purveyor staff were conducted outside the site-specific QAPP requirements for this PA/SI.

The findings of the PA were used to guide selection of the SI sampling locations. The SI was conducted in three phases. In Phase I, existing groundwater monitoring wells were sampled. In Phase II, new shallow groundwater monitoring wells were installed in select areas and additional existing monitoring wells were sampled. In Phase III, new deep groundwater monitoring wells were installed and sampled and off-base production wells within a half-mile of the JBLM perimeter fence line were sampled.

All Phase I sampling was completed in June 2018. Results of Phase I sampling event, in conjunction with the finding of the PA, were used to guide the selection of the Phase II and III sampling locations, which consisted of the installation of new groundwater monitoring wells in several potential source areas identified during the PA. This section describes the sample locations, rationale, and methodology for each SI event.

All drilling and well development services were provided by Holt Drilling. Investigation-derived waste (IDW) water containment, transport, and disposal were provided by Cascade Environmental Services. Surveying was provided by Bush, Roed, and Hitchings. Quantitative analytical laboratory services were provided by Eurofins, Lancaster.

4.1. Phase I Event

4.1.1 Phase I Sampling Locations

The Phase I sampling event was performed from June 6 to 26, 2018. Phase I sampling consisted of:

- Sampling of 38 existing groundwater monitoring wells
- Sampling of influent and effluent for three P&T treatment systems associated with the Logistics Center TCE groundwater plume at the Logistics Center
- Collection of a surface water sample from Clover Creek

Sampling locations are shown on Figure 4-1. The rationale for each Phase I sampling location is provided in Table 4-1, which also includes information on the nearest potential PFAS source area and nearest drinking water production well.

4.1.2 Phase I Sampling Methodologies

4.1.2.1 Surface Water Sampling

Surface water sampling was conducted in accordance with Standard Operating Procedures (SOPs) A and E of the QAPP (JBLM 2018a). One surface water sample was collected using a peristaltic pump fitted with disposable high-density polyethylene (HDPE) tubing affixed to a telescoping rod. The intake of the

HDPE tubing was positioned approximately 6 inches below the water surface to prevent sediment disturbance. The sample volume was collected through the HDPE tubing and decanted directly into the laboratory bottleware. Water quality parameters, including pH, temperature, dissolved oxygen (DO), oxidation-reduction potential (ORP), turbidity, and specific conductance were measured directly from the surface water sampling location and recorded on the field sampling form. Prior to the collection of water quality parameters, the instrument was calibrated in accordance with SOP C of the QAPP. A small volume (~10-25 milliliters [mL]) of surface water was field screened using a shaker test in accordance with SOP A of the QAPP. IDW water was contained in labeled, U.S. Department of Transportation (DOT)-approved containers and stored at a location specified by JBLM DPW. Surface water sample collection field logs are provided in Appendix B.

Seven additional surface water samples were collected and analyzed by JBLM outside of the site-specific QAPP requirements for this PA/SI.

4.1.2.2 Groundwater Sampling

Groundwater samples were collected during the Phase I event using low-flow techniques in accordance with SOP B of the QAPP. Water quality parameters, including pH, temperature, DO, ORP, turbidity, and specific conductance were recorded during sampling in accordance with SOPs A and D of the QAPP. Depth to groundwater was also collected from each sampled location. Prior to the collection of water quality parameters, the instrument was calibrated in accordance with SOP C of the QAPP. A small volume (~10-25 mL) of groundwater was collected from each location and field screened using a shaker test in accordance with SOP A of the QAPP. IDW water was contained in labeled, DOT-approved containers and stored at a location specified by JBLM DPW. Groundwater sample collection field logs are provided in Appendix B.

4.2. Phase II and III Events

4.2.1 Phase II and III Sampling Locations

Phase II and III sampling events were performed from January through May 2019 and included the sampling of existing monitoring wells and the installation and sampling of new monitoring wells. Samples were collected from 34 monitoring wells, 15 existing groundwater monitoring wells and 19 newly installed wells (Figure 4-2). The rationale for each Phase II and Phase III sampling location is provided in Table 4-2, which also includes information on the nearest potential PFAS source area and nearest drinking water production well.

4.2.2 Phase II and III Sampling Methodologies

4.2.2.1 Groundwater Monitoring Well Installation

All drilling and well installation activities performed during the Phase II and III events were conducted by a State of Washington-licensed well drilling contractor using sonic drilling methods. Continuous soil cores were collected to the total depth of each boring and immediately logged upon retrieval. A tubular plastic sleeve with a sealed bottom was placed beneath the core barrel. The core barrel was then vibrated, causing the soil sample to be extruded into the plastic sleeve. Each plastic sleeve was then marked with the sample interval using indelible ink. To prevent cross-contamination across separate water-bearing units, bentonite slurry seals were injected into the subsurface when a significant aquitard

(e.g., between the Upper Vashon and Lower Vashon Aquifers or between the Vashon Aquifer and Sea Level Aquifers) was encountered. When an aquitard was identified using the core sample collected with the smaller diameter inside core barrel, bentonite slurry was injected into the outer casing to a depth of several feet above the contact with the aquitard. After the bentonite had properly sealed, a smaller diameter casing was advanced through the bentonite seal into the next sampling interval. Several borings required the use of water or bentonite gel/barite mud to control sand heave. Water/mud volume used at each well location was accurately tracked in the field logbook to ensure that it would be removed during well development.

Recovered soil was visually examined for evidence of contamination and classified in accordance with the Unified Soil Classification System. Soil was field screened with a photoionization detector (PID) by inserting the PID probe into the plastic sleeve containing the soil core, assessing organic vapors along the length of the core, and documenting the results on the field boring logs as prescribed in SOP G of the QAPP. The PID was calibrated in accordance with the manufacturer's instructions at the beginning of each day. Core barrel samples, soil cuttings, and decontamination fluids were contained in labeled, DOT-approved 55-gallon drums and transported to a location designated by JBLM DPW.

Groundwater monitoring wells were installed in accordance with SOP H of the QAPP. Well screen intervals were determined based on the Phase I groundwater sampling results, a review of adjacent wells/soil borings, and observed field conditions during the drilling activities, in consultation with the USACE and JBLM.

Monitoring wells that were 60 feet or less in depth were constructed of 2-inch-diameter, flush-threaded Schedule 40 polyvinyl chloride (PVC) with 10 feet of 0.010 slot well screen and blank well casing to ground surface. The well casing was sealed with a lockable compression cap. The filter pack within the annular space around the screen consisted of 2/12 Monterrey sand placed at least two feet above the top of the well screen. A well seal consisting of hydrated bentonite chips was installed above the sand pack.

Monitoring wells installed to depths greater than 60 feet were constructed of 4-inch-diameter, flush-threaded Schedule 40 PVC with 20 feet of 0.010 slot well screen and blank well casing to ground surface. The filter pack around the screen consisted of 2/12 Monterrey sand placed to at least two feet above the top of the well screen. For well installations less than or greater than 60 feet, the remaining annular space was sealed with a bentonite slurry.

Wells were completed with above-ground steel "stick-up" protective casings surrounded by three traffic bollards in unpaved portions of the site and with traffic-rated flush mount monuments in paved portions of the site.

Boring logs and well construction diagrams for each of the newly constructed wells are provided in Appendix C. Photos representative of the various recovered subsurface materials are also provided in each of the respective bore logs in Appendix C.

4.2.2.2 Well Development

The newly installed monitoring wells were developed to establish a hydraulic connection between the well and the surrounding saturated formation, settle the filter pack, remove accumulated sediment/suspended solids that entered the well during installation, and remove water/drilling mud used to control sand heave during well installation, in accordance with SOP I of the QAPP. Well development was performed at least 24 hours after well construction to allow time for the bentonite or

grout seal to cure. Development was performed by first using a surge block followed by a bailer (PVC or stainless steel), pneumatic pump, or submersible pump to remove sediment from the well and surrounding filter pack.

Once the bailed/pumped water is visually free of sediment, development was continued using high-flow pumping techniques (greater than 0.5 liter per minute) until the water quality parameters (temperature, pH, specific conductance, and turbidity) stabilized to within 10 percent of the previous reading for three consecutive measurements, or until five borehole volumes (well casing plus annular space) were removed. Additionally, at locations requiring the use of water to control heave during drilling, the volume of added water was removed during development. Development water was pumped directly into a vacuum track and was then transported to one of two 21,000-gallon frac tanks staged at a location designated by JBLM DPW. Development logs for each newly installed well are provided in Appendix C.

4.2.2.3 Monitoring Well Surveying

All newly installed monitoring wells were surveyed by a State of Washington-licensed surveyor. After the monitoring wells were installed, a mark was made at the top of the inner casing. The vertical and horizontal location of the top of inner PVC casing, the outer steel protective casing, and ground surface adjacent to each well were surveyed to an established benchmark. All elevations were referenced to the North American Vertical Datum 1988 to within 0.01 foot. The horizontal locations of each point are documented in North American Datum (1983/91) Washington State Plane North Zone with an accuracy of up to 0.1 foot. A summary of the survey data is provided in Appendix D.

4.2.2.4 Groundwater Sampling

Groundwater samples were collected during the Phase II and III event using low-flow techniques in accordance with SOP B of the QAPP. Water quality parameters, including pH, temperature, DO, ORP, turbidity, and specific conductance, were recorded during sampling in accordance with SOPs A and D of the QAPP. Prior to collection of water quality parameters, the instrument was calibrated in accordance with SOP C of the QAPP. A small volume (~10-25 mL) of groundwater was collected from each location and field screened using a shaker test in accordance with SOP A of the QAPP. IDW water was contained in labeled, DOT-approved containers and stored at a location specified by JBLM DPW.

4.2.2.5 Water Sample Analysis

On February 20, 2018, an Army Guidance Memo was issued that required PFAS assessments to include the 14 analytes identified by EPA Method 537 (U.S. Army 2018). All water samples collected during this SI were analyzed for the 14 analytes by EPA Method 537.1 at the time.

These analytes were:

- PFOS – perfluorooctane sulfonate – UCMR-3 compound
- PFOA – perfluorooctanoic acid – UCMR-3 compound
- PFBS – perfluorobutane sulfonate – UCMR-3 compound
- PFHpA – perfluoroheptanoic acid – UCMR-3 compound
- PFHxS – perfluorohexanesulfonate – UCMR-3 compound
- PFNA – perfluorononaoic acid – UCMR-3 compound

- PFHxA – perfluorohexanoic acid
- PFNA – perfluorononanoic acid
- PFTeA – perfluorotetradecanoic acid
- PFTrDA – perfluorotridecanoic acid
- PFUnDA – perfluoroundecanoic acid
- NEtFOSAA – n-ethyl perfluorooctanesulfonamidoacetic acid
- NMeFOSAA – n-methyl perfluorooctanesulfonamidoacetic acid
- PFDA – perfluorodecanoic acid

The six UCMR-3 compounds are identified above.

Analyses were conducted in accordance with the project-specific QAPP (JBLM 2018a and 2018b) and Quality Systems Manual version 5.1 (DoD 2017) by a Department of Defense Environmental Laboratory Accreditation Program accredited laboratory.

4.3. Treatment System Sample Collection

Six samples were collected from the Landfill #2, I-5, and Sea Level Aquifer P&T system influent and effluent streams. Samples were collected directly from sampling ports under operating conditions. The rationale for treatment system sample collection, including the nearest potential PFAS source area and nearest drinking water production well, is provided in Table 4-3. Sampling locations are shown on Figure 4-1.

4.4. JBLM DPW Off-Base Production Well Sampling

Water samples were collected from 13 off-base production wells between May 1, 2018, and December 17, 2018. The samples were collected and submitted for analysis by JBLM DPW IRP staff and/or the water purveyors. The samples were collected directly from the existing production well infrastructure sampling points; permission for sampling was granted by the water suppliers who own the wells. The rationale for JBLM DPW off-base production well sampling is provided in Table 4-4, which also includes the following: the apparent screen interval, the aquifer from which water is being withdrawn, and the well owner. Sampling locations are shown on Figure 4-2.

4.5. JBLM DPW Surface Water Sample Collection

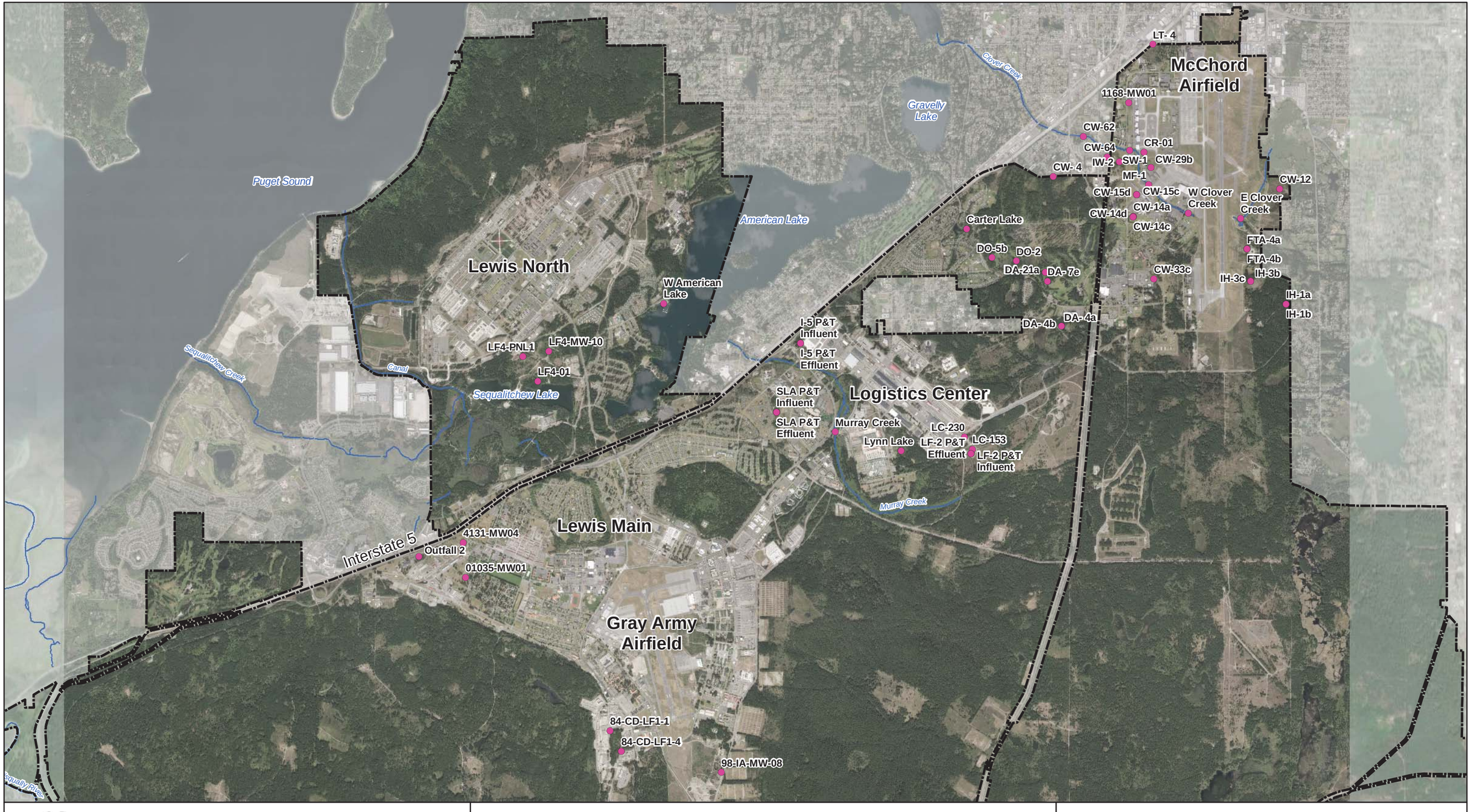
Six surface water samples were also collected across the installation by JBLM DPW IRP staff to assess for the presence or absence of PFOS and PFOA in surface water samples. Sample locations are shown on Figure 4-1. Samples were collected from Clover Creek, Murray Creek, a stormwater retention pond, Lynn Lake, west American Lake, and Carter Lake.

4.6. QAPP Deviations

A summary of QAPP deviations are provided in Table 4-5.

4.7. Investigation-Derived Waste

Drill cuttings generated during monitoring well installation were contained in labeled, DOT-approved 55-gallon drums filled approximately two-thirds full. The drums were transported to a storage location identified by JBLM DPW. IDW purge/decontamination water was contained in poly totes and transferred at the end of each day into one of two 21,000-gallon frac tanks staged at a location designated by JBLM. Both IDW soil and water were sampled and characterized to determine the appropriate method and facility for disposal. Soil cutting characterization data was provided to JBLM DPW. IDW purge/decontamination water was transported by Cascade Environmental to Waste Management for treatment and final disposal. This water was treated by solidification and disposed of at Columbia Ridge Landfill in Arlington, Oregon. IDW water disposal documentation is provided in Appendix E.



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Legend

- Phase I Surface Water and Groundwater
- JBLM Boundary

Figure 4-1
Phase I Sampling Locations

PFAS Preliminary Assessment Site Inspection
Joint Base Lewis McChord
Lakewood, WA

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- Phase II and III Sampling Locations
- JBLM Boundary

Figure 4-2
Phase II and III Sampling Locations

PFAS Preliminary Assessment Site Inspection
Joint Base Lewis McChord
Lakewood, WA

Document Path: S:\60555402-SEA1\900-CAD-GIS\940-GIS\MXDs\PASI_Report\draft\Figure 4-2 Phase II and III Sampling Locations.mxd

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Table 4-1
Phase I Sampling Locations and Rationale

Sampling Location/ ID Number	Matrix	Screen Interval (feet bgs)	Rationale	Nearest AOPIs	Nearest Drinking Water Production Well
LT-4	Groundwater	16.3-26.3	Assess for the presence or absence of PFAS in shallow groundwater along JBLM boundary	AOPI 1 – McChord Airfield Runway AOPI 3 – McChord Airfield, North Hangar Area	North Well
1168-MW01	Groundwater	7-22	Assess for the presence or absence of PFAS in shallow groundwater along JBLM boundary	AOPI 3 – McChord Airfield, North Hangar Area	North Well
CR-01	Groundwater	8-38	Assess for the presence or absence of PFAS in shallow groundwater	AOPI 3 – McChord Airfield, North Hangar Area	North Well
CW-62	Groundwater	30-40	Assess for the presence or absence of PFAS in shallow groundwater adjacent to a losing reach of Clover Creek	AOPI 3 – McChord Airfield, North Hangar Area AOPI 5 - McChord Airfield, South Hangar Area AOPI 1 – McChord Airfield Runway	North Well
CW-12	Groundwater	11-21	Background sample to assess for the presence or absence of PFAS in shallow groundwater upgradient of potential areas of concern, adjacent to the JBLM boundary	AOPI 4 - McChord Airfield Historical FT 028, FT029, FT030	East Well
IW-2	Groundwater	35-45	Assess for the presence or absence of PFAS in shallow groundwater and distribution following sodium permanganate oxidation	AOPI 5 - McChord Airfield, South Hangar Area	North Well
CW-64	Groundwater	45-60	Assess for the presence or absence of PFAS in shallow groundwater	AOPI 5 - McChord Airfield, South Hangar Area	North Well
CW-29B	Groundwater	18-23	Assess for the presence or absence of PFAS in shallow groundwater	AOPI 5 - McChord Airfield, South Hangar Area	North Well
CW-15c	Groundwater	98.6-108.6	Assess for the presence or absence of PFAS in deep groundwater immediately adjacent to North Well, within discrete intervals that correspond with North Well perforated zones	AOPI 5 - McChord Airfield, South Hangar Area	North Well
CW-15d	Groundwater	255.4-265.4	Assess for the presence or absence of PFAS in deep groundwater immediately adjacent to North Well, within discrete intervals that correspond with North Well perforated zones	AOPI 5 - McChord Airfield, South Hangar Area	North Well

Table 4-1 (Continued)
Phase I Sampling Locations and Rationale

Sampling Location/ ID Number	Matrix	Screen Interval (feet bgs)	Rationale	Nearest AOPIs	Nearest Drinking Water Production Well
MF-1	Groundwater	4.5-19.5	Assess for the presence or absence of PFAS in shallow groundwater adjacent to Clover Creek	AOPI 5 - McChord Airfield, South Hangar Area	North Well
CW-14a	Groundwater	25-35	Assess for the presence or absence of PFAS in shallow groundwater immediately adjacent to South Well	AOPI 5 - McChord Airfield, South Hangar Area	South Well
CW-14c	Groundwater	159.5-169.5	Assess for the presence or absence of PFAS in deep groundwater immediately adjacent to South Well, within discrete intervals that correspond with North Well perforated zones	AOPI 5 - McChord Airfield, South Hangar Area	South Well
CW-14d	Groundwater	265-275	Assess for the presence or absence of PFAS in deep groundwater immediately adjacent to South Well, within discrete intervals that correspond with North Well perforated zones	AOPI 5 - McChord Airfield, South Hangar Area	South Well
SW- 1	Surface water	n/a	Assess for the presence or absence of PFAS in surface water within Clover Creek down gradient of McChord Hangar/Runway surface water discharge	AOPI 5 - McChord Airfield, South Hangar Area	North Well
FTA-4a	Groundwater	16-26	Assess for the presence or absence of PFAS in shallow groundwater downgradient of FT032	AOPI 6 – McChord Airfield FT031, FT032, Landfill 013, Landfill 022	East Well
FTA-4b	Groundwater	68-78	Assess for the presence or absence of PFAS in intermediate groundwater downgradient of FT032	AOPI 6 – McChord Airfield FT031, FT032, Landfill 022, Landfill 013	East Well
IH-1a	Groundwater	32.8-37.8	Background sample to assess for the presence or absence of PFAS in shallow groundwater upgradient of potential areas of concern, adjacent to the JBLM boundary	AOPI 6 – McChord Airfield FT031, FT032, Landfill 022, Landfill 013	East Well
IH-1b	Groundwater	51.8-56.8	Background sample to assess for the presence or absence of PFAS in intermediate groundwater upgradient of potential areas of concern, adjacent to the JBLM boundary	AOPI 6 – McChord Airfield FT031, FT032, Landfill 022, Landfill 013	East Well

Table 4-1 (Continued)
Phase I Sampling Locations and Rationale

Sampling Location/ ID Number	Matrix	Screen Interval (feet bgs)	Rationale	Nearest AOPIs	Nearest Drinking Water Production Well
IH-3b	Groundwater	52.8-57.8	Assess for the presence or absence of PFAS in intermediate groundwater downgradient of Landfill 013	AOPI 6 – McChord Airfield FT031, FT032, Landfill 022, Landfill 013	East Well
IH-3C	Groundwater	79.2-89.2	Assess for the presence or absence of PFAS in intermediate groundwater downgradient of Landfill 013	AOPI 6 – McChord Airfield FT031, FT032, Landfill 022, Landfill 013	East Well
CW-33c	Groundwater	70-80	Assess for the presence or absence of PFAS in intermediate groundwater adjacent to and within the capture zone/wellhead protection area of Prime Beef Replacement Well I	AOPI 6 – McChord Airfield FT031, FT032, Landfill 022, Landfill 013	Prime Beef Replacement Well I
Clover Creek	Surface water	n/a	Assess presence or absence of PFAS in Clover Creek	AOPI 6 – McChord Airfield FT031, FT032, Landfill 022, Landfill 013	East Well
CW-4	Groundwater	16.9-26.9	Assess for the presence or absence of PFAS in shallow groundwater along JBLM boundary	AOPI 7 – McChord Airfield Main Bulk Fuel Tank Farm	North Well
DA-7e	Groundwater	115-125	Assess for the presence or absence of PFAS in deep groundwater downgradient of Landfill 005	AOPI 8 – American Lake Garden Tract Landfill 005	MARS Hill
DA-21a	Groundwater	27.6-32.6	Assess for the presence or absence of PFAS in shallow groundwater downgradient of Landfill 005	AOPI 8 – American Lake Garden Tract Landfill 005	MARS Hill
DO-2	Groundwater	40-70	Assess for the presence or absence of PFAS in intermediate groundwater downgradient of Landfill 005	AOPI 8 – American Lake Garden Tract Landfill 005	Housing Well I
DO-5b	Groundwater	13-18	Assess for the presence or absence of PFAS in shallow groundwater adjacent to ALGT treatment system recharge trenches	AOPI 8 – American Lake Garden Tract Landfill 005	Housing Well I
DA-4a	Groundwater	36.6–41.6	Assess for the presence or absence of PFAS in shallow groundwater in the vicinity of a new proposed production well	AOPI 8 – American Lake Garden Tract Landfill 005	Sage Well I
DA-4b	Groundwater	60.9–65.9	Assess for the presence or absence of PFAS in shallow groundwater in the vicinity of a new proposed production well	AOPI 8 – American Lake Garden Tract Landfill 005	Sage Well I

Table 4-1 (Continued)
Phase I Sampling Locations and Rationale

Sampling Location/ ID Number	Matrix	Screen Interval (feet bgs)	Rationale	Nearest AOPIs	Nearest Drinking Water Production Well
Carter Lake	Surface water	n/a	Assess presence or absence of PFAS in Carter Lake	AOPI 8 – American Lake Garden Tract Landfill 005	Housing Wells I, II, and III
LC-153	Groundwater	27.5-37.5	Assess for the presence or absence of PFAS in shallow groundwater within Landfill #2	AOPI 11 – Logistics Center Landfill #2	MAMC-04/Sage Well II
LC-230	Groundwater	24-44	Assess for the presence or absence of PFAS in shallow groundwater downgradient of Landfill #2	AOPI 11 – Logistics Center Landfill #2	MAMC-04/Sage Well II
Murray Creek	Surface water	n/a	Assess presence or absence of PFAS in Murray Creek	AOPI 11 – Logistics Center Landfill #2	MAMC-04
Murray Creek	Surface water	n/a	Assess presence or absence of PFAS in Murray Creek	AOPI 11 – Logistics Center Landfill #2	MAMC-04
Lynn Lake	Surface water	n/a	Assess presence or absence of PFAS in Lynn Lake	AOPI 11 – Logistics Center Landfill #2	MAMC-04
LF4-PNL1	Groundwater	22-37	Assess for the presence or absence of PFAS in shallow groundwater adjacent to Landfill #4, in the vicinity of Sequalitchew Springs and Well 12B	AOPI 12 – Lewis North Landfill #4	Sequalitchew Springs/Well 12B
LF4-01	Groundwater	22-28	Assess for the presence or absence of PFAS in shallow groundwater adjacent to Landfill #4, in the vicinity of Sequalitchew Springs and Well 12B	AOPI 12 – Lewis North Landfill #4	Sequalitchew Springs/Well 12B
LF4-MW-10	Groundwater	22-37	Assess for the presence or absence of PFAS in shallow groundwater adjacent to Landfill #4, in the vicinity of Sequalitchew Springs and Well 12B	AOPI 12 – Lewis North Landfill #4	Sequalitchew Springs/Well 12B
West American Lake	Surface water	n/a	Assess presence or absence of PFAS in West American Lake	AOPI 12 – Lewis North Landfill #4	Sequalitchew Spring
84-CD-LF1-1	Groundwater	20-60	Assess for the presence or absence of PFAS in shallow groundwater upgradient of Landfill #1, in the vicinity of Well 14	AOPI 18 – Lewis Main SWMU-47 and FLT-54 Wash Rack	Well 14
84-CD-LF1-4	Groundwater	20-60	Assess for the presence or absence of PFAS in shallow groundwater downgradient of Landfill #1, in the vicinity of Well 14	AOPI 18 – Lewis Main SWMU-47 and FLT-54 Wash Rack	Well 14

Table 4-1 (Continued)
Phase I Sampling Locations and Rationale

Sampling Location/ ID Number	Matrix	Screen Interval (feet bgs)	Rationale	Nearest AOPIs	Nearest Drinking Water Production Well
98-IA-MW-08	Groundwater	38-43	Assess for the presence or absence of PFAS in shallow groundwater upgradient of Well 14 and SWMU-47, and within the capture zone/wellhead protection area of Well 20	AOPI 18 – Lewis Main SWMU-47 and FLT-54 Wash Rack	Well 20
4131-MW04	Groundwater	23-33	Assess for the presence or absence of PFAS in shallow groundwater upgradient of and within the capture zone/wellhead protection area of Well 17	AOPI 23 – Lewis Main Buildings 04074,04076, 1401, 4100, 1206 and 1210	Well 17
01035-MW01	Groundwater	15-30	Assess for the presence or absence of PFAS in shallow groundwater upgradient of Well 17	AOPI 23 – Lewis Main Buildings 04074,04076, 1401, 4100, 1206 and 1210	Well 17
Storm water retention pond	Surface water	n/a	Assess presence or absence of PFAS in retention pond	AOPI 23 – Lewis Main Buildings 04074,04076, 1401, 4100, 1206 and 1210	Well 17

Notes:
bgs – feet below ground surface
ID – identification
n/a – not applicable

Table 4-2
Phase II/III Sampling Locations and Rationale

Sampling Location/ ID Number	Matrix	Screen Interval (feet bgs)	Rationale	Nearest AOPIs	Nearest Drinking Water Production Well
2018-LT-12	Groundwater	39-49	Assess for the presence or absence of PFAS in shallow groundwater at the north end of McChord Field	AOPI 1 – McChord Airfield Runway AOPI 2 - McChord Airfield Historical FT Area 027	North Well
2019-LT-13	Groundwater	179.5-199.5	Assess for the presence or absence of PFAS in deep groundwater	AOPI 1 – McChord Airfield Runway AOPI 2 - McChord Airfield Historical FT Area 027	Scotts Well
2019-LT-14	Groundwater	180-200	Assess for the presence or absence of PFAS in deep groundwater	AOPI 1 – McChord Airfield Runway AOPI 2 - McChord Airfield Historical FT Area 027	Scotts Well
2018-FT027-MW1	Groundwater	20-30	Assess for the presence or absence of PFAS in shallow groundwater within former fire training area FT027	AOPI 2 - McChord Airfield Historical FT Area 027	North Well
Parkland Well #7	Production well water	?-31	Assess for the presence or absence of PFAS in production well water	AOPI 2 - McChord Airfield Historical FT Area 027 AOPI 4 - McChord Airfield Historical FT 028, FT029, FT030 AOPI 1 – McChord Airfield Runway	Parkland Well #7
Parkland Well #9	Production well water	?-30	Assess for the presence or absence of PFAS in production well water	AOPI 2 - McChord Airfield Historical FT Area 027 AOPI 4 - McChord Airfield Historical FT 028, FT029, FT030 AOPI 1 – McChord Airfield Runway	Parkland Well #9
Laurel Lane MC Well #1	Production well water	?-108	Assess for the presence or absence of PFAS in production well water	AOPI 2 - McChord Airfield Historical FT Area 027 AOPI 1 – McChord Airfield Runway	Laurel Lane MC Well #1
CW-32A	Groundwater	100-110	Assess for the presence or absence of PFAS in shallow groundwater	AOPI 3 – McChord Airfield, North Hangar Area	North Well
CW-32C	Groundwater	362-372	Assess for the presence or absence of PFAS in deep groundwater	AOPI 3 – McChord Airfield, North Hangar Area	North Well

Table 4-2 (Continued)
Phase II/III Sampling Locations and Rationale

Sampling Location/ ID Number	Matrix	Screen Interval (feet bgs)	Rationale	Nearest AOPIs	Nearest Drinking Water Production Well
Lakewood 112th Sr R-1	Production well water	?-564	Assess for the presence or absence of PFAS in production well water	AOPI 3 – McChord Airfield, North Hangar Area AOPI 1 – McChord Airfield Runway	Lakewood 112th Sr R-1
Lakewood 88th and Pine J-1	Production well water	?-156	Assess for the presence or absence of PFAS in production well water	AOPI 3 – McChord Airfield, North Hangar Area AOPI 1 – McChord Airfield Runway	Lakewood 88th and Pine J-1
2019-LT-15	Groundwater	160-180	Assess for the presence or absence of PFAS in deep groundwater	AOPI 3 – McChord Airfield, North Hangar Area	North Well
2019-LT-19	Groundwater	159-179	Assess for the presence or absence of PFAS in deep groundwater	AOPI 3 – McChord Airfield, North Hangar Area AOPI 1 – McChord Airfield Runway	Lakewood Scotts G-2
Lakewood Scotts G-2	Production well water	152-180	Assess for the presence or absence of PFAS in production well water	AOPI 3 – McChord Airfield, North Hangar Area AOPI 1 – McChord Airfield Runway	Lakewood Scotts G-2
Lakewood Ponders H2	Production well water	86-110	Assess for the presence or absence of PFAS in production well water	AOPI 3 – McChord Airfield, North Hangar Area AOPI 5 - McChord Airfield, South Hangar Area AOPI 1 – McChord Airfield Runway	Lakewood Ponders H2
2019-LT-16	Groundwater	90-110	Assess for the presence or absence of PFAS in deep groundwater	AOPI 5 - McChord Airfield, South Hangar Area AOPI 7 – McChord Airfield Main Bulk Fuel Tank Farm	Ponders Well
2018-FT033-MW1	Groundwater	25-35	Assess for the presence or absence of PFAS in shallow groundwater adjacent to FT033, McChord Field	AOPI 5 - McChord Airfield, South Hangar Area	North Well
93-MFS-C5-3	Groundwater	20-30	Assess for the presence or absence of PFAS in shallow groundwater within Landfill #5	AOPI 8 – American Lake Garden Tract Landfill 005	Sequalitchew Springs
MW-2008-1	Groundwater	17-27	Assess for the presence or absence of PFAS in shallow groundwater within Landfill #5	AOPI 8 – American Lake Garden Tract Landfill 005	Sequalitchew Springs

Table 4-2 (Continued)
Phase II/III Sampling Locations and Rationale

Sampling Location/ ID Number	Matrix	Screen Interval (feet bgs)	Rationale	Nearest AOPIs	Nearest Drinking Water Production Well
LF4-MW-01A	Groundwater	37-52	Assess for the presence or absence of PFAS in shallow groundwater adjacent to Landfill #4, in the vicinity of Sequalitchew Springs and Well 12B	AOPI 12 – Lewis North Landfill #4	Sequalitchew Springs
LF4-MW-01B	Groundwater	119-124	Assess for the presence or absence of PFAS in shallow groundwater adjacent to Landfill #4, in the vicinity of Sequalitchew Springs and Well 12B	AOPI 12 – Lewis North Landfill #4	Sequalitchew Springs
LF4-MW-03A	Groundwater	26-41	Assess for the presence or absence of PFAS in shallow groundwater adjacent to Landfill #4, in the vicinity of Sequalitchew Springs and Well 12B	AOPI 12 – Lewis North Landfill #4	Sequalitchew Springs
LC-92D-1	Groundwater	192-212	Assess for the presence or absence of PFAS in deep groundwater in Sea Level Aquifer downgradient of Logistics Center	AOPI 9 – Northwest Logistics Center AOPI 10 – Central Logistics Center AOPI 11 – Logistics Center Landfill #2 AOPI 16 – Gray Army Airfield Hangars 3106, 3146, 3101 and FTLE-17owngradient of Logistics Center/Gray Army Airfield	Bell Hill #3
LC-93D-1	Groundwater	195-215	Assess for the presence or absence of PFAS in deep groundwater in Sea Level Aquifer downgradient of Logistics Center	AOPI 9 – Northwest Logistics Center AOPI 10 – Central Logistics Center AOPI 11 – Logistics Center Landfill #2 AOPI 16 – Gray Army Airfield Hangars 3106, 3146, 3101 and FTLE-17owngradient of Logistics Center/Gray Army Airfield	Bell Hill #3

Table 4-2 (Continued)
Phase II/III Sampling Locations and Rationale

Sampling Location/ ID Number	Matrix	Screen Interval (feet bgs)	Rationale	Nearest AOPIs	Nearest Drinking Water Production Well
LC-93D-2	Groundwater	232-252	Assess for the presence or absence of PFAS in deep groundwater in Sea Level Aquifer downgradient of Logistics Center	AOPI 9 – Northwest Logistics Center AOPI 10 – Central Logistics Center AOPI 11 – Logistics Center Landfill #2 AOPI 16 – Gray Army Airfield Hangars 3106, 3146, 3101 and FTLE-17owngradient of Logistics Center/Gray Army Airfield	Bell Hill #3
LC-89D-2	Groundwater	232-252	Assess for the presence or absence of PFAS in deep groundwater in Sea Level Aquifer downgradient of Logistics Center	AOPI 9 – Northwest Logistics Center AOPI 10 – Central Logistics Center AOPI 11 – Logistics Center Landfill #2 AOPI 16 – Gray Army Airfield Hangars 3106, 3146, 3101 and FTLE-17owngradient of Logistics Center/Gray Army Airfield	Bell Hill #3
JP-MW-02	Groundwater	39 – 49	Assess for the presence or absence of PFAS in shallow groundwater downgradient of Gray Army Airfield	AOPI 19 – Gray Army Airfield Hangar 3063 and Fire Station 102 AOPI 17 – Gray Army Airfield Hangar 3273 and storm drainage	Well 17
03075-MW01	Groundwater	20-35	Assess for the presence or absence of PFAS in shallow groundwater downgradient of Gray Army Airfield	AOPI 19 – Gray Army Airfield Hangar 3063 and Fire Station 102 AOPI 17 – Gray Army Airfield Hangar 3273 and storm drainage	Well 17
97-MW-1	Groundwater	14-29	Assess for the presence or absence of PFAS in shallow groundwater	AOPI 16 – Gray Army Airfield Hangars 3106, 3146, 3101 and FTLE-17	Well 14 and Well 20
2018-03106-MW1	Groundwater	39-49	Assess for the presence or absence of PFAS in shallow groundwater adjacent to Gray Army Airfield Air National Guard hangar	AOPI 16 – Gray Army Airfield Hangars 3106, 3146, 3101 and FTLE-17	Well 14 and Well 20

Table 4-2 (Continued)
Phase II/III Sampling Locations and Rationale

Sampling Location/ ID Number	Matrix	Screen Interval (feet bgs)	Rationale	Nearest AOPIs	Nearest Drinking Water Production Well
2018-FTLE17-MW1	Groundwater	39-49	Assess for the presence or absence of PFAS in shallow groundwater within former fire training area FTLE-17	AOPI 16 – Gray Army Airfield Hangars 3106, 3146, 3101 and FTLE-17	Well 14
2018-03273-MW1	Groundwater	39-49	Assess for the presence or absence of PFAS in shallow groundwater adjacent to Gray Army Airfield Hangar 03273	AOPI 17 – Gray Army Airfield Hangar 3273 and storm drainage	Well 14
2018-05275-MW1	Groundwater	39-49	Assess for the presence or absence of PFAS in shallow groundwater downgradient of Gray Army Airfield and upgradient of Well 17	AOPI 16 – Gray Army Airfield Hangars 3106, 3146, 3101 and FTLE-17	Well 17
2018-SWMU47-MW1	Groundwater	29-39	Assess for the presence or absence of PFAS in shallow groundwater downgradient of SWMU-47 FTA and Washrack 6 and upgradient of Well 14	AOPI 18 – Lewis Main SWMU-47 and FLT-54 Wash Rack	Well 14
2018-2014-MW1	Groundwater	38-48	Assess for the presence or absence of PFAS in shallow groundwater near Firehouse and upgradient of Well 17	AOPI 22 – Lewis Main Fire Station 7 Building 2014	Well 17
2019-LT-18	Groundwater	261-281	Assess for the presence or absence of PFAS in deep groundwater adjacent to historical laundry facility	AOPI 22 – Lewis Main Fire Station 7 Building 2014	Well 17
2018-4074-MW1	Groundwater	37-47	Assess for the presence or absence of PFAS in shallow groundwater adjacent to historical water proofing facility	AOPI 23 – Lewis Main Buildings 04074,04076, 1401, 4100, 1206 and 1210	Well 17
2018-1401-MW1	Groundwater	40-50	Assess for the presence or absence of PFAS in shallow groundwater adjacent to historical laundry facility	AOPI 23 – Lewis Main Buildings 04074,04076, 1401, 4100, 1206 and 1210	Well 17

Table 4-2 (Continued)
Phase II/III Sampling Locations and Rationale

Sampling Location/ ID Number	Matrix	Screen Interval (feet bgs)	Rationale	Nearest AOPIs	Nearest Drinking Water Production Well
2019-LT-17	Groundwater	280-300	Assess for the presence or absence of PFAS in deep groundwater downgradient of historical laundry facility, waterproofing, and Landfill #9	AOPI 23 – Lewis Main Buildings 04074,04076, 1401, 4100, 1206 and 1210	Well 22 and Hoffman Hill #2
Dupont Bell Hill #1	Production well water	248-293	Assess for the presence or absence of PFAS in production well water	AOPI 23 – Lewis Main Buildings 04074,04076, 1401, 4100, 1206 and 1210 AOPI 24 - Lewis Main Landfill #9	Dupont Bell Hill #1
Dupont Bell Hill #2	Production well water	362-508	Assess for the presence or absence of PFAS in production well water	AOPI 23 – Lewis Main Buildings 04074,04076, 1401, 4100, 1206 and 1210 AOPI 24 - Lewis Main Landfill	Dupont Bell Hill #2
Dupont Bell Hill #3	Production well water	197-282	Assess for the presence or absence of PFAS in production well water	AOPI 23 – Lewis Main Buildings 04074,04076, 1401, 4100, 1206 and 1210 AOPI 24 - Lewis Main Landfill	Dupont Bell Hill #3
Dupont Hoffman Hill #1	Production well water	415-497	Assess for the presence or absence of PFAS in production well water	AOPI 23 – Lewis Main Buildings 04074,04076, 1401, 4100, 1206 and 1210 AOPI 24 - Lewis Main Landfill	Dupont Hoffman Hill #1
Dupont Hoffman Hill #2	Production well water	295-375	Assess for the presence or absence of PFAS in production well water	AOPI 23 – Lewis Main Buildings 04074,04076, 1401, 4100, 1206 and 1210 AOPI 24 - Lewis Main Landfill	Dupont Hoffman Hill #1
2018-LF9-MW1	Groundwater	48.4-58.4	Assess for the presence or absence of PFAS in shallow groundwater near Landfill #9	AOPI 24 - Lewis Main Landfill #9	Well 22

1 Notes:
2 bgs – feet below ground surface

Table 4-3
Treatment System Sampling Locations and Rationale

Sampling Location/ ID Number	Matrix	Screen Interval (feet bgs)	Rationale	Nearest Potential PFAS Source Area	Nearest Drinking Water Production Well
LF-2 P&T Influent	Groundwater	n/a	Assess for the presence or absence of PFOS/PFOA in influent groundwater intercepted by treatment system	Landfill #2	MAMC-04
LF-2 P&T Effluent	Groundwater	n/a		Landfill #2	MAMC-04
I-5 P&T Influent	Groundwater	n/a		Landfill #2	MAMC-04
I-5 P&T Effluent	Groundwater	n/a		Landfill #2	MAMC-04
SLA P&T Influent	Groundwater	n/a		Landfill #2	MAMC-04
SLA P&T Effluent	Groundwater	n/a		Landfill #2	MAMC-04

Notes:
bgs – feet below ground surface

Table 4-4
Off-Base Production Well Sampling Locations and Rationale

Production Well ID	Matrix	Screen Interval (feet bgs)	Rationale	Aquifer	Well Owner
Ponders H-1/H-2	Water	90-110/86-105	Assess for the presence or absence of PFOS and PFOA in production well water	Vashon	Lakewood Water District
Scotts G-1/G-2	Water	153-173/154-180		Vashon	Lakewood Water District
Tillicum A-3	Water	441 – 481		Stuck	Lakewood Water District
112th St R-1	Water	494 – 552		Stuck	Lakewood Water District
88th and Pine J-1	Water	136 – 157		Vashon	Lakewood Water District
Bell Hill #1	Water	248 – 293		Sea Level	City of Dupont
Bell Hill #2	Water	362 – 508		Sea Level	City of Dupont
Bell Hill #3	Water	197 – 282		Sea Level	City of Dupont
Hoffman Hill #1	Water	415 – 497		Sea Level	City of Dupont
Hoffman Hill #2	Water	295 – 375		Sea Level	City of Dupont
Well #7	Water	? – 31		Vashon	Parkland Light and Water
Well #9	Water	? – 30		Vashon	Parkland Light and Water
Laurel Lane MHC Well #1	Water	? – 108		Vashon	Laurel Lane Mobil Housing Complex LLC

Notes:
bgs – feet below ground surface

Table 4-5
Summary of QAPP Deviations

Date	Deviation	Sample Location Affected	Applicable QAPP Section	Description of Deviation	Reason for Deviation	Impact to Project
6/11/2019	Monitoring well CW-14b	CW-14b	Worksheet #18 - Sampling Locations and Methods	A groundwater sample was collected from monitoring well CW-14d in lieu of well CW-14b.	Monitoring well CW-14b was observed to be damaged and unsamplable.	None. A suitable replacement well was available.
6/26/2018	Monitoring well LC-23	LC-23	Worksheet #18 - Sampling Locations and Methods	A groundwater sample was collected from monitoring well LC-153 in lieu of well LC-23.	Monitoring well LC-23 was unlocatable.	None. A suitable replacement well was available.
6/26/2019	Monitoring well LT-9	LT-9	Worksheet #18 - Sampling Locations and Methods	Proposed monitoring well LT-9 not sampled.	Monitoring well LT-9 was not locatable.	A suitable replacement for LT-9 was not available, creating a data gap between confirmed source area FT032 and the East production well.
6/22/2019	Monitoring well IH-3c	IH-3c	Worksheet #18 - Sampling Locations and Methods	Monitoring well IH-3c was not included in the QAPP as a well to be sampled.	Assess deeper groundwater downgradient of Landfill 013.	None.
2/7/2019	Deep Well Construction Materials	2019-LT-13 2019-LT-14 2019-LT-15 2019-LT-16 2019-LT-17 2019-LT-18 2019-LT-19	Worksheet #17 –Sampling Design and Rational Drilling and Monitoring Well Installation	- Use a bentonite slurry grout rather than bentonite chips to construct the well seal. - Use a three-foot minimum transitional sand seal on top of the sand filter pack.	- Injection of a bentonite slurry grout from the bottom up will eliminate the risk of bentonite chip bridging and ensure a more uniform well seal. - A transitional sand seal will prevent the injected bentonite slurry grout from fouling the sand filter pack.	None.

Table 4-5 (Continued)
Summary of QAPP Deviations

Date	Deviation	Sample Location Affected	Applicable QAPP Section	Description of Deviation	Reason for Deviation	Impact to Project
27/2019	Groundwater Sampling Equipment	LF4-MW-1A	Worksheet #17 -Sampling Design and Rationale Groundwater Sampling	A disposable HDPE bailer was used to collect a groundwater sample from existing monitoring well LF4-MW-1A in lieu of a bladder or peristaltic pump.	Only two feet of water was measured in the well during sampling. The minimal water column prevented the use of a submersible bladder pump and the depth to water (45 feet below ground surface) prevented the use of a peristaltic pump.	None.
3/26/2019	Monitoring well LC-92D-2	LC-92D-2	Worksheet #18 - Sampling Locations and Methods	Proposed well LC-92D-2 not sampled.	Well casing was observed to be damaged, preventing the insertion of a bladder pump.	None. A suitable replacement well was available.
3/29/2019	Monitoring well JP-MW-03	JP-MW-03	Worksheet #18 - Sampling Locations and Methods	Proposed well JP-MW-03 not sampled.	Well was inaccessible due to a disabled vehicle being parked over it.	None. A suitable replacement well was available.
3/26/2019	Monitoring well 03075-MW02	03075-MW-02	Worksheet #18 - Sampling Locations and Methods	Proposed well 03075-MW02 not sampled.	Well was not locatable and appeared to have been paved over.	None. A suitable replacement well was available.
3/29/2019	CW-32B	CW-32B	Worksheet #18 - Sampling Locations and Methods	Proposed well CW-32B not sampled.	Well casing was observed to be damaged, preventing the insertion of a bladder pump.	A suitable replacement for CW-32B was not available, creating a data gap in this area.

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5.0 SITE INSPECTION SAMPLING RESULTS AND DATA EVALUATION

5.1. Data Quality Assessment

No data quality issues were identified during validation, and the precision and accuracy of all laboratory data were determined to be acceptable. Although some of the planned Phase I and II sample locations were not accessible due to well damage or access limitations, alternate locations were chosen and sampled with the approval of JBLM. All analytical data were of acceptable quality. For wells not accessible for sampling, alternate sampling locations were identified and sampled. Therefore, the data set is 100 percent complete, and the data is representative of the site conditions, as defined in the QAPP and by mutual approval of JBLM, USACE, regulators, and project stakeholders. Comparability of the data is determined to be acceptable based on the participation of the laboratory in the DoD Environmental Laboratory Approval Program. Based on the data quality assessment, all data generated are determined to be usable for the project objectives. Data validation reports are presented as Appendix F.

5.2. Site Inspection Screening Criteria

It was determined during TPP meeting #1, prior to issue of OSD SLs, that the sum of the full six UCMR-3 compounds would be compared against a 70 ppt SL to identify an area as a "potential source" needing further evaluation. The approved QAPP made this specification. However, given the subsequent issue of OSD SLs for PFOS, PFOA, and PFBS, the results, as discussed below, from comparing the sum of six UCMR-3 compounds against a 70 ppt SL are for informational purposes only. These results are summarized in Table 5-1 and shown on Figure 5-3, Figure 5-6, and Figure 5-9. The groundwater analytical results, compared to the DoD SLs, are discussed below and are used for decision-making. These results are summarized in Table 5-1 and shown on Figure 5-1, Figure 5-2, Figure 5-4, Figure 5-5, Figure 5-7, and Figure 5-8. Several offsite groundwater production wells were sampled by JBLM during this PA/SI. The analytical results, comparing the sum of PFOS and PFOA against the 70 ppt HAL are discussed below. These results are summarized in Table 5-3 and shown on Figure 5-10.

5.3. Summary of Groundwater Analytical Results

On-Base Sample Results Summary

Seventy-seven (77) groundwater water samples were collected and analyzed for 14 PFAS compounds, along with eight duplicate samples (Table 5-1). These samples were collected from existing and new groundwater monitoring wells, operating remediation systems, and surface water bodies on-base locations. Of these samples, 60 were collected from wells screened in the Vashon Aquifer; 16 were collected from wells screened in the Sea Level Aquifer; and 1 sample was interpreted to be collected from a well screened in the Stuck Formation.

PFOS was measured at concentration greater than 40 ppt in 23 of the 77 analyzed samples. PFOS concentrations greater than 40 ppt ranged from 44 ppt to 28,000 ppt. PFOA was measured at a concentration greater than 40 ppt in 12 of the 77 analyzed samples. PFOA concentrations greater than 40 ppt ranged from 44 ppt to 1,400 ppt. PFBS was not measured at a concentration greater than 40 ppb in any of the 77 analyzed samples. The highest measured PFBS concentration was 630 ppt, which is well

below the 40,000 ppt OSD SL. Figure 5-1 and Figure 5-2 show groundwater PFOS and PFOA results compared to the 40 ppt OSD SL, respectively.

The sum of the six UCMR-3 compounds was measured at concentrations greater than 70 ppt in 33 of the 77 analyzed samples. The sum of six UCMR-3 compound concentrations greater than 70 ppt ranged from 73 to 37,170 ppt. The sum of six UCMR-3 results greater than or less than 70 ppt are shown on Figure 5-3 for the entire installation.

In most cases, PFOS was the dominant compound, compared to PFOA, with higher measured concentrations. Several monitoring wells sampled during the SI, which are positioned on the JBLM boundary, detected concentrations of PFOS above the OSD SL of 40 ppt.

Off-Base Sample Results Summary

Thirteen water samples were collected from off-base production wells operated by publicly owned entities or cities (Table 5-3): Six samples from the Vashon Aquifer, five samples from the Sea Level Aquifer, and two from the Stuck Formation.

The sum of PFOS and PFOA only was not measured at a concentration greater than the 70 ppt HAL in any of the 13 sampled off-base production wells. These samples contained the sum of PFOS and PFOA only at concentrations ranging from a reported non-detect to 62 ppt.

The dominant compound in these samples varied between PFOS and PFOA.

5.3.1 McChord Hangars and Runways, Fire Training Area FT033, and Clover Creek Area

These areas occupy the runway and the northern and central portions of McChord Field west of the runways (Figure 5-4 through Figure 5-6) and include the following AOPIs:

- AOPI 1 – McChord Airfield Runway
- AOPI 3 – McChord Airfield, North Hangar Area
- AOPI 5 - McChord Airfield, South Hangar Area

Twenty-three groundwater samples (plus three blind field duplicate samples) were collected within the immediate vicinity or downgradient of the McChord hangars, runways, fire training area FT033, and Clover Creek. Groundwater samples were collected from the monitoring wells:

- CW-62 – Screened in Vashon Aquifer
- CW-32A – Screened in Vashon Aquifer
- CW032C – Screened in Stuck Formation
- CW-64 – Screened in Vashon Aquifer
- IW-2 – Screened in Vashon Aquifer
- CR-01 – Screened in Vashon Aquifer
- CW-14a – Screened in Vashon Aquifer
- CW-14c – Screened in Vashon Aquifer
- CW-14d – Screened in Sea Level Aquifer

- CW-15c – Screened in Vashon Aquifer
- CW-15d – Screened in Sea Level Aquifer
- CW-29b – Screened in Vashon Aquifer
- CW-4 – Screened in Vashon Aquifer
- MF-1 – Screened in Vashon Aquifer
- 1168-MW01 – Screened in Vashon Aquifer
- LT-4 – Screened in Vashon Aquifer
- 2018-LT-12 – Screened in Vashon Aquifer
- 2018-LT-13 – Screened in Sea Level Aquifer
- 2018-LT-14 – Screened in Sea Level Aquifer
- 2019-LT-15 – Screened in Sea Level Aquifer
- 2019-LT-19 – Screened in Sea Level Aquifer
- 2018 FT033-MW1 – Screened in Vashon Aquifer
- 2019-LT-16 – Screened in Vashon Aquifer

Sixteen of these wells were screened in the Vashon Aquifer, six of these wells were screened in the Sea Level Aquifer, and one well was interpreted to be screened in the Stuck Formation.

The sum of six UCMR-3 compounds measured in groundwater in these areas is summarized as follows:

- Fourteen samples with sum of six UCMR-3 compounds at concentrations greater than 70 ppt screening criteria for potential source area identification
  - 12 samples collected from wells screened in the Vashon Aquifer with concentrations ranging from 79 (CW-64) to 998 ppt (2018-FT033-MW1)
  - 2 samples collected from wells screened in the Sea Level aquifer with concentrations of 160 ppt (CW-14d) and 225 ppt (2019-LT-15)

Ten of the sixteen sampled wells screened in the Vashon Aquifer yielded groundwater samples with PFOS concentrations greater than the 40 ppt OSD SL (Table 5-1). PFOA was detected in three of the sixteen wells at concentrations greater than the 40 ppt OSD SL. PFBS was not detected in any of the sixteen Vashon wells at a concentration greater than the 40 ppb OSD SL. Two of the six sampled wells screened in the Sea Level reported concentrations of PFOS greater than the 40 ppt OSD SL. PFOA and PFBS were not detected at concentrations greater than 40 ppt and 40 ppb, respectively, in any of the six Sea Level wells. PFOS, PFOA and PFBS were all detected below the OSD SLs in the well screened in what is interpreted as the Stuck Formation.

The highest concentration of PFOS (640 ppt) was observed at well CW-15c, which is closest to FT033 (AOPI-5,) with concentrations decreasing downgradient. The highest concentration of PFOA (150 ppt) was observed at well 2018-FT033-MW1, which is located within AOPI-5.

Sampling results for PFOS and PFOA compared to the 40 ppt OSD SLs are shown on Figure 5-4 and Figure 5-5.The sum of six UCMR-3 results are shown on Figure 5-6. PFOS and PFOA concentrations in groundwater indicate that the general area of McChord Hangers and Runway and Fire Training Area

FT033 require further evaluation. The highest concentrations were measured in samples from Fire Training Area FT033.

5.3.2 Fire Training Areas FT027 and FT032

Five groundwater samples (plus one blind field duplicate) were collected from existing or newly installed monitoring wells to assess potential sources associated with fire training areas FT027 (AOPI-2) and FT032 (AOPI-6) (Figure 5-4 through Figure 5-6).

The monitoring wells sampled were:

- 2018-FT027-MW1
- CW-12
- FTA-4a
- FTA-4b
- CW-33c

All of the wells were screened in the Vashon Aquifer. PFOS and PFOA were measured in groundwater samples collected from wells FTA-4a and FTA-4b (AOPI-6) at concentrations exceeding the OSD screening criteria. FTA4-4a reported a PFOS concentration of 19,000 ppt and a PFOS concentration of 630 ppt. FTA4-4b reported a PFOS concentration of 28,000 ppt and a PFOS concentration of 1,400 ppt (Table 5-1). The remaining wells reported detections of PFOS, PFOA, and PFBS, but at concentrations below the OSD SLs. PFOS and PFOA results compared to the OSD SLs are shown on Figure 5-4 and Figure 5-5.

The sum of six UCMR-3 compounds greater than the QAPP screening criteria for potential source identification of 70 ppt was measured in three groundwater samples at concentrations ranging from 97 (2018FT027-MW1) to 37,170 ppt (FTA-4b). The sum of six UCMR-3 results are shown on Figure 5-6. The PFOS and PFOA concentrations in groundwater samples associated with Fire Training Area FT032 indicate that further is evaluation is necessary. PFOS and PFOA concentrations in groundwater samples associated with Fire Training Area FT027 indicate that further evaluation is not necessary at this time.

5.3.3 Lewis Main Gray Army Airfield Hangars, Fire Training Area FTLE-17, and SWMU-47 Area

This area comprises Gray Army Airfield and SWMU-47 off the southern end of Gray Army Airfield (Figure 5-7 through Figure 5-9) and includes the following AOPIs:

- AOPI 16 – Gray Army Airfield Hangars 3106, 3146, 3101 and FTLE-17
- AOPI 17 – Gray Army Airfield Hangar 3273 and storm drainage
- AOPI 18 – Lewis Main SWMU-47 and FLT-54 Wash Rack
- AOPI 19 – Gray Army Airfield Hangar 3063 and Fire Station 102
- AOPI 20 -Gray Airfield Hangar 3098 and Buildings 3095 and 3099

Nine groundwater samples were collected from existing and newly installed monitoring wells associated with Gray Army Airfield Hangars, Fire Training Area FTLE-17, and SWMU-47. Sampled wells are:

Gray Army Airfield Hangars

- JP-MW-02
- 03075-MW1
- 97-MW-1
- 2018-03106-MW1
- 2018-03273-MW1
- 2018-05275-MW1

Fire Training Area FTLE-17

- 2018-FTLE-17-MW1

SWMU-47

- 98-IA-MW08
- SWMU47-MW1

All nine wells were screened in the Vashon Aquifer. PFOS was detected at a concentration exceeding the OSD SL in three wells: JP-MW-02, 03075-MW1, and 2018-05275-MW1. Detections exceeding the OSD SL of 40 ppt ranged from 49 ppt (2018-05275-MW1) to 220 ppt (JP-MW-02). PFOS was detected at a concentration equal to or exceeding the OSD SL in two wells: JP-MW-02, 03075-MW1 and 2018-FTLE17-MW1. Detections in these three wells ranged from 40 ppt (JP-MW-02) to 100 ppt (03075-MW1). PFOS, PFOA, and PFBS were detected in the remaining wells but at concentrations below the OSD SLs. PFOS and PFOA results compared to the OSD SLs are provided in Table 5-1 and shown on Figure 5-7 and Figure 5-8.

The sum of six UCMR-3 compounds was measured at concentrations greater than the QAPP screening criteria for potential source identification of 70 ppt in samples from five wells ranging from 73 ppt (97-MW-1) to 442 ppt (JP-MW-02). The highest concentration was measured west of the Gray Army Airfield hangars on the west side of the runway. The sum of six UCMR-3 results are shown on Figure 5-9.

PFOS and PFOA concentrations in groundwater samples associated with Gray Army Airfield Hangars and FTLE-17 (AOPI- 16, AOPI-17, AOPI-19, and AOPI-20) indicate that further is evaluation is necessary. PFOS and PFOA concentrations in groundwater samples associated with SWMU-47 and LT-54 Wash Rack (AOPI-18) indicate that further evaluation is not necessary at this time.

5.3.4 Historical Waterproofing, Laundry Operations, and Fire Station Building-2014

The Historical Waterproofing, Laundry Operations, and Fire Station Building-2014 areas are located in western Lewis Main (Figure 5-7 through Figure 5-9) and includes the following AOPIs:

- AOPI 22 – Lewis Main Fire Station 7 Building 2014
- AOPI 23 – Lewis Main Buildings 04074, 04076, 1401, 4100, 1206 and 1210

Seven groundwater samples and two field duplicates were collected from these areas. Sampled wells are:

Fire Station Building 2014

- 2018-2014-MW1 – Screened in the Vashon Aquifer
- 2019-LT-18 – Screened in the Sea Level Aquifer

Historical Waterproofing and Laundry Facilities

- 01035-MW01 – Screened in the Vashon Aquifer
- 4131-MW04 – Screened in the Vashon Aquifer
- 2018-4074-MW1 – Screened in the Vashon Aquifer
- 2018-1401-MW1 – Screened in the Vashon Aquifer
- 2019-LT-17 – Screened in the Sea Level Aquifer

Five of these wells were screened in the Vashon Aquifer. The remaining wells in this area is screened in the Sea Level Aquifer.

The sample from well 2018-2014-MW-1 (AOPI 22 – Lewis Main Fire Station 7 Building 2014) did not contain concentrations of PFOS or PFOA above the OSD SLs. The deeper sample from 2019-LT-18 contained PFOS and PFOA at a concentration of 68 ppt and 160 ppt, respectively, which exceeded the OSD SLs. The sample collected from 2018-2014-MW-1 did not detect the sum of six UCMR-3 compounds at concentrations above 70 ppt. The sample collected from 2019-LT-18 detected the sum of 6 UCMR-3 compounds at a concentration of 354 ppt. PFOS and PFOA concentrations in groundwater samples associated with the Lewis Main Fire Station 7 Building 2014 (AOPI – 22) indicate that further is evaluation is necessary.

Three of the four groundwater samples, associated with historical waterproofing and laundry facilities (AOPI 23 – Lewis Main Buildings 04074, 04076, 1401, 4100, 1206 and 1210) from wells screened in the Vashon aquifer contained PFOS at concentrations exceeding the OSD SLs. These concentrations ranged from 60 ppt (2018-4074-MW1) to 100 ppt (2018-1401-MW1). PFOA was also detected in these wells but at concentrations below the OSD SL. PFOS and PFOS were detected in the sample collected from well 4131-MW04 at concentrations below the OSD SLs. The sample collected from Sea Level well 2019-LT-17 contained PFOA at a concentration of 64 ppt, exceeding the OSD SL. PFOS was also detected in this sample, but at a concentration below the OSD SL. PFOS and PFOA results compared to the OSD SLs are provided in Table 5-1 and shown on Figure 5-7 and Figure 5-8.

Three of the four historical waterproofing and laundry facilities groundwater samples from wells screened in the Vashon aquifer contained the sum of the six UCMR-3 compounds at concentrations greater than 70 ppt. The sum of six UCMR-3 compounds above the potential area source identification SL of 70 ppt in samples from Vashon Aquifer wells ranged from 132 (2018-4074-MW1) to 258 ppt (2018-1401-MW1). The Sea Level aquifer well samples contained both the sum of PFOS and PFOA and sum of six UCMR compounds at concentrations greater than 70 ppt. The sum of six UCMR-3 results are shown on Figure 5-9. PFOS and PFOA concentrations in groundwater samples associated with the Lewis Main Buildings 04074, 04076, 1401, 4100, 1206 and 1210 (AOPI – 23) indicate that further evaluation is necessary.

5.3.5 Landfills

Landfill 013 – McChord Airfield

Samples were collected from four wells (IH-1a, IH-1b, IH-3b, IH-3c) related to Landfill 13, which is located off the southeast end of the McChord Field runway (Figure 5-4 through Figure 5-6) and is included with AOPI – 6 (McChord Airfield FT031, FT032, Landfill 022, Landfill 013). All four of these wells were screened in the Vashon Aquifer. Wells IH-1a and IH-1b are located in an inferred upgradient direction from Landfill 13. Both PFOS and PFOA were detected at concentrations below the OSD SLs in two wells, Well IH-3b and IH-3C, which are located adjacent to Landfill 13. PFOS was measured at concentrations of 1,200 ppt (IH-3B) and 740 ppt (IH-3C). PFOS was measured at concentrations of 210 ppt (IH-3B) ad 760 ppt (IH-3C). PFOS and PFOA results compared to the OSD SLs are provided in Table 5-1 and shown on Figure 5-4 and Figure 5-5.

The sum of six UCMR-3 compounds from samples collected at IH-1a and IH-1b (Figure 5-6) were detected at concentrations less than 70 ppt. The sum of six UCMR-3 compound concentrations were 2,478 ppt (IH3B) and 2,653 ppt (IH-3C). IH-3C was screened approximately 21 feet deeper than IH-3B. PFOS and PFOA concentrations in groundwater samples associated with the McChord Airfield Landfill 13 (AOPI – 6) indicate that further evaluation is necessary.

AOPI 8 – ALGT Landfill 005

Six groundwater samples were collected from existing monitoring wells associated with ALGT Landfill 005 (AOPI – 8). Samples were collected from monitoring wells: DA-21e, DA-7e, DO-2, DO-5b, DA-4a, and DA-4b. All six wells were screened in the Vashon Aquifer.

PFOS and PFOA were not measured at concentrations greater than 40 ppt in any of the six samples. PFOS and PFOA results compared to the OSD SLs are provided in Table 5-1 and shown on Figure 5-4 and Figure 5-5. The sum of six UCMR-3 compounds was measured at 81 ppt in the sample from DO-5b (Figure 5-6). Results are provided in Table 5-1 and shown on Figure 5-6. PFOS and PFOA concentrations in groundwater samples associated with the ALGT Landfill 005 (AOPI – 8) indicate that further evaluation is not necessary at this time.

AOPI 11 – Logistics Center Landfill #2

Landfill #2 is off the southeast end of the Logistics Center on Lewis Main (Figure 5-7 through Figure 5-9). A total of eight groundwater samples were collected from this AOPI: two groundwater samples from existing monitoring wells and an influent and effluent sample from three operating remediation systems associated with Landfill #2. Monitoring wells and treatment systems are:

- LC-153 – screened in Vashon Aquifer
- LC-230 – screened in Vashon Aquifer
- Treatment system samples from LF-2 P&T Influent and LF-2 P&T Effluent – Extracting water from Vashon Aquifer
- Treatment system samples from I-5 P&T Influent and I-5 P&T Effluent – Extracting water from Sea Level Aquifer
- SLA P&T Influent, and SLA P&T Effluent were sampled – Extracting water from Sea Level Aquifer

PFOS and PFOA were detected in all samples but at concentrations below the OSD SLs. PFOS and PFOA results compared to the OSD SLs are provided in Table 5-1 and shown on Figure 5-7 and Figure 5-8. These results indicate that the Logistics Center Landfill #2 (AOPI – 11) requires no further evaluation at this time.

The sum of six UCMR-3 compounds were not measured at a concentration greater than 70 ppt in any of these samples The sum of six UCMR-3 results are shown on Figure 5-9.

AOPI 21 – Gray Army Airfield Landfill #1

Groundwater samples were collected from wells 84-CD-LF1-1 and 84-CD-LF1-4 at Gray Army Airfield Landfill #1 (AOPI – 21) near the south end of Gray Army Airfield (Figure 5-7- through Figure 5-9). Both of these wells were screened in the Vashon Aquifer.

PFOS and PFOA and were detected at concentrations below the OSD SLs. PFOS and PFOA results compared to the OSD SLs are provided in Table 5-1 and shown on Figure 5-7 and Figure 5-8.

The sum of six UCMR-3 compounds were not measured at a concentration well below the applicable screening criteria. The sum of six UCMR-3 results are shown on Figure 5-9.

PFOS and PFOA concentrations in groundwater samples associated with Gray Army Airfield Landfill #1 (AOPI – 21) indicate that further evaluation is not necessary, at this time.

AOPI 24 - Lewis Main Landfill #9

Lewis Main Landfill #9 (AOPI – 24) is located south of I-5 on Lewis Main (Figure 5-7 through Figure 5-9). This landfill was closed in the 1950s and was voluntarily sampled to assess for the presence or absence of PFOS and PFOA in groundwater near the landfill.

Monitoring 2018-LF9-MW1 was sampled in this area. It was screened in the Vashon Aquifer.

PFOS and PFOA were measured at a concentrations of 0.9 ppt and 0.9 ppt, respectively, which are well below the OSD SLs. PFOS and PFOA results compared to the OSD SLs are provided in Table 5-1 and shown on Figure 5-7 and Figure 5-8.

The sum of six UCMR-3 compounds were reported at a concentration of 5.4 ppt. The sum of six UCMR-3 results are shown on Figure 5-9.

PFOS and PFOA concentrations in groundwater samples associated with Lewis Main Landfill # (AOPI – 24) indicate that further evaluation is not necessary, at this time.

AOPI 12 – Lewis North Landfill #4

Six existing monitoring wells were sampled in the Lewis North Landfill #4 (AOPI – 12) a, which is located in Lewis North immediately adjacent to the northern side of I-5. Samples were collected from six wells, all screened in the Vashon Aquifer.

The sampled wells are:

- LF4-01
- LF4-MW-10
- LF4-PNL1
- LF4-MW-03A

- LF4-MW-01A
- LF4-MW-01B

PFOS and PFOA were detected in all wells, but at concentrations below the OSD SLs. PFOS and PFOA results compared to the OSD SLs are provided in Table 5-1 and shown on Figure 5-7 and Figure 5-8.

The sum of six UCMR-3 compounds were detected below 70 ppt for all of the samples collected from these six wells. The sum of six UCMR-3 results are shown on Figure 5-9.

PFOS and PFOA concentrations in groundwater samples associated with Lewis North Landfill #4 (AOPI – 12) indicate that further evaluation is not necessary, at this time.

AOPI 15 – Lewis North Landfill #5

Two monitoring wells were sampled in the Lewis North Landfill #5 (AOPI – 15), located in the northwestern corner of Lewis North. This landfill was closed in 2000 and is currently in post-closure monitoring. Landfill #5 was voluntarily sampled to assess for the presence or absence of PFOS and PFOA in groundwater near the landfill. Both wells were screened in the Vashon Aquifer.

PFOS and PFOA were detected, but at concentrations below the OSD SLs. PFOS and PFOA results compared to the OSD SLs are provided in Table 5-1 and shown on Figure 5-7 and Figure 5-8.

The sum of six UCMR-3 compounds were detected below 70 ppt in the sample collected from well MW-2008-1. Well MW-2008-1 is upgradient of Landfill #5. The sum of six UCMR-3 compounds was detected above 70 ppt in the sample collected from well 93-MFS-C5-3 (80 ppt). This well is located downgradient of Landfill #5. Well MW-2008-1 is upgradient of Landfill #5. The sum of six UCMR-3 results are shown on Figure 5-9.

PFOS and PFOA concentrations in groundwater samples associated with Lewis North Landfill #5 (AOPI – 15) indicate that further evaluation is not necessary, at this time.

5.3.6 Sea Level Aquifer Wells

Four wells were installed to further assess the presence or absence of PFOS and PFOA in Sea Level Aquifer groundwater. These wells are located in north-central Lewis Main and south-central Lewis North, along I-5 (Figure 5-7 through Figure 5-9). The four wells sampled were:

- LC-89D-2
- LC-92D-1
- LC-93D-1
- LC-93D-2

PFOS and PFOA were not measured at concentrations greater than the OSD SLs in all four wells. PFOS and PFOA results compared to the OSD SLs are provided in Table 5-1 and shown on Figure 5-7 and Figure 5-8.

The sum of the 6UCMR-3 compounds were not measured above the 70 ppt SL in all four wells. The sum of six UCMR-3 results are shown on Figure 5-9.

5.3.7 Off-Base Production Well Sampling

To assess for the presence or absence of PFOS and PFOA in water at off-base production well locations, thirteen off-site production wells were sampled by JBLM DPW Installation Restoration staff and/or the water purveyors (Figure 5-10). These wells are:

Lakewood Water District

- Scotts H-2 – Screened in the Sea Level Aquifer
- Ponders –-2 - Screened in the Vashon Aquifer
- Tillicum A-3 – Screened in the Stuck Aquifer
- 12th St R-1 – Screened in the Stuck Aquifer
- 88th and Pine J-1 – Screened in the Vashon Aquifer

City of Dupont

- Bell Hill #1 – Screened in the Sea Level Aquifer
- Bell Hill #2 – Screened in the Sea Level Aquifer
- Bell Hill #3 – Screened in the Sea Level Aquifer
- Hoffman Hill #1 – Screened in the Sea Level Aquifer
- Hoffman Hill #2 – Screened in the Sea Level Aquifer

Parkland

- Well #7 – Screened in the Vashon Aquifer
- Well #9 – Screened in the Vashon Aquifer

Laurel Lane MHC LLC

- Well #1 – Screened in the Vashon Aquifer

None of the samples from the 13 off-site production wells contained the sum of PFOS and PFOA at a concentration greater than the EPA HAL of 70 ppt (Table 5-3).

5.4. Summary of Surface Water Analytical Results

Seven of the eight surface water samples were collected and analyzed by JBLM outside of the site-specific QAPP requirements for this PA/SI. These samples were collected to assess for the presence or absence of PFOS and PFOA in these surface water bodies.

Surface water samples were collected from:

- Clover Creek near the McChord Hangars and FT033 (2 locations)
- Clover Creek east side of the McChord runway
- Murray Creek north east of the Log Center
- Murray Creek southwest of the Log Center

- Murray Creek west of the Log Center
- American Lake
- A pond west of Building 1401 in western Lewis Main just south of I-5 (Outfall 2)

A total of eight surface water samples were collected.

There are currently no screening criteria for PFOS or PFOA in surface water. These results were compared to the OSD SLs for frame-of-reference purpose only. None of the surface water results detected concentrations of PFOS or PFOA above the OSD SLs. PFOS and PFOA results compared to the OSD SLs are provided in Table 5-2 and shown on Figure 5-7 and Figure 5-8.

The sum of six UCMR-3 compounds in surface water samples ranged from not detected above the reporting limit to 84.8 ppt. The sum of six UCMR-3 compounds was measured at a concentration greater than the 70 ppt EPA HAL in the sample collected from Outfall 2, near Building 1401 (84.8 ppt). The sum of six UCMR-3 compounds was not measured at a concentration greater than 70 ppt in the remaining surface water samples that were analyzed. The sum of six-UCMR-3 compounds below 70 ppt ranged from a reported non-detect to 41.4 ppt. Results are shown on Figure 5-9.

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Surface Water
- ≤ 40 ppt
- > 40 ppt

Vashon Aquifer (A)
- ≤ 40 ppt
- > 40 ppt

Sea Level Aquifer (C)
- ≤ 40 ppt
- > 40 ppt

Stuck Aquifer (E)
- ≤ 40 ppt
- > 40 ppt

Orting Aquifer (G)
- ≤ 40 ppt
- > 40 ppt

Notes:
1. PFOS Units are Parts Per Trillion (PPT)

2. Samples collected December 2018 through May 2019

Suspected Source Areas
- Area of Potential Interest Requiring Further Evaluation
- Area of Potential Interest Not Requiring Further Evaluation at This Time

Groundwater Flow Direction Arrow (USGS)

Aquifer
- Vashon "A" Aquifer (USGS)
- Sea Level "C" Aquifer (USGS)

Other Features
- JBLM Boundary
- Stream, Creek

Puget Sound
Gravelly Lake
American Lake
Lewis North
McChord Airfield
Logistics Center
Lewis Main
Gray Army Airfield
Canal
Sequalitchew Lake
Sequalitchew Creek
Murray Creek
Nisqually River
Interstate 5
1
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4
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FIGURE 5-1
PHASE I, II, III GROUNDWATER AND SURFACE WATER SAMPLING RESULTS FOR PFOS COMPARED TO 40 PPT OSD SCREENING LEVEL

PFAS Preliminary Assessment Site Inspection
Joint Base Lewis McChord
Lakewood, WA

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Surface Water
- ≤ 40 ppt
- > 40 ppt

Vashon Aquifer (A)
- ≤ 40 ppt
- > 40 ppt

Sea Level Aquifer (C)
- ≤ 40 ppt
- > 40 ppt

Stuck Aquifer (E)
- ≤ 40 ppt
- > 40 ppt

Orting Aquifer (G)
- ≤ 40 ppt
- > 40 ppt

Notes:
1. PFOA Units are Parts Per Trillion (PPT)

2. Samples collected December 2018 through May 2019

Suspected Source Areas
- Area of Potential Interest Requiring Further Evaluation
- Area of Potential Interest Not Requiring Further Evaluation at This Time

Groundwater Flow Direction Arrow (USGS)

Aquifer
- Vashon "A" Aquifer (USGS)
- Sea Level "C" Aquifer (USGS)

Other Features
- JBLM Boundary
- Stream, Creek

Puget Sound
Gravelly Lake
American Lake
Lewis North
McChord Airfield
Canal
Sequalitchew Lake
Sequalitchew Creek
Logistics Center
Murray Creek
Lewis Main
Gray Army Airfield
Nisqually River
Interstate 5
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

PUBLIC WORKS

N

0 1
Miles

FIGURE 5-2
PHASE I, II, III GROUNDWATER AND SURFACE WATER SAMPLING RESULTS FOR PFOA COMPARED TO 40 PPT OSD SCREENING LEVEL

PFAS Preliminary Assessment Site Inspection
Joint Base Lewis McChord
Lakewood, WA

Document Path: S:\60555402-SEA1\900-CAD-GIS\940-GIS\MXDs\PASI_Report\draft\Figure 5-2 Phase I II III GW SW PFOA.mxd

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Legend

Surface Water
- ≤ 70 ppt
- > 70 ppt

Vashon Aquifer (A)
- ≤ 70 ppt
- > 70 ppt

Sea Level Aquifer (C)
- ≤ 70 ppt
- > 70 ppt

Stuck Aquifer (E)
- ≤ 70 ppt
- > 70 ppt

Orting Aquifer (G)
- ≤ 70 ppt
- > 70 ppt

Suspected Source Areas

Suspected Source Areas
- Area of Potential Interest Requiring Further Evaluation
- Area of Potential Interest Not Requiring Further Evaluation at This Time

Groundwater Flow Direction Arrow (USGS)

Aquifer
- Vashon "A" Aquifer (USGS)
- Sea Level "C" Aquifer (USGS)
- JBLM Boundary
- Stream, Creek

Notes:
1. UCMR Units are Parts Per Trillion (PPT)

2. Samples collected December 2018 through May 2019

Puget Sound
Clover Creek
Gravelly Lake
American Lake
McChord Airfield
Lewis North
Logistics Center
Lewis Main
Gray Army Airfield
Sequalitchew Lake
Sequalitchew Creek
Murray Creek
Nisqually River
Interstate 5
Canal

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

0 0.5 1 2
Miles

N

FIGURE 5-3
PHASE I, II, III GROUNDWATER AND SURFACE WATER SAMPLING RESULTS
SUM OF SIX UCMR-3 COMPOUNDS
COMPARED TO 70 PPT

PFAS Preliminary Assessment Site Inspection
Joint Base Lewis McChord
Lakewood, WA

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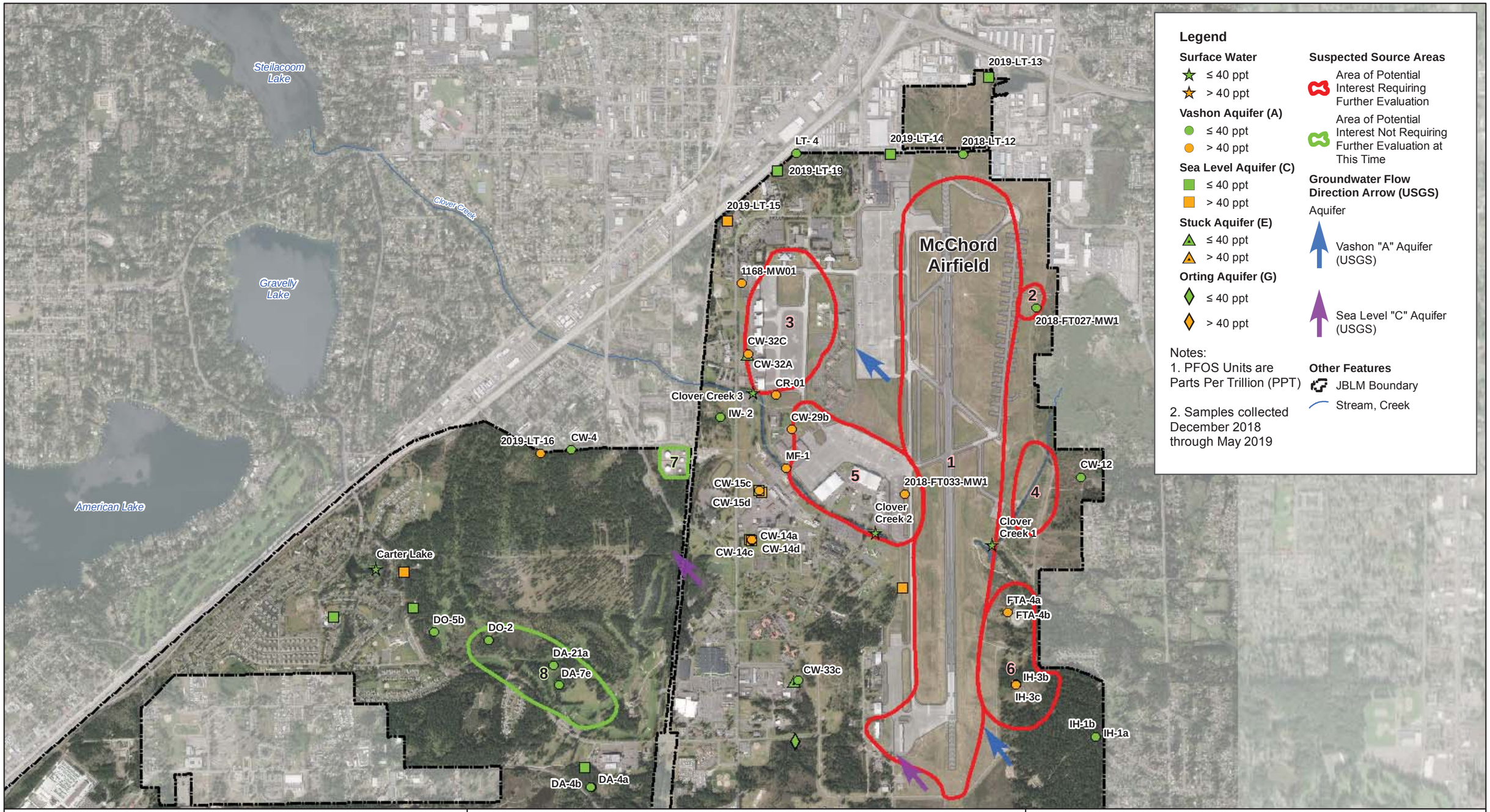

FIGURE 5-4
PHASE I, II, III GROUNDWATER AND SURFACE WATER SAMPLING RESULTS - MCCHORD FIELD AREA FOR PFOS COMPARED TO 40 PPT OSD SCREENING LEVEL

PFAS Preliminary Assessment Site Inspection
Joint Base Lewis McChord
Lakewood, WA

Document Path: S:\60555402-SEA1\900-CAD-GIS\940-GIS\MXDs\PASI_Report\draft\Figure 5-4 Phase I II III GW SW Results McChord PFOS.mxd

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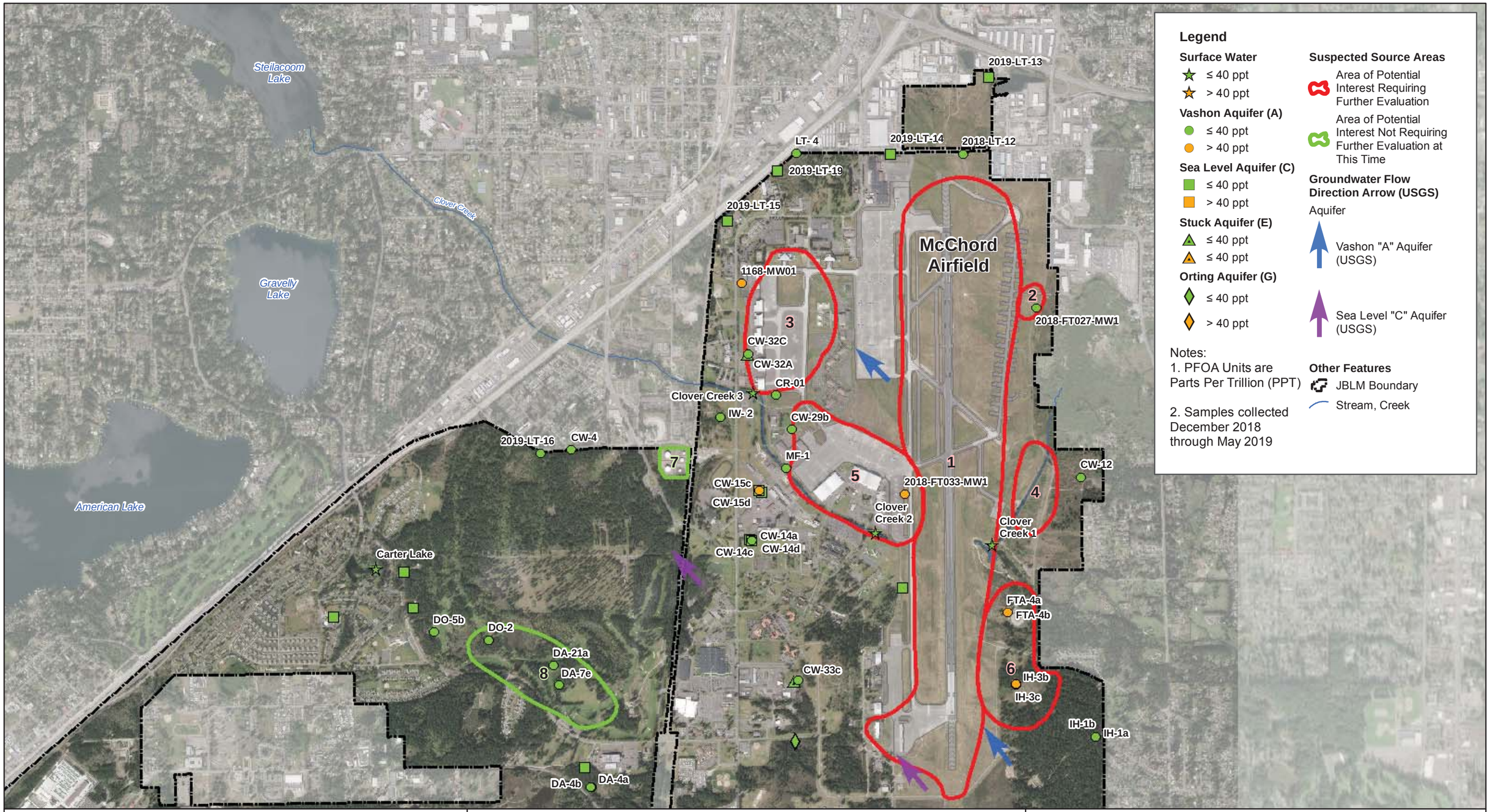

N

0 0.25 0.5

Miles

FIGURE 5-5
PHASE I, II, III GROUNDWATER AND SURFACE WATER SAMPLING RESULTS - MCCHORD FIELD AREA FOR PFOA COMPARED TO 40 PPT OSD SCREENING LEVEL

PFAS Preliminary Assessment Site Inspection
Joint Base Lewis McChord
Lakewood, WA

Document Path: S:\60555402-SEA1\900-CAD-GIS\940-GIS\MXDs\PASI_Report\draft\Figure 5-5 Phase I II III GW SW Results McChord PFOA.mxd

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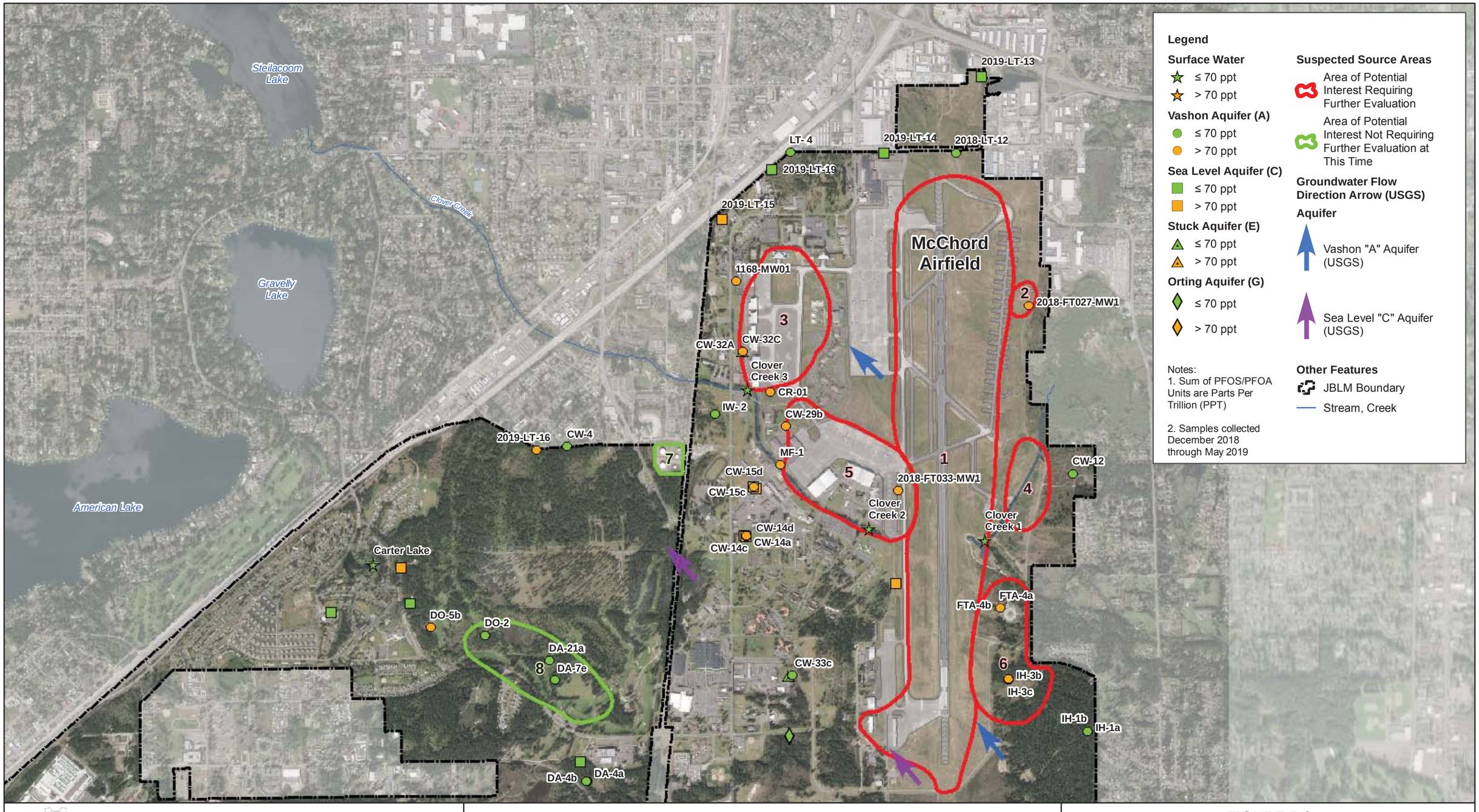

Legend

Surface Water
- ≤ 70 ppt
- > 70 ppt

Vashon Aquifer (A)
- ≤ 70 ppt
- > 70 ppt

Sea Level Aquifer (C)
- ≤ 70 ppt
- > 70 ppt

Stuck Aquifer (E)
- ≤ 70 ppt
- > 70 ppt

Orting Aquifer (G)
- ≤ 70 ppt
- > 70 ppt

Notes:
1. Sum of PFOS/PFOA Units are Parts Per Trillion (PPT)

2. Samples collected December 2018 through May 2019

Suspected Source Areas
- Area of Potential Interest Requiring Further Evaluation
- Area of Potential Interest Not Requiring Further Evaluation at This Time

Groundwater Flow Direction Arrow (USGS)

Aquifer
- Vashon "A" Aquifer (USGS)
- Sea Level "C" Aquifer (USGS)

Other Features
- JBLM Boundary
- Stream, Creek

N

0 0.175 0.35 0.7

Miles

FIGURE 5-6
PHASE I, II, III GROUNDWATER AND SURFACE WATER SAMPLING RESULTS - MCCHORD FIELD AREA SUM OF SIX UCMR-3 COMPOUNDS COMPARED TO 70 PPT

PFAS Preliminary Assessment Site Inspection
Joint Base Lewis McChord
Lakewood, WA

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Legend

Vashon Aquifer (A)
- ≤ 40 ppt
- > 40 ppt

Surface Water
- ≤ 40 ppt
- > 40 ppt

Stuck Aquifer (E)
- ≤ 40 ppt
- > 40 ppt

Sea Level Aquifer (C)
- ≤ 40 ppt
- > 40 ppt

Orting Aquifer (G)
- ≤ 40 ppt
- > 40 ppt

Suspected Source Areas
- Area of Potential Interest Requiring Further Evaluation
- Area of Potential Interest Not Requiring Further Evaluation at This Time

Groundwater Flow Direction Arrow (USGS)

Aquifer
- Vashon "A" Aquifer (USGS)
- Sea Level "C" Aquifer (USGS)

Notes:
1. PFOs Units are Parts Per Trillion (PPT)
2. Samples collected December 2018 through May 2019

Other Features
- JBLM Boundary
- Surface Water Course Centerline

N

0 0.25 0.5 1
Miles

FIGURE 5-7
PHASE I, II, III GROUNDWATER AND SURFACE WATER SAMPLING RESULTS - GRAY FIELD AREA PFOS COMPARED TO 40 PPT OSD SCREENING LEVEL
PFAS Preliminary Assessment Site Inspection
Joint Base Lewis McChord
Lakewood, WA

Document Path: S:\60555402-SEA1\900-CAD-GIS\940-GIS\MXDs\PASI_Report\draft\Figure 5-7 Phase I II III GW SW Results Gray PFOS.mxd

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Legend

Vashon Aquifer (A)
- ≤ 40 ppt
- > 40 ppt

Surface Water
- ≤ 40 ppt
- > 40 ppt

Stuck Aquifer (E)
- ≤ 40 ppt
- > 40 ppt

Sea Level Aquifer (C)
- ≤ 40 ppt
- > 40 ppt

Orting Aquifer (G)
- ≤ 40 ppt
- > 40 ppt

Suspected Source Areas
- Area of Potential Interest Requiring Further Evaluation
- Area of Potential Interest Not Requiring Further Evaluation at This Time

Groundwater Flow Direction Arrow (USGS)

Aquifer
- Vashon "A" Aquifer (USGS)
- Sea Level "C" Aquifer (USGS)

Notes:
1. PFOA Units are Parts Per Trillion (PPT)
2. Samples collected December 2018 through May 2019

Other Features
- JBLM Boundary
- Surface Water Course Centerline

N

0 0.25 0.5 1
Miles

FIGURE 5-8
PHASE I, II, III GROUNDWATER AND SURFACE WATER SAMPLING RESULTS - GRAY FIELD AREA PFOA COMPARED TO 40 PPT OSD SCREENING LEVEL
PFAS Preliminary Assessment Site Inspection
Joint Base Lewis McChord
Lakewood, WA

Document Path: S:\60555402-SEA1\900-CAD-GIS\940-GIS\MXDs\PASI_Report\draft\Figure 5-8 Phase I II III GW SW Results Gray PFOA.mxd

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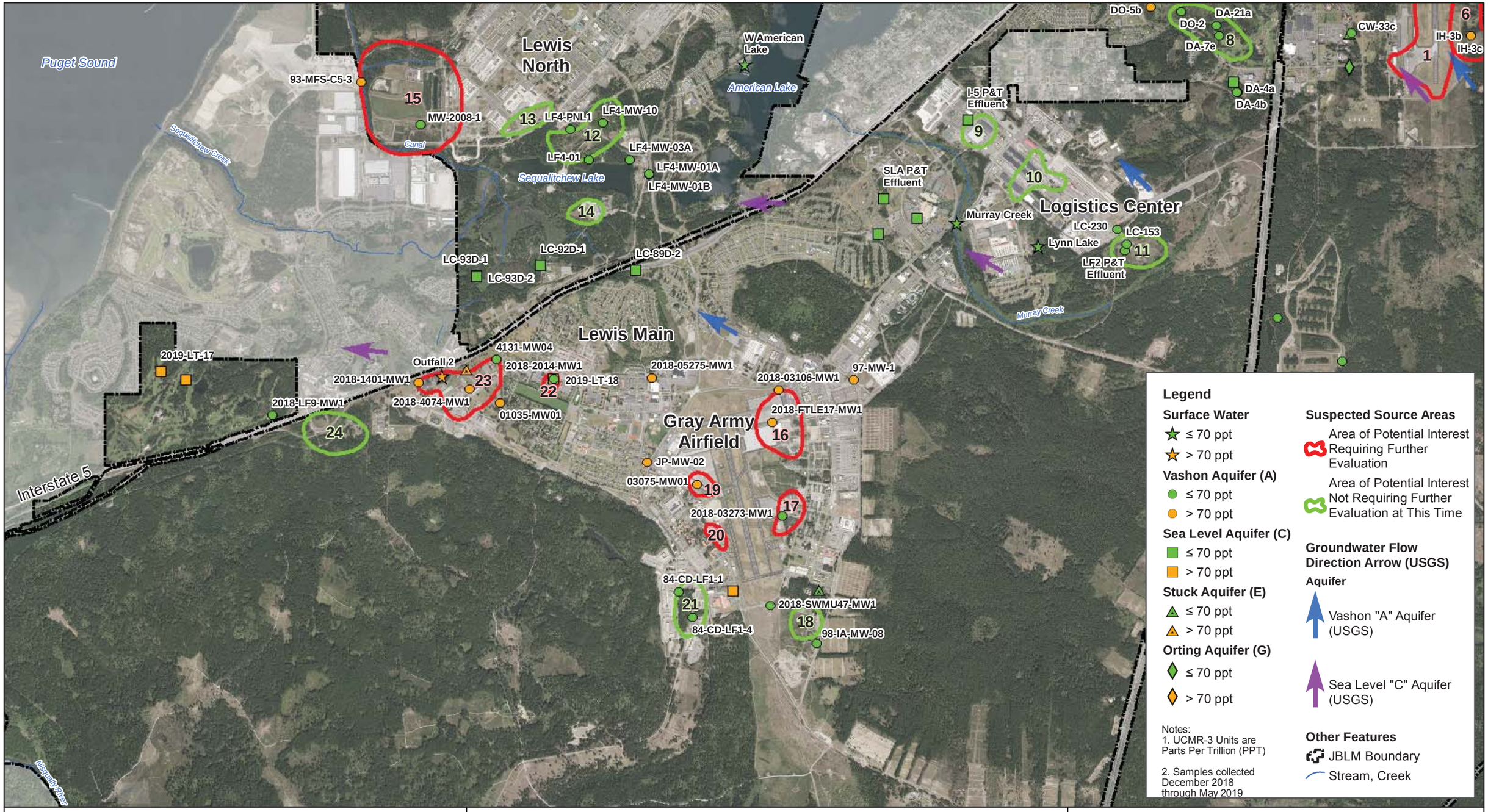

Legend

Surface Water
- ≤ 70 ppt
- > 70 ppt

Vashon Aquifer (A)
- ≤ 70 ppt
- > 70 ppt

Sea Level Aquifer (C)
- ≤ 70 ppt
- > 70 ppt

Stuck Aquifer (E)
- ≤ 70 ppt
- > 70 ppt

Orting Aquifer (G)
- ≤ 70 ppt
- > 70 ppt

Notes:
1. UCMR-3 Units are Parts Per Trillion (PPT)

2. Samples collected December 2018 through May 2019

Suspected Source Areas
- Area of Potential Interest Requiring Further Evaluation
- Area of Potential Interest Not Requiring Further Evaluation at This Time

Groundwater Flow Direction Arrow (USGS)

Aquifer
- Vashon "A" Aquifer (USGS)
- Sea Level "C" Aquifer (USGS)

Other Features
- JBLM Boundary
- Stream, Creek

N

0 0.5 1

Miles

FIGURE 5-9
PHASE I, II, III GROUNDWATER AND SURFACE WATER SAMPLING RESULTS - GRAY FIELD AREA SUM OF SIX UCMR-3 COMPOUNDS COMPARED TO 70 PPT

PFAS Preliminary Assessment Site Inspection
Joint Base Lewis McChord
Lakewood, WA

Document Path: S:\60555402-SEA1\900-CAD-GIS\940-GIS\MXDs\PASI_Report\draft\Figure 5-9 Phase I II III GW SW Gray Sum6UCMR 20200309.mxd

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Legend

Vashon Aquifer (A)
- ≤ 70 ppt
- > 70 ppt

Sea Level Aquifer (C)
- ≤ 70 ppt
- > 70 ppt

Stuck Aquifer (E)
- ≤ 40 ppt
- > 40 ppt

Suspected Source Areas
- Area of Potential Interest Requiring Further Evaluation
- Area of Potential Interest Not Requiring Further Evaluation at This Time

Groundwater Flow Direction Arrow (USGS)

Aquifer
- Vashon "A" Aquifer (USGS)
- Sea Level "C" Aquifer (USGS)

Other Features
- JBLM Boundary
- Stream, Creek

Notes:
1. PFOS and PFOA Units are Parts Per Trillion (PPT)

2. Samples collected December 2018 through May 2019

Puget Sound
Gravelly Lake
American Lake
McChord Airfield
Lewis North
Lewis Main
Gray Army Airfield
Logistics Center
Canal
Sequalitchew Lake
Sequalitchew Creek
Murray Creek
Nisqually River
Interstate 5
1
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24

PUBLIC WORKS

N

0 0.5 1
Miles

FIGURE 5-10
OFFSITE PRODUCTION WELL SAMPLING RESULTS FOR THE SUM OF PFOS AND PFOA COMPARED TO 70 PPT HAL

PFAS Preliminary Assessment Site Inspection
Joint Base Lewis McChord
Lakewood, WA

Document Path: S:\60555402-SEA1\900-CAD-GIS\940-GIS\MXDs\PASI_Report\draft\Figure 5-10 Phase I II III GW SW OPW PFOA+PFOA.mxd

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Table 5-1
Groundwater Results for PFOS, PFOA, and PFBS/Sum of 6 UCMR-3 Compounds

Potential Area of Concern								Analyte			
Well ID	Field ID	Laboratory ID	Nearest Drinking Water Well	Investigation Phase	Aquifer	Screen Interval (feet bgs)	Date Collected	PFOS (ppt)	PFOA (ppt)	PFBS (ppt)	Sum of UCMR-3 Compounds (ppt)
							Screening Level:	40 [a]	40 [a]	40,000 [a]	70 [b, c]
Clover Creek											
CW-62	CW-62-180619	9674149	North Well	Phase I	Vashon	30-40	6/19/2018	60	7.4	9.2	115
McChord Hangars, Runways and Clover Creek											
CW-32A	CW-32A-190212	9987834	North Well	Phase II	Vashon	100-110	2/12/2019	57	5.0	5.3	100
CW-32C	CW-32C-190215	9990367	North Well	Phase II	Stuck	362-372	2/15/2019	0.62 J	1.0 U	0.96 U	4.9
CW-64	CW-64-180619	9674148	North Well	Phase I	Vashon	45 - 60	6/19/2018	34	23	4.1	79
IW-2	IW-2-180608	9651200	North Well	Phase I	Vashon	35 - 45	6/8/2018	3.1	5.7	23	43
CR-01	CR-01-180611	9663703	North Well	Phase I	Vashon	8 - 38	6/11/2018	57	7.6	5.5	123
CW-14a	CW-14A-180606	9651187	South Well	Phase I	Vashon	25 -35	6/6/2018	44	16	10	140
CW-14c	CW-14C-180611	9663705	South Well	Phase I	Vashon	159.5 - 169.5	6/11/2018	200	16	17	340
CW-14d	CW-14D-180611	9663704	South Well	Phase I	Sea Level	265 -275	6/11/2018	95	6.6	9.1	160
	GWDUP2-180611	9663706					6/11/2018 (DUP)	96	6.5	8.4	160
CW-15c	CW-15C-180606	9651188	North Well	Phase I	Vashon	98.6 -108.6	6/6/2018	640	43	29	973
CW-15d	CW-15D-180606	9651189	North Well	Phase I	Sea Level	255.4 - 265.4	6/6/2018	1.0 J	1.1 U	1.0 U	5.3
	GWDUP1-180606	9651191					6/6/2018 (DUP)	0.85 J	0.29 J	1.0 U	4.4
CW-29b	CW-29B-180612	9663713	North Well	Phase I	Vashon	18 -23	6/12/2018	89	11	9.5	183
CW-4	CW-4-180619	9674150	North Well	Phase I	Vashon	16.9 - 26.9	6/19/2018	2.0 U	1.1 U	0.36 J	5.51
MF-1	MF-1-180619	9674151	North Well	Phase I	Vashon	4.5 - 19.5	6/19/2018	310	37	17	618
North McChord Hangars and Runways											
1168-MW01	1168-MW01-180612	9663714	North Well	Phase I	Vashon	7 - 22	6/12/2018	50	71	3.0	383
LT-4	LT-4-180613	9663718	North Well	Phase I	Vashon	16.3 - 26.3	6/13/2018	17	1.6 J	3.1	35
2018-LT-12	2018-LT-12-190328	1024105	North Well	Phase II	Vashon	39-49	3/28/2019	13	5.3	14	68
2019-LT-13	2019-LT-13-190524	1067013	Scotts Well	Phase III	Sea Level	179.5-199.5	5/24/2019	1.8 U	1.7 J	1.1 J	8.7
2019-LT-14	2019-LT-14-190523	1067009	Scotts Well	Phase III	Sea Level	180-200	5/23/2019	1.0 U	1.0 U	0.43 J	4.24
	GWDUP4-190523	1067012		Phase III			5/23/2019 (DUP)	2.5 J	0.54 J	0.40 J	5.9
2019-LT-15	2019-LT-15-190522	1067006	North Well	Phase III	Sea Level	160-180	5/22/2019	69	35	17	225
2019-LT-19	2019-LT-19-190523	1067008	Scotts Well	Phase III	Sea Level	159-179	5/23/2019	1.8 U	33	6.6	67
FT033, McChord Hangars and Runways											
2018-FT033-MW1	2018-FT033-MW1-190328	1024107	North Well	Phase II	Vashon	25-35	3/28/2019	260	150	40	846
	GWDUP3-190328	1024111		Phase II			3/28/2019 (DUP)	370	150	38	998.1
2019-LT-16	2019-LT-16-190522	1067005	Ponders Well	Phase III	Vashon	90-110	5/22/2019	90	8.0	14	171
FT027 and McChord Runways											
2018-FT027-MW1	2018-FT027-MW1-190328	1024106	North Well	Phase II	Vashon	20-30	3/28/2019	32	20	3.9	97
FT029											
CW-12	CW-12-180607	9651192	East Well	Phase I	Vashon	11 - 21	6/7/2018	24	7.1	3.9	43

Table 5-1 (Continued)
Groundwater Results for PFOS, PFOA, and PFBS/Sum of 6 UCMR-3 Compounds

Potential Area of Concern								Analyte			
Well ID	Field ID	Laboratory ID	Nearest Drinking Water Well	Investigation Phase	Aquifer	Screen Interval (feet bgs)	Date Collected	PFOS (ppt)	PFOA (ppt)	PFBS (ppt)	Sum of UCMR-3 Compounds (ppt)
FT032											
FTA-4a	FTA-4A-180607	9651193	East Well	Phase I	Vashon	16 - 26	6/7/2018	19,000	630	81	22,089
FTA-4b	FTA-4B-180607	9651194	East Well	Phase I	Vashon	68 - 78	6/7/2018	28,000	1,400	630	37,170
Landfill 013											
IH-1a	IH-1A-180607	9651196	East Well	Phase I	Vashon	32.8 - 37.8	6/7/2018	2.1 U	1.1 U	1.0 U	5.9
IH-1b	IH-1B-180607	9651195	East Well	Phase I	Vashon	51.8 - 56.8	6/7/2018	2.0 J	1.1 U	0.30 J	5.5
IH-3b	IH-3B-180612	9663711	East Well	Phase I	Vashon	52.8 - 57.8	6/12/2018	1,200	210	51	2,478
IH-3c	IH-3C-180626	9682100		Phase I	Vashon	79.2 - 89.2	6/26/2018	740	760	62	2,653
	GWDUP4-180626	9682104					6/26/2018 (DUP)	720	720	61	2,585
Landfill 013/FT032											
CW-33c	CW-33C-180612	9663708	Prime Beef Replacement Well I	Phase I	Vashon	70- 80	6/12/2018	11	0.59 J	2.9	25
Landfill 005											
DA-21a	DA-21A-180614	9663720	MARS Hill	Phase I	Vashon	27.6 - 32.6	6/14/2018	20	2.9	2.6	41
DA-7e	DA-7E-180614	9663721	MARS Hill	Phase I	Vashon	115 - 125	6/14/2018	5.7 U	3.0 U	2.7 U	16
DO-2	DO-2-180614	9663719	Housing Well I	Phase I	Vashon	40 - 70	6/14/2018	17	4.0	2.9	43
DO-5b	DO-5B-180614	9663722	Housing Well I	Phase I	Vashon	13 - 18	6/14/2018	38	5.6	4.1	81
Landfill 005											
DA-4a	DA-4A-180613	9663715	Sage Well I	Phase I	Vashon	36.6 – 41.6	6/13/2018	7.1	1.9	0.68 J	15
DA-4b	DA-4B-180613	9663716	Sage Well I	Phase I	Vashon	60.9 – 65.9	6/13/2018	3.4	1.1 U	0.74 J	11
Landfill #2											
LC-153	LC-153-180626	9682101	MAMC-04/Sage Well II	Phase I	Vashon	27.5 - 37.5	6/26/2018	2.0 U	0.73 J	0.97 U	5.6
LC-230	LC-230-180615	9663724	MAMC-04/Sage Well II	Phase I	Vashon	24 -44	6/15/2018	2.1 U	0.38 J	3.0	11
LF-2 P&T Influent	LF-2-I-180618	9674137	MAMC-04	Phase I	Vashon	NA	6/18/2018	9.1	9.9	1.0 J	29
LF-2 P&T Effluent	LF-2-E-180618	9674138	MAMC-04	Phase I	Vashon	NA	6/18/2018	2.0 U	0.36 J	0.96 U	5.0
I-5 P&T Influent	I5-I-180618	9674139	MAMC-04	Phase I	Sea Level	NA	6/18/2018	29	10	2.1	63
I-5 P&T Effluent	I5-E-180618	9674140	MAMC-04	Phase I	Sea Level	NA	6/18/2018	31	10	2.1	65
SLA P&T Influent	SLA-I-180618	9674141	MAMC-04	Phase I	Sea Level	NA	6/18/2018	5.7	5.0	0.80 J	17
SLA P&T Effluent	SLA-E-180618	9674142	MAMC-04	Phase I	Sea Level	NA	6/18/2018	4.8	4.7	0.74 J	16
Gray Army Airfield Hangers											
JP-MW-02	JP-MW-02-190329	1024110	Well 17	Phase II	Vashon	39-49	3/29/2019	220	40	10	442
03075-MW1	03075-MW1-190326	1024104	Well 17	Phase II	Vashon	20-35	3/26/2019	97	100	6.3	430
97-MW-1	97-MW-1-190205	9984450	Well 14 and Well 20	Phase II	Vashon	14-29	2/5/2019	1.8 J	14	1.5 J	73

Table 5-1 (Continued)
Groundwater Results for PFOS, PFOA, and PFBS/Sum of 6 UCMR-3 Compounds

Potential Area of Concern								Analyte			
Well ID	Field ID	Laboratory ID	Nearest Drinking Water Well	Investigation Phase	Aquifer	Screen Interval (feet bgs)	Date Collected	PFOS (ppt)	PFOA (ppt)	PFBS (ppt)	Sum of UCMR-3 Compounds (ppt)
Gray Army Airfield Hangers and Runways											
2018-03106-MW1	2018-03106-MW1-190215	9990370	Well 14 and Well 20	Phase II	Vashon	39-49	2/15/2019	67	8.4	4.4	128
2018-03273-MW1	2018-03273-MW-1-190215	9990368	Well 14	Phase II	Vashon	39-49	2/15/2019	8.7	5.5 J	4.0	44
2018-05275-MW1	2018-05275-MW1-190208	9987831	Well 17	Phase II	Vashon	39-49	2/8/2019	49	32	4.4	125
Gray Army Airfield Hangers and Runways, and FTLE-17											
2018-FTLE17-MW1	2018FTLE17-MW1-190215	9990369	Well 14	Phase II	Vashon	39-49	2/15/2019	9.6 J	43	3.6	92
	GWDUP2-190215	9990372		Phase II			2/15/2019 (DUP)	15 J	48	8.0	121
Lewis Main Landfill #1											
84-CD-LF1-1	84-CD-LFI-1-180626	9682099	Well 14	Phase I	Vashon	20 - 60	6/26/2018	1.4 J	0.27 J	0.80 J	5.9
84-CD-LF1-4	84-CD-LFI-4-180626	9682098	Well 14	Phase I	Vashon	20 - 60	6/26/2018	0.85 J	0.37 J	0.36 J	4.6
SWMU 47											
98-IA-MW-08	98-IA-MW08-180618	9674143	Well 20	Phase I	Vashon	38 - 43	6/18/2018	15	1.7 J	0.96 U	23
SWMU47-MW1	SWMU47-MW1-190213	9987835	Well 14	Phase II	Vashon	29-39	2/13/2019	16	16	0.33 J	40
Firehouse (Building 2014)											
2018-2014-MW1	2018-2014-MW1-190208	9987830	Well 17	Phase II	Vashon	38-48	2/8/2019	18	14	4.7	58
	GWDUP1-190208	9987832		Phase II			2/8/2019 (DUP)	18	14	4.9	59
2019-LT-18	2019-LT-18-190524	1067015	Well 17	Phase III	Sea Level	261-281	5/24/2019	68	160	12	354
Historical Water Proofing and Laundry Facilities											
01035-MW01	01035-MW01-180618	9674146	Well 17	Phase I	Vashon	15 - 30	6/18/2018	82	26	5.7	169
4131-MW04	4131-MW04-180618	9674144	Well 17	Phase I	Vashon	23 - 33	6/18/2018	23	12	4.6	61
	GWDUP3-180618	9674147					6/18/2018 (DUP)	22	11	4.5	59
2018-4074-MW1	2018-4074-MW1-190206	9984454	Well 17	Phase II	Vashon	37-47	2/6/2019	60	25	3.8	132
2018-1401-MW1	2018-1401-MW1-190206	9984453	Well 17	Phase II	Vashon	40-50	2/6/2019	100	16	14	258
2019-LT-17	2019-LT-17-190523	1067011	Well 22 and Hoffman Hill #2	Phase III	Sea Level	280-300	5/23/2019	14	64	4.7	120
Lewis Main Landfill #9											
2018-LF9-MW1	2018-LF9-MW1-190208	9987829	Well 22	Phase II	Vashon	48.4-58.4	2/8/2019	1.1 U	1.1 U	0.99 U	5.4
Lewis North Landfill #4											
LF4-01	LF4-01-180620	9674154	Sequalitchew Springs/Well 12B	Phase I	Vashon	22 - 28	6/20/2018	5.3	5.9	3.5	20
LF4-MW-10	LF4-MW-10-180620	9674153	Sequalitchew Springs/Well 12B	Phase I	Vashon	22 - 37	6/20/2018	4.0	2.3 J	3.7	16
LF4-PNL1	LF4-PNL1-180626	9682103	Sequalitchew Springs/Well 12B	Phase I	Vashon	22 - 37	6/26/2018	3.6	2.7	2.4	13
LF4-MW-03A	LF4-MW03A-190207	9984457	Sequalitchew Springs	Phase II	Vashon	26-41	2/7/2019	8.6	8.5	3.2	29
LF4-MW-01A	LF4-MW01A-190207	9984456	Sequalitchew Springs	Phase II	Vashon	37-52	2/7/2019	20	6.6	5.3	46
LF4-MW-01B	LF4-MW01B-190207	9984455	Sequalitchew Springs	Phase II	Vashon	119-124	2/7/2019	6.7	3.5	3.2	23

Table 5-1 (Continued)
Groundwater Results for PFOS, PFOA, and PFBS/Sum of 6 UCMR-3 Compounds

Potential Area of Concern								Analyte			
Well ID	Field ID	Laboratory ID	Nearest Drinking Water Well	Investigation Phase	Aquifer	Screen Interval (feet bgs)	Date Collected	PFOS (ppt)	PFOA (ppt)	PFBS (ppt)	Sum of UCMR-3 Compounds (ppt)
Lewis Sea Level Aquifer											
LC-92D-1	LC-920-1-190213	9987837	Bell Hill #3	Phase II	Sea Level	192-212	2/13/2019	3.9	6.4 J	1.1 J	17
LC-89D-2	LC-89D-2-190326	1024103	Bell Hill #3	Phase II	Sea Level	232-252	3/26/2019	1.1 U	1.1 U	0.96 U	4.9
LC-93D-1	LC-93D-1-190326	1024102	Bell Hill #3	Phase II	Sea Level	195-215	3/26/2019	2.7	25	1.1 J	37
LC-93D-2	LC-93D-2-190325	1024101	Bell Hill #3	Phase II	Sea Level	232-252	3/25/2019	1.3 J	2.3	0.56 J	8.3
Lewis North Landfill #5											
93-MFS-C5-3	93-MFS-C5-3-190205	9984452	Sequalitchew Springs	Phase II	Vashon	20-30	2/5/2019	15	37	7.4	80
MW-2008-1	MW-2008-1-190205	9984451	Sequalitchew Springs	Phase II	Vashon	17-27	2/5/2019	9.7	3.4	2.2	23

Notes:
[a] Assistant Secretary of Defense, 2019. Risk Based Screening Levels calculated for PFOS, PFOA and PFBS in Groundwater using EPA's Regional Screening Level Calculator. Hazard Quotient=0.1, 15 October 2019. Groundwater screening levels are based on residential scenario for direct ingestion of groundwater.
[b] UCMR-3 compounds are PFOS, PFOA, PFBS, PFHpA, PFHxS, and PFNA.
[c] If reported as not detected, one-half the LOQ was used in the calculation (see the associated laboratory report for the LOQ).

Values in bold font indicate that the compound was reported as detected.
Results reported as not detected by the laboratory are shown with a 'U' flag assigned to the limit of detection as reported by the laboratory. Results reported as detected below the LOQ but above the detection limit were assigned a 'J' qualifier by the laboratory.
Results qualified as not detected, as described in the data validation memoranda, are shown with a 'U' flag assigned to the LOQ as reported by the laboratory.
Yellow highlighting indicates that the concentration is at or exceeds the project action limit.

bgs – below ground surface
DUP – Field duplicate
J – estimated value
LOQ – limit of quantitation
NA – not analyzed
PFBS – perfluorobutane sulfonate
PFNA – perfluorononanoic acid
PFOA – perfluorooctanoic acid
PFOS – perfluorooctane sulfonate
ppt – part per trillion, or nanogram per liter
U – Analyte was not detected above the limit shown.
UCMR-3 – Unregulated Contaminant Monitoring Rule

Table 5-2
Surface Water Sample Results for PFOS, PFOA and PFBS

Location	PFOS (ppt)	PFOA (ppt)	PFBS (ppt)
SW-1	19	4.2	4.5
E Clover Creek	8.8	0	7.4
W Clover Creek	8.9	3.2	6.3
Carter Lake	20	3.5	3.1
Murray Creek	0	0	0
Lynn Lake	1.6	0	0
W American Lake	9.2	4.9	2.8
Outfall 2	33	17	4.9

Notes:
ppt – part per trillion
PFOA - perfluorooctanoic acid
PFOS – perfluorooctane sulfonate
PFBS – perfluorobutane sulfonate

Table 5-3
Analytical Results for PFAS in Off-Base Production Wells
Collected by JBLM DPW and Others

Well Owner / Well ID	Aquifer	Screen Interval (feet bgs)	Date Collected	Per- and Poly-Fluoroalkyl Substances (ng/L) UCMR-3 Compounds PFOS	PFOA	PFBS	PFHpA	PFHxS	PFNA	PFOS and PFOA
Project Action Limit [a]:				70 [c]	70 [c]	400,000 [b]	NE	NE	NE	70 [a]
Lakewood										
Ponders H-1/H-2	Vashon	86 – 110	11/7/2018	41	8.4	9.8	3.8	22	0	49
Scotts G-1/G-2	Sea Level	153 – 180	11/7/2018	43	4.9	7.6	2.4	29	0	48
Tillicum A-3	Stuck	441 – 481	10/1/2018	0	0	0	0	0	0	0
112th St R-1	Stuck	494 – 552	5/1/2018	0	0	NA	0	0	0	0
88th and Pine J-1	Vashon	136 – 157	10/1/2018	12	6.4	7	2.4	9.9	0	18
Dupont										
Bell Hill #1	Sea Level	248-293	12/17/2018	3.9	8.5	0	0	7	0	12.4
Bell Hill #2	Sea Level	362-508	12/17/2018	0	0	0	0	0	0	0
Bell Hill #3	Sea Level	197-282	12/17/2018	3.9	8.4	0	0	5.8	0	12.3
Hoffman Hill #1	Sea Level	415-497	12/17/2018	13	49	4	3.8	24	0	62
Hoffman Hill #2	Sea Level	295-375	12/17/2018	14	30	4	3.7	21	0	44
Parkland										
Well #7	Vashon	? - 31	12/12/2018	6.6	0	4.6	0	2.3	0	6.6
Well#9	Vashon	? - 30	12/12/2018	5.9	0	4	0	0	0	6
Laurel Lane MHC LLC										
Laurel Lane MC Well #1	Vashon	–108 - ?	12/12/2018	44	13	21	4.7	6.3	0	57

Table 5-3 (Continued)
Analytical Results for PFAS in Off-Base Production Wells
Collected by JBLM DPW and Others

Notes:

[a] Fact Sheet PFOA & PFOS Drinking Water Health Advisories. EPA 800-F-16-003, November 2016 (EPA 2016c). Guidance provides a health advisory level of 70 ppt for PFOS and PFOA. If both PFOS and PFOA are found to be present, their combined concentration is compared to the value of 70 ppt.

[b] Based on EPA Regional Screening Levels (EPA 2017).

[c] EPA Health Advisory Level

[d] UCMR-3 compounds are PFOS, PFOA, PFBS, PFHpA, PFHxS, and PFNA.

Values in bold font indicate that the compound was reported as detected.

bgs – below ground surface
NA – not analyzed
NE – not established
ng/L – nanogram per liter
PFBS – perfluorobutane sulfonate
PFHpA – perfluoroheptanoic acid
PFHxS – perfluorohexanesulfonate
PFNA – perfluorononanoic acid
PFOA – perfluorooctanoic acid
PFOS – perfluorooctane sulfonate
UCMR-3 – Unregulated Contaminant Monitoring Rule

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6.0 PRELIMINARY CONCEPTUAL SITE MODEL

A preliminary conceptual site model was developed based on the available data specific to PFAS occurrence at JBLM. Most of the groundwater monitoring wells network was completed to depths less than 100 feet and deeper aquifers have not been fully assessed. As additional information regarding the subsurface conditions are obtained, this model will be refined.

6.1. Source Areas and Release Mechanisms

The PA indicated that there are approximately 52 potential PFAS operations/use areas located in 24 general AOPIs at JBLM. The primary potential sources are fire training areas, emergency responses, large and small releases from firefighting systems in hangars, and landfills. Secondary potential sources include waterproofing activities, laundry services, cleaning activities at wash racks, and AFFF storage and handling facilities. All of these potential source areas are surface or near surface releases. The releases are direct discharge to ground through training or emergency fire-fighting, releases in hangars due to system malfunctions or in response to emergencies, and accidental spillage.

6.2. Transport Mechanisms

PFOS and PFOA were measured in water samples from JBLM production wells at concentrations greater than the EPA HAL of 70 ppt and the recently established 40 ppt SL. These production wells range from 150 to over 500 feet deep. Cross-sections in the vicinity of McChord Field and Gray Army Airfield/Lewis Main provide a generalized depiction of the localized geology as shown on Figure 6-1 and Figure 6-2, respectively. The cross-sections were developed based on data collected during this SI, relevant boring logs from various RI/FS work, and other regional research (Borden and Troost 2001). The flow path or process by which the PFAS surface releases have migrated through the aquifers and aquitards to affect the deep drinking water production wells is not understood. Deeper monitoring wells screened within the various aquifers will be required to better understand the vertical and lateral migration pathways of PFAS and interactions with the drinking water production wells beneath the installation.

Four aquifers were penetrated for investigation or production well water withdrawal purposes at JBLM (Figure 6-1 and Figure 6-2). The aquifers and separating aquitard units from shallow to deep are:

- Upper Vashon Aquifer (A1)
- Vashon Till (aquitard) (A2)
- Lower Vashon Aquifer (A3)
- Kitsap Formation (aquitard) (B)
- Sea Level Aquifer (Salmon Springs) (C)
- Puyallup Formation (aquitard) (D)
- Stuck Formation (E)

The Upper (A1) and Lower (A3) Vashon Aquifers are separated by the Vashon Till (A2). The lower Vashon Aquifer and Sea Level Aquifer are separated by the Kitsap Formation (B). The Sea Level Aquifer (C) and Stuck Formation (E) are separated by the Puyallup Formation (D). Although aquitards are substantially

lower in permeability than the aquifers, they do not prevent water from migrating vertically into underlying aquifers due to variabilities in hydraulic properties (e.g., hydraulic conductivities) and thickness or absence.

A generalized south to north cross-section for the McChord area (Figure 6-1) shows the Vashon Till, separating the Upper and Lower Vashon Aquifers except in the northern portion of the cross-section. The Vashon Till does not appear to be present at the 2019-LT-19 location (northwest corner of McChord Field). The initial interpretation shown on Figure 6-1 suggests that the Upper and Lower Vashon aquifers may have a direct communication north of the McChord Hangars. Based on the existing information, the Kitsap Formation (aquitard separating the Lower Vashon and Sea Level aquifers) does not appear to be present in the McChord area. This allows direct communication between the Lower Vashon and Sea Level aquifers in the McChord area. The Puyallup formation appears to underlie the entire McChord area; thus, no direct interconnection between the Sea Level Aquifer and the Stuck Formation is presently evident.

An east to west generalized cross-section across Gray Army Airfield/Lewis Main is shown on Figure 6-2. The three aquitards (Vashon Till, Kitsap Formation, and Puyallup Formation) appear to be consistently present across this section.

In general, downward vertical migration requires downward vertical gradients that can be both natural and/or induced by groundwater pumping. The presence or absence of an aquitard can change the rate of vertical migration depending on the vertical permeability of the aquitard. Pumping from production wells at JBLM likely induce downward vertical gradients. Also, wells that penetrate multiple aquifers can create interconnections between the various aquifers. In addition, several of the production wells at JBLM are old and drilling and construction methods previously used may be providing a pathway between aquifers.

Contaminants can migrate along concentration gradients, including vertically. However, this mechanism is considered to be slower than migrating with groundwater movement.

Based on data available from previous CERCLA investigations and USGS research (Savoca et al. 2010), groundwater flow is generally to the northwest in the five aquifers (Figure 5-1). The Sea Level aquifer has a westerly flow path around American Lake. The primarily northwest flowing Clover Creek, which flows through McChord Field, could also be a transport mechanism off installation. Clover Creek flows near the fire training areas and just west of the McChord field hangars. Soil at the potential source areas could be acting as residual sources.

Releases to the surface from multiple source areas across McChord would migrate vertically through the unsaturated zone into the shallow groundwater. The affected groundwater would then migrate northwesterly via advective flow and vertically in response to downward gradients and along concentration gradients via diffusion. There are multiple potential source areas and very complex geology/hydrogeology. How these differing sources are contributing to groundwater is unknown. Soil PFAS concentration data are needed to support source identification or quantify source strength. Measurement of vertical gradients across JBLM are required to evaluate the migration potential between aquifers. A much higher resolution of groundwater flow across JBLM is required to evaluate groundwater transport mechanisms. Surface water/groundwater interactions are also critical to evaluate how surface releases migrate once they hit surface water bodies.

6.3. Extent at McChord Airfield

The extent of PFOS and PFOA in soil and groundwater at McChord Field has not been assessed. The objective of this PA/SI is to identify potential source areas.

Based on existing data, PFOS and, to a lesser extent, PFOA, greater than 40 ppt in the Vashon Aquifer at McChord extend from the fire-training FT032/Landfill 013 area just east of the southern end of the McChord runway northwest to the installation boundary. PFOS, and to a much lesser extent PFOA, are present in the Sea Level aquifer beneath McChord Field and extend to the northwest McChord boundary. It is not known if or how PFOS and PFOA reach the Sea Level aquifer before McChord Field. There are only six wells screened in the Sea Level Aquifer available for sampling at McChord Field. This covers an area approximately 11,000 by 6,000 feet (approximately 1,500 acres). Additional data are required to refine the conceptual site model.

The apparent missing aquitard between the Upper and Lower Vashon aquifers in the McChord area is a potential vertical migration route. The interpretation of the missing aquitard is based on the bore log for one drilling location, 2019-LT-19 (Figure 6-1). Additional data are required to confirm this interpretation.

Shallow groundwater transport from the McChord hangars to Clover Creek is a potential surface water migration pathway. Clover Creek flows to Steilacoom Lake. Clover Creek could be a residual source to downgradient groundwater during its path to Steilacoom Lake if there are any losing reaches. There are other creeks and surface water bodies on JBLM. However, Clover Creek is the only creek that is immediately adjacent to a potential source.

6.4. Extent at Lewis Main

The extent of PFOS and PFOA in soil and groundwater at Lewis Main has not been assessed. The objective of this PA/SI is to identify potential source areas.

Based on existing data, PFOS greater than 40 ppt at Lewis Main extends from east of Gray Army Airfield to the western boundary of JBLM in the Upper and Lower Vashon aquifers and the Sea Level Aquifer. There is no obvious vertical migration route based on the interpretation shown on Figure 6-2. There are only 10 wells screened in the Sea Level Aquifer available for sampling at Lewis Main. This covers an area approximately 36,000 by 20,000 feet (approximately 16,000 acres). Additional data are required to refine the conceptual site model.

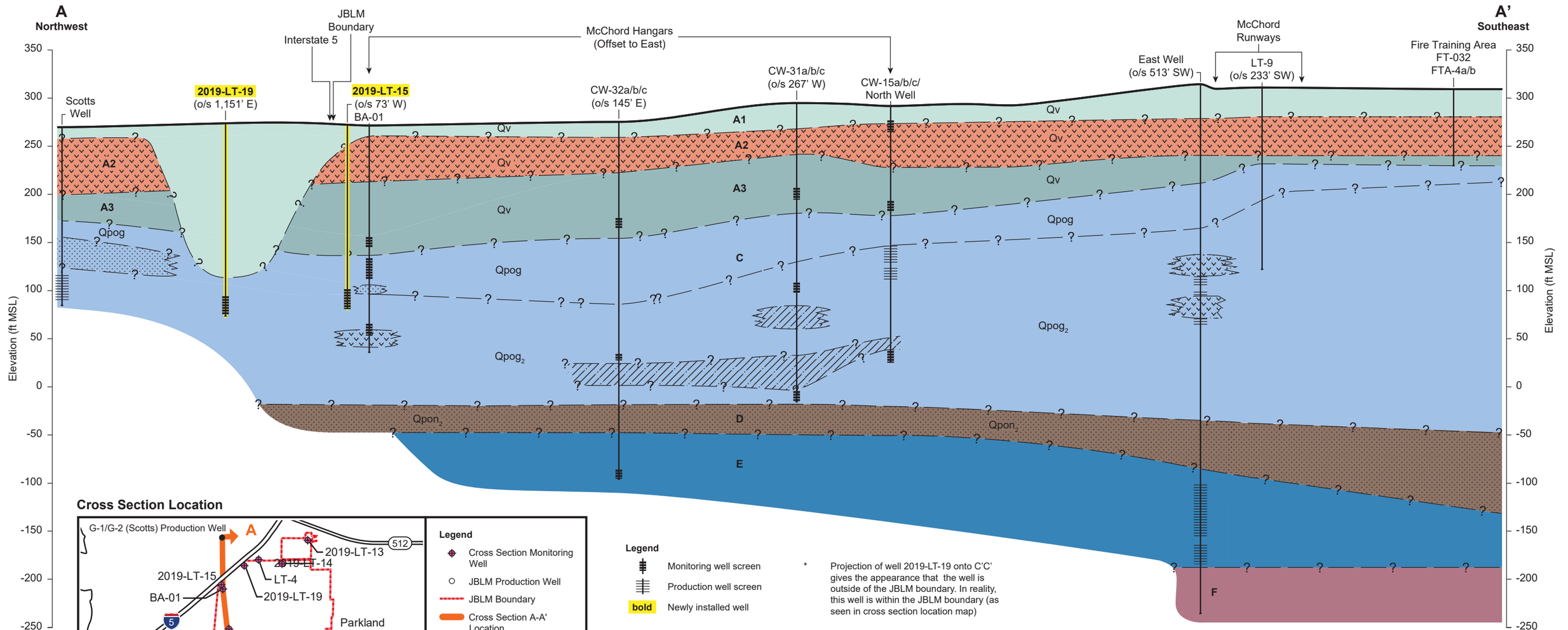
6.5. Potential Pathways and Receptors

Figure 6-3 shows a conceptual exposure model for groundwater and soil. Groundwater samples from JBLM production wells indicate that human exposure is a complete pathway via the JBLM water system. As a result, the groundwater to on-installation drinking water exposure pathway is considered to be complete. However, mitigation efforts have been underway to break this pathway, consistent with Army Policy. Given the presence of PFOS and PFOA in groundwater at the border of McChord field and western Lewis Main (Figure 5-3 and Figure 5-5), there is a potential for an off-site pathway leading to downgradient off-site receptors. As a result, the groundwater to off-base drinking water exposure pathway is considered to be potentially complete.

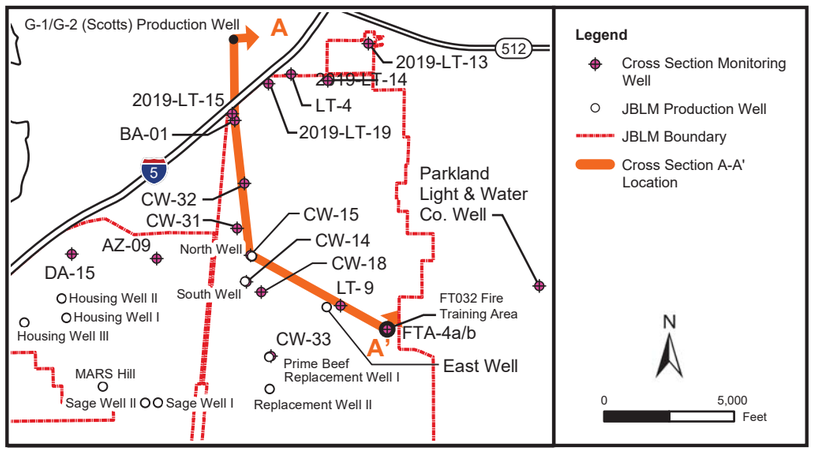
Since most release mechanisms include direct discharge to ground, soil exposure is a possibility (Figure 6-3). The identified AOPIs are on the access-controlled portions of JBLM with current land use consisting of airfield/industrial/military, and not in JBLM housing areas. Therefore, residential soil exposure is considered incomplete and not further discussed. Construction could take place in the source areas resulting in potential exposure to workers. Therefore, the worker soil exposure pathway is considered to be complete. Recreational exposure is not considered to be complete since the identified potential source areas are not conducive to recreational activities.

PFAS compounds are not volatile and do not pose a vapor intrusion risk or airborne exposure potential. There is some potential for airborne exposure to fire fighters and AFFF-handling personnel only during training exercises, emergency actions, and material handling. However, the exposure is terminated at the conclusion of the exposing activity.

Off-installation sources were not evaluated as part of this PA/SI.



Cross Section Location



Legend

- Cross Section Monitoring Well
- JBLM Production Well
- JBLM Boundary
- Cross Section A-A' Location

Legend

- Monitoring well screen
- Production well screen
- **bold** Newly installed well

* Projection of well 2019-LT-19 onto C'C' gives the appearance that the well is outside of the JBLM boundary. In reality, this well is within the JBLM boundary (as seen in cross section location map)

Stratigraphic designations (delineated by bold lines)

Qv	Vashon Drift
Qob	Olympia beds
Qpog	Pre-Olympia glacial drift
Qpon	Second nonglacial deposits
$Qpog_2$	Third glacial drift
$Qpon_2$	Third nonglacial deposits

Source: Borden & Troost, 2001

Lithologic symbols

Glacial:
- Till
- Glaciolacustrine deposits
- Sand/gravel outwash (typically water-bearing)

Nonglacial:
- Coarse-grained fluvial sediments (typically water-bearing)
- Fine-grained fluvial/ lacustrine sediments
- Mudflow deposits

- - ?---?--- Contacts are dashed where inferred and queried where uncertain.

Hydrogeologic units

- **A1** Aquifer (Upper Vashon)
- **A2** Confining Unit (Vashon Till)
- **A3** Aquifer (Lower Vashon)
- **B** Confining Unit (Olympia Beds, Kitsap Formation)
- **C** Aquifer (Salmon Springs Drift)
- **D** Confining Unit (Puyallup Formation)
- **E** Aquifer (Stuck Drift)
- **F** Confining Unit (Alderton Formation)

Source: Savoca et al., 2010

0 1,000 2,000

Horizontal Scale in Feet
Vertical Exaggeration = 10x

Figure 6-1
Geologic Cross Section A to A' – McChord Field Area

PFAS Preliminary Assessment Site Inspection
Joint Base Lewis McChord
Lakewood, WA

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Stratigraphic designations
(delineated by bold lines)

Qv	Vashon Drift	Qpon	Second nonglacial deposits
Qob	Olympia beds	$Qpog_2$	Third glacial drift
Qpog	Pre-Olympia glacial drift	$Qpon_2$	Third nonglacial deposits

Lithologic symbols

Glacial
- Till
- Glaciolacustrine deposits
- Sand/gravel outwash (typically water-bearing)

Nonglacial
- Coarse-grained fluvial sediments (typically water-bearing)
- Fine-grained fluvial/ lacustrine sediments
- Mudflow deposits

- -?---?--- Contacts are dashed where inferred and queried where uncertain.

Source: Borden & Troost, 2001

Hydrogeologic units

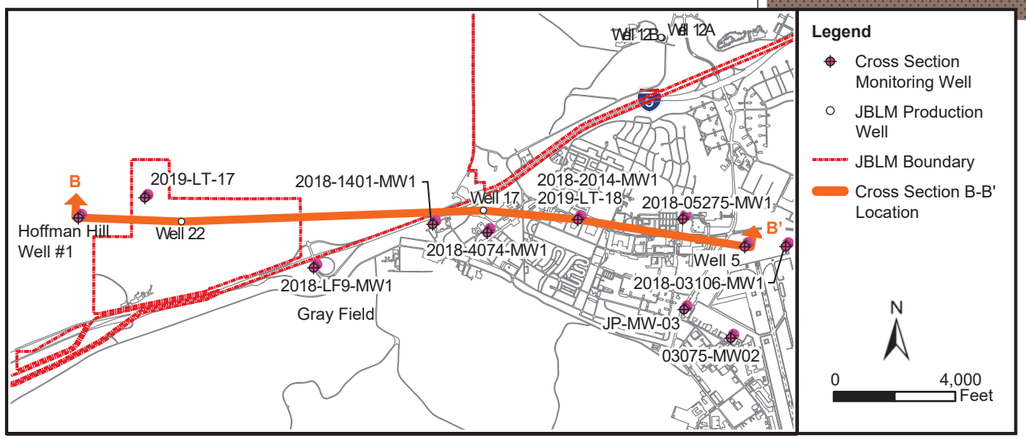
- **A1** Aquifer (Upper Vashon)
- **A2** Confining Unit (Vashon Till)
- **A3** Aquifer (Lower Vashon)
- **B** Confining Unit (Olympia Beds, Kitsap Formation)
- **C** Aquifer (Salmon Springs Drift)
- **D** Confining Unit (Puyallup Formation)
- **E** Aquifer (Stuck Drift)
- **F** Confining Unit (Alderton Formation)
- **G** Aquifer (Orting Drift)

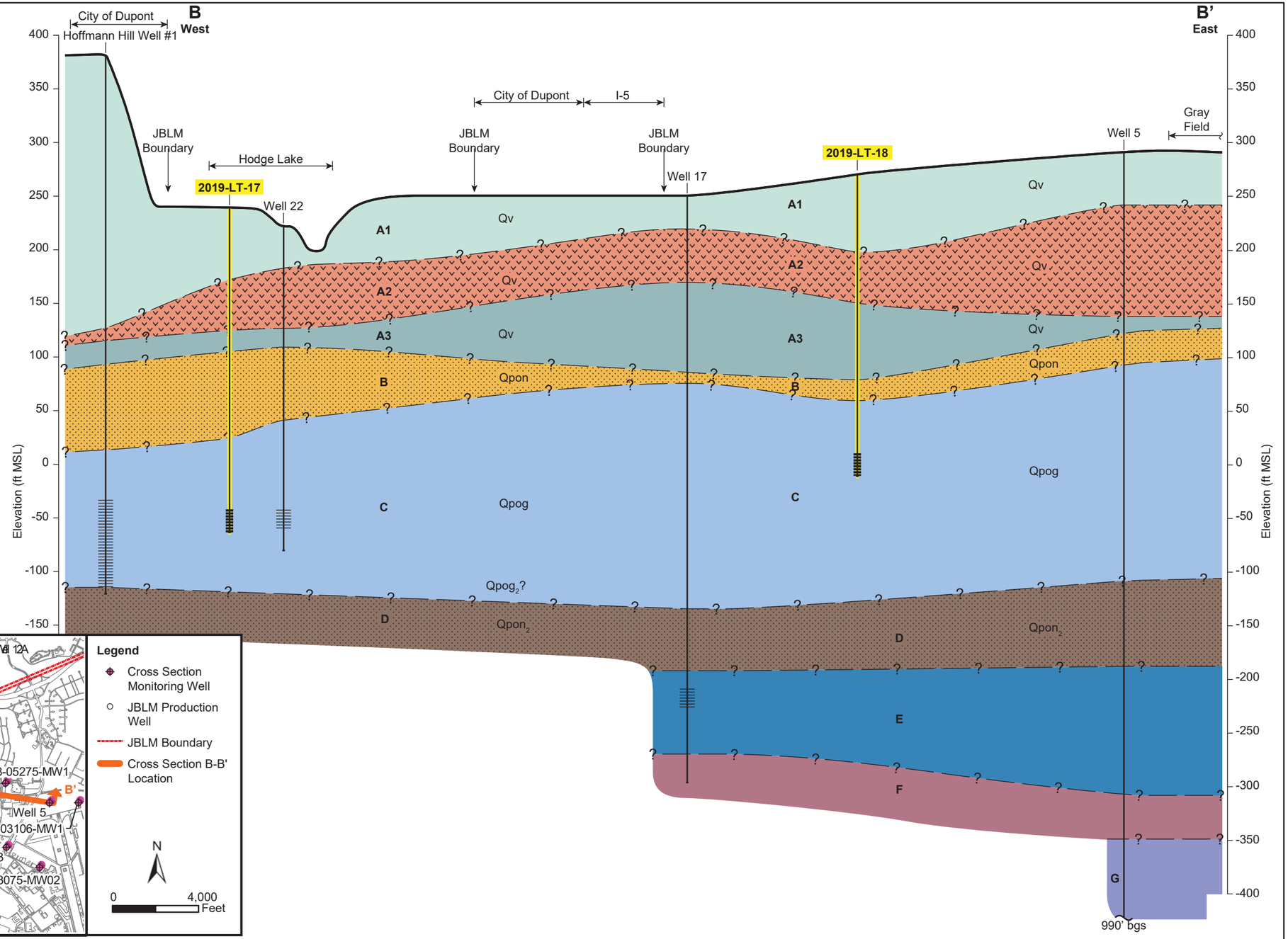
Source: Savoca et al., 2010

Legend

Monitoring well | Production well screen | **bold** Newly installed well

Cross Section Location





0 2,000 4,000

Horizontal Scale in Feet
Vertical Exaggeration = 20x

Figure 6-2
Geologic Cross Section B to B' – Gray Field/Fort Lewis Area

PFAS Preliminary Assessment Site Inspection
Joint Base Lewis McChord
Lakewood, WA

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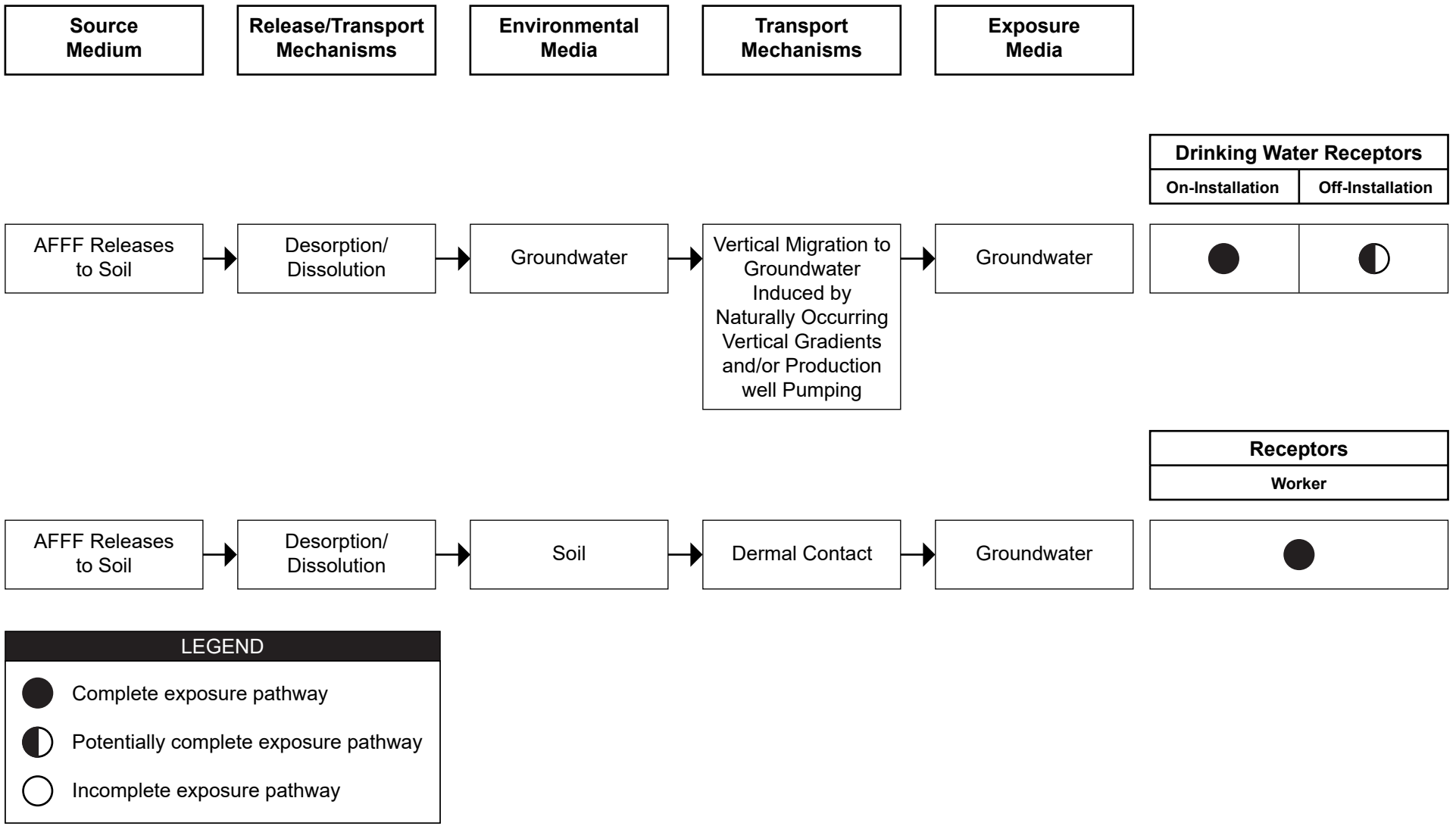

Figure 6-3
Conceptual Exposure Model for Drinking Water and Soil Pathways, JBLM Fire Training Areas

PFAS Preliminary Assessment Site Inspection
Joint Base Lewis McChord
Lakewood, WA

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7.0 DOD SCREENING GUIDANCE AND RECOMMENDATIONS

The PA identified 24 AOPIs across McChord Airfield, Gray Army Airfield, Lewis Main, and Lewis North. Based on a comparison of SI sampling results to the OSD SLs, there are 13 remaining AOPIs that will require further evaluation as identified in Table 7-1.

Additional investigation is required to evaluate the nature and extent of PFOS, PFOA, and PFBS in soil and groundwater at these sites. Soil sampling is important for identifying areas that could be acting as ongoing sources to groundwater and their relative contributions.

Multiple, site-specific investigations have been conducted at JBLM that describe the geology and hydrogeology for portions of the installation. A great deal of data do currently exist. However, to date, conceptual site models have been developed relative to individual sites. The occurrence of PFOS and PFOA in groundwater is an installation-wide issue and PFAS compounds have the ability to migrate very long distances in groundwater. As a result, an installation-wide conceptual site model is required.

The vast majority of the investigations have been limited to the Vashon (shallowest) Aquifer. Data on the Sea Level Aquifer are very limited, particularly at McChord Field. Vertical gradients between aquifers need to be evaluated and quantified to assess the downward vertical migration potential.

It is recommended that an installation-wide conceptual site model continue to be developed using all the available data prior to conducting further investigation relative to fate and transport. Geophysical methods are recommended to augment the existing data and help identify aquitard discontinuities and paleo-channels. JBLM is located in an area where unconsolidated deposits that make up the Puget Sound Basin were primarily deposited during multiple periods of glacial advance and retreat. This depositional environment resulted in numerous discontinuous stratigraphic layers. The hydrogeologic subsurface units are complex making contaminant fate and transport evaluation extremely difficult. These hydrogeologic units have variable horizontal continuity due to their depositional environments but are also cross-cut by incised stream valleys filled with alluvial units and mudflow deposits.

Environmental sequencing stratigraphy helps define groundwater flow paths and preferential contaminant migration pathways. This aids data gap identification and facilitates high resolution site characterization, which helps determine appropriate locations for monitoring and sampling points, and focused remedial actions. A synoptic base-wide groundwater/piezometric surface elevation measurement in all accessible wells and screened aquifers will provide a higher resolution view of groundwater flow in all aquifers and vertical gradients between aquifers. Numeric, base-wide, three-dimensional groundwater modeling and geologic visualization modeling should be considered to support fate and transport evaluation and future potential remedial alternatives evaluations. Ultimately, these methods are used to better understand groundwater flow and contaminant migration pathways and significantly refine the three-dimensional, base-wide conceptual site model.

Table 7-1
AOPI Status Based on PA/SI Results

AOPI	Known/Potential PFAS Operations/Uses	SI Groundwater Samples Exceeded OSD SLs	Not Evaluated	Further Evaluation Required	Further Evaluation Not Required
AOPI 1 – McChord Airfield Runway	McChord – Aircraft Accident Responses	X		X	
	Landfill #12	X		X	
AOPI 2 - McChord Airfield Historical FT Area 027	FT027				X
AOPI 3 – McChord Airfield, North Hangar Area	Hangar 5 Building 1178	X		X	
	McChord AFFF Sump between Hangars 5 and 6	X		X	
	Hangar 6 Building 1160	X		X	
	Hangar 7 Building 1164	X		X	
	Hangar 9 Building 1166	X		X	
	McChord AFFF Sump between Hangars 9 and 10	X		X	
	Hangar 10 Building 1167	X		X	
	McChord Flight line Infield – 4 Aviation Fuel Tanks		X	X	
	Hangar 13 Building 1174	X		X	
	McChord AFFF Sump West of Hangar 13	X		X	
AOPI 4 - McChord Airfield Historical FT 028, FT029, FT030	FT028		X	X	
	FT029		X	X	
	Historical FT Area 30		X	X	
AOPI 5 - McChord Airfield, South Hangar Area	Historic FT Area 033 Fire Station #105/ Building J00006	X		X	
	Clover Creek	X		X	
	Hangars 1 and 2 Buildings J00001 and J00002	X		X	
	Hangars 3 and 4 Buildings J00003 and J00004	X		X	
	Hangar 301 McChord Field Runway	X		X	
	Historical wash rack and Taxiway D		X	X	

Table 7-1 (Continued)
AOPI Status Based on PA/SI Results

AOPI	Known/Potential PFAS Operations/Uses	SI Groundwater Samples Exceeded OSD SLs	Not Evaluated	Further Evaluation Required	Further Evaluation Not Required
AOPI 6 – McChord Airfield FT031, FT032, Landfill 022, Landfill 013	FT031		X	X	
	FT032	X		X	
	Landfill 013	X		X	
	Landfill 022	X		X	
AOPI 7 – McChord Airfield Main Bulk Fuel Tank Farm	McChord – Main Bulk Fuel Tank Farm		X	X	
AOPI 8 – American Lake Garden Tract Landfill 005	Landfill 005				X
AOPI 9 – Northwest Logistics Center	Historical waterproofing in area of Buildings 9570/9580		X	X	
AOPI 10 – Central Logistics Center	Building 9612 Current wash rack		X	X	
	Building 9626 Historical wash rack		X	X	
	Building 9636 Bulk “Fuel Spot"		X	X	
	Historical waterproofing in area of Buildings 9630/9640		X	X	
	Historical Laundry-Building 9060		X	X	
AOPI 11 – Logistics Center Landfill #2	Landfill #2				X
AOPI 12 – Lewis North Landfill #4	Lewis North - Landfill #4				X
AOPI 13 – Lewis North AOC 15-1 and Wash Rack	AOC 15 (1957)		X	X	
	Current wash rack		X	X	
AOPI 14 – Historic Solvent Refined Coal Power Plant	SRCPP (FTLE-32)		X	X	
AOPI 15 – Lewis North Landfill #5	Landfill #5				X
AOPI 16 – Gray Army Airfield Hangars 3106, 3146, 3101 and FTLE-17	Army National Guard Hangar 3106	X		X	
	FTLE-17	X		X	
	Hangar 3146	X		X	
	Hangar 3101	X		X	
AOPI 17 – Gray Army	Army Reserve Hangar 3273	X		X	

Table 7-1 (Continued)
AOPI Status Based on PA/SI Results

AOPI	Known/Potential PFAS Operations/Uses	SI Groundwater Samples Exceeded OSD SLs	Not Evaluated	Further Evaluation Required	Further Evaluation Not Required
Airfield Hangar 3273 and storm drainage	Storm water Drainage Swale near Hangar 3273	X		X	
AOPI 18 – Lewis Main SWMU-47 and FLT-54 Wash Rack	SWMU-47 Historical Firefighting Training Area				X
	FLT-54 Wash Rack Equipment 3559 - 3562				X
AOPI 19 – Gray Army Airfield Hangar 3063 and Fire Station 102	Hangar 3063	X		X	
	Fire Station 102 – Building 3081	X		X	
AOPI 20 -Gray Airfield Hangar 3098 and Buildings 3095 and 3099	Hangar 3098	X		X	
	Building 3095	X		X	
	Building (Temporary) 3099	X		X	
AOPI 21 – Gray Airfield Landfill #1	Landfill #1				X
AOPI 22 – Lewis Main Fire Station 7 Building 2014	Fire Station 7 – Building 2014	X		X	
AOPI 23 – Lewis Main Buildings 04074,04076, 1401, 4100, 1206 and 1210	Buildings 04074 & 04076	X		X	
	Building 1401 - Formerly known as Building 1402 Historical Laundry operation since 1941	X		X	
	Fire Station 1 – Building 4100	X		X	
	Buildings 1206/ 1210 Ranges		X		
AOPI 24 - Lewis Main Landfill #9	Landfill #9				X

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APPENDICES
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APPENDIX A

Abbreviations and Acronyms

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AEC	Army Environmental Command
AFB	Air Force Base
AFFF	aqueous film-forming foam
ALGT	American Lakes Garden Tract
AOPI	area of potential interest
ARFF	aircraft rescue and firefighting
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DD	Decision Document
DO	dissolved oxygen
DoD	United States Department of Defense
DOH	Department of Health
DOT	United States Department of Transportation
DPW	Department of Public Works
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
FS	feasibility study
FT	fire training
FTA	fire training area
HAL	Health Advisory Level
HDPE	high-density polyethylene
ID	identification
IDW	investigation-derived waste
IRP	Installation Restoration Program
JBLM	Joint Base Lewis-McChord
JP	jet petroleum
LUC	land use control
mL	milliliter
MTCA	Model Toxics Control Act
NFA	no further action
NFRAP	no further remedial action planned
NPL	National Priorities List
ORP	oxidation-reduction potential

OSD	Office of the Secretary of Defense
P&T	pump and treat
PA	preliminary assessment
PAH	polynuclear aromatic hydrocarbon
PFAS	per- and polyfluorinated alkyl substances
PFBS	perfluorobutane sulfonate
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
PID	photoionization detector
ppb	part per billion
ppt	part per trillion
PVC	polyvinyl chloride
QAPP	quality assurance project plan
RCRA	Resource Conservation and Recovery Act
RFA	RCRA facility assessment
RI	remedial investigation
ROD	Record of Decision
SI	site inspection
SL	screening level
SOP	standard operating procedure
SVOC	semivolatile organic compound
TCE	trichloroethylene
TPH	total petroleum hydrocarbons
TPP	Technical Project Planning
U.S.	United States
UCMR	Unregulated Contaminant Monitoring Rule
USACE	United States Army Corps of Engineers
USAF	United States Air Force
USGS	United States Geological Survey
VOC	volatile organic compound
WSDOT	Washington State Department of Transportation

APPENDIX B

PA Database Outputs, Historical Documents, Interview Logs, and Photo Log