FINAL
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SITE-SPECIFIC QUALITY ASSURANCE PROJECT PLAN FOR GROUNDWATER MONITORING AT THE FORMER FIRE TRAINING PIT AND TRACKED VEHICLE REPAIR/OLD MOBILIZATION AND TRAINING EQUIPMENT SITE

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Yakima, Washington

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CONTRACT NO. W912DW19D1022, TASK ORDER W912DQ22F0025

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JOINT BASE LEWIS-MCCHORD, YAKIMA TRAINING CENTER
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LIST OF ACRONYMS AND ABBREVIATIONS

amsl	above mean sea level
bgs	below ground surface
BTEX	benzene, ethylbenzene, toluene, and total xylenes
CAs	corrective actions
COCs	chemicals of concern
cPAHs	total carcinogenic polycyclic aromatic hydrocarbons
DL	detection limit
DNAPL	dense nonaqueous-phase liquid
DQO	data quality objective
EA	EA Engineering, Science, and Technology, Inc.
E&E	Ecology and Environment, Inc.
Ecology	Washington State Department of Ecology
ERP	Environmental Restoration Program
Fremont	Fremont Analytical, Inc.
FTP	Fire Training Pit
IC	institutional control
IDQTF	Intergovernmental Data Quality Task Force
IDW	investigation-derived waste
IEJV	Innovex-ERRG Joint Venture
IRP	Installation Restoration Program
JBLM	Joint Base Lewis-McChord
LNAPL	light non-aqueous phase liquid
LOD	limit of detection
LOQs	limits of quantitation
LTM	long-term management
LUCs	land use controls
MATES	Mobilization and Training Equipment Site
MCL	maximum contaminant level
mg/kg	milligram(s) per kilogram
mg/L	milligram(s) per liter
MMP	Main Motor Pool
MTCA	Model Toxics Control Act
NPL	National Priorities List
ORC	oxygen release compound
Pace	Pace Analytical National Center for Testing & Innovation Laboratory
PAIC	Pomona Artesian Irrigation Company
PAHs	polycyclic aromatic hydrocarbons
PALs	project action limits
PDBs	passive diffusion bags

LIST OF ACRONYMS AND ABBREVIATIONS *(continued)*

Pegasus	Pegasus Environmental Management Services Inc.
PFAS	per- and polyfluoroalkyl substances
PNNL	Pacific Northwest National Laboratory
PPE	personal protective equipment
PQL	project quantitation limit
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RCRA	Resource Conservation and Recovery Act
RFA	RCRA facility assessment
SAIC	Science Applications International Corporation
SI	site investigation
SOPs	standard operating procedures
SVOCs	semivolatile organic compounds
SWMU	Solid Waste Management Unit
TCE	trichloroethene
TCLP	Toxicity Characteristic Leaching Procedure
TEC	toxic equivalent concentration
TEF	toxicity equivalency factor
TPH	total petroleum hydrocarbon
TPH-D	total petroleum hydrocarbons – diesel range
TPH-G	total petroleum hydrocarbons – gasoline range
TPH-O	total petroleum hydrocarbons – heavy oil range
TtEC	Tetra Tech EC, Inc.
TTEC	total toxic equivalent concentration
TVR	Tracked Vehicle Repair
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
UFP	Uniform Federal Policy
USTs	underground storage tanks
VOCs	volatile organic compounds
WAARNG	Washington Army National Guard
WAC	Washington Administrative Code
YTC	Yakima Training Center
µg/L	microgram(s) per liter

Executive Summary

Innovex-ERRG Joint Venture (IEJV) has prepared this Site-Specific Uniform Federal Policy (UFP) Quality Assurance Project Plan (QAPP) in support of groundwater monitoring at the following two sites on Joint Base Lewis-McChord's (JBLM) Yakima Training Center (YTC): Former Fire Training Pit (FTP) (YFCR-53) and Tracked Vehicle Repair (TVR)/Old Mobilization and Training Equipment Site (MATES) (YFCR-01). This Site-Specific QAPP is prepared in the UFP-QAPP format and will be referred to herein as the "Site-Specific QAPP."

The purpose of this Site-Specific QAPP is to outline the policies, organization, and specific quality assurance (QA) and quality control (QC) measures to be implemented during the collection, analysis, and reporting of data associated with groundwater monitoring activities at the Former FTP and TVR/Old MATES. This QAPP includes project-specific data acquisition operations; specifies the data usability requirements to support the decision-making process; and provides a clear, concise, and complete plan for the data collection and evaluation.

This QAPP will be used in conjunction with the Programmatic QAPP (IEJV, 2022b) to address the elements of the work to be performed. The Programmatic QAPP has been prepared to consistently address the information applicable to multiple sites at JBLM and YTC and to eliminate the replication of common information. The Site-Specific QAPP ties to the Programmatic QAPP (IEJV, 2022b), and only those worksheets that provide information specific to the execution of project tasks at the Former FTP and TVR/Old MATES are presented herein.

When used in conjunction with the Programmatic QAPP, this document meets the requirements and elements set forth in the Intergovernmental Data Quality Task Force's (IDQTF) UFP–QAPP Manual (IDQTF, 2005). The UFP-QAPP Manual integrates the U.S. Environmental Protection Agency (USEPA) seven-step data quality objective (DQO) process (USEPA 2006), and the terminology in this QAPP is consistent with the UFP-QAPP Manual (IDQTF, 2005). The worksheets in this document follow the Optimized QAPP Worksheets format (IDQTF, 2012), as outlined in Table ES-1.

Table ES-1. UFP-QAPP Worksheet Summary

Worksheet No.	Worksheet Title	Crosswalk Reference
1 and 2	Title and Approval Page	
3 and 5	Project Organization and Quality Assurance Project Plan Distribution	Programmatic QAPP for Environmental Remediation Program Services, August 2022 (Programmatic QAPP), Page 7
4, 7, and 8	Personnel Qualifications and Sign-Off Sheet	Programmatic QAPP, Page 10
6	Communication Pathways	Programmatic QAPP, Page 13
9	Project Planning Session Summary	Programmatic QAPP, Page 15 and Site-Specific QAPP
10	Conceptual Site Model	
11	Project/Data Quality Objectives	
12	Measurement Performance Criteria	Programmatic QAPP, Page 20
13	Secondary Data Uses and Limitations	
14 and 16	Project Tasks and Schedule	
15	Project Screening Levels and Laboratory-Specific Detection Limits	
17	Sample Design and Rationale	
18	Sampling Locations and Methods	
19 and 30	Sample Containers, Preservation, and Hold Times	Programmatic QAPP, Page 27
20	Field Quality Control Summary	
21	Field Standard Operating Procedures	Programmatic QAPP, Page 31
22	Field Equipment Calibration, Maintenance, Testing, and Inspection	Programmatic QAPP, Page 33
23	Analytical Standard Operating Procedures	Programmatic QAPP, Page 34
24	Analytical Instrument Calibration	Programmatic QAPP, Page 37
25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection	Programmatic QAPP, Page 44
26 and 27	Sample Handling, Custody, and Disposal	Programmatic QAPP, Page 47
28	Analytical Quality Control and Corrective Action	Programmatic QAPP, Page 50
29	Project Documents and Records	Programmatic QAPP, Page 69
31, 32, and 33	Assessments and Corrective Action	Programmatic QAPP, Page 72
34	Data Verification and Validation Inputs	Programmatic QAPP, Page 74
35	Data Verification Procedures	Programmatic QAPP, Page 76
36	Data Validation Procedures	Programmatic QAPP, Page 78
37	Data Usability Assessment	Programmatic QAPP, Page 79

Worksheets #1 and 2: Title and Approval Page

Site Location: Former FTP and TVR/Old MATES, YTC

Contract/Work Assignment: W912DW19D1022, Delivery Order W912DW22F0025

Document Title: Site-Specific QAPP for Groundwater Monitoring at the Former FTP and TVR/Old MATES

Preparation Date: September 2023

Lead Organization: JBLM Public Works – Environmental Division

Lead Organization Program Manager

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Worksheets #3 and 5: Project Organization and Quality Assurance Project Plan Distribution

This worksheet is presented in the Programmatic QAPP (IEJV, 2022b).

Worksheets #4, 7, and 8: Personnel Qualifications and Sign-Off Sheet

This worksheet is presented in the Programmatic QAPP (IEJV, 2022b).

Worksheet #6: Communication Pathways

This worksheet is presented in the Programmatic QAPP (IEJV, 2022b).

Worksheet #9: Project Planning Session Summaries

This worksheet is presented in the Programmatic QAPP (IEJV, 2022b). If site-specific decisions are made at a project planning session, this worksheet will be updated in the applicable site-specific QAPP.

Worksheet #10: Conceptual Site Model

This worksheet summarizes the available site information for the Former FTP (YFCR-53) and TVR/Old MATES (YFCR-01), including the site background, regulatory framework, physical setting, investigative history, current and anticipated future land use, sources of known or suspected contamination, known or suspected contaminants or classes of contaminants, primary release mechanisms, nature and extent of contamination, fate and transport considerations, and potential receptors and exposure pathways. This information serves as the conceptual site model for the Former FTP and TVR/Old MATES.

10.1 SITE BACKGROUND

YTC has been used for training military artillery, infantry, and engineering units since 1941. Expansion of YTC occurred in the early 1950s with the acquisition of additional land and permanent construction of the Cantonment Area in the southwest portion of YTC. An expansion of YTC to the north occurred in the early 1990s. Currently YTC is approximately 327,233 acres and is divided into the Cantonment Area and the down range area. The Former FTP and TVR/Old MATES are located within the Cantonment Area (Figure 10-1).

10.1.1 Former Fire Training Pit

The Former FTP is an approximately 15,000 square-foot site located in the northeast portion of the Cantonment Area east-northeast of the New MATES Facility/Building 850 (Figure 10-2). The site is identified as Solid Waste Management Unit (SWMU) 59 in the September 1995 Resource Conservation and Recovery Act (RCRA) facility assessment (RFA) performed by USEPA. Section 10.2 further discusses the 1995 RFA.

The Former FTP was used to practice extinguishing fires two or three times a year from an unknown start date until 1987, with a single training event in 1990 (Shapiro & Associates, 1991). Practice events consisted of saturating an open, unlined earthen pit with water; adding and igniting 500 to 1,000 gallons of waste JP-4 aviation fuel, diesel fuel, or motor gasoline; and then extinguishing the fire. During the 1990s, the site was used for storing stockpiles of waste sand filter material and sediments from the adjacent vehicle wash rack treatment system (Ecology and Environment, Inc. [E&E], 1993), as well as storing fuel bladders (Shannon & Wilson, Inc., 2001). The site is currently vacant and not used by YTC. Per- and polyfluoroalkyl substances (PFAS) in groundwater are being addressed under a separate investigation.

10.1.2 Tracked Vehicle Repair/Old Mobilization and Training Equipment Site

The TVR/Old MATES is associated with a trichloroethene (TCE) groundwater plume in an area between Old MATES (Building 951) and Building 810 located on the YTC Supply & Maintenance Facility (Figure 10-3). The former TVR Building 845 is between Building 951 and Building 810. The source of TCE in groundwater appeared to be historical releases due to past use and handling of solvents at both the Old MATES and the former TVR (Building 845) facilities (Fort Lewis Environmental Restoration Program [ERP], 2007b).

Worksheet #10: Conceptual Site Model *(continued)*

The Washington Army National Guard (WAARNG) performed tracked vehicle maintenance and repair activities and used degreasing solvents, such as TCE, at the TVR facility from 1968 until 1975, when they started using Building 951 on the Old MATES facility for repairs (EHS-International, Inc., 2010; Science Applications International Corporation [SAIC], 1995). The Old MATES/Building 951 was used for maintenance, repair, and washing of tracked and wheeled military vehicles owned by the WAARNG at YTC until 2008, when vehicle maintenance operations were transferred to the New MATES Facility (Building 960) (EHS-International, Inc., 2010). Degreasing solvents, including TCE, have been used since about 1968 at Building 845 and since 1975 at Building 951 (Shapiro & Associates, 1991). No records were identified regarding when TCE use was suspended or when TCE was replaced by other products. No records were identified detailing past use, handling, and storage of TCE at either facility (EHS-International, Inc., 2010). However, a former floor drain at the TVR facility (Building 845) discharged immediately adjacent to the location of monitoring well TVR-1 (Cory, 2004). No similar locations of historical discharges at Old MATES have been identified (Fort Lewis ERP, 2007b).

Waste oil underground storage tanks (USTs) were also considered a possible source of TCE in groundwater at TVR/Old MATES. Four 250-gallon waste oil USTs were in use at the TVR facility (Building 845) from the mid-1970s until 1991 (Shapiro & Associates, 1991; Pegasus Environmental Management Services Inc. [Pegasus], 1993; SAIC, 1995). A fifth 650-gallon waste oil UST was used at Building 845 from 1980 until 1991. In addition, one 2,000-gallon waste oil UST at the Old MATES was reportedly in operation from 1968 until 1995 (Shapiro & Associates, 1991; SAIC, 1995; EHS-International, Inc., 2010). All six former waste oil USTs were removed in 1991. Three of the five waste oil tanks at Building 845 and the 2,000-gallon waste oil UST at Building 951 were "clean closed," with either no contaminants detected in soil or contaminant concentrations in confirmation soil samples less than Model Toxics Control Act (MTCA) soil cleanup levels (CEcon Corporation, 1994; SAIC, 1995).

SWMUs 43 and 44 referred to former waste oil USTs 845-3 and 845-4 associated with TVR (Building 845). During the removal of USTs 845-3 and 845-4 in 1993, the excavations could not be cleaned closed because contamination was present under Building 845 and further excavation would have compromised the structural integrity of the building. Therefore, soil contamination from waste oil USTs 845-3 and 845-4 remains under Building 845. Section 10.4.3 provides further information on the UST removals and soil sampling. Although possible, it is unlikely that contamination remaining under Building 845 from USTs 845-3 and 845-4 is the source of TCE at TVR. Concentrations of TCE in monitoring well TVR-2, installed immediately downgradient of former USTs 845-3 and 845-4, are relatively low (Fort Lewis ERP, 2007a). In addition, the downgradient contamination associated with former USTs 845-3 and 845-4 cannot be the source of TCE located upgradient of the former USTs between Old MATES Building 951 and TVR Building 845.

Worksheet #10: Conceptual Site Model *(continued)*

10.2 REGULATORY FRAMEWORK

YTC is a sub-installation of JBLM. YTC is not on the National Priorities List (NPL); however, it is addressed under the RCRA. USEPA completed an RFA in 1995 in response to a RCRA permit application for a hazardous waste open burning/open detonation unit. The RFA identified 77 SWMUs and 38 areas of concern and recommended corrective action (CAs) for most of the SWMUs and areas of concern. In Washington, a RCRA CA is addressed in accordance with the MTCA regulations. JBLM is addressing the RCRA CA sites at YTC under RCRA authority administered by the Washington State Department of Ecology (Ecology) Hazardous Waste and Toxics Reduction Program.

Final remedies have been selected at IRP sites with concurrence from Ecology. As of March 2014, the status of the YTC IRP sites was remedy-in-place/response complete. Long-term management (LTM) remedies, including land use controls (LUCs) and groundwater monitoring, were selected in accordance with their respective Decision Documents and are in place at the Former FTP (Fort Lewis ERP, 2007a) and TVR/Old MATES (Fort Lewis ERP, 2007b).

LUCs were implemented and are maintained at the sites in accordance with the Decision Documents (Fort Lewis ERP, 2007a and 2007b) because current MTCA regulations require an institutional control (IC) whenever a contaminant concentration exceeds its MTCA Method A/MTCA Standard Method B cleanup level (regardless of actual risk). LUCs are presented in the LUC Plan, which was updated in 2021 (EA Engineering, Science, and Technology, Inc. [EA], 2021). LUCs at both sites prevent the installation of new drinking water wells without an approved monitoring plan. In addition, LUCs at TVR/Old MATES were implemented to prevent the installation of on-post water supply wells within 1,000 feet of the site boundary as long as concentrations of contaminants of potential concern in existing monitoring wells exceed MTCA Method A/MTCA Standard Method B groundwater cleanup levels, and to investigate and address potential soil contamination as necessary if Building 845 is deconstructed in the future (Fort Lewis ERP, 2007b). Institutional controls include dig permits and restrictions on land use (JBLM, 2017).

Per the YTC LUC Plan (EA, 2021), annual inspections are performed to determine if LUC mechanisms remain in place. Annual LUC inspection checklists are currently included in the annual groundwater monitoring reports. Inspections consist of checking all sites for potential residential land use and/or unplanned construction/excavation. Interviews also are conducted to ensure that Geographic Information System layer data are kept current and that Fort Lewis and YTC personnel have appropriate access

Semiannual groundwater monitoring is performed to evaluate the natural attenuation of site-related contaminants (petroleum hydrocarbons, volatile organic compounds [VOCs], and semivolatile organic compounds [SVOCs]) at the former FTP site and VOCs at TVR/Old MATES until contaminant concentrations are less than MTCA Method A/MTCA Standard Method B groundwater cleanup levels (JBLM, 2021).

The U.S. Army performed Periodic Five-Year Reviews of the IRP sites in 2012, 2017, and 2022 to determine whether the remedial actions implemented are protective of human health and to

Worksheet #10: Conceptual Site Model *(continued)*

identify any problems or concerns that are affecting or may in the future affect the protectiveness of the remedy. The 2017 review concluded that the remedies at the Former FTP and TVR/Old MATES currently protect human health and the environment.

10.3 PHYSICAL PROFILE INFORMATION

YTC is located within the Yakima Fold Belt sub-province of the Columbia Plateau physiographic province east of the Cascade Mountain Range in south-central Washington. YTC and the surrounding area supports a shrub-steppe habitat; natural vegetation primarily consists of sagebrush, bitterbrush, and various species of bunch grasses (Fort Lewis 2010; National Archives and Records Administration, 2010). This section provides further information, including local climate, topography, geology, hydrogeology, and hydrology, on YTC and the IRP sites.

10.3.1 Climate

Yakima, Washington, has a high desert climate with cold winters and hot summers. The climate is modified by the complex topography of the Cascade Mountains to the west and the Rocky Mountains to the east. Because YTC lies in the rain shadow of the Cascade Mountains, it is sheltered from large accumulations of precipitation.

The area experiences an average annual precipitation of 8 inches of rainfall and 23 inches of snowfall a year, with precipitation occurring mostly in the late fall and early winter[1]. Evapotranspiration is estimated at 25 to 57 inches a year for Yakima (Tomlinson, 1997). Because of the low precipitation and high evapotranspiration rates, surface drainages are not sustained year-round.

Summers are typically dry and hot, with July being the warmest and driest month. Diurnal temperature fluctuations in June and July average approximately 34°F, with maximum temperatures in the upper 80s and minimum temperatures in the low 50s. On average, July accumulates the least amount of monthly precipitation (0.19 inches).

Winter temperatures are cold and diurnal temperature variations are less extreme (approximately 17°F). Minimum temperatures average 20.9°F in January. December accounts for the highest average monthly precipitation of 1.34 inches. Occasional light snowfall contributes to an average snow depth of 3 inches in January (EA, 2019).

On a yearly basis, evapotranspiration is low because most of the precipitation occurs during the winter months. Yearly evapotranspiration is estimated to be 20 inches. The frequent winter rainfalls combine with the low seasonal evaporation potentials, resulting in increased surface runoff and aquifer recharge. Based on annual average precipitation and, assuming the soil capacity ranges from 2 to 6 inches, it is estimated that between 13 and 17 inches of net annual precipitation infiltrates to groundwater (EA, 2019).

[1] Yakima Air Terminal, Washington - Climate Summary (www.wrcc.dri.edu), accessed on 4/5/2022.

Worksheet #10: Conceptual Site Model *(continued)*

10.3.2 Topography

The YTC Cantonment Area is located just south of Selah Canyon, which cuts through the valley falling between Umtanum Ridge and Yakima Ridge. The Selah Canyon area runs east-west on the northern portion and contains steep slopes. While still quite variable, the land area south of the Selah Canyon is the most level, thus it is the most developable area within the YTC Cantonment Area (USACE, 2017).

10.3.3 Geology

YTC is located within the Yakima Fold Belt, which is characterized by southeast-trending anticlines and synclines. The anticlines are expressed as ridges and intervening synclines form valleys. Most of the YTC Cantonment Area is located within the synclinal valley between the anticlinal Yakima Ridge and Umtanum Ridge. In general, YTC is underlain by a thick sequence of basalt flows known as the Columbia River Basalt Group. From youngest to oldest, the four formations that comprise the Columbia River Basalt Group are the Saddle Mountain Basalt, Wanapum Basalt, Grande Ronde Basalt, and Imnaha Basalt (Schuster et. al., 1997).

The Columbia River Basalt Group lava flows have a total thickness greater than 10,000 feet in parts of eastern Washington. Individual flows range from a few feet to more than 100 feet thick. Each flow typically consists of a vesicular or rubbly flow top, a relatively thick internal zone that has a hackly texture of random cooling joints, and lower zone that is characterized by columnar jointing perpendicular to the base of the flow (USACE, 2017).

Portions of the YTC Cantonment Area have sedimentary rocks/deposits of the Ellensburg Formation and/or quaternary deposits on top of the basalt flows. The Ellensburg Formation is composed of partially consolidated sand and gravel, and sediments ranging from unconsolidated sand, silt, and clay to weakly indurated sandstone, siltstone, and claystone. The sediments range from a few feet to several hundred feet thick and are generally thickest in underlying lowland areas. Younger quaternary deposits that locally overlie the Ellensburg Formation and the Columbia River Basalt in the YTC area include unconsolidated alluvial sand and gravel along the stream channels and floodplains, alluvial fan deposits of silty sand and gravel along the flanks of the ridges, and windblown silt deposits (loess) (USACE, 2017).

10.3.3.1 Former Fire Training Pit

The uppermost materials underlying the Former FTP consist of localized fill material and up to 12 feet of alluvium composed primarily of unconsolidated silty sand (Shannon & Wilson, Inc., 2001). The uppermost bedrock geologic unit at the Former FTP is the Pomona Flow of the Saddle Mountain Basalt Formation (E&E, 1993; Schuster et al., 1997; Shannon & Wilson, Inc., 2001). In general, this unit is present at a depth of approximately 5 to 10 feet below ground surface (bgs) at the Former FTP (E&E, 1993; Shannon & Wilson, Inc., 2001). Basalt apparently extends to an approximate depth of 150 feet bgs without significant interbeds at the site.

Worksheet #10: Conceptual Site Model *(continued)*

10.3.3.2 Tracked Vehicle Repair/Old Mobilization and Training Equipment Site

The uppermost bedrock unit underneath the overburden in the TVR/Old MATES is the Pomona Flow of the Saddle Mountain Basalt Formation (E&E, 1993; Shannon & Wilson, Inc., 2001). In general, the unit was encountered at depths between 10 and 45 feet bgs in the six monitoring wells at TVR, MATES, and Main Motor Pool (MMP) (E&E, 1993). Saddle Mountain Basalt extends beneath the site without significant interbeds to a depth of greater than 100 feet bgs.

10.3.4 Hydrogeology

Groundwater in the region occurs principally within (1) the alluvial sand and gravel, (2) the sand and gravel deposits within the Ellensburg Formation, and (3) the basalt flows and interbedded sediments of the Columbia River Basalt sequence (USACE, 2017).

The alluvial deposits are typically moderately to highly permeable, and groundwater within them generally is unconfined. The water table in these deposits is typically at or near the elevation of the nearby streams. Groundwater within the Ellensburg Formation occurs within the sand and gravel units and can be either confined or unconfined, depending on the local thickness and composition of the formation. The basalt flows and associated sedimentary interbeds form the most productive aquifer system in the region. Groundwater within this system occurs principally within fracture and rubble zones of the basalt flows and in the sand and gravel layers that occur between some of the flows. The water-yielding zones within the sequence range from a few feet to over 50 feet thick. Their lateral extent ranges from short distances to several miles, depending on the stratigraphic continuity of the water-bearing unit (USACE, 2017).

The uppermost groundwater in the YTC Cantonment Area occurs in the basaltic bedrock and interbedded sediments at depths ranging from 70 to 105 feet bgs, based on the geologic profile from the 1993 monitoring wells installed during the site investigation (SI) in the central and western portions of the Cantonment Area. The aquifer is confined, has a piezometric surface at about 60 to 70 feet bgs, and has a westward flow gradient of about 30 feet per mile. The groundwater flow direction in any given area is strongly influenced by the distribution of the stratigraphic units. Flow in the flanks of the valley has a northerly or southerly component, toward the axis of the valley and away from the flanking anticlinal ridges (USACE, 2017).

Two public water supply wells (Pomona and Pomona Artesian Irrigation Company [PAIC] wells) are located near the Former FTP. The Pomona Well is an artesian well used by YTC as a primary production source for the Cantonment Area Water System. Washington State classifies this well as a Type A Community System. The well was reported to be completed in the Wanapum and/or Grande Ronde Formation (Hong West and Associates, 1996). Well logs generated during pump tests performed in 1940 identified that the well was constructed with a 10-inch-diameter casing to a depth of 60 feet bgs and a 6 and 5/8-inch-diameter casing from 60 to 430 feet bgs. However, a down-hole video survey performed by YTC in 1995 identified open borehole construction completed to between approximately 353 and 407 feet bgs (Fain, 2000; Cory, 2004). The video survey also identified that water was entering the Pomona Well apparently along a sedimentary interbedded or fracture zone at approximately 401 feet bgs (Fain, 2000). Except for the 1995

Worksheet #10: Conceptual Site Model *(continued)*

down-hole video survey, available sources of information on construction of the Pomona Well have presented incorrect data, including a typographical error in Table 2-1 of the Water System Plan (Cory, 2004). The 1995 video survey of the Pomona Well is therefore considered to be the most accurate source of well construction information available to date.

The Pomona Well reportedly flows at 250 gallons per minute. The high artesian pressure in the well is interpreted to indicate that groundwater flow to the well is due largely to the structural down-warp in which the YTC is located. The groundwater at depth in this area occurs in basalt fractures and interbedded sediments. The flow system is presumably recharged from a considerably higher area farther up slope and is confined under pressure beneath less permeable strata consisting of basalt or fine-grained sediment (USACE, 2017).

The PAIC Well is an artesian well used as the sole production well for the PAIC Water System that serves approximately 60 homes and businesses located west of YTC (Wilson, 2004). Washington State classifies this well as a Type A Community System. Well logs from pump tests performed in 1940 indicate identical (although very generic) well construction details as those presented for the Pomona Well (Fain, 2000). However, because the 1995 video survey of the Pomona Well showed that the 1940 well log and other sources of post-drilling anecdotal information were incorrect, it is reasonable to assume that the 1940 well log for the PAIC Well may also be inaccurate, and that construction of the PAIC Well may match that of the Pomona Well (open borehole). The basis for assuming similar or identical well construction for the Pomona Well and PAIC Well are as follows: both wells are artesian, both wells have similar production capacities, both wells were installed at the same time and location by the same well driller working for the same water system, and both wells have identical 1940 well logs.

10.3.4.1 Former Fire Training Pit

The Former FTP has perched groundwater located in vesiculated, fractured basalt near the top of the Pomona Basalt flow (E&E, 1993; Shannon & Wilson, Inc., 2001). Depth to water at the site is approximately 10 to 25 feet bgs (Shannon & Wilson, Inc., 2001). The direction of perched groundwater flow is southwest and generally mirrors the surface topography. Seasonal fluctuation in groundwater elevation appears to be slight based on limited data. The next deepest groundwater-bearing unit is at approximately 150 feet below the site.

10.3.4.2 Tracked Vehicle Repair/Old Mobilization and Training Equipment Site

The Selah Interbed Aquifer is a fractured basalt-zone-confined aquifer and is the shallowest groundwater underneath the site, at depths of 100 to 150 feet bgs. Monitoring wells TVR-1, TVR-2, MTS-1, MTS-2, MMP-1, and MMP-2 were completed within the Selah Interbed (of the Ellensburg Formation) beneath the Pomona basalt flow (E&E, 1993). The direction of groundwater flow is to the west/southwest. The Selah Interbed Aquifer is underlain by a thick sequence of basalt flows within the Columbia River Basalt Group (JBLM, 2010).

Worksheet #10: Conceptual Site Model *(continued)*

10.3.5 Hydrology

The Yakima and Columbia rivers border YTC to the west and east, respectively, and flow from north to south (Kurtz, 2010). Drainage of natural surface waters, including streams and creeks, on YTC are defined by a series of ridges and valleys; numerous small gullies dissect the valleys. Surface waters flow along the gullies from numerous springs into several streams, which eventually flow into the Yakima or Columbia River. Major streams on YTC predominantly flow to the west and discharge into the Yakima River or to the east and discharge into the Columbia River. Streams on YTC are fed by direct precipitation runoff and in some cases by discharge of groundwater (springs and seeps). Due to the arid and semi-arid climate of the region and occasional high-volume precipitation and snowmelt events, streams at YTC have high variation in flows.

No perennial surface water bodies are located at the Former FTP or TVR/Old MATES (EHS-International, Inc., 2010). The closest perennial surface water is Selah Creek, approximately 1.7 miles north of the TVR/Old MATES and 1.1 miles north of the Former FTP. Selah Creek flows from east to west and drains into the Yakima River.

No naturally occurring streams or other surface water features, such as lakes, ponds, or marshes, exist at the sites or on adjoining properties (EHS-International, Inc., 2010). The sites and adjoining properties are located outside of the Federal Emergency Management Agency 100-year and 500-year flood zones (Environmental Data Resources, Inc., 2010a and 2010b).

10.4 INVESTIGATIVE HISTORY

This section summarizes the investigative history, including facility-wide and site-specific investigations and remedial actions, of the Former FTP and TVR/Old MATES.

10.4.1 Facility-Wide Investigations

A facility-wide preliminary assessment of YTC was completed in the early 1990s (Shapiro & Associates, Inc., 1991). The preliminary assessment documented the Former FTP and TVR/Old MATES usage, identified potential receptors, and concluded that sites such as the two sites addressed in this QAPP could potentially be releasing hazardous substances to groundwater as a result of historical activities.

TCE was detected in groundwater from a domestic drinking water well (former Marie Well) located within the YTC Cantonment Area between 0.25 and 0.5 mile west-southwest of the TVR (Building 845) and Old MATES (Building 951) before the well was decommissioned in the 1990s, which prompted subsequent investigations in 1993 (EHS-International, Inc., 2010).

A Site Screening Inspection and Hazard Ranking System Score for YTC was completed in January 1993 (Resource Applications, Inc., 1993) and an SI was completed in September 1993 (E&E, 1993). A Hazard Ranking System score was calculated; however, it was too low for YTC

Worksheet #10: Conceptual Site Model *(continued)*

to be considered for inclusion on the Comprehensive Environmental Response, Compensation, and Liability Act NPL.

Yakima Health District collected groundwater samples from 12 private domestic wells located downgradient of YTC and analyzed those samples for VOCs in 1995 (Yakima Health District, 1995). The PAIC Well, located on YTC across the street from YTC's Pomona Well, was one of the 12 wells sampled. No contaminants were detected in the wells, except for styrene in a single well at a concentration equal to the detection limit (DL) of 0.1 microgram per liter (µg/L).

The Final RFA Report was completed in September 1995 (SAIC, 1995). The RFA for the entire installation was a result of a RCRA Part B Permit Application for the Range 14 open burning/open detonation area. Although the 1995 RFA did not explicitly address TCE in groundwater in the TVR/Old MATES, the RFA recommended a CA to address soil contamination that remained under a building adjacent to waste oil USTs 845-3 (SWMU 43) and 845-4 (SWMU 44). RCRA CAs that were recommended or implied by the RFA needed to satisfy MTCA regulations in accordance with Washington Administrative Code (WAC) 173-303-646(3).

In October 2012, YTC had its first 5-year periodic review regarding six sites currently managed under the JBLM IRP. The review focused on sites where environmental remedies are currently in place; however, the chemicals of concern (COCs) continued to exceed their respective cleanup levels (USACE, 2012). Both the Former FTP and the TVR/Old MATES were part of the first 5-year periodic review. No significant concerns regarding the monitoring network were noted for the Former FTP and no recommendations were made. One concern was noted regarding the TVR/Old MATES monitoring network. TCE concentrations had been increasing over time in samples collected from monitoring well TVR 6, located on the western end of the monitoring network. It was suggested that, if TCE concentrations continued to increase in TVR-6, it may warrant installing additional downgradient monitoring wells.

The second and third 5-year periodic reviews occurred in 2017 and 2021, respectively. Both reviews concluded that remedies at the Former FTP and TVR/Old MATES are protective of human health and the environment through LUCs. The second periodic review repeated the recommendation that additional downgradient wells should be installed at the TVR/Old MATES to better define the downgradient plume extent and confirm that TCE is not migrating off YTC. TCE concentrations at TVR-6 have consistently been less than the MTCA maximum contaminant level (MCL) of 5 µg/L since March 2017, therefore, the addition of wells near TVR-6 may no longer be warranted (EA, 2022).

10.4.2 Former Fire Training Pit

The Former FTP was one of the YTC sites investigated during the September 1993 SI (E&E, 1993). One borehole was advanced approximately 150 feet topographically and hydraulically downgradient (southwest) of the Former FTP. Significant groundwater was not encountered during drilling of the borehole to a depth of approximately 140 feet. However, when it came time to decommission the borehole, several gallons of petroleum product were reportedly discovered on top of the groundwater. As a result, monitoring well FTP-1 was completed to a depth of

Worksheet #10: Conceptual Site Model *(continued)*

approximately 20 feet in the perched groundwater located at the fractured top of the uppermost basalt flow, with a screen interval depth of 8 to 18 feet.

The 1995 RFA indicated a high potential for releases of petroleum product to soil and possibly groundwater at the Former FTP (SAIC, 1995). Remedial action to remediate contaminated soil and the petroleum product in well FTP-1 was recommended.

A RCRA Facility Investigation was performed from 1999 through 2001 to further delineate the nature and extent of contamination at the Former FTP (Shannon & Wilson, Inc., 2001). Nine soil borings were advanced and four monitoring wells (FTP-13 through FTP-16) were installed in 1999 in the perched groundwater located at the fractured top of the uppermost basalt flow. Total petroleum hydrocarbon (TPH) indicators in the gasoline range (TPH-G), diesel range (TPH-D), and heavy oil range (TPH-O) were reported in soil samples collected from 2.5 to 6 feet bgs at concentrations greater than MTCA MCLs for unrestricted land use (100 milligrams per kilogram [mg/kg] for TPH-G and 200 mg/kg for TPH-D and TPH-O at the time of the sampling).

Groundwater monitoring was performed as part of the RCRA Facility Investigation at previously installed well FTP-1 and newly installed wells FTP-13 through FTP-16 in July 1999, November 2000, and May 2001. Analytical results indicated petroleum product constituents (e.g., benzene and 1,3,5-trimethylbenzene), various polycyclic aromatic hydrocarbons (PAHs), and TPH-G, TPH-D, and TPH-O in one onsite monitoring well (FTP-1) at concentrations that exceeded MTCA MCLs. Light nonaqueous-phase liquid (LNAPL) and dense nonaqueous-phase liquid (DNAPL) were reportedly encountered at FTP-1 during each event; however, the thicknesses of LNAPL and DNAPL were not accurately quantified.

10.4.2.1 Soil Removal

An interim remedial action was completed at the Former FTP in 2003 to remove soil with chemical concentrations that exceeded MTCA Method A/MTCA Standard Method B cleanup levels. Soil was excavated during three separate mobilizations: July 2003, September 2003, and October 2003. The total excavation area was approximately 5,000 square feet and extended downward until the underlying basalt was encountered. Soil (1,351 tons) was disposed of at an appropriate offsite facility in November 2003. Chemical concentrations in confirmation soil samples were less than MTCA MCLs, except for TPH-G and TPH-D in two samples collected from the soil/basalt interface. The excavation was backfilled with clean soil. The cleanup action was documented in a January 2004 report (Bay West, 2004).

10.4.2.2 Groundwater Monitoring

Groundwater monitoring has been performed semiannually at wells FTP-1, FTP-14, FTP-15, and FTP-16 since 2005. One sampling event, considered the “wet season” (or spring event) is typically performed in February or March of each year. The second sampling event, considered the “dry season” (or fall event) is typically performed in August or September of each year. Groundwater samples are collected for analysis of hydrocarbons and depths to water are measured during each event (EA, 2022). Between March 2005 and March 2007, Fort Lewis ERP installed 4-inch-

Worksheet #10: Conceptual Site Model *(continued)*

diameter "socks" containing oxygen release compound (ORC) in monitoring well FTP-1 between 11 to 18 feet bgs.

TPH concentrations in samples from wells FTP-14, FTP-15, and FTP-16 have consistently been less than the MTCA MCLs since monitoring began at the Former FTP (EA, 2020). The sampling frequency for TPH-G, TPH-D, and TPH-O was reduced from semiannual to annual in 2018 with Ecology concurrence. Sampling was then discontinued at FTP-14, FTP-15, and FTP-16 in 2019 with Ecology concurrence (EA, 2022). Samples are still collected semi-annually at one well (FTP-1) because of TPH and benzene concentrations in groundwater as described below:

- TPH-G, TPH-D, and TPH-O have been consistently reported at concentrations exceeding their MTCA MCLs (800, 500, and 500 µg/L, respectively) (Tetra Tech EC, Inc. [TtEC], 2018).
- Benzene has historically been reported at concentrations both greater and less than the MTCA MCL of 5 µg/L; however, benzene concentrations in FTP-1 have been less than the MCL since March 2017.
- Toluene, ethylbenzene, and total xylenes have been consistently reported in groundwater at FTP-1 at concentrations less than their MTCA MCL (1,000, 700, and 1,000 µg/L, respectively) (EA, 2022).

10.4.3 Tracked Vehicle Repair/Old Mobilization and Training Equipment Site

This section describes the site-specific investigations and removals that have been completed at TVR/Old MATES.

10.4.3.1 UST Removal

In October 1991, five waste oil USTs at the TVR (Building 845) were emptied, excavated, removed, cleaned, and disposed of at an appropriate offsite facility (Pegasus, 1993). The contractor (Pegasus) performing the work noted visible surface contamination associated with three of the UST excavations. Soil samples were collected from each excavation and analyzed for TPH; benzene, ethylbenzene, toluene, and total xylenes (BTEX); Toxicity Characteristic Leaching Procedure (TCLP) VOCs, and TCLP metals. TPH concentrations exceeding 10,000 mg/kg were detected in samples collected from the five UST excavations. TCLP TCE was detected at concentrations of 20 milligrams per liter (mg/L) in samples collected from the UST 845-5 excavation, and TCLP tetrachloroethene was detected at a concentration of 17 mg/L in samples collected from the UST 845-6 excavation. No TCLP VOCs were detected in samples collected from the UST 845-3 (SWMU 43) and UST 845-4 (SWMU 44) excavations. No additional CA was taken at that time due to contract limitations.

10.4.3.2 Soil Removal

CEcon Corporation was contracted to excavate and remove contaminated soil left in place following the tank removal activities by Pegasus (CEcon, 1994). In October 1993, CEcon

Worksheet #10: Conceptual Site Model *(continued)*

Corporation removed approximately 1,000 cubic yards of soil during excavation activities at the five waste oil tank sites at Building 845. Analytical results for confirmation soil samples verified that no further action was required for USTs 845-2 (SWMU 42), 845-5 (SWMU 45), and 845-6 (SWMU 46). However, some TPH-contaminated soil was left in place on the north and east sidewalls of the UST 845-3/UST 845-4 (SWMUs 43 and 44) excavation because existing structures (Building 845 lube rack and oil-water separator) were present. The structures prevented further excavation in the north and east directions.

10.4.3.3 Additional Investigation

TVR, Old MATES, and the MMP were among the facilities/sites investigated during the September 1993 SI (E&E, 1993). Monitoring wells TVR-1 and TVR-2 were installed near the TVR facility (Building 845), wells MTS-1 and MTS-2 were installed near the Old MATES (Building 951), and wells MMP-1 and MMP-2 were installed near the former Marie Well southwest of both Buildings 845 and 951. Soil samples were collected from each monitoring well borehole during drilling and were analyzed for VOCs, SVOCs, pesticides/polychlorinated biphenyls, metals, and TPH. Groundwater samples were collected from newly installed monitoring wells, the decommissioned Marie Well, two MMP monitoring wells located adjacent to the Marie Well, and two drinking water wells (Pomona Well and PAIC Well) located approximately 250 feet southwest of monitoring well TVR-1. TCE was reported in groundwater at concentrations greater than the MTCA MCL of 5.0 µg/L at TVR-1 (35 µg/L), TVR-2 (14 µg/L), MTS-1 (7.90 µg/L), and MTS-2 (7.4 µg/L). TCE at the Marie Well was reported below the MTCA MCL at a concentration of 1.2 µg/L. Based on the presence of TCE in groundwater at the TVR and Old MATES wells and the absence of contamination in corresponding soil samples, the SI Report concluded that TCE contamination in groundwater may indicate migration from an unidentified source (E&E, 1993).

A subsequent groundwater sampling event was performed at the TVR wells (TVR-1 and TVR-2) and Old MATES wells (MTS-1 and MTS-2) in 2004. TCE was reported at concentrations ranging from 3.6 µg/L (TVR-2) to 12 µg/L (MTS-2 and TVR-1) in samples collected during this event. Monitoring wells TVR-3, TVR-4, MTS-3, and MTS-4, were installed in October and November 2004, and subsequent groundwater monitoring events were performed in March 2005 and August 2006. Samples could not be collected from TVR-4, which was dry. TCE concentrations were reported in samples from wells TVR-1, TVR-2, MTS-1, MTS-2, TVR-3, and MTS-4. Concentrations in March 2005 ranged from 4.4 µg/L (TVR-2) to 25 µg/L (MTS-2), and concentrations in August 2005 ranged from 3.4 µg/L (TVR-2) to 38 µg/L (MTS-2) (TtEC, 2018).

The extent of TCE in groundwater had not been determined as of August 2005; therefore, monitoring wells TVR-5, TVR-6, TVR-7, and 815-2 were installed and sampled in October 2005 to further delineate the contamination. TCE concentrations were reported at wells TVR-1, TVR-2, TVR-3, MTS-1, MTS-2, MTS-4, TVR-5, TVR-6, TVR-7, and 815-2. Concentrations ranged from 1.6 µg/L (TVR-5) to 38 µg/L (TVR-7) (TtEC, 2018).

Groundwater monitoring was performed semiannually from 2005 until 2019 at wells MTS-1, MTS-2, MTS-4, TVR-1, TVR-2, TVR-3, TVR-5, TVR-6, TVR-7, 815-2, and MMP-1, as well as

Worksheet #10: Conceptual Site Model *(continued)*

the two currently active water supply wells (Pomona Well and PAIC Well). TVR-4 has been consistently dry. Chemical concentrations in samples from wells TVR-2, TVR-5, 815-2, and MMP-1, were less than the MTCA MCL, and all wells exhibited statistically significant downward trends in TCE concentrations (EA, 2020). Wells TVR-2, TVR-5, 815-2, and MMP-1 were removed from the monitoring program in 2019 with Ecology concurrence (EA, 2022).

10.5 CURRENT AND POTENTIAL FUTURE LAND AND RESOURCE USE

The mission of YTC is to provide military training facilities, maneuver areas, and ranges for the United States and allied nations. The Former FTP and TVR/Old MATES are located within the Cantonment Area, which is within the general use zone of YTC (JBLM, 2010). Land use within the Cantonment Area includes transient residential, administrative, commercial, and light industrial facilities and open space. The YTC population is predominantly transient soldiers and a few permanent adult residents and onsite workers and no children. (JBLM, 2017). The principal users of YTC are active-duty U.S. Army units and units of the WAARNG. YTC is also used by units of the U.S. Army Reserve, U.S. National Guard, U.S. Marine Corps, U.S. Air Force, U.S. Navy, U.S. Coast Guard, and U.S. Special Operations Command; local and federal law enforcement; and forces from Canada, Japan, and other allied nations. The only significant adjacent population center is Selah (census[2] population 8,153) approximately three miles west of the site (JBLM, 2017).

The Former FTP is currently vacant and not being used by YTC. The TCE plume at TVR/Old MATES extends to the Old MATES Building 951 and Old MATES facility, with its gravel parking lot for wheeled and tracked vehicles to the northeast; the former TVR/Building 845 with gravel parking/staging areas and tracked vehicle gravel road to the north; the U.S. Army Garrison YTC Supply and Maintenance Facility to the northwest; 7th Avenue/Firing Center Road, vegetated and undeveloped land, gravel parking/staging areas, and tracked vehicle gravel road to the south; and a paved parking area to the southwest.

The Pomona and PAIC Wells are public water supply wells located on either side of Fire Training Center Road near D Street, approximately 1 mile southwest of the Former FTP and approximately 250 feet southwest of monitoring well TVR-1 (Figure 10-3). Public Water Supply Wells require wellhead protection from any potential source of contamination for a 100-foot radius around the wells, per WAC 246-290-135, "Source Water Protection." There are no plans nor need for an additional water supply well to serve the YTC Cantonment Area Water System (Fort Lewis ERP, 2007b). Over the past decade, residential drinking water wells have been installed west of the YTC boundary, approximately 1,500 to 3,000 feet northwest of the TCE plume at TVR/Old MATES.

Current and future land use are restricted by institutional controls. Institutional controls at both the former YTC site and TVR/Old MATES include dig permits and restrictions on land use (JBLM, 2017). LUCs were implemented in March 2007 Decision Documents for the Former FTP (Fort Lewis ERP, 2007a) and TVR/Old MATES (Fort Lewis ERP, 2007b) to ensure that a new

2 Census.gov; website accessed on March 21, 2022.

Worksheet #10: Conceptual Site Model *(continued)*

drinking water well is not installed within the Former FTP boundary or 1,000 feet of the TVR/Old MATES boundary without an approved monitoring plan (Bussey, 2007). In addition, a LUC for Building 845 at the TVR/Old MATES was implemented to address, as necessary, potential contamination under the building if the building is deconstructed.

10.6 SOURCES OF KNOWN OR SUSPECTED CONTAMINATION

The source of contamination at the Former FTP was fire training practices involving the use and burning of petroleum fuel (e.g., aviation fuel, diesel fuel, gasoline) in an open, unlined earthen pit at the site. Leaking and leaching of petroleum products led to the contamination of subsurface soil and groundwater. Source control included the removal of petroleum-contaminated soil, which was completed in 2003 (EHS-International, Inc., 2010).

The source of TCE in groundwater under TVR/Old MATES appears to be historical discharges of TCE at both the TVR facility (Building 845) and Old MATES (Building 951) due to past use and handling of solvents at both facilities. A former floor drain at the TVR facility discharged immediately adjacent to monitoring well TVR-1. No similar locations of historical discharges at Old MATES have been identified. Leaching and infiltration of TCE led to contamination of groundwater.

10.7 KNOWN OR SUSPECTED CONTAMINANTS OR CLASSES OF CONTAMINANTS

COCs at the Former FTP are TPH-G, TPH-D, and TPH-O, which have continuously been reported at concentrations exceeding their MTCA MCLs (800, 500, and 500 μg/L, respectively) at FTP-1. BTEX also have been reported in groundwater, with benzene exceeding the MTCA MCL of 5 μg/L.

The COC at TVR/Old MATES is TCE, which has been reported in monitoring wells at concentrations exceeding the MTCA MCL of 5 μg/L. No other VOCs have been detected at the site, except for cis-l,2-dichloroethene, a degradation product of TCE, in three monitoring wells at concentrations less than its MTCA MCL of 16 μg/L.

10.8 NATURE AND EXTENT OF CONTAMINATION

Contamination at the Former FTP is confined to shallow perched groundwater encountered at depths of 10 to 25 feet bgs in vesiculated fractured basalt near the top of the Pomona Basalt flow. TPH concentrations exceeding the MTCA MCLs are localized near FTP-1.

The TCE plume at the TVR/Old MATES is present within the Selah Interbed Aquifer, a fractured basalt-zone-confined aquifer. It is the shallowest groundwater underneath the site at depths of 100 to 150 feet bgs. The TCE plume extends southwest from the Old MATES facility to beyond Firing Center Road. VOCs have not been detected in either of the currently active water supply wells (the YTC Pomona and the PAIC Wells) located in the vicinity of the TVR facility.

Worksheet #10: Conceptual Site Model *(continued)*

10.9 FATE AND TRANSPORT CONSIDERATIONS

This section summarizes the possible fate and transport mechanisms affecting chemicals in groundwater at the site.

Leaching of Chemicals from Soil to Groundwater: Contaminants found in surface and subsurface soil at FTP may become mobilized and migrate downward to groundwater. Contaminants may leach to groundwater as either free-phase or dissolved contamination. Project site characteristics that affect leaching include surface topography; soil type, structure, and pH; depth to groundwater; and water table fluctuations caused by precipitation, pumping, or tidal influence.

Migration of Chemicals from Groundwater Off Site: The migration of contaminated groundwater at the Former FTP, as based on previous groundwater elevation data, is southwest toward the New MATES facility (TtEC, 2018; EA, 2022). TPH-G, TPH-D, and TPH-O continue to be detected at concentrations exceeding their MTCA MCLs of 800, 500, and 500 µg/L, respectively, in samples from well FTP-1. TPH-G, TPH-D, and TPH-O continue to either not be detected or be detected at concentrations less than the MTCA MCLs in downgradient wells. Those results suggest that petroleum hydrocarbons in groundwater are localized near well FTP-1 and are not migrating in a significant manner.

The groundwater flow direction beneath the Old MATES and TVR facilities is to the west-southwest as based on previous groundwater elevation data (TtEC, 2018; EA, 2022). Groundwater samples from three monitoring wells (MTS-2, MTS-4, and TVR-1) continue to exhibit TCE concentrations exceeding the MTCA MCL of 5 µg/L.

Based on annual groundwater monitoring reports, the TCE plume at TVR/Old MATES does not appear to be migrating off YTC. However, because the groundwater flow frequently shifts from west to south downgradient near TVR-6 and TVR-7, the 2017 Periodic Five-Year Review recommended one or two downgradient wells should be installed to better define the downgradient plume extent and confirm that TCE is not migrating off site (USACE, 2017). The 2021 review concluded that the remedies at the Former FTP and TVR/Old MATES currently protect human health and the environment. (JBLM Public Works, 2021).

10.10 POTENTIAL RECEPTORS AND EXPOSURE PATHWAYS

The following potential receptors were considered for the IRP sites at YTC:

- Residents
- Commercial/Industrial Workers
- Construction Workers
- Visitors
- Terrestrial Wildlife
- Aquatic Wildlife

Worksheet #10: Conceptual Site Model *(continued)*

- Plants (terrestrial and aquatic)

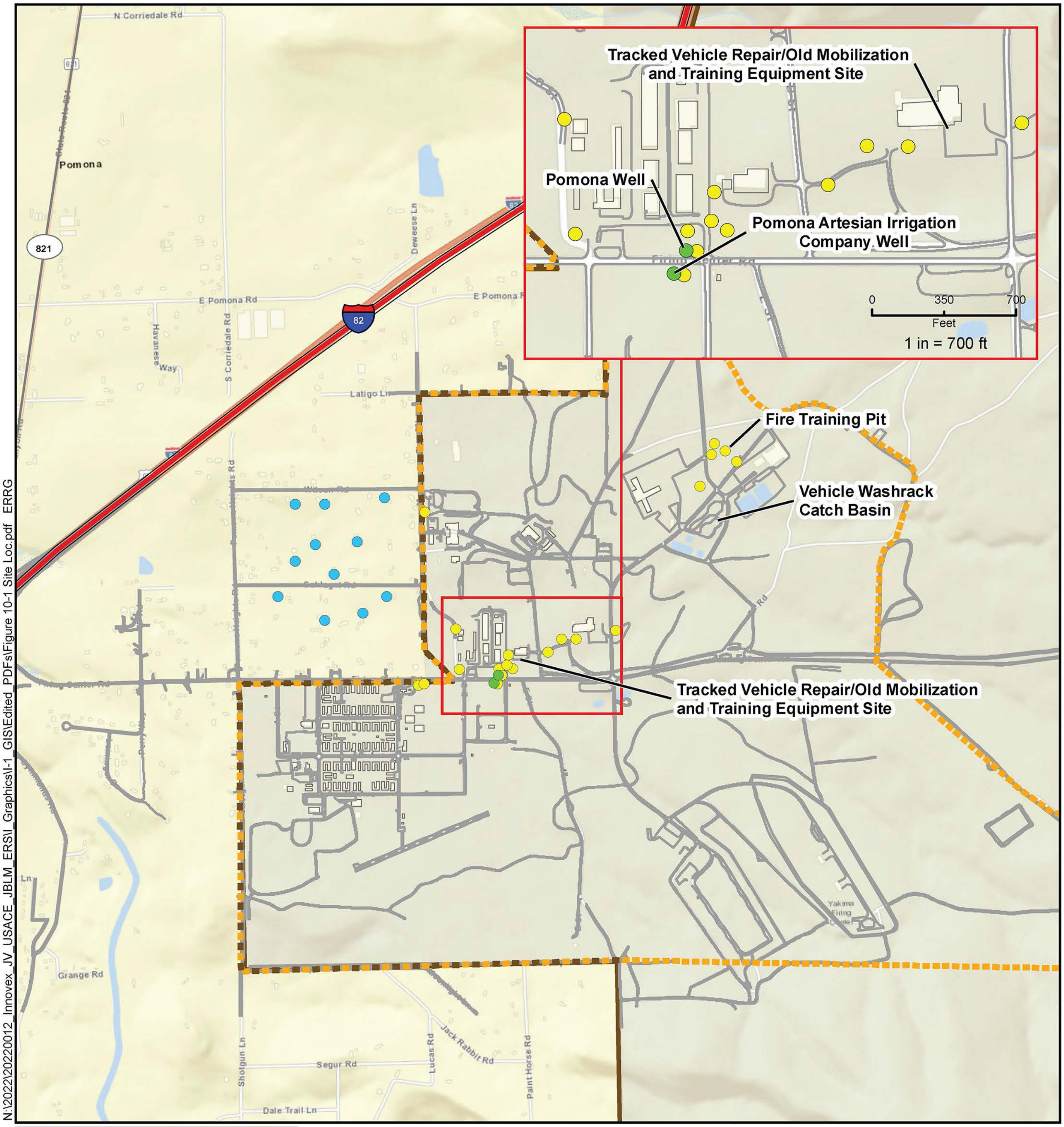
A risk-based screening evaluation for human and ecological receptors was performed for the Former FTP (Fort Lewis ERP, 2002). Based on the evaluation, potential receptors that could be exposed to TPH-contaminated soil included current and future onsite workers, as well as residents under an assumed future residential land use scenario. Soil was subsequently excavated in 2003. The site is currently undeveloped and is not actively being used or expected to be used in the future. LUCs have been implemented for this site and include media-specific restrictions (restrict drinking water well installation and land use), and ICs (dig permits and restrictions on land use) (USACE, 2017). The terrestrial ecological pathway for the Former FTP was considered incomplete during the April 2006 terrestrial ecological evaluation (PNNL, 2006).

The potential groundwater ingestion/inhalation pathway at the Former FTP is incomplete because groundwater impacts in shallow perched groundwater immediately downgradient of the former FTP do not pose a potential risk or hazard to current or future potential receptors (USACE, 2017). Monitoring well FTP-1 is located 100 feet southwest (the assumed direction of groundwater flow) of the Former FTP. All existing water supply wells are located a considerable distance from the site. In addition, contamination is within a shallow perched groundwater-bearing zone and not within a regionally important aquifer. Given the distance of both the Pomona Well and PAIC Well from the Former FTP and the hydraulic separation between the perched groundwater and the aquifer(s) the water supply wells are completed in, it is considered unlikely that these wells will be impacted by the Former FTP.

The only potentially complete exposure pathways at the TVR/Old MATES are the potential direct contact and groundwater ingestion/inhalation pathways due to the presence of TCE in the Selah Interbed Aquifer. LUCs have been implemented 1,000 feet around the TVR/Old MATES boundary (drinking water control) and at Building 843 (excavation control). In addition, media-specific restrictions (prohibit, or otherwise manage excavation, and restrict drinking water well installation) and ICs (permits and restrictions on land use) have been implemented for the site (USACE, 2017).

The potential direct contact and groundwater ingestion/inhalation pathways at TVR/Old MATES do not pose an unacceptable risk or hazard given the current and anticipated future land use. While the Pomona and PAIC Wells are located within the plume boundary at TVR/Old MATES, it is unlikely the water supply wells would be impacted by TCE contamination in the TVR/Old MATES area given the relatively low TCE concentrations in monitoring wells and the hydraulic separation between the Selah Interbed Aquifer and the deeper aquifer(s) in which the water supply wells are completed. VOCs have not been detected in either of the currently active water supply wells (the YTC Pomona and the PAIC Wells) located in the vicinity of the TVR facility.

The nearest off-post residential well is located approximately 0.25 mile northwest/cross-gradient of the most downgradient monitoring well and is likely completed within the Selah Interbed Aquifer. It is unlikely that off-post wells would be impacted with TCE because the plume has not expanded beyond the YTC boundary.



0 1,000 2,000 4,000
Feet
1 in = 2,000 ft

N

Legend

- Yakima Training Center
- Cantonment Area Boundary
- Building
- Monitoring Wells
- Residential Drinking Water Well
- Water Supply Well
- Interstate
- State Route
- Road

FIGURE 10-1
SITE LOCATIONS MAP

Map Date: 8/15/2018
Coordinate System: UTM Zone 10
Horizontal Datus: WGS 84

N:\2022\20220012_Innovex_JV_USACE_JBLM_ERS\I_GIS\Edited_PDFs\Figure 10-1 Site Loc.pdf ERRG

\\Eafp\Departments\Federal\Kansas City PRAC 2016\Projects\JBLM\GIS\GWM Reports\YTC IRP GWM Report\2021\Figure3_FTPGroundwaterContours.mxd

Legend

● Monitoring Well

Spring 2021 Groundwater Elevation Contours (ft AMSL)

Fall 2021 Groundwater Elevation Contours (ft AMSL)

1,452.64 Spring 2021 Water Level (ft AMSL)

1,453.38 Fall 2021 Water Level (ft AMSL)

N

0 75 150
Feet

FIGURE 10-2
FORMER FIRE TRAINING PIT SITE LAYOUT

Source: 2021 ANNUAL GROUNDWATER MONITORING AND REPORTING

Map Date: 12/1/2021
Coordinate System: UTM Zone 10
Horizontal Datus: WGS 84

Legend

- ● Monitoring Well
- ● Production Well
- Spring 2021 Groundwater Elevation Contours (ft AMSL) (blue line)
- Fall 2021 Groundwater Elevation Contours (ft AMSL) (red line)
- 1234.24 — Spring 2021 Water Level (ft AMSL)
- 1335.40 — Fall 2021 Water Level (ft AMSL)

Note:
TVR — Tracked Vehicle Repair

N

0 — 225 — 450
Feet

Map Date: 12/2/2021
Coordinate System: UTM Zone 10
Horizontal Datum: WGS 84

FIGURE 10-3
TVR/OLD MATES AREA
SITE LAYOUT

Source: 2021 ANNUAL GROUNDWATER MONITORING AND REPORTING

N:\2022\20220012_Innovex_JV_USACE_JBLM_ERS\I_Graphics\I-1_GIS\Edited_PDFs\Figure 10-3 TVR-Old MATES.pdf ERRG

Worksheet #11: Project/Data Quality Objectives

This worksheet includes information to fulfill Steps 1 through 7 of the USEPA seven-step DQO process as defined in "Guidance on Systematic Planning Using the Data Quality Objective Process, EPA QA/G-4" (USEPA, 2006). Worksheet #10 includes more detailed information to fulfill Step 1 of the DQO process.

Table 11-1 Project/Data Quality Objectives

DQO Step	Description
Step 1: State the Problem	Groundwater contaminants are present at the Former FTP and TVR/Old MATES at concentrations exceeding the MTCA Method A or MTCA Standard Method B cleanup levels, as applicable. Groundwater contamination has the potential to impact downgradient drinking water wells. Continued LTM, including groundwater monitoring, is required in accordance with the final Decision Documents to evaluate groundwater conditions and assess concentration trends at designated monitoring wells.
Step 2: Identify the Goals of the Study	The goal of the study is to: ▪ Obtain data through groundwater sampling and laboratory analysis to characterize the presence and concentration of COCs ▪ Identify whether COCs in groundwater are migrating off the site toward drinking water wells or surface water ▪ Determine when groundwater cleanup levels have been met The principal study questions to be answered include: ▪ Are COCs present in groundwater at concentrations exceeding the project action limits (PALs)? ▪ Are COC concentration trends increasing, decreasing, or stable? ▪ Is there evidence of offsite migration?
Step 3: Identify the Information Inputs	The information inputs to the project decision include: ▪ Historical information, investigation results, and analytical data from previous reports (see Worksheet #10). ▪ Water-level and groundwater data collected during this project (see Worksheets #17 and #18). ▪ PALs for COCs in groundwater (see Worksheet #15). ▪ The data users include JBLM, USACE, the regulatory agency (Ecology), and the contractor.
Step 4: Define the Boundaries of the Study	The temporal, geographical, and chemical boundaries for the study are as follows: ▪ Temporal: Groundwater monitoring events are scheduled to occur on a semiannual basis (i.e., first and third quarters). ▪ Geographical: The lateral boundary for groundwater gauging and sampling activities includes the existing monitoring wells and supply wells at the Former FTP and TVR/Old MATES. The vertical boundary for groundwater sampling is the maximum depth of the existing monitoring well network.

Worksheet #11: Project/Data Quality Objectives *(continued)*

DQO Step	Description
	▪ Chemical: The chemical boundary for groundwater includes established COCs (i.e., TPH-G, TPH-D, TPH-O, VOCs, and SVOCs).
Step 5: Develop the Analytic Approach	The data generated by the monitoring program will be evaluated in accordance with the following "if/then" statements to support decision-making at each site: ▪ **IF** groundwater monitoring data indicate that COC concentrations in one or more groundwater wells continue to exceed the cleanup levels, **THEN** semiannual monitoring will be continued. ▪ **IF** COC concentrations demonstrate decreasing trends or are less than cleanup levels in a specific monitoring well or series of wells at a given site, **THEN** the monitoring program will be evaluated to determine if the sampling frequency at certain wells may be reduced or eliminated or if changes to the target analyte list are appropriate. ▪ **IF** groundwater monitoring data indicate that the current monitoring program is inadequate to evaluate the extent of contamination, **THEN** the monitoring network and/or monitoring frequency will be modified to ensure accurate tracking of contaminant concentrations. ▪ **IF** the TCE plume at TVR/Old MATES expands in the future such that TCE concentrations in monitoring wells installed adjacent to the YTC boundary (i.e., MMP-1, TVR-5, and 815-2) exceed the PALs for two consecutive monitoring events, **THEN** the selected remedy (LUCs and groundwater monitoring) will be reevaluated in consultation with JBLM, USACE, and Ecology. Unusually high or low concentrations will be evaluated by professional judgment and may include graphing the data, statistical analysis, and/or visual comparison. When concentrations are determined to be unusual, confirmation samples may be collected as soon as possible to confirm the measurement. If the check sample agrees with the original sample, then the original and check sample values will stay within the data set. If the check sample's value is more realistic than the original sample's value, then the check sample will be used during data analysis. The original sample's data values will be recommended for rejection for use in data analysis and will be identified with an "X" qualifier in the data table. Worksheets #14 and 16 provide additional detail on the statistical analysis to support trend analysis and evaluation of monitoring data.
Step 6: Specify Performance or Acceptance Criteria	Decision errors include sampling design and measurement errors. Decision errors will be limited by a careful evaluation of the data and by adherence to established data collection procedures. Analytical method requirements and project-specific DQOs were established to limit the decision errors. To ensure the quality of the data, they will be reviewed and verified and will undergo a validation process. Worksheets #12, #15, and #28 specify the sampling and analytical performance or acceptance criteria. The laboratory will be provided the final version of the QAPP to ensure all specified requirements are met. To ensure usability of the laboratory data, appropriate laboratory methods have been selected to provide the necessary laboratory limits of quantitation (LOQs). Validation will be performed as described in Worksheets #34, #35, and #36. No temporal performance or acceptance criteria are currently available for this project. Lastly, data usability will be assessed per the precision, accuracy, representativeness, comparability, completeness, and

Worksheet #11: Project/Data Quality Objectives *(continued)*

DQO Step	Description
	sensitivity requirements, as described in Worksheet #37, and as evaluated by the data evaluation process.
Step 7: Develop the Detailed Plan for Data Collection	Depth-to-water measurements will be collected at both sites, using an electronic water-level indicator, prior to collection of groundwater samples. Groundwater samples at the Former FTP will be collected using low-flow purging and sampling and submitted for offsite laboratory analysis of TPH-G, TPH-D, TPH-O, VOCs, and SVOCs. Groundwater samples at the TVR/Old MATES will be collected using PDBs and submitted for offsite laboratory analysis of VOCs. Worksheets #14 and 16, #17, and #18 provide additional details on the sampling plan.

Worksheet #12: Measurement Performance Criteria for Analytical Testing

This worksheet is presented in the Programmatic QAPP (IEJV, 2022b).

Worksheet #13: Secondary Data Uses and Limitations

Sources of secondary data that may be used for this task order are provided below. Note this is not an exhaustive list because additional documents may be identified later that provide use to the current effort.

Data Type	Data Source (originating organization, report title, and date)	Data Generator(s) (data types, data generation/collection dates)	How data may be used (if deemed usable during data assessment stage)	Factors affecting reliability of data and limitations on data use
Planning Document	EA, Final Site-Specific QAPP for Groundwater Monitoring at the Former FTP and TVR/Old MATES, January 2019	Previous guidance for groundwater monitoring	Guidance for sampling locations, frequencies, and methods used during previous monitoring events and detailed information on site background, site history, and physical profile information	These data are valid and usable for comparison
Report	EA, Draft. 2021 Annual Groundwater Monitoring Report, Former FTP and TVR/Old MATES, January 2022	Previous groundwater monitoring report and analytical data	Detailed information on current site conditions and groundwater concentrations and analytical data and statistical analysis and trends	These data are valid and usable for comparison
Report	EA, Draft Final. 2020 Annual Groundwater Monitoring Report, Former FTP and TVR/Old MATES, February 2021	Previous groundwater monitoring report and analytical data	Detailed information on current site conditions and groundwater concentrations and analytical data and statistical analysis and trends	These data are valid and usable for comparison
Report	EHS-International, Inc., Final Report Environmental Baseline Surveys, WAANG Yakima Sites 1 and 2, YTC, Yakima and Kittitas Counties, Washington, September 2010	Investigation report presenting site background information	Detailed information on site history, geology/hydrogeology, and nature and extent of contamination	These data are valid and usable for comparison
Report	JBLM, YTC Army Defense ERP Installation Action Plan, June 2017	Report presenting site background information	Detailed information on regulatory framework, site history, and COCs	These data are valid and usable for comparison

Worksheet #13: Secondary Data Uses and Limitations *(continued)*

Data Type	Data Source (originating organization, report title, and date)	Data Generator(s) (data types, data generation/collection dates)	How data may be used (if deemed usable during data assessment stage)	Factors affecting reliability of data and limitations on data use
Review Report	JBLM Public Works, Draft Third Periodic Review Report, YTC, Yakima, Washington, December 2021	Review report for remedies at IRP sites performed from 2017–2021 and summary of previous investigative and remedial activities and data	Detailed information on regional and site history, geology/hydrogeology, water supplies, nature and extent of contamination, exposure pathways/receptors, and site remedies and presents recommendations for future monitoring activities	These data are valid and usable for comparison
Review Report	USACE, Draft Periodic Review Report, YTC, Yakima, Washington, March 2017	Review report for remedies at IRP sites conducted prior to 2017. Summary of previous investigative and remedial activities and data.	Detailed information on regional and site history, geology/hydrogeology, water supplies, nature and extent of contamination, exposure pathways/receptors, and site remedies and present recommendations for future monitoring activities	These data are valid and usable for comparison
Decision Document	Fort Lewis ERP, Decision Document for Selected Remedy at Former FTP (SWMU 59), March 2007	Decision Document for former FTP site including selected remedy and remedial levels.	To describe site history and site remedy	These data are valid and usable for comparison
Decision Document	Fort Lewis ERP, Decision Document for Selected Remedy at TVR/Old MATES Area, March 2007	Decision Document for TVR/Old MATES including selected remedy.	To describe site history, site remedy, and potential receptors/risk	These data are valid and usable for comparison
Decision Document	Fort Lewis ERP, Decision Document for a Remedial Action, FTP, YTC, WA, September 2002	Decision Document for soil excavation remedial action at former FTP site.	To describe site history, site remedy, and potential receptors/risk	These data are valid and usable for comparison
Guidance Document	EA, 2021 Comprehensive LUC Plan, JBLM, Pierce County, Washington, October 2021	LUC Plan for YTC	To describe LUCs and ICs	These data are valid and usable for comparison

Worksheets #14 and 16: Project Tasks and Schedule

This worksheet provides an overview of the project tasks, describes the procedures to be followed, and summarizes the project deliverables to be prepared in support of the groundwater monitoring activities at the Former FTP and TVR/Old MATES. Field tasks will be performed in accordance with applicable Ecology regulations (i.e., WAC Chapters 173-340-820 and 173-340-810), and USEPA and Ecology guidance. Field standard operating procedures (SOPs) and forms are provided in Appendices A and B, respectively, of the Programmatic QAPP (IEJV, 2022b). A general project schedule is presented at the end of this worksheet.

14.1 MOBILIZATION/DEMOBILIZATION

Mobilization includes the procurement of field equipment and supplies and mobilization of field staff. The following tasks will be performed prior to mobilization:

- Notify the YTC point-of-contact at least 1 week prior to mobilizing equipment and field personnel to the base
- Obtain the necessary information from field personnel to meet installation access requirements
- Coordinate with field and subcontractors as needed
- Obtain necessary access and escorts
- Determine staging areas for equipment, if necessary
- Order sample bottles and field monitoring equipment.

Worksheet #19 and 30 present the sample container requirements.

Daily safety meetings will be held prior to the start of fieldwork to familiarize team personnel with site health and safety requirements, the objectives and scope of field activities, and chain-of-command. Personnel mobilized to the site will meet the requirements for Occupational Safety and Health Administration hazardous waste operations training and medical surveillance requirements as specified in the Accident Prevention Plan, which has been submitted under separate cover (IEJV, 2022a). Site personnel will also be trained to perform the specific tasks to which they are assigned. At no time will site personnel be tasked with performing an operation or duty for which they do not have appropriate training. The field team will be familiar with sample locations and will identify related field support areas and requirements.

The following subsections and the SOPs in Worksheet #21 detail the equipment necessary to execute fieldwork and complete the project tasks. Demobilization includes removing field equipment and supplies, returning rented equipment, managing investigation-derived waste (IDW) as described in Section 14.5, performing general cleanup, and organizing and finalizing field documentation.

Worksheet #14 and 16: Project Tasks and Schedule *(continued)*

14.2 GROUNDWATER ELEVATIONS

Static water-level and well depth measurements will be measured using an electronic water-level indicator (water-level meter or interface probe) at each well location listed in Worksheet #18 in accordance with SOP FS-020 (Appendix A of the Programmatic QAPP [IEJV, 2022b]). An interface probe will be used to determine the presence and thickness of LNAPL, if any, prior to measuring groundwater levels. Measurements will be recorded to the nearest 0.01 foot from the top of the well casing at each well location. Measurements will be recorded in the field logbook or on a well gauging logsheet. The electronic instrument will be decontaminated before use, between wells, and at the end of the day.

14.3 GROUNDWATER SAMPLING

Worksheet #18 presents the sample collection frequency and distribution. Sample containers will be provided by the analytical laboratory prior to sampling. Worksheet #19 and 30 presents the required sample containers, volumes, preservation requirements, and holding times.

14.3.1 Former Fire Training Pit

Groundwater sampling at the Former FTP will be performed using low-flow purging and sampling methods. Only one well (FTP-1) is scheduled for sampling under the current monitoring program. Monitoring well FTP-1 will be purged and sampled using low-flow procedures in accordance with SOP FS-022 (Appendix A of the Programmatic QAPP [IEJV, 2022b) or until the monitoring well is dry, whichever occurs first. Pertinent sampling information and observations will be recorded on purge forms (Appendix B of the Programmatic QAPP [IEJV 2022b]) and in the field notebook.

If the well is pumped dry during purging, groundwater samples will be collected once the wells have recharged to at least 80 percent of the initial water volume. Sample volumes for the analysis of volatile analytes (VOCs and TPH-G) will be collected before the others.

14.3.2 Tracked Vehicle Repair/Old Mobilization and Training Equipment Site

Monitoring wells at the TVR/Old MATES will be sampled using PDBs in accordance with SOP FS-026 (Appendix A of the Programmatic QAPP [IEJV, 2022b]). PDB samplers in wells sampled semiannually will be installed during the previous semiannual sampling event. A dedicated harness will be used to position the PDB sampler approximately 2 to 5 feet above the bottom of the monitoring well screen. Following the equilibration period, the PDBs will be extracted and samples will be collected for VOC analysis. PDB installation dates and sampling information will be recorded in the field logbook.

An unfiltered sample will be collected from a spigot on the Pomona Well and the PAIC Well during each monitoring event. The spigot will be opened and allowed to run to clear stagnant water from the line. The water volume will then be reduced to a low flow and a sample will be collected for VOC analysis from each well while the pumps are running. Water quality parameters will not be measured while collecting samples from the Pomona and PAIC Wells.

Worksheet #14 and 16: Project Tasks and Schedule *(continued)*

Sampling information, including PDB installation dates (as applicable), will be recorded on sample forms provided in Appendix B of the Programmatic QAPP (IEJV, 2022b) and in the field notebook.

14.4 EQUIPMENT DECONTAMINATION

Non-disposable equipment, including water-level indicators and/or pumps, that may directly or indirectly contact samples will be decontaminated prior to starting work on the first sampling location, between well/sampling locations, and at the end of the day in accordance with SOP FS-010 (Appendix A of the Programmatic QAPP [IEJV, 2022b]). Non-disposable personal protective equipment (PPE) or clothing that becomes contaminated during site work will be appropriately cleaned before reuse or will be disposed of and replaced.

14.5 INVESTIGATION-DERIVED WASTE MANAGEMENT

IDW generated during sampling activities is anticipated to be limited to excess water from PDBs and purging, used PDBs and tubing, and PPE (e.g., nitrile gloves). Purge water and decontamination water will be containerized and discharged to the oil-water separator at the main vehicle washrack catch basin. IDW disposal will be coordinated with the YTC Wastewater Treatment Plant Operator prior to disposal. PPE, used PDBs, and other garbage will be disposed of in a designated collection bin as part of the normal solid waste stream.

14.6 LABORATORY ANALYSIS

Samples will be submitted for analysis to Pace Analytical National Center for Testing & Innovation Laboratory (Pace) in Mount Juliet, Tennessee, and Fremont Analytical, Inc. (Fremont) (SW8260D SIM and SW8270E SIM). Both laboratories are certified under the U.S. Department of Defense Environmental Laboratory Accreditation Program. Samples from each site will be analyzed as follows:

- **Former FTP:** TPH-G by Method NWTPH-Gx, TPH-D and TPH-O by Method NWTPH-Dx, VOCs by USEPA Method SW8260D, vinyl chloride by USEPA Method SW8260D SIM, SVOCs by USEPA Method SW8270E, and PAHs by USEPA Method SW8270E SIM
- **TVR/Old MATES**: VOCs by USEPA Method SW8260D and vinyl chloride by USEPA Method SW8260D SIM

Laboratory analysis will be performed in accordance with the SOPs listed in Worksheet #23, the laboratory procedures described in Worksheets #24 and #25, and the QA/QC procedures described in Worksheet #28. Analytical data will be validated as described in Worksheet #36. Validated analytical results will be compared to the PALs presented in Worksheet #15.

Worksheet #14 and 16: Project Tasks and Schedule *(continued)*

14.7 POST-FIELDWORK REPORTING AND EVALUATION

Following completion of field activities, the analytical laboratory (Pace and Fremont) will generate analytical data packages for the project. The laboratory data package will include a case narrative, chain-of-custody record, QC summary data, sample results, and standards data for each analytical method.

After receipt of data packages from the analytical laboratory, IEJV will perform data validation (as detailed in Worksheet #36) and prepare an annual monitoring report. At a minimum, the report will include the following:

- Brief site chronology
- Brief discussion of sampling methodology, including any deviations from the planning documents
- Site maps for each groundwater sampling event showing relevant surface features, sampling locations, the estimated potentiometric surface contours based on measurements obtained during each sampling event, and COC concentrations obtained during the groundwater monitoring event
- A summary table of historical and recent COC concentrations and comparison with screening criteria presented in Worksheet #15
- Statistical summary of key analytes detected in monitoring well FTP-1 and multiple monitoring wells for TVR/Old MATES
- Plots showing key COC concentrations over time; previous reports have only included plots for FTP-1 because it is the most impacted well at the site and the only well with TPH-G, TPH-D, and TPH-O concentrations exceeding the MTCA MCLs of 800, 500, and 500 µg/L, respectively
- Copies of original field forms
- Laboratory reports of analysis with chain-of-custody records
- A brief discussion of the QA/QC review and verification process, including implications for project data
- A summary of the results and conclusions

Summary statistics will be calculated using Microsoft Excel's Descriptive Statistics tool. The Shapiro-Wilk test for normality and linear regression analysis will be performed on the data using ChemStat, or equivalent. The Mann-Kendall correlation test will be performed on non-parametric data using ChemStat and/or Microsoft Excel.

Concentration measurements not known to be in error are considered valid; suspect "outliers" are not removed from the data set and will be included in the analyses. Non-detect data, which represent concentrations measured less than the LOQ but greater than the method DL for each constituent, will be evaluated at the limit of detection (LOD). Non-detect data will be labeled with

Worksheet #14 and 16: Project Tasks and Schedule *(continued)*

U or UJ qualifiers in the data table. Analysis of data can only be done when most data are not non-detect. When the data set contains mostly non-detect data, the analysis is not valid and therefore not performed. Typically, a data set may contain up to 15 percent non-detect data for the tests that are performed.

14.7.1 Shapiro-Wilk Test for Normality

Prior to analyzing the data for trends, the data will be tested for normal distribution using the Shapiro-Wilk Test for normality. The null and alternate hypotheses are a summary of the objectives of a test, which in this case is to test for the distribution of the data. The null hypothesis, or what is assumed to be true before given evidence that it may be false, for tests for normality is that a data set is normally distributed. The alternate hypothesis is that a data set is not normally distributed (Helsel and Hirsch, 2002). A significance level, or alpha level, of 0.05 will be used when determining whether or not historical data from monitoring wells are normally distributed. P values, generated using the Shapiro-Wilk Test for Normality, will then be compared to the alpha level. The alpha level is the "cutoff" point for the test statistic in deciding whether the data were normally distributed or not. P values show the strength of the test in determining whether the data was normally distributed or not. P values range from 0 to 1; the closer a P value is to 1 the better the data set is normally distributed. P values equal to or below 0.05 (alpha level) are not considered normally distributed.

Data sets that are not considered normally distributed will then be transformed by taking the natural log of the original values. This approach is generally the most common transformation of water resources data. The Shapiro-Wilk Test for normality will be run on the transformed data with the same criteria as the data sets above.

14.7.2 Linear Regression and Mann-Kendall Correlation Analyses

Linear regression trend analyses will be conducted on concentration data that are found to be normally or log normally distributed from the Shapiro-Wilk Test. In this instance the null hypothesis for the test is that there is no trend in the data (Helsel and Hirsch, 2002). The alpha level for the linear regression analysis is set at 0.05. P values generated by the analysis are then compared to the alpha level. P values less than the alpha value suggest a trend in the data.

The Mann-Kendall test for correlation is performed on data that are not normally or log-normally distributed. No assumptions need to be made about the distribution of the data to perform the Mann-Kendall test (Helsel and Hirsch, 2002). The null hypothesis is the same as the linear regression test above in that there is no trend in the data. The alpha level will be kept the same at 0.05, although the Mann-Kendall test computes a P value for a two-tailed prediction interval. As such, the alpha levels are actually 0.025 or 0.975. A P value that is smaller than 0.025 or larger than 0.975 suggests a correlation between the change in constituent concentration and time.

Worksheet #14 and 16: Project Tasks and Schedule *(continued)*

14.7.3 Total Toxic Equivalent Concentrations of cPAHs

During YTC's 5-year review conducted by USACE in 2011, it was noted that the updated 2007 Groundwater Monitoring Plan stated that total carcinogenic PAHs (cPAHs) would be evaluated for the Former FTP using the total toxic equivalent concentrations (TTEC) of benzo(a)pyrene, as outlined in WAC Chapter 173-340-708(8)(e). The analytical laboratory will report concentrations of cPAHs, which include benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3 cd)pyrene. The measured concentration of each cPAH is then multiplied by its corresponding toxicity equivalency factor (TEF), provided in Table 708-2 (WAC Chapter 173-340-900), to obtain the toxic equivalent concentration (TEC) of benzo(a)pyrene for that cPAH. For each sample analyzed, the TECs for each cPAH are then summed to obtain the TTEC of benzo(a)pyrene for that sample. If a cPAH result is not detected, a TEC is not calculated.

The TTEC result is compared to the applicable compliance monitoring requirements in WAC Chapter 173 340 720, "Groundwater Cleanup Standards," to determine if the TTEC of the samples comply with the cleanup level for the mixture. If the TTEC for the six cPAHs listed above is equal to or greater than MTCA MCL of 0.1 µg/L for benzo(a)pyrene, then the results for cPAHs exceed the MTCA MCL of 0.1 µg/L.

14.9 PROJECT SCHEDULE

Table 14-1 presents the general project schedule.

Table 14-1. Project Schedule

Activity	Responsible Party	Frequency	Deliverable(s)	Completion Date
PDB installation (TVR/Old MATES only)	IEJV	Semiannually during the first quarter and third quarter[1]	Not applicable	Not applicable
Groundwater monitoring (Former FTP and TVR/Old MATES)	IEJV	Semiannually first quarter (spring/wet season i.e., March) and third quarter (fall/dry season i.e., September)	Draft Annual Groundwater Monitoring Report	45 days after receipt of analytical data
			Draft Final Annual Groundwater Monitoring Report	14 days after receipt of comments on the Draft Annual Groundwater Monitoring Report
			Final Annual Groundwater Monitoring Report	14 days after receipt of comments on the Draft Final Annual Groundwater Monitoring Report

Notes:

1 = PDB samplers will be installed in wells during each semiannual sampling event to be sampled during the subsequent semiannual sampling event.

Worksheet #15: Project Screening Levels and Laboratory-Specific Detection Limits

This worksheet identifies the PALs and achievable laboratory limits (including the LOQ, LOD, and DL) for each target analyte. Matrix effects or necessary dilutions may affect the actual laboratory limits reported for project samples. Analytical results will be compared to the PALs, which consist of screening levels from WAC Chapter 173-340-900. If a MTCA Method A MCL[3] is not established for an analyte, the MTCA Standard Method B screening levels or TEF (defined by Table 708-2 in WAC Chapter 173-340-900) will be used as the PAL, as identified in the table below.

Table 15-1. Project Screening Levels and Laboratory-Specific Detection Limits

Analyte	Chemical Abstracts Service Registry Number	PAL (µg/L)	PAL Source	PQL Goal[1] (µg/L)	Laboratory Limits (µg/L)		
					LOQ	LOD	DL
TPH by Methods NWTPH-Gx and -Dx							
TPH-G	NE	800	MTCA Method A	400	134	67	31.6
TPH-D	NE	500	MTCA Method A	250	150	75	33.3
TPH-O	NE	500	MTCA Method A	334	334	167	83.3
VOCs by USEPA Method 8260D							
Acetone	67-64-1	NE	NE	50	50	25	11.3
Benzene	71-43-2	5.0	MTCA Method A	2.5	1.0	0.50	0.0941
Bromobenzene	108-86-1	NE	NE	1.0	1.0	0.50	0.118
Bromochloromethane	74-97-5	NE	NE	1.0	1.0	0.50	0.128
Bromodichloromethane	75-27-4	NE	NE	1.0	1.0	0.50	0.136
Bromoform	75-25-2	NE	NE	1.0	1.0	0.50	0.129
Bromomethane (Methyl bromide)	74-83-9	NE	NE	5.0	5.0	2.0	0.605
2-Butanone (Methyl ethyl ketone)	78-93-3	NE	NE	10	10.0	5.0	1.19

[3] MTCA Method A MCL from Washington Administrative Code Chapter 173-340-900, Table 720-1 Method A Cleanup Levels for Groundwater (Washington State Legislature July 2021).

Worksheet #15: Project Action Limits and Laboratory-Specific Detection Limits *(continued)*

Analyte	Chemical Abstracts Service Registry Number	PAL (µg/L)	PAL Source	PQL Goal[1] (µg/L)	Laboratory Limits (µg/L)		
					LOQ	LOD	DL
n-Butylbenzene	104-51-8	NE	NE	1.0	1.0	0.50	0.157
VOCs by USEPA Method 8260D *(continued)*							
sec-Butylbenzene	135-98-8	NE	NE	1.0	1.0	0.50	0.125
tert-Butylbenzene	98-06-6	NE	NE	1.0	1.0	0.50	0.127
Carbon disulfide	75-15-0	NE	NE	1.0	1.0	0.5	0.0962
Carbon tetrachloride	56-23-5	NE	NE	1.0	1.0	0.50	0.128
Chlorobenzene	108-90-7	NE	NE	1.0	1.0	0.50	0.116
Chloroethane (Ethyl chloride)	75-00-3	NE	NE	5.0	5.0	2.0	0.192
Chloroform	67-66-3	NE	NE	5.0	5.0	2.0	0.111
Chloromethane (Methyl chloride)	74-87-3	NE	NE	4.0	4.0	2.0	0.96
2-Chlorotoluene	95-49-8	NE	NE	1.0	1.0	0.50	0.106
4-Chlorotoluene	106-43-4	NE	NE	1.0	1.0	0.50	0.114
1,2-Dibromo-3-chloropropane (DBCP)	96-12-8	NE	NE	5.0	5.0	2.0	0.276
Dibromochloromethane (Chlorodibromomethane)	124-48-1	NE	NE	1.0	1.0	0.50	0.14
1,2-Dibromoethane (Ethylene dibromide [EDB])	106-93-4	0.010	MTCA Method A	1.0	1.0	0.50	0.126
Dibromomethane (Methylene bromide)	74-95-3	NE	NE	1.0	1.0	0.50	0.122
1,2-Dichlorobenzene	95-50-1	NE	NE	1.0	1.0	0.50	0.107
1,3-Dichlorobenzene	541-73-1	NE	NE	1.0	1.0	0.50	0.11
1,4-Dichlorobenzene	106-46-7	NE	NE	1.0	1.0	0.50	0.12
Dichlorodifluoromethane	75-71-8	NE	NE	5.0	5.0	2.0	0.374

Worksheet #15: Project Action Limits and Laboratory-Specific Detection Limits *(continued)*

Analyte	Chemical Abstracts Service Registry Number	PAL (µg/L)	PAL Source	PQL Goal[1] (µg/L)	Laboratory Limits (µg/L)		
					LOQ	LOD	DL
1,1-Dichloroethane	75-34-3	NE	NE	1.0	1.0	0.50	0.10
VOCs by USEPA Method 8260D *(continued)*							
1,2-Dichloroethane	107-06-2	5.0	MTCA Method A	2.5	1.0	0.50	0.0819
1,1-Dichloroethene	75-35-4	NE	NE	1.0	1.0	0.50	0.188
1,2-Dichloroethene (cis)	156-59-2	70	MTCA Standard Method B	35	1.0	0.50	0.126
1,2-Dichloroethene (trans)	156-60-5	NE	NE	1.0	1.0	0.50	0.149
1,2-Dichloropropane	78-87-5	NE	NE	1.0	1.0	0.50	0.149
1,3-Dichloropropane	142-28-9	NE	NE	1.0	1.0	0.50	0.110
2,2-Dichloropropane	594-20-7	NE	NE	1.0	1.0	0.50	0.161
1,1-Dichloropropene	563-58-6	NE	NE	1.0	1.0	0.50	0.142
1,3-Dichloropropene (cis)	10061-01-5	NE	NE	1.0	1.0	0.50	0.111
1,3-Dichloropropene (trans)	10061-02-6	NE	NE	1.0	1.0	0.50	0.118
1,3-Dichloropropene (total)	542-75-6	NE	NE	1.0	1.0	0.5	0.110
Ethylbenzene	100-41-4	700	MTCA Method A	350	1.0	0.50	0.137
Hexachloro-1,3-butadiene	87-68-3	NE	NE	1.5	1.5	0.75	0.337
2-Hexanone	591-78-6	NE	NE	10.0	10.0	5.0	0.787
Isopropylbenzene (Cumene)	98-82-8	NE	NE	1.0	1.0	0.50	0.105
4-Methyl-2-pentanone (Methyl isobutyl ketone)	108-10-1	NE	NE	10.0	10.0	5.0	0.478
Methylene chloride	75-09-2	5.0	MTCA Method A	5.0	5.0	2.0	0.430
n-Propylbenzene	103-65-1	NE	NE	1.0	1.0	0.50	0.0993
Styrene	100-42-5	NE	NE	1.0	1.0	0.50	0.118

Worksheet #15: Project Action Limits and Laboratory-Specific Detection Limits *(continued)*

Analyte	Chemical Abstracts Service Registry Number	PAL (µg/L)	PAL Source	PQL Goal[1] (µg/L)	Laboratory Limits (µg/L)		
					LOQ	LOD	DL
1,1,1,2-Tetrachloroethane	630-20-6	NE	NE	1.0	1.0	0.50	0.147
VOCs by USEPA Method 8260D *(continued)*							
1,1,2,2-Tetrachloroethane	79-34-5	NE	NE	1.0	1.0	0.50	0.133
Tetrachloroethene (PCE)	127-18-4	5.0	MTCA Method A	2.5	1.2	0.6	0.300
Toluene	108-88-3	1,000	MTCA Method A	500	1.2	0.60	0.278
1,2,3-Trichlorobenzene	87-61-6	NE	NE	1.0	1.0	0.50	0.230
1,2,4-Trichlorobenzene	120-82-1	NE	NE	2.0	2.0	1.0	0.481
1,1,1-Trichloroethane	71-55-6	200	MTCA Method A	100	1.0	0.50	0.149
1,1,2-Trichloroethane	79-00-5	NE	NE	1.0	1.0	0.50	0.158
Trichloroethene (TCE)	79-01-6	5.0	MTCA Method A	2.5	1.0	0.5	0.190
Trichlorofluoromethane	75-69-4	NE	NE	5.0	5.0	2.0	0.160
1,2,3-Trichloropropane	96-18-4	NE	NE	2.5	2.5	1.0	0.237
1,2,4-Trimethylbenzene	95-63-6	NE	NE	2.0	2.0	1.0	0.322
1,3,5-Trimethylbenzene	108-67-8	NE	NE	1.0	1.0	0.50	0.104
m- & p-Xylenes	179601-23-1	NE	NE	2.0	2.0	1.0	0.43
o-Xylene	95-47-6	NE	NE	1.0	1.0	0.5	0.43
Xylenes (total)	1330-20-7	1,000	MTCA Method A	500	3.0	1.5	0.174
VOCs by USEPA Method 8260D SIM							
Vinyl chloride	75-01-4	0.20	MTCA Method A	0.1	0.1	0.028	0.0138
PAHs by USEPA Method 8270E SIM							
Acenaphthene	83-32-9	NE	NE	0.1	0.1	0.5	0.019

Worksheet #15: Project Action Limits and Laboratory-Specific Detection Limits *(continued)*

Analyte	Chemical Abstracts Service Registry Number	PAL (µg/L)	PAL Source	PQL Goal[1] (µg/L)	Laboratory Limits (µg/L)		
					LOQ	LOD	DL
Acenaphthylene	208-96-8	NE	NE	0.1	0.1	0.5	0.0171
Anthracene	120-12-7	NE	NE	0.1	0.1	0.5	0.019
Benzo(a)anthracene	56-55-3	0.1	TEF	0.1	0.1	0.5	0.0203
Benzo(b)fluoranthene	205-99-2	0.1	TEF	0.1	0.1	0.5	0.0168
Benzo(k)fluoranthene	207-08-9	0.1	TEF	0.1	0.1	0.5	0.0202
Benzo(g,h,i)perylene	191-24-2	NE	NE	0.1	0.1	0.5	0.0184
Benzo(a)pyrene	50-32-8	0.1	MTCA Method A	0.1	0.1	0.5	0.0184
Chrysene	218-01-9	0.01	TEF	0.1	0.1	0.5	0.0179
Dibenz(a,h)anthracene	53-70-3	0.1	TEF	0.1	0.1	0.5	0.016
Fluoranthene	206-44-0	NE	NE	0.12	0.12	0.6	0.027
Fluorene	86-73-7	320	MTCA Standard Method B	160	0.1	0.05	0.0169
Indeno(1,2,3-cd)pyrene	193-39-5	0.1	TEF	0.08	0.08	0.04	0.0158
1-Methylnaphthalene	90-12-0	1.5	MTCA Standard Method B	0.75	0.4	0.2	0.0687
2-Methylnaphthalene	91-57-6	32	MTCA Standard Method B	16	4	2	0.0674
Naphthalene	91-20-3	160	MTCA Standard Method B	80	0.4	0.2	0.0917
Phenanthrene	85-01-8	NE	NE	0.1	0.1	0.05	0.018
Pyrene	129-00-0	NE	NE	0.1	0.1	0.05	0.0169

Worksheet #15: Project Action Limits and Laboratory-Specific Detection Limits *(continued)*

Analyte	Chemical Abstracts Service Registry Number	PAL (µg/L)	PAL Source	PQL Goal[1] (µg/L)	Laboratory Limits (µg/L)		
					LOQ	LOD	DL
SVOCs by USEPA Method 8270E							
Benzoic acid	65-85-0	NE	NE	50	50	25	1.7
Benzyl alcohol	100-51-6	NE	NE	10	10	5	0.563
Bis(2-chloroethoxy)methane	111-91-1	NE	NE	10.0	10.0	5.0	0.116
Bis(2-chloroethyl)ether	111-44-4	NE	NE	10.0	10.0	5.0	0.137
Bis(2-chloroisopropyl) ether	108-60-1	NE	NE	10	10	5	0.563
Bis(2-ethylhexyl) phthalate	117-81-7	6.3	MTCA Standard Method B	4.0	4.0	2.0	0.895
4-Bromophenyl phenyl ether	101-55-3	NE	NE	10.0	10.0	5.0	0.0877
Butyl benzyl phthalate	85-68-7	NE	NE	4	4	2	0.765
Carbazole	86-74-8	NE	NE	10	10	5	0.111
4-Chloro-3-methylphenol	59-50-7	NE	NE	10.0	10.0	5.0	0.131
4-Chloroaniline	106-47-8	NE	NE	10	10	5	0.234
2-Chloronaphthalene	91-58-7	NE	NE	1.0	1.0	0.5	0.0648
2-Chlorophenol	95-57-8	NE	NE	10.0	10.0	5.0	0.133
4-Chlorophenyl phenyl ether	7005-72-3	NE	NE	10.0	10.0	5.0	0.0926
Dibenzofuran	132-64-9	NE	NE	10.0	10.0	5.0	0.097
3,3'-Dichlorobenzidine	91-94-1	NE	NE	10.0	10.0	5.0	0.212
2,4-Dichlorophenol	120-83-2	NE	NE	10.0	10.0	5.0	0.102
Diethyl phthalate	84-66-2	NE	NE	3.0	3.0	1.5	0.287
2,4-Dimethylphenol	105-67-9	NE	NE	10.0	10.0	5.0	0.0636
4,6-Dinitro-2-methylphenol	534-52-1	NE	NE	10.0	10.0	5.0	1.120

Worksheet #15: Project Action Limits and Laboratory-Specific Detection Limits *(continued)*

Analyte	Chemical Abstracts Service Registry Number	PAL (µg/L)	PAL Source	PQL Goal[1] (µg/L)	Laboratory Limits (µg/L)		
					LOQ	LOD	DL
SVOCs by USEPA Method 8270E							
2,4-Dinitrophenol	51-28-5	NE	NE	30.0	30.0	15.0	5.930
2,4-Dinitrotoluene	121-14-2	NE	NE	10.0	10.0	5.0	0.0983
2,6-Dinitrotoluene	606-20-2	NE	NE	10.0	10.0	5.0	0.250
Dimethyl phthalate	131-11-3	NE	NE	3.0	3.0	1.5	0.260
Di-n-butyl phthalate	84-74-2	NE	NE	3.0	3.0	1.5	0.453
Di-n-octyl phthalate	117-84-0	NE	NE	4.0	4.0	2.0	0.932
Hexachlorobenzene	118-74-1	NE	NE	1.0	1.0	0.5	0.0755
Hexachlorocyclopentadiene	77-47-4	NE	NE	10.0	10.0	5.0	0.0598
Hexachloroethane	67-72-1	NE	NE	10.0	10.0	5.0	0.127
Isophorone	78-59-1	NE	NE	10.0	10.0	5.0	0.143
2-Methylphenol	95-48-7	NE	NE	10.0	10.0	5.0	0.0929
3- & 4-Methylphenols	15831-10-4	NE	NE	10.0	10.0	5.0	0.168
2-Nitroaniline	88-74-4	NE	NE	10.0	10.0	5.0	0.102
4-Nitroaniline	100-01-6	NE	NE	10.0	10.0	5.0	0.091
Nitrobenzene	98-95-3	NE	NE	10.0	10.0	5.0	0.297
2-Nitrophenol	88-75-5	NE	NE	10.0	10.0	5.0	0.117
4-Nitrophenol	100-02-7	NE	NE	10.0	10.0	5.0	0.143
N-Nitrosodimethylamine	62-75-9	NE	NE	10.0	10.0	5.0	0.998
N-Nitrosodi-n-propylamine	621-64-7	NE	NE	10.0	10.0	5.0	0.2610
N-Nitrosodiphenylamine	86-30-6	NE	NE	10.0	10.0	5.0	2.370

Worksheet #15: Project Action Limits and Laboratory-Specific Detection Limits *(continued)*

Analyte	Chemical Abstracts Service Registry Number	PAL (µg/L)	PAL Source	PQL Goal[1] (µg/L)	Laboratory Limits (µg/L)		
					LOQ	LOD	DL
SVOCs by USEPA Method 8270E							
Pentachlorophenol	87-86-5	NE	NE	10.0	10.0	5.0	0.313
Phenol	108-95-2	NE	NE	20.0	20.0	10.0	4.330
1,2,4-Trichlorobenzene	120-82-1	NE	NE	10.0	10.0	5.0	0.0698
2,4,5-Trichlorophenol	95-95-4	NE	NE	10.0	10.0	5.0	0.109
2,4,6-Trichlorophenol	88-06-2	NE	NE	10.0	10.0	5.0	0.10
3-Nitroaniline	99-09-2	NE	NE	10.0	10.0	5.0	0.0869

Notes:

1 = The PQL Goal is set to one-half the PAL, or to the LOQ when the PAL is not established or is less than the LOQ.

NE = not established

PQL = project quantitation limit

Worksheet #17: Sample Design and Rationale

This worksheet documents the overall process for the design and rationale of the field testing, analytical sampling, and field monitoring to be performed to collect and evaluate data collection.

Describe and provide a rationale for choosing the sampling approach:

Groundwater monitoring is performed under the LTM (LUCs and groundwater monitoring) remedies for the Former FTP and TVR/Old MATES. Groundwater monitoring activities include the collection and laboratory analysis of groundwater samples from existing wells.

Describe the sampling design and rationale in terms of what matrices will be sampled, what analytical groups will be analyzed and at what concentration levels, the sampling locations, numbers of samples to be taken, and sampling frequency.

Former FTP

- Groundwater elevations will be measured in the first quarter (spring/wet season; March) and third quarter (fall/dry season; September) at five monitoring wells (FTP-1, FTP-13, FTP-14, FTP-15, and FTP-16).
- Semiannual groundwater sampling will be performed in the first quarter (spring/wet season; March) and third quarter (fall/dry season; September) at one monitoring well (FTP-1).

TVR/Old MATES

- Groundwater elevations will be measured in the first quarter (spring/wet season; March) and third quarter (fall/dry season; September) at 12 monitoring wells (MTS-1, MTS-2, MTS-3, MTS-4, TVR-1, TVR-2, TVR-3, TVR-5, TVR-6, TVR-7, 815-2, and MMP-1).
- Semiannual groundwater sampling will be performed in the first quarter (spring/wet season; March) and third quarter (fall/dry season; September) at seven monitoring wells (MTS-1, MTS-2, MTS-4, TVR-1, TVR-3, TVR-6, TVR-7) and two currently active water supply wells (Pomona Well and PAIC Well).

Sampling data needs are presented in Tables 17-1 and 17-2. Worksheet #18 further discusses the sample locations, analytical methods, and frequency. Worksheets #14 and 16 discuss the field activities that will be performed in accordance with the SOPs listed in Worksheet #21.

Table 17-1 Data Needs for Monitoring: Former Fire Training Pit

Well ID	Location	Parameter	Equipment and/or Method	Rationale for Analysis and Data Use
FTP-1	150 ft topographically and hydraulically downgradient/southwest of the former FTP	Groundwater elevations	Electronic water level indicator	Long-term monitoring in accordance with the 2007 Decision Document (Fort Lewis Environmental Restoration Program 2007a) and subsequent Groundwater Monitoring Reports.
		VOCs, SVOCs, TPH-G, TPH-D, and TPH-O	Grundfos® Redi-Flo2 pump with variable frequency drive controller; USEPA Method 8260D, USEPA Method 8270E, Method NWTPH-Gx, Method NWTPH-Dx	
FTP-13	Approximately 230 ft southeast of the former FTP	Groundwater elevations	Electronic water level indicator	
FTP-14	Approximately 190 ft west-southwest of FTP-1 and 150 ft south-southwest of FTP-15	Groundwater elevations	Electronic water level indicator	
FTP-15	Approximately 220 ft west of the former FTP	Groundwater elevations	Electronic water level indicator	
FTP-16	Downgradient of the former FTP approximately 600 ft southwest of FTP-1. Within the east-southeast corner of the New MATES Facility.	Groundwater elevations	Electronic water level indicator	

Notes:

ft = feet

FTP = fire training pit

MATES = Mobilization and Training Equipment Site

NWTPH-Dx = Northwest total petroleum hydrocarbon for diesel-range organics

NWTPH-Gx = Northwest total petroleum hydrocarbon for gasoline-range organics

SOP = standard operating procedure

SVOC = semivolatile organic compound.

TPH-D = Total petroleum hydrocarbons – diesel range

TPH-G = Total petroleum hydrocarbons – gasoline range

TPH-O = Total petroleum hydrocarbons – heavy oil range

USEPA = U.S. Environmental Protection Agency

VOCs = volatile organic compounds

Table 17-2 Data Needs for Monitoring: Tracked Vehicle Repair/Old Mobilization and Training Equipment Site

Well ID No.	Location	Parameter	Equipment and/or Method	Rationale for Analysis and Data Use
MTS-1	Within the southern portion of the Old MATES Facility	Groundwater elevations	Electronic water level indicator	Long-term monitoring in accordance with the 2007 Decision Document (Fort Lewis Environmental Restoration Program 2007b) and subsequent Groundwater Monitoring Reports.
		VOCs	USEPA Method 8260D	
MTS-2	Within the southern portion of the Old MATES Facility	Groundwater elevations	Electronic water level indicator	
		VOCs	USEPA Method 8260D	
MTS-3	East and topographically upgradient of the Old MATES Facility	Groundwater elevations	Electronic water level indicator	
MTS-4	South-southwest and adjacent to the Old MATES Facility	Groundwater elevations	Electronic water level indicator	
		VOCs	USEPA Method 8260D	
TVR-1	South-southwest and adjacent to the TVR (Building 845); hydraulically downgradient of the Old MATES Facility	Groundwater elevations	Electronic water level indicator	
		VOCs	USEPA Method 8260D	
TVR-2	West and adjacent to the TVR (Building 845); hydraulically downgradient of the Old MATES Facility	Groundwater elevations	Electronic water level indicator	
TVR-3	Approximately 300 ft southwest of the TVR (Building 845); hydraulically downgradient of the Old MATES Facility	Groundwater elevations	Electronic water level indicator	
		VOCs	USEPA Method 8260D	
TVR-5	Approximately 800 ft west-southwest of the TVR (Building 845); hydraulically downgradient of the Old MATES Facility	Groundwater elevations	Electronic water level indicator	
TVR-6	Approximately 500 ft south-southwest of the TVR (Building 845); hydraulically downgradient of the Old MATES Facility	Groundwater elevations	Electronic water level indicator	
		VOCs	USEPA Method 8260D	
TVR-7	Approximately 250 ft southwest of the TVR (Building 845); hydraulically downgradient of the Old MATES Facility	Groundwater elevations	Electronic water level indicator	
		VOCs	USEPA Method 8260D	
815-2	Approximately 900 ft northeast of the TVR (Building 845)	Groundwater elevations	Electronic water level indicator	
MMP-1	Northeast and east of Buildings T271, T204, and T205; topographically downgradient of the Old MATES Facility; near the vicinity of the former Marie Well	Groundwater elevations	Electronic water level indicator	
Pomona Well	Adjacent to Cold Creek Road, southwest of the TVR (Building 845) Facility	VOCs	USEPA Method 8260D	
PAIC Well	Adjacent to Cold Creek Road, southwest of the TVR (Building 845) Facility	VOCs	USEPA Method 8260D	

Notes:
ft = feet
MATES = Mobilization and Training Equipment Site
USEPA = U.S. Environmental Protection Agency
TVR = Tracked vehicle repair
VOCs = volatile organic compounds

Worksheet #18: Sample Locations and Methods

This worksheet identifies the sample locations and methods for the Former FTP Site and the TVR/Old MATES Site.

Table 18-1 Sample Locations and Methods

Well ID	Date Installed	Northing[1]	Easting[1]	Ground Surface Elevation[2] (feet amsl)	Elevation at Top of Casing[2] (ft amsl)	Total Depth (feet)	Screen Interval (feet bgs)	First quarter (spring/wet season; March) /Third Quarter (fall/dry season; September) Sampling Event					Methods
								Depth to Water Measured	VOCs	SVOCs/ PAHs	TPH-G	TPH-D and TPH-O	
Former FTP Site													
FTP 1	March 1993	5173198.0	695828.3	1464.59	1467.72	21.0	8-18	X	X	X	X	X	Water-level meter and low-flow pump
FTP 13	7-Sep-99	5173153.0	695878.5	1470.96	1473.07	25.0	10-20	X	---	---	---	---	
FTP 14	8-Sep-99	5173185.2	695771.4	1455.35	1457.48	22.0	12-22	X	---	---	---	---	
FTP 15	9-Sep-99	5173228.9	695783.1	1458.72	1460.88	20.0	10-20	X	---	---	---	---	
FTP 16	22-Sep-99	5173050.7	695722.0	1442.68	1444.81	30.0	20-30	X	---	---	---	---	
TVR/Old MATES													
815-2	12-Oct-2005	5172445.5	694687.7	1301.86	1304.28	132.0	115-130	X	---	---	---	---	Water-level meter and PDB
MMP-1	2-Mar-1993	5172215.3	694553.4	1298.39	1301.37	100.5	88-98	X	---	---	---	---	
MTS-1	24-Feb-1993	5172404.6	695196.9	1359.05	1361.02	127.0	115-125	X	X	---	---	---	
MTS-2	25-Feb-1993	5172405.4	695135.9	1348.79	1351.88	113.0	101-111	X	X	---	---	---	
MTS-3	27-Oct-2004	5172439.6	695366.1	1362.62	1362.36	72.0	62-72	X	---	---	---	---	
MTS-4	28-Oct-2004	5172347.7	695078.6	1332.14	1331.88	97.0	82-97	X	X	---	---	---	
TVR-1	25-Feb-1993	5172286.6	694936.0	1317.32	1320.17	105.0	93-103	X	X	---	---	---	
TVR-2	26-Feb-1993	5172337.7	694910.0	1314.18	1317.56	95.0	83-93	X	---	---	---	---	
TVR-3	29-Oct-2004	5172282.5	694872.9	1310.86	1310.60	158.0	143-158	X	X	---	---	---	
TVR-5	185-Oct-2005	5172275.0	694704.2	1299.42	1302.04	142.0	132-142	X	---	---	---	---	

Worksheet #18: Sample Locations and Methods *(continued)*

TVR-6	20-Oct-2005	5172214.0	694866.4	1310.30	1310.06	139.0	139-149	X	X	---	---	---	
TVR-7	22-Oct-2005	5172255.6	694882.5	1311.63	1310.95	140.0	140-150	X	X	---	---	---	
Pomona Well	---	---	---	---	---	---	---	---	X	---	---	---	Grab sample from tap
PAIC Well	---	---	---	---	---	---	---	---	X	---	---	---	

Notes:

1 = Northing and easting coordinates are in Universal Transverse Mercator World Geodetic System of 1984, meters.

2 = Vertical values are referenced to the National Geodetic Vertical Datum of 1929.

amsl = above mean sea level

--- = not applicable

Worksheets #19 and 30: Sample Containers, Preservation, and Hold Times

This worksheet is presented in the Programmatic QAPP (IEJV, 2022b).

Worksheet #20: Field Quality Control Summary

Matrix	Analytical Group	No. of Samples[1]	No. of Field Duplicates[2]	Number of Matrix Spike/Matrix Spike Duplicate Pairs[3]	Number of Trip Blanks[4]	Number of Equipment Blanks[5]
Former Fire Training Pit Site (Per Sampling Event)						
Groundwater	VOCs	1	1	1	1	1
Groundwater	SVOCs	1	1	1	0	1
Groundwater	PAHs	1	1	1	0	1
Groundwater	TPH-G	1	1	1	0	1
Groundwater	TPH-D and TPH-O	1	1	1	0	1
Tracked Vehicle Repair/Old Mobilization and Training Equipment Site First Quarter (Per Sampling Event)						
Groundwater	VOCs	9	1	1	0	0

Notes:

1 = Standard non-QC field samples per sampling event. Sample numbers listed are anticipated but may depend on sample recovery. See Worksheet #18 for more detail on sample numbers.

2 = Minimum 10 percent (1 per 10 samples) per event per site.

3 = Minimum 5 percent (one set per up to 20 samples) per event per site. Matrix Spike/Matrix Spike Duplicate pairs require extra volume (i.e., triple volume for each analysis).

4 = Trip blanks will be shipped at a rate of one per cooler (one in each cooler that contains aqueous VOC samples).

5 = Minimum 1 equipment blank per analyte per day when non-disposal sampling equipment is used.

Worksheet #21: Field Standard Operating Procedures

This worksheet is presented in the Programmatic QAPP (IEJV, 2022b).

Worksheet #22: Field Equipment Calibration, Maintenance, Testing, and Inspection

This worksheet is presented in the Programmatic QAPP (IEJV, 2022b).

Worksheet #23: Analytical SOPs

This worksheet is presented in the Programmatic QAPP (IEJV, 2022b).

Worksheet #24: Analytical Instrument Calibration

This worksheet is presented in the Programmatic QAPP (IEJV, 2022b).

Worksheet #25: Analytical Instrument and Equipment Maintenance, Testing, and Inspection

This worksheet is presented in the Programmatic QAPP (IEJV, 2022b).

Worksheets #26 and 27: Sample Handling, Custody, and Disposal

This worksheet is presented in the Programmatic QAPP (IEJV, 2022b).

Worksheet #28: Analytical Quality Control and Corrective Action

This worksheet is presented in the Programmatic QAPP (IEJV, 2022b).

Worksheet #29: Project Documents and Records

This worksheet is presented in the Programmatic QAPP (IEJV, 2022b).

Worksheet #31, 32, and 33: Assessments and Corrective Action

This worksheet is presented in the Programmatic QAPP (IEJV, 2022b).

Worksheet #34: Data Verification and Validation Inputs

This worksheet is presented in the Programmatic QAPP (IEJV, 2022b).

Worksheet #35: Data Verification Procedures

This worksheet is presented in the Programmatic QAPP (IEJV, 2022b).

Worksheet #36: Data Validation Procedures

This worksheet is presented in the Programmatic QAPP (IEJV, 2022b).

Worksheet #37: Data Usability Assessment

This worksheet is presented in the Programmatic QAPP (IEJV, 2022b).

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