October 2018

DRAFT FINAL
WORK PLAN FOR REMEDIAL INVESTIGATION AT THE FORMER LANDFILL COMPLEX

Joint Base Lewis-McChord Yakima Training Center
Yakima, Washington

Joint Base Lewis-McChord Public Works – Environmental Division
IMLM-PWE
MS 17 Box 339500
Joint Base Lewis-McChord, Washington 98433

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Joint Base Lewis-McChord Yakima Training Center Yakima, Washington

Prepared for

Joint Base Lewis-McChord
Public Works – Environmental Division
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LIST OF ACRONYMS AND ABBREVIATIONS

°F	Degrees Fahrenheit
bgs	Below ground surface
EA	EA Engineering, Science, and Technology, Inc., PBC
ft	Foot (feet)
FS	Feasibility study
JBLM	Joint Base Lewis-McChord
LUC	Land use control
MTCA	Model Toxics Control Act
OGC	Office of the Garrison Commander, Fort Lewis
PAH	Polycyclic aromatic hydrocarbons
PCB	Polychlorinated biphenyl
PCE	Tetrachloroethene
QAPP	Quality assurance project plan
RCRA	Resource Conservation and Recovery Act
RFA	Resource Conservation and Recovery Act Facility Assessment
RFI	Resource Conservation and Recovery Act Facility Investigation
RI	Remedial investigation
RSL	Regional screening level
SAIC	Science Applications International Corporation
SVOC	Semivolatile organic compound
SWMU	Solid waste management unit
TCE	Trichloroethene
TCLP	Toxicity characteristic leaching procedure
TPH	Total petroleum hydrocarbons
TPH-DRO	Total petroleum hydrocarbons diesel-range organics
TPH-GRO	Total petroleum hydrocarbons gasoline-range organics
USEPA	U.S. Environmental Protection Agency
VOC	Volatile organic compound
VSP	Visual Sample Plan

YTC	Yakima Training Center

1. INTRODUCTION

EA Engineering, Science, and Technology, Inc., PBC (EA) has prepared this work plan in support of a remedial investigation (RI) and focused feasibility study (FS) for the Former Landfill Complex, which includes Solid Waste Management Unit (SWMU) 57, at Yakima Training Center (YTC). This work is being performed under the Environmental Remediation Multiple Award Indefinite Delivery/Indefinite Quantity Contract W912DQ-16-D-3001. The lead organization for this project is Joint Base Lewis-McChord (JBLM) Public Works, Environmental Division, and the Lead Regulatory Agency is the Washington State Department of Ecology.

1.1 PROJECT OBJECTIVE AND SCOPE

YTC is an active United States Army sub-installation of JBLM and is located approximately 5 miles northeast of the city of Yakima, Washington. The Former Landfill Complex is located in the southwest corner of YTC and the northwest corner of the Cantonment Area (Figure 1). Historical information indicates that municipal solid waste was burned and disposed of in the Former Landfill Complex area, primarily in SWMU 57 (TerranearPMC, LLC 2017). The investigation of the potential for environmental impacts and the lateral extent of disposal activities at the Former Landfill Complex has been ongoing for over 20 years, with the most recent activity being completion of a Site Inspection Report (TerranearPMC, LLC 2017).

The available information indicates that the Former Landfill Complex has impacts related to the former disposal activities. A geophysical survey was completed in 2016 as part of the Site Inspection to provide an initial delineation of the lateral extent of subsurface debris at the Former Landfill Complex. Land use controls (LUCs) are in place that restrict disturbance of the land's surface or development of the study area and are protective under the current land use. These LUCs cover a large area (Figure 2), and a refined characterization of the lateral extent of subsurface debris would be needed if development activities were to be considered in the future.

The ultimate objective of the current project is to complete a Decision Document, in accordance with the State of Washington Model Toxics Control Act (MTCA) and federal Resource Conservation and Recovery Act (RCRA) Corrective Action regulations, that identifies a selected remedy for the Former Landfill Complex and determines what actions would be necessary if future development activities were to be pursued. The following activities will be completed as part of the RI/focused FS to facilitate achievement of this objective and are included in the project scope:

- Evaluate existing geophysical and analytical data to develop a conceptual site model.

- Generate data via test pits to refine the delineation of the lateral extent of subsurface debris.

- Generate data via soil sampling to further characterize concentrations of volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), total petroleum hydrocarbons (TPH), organochlorine pesticides, polychlorinated biphenyls (PCBs), chlorinated herbicides, and metals in soil.

- Prepare an RI that synthesizes the new and existing information and presents a refined conceptual site model and lateral extent of subsurface debris.

- Prepare a focused FS that evaluates potential cleanup actions and estimates costs associated with those actions.

1.2 PROJECT PLANNING

The Programmatic Quality Assurance Project Plan (QAPP) (EA 2018b) and other project-level documents (e.g., the Accident Prevention Plan [EA 2018a] and Project Management Plan [EA 2018c]), this work plan, and the Former Landfill Complex Site-Specific QAPP (Appendix A) constitute the planning documents associated with the RI and focused FS efforts for the Former Landfill Complex. These documents present the plans for conducting work at the site in a safe manner and in a way that will allow the generation of data that meet project data quality objectives.

1.3 WORK PLAN ORGANIZATION

This work plan was developed to outline the project objective and scope, summarize the site history, describe the site setting, and present the initial evaluation of existing site data and the associated conceptual site model. The work plan also outlines the sampling approach developed to fill data gaps identified during the initial data evaluation. Details of the data needs, data quality objectives, data verification and validation activities, and sampling procedures and analysis methods are provided in the Programmatic QAPP (EA 2018b) and Site-Specific QAPP. The Site-Specific QAPP is included as Appendix A to this work plan.

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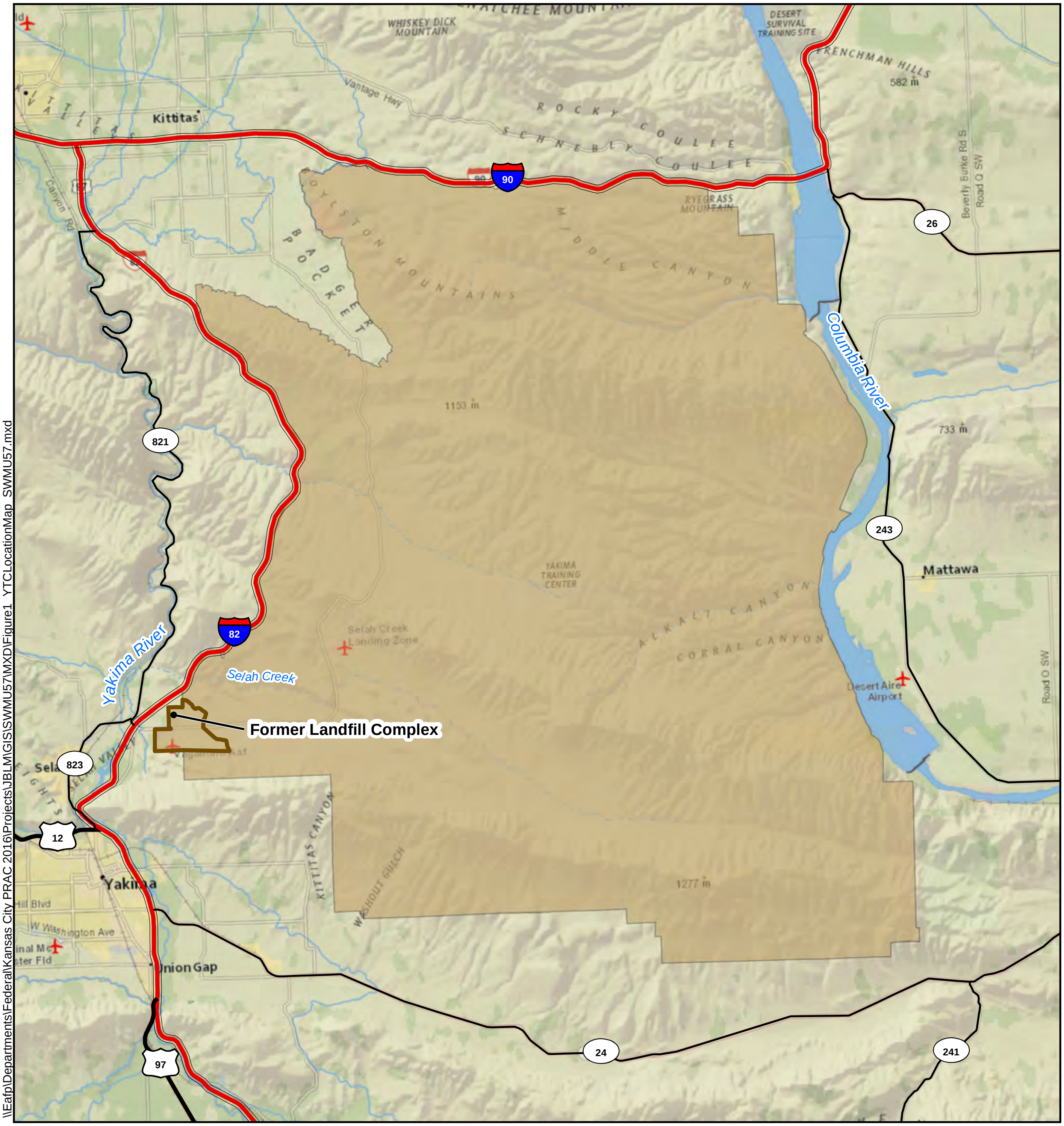


0 2.5 5 10
Miles

1 inch equals 5 miles

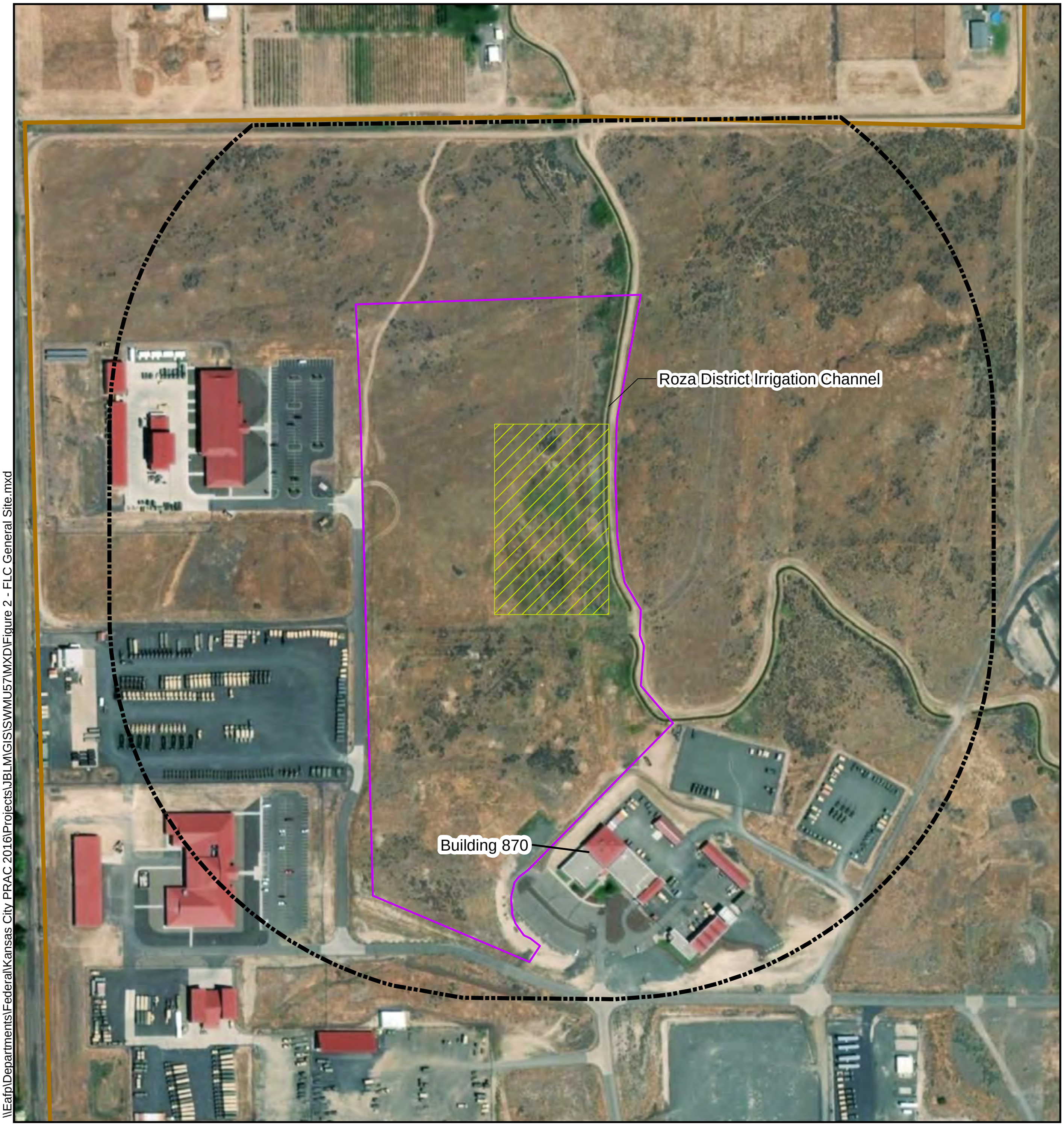
N

Legend

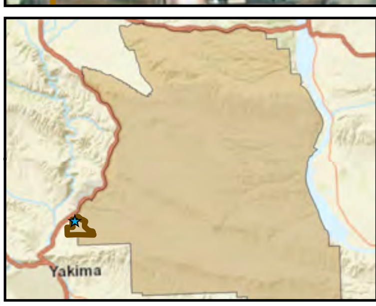
- Yakima Training Center
- Cantonment Area Boundary
- Interstate
- State Route
- US Route

FIGURE 1
YAKIMA TRAINING CENTER
LOCATION MAP
WORK PLAN

Map Date: 6/27/2018
Coordinate System: UTM Zone 10
Horizontal Datus: WGS 84



\\Eafp\Departments\Federal\Kansas City PRAC 2016\Projects\JBLM\GIS\SWMU57\MXD\Figure 2 - FLC General Site.mxd



Legend

- Site Inspection Study Area Boundary
- Solid Waste Management Unit 57
- Land Use Control Area Cantonment
- Area Boundary

FIGURE 2
FORMER LANDFILL COMPLEX, SWMU 57, AND ASSOCIATED LAND USE CONTROL AREA
WORK PLAN

0 175 350 700
Feet

1 inch equals 0.07 miles

N

Map Date: 7/19/2018
Coordinate System: UTM Zone 10
Horizontal Datus: WGS 84

2. SITE BACKGROUND AND SETTING

2.1 SITE LOCATION AND DESCRIPTION

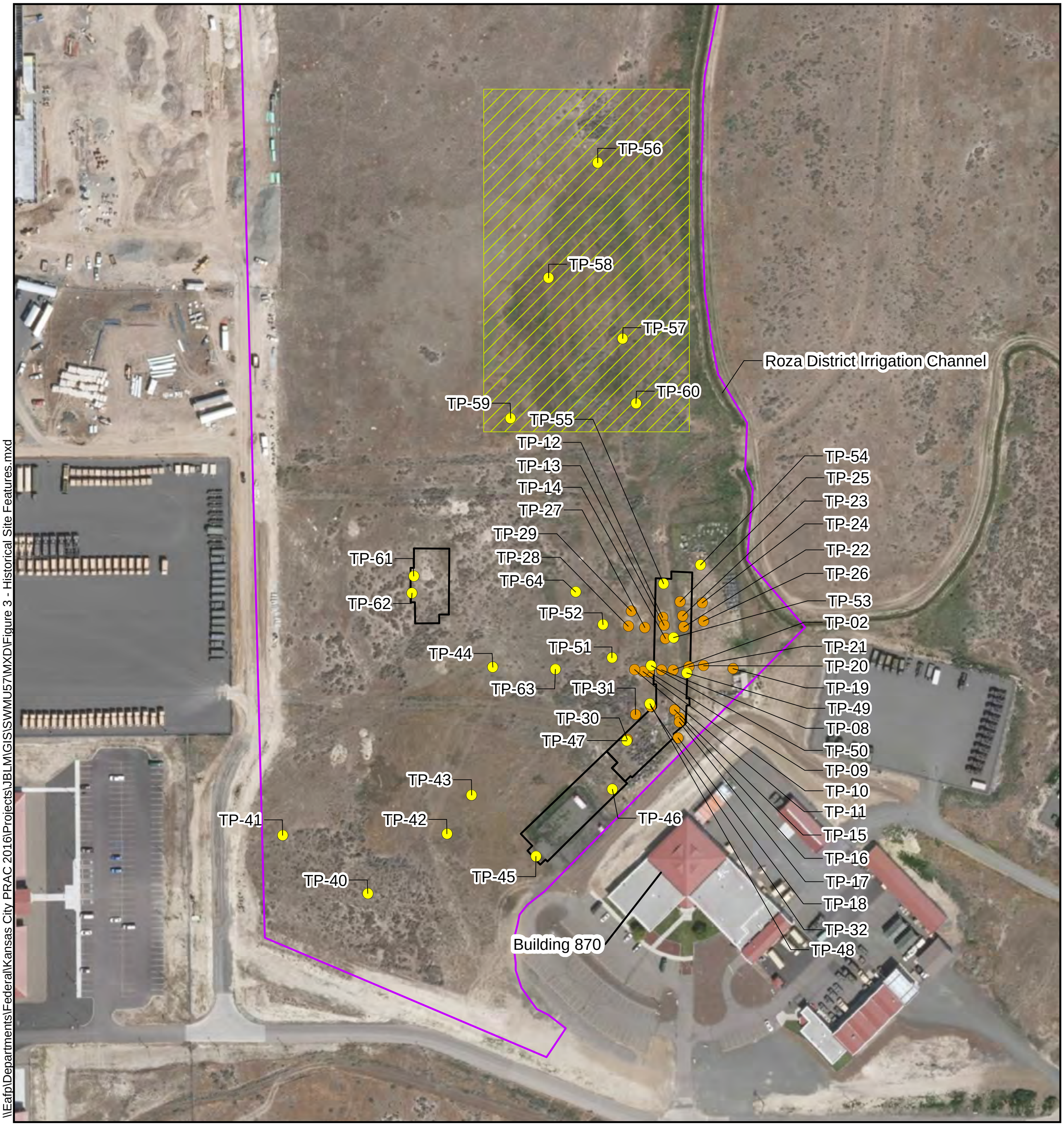
YTC is located in south-central Washington in Yakima and Kittitas Counties approximately 5 miles north of the city of Yakima. The YTC facility occupies over 323,000 acres and is divided into the Cantonment Area and the Down Range Area. The Former Landfill Complex is located in the western portion of the YTC Cantonment Area (Figure 1).

The Former Landfill Complex is approximately 27 acres and includes SWMU 57, which is approximately 3 acres in size (Figure 2). The area surrounding the Former Landfill Complex is predominately open, undeveloped high desert to the north and northeast with developed buildings to the south and west. The Roza District Irrigation Channel forms the approximate eastern boundary of the site.

The 2016 Site Inspection (TerranearPMC, LLC 2017) focused on the southern 20 acres of the Former Landfill Complex where disposal activities were suspected to have occurred and where construction of a National Guard barracks and dining facility was proposed for the southeastern portion of the Former Landfill Complex, near Building 870 (Figure 3). However, construction activities are no longer planned for the site.

2.2 SITE HISTORY AND OPERATIONS

Since 1941 YTC has been used for training artillery, infantry, and engineering units. SWMU 57 was initially identified as the 1954-1968 Landfill/Burn Pits, reflecting the time period during which the area is thought to have been actively used. Site-related documents, including a 2007 Decision Document (Office of the Garrison Commander, Fort Lewis [OGC] 2007) and a 1995 RCRA Facility Assessment (RFA) (Science Applications International Corporation [SAIC] 1995), indicate that municipal solid waste generated in the Cantonment Area and training areas was placed in open unlined trenches and burned. Burning often occurred on a daily basis, and as many as seven trenches may have been present as well as a disposal area south of SWMU 57 (TerranearPMC, LLC 2017). The pits at SWMU 57 were reportedly backfilled with at least 1.5 feet (ft) of soil over the waste materials (OGC 2007).



\\Eafp\Departments\Federal\Kansas City PRAC 2016\Projects\JBLM\GIS\SWMU57\MXD\Figure 3 - Historical Site Features.mxd

Legend

- 2012 Test Pits
- 2016 Test Pits
- Solid Waste Management Unit 57
- Footprint of Formerly Proposed Building Former
- Site Inspection Study Area Boundary

0 100 200 400
Feet

1 inch equals 0.04 miles

N

FIGURE 3
HISTORICAL SITE FEATURES
WORK PLAN

Map Date: 7/19/2018
Coordinate System: UTM Zone 10
Horizontal Datus: WGS 84

2.3 PREVIOUS INVESTIGATIONS

2.3.1 Historical Investigations

Previous investigations have been undertaken to support the identification of SWMU 57 and the LUCs implemented in accordance with the 2007 Decision Document (OGC 2007).

An RFA was performed for YTC in 1995 (SAIC 1995); SWMU 57 was one of 77 SWMUs and 38 areas of concern identified in the RFA. The findings from the RFA were used to conduct a Relative Risk Site Evaluation for YTC (Pacific Northwest National Laboratory 1996). This evaluation concluded that the potential for risks associated with site conditions were low (see Section 2.4).

A RCRA Facility Investigation (RFI) was conducted at SWMU 57 (Hart Crowser, Inc. 2003) to evaluate conditions within the soil at the former landfill/burn pits. Results indicated that soil impacts were observed to depths of at least 6 ft below ground surface (bgs) as a result of previous site activities. Soil data indicated that concentrations of antimony, cadmium, copper, lead and tetrachloroethene (PCE) were detected at concentrations greater than soil cleanup levels for unrestricted land use. There were no exceedances of screening levels for other constituents of potential concern from the following analytical suite: TPH, metals, PCBs, polycyclic aromatic hydrocarbons (PAHs), and VOCs (with the exception of PCE). Although four test pits were excavated to a depth of 6 ft bgs, the vertical and horizontal extent of impacts was not fully delineated.

Based on the outcome of these investigations, LUCs were selected as the remedy in the 2007 Decision Document. LUCs were selected to prevent unmitigated future residential land use of SWMU 57 and a buffer area (Figure 2) and unplanned excavation within the landfill/burn pit boundary. LUC implementation is described in the Land Use Control Plan dated May 2007, which remains in effect and requires excavation permit approval to ensure that LUC objectives are met (TerranearPMC, LLC 2017).

Pre-construction geotechnical testing was conducted in 2012-2013 for the proposed construction of National Guard barracks adjacent to Building 870. Burn residue and waste that appeared to be similar to what was encountered within SWMU 57, which is to the north of the proposed barracks location (Figure 3), was encountered during testing. Twelve of 26 test pits completed within and adjacent to the foot print of the proposed National Guard barracks contained buried waste at depths ranging from 1.2 to 8 ft bgs; waste thickness ranged from trace to 6.5 ft and, although previous studies indicated that a soil cover was placed over SWMU 57, some waste in this area was observed at the surface. These results indicate that the distribution of waste is greater than the previously identified SWMU 57, and were the impetus for the Site Inspection completed in 2016. Table 1 presents a summary of the observations made at each test pit. The construction of the National Guard barracks and dining facility is no longer proposed at the Former Landfill Complex.

Table 1. Historical Test Pit Observations

Test Pit Number	Depth (ft)	Refusal Encountered	Date Installed	Observations
TP-2	8	Yes	3/16/2012	3-8 ft: Garbage—burnt wood, glass bottles. Hard pan at 8 ft.
TP-8	8.5	No	7/19/2012	1.5-6.5 ft: Garbage—ash, burnt wood, glass bottles, wires.
TP-9	6	No	7/19/2012	0-6 ft: Garbage—rebar, cable wires, ash, burnt wood, glass bottles. Stopped digging at 6 ft depth due to cable wires tangling backhoe bucket. Bottom of test pit at 6 ft in garbage.
TP-10	7	Yes	7/19/2012	No debris reported. Hard pan at 7 ft.
TP-11	7.5	No	7/19/2012	No debris reported.
TP-12	7.5	No	7/19/2012	No debris reported.
TP-13	7.5	No	7/19/2012	3-4.5 ft: Garbage—metal debris.
TP-14	9	No	7/19/2012	2.5-7.5 ft: Garbage—metal debris, metals rods, ash, burnt wood, glass bottles.
TP-15	8	No	7/19/2012	3-6 ft: Garbage—metal debris, ash.
TP-16	6	Yes	7/19/2012	No debris reported. Hard pan at 6 ft.
TP-17	6.5	Yes	7/19/2012	No debris reported. Hard pan at 6.5 ft.
TP-18	5.5	Yes	7/19/2012	No debris reported. Hard pan at 5.5 ft.
TP-19	4	Yes	7/19/2012	No debris reported. Hard pan at 4 ft.
TP-20	4.5	Yes	7/19/2012	No debris reported. Hard pan at 4.5 ft.
TP-21	7	Yes	7/19/2012	0.5-7 ft: Garbage—ash, burnt wood, metal debris, glass bottles, wires, wood. Hard pat at 7 ft.
TP-22	7.5	Yes	7/19/2012	4.5-7 ft: Garbage—ash, burnt wood, metal debris, glass bottles. Hard pat at 7.5 ft.
TP-23	6	Yes	7/19/2012	1.5-6 ft: Garbage—ash, burnt wood, metal debris, glass bottles. Hard pat at 6 ft.
TP-24	6	Yes	7/19/2012	No debris reported. Hard pan at 6 ft.
TP-25	6	Yes	7/19/2012	A small pocket of bluish colored granules (like laundry soap) at 1.2 ft bgs was observed at the southwest corner of the test pit and a few metal debris and rusty soil was observed at 3 ft bgs at the south end of the test pit. Other than these two anomalies, the test pit was free of garbage. Hard pan at 6 ft.
TP-26	5	Yes	7/19/2012	No debris reported. Hard pan at 5 ft.
TP-27	7.5	Yes	7/20/2012	2-7.5 ft: Garbage—metal debris, glass bottles, wires. Hard pan at 7.5 ft.
TP-28	7	Yes	7/20/2012	No debris reported. Hard pan at 7 ft.
TP-29	7	Yes	7/20/2012	No debris reported. Hard pan at 7 ft.
TP-30	3.3	Yes	7/20/2012	No debris reported. Hard pan at 3.3 ft.
TP-31	5.5	Yes	7/20/2012	No debris reported. Hard pan at 5.5 ft.
TP-32	8	Yes	7/20/2012	2-8 ft: Garbage isolated only at southeast corner of test pit—metal debris, glass bottles, wires, wire cables, ash. Remaining test pit was free of garbage. Hard pan at 8 ft.
TP-40	3	Yes	10/25/2016	Debris (glass, cans, and misc. debris) encountered at 2.5 ft bgs.
TP-41	7	Yes	10/25/2016	No debris or staining observed.
TP-42	4.5	Yes	6/27/2016	No debris or staining observed.
TP-43	10	No	10/25/2016	Rolls of barbed wire encountered 3-10 ft bgs.
TP-44	4	Yes	10/28/2016	No debris or staining observed.

Test Pit Number	Depth (ft)	Refusal Encountered	Date Installed	Observations
TP-45	4.5	Yes	6/22/16	No debris or staining observed.
TP-46	3.5	Yes	6/22/16	No debris or staining observed.
TP-47	4.5	Yes	6/22/16	Green colored soil 2-2.5 ft bgs; PID readings were normal.
TP-48	7	Yes	6/22/16	Debris (broken glass, glass bottles, rusty cans, misc. metal, small pockets of ash) 5-7 ft bgs.
TP-49	8	Yes	6/23/16	No debris or staining observed.
TP-50	8	Yes	6/23/16	Debris (glass, metal can and ash) 3-8 ft bgs.
TP-51	8	Yes	6/24/2016	Debris (glass, metal can and ash) 2-8 ft bgs.
TP-52	11		6/24/2016	Debris (glass, metal can and ash) 2-4 ft bgs. Void space 4-7 ft bgs; drum fragments 7-8 ft bgs. PID readings were normal.
TP-53	6.5	Yes	6/27/2016	Iron staining, metal drum rings, steel banding, glass and wood debris 2.5-6.5 ft bgs; PID readings were normal.
TP-54	5	Yes	6/27/2016	No debris or staining observed.
TP-55	6	Yes	6/27/2016	Staining at 2 ft bgs; glass, metal, cans, and ash debris 2-6 ft bgs.
TP-56	8.5	Yes	10/31/2016	No debris or staining observed.
TP-57	12	Yes	6/30/16	Orange to brown soil; glass, metal, and wood debris; PID readings were normal 1.5-7.5 ft bgs. Two inert shells encountered within the debris; one was described as a 105 millimeter shell, the other as an empty and smashed M105 with the primer removed. No debris or staining 7.5-12 ft bgs.
TP-58	7	Yes	10/28/2016	Debris (glass, metal, and wood) with red staining due to rusting metal 3-5 ft bgs, no odor. No debris or staining 5-7 ft bgs.
TP-59	5.5	Yes	6/29/2016	Soil matrix greenish brown 1.5-5.5 bgs; PID readings were normal.
TP-60	9	Yes	6/30/2016	Orange to brown soil stain; glass and wood debris; PID readings were normal 2 to 9 ft bgs.
TP-61	3	Yes	10/27/2016	No debris or staining observed.
TP-62	4	Yes	10/27/2016	No debris or staining observed.
TP-63	9	Yes	6/24/2016	No debris or staining observed.
TP-64	7.5	Yes	6/27/2016	Debris (metal pieces, glass, ash, and assorted trash), soil iron staining encountered 6-7.5 ft bgs.

NOTES: bgs = Below ground surface.
ft = Feet.
PID = Photoionization detector.

2.3.2 Site Inspection

From June to November 2016, a site inspection of the Former Landfill Complex was completed (TerranearPMC, LLC 2017). Site inspection activities were focused on the southern 20 acres of the Complex where disposal activities were suspected to have occurred and where construction of the National Guard barracks and dining facility was proposed. It was noted in the site inspection report that surface features that may have been associated with former landfilling and/or burning activities were not identifiable during an initial site reconnaissance, with the exception of linear depressions within SWMU 57.

A geophysical survey, soil gas sampling, the completion of test pits, and soil sampling were conducted in support of the site inspection. The data generated during the site inspection were re-evaluated during development of this work plan and form the basis of the conceptual site model that is discussed in Section 3.

2.3.2.1 Geophysical Survey

The geophysical survey was completed to support the delineation of the lateral extent of subsurface debris and to assist in focusing the site inspection soil sampling on areas that had the highest likelihood of chemical impacts as a result of previous site activities. Terrain conductivity (i.e., quadrature) and in-phase response data were generated for the 20 acres that were the focus of the site inspection.

The conductivity data identified disturbed subsurface materials throughout most of the eastern portion of the surveyed area. The in-phase data, which provide an indication of subsurface metallic debris, suggested several localized areas with elevated responses (i.e., likely subsurface metal). The in-phase results also indicated that there were linear features that may indicate filled trenches within SWMU 57 and the southern portion of the 20 acres. Within SWMU 57, the elevated responses corresponded to the linear depressions observed during the site reconnaissance. Based on the results of the geophysical survey, the approximate boundary of previous landfill activity was inferred. Relevant figures from the site inspection are provided in Appendix B (Site Inspection Figures 3-3 and 3-4).

2.3.2.2 Soil Gas Sampling

Passive diffusion samplers were used to collect soil gas samples from the 2-3 ft bgs depth interval to determine the presence or absence of VOCs in soil. Samples were located on an approximately 50-foot grid within the (then) proposed National Guard barracks and dining facility building footprints.

There were no detections of any analytes in 11 of 22 samples collected, and no analytes were detected in the trip blanks. Therefore, it was concluded that any detected analytes were likely site related. Trichloroethene (TCE) and PCE were detected in samples collected from within the footprint of the formerly proposed barracks. The maximum concentration of any analyte measured was of TCE at 405 micrograms per meter cubed. This sample was collected near the northern end of the formerly proposed barracks building. Petroleum, oil, and lubrication compounds were also detected within the footprints of the formerly proposed barracks and dining facility buildings.

2.3.2.3 Test Pits and Subsurface Soil Sampling

Test pits were excavated at 25 locations that were selected based on the results of the geophysical survey and soil gas survey (Figure 3). Fifty subsurface soil samples were collected from the test pits (two from each test pit) at the depth interval that was representative of waste material/burn residue or just above the hard pack if no debris was encountered. Test pit soil samples were analyzed for VOCs, SVOCs/PAHs, pesticides, PCBs, herbicides, metals, TPH gasoline-range organics (TPH-GRO) and TPH diesel-range organics (TPH-DRO).

Five samples were collected to characterize the potential for the soil to represent a RCRA waste. Waste characterization included toxicity characteristic leaching procedure (TCLP) VOC, TCLP SVOC, and TCLP metals as well as ignitibility, reactivity, and corrosivity.

The report indicated that, in most test pits, the contact between debris and native soil was readily identified and residue from historical activities could be discerned. At 11 of the 25 test pits no debris or staining was encountered, and all but 2 test pits were terminated when hard packed sandstone resulted in excavator refusal. Table 1 presents a summary of the observations made at each test pit.

Acetone and TCE were the only VOCs detected in subsurface soil samples; however, none of the detected concentrations were greater than project action limits for residential direct exposure. The acetone was attributed to laboratory contamination. While the concentration of TCE measured was below its project action limit, the detection was in the general vicinity of the soil gas detections of TCE.

TPH-GRO was not detected in any of the subsurface soil samples. SVOCs, TPH-DRO, pesticides, PCBs, and herbicides were detected at least once; however, none of the detected concentrations were greater than the project action limits (MTCA Method A Soil Cleanup Levels for Unrestricted Land Uses or U.S. Environmental Protection Agency [USEPA] residential soil regional screening levels [RSLs]).

Arsenic was detected at a concentration slightly above the project action limit in one sample from Test Pit 54. Thallium concentrations exceeded the project action limit in 12 samples; however, the report concluded that the thallium concentrations were not indicative of a release because all concentrations were less than the detection limit for the State of Washington background metals concentrations in soil. Iron and lead were found in subsurface soil at concentrations greater than project action limits in Test Pits 51, 52, 53, 57, 58, and 64. These test pits were located within the former SWMU 57 boundary or in the vicinity of the proposed barracks building (Figure 3).

2.3.2.4 Surface Soil Samples

Historical site information suggests that a soil cover was placed on top of the waste material in SWMU 57; however, test pits excavated in 2012 (south of SWMU 57) encountered waste material at the surface. As a result, 20 surface soil samples were collected during the site inspection from 6-12 inches bgs/below the vegetation root mass to characterize the presence or absence of VOCs, SVOCs, PAHs, pesticides, PCBs, herbicides, metals, TPH. Surface soil samples were biased to locations that indicated potential impacts.

SVOCs, TPH-GRO, and herbicides were not detected in any of the surface soil samples. Acetone was the only VOC detected, and was attributed to laboratory contamination. PAHs, pesticides, TPH-DRO, and one PCB were detected at least once; however, none of the detected concentrations were greater than the project action limits (MTCA Method A Soil Cleanup Levels for Unrestricted Land Uses or USEPA residential soil RSLs).

Lead and thallium were detected in surface soil at concentrations greater than their respective project action limits. Lead was detected at a concentration exceeding the project action limit in one sample. This sample was surrounded by Test Pits 51, 52, 53, and was in the vicinity of Test Pit 64. Elevated lead concentrations were found in subsurface soil samples collected from these test pits. The project action limit for thallium was exceeded in samples from two locations. The report noted that thallium does not have a clear relationship with historical Department of Defense activities and, therefore, it was concluded that the thallium was not site-related.

2.3.2.5 Unexploded Ordnance

During the site inspection two inert shells were encountered within the debris at Test Pit 57. One of the items was described as a 105-millimeter shell and the other was an empty and smashed M105 with the primer removed.

Procedures relating to unexploded ordnance that will be followed when conducting intrusive work at the Former Landfill Complex are discussed in Section 4.2.

2.4 SITE RISK

A Relative Risk Site Evaluation for YTC was completed in 1996 (Pacific Northwest National Laboratory 1996). The document evaluated potential contaminant migration pathways for groundwater, surface water/sediment, and soil. Potential receptors for SWMU 57 were identified as those associated with an industrial area to which access is restricted to authorized personnel. The potential for receptors to come in contact with contaminants was considered minimal because the contaminants were below ground and in a low-traffic area.

SWMU 57 was described as being located on top of a hill, and information from wells drilled at the bottom of the hill showed that the top of the Pomona basalt is 3-5 ft bgs and that there is no unconfined aquifer. Therefore, it was concluded that the groundwater pathway would consist of leaching of landfill constituents by natural precipitation to the top of the basalt, where the water would either flow along the basalt until it entered an unconfined aquifer an unknown distance to the west or it could migrate through approximately 100 ft of basalt rock to the confined aquifer. Based on these migration pathways, contaminant migration from SWMU 57 via groundwater was considered an insignificant pathway. The Relative Risk Site Evaluation also noted that the area has low annual precipitation, which would limit the likelihood of constituents leaching out of buried material. Furthermore, four monitoring wells located downgradient of SWMU 57 were sampled as part of the 1993 site investigation and were found to contain no contaminant concentrations greater than regulatory limits. The Contaminant Hazard Factor for groundwater was determined to be minimal.

The surface water and sediment migration pathways were found to be incomplete because the nearest surface waterbody (irrigation canal) is located 0.5 miles west of SWMU 57 and evidence of surface runoff from the site was lacking. The Contaminant Hazard Factor for surface water and sediment was determined to be minimal.

The soil migration pathway was found to be limited because the area had been regraded and covered with clean soil, because there was little potential for receptors to access the buried waste, access to the area was restricted to authorized personnel, and because low annual precipitation would limit the potential for erosion. The Contaminant Hazard Factor for soil was determined to be minimal.

The potential for SWMU 57 to pose risk was also taken into consideration in the 2007 Decision Document (OGC 2007). In addition to the findings of the Relative Risk Site Evaluation, the Decision Document noted that constituent concentrations detected in samples from SWMU 57 were less than MTCA cleanup levels for an industrial/commercia1 scenario, which was considered the appropriate land use scenario for the site. Because there were some constituent concentrations (for lead and antimony) that were greater than MTCA direct contact cleanup levels for a residential land use scenario, the Decision Document established LUCs to prevent unmitigated future residential land use and unplanned excavation within the SWMU 57 boundary (OGC 2007).

Data generated since completion of the Decision Document (e.g., data generated as part of the Site Inspection) are consistent with the data upon which the selected remedy was based. As described in Section 2.3.2, few analytes were detected in soil samples at concentrations greater than Site Inspection project action limits, which were criteria for unrestricted land use (MTCA Method A Soil Cleanup Levels for Unrestricted Land Uses or USEPA residential soil RSLs). However, current and anticipated future land use at the Former Landfill Complex is industrial. When compared to criteria for industrial land uses, only two subsurface soil samples from test pits containing debris (test pits 51 and 57) had elevated concentrations of lead and one subsurface soil sample duplicate from a test pit without debris (test pit 54) had a slightly elevated concentration. The concentration of arsenic in the parent sample collected from test pit 54 was less than criteria for industrial land uses. Based on current and anticipated future land use, the existing conclusions regarding the lack of site risks from chemical constituents are still applicable, and a re-evaluation of site risks is not warranted.

2.5 PHYSICAL PROFILE

2.5.1 Climate

Yakima, Washington has a high desert climate with cold winters and hot summers. Since 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. Evapotranspiration is estimated at 25-57 inches a year for Yakima. Because of the low precipitation and high evapotranspiration rates, surface drainages are not sustained year-round (TerranearPMC, LLC 2017).

Summers are typically dry and hot, with July being the warmest and driest month. Diurnal temperature variations in June and July average to approximately 34 degrees Fahrenheit (°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) (TerranearPMC, LLC 2017).

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 (TerranearPMC, LLC 2017).

2.5.2 Hydrology

The Yakima and Columbia rivers border YTC to the west and east, respectively, and flow from north to south. 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 these 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 (TerranearPMC, LLC 2017).

There is an irrigation channel along the eastern boundary of the Former Landfill Complex. The channel is located topographically higher than the site and does not receive runoff from the site. Surface water at the Former Landfill Complex drains toward the southwest and is captured by existing stormwater management features on the adjacent developed lots; flows in surface water features are usually associated with storm water runoff. No natural surface water features exist within the Former Landfill Complex or adjacent parcels. A small pond exists south of Firing Center Road, approximately one half mile from the Complex (TerranearPMC, LLC 2017).

2.5.3 Regional and Local Geology

The Former Landfill Complex lies within Columbia Basin terrain, in the western part of the Columbia Plateau of the Yakima Fold Belt, which is a transitional zone between the Cascade Mountains and the Columbia Plateau basalts. The fold belt is characterized by a series of elongated, generally asymmetrical tightly folded southeast-trending synclines and anticlines. The fold belt is largely comprised of a sequence of the Columbia River Basalt Group interbedded with the sedimentary Ellensburg Formation. The Columbia River Group is from the Miocene epoch and is over 4,000 ft thick in the area of YTC. Each basalt formation within the Columbia River Group consists of several individual flows. Interbedded within and over the basalt

sequences are sedimentary units of the Ellensburg Formation, which represent deposition during quiescent periods between eruptions. Overlying this sequence are various Quaternary to recent deposits of fanglomerates, loess, alluvium and landslide deposits.
Within the Former Landfill Complex, the depth to the fold belt is predicted to be approximately 100 ft bgs with Quaternary or recent deposits representing the surface materials. SWMU 57 is located on the top of a hill on the north side of a syncline.

The Former Landfill Complex slopes gently toward the west with an elevation difference of approximately 50 ft between the northeast site boundary (the Roza Irrigation Canal) and the downgradient boundary to the southwest (8th Street). Sagebrush is the primary vegetation onsite (TerranearPMC, LLC 2017).

2.5.4 Hydrogeology and Local Water Supply

Groundwater aquifers within the Columbia River Basalts are best developed within the tops of the basalt flows, where rapid cooling formed permeable, rubbly basalt. These aquifers are typically confined by the basalt flows and generally receive recharge from the exposures in the foothills of the Cascade Mountains. The U.S. Geological Survey has also identified the possible existence of an aquifer in the sedimentary units overlying the basalt group, primarily in the Ellensburg Formation. Groundwater flow direction is controlled by the structural orientation of the anticlines and synclines and is generally from the ridges toward the synclinal valleys and then toward the Yakima River. As of 2003, no wells had been completed in the overburden materials within the YTC Cantonment Area. The depth to groundwater in the Cantonment Area is predicted to be 100-200 ft bgs (TerranearPMC, LLC 2017) and therefore, is not considered to be a media of concern for the Former Landfill Complex.

YTC provides potable water for buildings in the vicinity of the Former Landfill Complex. The primary source of public drinking water at YTC is groundwater extracted from the Pomona wells; some surrounding landowners also use groundwater as their primary source (TerranearPMC, LLC 2017). Local river water, diverted through the Roza Irrigation canal, is used for irrigation purposes. Use of ground water beneath the Former Landfill Complex is restricted by the existing LUCs (OGC 2007).

A search of the Washington State Department of Ecology state well log viewer geographical information system performed in 2016 as part of the Site Inspection identified the following: 20 water wells within 1 mile of the Former Landfill Complex, and 438 wells within 3 miles of the Former Landfill Complex (TerranearPMC, LLC 2017). The majority of the wells within 3 miles of the Complex are located on the western side of the Yakima River.

2.6 DEMOGRAPHICS

2.6.1 Adjacent and Future Land Use

The small town of East Selah, Washington lies approximately 2 miles to the southwest of the site. The area west of the Former Landfill Complex is undergoing development by the

Department of Defense and may be characterized as light industrial. The area to the east mainly consists of undeveloped land (Figure 2).

2.6.2 Nearby Population

The population of Yakima County, Washington was 243,237 in 2010 with a density of 56.6 people per square mile. The population increased 2.3 percent between 2000 and 2015 (TerranearPMC, LLC 2017). The median age in 2010 was 31.7 years. The largest fraction of private sector jobs are within healthcare followed by manufacturing and construction.

2.7 SENSITIVE ENVIRONMENTS

No sensitive environments were identified at the Former Landfill Complex during the Site Inspection (TerranearPMC, LLC 2017).

3. INITIAL EVALUATION

To support the development of this work plan, the existing geophysical, test pit, and soil analytical data were evaluated to develop a conceptual site model and better define the lateral extent of disposal features at the Former Landfill Complex.

3.1 2018 EVALUATION OF EXISTING GEOPHYSICAL AND TEST PIT DATA

EA performed an analysis of the Terranear EM31-MK2 data, test pit data collected during the 2016 Site Inspection (TerranearPMC, LLC. 2017), and test pit data collected in 2012 (provided in Appendix A of TerranearPMC, LLC. 2017) to identify features that are indicative of possible trench locations within the Former Landfill Complex. EA used Geosoft's Oasis Montaj v7 geophysical mapping software to color contour and display the processed Terranear EM31-MK2 data. Data from the in-phase channel of the EM31-MK2 were used for this analysis because this channel is often more sensitive than the quadrature channel (i.e., terrain conductivity) to metallic and other debris often found in disposal trenches. The terrain conductivity is often influenced by near-surface geologic variations and moisture content that can mask responses from trench material. The identification of trenches was based on linear features of increased in-phase readings or pairs of low and high amplitude linear features. Once potential trenches were identified, the test pit sampling results were plotted on the color contoured in-phase map to correlate the two data sets. Figure 4 shows EA's interpretation of the trench locations on the in-phase map along with the test pit results.

3.1.1 2018 Geophysical Data Interpretation

There appear to be three trench complexes with four or more individual trenches within each complex. One trench complex is within the original SWMU 57 boundary. The second trench complex is located approximately 400 ft south of SWMU 57 where the 2012 test pits were located. The third trench complex is located approximately 300 ft southwest of the second trench complex. Individual trenches were less pronounced in the third, southwestern most, trench complex than in the other two trench complexes. It is suspected that this is the result of elevated conductivity, which obscures the trench features. It is also possible that this area is not made up of well-defined trenches, but rather is more of a general disposal area. There appears to be a single east-west oriented trench located approximately 150 ft southwest of the third trench complex.

Some of the trenches appear relatively continuous while others appear discontinuous, which may be the result of lateral variations in fill material within each trench. The interpreted trench extents were drawn to the point where the subsurface anomaly was no longer indicated by the in-phase data. However, because parts of the trenches may be filled with material not easily detected by the EM31-MK2, there is some uncertainty regarding the location of the actual ends of the trenches.

Most of the trenches appear to be approximately 10 ft wide with about 10 ft between each trench. The identified trenches are oriented in a north-south direction, with the one exception noted above. Although there are east-west oriented in-phase linear anomalies, most of these appear to be data collection artifacts. The EM31-MK2 in-phase response is notorious for creating false anomalies oriented in the direction of data collection due to minor shifts in the data that result from instrument "bumps." For this reason, geophysical surveys are typically designed to collect data perpendicular to anticipated trench orientation. The Terranear EM31-MK2 data were collected in an east-west direction, which is the correct orientation for investigating subsurface features that are oriented north-south[1]. Some of the east-west oriented anomalies were sampled during the Site Inspection (e.g., Test Pit 61), and buried debris was not found in the associated test pits. This supports the conclusion that the east-west anomalies are unlikely to be the result of subsurface disturbance. However, it is possible that not all of the east-west trending anomalies are false anomalies; therefore care should be taken when viewing the data.

3.1.2 Test Pit Data Interpretation

In general, the test pit data correlate well with the in-phase data. Table 2 shows the sampling results for each test pit, whether the test pit was located within one of the interpreted trenches, and whether it was located within one of the interpreted trench complexes. Test pit results are also plotted on Figure 4.

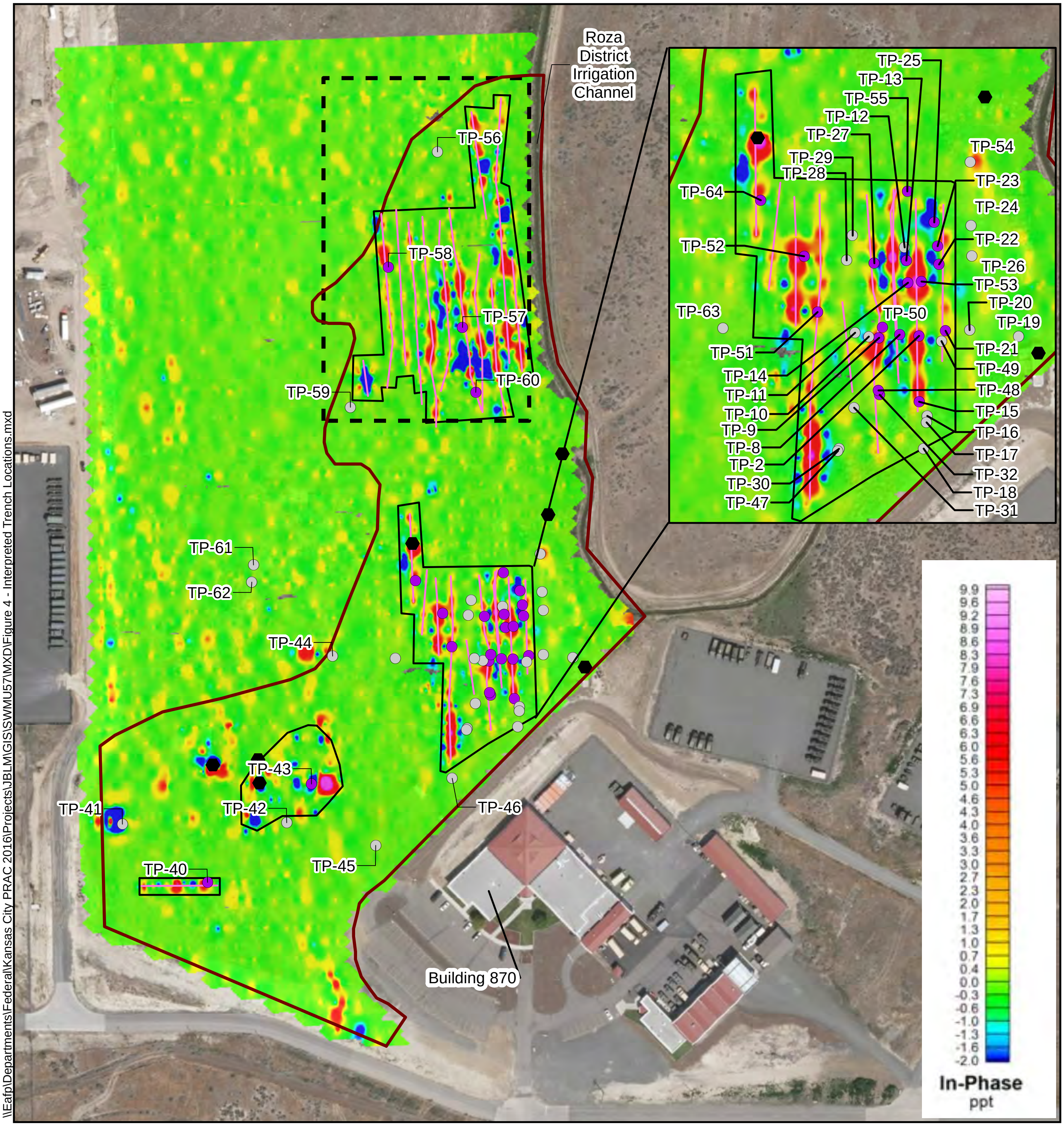
Of the 24 test pits with debris:

- 20 appear to be co-located with interpreted trench locations
- 2 appear to be close to trench edges (but outside of the trench)
- 1 is located in the trench complex where individual trenches could not be discerned (Test Pit 43)
- 1 appears to be located between trenches (Test Pit 13)
- 24 were located within trench complexes.

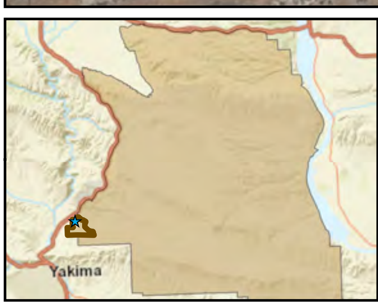
Of the 27 test pits with no debris:

- 1 appears to be co-located with an interpreted trench (Test Pit 49)
- 2 appear to be close to trench edges (but outside of the trench)
- 4 were between or at the end of interpreted trench locations
- 7 were within trench complexes.

1 It should be noted that the 1995 RFA (SAIC 1995), and subsequent documents that cite the RFA (e.g., the RFI, Hart Crowser, Inc. 2003), states that the disposal trenches were oriented in an east-west direction. However, the Site Inspection (TerranearPMC, LLC 2017) states that the disposal trenches were oriented in a north-south direction. Field work conducted for the Site Inspection was conducted in a manner that is consistent with a north-south trench orientation.



\\Eafp\Departments\Federal\Kansas City PRAC 2016\Projects\JBLM\GIS\SWMU57\MXD\Figure 4 - Interpreted Trench Locations.mxd



0 75 150 300
Feet

1 inch equals 0.04 miles

Legend

- Test Pit With Debris
- Test Pit Without Debris
- Surface Debris
- Interpreted Trench
- Interpreted Trench Complex
- 2017 Site Inspection Estimated Landfill Boundary
- Solid Waste Management Unit 57

FIGURE 4
INTERPRETED TRENCH LOCATIONS
WORK PLAN

Source: Final Site Inspection of Former Landfill Complex YTC SWMU 57 - 2017, TerranearPMC, LLC.
Map Date: 7/19/2018
Coordinate System: UTM Zone 10
Horizontal Datus: WGS 84

Table 2. Relationship Between Historical Test Pits and 2018 Interpreted Trenches

Test Pit Number	Date Installed	Observations	2018 Interpretation	
			In Trench?	In Trench Complex?
TP-2	3/16/2012	3-8 ft: Garbage—burnt wood, glass bottles. Hard pan at 8 ft.	Yes	Yes
TP-8	7/19/2012	1.5-6.5 ft: Garbage—ash, burnt wood, glass bottles, wires.	Yes	Yes
TP-9	7/19/2012	0-6 ft: Garbage—rebar, cable wires, ash, burnt wood, glass bottles. Stopped digging at 6 ft depth due to cable wires tangling backhoe bucket. Bottom of test pit at 6 ft in garbage.	Yes	Yes
TP-10	7/19/2012	No debris reported. Hard pan at 7 ft.	No, edge	Yes
TP-11	7/19/2012	No debris reported.	No, edge	Yes
TP-12	7/19/2012	No debris reported.	No	Yes
TP-13	7/19/2012	3-4.5 ft: Garbage—metal debris.	No	Yes
TP-14	7/19/2012	2.5-7.5 ft: Garbage—metal debris, metals rods, ash, burnt wood, glass bottles.	Yes	Yes
TP-15	7/19/2012	3-6 ft: Garbage—metal debris, ash.	Yes	Yes
TP-16	7/19/2012	No debris reported. Hard pan at 6 ft.	No	Yes
TP-17	7/19/2012	No debris reported. Hard pan at 6.5 ft.	No	Yes
TP-18	7/19/2012	No debris reported. Hard pan at 5.5 ft.	No	No
TP-19	7/19/2012	No debris reported. Hard pan at 4 ft.	No	No
TP-20	7/19/2012	No debris reported. Hard pan at 4.5 ft.	No	No
TP-21	7/19/2012	0.5-7 ft: Garbage—ash, burnt wood, metal debris, glass bottles, wires, wood. Hard pat at 7 ft.	Yes	Yes
TP-22	7/19/2012	4.5-7 ft: Garbage—ash, burnt wood, metal debris, glass bottles. Hard pat at 7.5 ft.	Yes, edge	Yes
TP-23	7/19/2012	1.5-6 ft: Garbage—ash, burnt wood, metal debris, glass bottles. Hard pat at 6 ft.	Yes, edge	Yes
TP-24	7/19/2012	No debris reported. Hard pan at 6 ft.	No	No
TP-25	7/19/2012	A small pocket of bluish colored granules (like laundry soap) at 1.2 ft bgs was observed at the southwest corner of the test pit and a few metal debris and rusty soil was observed at 3 ft bgs at the south end of the test pit. Other than these two anomalies, the test pit was free of garbage. Hard pan at 6 ft.	No, edge	Yes
TP-26	7/19/2012	No debris reported. Hard pan at 5 ft.	No	No
TP-27	7/20/2012	2-7.5 ft: Garbage—metal debris, glass bottles, wires. Hard pan at 7.5 ft.	Yes	Yes
TP-28	7/20/2012	No debris reported. Hard pan at 7 ft.	No	No
TP-29	7/20/2012	No debris reported. Hard pan at 7 ft.	No	No
TP-30	7/20/2012	No debris reported. Hard pan at 3.3 ft.	No	No
TP-31	7/20/2012	No debris reported. Hard pan at 5.5 ft.	No	Yes
TP-32	7/20/2012	2-8 ft: Garbage isolated only at southeast corner of test pit—metal debris, glass bottles, wires, wire cables, ash. Remaining test pit was free of garbage. Hard pan at 8 ft.	Yes	Yes
TP-40	10/25/2016	Debris (glass, cans, and misc. debris) encountered at 2.5 ft bgs.	Yes	Yes
TP-41	10/25/2016	No debris or staining observed.	No	No

Test Pit Number	Date Installed	Observations	2018 Interpretation	
			In Trench?	In Trench Complex?
TP-42	6/27/2016	No debris or staining observed.	No	No
TP-43	10/25/2016	Rolls of barbed wire encountered 3-10 ft bgs.	No, edge	Yes
TP-44	10/28/2016	No debris or staining observed.	No	No
TP-45	6/22/16	No debris or staining observed.	No	No
TP-46	6/22/16	No debris or staining observed.	No	No
TP-47	6/22/16	Green colored soil 2-2.5 ft bgs; PID readings were normal.	No	No
TP-48	6/22/16	Debris (broken glass, glass bottles, rusty cans, misc. metal, small pockets of ash) 5-7 ft bgs.	Yes	Yes
TP-49	6/23/16	No debris or staining observed.	Yes	Yes
TP-50	6/23/16	Debris (glass, metal can and ash) 3-8 ft bgs.	Yes	Yes
TP-51	6/24/2016	Debris (glass, metal can and ash) 2-8 ft bgs.	Yes	Yes
TP-52	6/24/2016	Debris (glass, metal can and ash) 2-4 ft bgs. Void space 4-7 ft bgs; drum fragments 7-8 ft bgs. PID readings were normal.	Yes, edge	Yes
TP-53	6/27/2016	Iron staining, metal drum rings, steel banding, glass and wood debris 2.5-6.5 ft bgs; PID readings were normal.	Yes, edge	Yes
TP-54	6/27/2016	No debris or staining observed.	No	No
TP-55	6/27/2016	Staining at 2 ft bgs; glass, metal, cans, and ash debris 2-6 ft bgs.	No, edge	Yes
TP-56	10/31/2016	No debris or staining observed.	No	No
TP-57	6/30/16	Orange to brown soil; glass, metal, and wood debris; PID readings were normal 1.5-7.5 ft bgs. Two inert shells encountered within the debris; one was described as a 105 millimeter shell, the other as an empty and smashed M105 with the primer removed. No debris or staining 7.5-12 ft bgs.	Yes	Yes
TP-58	10/28/2016	Debris (glass, metal, and wood) with red staining due to rusting metal 3-5 ft bgs, no odor. No debris or staining 5-7 ft bgs.	Yes	Yes
TP-59	6/29/2016	Soil matrix greenish brown 1.5-5.5 bgs; PID readings were normal.	No	No
TP-60	6/30/2016	Orange to brown soil stain; glass and wood debris; PID readings were normal 2 to 9 ft bgs.	Yes	Yes
TP-61	10/27/2016	No debris or staining observed.	No	No
TP-62	10/27/2016	No debris or staining observed.	No	No
TP-63	6/24/2016	No debris or staining observed.	No	No
TP-64	6/27/2016	Debris (metal pieces, glass, ash, and assorted trash), soil iron staining encountered 6-7.5 ft bgs.	Yes	Yes
NOTES: bgs =		Below ground surface.		
ft =		Feet.		
PID =		Photoionization detector.		

It should be noted that the location accuracy of the test pit locations and the EM31-MK2 data is not known precisely and each could be as much as 1-2 meters off from the location plotted on the map. In addition, the length and orientation of each test pit is not precisely known because they were interpreted from the EM31-MK2 data. It is likely that test pits containing disposal material and that were shown on the edge of an interpreted trench were just within the trench. Similarly, test pits containing no disposal material that appeared to be on the edge of a trench were likely just outside of the interpreted trench.

There appear to be non-trench-like anomalies throughout the geophysical survey area that are not within the trench complexes (red and/or blue colored features in Figure 4). Some of these were identified as above ground objects, but others were not. Some of the individual anomalies not attributed to above ground objects were investigated during the Site Inspection but no buried debris was observed in the associated test pits (e.g., Test Pit 41, Test Pit 44, and Test Pit 54). It is possible that some of these are in-phase "artifacts" or the test pits were not precisely located over the anomaly.

3.2 2018 REMEDIAL INVESTIGATION TEST PIT INVESTIGATION

One of the objectives of the work outlined in this work plan is to refine the lateral extent of subsurface debris at the Former Landfill Complex. The 2016 Site Inspection identified the southeastern portion of the Former Landfill Complex as the estimated area of historical landfill activity, with four specific areas of suspected trenches or buried material (Appendix B). The 2018 EA evaluation of the geophysical data, discussed in Section 3.1, resulted in the identification of three trench complexes and one stand-alone trench (Figure 4). To test the hypothesis that historical disposal activities were limited to the areas delineated on Figure 4, test pits will be completed in the remaining portion of the Former Landfill Complex (i.e., all test pits will be placed outside of the trench complexes and trench area identified in Figure 4).

Test pit locations were selected using systematic grid sampling (fixed spacing) with *Visual Sample Plan* (VSP) (VSP Development Team 2018). In accordance with Section 5.8 of the Performance Work Statement (26 September 2017), 20 test pits will be completed at the site. The completion of 20 test pits inside the Former Landfill Complex suspected to be free of historical disposal debris is sufficient to make the following determination:

- If 20 of 20 test pits are free of historical disposal debris, then it can be stated with 95 percent confidence that if enough test pits were completed to cover the entire Former Landfill Complex (24 acres, which is equivalent to approximately 10,454 test pits that are 100 square feet each), at least 86 percent of them would be free of debris associated with historical disposal activities. If one or more of the 20 test pits contains historical disposal debris then the hypothesis is rejected, and EA will re-estimate the proportion of test pits without historical disposal debris at the 95 percent confidence interval.

Proposed test pit locations are presented on Figure 5 and Table 3. It should be noted that three test pit locations were shifted slightly from the VSP-designated location. Test Pit 79 was shifted slightly west to avoid the Roza District Irrigation Channel, Test Pit 82 was shifted slightly west to avoid what appears to be a dirt road and above ground surface features to the east of the road (Figure 5), and Test Pit 88 was shifted slightly south ensure a buffer between the test pit and the inferred trench feature. It should also be noted that the location of Test Pit 85 may need to be adjusted in the field based on the location of above ground surface features that appear to be in the vicinity of that test pit (Figure 5).

Information on field procedures is provided in Section 4 and the Site-Specific QAPP provided in Appendix A.

Table 3. Proposed Test Pit Locations

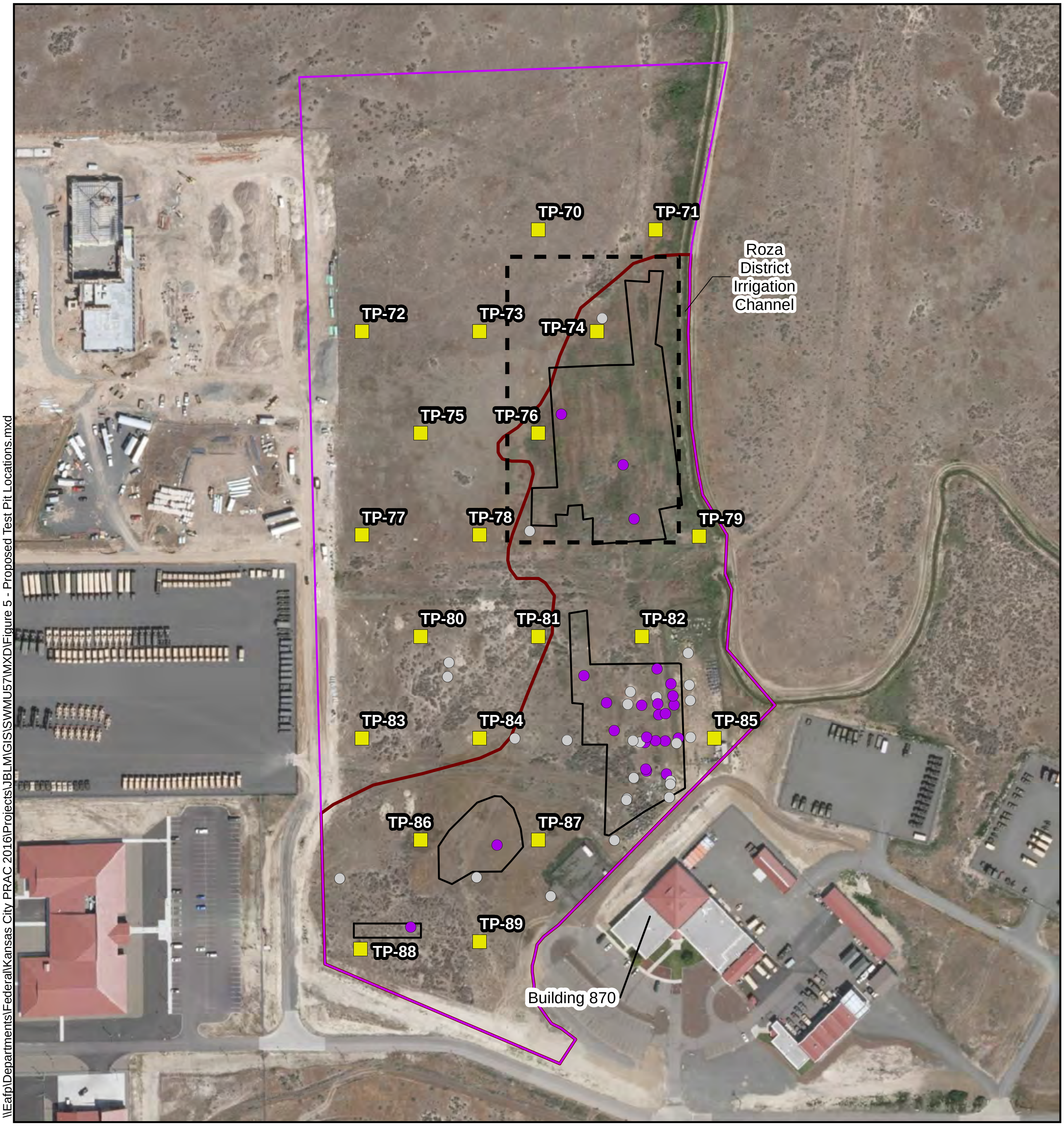
Test Pit Number	X Coordinate[(a)]	Y Coordinate[(a)]
TP-70	694921.0617	5173217.519
TP-71	694983.0851	5173217.519
TP-72	694828.0266	5173163.806
TP-73	694890.05	5173163.806
TP-74	694952.0734	5173163.806
TP-75	694859.0383	5173110.092
TP-76	694921.0617	5173110.092
TP-77	694828.0266	5173056.378
TP-78	694890.05	5173056.378
TP-79	695006.0621	5173055.574
TP-80	694859.0383	5173002.664
TP-81	694921.0617	5173002.664
TP-82	694975.8539	5173002.664
TP-83	694828.0266	5172948.95
TP-84	694890.05	5172948.95
TP-85	695014.0968	5172948.95
TP-86	694859.0383	5172895.236
TP-87	694921.0617	5172895.236
TP-88	694827.2231	5172837.505
TP-89	694890.05	5172841.523

a. Coordinate system is WGS 1984 UTM Zone 10N, meters.

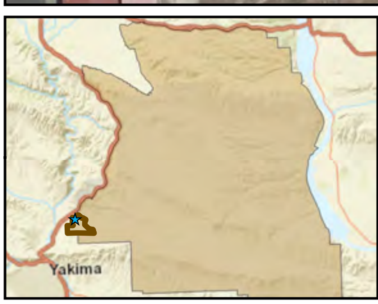
3.3 2018 REMEDIAL INVESTIGATION SOIL SAMPLING

In conjunction with the test pits, soil samples will be collected to further characterize concentrations of VOCs, SVOCs, TPH, organochlorine pesticides, PCBs, chlorinated herbicides, and metals in soil. As discussed in Sections 2.3.2 and 2.4, the potential for risk or hazards to receptors at the Former Landfill Complex from exposure to chemical contaminants is low. However, soil sampling will be completed to confirm this characterization of site risks and hazards. One soil sample will be collected from each test pit.

Information on field procedures is provided in Section 4 and the Site-Specific QAPP provided in Appendix A.



\\Eafp\Departments\Federal\Kansas City PRAC 2016\Projects\JBLM\GIS\SWMU57\MXD\Figure 5 - Proposed Test Pit Locations.mxd



0 75 150 300
Feet

1 inch equals 0.05 miles

N

Legend

- Proposed Test Pit Location
- Test Pit With Debris
- Test Pit Without Debris
- Site Inspection Study Area Boundary
- Solid Waste Management Unit 57
- Interpreted Trench Complex
- 2017 Site Inspection Estimated Landfill Boundary

FIGURE 5
PROPOSED TEST PIT LOCATIONS
WORK PLAN

Map Date: 7/19/2018
Coordinate System: UTM Zone 10
Horizontal Datus: WGS 84

4. FIELD ACTIVITIES

Field activities will consist of digging, logging, and closing 20 test pits and collecting 20 soil samples. An overview of field activities is provided here and details such as standard operating procedures, quality assurance and quality control measures, data quality objectives, and laboratory information is provided in the Site-Specific QAPP (Appendix A).

4.1 SITE ACCESS

Access to the Former Landfill Complex will be coordinated with JBLM and YTC. Access will be limited to only those personnel required to accomplish the specific operations or to those personnel who have a specific purpose and authorization to be on the site.

Per the LUCs currently in place at the Former Landfill Complex permission is required for intrusive work. Prior to initiation of field work, approval of the planned intrusive activities will be obtained.

4.2 SAFETY AND OPERATIONAL TRAINING AND BRIEFING

Field activities will be conducted in accordance with the project Accident Prevention Plan (EA 2018a). In addition, because unexploded ordnance items have been found at the Former Landfill Complex (Section 2.3.2.5), munitions and explosives of concern awareness training will be conducted prior to initiating field work for the field team and any subcontractors. Field workers will be specifically trained in the "3 Rs," Recognize, Retreat, Report. Potential munitions items found during field activities will be reported to the appropriate authorities at YTC.

4.3 TEST PITS

Test pits will be excavated with a backhoe, in an area 5 ft by 5 ft to a depth of 10 ft. A utility locate will be performed prior to the field investigation. Test pit locations will be revised in the field accordingly with attention to avoiding utilities without compromising the statistical basis for test pit location. Where visual observations suggest that additional excavation of the sidewall or bottom would be warranted, additional excavation may be performed. If debris is observed in test pits it will be left in place, noted on the field form, and covered when the test pit is closed. If a photograph permit is obtained, photographs of the test pits will be collected and cataloged for inclusion in the RI report. The locations of the test pits will be determined using a global positioning system unit, and field observations will be recorded on field forms provided in Appendix C. Test pits will be backfilled with the excavated material and regraded to match the original land surface. No field screening of soils will be performed.

More detailed information regarding field procedures and test pit naming is provided in the Site-Specific QAPP (Appendix A).

4.4 SOIL SAMPLES

One soil sample will be collected from each test pit. The depth and specific location of sample collection will be determined in the field. Soil samples will be collected from a depth of 5 ft from one of the excavation sidewalls of the test pit if no debris is encountered. If debris is encountered or olfactory or visual indicators suggest a potential for impacts to soil, the soil sample will be collected from the depth interval that appears to have the greatest impact. Sampling personnel will not enter excavations; samples will be collected from the contents of the excavator bucket. The excavator bucket will be decontaminated prior to arrival at the site. Dry decontamination methods (brushing and hand spraying/wiping) will be used to remove visible material between test pits.

Information relating to the collection, naming, and shipping of soil samples and the analysis and validation of soil sample data is provided in the Site-Specific QAPP (appendix A).

4.5 INVESTIGATION-DERIVED WASTE

Investigation derived waste will be generated during the soil sampling and will consist of disposable sampling equipment (e.g., scoops), dry decontamination materials (e.g., wipes), and personal protective equipment (e.g., nitrile gloves). Disposable sampling equipment, dry decontamination materials, personal protective equipment will be placed into trash bags and disposed of as sanitary waste. Soil from the test pits will be returned to the excavations and regraded to match the original land surface.

5. REMEDIAL INVESTIGATION REPORT

The field investigation activities and findings will be summarized in an RI Report. The RI Report will synthesize the new and existing information and present a refined conceptual site model and lateral extent of subsurface debris. The RI will also evaluate the newly generated soil data relative to criteria for unrestricted and industrial land uses (i.e., MTCA Method A Soil Cleanup Levels for Unrestricted Uses, USEPA RSLs for residential soil, MTCA Method A Soil Cleanup Levels for Industrial Properties, and USEPA RSLs for industrial soil). Data generated as part of the RI effort will be used to support the evaluation of potential cleanup actions in a focused FS for the Former Landfill Complex. Ultimately, a Decision Document will be prepared identifying a selected remedy for the Former Landfill Complex in accordance with Washington Administrative Code Chapter 173-340.

The RI report will be prepared in draft form for JBLM and U.S. Army Corps of Engineers review, and will be followed by a draft final report for regulatory review. A final report will be prepared after incorporation of regulatory and/or additional JBLM/U.S. Army Corps of Engineers comments.

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6. REFERENCES

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Appendix A

Site-Specific Quality Assurance Project Plan

October 2018

DRAFT FINAL
SITE-SPECIFIC QUALITY ASSURANCE PROJECT PLAN FOR REMEDIAL INVESTIGATION AT THE FORMER LANDFILL COMPLEX

Joint Base Lewis-McChord Yakima Training Center

Yakima, Washington

Joint Base Lewis-McChord Public Works – Environmental Division
IMLM-PWE
MS 17 Box 339500
Joint Base Lewis-McChord, Washington 98433

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Site-Specific Quality Assurance Project Plan for Remedial Investigation at the Former Landfill Complex

Joint Base Lewis-McChord Yakima Training Center Yakima, Washington

Prepared for

Joint Base Lewis-McChord
Public Works – Environmental Division
IMLM-PWE
MS 17 Box 339500
Joint Base Lewis-McChord, Washington 98433

Prepared by

EA Engineering, Science, and Technology, Inc., PBC
2200 6th Avenue, Suite 707
Seattle, Washington 98121

Timothy McCormack, LHG	Date
Project Manager	

James Costello, P.G.	Date
Program Manager	

October 2018
Version: DRAFT FINAL
EA Project No. 63043.05

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LIST OF FIGURES

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LIST OF ACRONYMS AND ABBREVIATIONS

°C	Degrees Celsius
APP	Accident Prevention Plan
bgs	Below ground surface
DL	Detection limit
DoD	Department of Defense
DOE	Department of Energy
DQO	Data quality objective
DRO	Diesel range organics
EA	EA Engineering, Science, and Technology, Inc., PBC
Ecology	Washington State Department of Ecology
ELAP	Environmental Laboratory Accreditation Program
ft	Feet/foot
FS	Feasibility study
GRO	Gasoline range organics
IDW	Investigation-derived waste
JBLM	Joint Base Lewis-McChord
LOD	Limit of detection
LOQ	Limit of quantitation
LUC	Land use control
mL	Milliliter
MS	Matrix spike
MSD	Matrix spike duplicate
MTCA	State of Washington Model Toxics Control Act
No.	Number
OGC	Office of the Garrison Commander, Fort Lewis
oz	Ounce
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PQL	Practical quantitation limit

QA	Quality assurance
QAPP	Quality Assurance Project Plan
QC	Quality control
RCRA	Resource Conservation and Recovery Act
RI	Remedial investigation
RRO	Residual range organics
RSL	Regional Screening Level
SI	Site investigation
SIM	Selected ion monitoring
SOP	Standard operating procedure
SVOC	Semivolatile organic compound
SWMU	Solid waste management unit
TPH	Total petroleum hydrocarbons
UFP	Uniform Federal Policy
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
VOA	Volatile organic analyte
VOC	Volatile organic compound
YTC	Yakima Training Center

1. INTRODUCTION

EA Engineering, Science, and Technology, Inc., PBC (EA) has prepared this Site-Specific Quality Assurance Project Plan (QAPP) in support of a remedial investigation (RI) and focused feasibility study (FS) for the Yakima Training Center (YTC) Former Landfill Complex, which includes Solid Waste Management Unit (SWMU) 57. This work is being performed under the Environmental Remediation Multiple Award Indefinite Delivery/Indefinite Quantity Contract W912DQ-16-D-3001. This QAPP is prepared in the Uniform Federal Policy (UFP) format and will be referred to herein as "QAPP." This QAPP will be used in conjunction with the Work Plan for RI at the Former Landfill Complex (referred to as the Work Plan), to which it is an Appendix, and in conjunction with the Programmatic QAPP prepared for environmental remediation program services conducted by EA at Joint Base Lewis-McChord (JBLM) and YTC (EA 2018b).

1.1 BACKGROUND

YTC is an active United States Army sub-installation of JBLM located approximately 5 miles northeast of Yakima, Washington (Figure 1). YTC occupies over 323,000 acres and is divided into the Cantonment Area and the Down Range Area. The Former Landfill Complex is located in the western portion of the YTC Cantonment Area (Figure 1).

The Former Landfill Complex is approximately 27 acres and includes SWMU 57, which is approximately 3 acres in size. In the mid-1950s through the late 1960s municipal solid waste generated in the Cantonment Area and training areas was placed in open unlined trenches and burned within SWMU 57 and other portions of the Former Landfill Complex (TerranearPMC, LLC 2017). A March 2007 Decision Document selected land use controls (LUCs) to prevent residential use and unplanned excavations as the remedy for the Former Landfill Complex in the vicinity of SWMU 57 (Office of the Garrison Commander, Fort Lewis [OGC] 2007). However, investigations conducted in 2012-2013 for the construction of National Guard barracks adjacent to Building 870 indicated that the distribution of waste was greater than the previously identified SWMU 57 (TerranearPMC, LLC 2017). A site investigation (SI) was conducted in 2016 to confirm the presence/absence of chemical impacts in soil associated with the former burning and landfilling activities. The geophysical, soil gas, and soil chemical data sets generated during the SI identified impacts related to the former disposal activities (TerranearPMC, LLC 2017). Based on the results of the SI, further investigation is warranted to refine the lateral extent of subsurface debris and further characterize soil contamination associated with the buried waste in order to select a remedy for the Former Landfill Complex and determine actions that may be necessary if future development activities were to be pursued.

Additional background information for YTC and the Former Landfill Complex is provided in the Work Plan.

1.2 DOCUMENT PURPOSE

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 RI activities at the Former Landfill Complex. This Site-Specific 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 document meets the requirements of Washington Administrative Code Chapters 173-340-820 and 173-340-830.

1.3 REPORT ORGANIZATION

This Site-Specific QAPP will be used in conjunction with the Programmatic QAPP (EA 2018b) and the Accident Prevention Plan (APP) (EA 2018a) to address elements of the work to be performed. The Programmatic QAPP consistently presents the information applicable to multiple sites at JBLM and YTC and eliminates the replication of common information. The Site-Specific QAPP ties to the Programmatic QAPP (EA 2018b), and only those worksheets that provide information specific to the execution of project tasks at the Former Landfill Complex are presented herein.

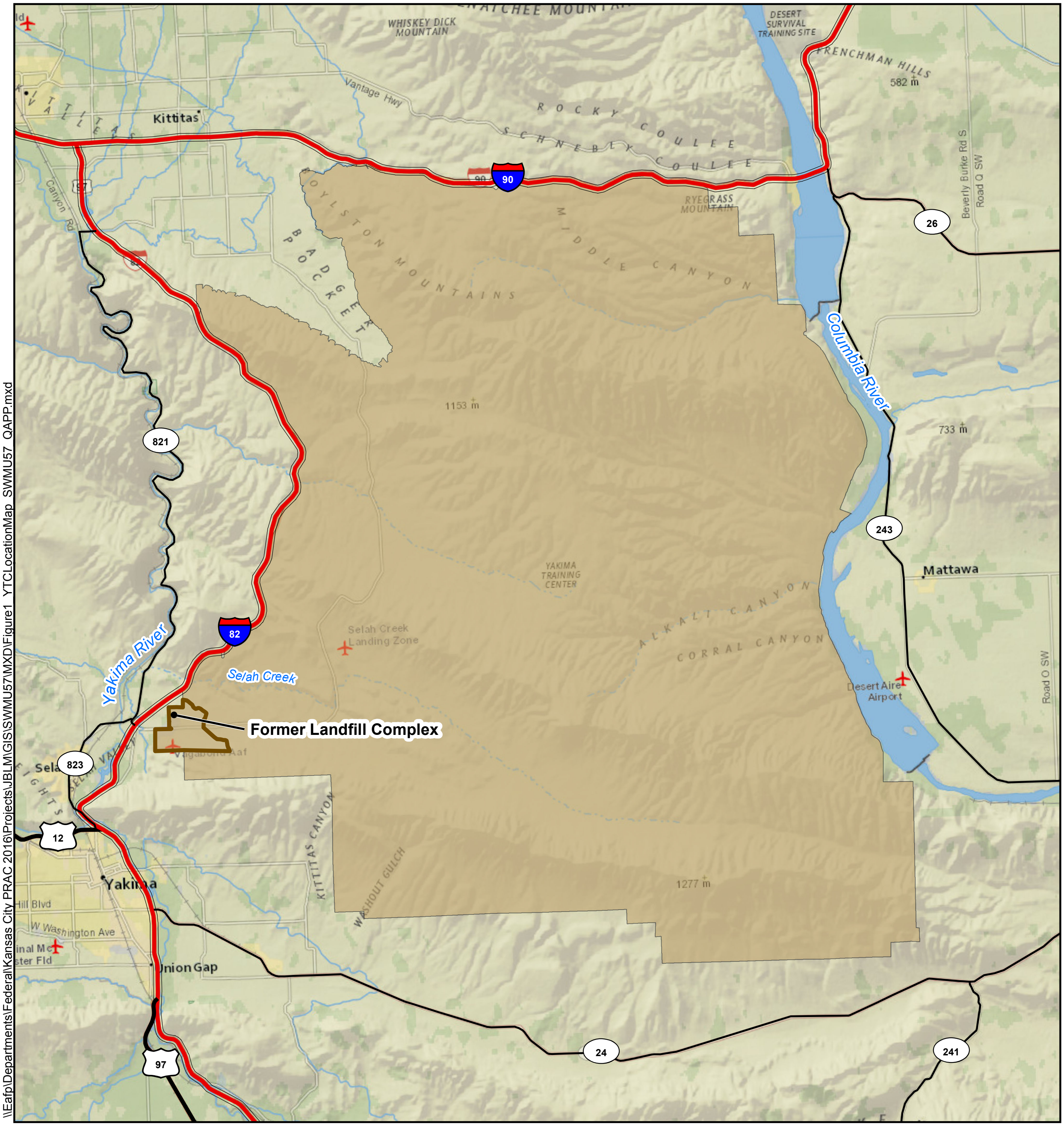
When used in conjunction with the Programmatic QAPP, this document meets the requirements and elements set forth in the Intergovernmental Data Quality Task Force UFP for QAPPs (U.S. Environmental Protection Agency [USEPA], Department of Defense [DoD], and U.S. Department of Energy [DOE] 2005). The QAPP Manual integrates the USEPA seven-step data quality objective (DQO) process (USEPA 2006), and the terminology in this QAPP is consistent with the QAPP Manual (USEPA, DoD, and DOE 2005). The worksheets in this document follow the optimized QAPP format of the QAPP Workbook (USEPA, DoD, and DOE 2012), as outlined in Table 1.

This document is organized as follows:

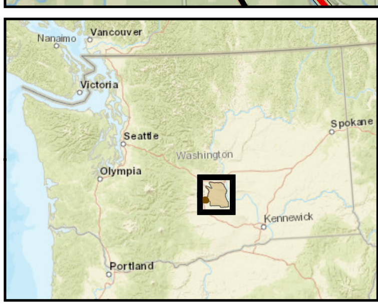
- ***Section 1, "Introduction"***—Describes the report organization, site background, and document purpose.

- ***Section 2, "Worksheets"***—Includes the optimized worksheets specified by the Intergovernmental Data Quality Task Force UFP for QAPPs.

- ***Section 3, "References"***—Provides reference information for the sources cited in the document.



\\Eafp\Departments\Federal\Kansas City PRAC 2016\Projects\JBLM\GIS\SWMU57\MXD\Figure1 YTCLocationMap SWMU57 QAPP.mxd



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Miles

1 inch equals 5 miles

N

Legend

- Yakima Training Center
- Cantonment Area Boundary
- Interstate
- State Route
- US Route

FIGURE 1
YAKIMA TRAINING CENTER LOCATION MAP

UNIFORM FEDERAL POLICY-
QUALITY ASSURANCE PROJECT PLAN

Map Date: 7/17/2018
Coordinate System: UTM Zone 10
Horizontal Datus: WGS 84

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2. WORKSHEETS

The worksheets presented in this section document the project organization, specific procedures for the execution of the work, QA/QC protocols, and the assessment and oversight planning that will ensure the quality of the data collection. This format satisfies the USEPA Requirements for QAPPs (USEPA 2006) and follows the current QAPP guidance (USEPA, DoD, and DOE 2005). The original 37 worksheets have been optimized into the 28 worksheets (USEPA, DoD, and DOE 2012) included in this QAPP and summarized in Table 1.

Table 1 Uniform Federal Policy-Quality Assurance Project Plan Worksheet Summary

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

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Worksheets #1 and #2: Title and Approval Page

Site Location: YTC Former Landfill Complex

Contract/Work Assignment: W912DQ-16-D-3001, Delivery Order W912DW-18-F-5012

Document Title: Site-Specific Quality Assurance Project Plan for Remedial Investigation at the Former Landfill Complex

Preparation Date: October 2018

Lead Organization: JBLM Public Works – Environmental Division

Lead Organization Program Manager

Signature:____________________ **Date**:__________

Meseret Ghebresllassie
JBLM Public Works – Environmental Division

Investigative Organization Project Manager

Signature:____________________ **Date**:__________

Timothy McCormack, LHG
EA

Regulatory Agency Project Manager

Signature:____________________ **Date**:__________

Thomas Mackie
Washington State Department of Ecology

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

This worksheet is presented in the Programmatic QAPP (EA 2018b).

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

This worksheet is presented in the Programmatic QAPP (EA 2018b).

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Worksheet #6: Communication Pathways

This worksheet is presented in the Programmatic QAPP (EA 2018b).

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Worksheet #9: Project Planning Session Summaries

This worksheet is presented in the Programmatic QAPP (EA 2018b).

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Worksheet #10: Conceptual Site Model

The conceptual site model for the Former Landfill Complex is presented in the Work Plan. A brief discussion of the site background and history and summaries of previous investigations is provided below.

Site Description, History, and Background

The Former Landfill Complex is located on YTC extending south to the northwestern border of Building 870. The Former Landfill Complex is approximately 27 acres and includes SWMU 57, which is approximately 3 acres in size. The surrounding area is predominately open, undeveloped high desert to the north and northeast with development to the south and west.

SWMU 57 was initially identified as the 1954-1968 Landfill/Burn Pits, reflecting the time period during which the area is thought to have been actively used. Municipal solid waste generated in the Cantonment Area and training areas was placed in open unlined trenches and burned, often on a daily basis. Site visits and investigations indicated as many as seven trenches may be present as well as a disposal area south of SWMU 57 (TerranearPMC, LLC 2017).

Previous Investigations

Several investigations have been completed at the Former Landfill Complex. A detailed description and evaluation of data from previous investigations is provided in Section 2.3 of the Work Plan. Brief descriptions of these investigations are provided below.

A 1995 Resource Conservation and Recovery Act (RCRA) Facility Assessment identified SWMU 57 as an area of concern (Science Applications International Corporation 1995).

A Relative Risk Site Evaluation for YTC concluded that the potential for risks associated with site conditions were low (Pacific Northwest National Laboratory 1996).

A 2003 RCRA Facility Investigation of SWMU 57 reported concentrations of antimony, cadmium, copper, lead, and tetrachloroethene in soil at concentrations greater than soil cleanup levels for unrestricted land use (Hart Crowser, Inc. 2003).

A 2007 Decision Document selected implementation and maintenance of LUCs to prevent unmitigated future residential land use and unplanned excavation within the Former Landfill Complex / burn pits boundary (OCG 2007).

During pre-construction geotechnical testing in 2012-2013 for the proposed construction of National Guard barracks adjacent to Building 870, burn residue and waste that appeared to be similar to what was found within SWMU 57 was encountered north of the proposed barracks location. Results indicated that the distribution of waste was greater than the previously identified SWMU 57 (TerranearPMC, LLC 2017).

A 2016 SI conducted on the southern 20 acres of the Former Landfill Complex indicated that the studied area had impacts related to the former disposal activities.

Worksheet #11: Project/Data Quality Objectives

This worksheet is used to develop the project DQOs using a systematic planning process that documents the environmental decisions that need to be made and the level of data quality needed to support them. The DQO process is outlined in the USEPA 2006 guidance document (USEPA 2006). The specific QA/QC requirements developed for the site are consistent with those presented in the DoD Quality Systems Manual, Version 5.1 (DoD and DOE 2017).

DQOs are both qualitative and quantitative statements that define the type, quality, and quantity of data necessary to support the decision-making process during project activities. The objective of this QAPP is to establish standard procedures so that the integrity, accuracy, precision, completeness, and representativeness of collected samples are maintained, and the required DQOs are achieved.

The DQO process provides a systematic procedure for defining the criteria that a data collection design should satisfy. The DQO process established by the USEPA and incorporated into the 2012 QAPP guidance consists of seven steps; these steps are used during the planning of the data collection process to ensure that field and analytical activities, and the resulting data, meet the project objectives. The DQO process is designed to: (1) clarify study objectives and decisions to be made based on the data collected, (2) define the most appropriate type of data to collect, (3) determine the most appropriate conditions for collecting the data, and (4) specify acceptable decision error limits based on the consequences of making an incorrect decision.

The seven steps in the DQO process are as follows: (1) state the problem; (2) identify the goals of the study; (3) identify information inputs; (4) define the boundaries of the study; (5) develop the analytic approach; (6) specify performance or acceptance criteria; and (7) develop the detailed plan for data collection.

Step 1: State the Problem

There is uncertainty regarding the extent of buried waste, and potentially associated chemical contaminants, at the Former Landfill Complex. Existing geophysical, test pit, and soil analytical data have been evaluated to refine the lateral extent of disposal activities conducted at the Former Landfill Complex (see Section 3.1 of the Work Plan). Further data collection will be completed to refine the understanding of the lateral extent of disposal activities conducted at the Former Landfill Complex. Data collection will consist of field observations from 20 test pits and analytical data from 20 soil samples collected from within the test pits (Figure 11-1).

Current LUCs are in place to restrict the disturbance of the land's surface or development of the Former Landfill Complex and are protective under the current land use. The ultimate objective of this RI is to complete a Decision Document (in accordance with the State of Washington Model Toxics Control Act [MTCA] and federal RCRA Corrective Action regulations) that identifies a selected remedy for the Former Landfill Complex and determines what actions would be necessary if future development activities were to be pursued.

Step 2: Identify the Goals of the Data Collection

The goals of the RI study are to:

- Refine the delineation of the lateral extent of subsurface debris
- Further characterize the nature and extent of potential chemical contaminants in soil
- Support the preparation of an RI and focused FS, and selection of a remedy for the Former Landfill Complex (including SWMU 57).

Principal Study Questions

Is the lateral extent of the buried wastes characterized accurately based on historical data?

- Alternative Actions
  - No action
  - Re-evaluate the LUCs and the area to which they apply
  - Perform additional digital geophysical mapping at a higher resolution around the trench complexes.

Do the newly collected soil data support the previous conclusion that there is a low risk of exposure to chemical contaminants at the Former Landfill Complex?

- Alternative Actions
  - No action
  - Re-evaluate exposure pathways, potential receptors, and the potential for risk to receptors
  - Perform additional chemical sampling.

Decision Statement

Determine if the following hypothesis is accepted or rejected: historical disposal activities were limited to the interpreted trench locations delineated on Figure 4 in the Work Plan. This hypothesis will be accepted if no debris associated with historical disposal activities is found in 20 of 20 test pits. The hypothesis will be rejected if debris associated with historical disposal activities is found in one or more test pits.

Determine if the previous conclusion that there is a low risk of exposure to chemical contaminants at the Former Landfill Complex is supported.

Step 3: Identify the Information Inputs

Information inputs include the following:

- Existing geophysical and analytical data from previous investigations.
- New test pits completed in the portion of the Former Landfill Complex where historical disposal activities are not thought to have occurred.
- Collection and analysis of soil samples from the new test pits for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), total petroleum hydrocarbons (TPH), organochlorine pesticides, polychlorinated biphenyls (PCBs), chlorinated herbicides, and metals.

Analytical results from the chemical analysis of soil samples from test pits will be compared to the project screening levels presented in Worksheet #15.

Data Users

The data users include JBLM, United States Army Corps of Engineers (USACE), the regulatory authorities (Washington State Department of Ecology [Ecology]), and the Contractor.

Step 4: Define the Boundaries of the Study

The boundaries of the study are the portion of the Former Landfill Complex that was included in the 2016 SI geophysical survey outside of the identified trench complexes (i.e., the area situated from approximately the northern border of SWMU 57 south to the developed area adjacent to Building 870).

Step 5: Develop the Analytic Approach

The data generated by the investigation will be evaluated in accordance with the following "if/then" statements to support decision making at the site:

- If 20 of 20 test pits are free of historical disposal debris, then it can be stated with 95 percent confidence that if enough test pits were completed to cover the entire Former Landfill Complex (24 acres, which is equivalent to approximately 10,454 test pits that are 100 square feet each), at least 86 percent of them would be free of debris associated with historical disposal activities.
- If one or more of the 20 test pits contains historical disposal debris, then the hypothesis that disposal activities were limited to the areas delineated on Figure 4 of the Work Plan will be rejected, and the proportion of test pits without debris associated with historical disposal activities will be re-estimated at the 95 percent confidence interval. The test pit

findings will be presented in the RI and to stakeholders, who will consider the Alternative Actions presented in Step 2 to select a path forward.

- If soil analytical data indicate that analyte concentrations are consistent with or less than historically reported concentrations, and concentrations are not above applicable screening criteria, then the existing conclusions regarding the lack of site risks from chemical constituents will be supported. Consistency between the 2018 and historical datasets will be determined using hypothesis testing or an equivalent statistical method.

- If soil analytical data indicate that analyte concentrations are higher than historically reported concentrations and applicable screening criteria, then the existing conclusions regarding site risks will be re-evaluated.

Step 6: Specify Performance or Acceptance Criteria

This section evaluates the consequences of making incorrect decisions and considerations and/or actions taken to mitigate decision error.

Decision Error and Potential Consequences

With respect to the chemical analytical data, the acceptable limits for false positive or false negative decision errors will be based on evaluating the potential consequences of these decision errors (such as risks to human health and the environment or unnecessary expenditures for additional sampling) if specific contaminants are detected or are not detected above action levels. Two potential decision errors could be made based upon interpreting sampling and analytical data:

1. Concluding that the concentration of a specific chemical at a sample location within an area is below the action level when it truly is above the action level.

2. Concluding that the concentration of a specific chemical at a sample location within an area is greater than the action level when it truly is below the action level.

The consequences of the first error could have severe implications because the contamination would be left undetected and leave risk at the site due to contaminant concentrations. The second error could result in unnecessary expenditure, and diversion of resources that could be used for cleanup of other contaminated areas.

The consequences of the first error are deemed more serious because of the potential risk. The baseline condition, therefore, is established such that the contaminant concentration is truly greater than or equal to the action level. The baseline condition is defined as the null hypothesis (H_0). The alternative is defined as the alternative hypothesis (H_a). This may be summarized as follows:

$$H_0: \text{[concentration]} \geq \text{action level}$$
$$H_a: \text{[concentration]} < \text{action level}$$

A false positive error, also known as a Type I error, occurs when the null hypothesis is falsely rejected (i.e., the sample data show that the concentration of a chemical is below the action level when it actually exceeds the action level). The measurement of the size of this error is called alpha (α), the level of significance. Alpha is expressed numerically as a probability or the tolerance for uncertainty.

A false negative error, also known as a Type II error, occurs when the null hypothesis is falsely accepted (i.e., the sample data show that the concentration of the chemical is above the action level when it actually is below the action level). The measurement of the size of this error is called beta (β), or the complement of the power of the hypothesis test.

The tolerance limits for decision error have been established at α=5 percent or 0.05 for false positives and β=20 percent or 0.2 for false negatives.

Sources of Error

Total study error potential is equally attributable to sampling and measurement error because of the steps and sample volume associated with the planned sample collection and analysis. Successfully managing the magnitude of total study error is the result of understanding the error sources, generating an appropriate sampling design, and choosing accurate measurement techniques.

The sources of decision error for soil data are equally attributable to sampling or measurement error. This conclusion is based upon review of the sampling and analysis strategy. The sampling design is straightforward, and the analysis will be performed using the services of a DoD Environmental Laboratory Accreditation Program (ELAP) accredited laboratory with standard methods.

The quality of sampling and analysis must be at a level that results in representative, precise, and reproducible data. The data generated will be sufficient for the intended use. "Good" data will be defined as data that are produced following the specified standard operating procedures (SOPs) and meeting the established criteria in this QAPP, including precision, accuracy, comparability, representativeness, completeness, and sensitivity.

The data need to be of adequate quality to make the decisions established for this site. The purpose of this is to minimize the possibility of either making erroneous conclusions or failing to keep uncertainty in estimates to within acceptable levels. Worksheet #12 of the Programmatic QAPP (EA 2018b) presents the measurement performance criteria applicable to the analytical sampling associated with this effort.

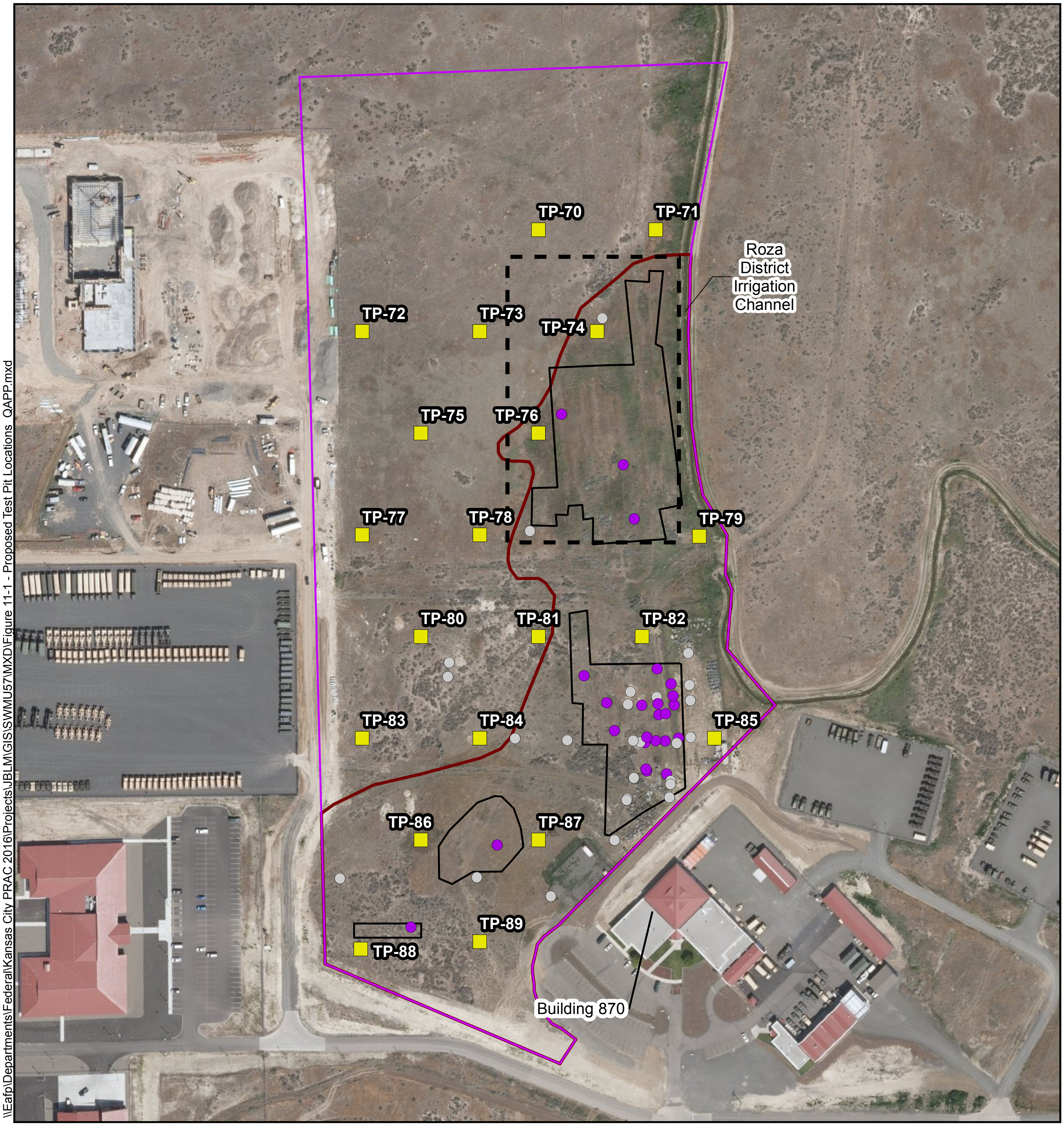
Step 7: Develop the Detailed Plan for Data Collection

The plan for data collection is described below.

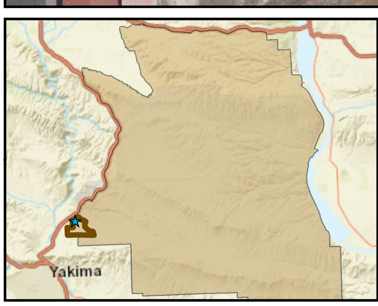
- Test pits will be excavated with a backhoe.

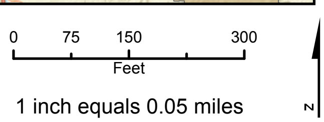
- Observations of potential waste will be made and noted on field forms for each test pit.
- Soil samples will be collected from the bottom or sidewall of the test pits. The depth and specific location of sample collection will be determined in the field based on field observations. Sampling personnel will not enter excavations; samples will be collected from the undisturbed contents of the excavator bucket.
- Soil samples will be shipped offsite for laboratory analysis of:
  - VOCs (SW8260C)
  - SVOCs (SW8270D)
  - Polycyclic aromatic hydrocarbons (PAHs) (SW8270D by selected ion monitoring [SIM])
  - TPH-gasoline range organics (GRO) (NWTPH-Gx)
  - TPH-diesel range organics (DRO) and residual range organics (RRO) (NWTPH-Dx)
  - Organochlorine pesticides (SW8081B)
  - PCBs as Aroclors (SW8082A)
  - Chlorinated herbicides (SW8151A)
  - Metals (SW6010C, SW6020A, and SW7471B).

Additional details pertaining to the sampling plan are provided in Worksheets #14 and 16, #17, and #18. Worksheet #20 details the field sample count and QC sample requirements.



\\Eafp\Departments\Federal\Kansas City PRAC 2016\Projects\JBLM\GIS\SWMU57\MXD\Figure 11-1 - Proposed Test Pit Locations_QAPP.mxd





1 inch equals 0.05 miles

Legend

- Proposed Test Pit Location
- Previous Test Pit With Debris
- Previous Test Pit Without Debris
- Site Inspection Study Area Boundary
- Solid Waste Management Unit 57
- Trench Complex
- 2017 Site Inspection Estimated Landfill Boundary

FIGURE 11-1
PROPOSED TEST PIT LOCATIONS
UNIFORM FEDERAL POLICY-
QUALITY ASSURANCE PROJECT PLAN

Map Date: 7/19/2018
Coordinate System: UTM Zone 10
Horizontal Datus: WGS 84

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Worksheet #12: Measurement Performance Criteria for Analytical Testing

This worksheet is presented in the Programmatic QAPP (EA 2018b).

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Worksheet #13: Secondary Data Uses and Limitations

Sources of secondary data that may be used for this task order are included below. Note this is not an exhaustive list, as 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
Report	Hart Crowser, Inc., RCRA Facility Investigation Report, Former Landfill/Burn Pits (SWMU 57), March 2003.	Soil data from five test pits, including results for TPH, metals, PCBs, SVOCs, and VOCs	Information regarding the potential for and distribution of chemical contaminants along the trenches where waste is buried.	These data are valid and usable for assessing the extent of impacts.
Decision Document	Decision Document for Selected Remedy 1954-1968 Landfill/Burn Pits (SWMU 57) Yakima Training Center, WA. February 2007.	Identification of remedy and establishment of LUCs	Information regarding site history, risk, and selected remedy	These data are valid and usable
Report	TerranearPMC, LLC. Site Inspection Former Landfill Complex Yakima Training Center, Yakima, Washington 98901. January 2017.	Geophysical data, soil gas data, and soil data from 25 test pits, including results for VOCs, SVOCs/PAHs, pesticides, PCBs, herbicides, metals, TPH-GRO, and TPH-DRO.	Information regarding the extent of buried waste and the distribution of associated chemical contaminants.	These data are valid and usable for assessing the extent of impacts.
Guidance Document	Sealaska Environmental Services, LLC, 2017 Comprehensive Land Use Controls Plan, Joint Base Lewis-McChord, Pierce County, Washington, January 2018.	Land Use Control Plan for YTC.	To describe land use controls and institutional controls.	These data are valid and usable for comparison.

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Worksheets #14 and 16: Project Tasks and Schedule

This worksheet provides an overview of the project tasks, describes the procedures to be followed, and presents a summary of the project deliverables to be prepared in support of the RI/focused FS at the Former Landfill Complex. Field tasks will be conducted in accordance with this worksheet and the field SOPs listed in Worksheet #21 and provided in Appendix A of the Programmatic QAPP (EA 2018b). The sampling design and rationale are discussed further in the Work Plan and in Worksheet #17. Worksheet #18 summarizes the test pit and soil sampling locations. A general project schedule detailing the specific tasks and planned start and end dates is presented at the end of this worksheet.

14.1 Mobilization/Demobilization Tasks

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

- Coordinate access to the Former Landfill Complex with JBLM and YTC
- Obtain necessary access, escorts, and permissions for conducting intrusive work
- Obtain the necessary information from field personnel to meet installation access requirements
- Coordinate with field personnel and subcontractors as needed
- Determine staging areas for equipment, if necessary
- Order sample bottles and field equipment.

Sample bottle requirements are presented in Worksheet #19 and 30. The equipment necessary to execute the field work and complete the project tasks is detailed below and in the SOPs identified in Worksheet #21.

Sampling personnel will meet with YTC personnel to obtain access to the Former Landfill Complex. Entrance briefing and safety meetings will be conducted prior to the start of fieldwork to familiarize the 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 have current Occupational Safety and Health Administration (OSHA) hazardous waste operations training and medical surveillance as specified in the APP, which has been submitted as a separate document (EA 2018a). Site personnel will also be trained to perform the specific tasks to which they are assigned and will receive munitions and explosives of concern awareness training, specifically the “3 Rs,” Recognize, Retreat, Report. 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 planned test pit locations and will identify related field support areas and requirements.

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.

14.2 Test Pit Tasks

Proposed test pit locations are shown on Figure 11-1, and approximate coordinates for the center of each test pit are provided in Worksheet #18. A utility locate will be performed prior to the field investigation. Test pit locations will be revised in the field accordingly with attention to avoiding utilities without compromising the statistical basis for test pit location. Actual test pit coordinates will be recorded with a global positioning system unit. Test pits will be excavated using a backhoe, and will cover a lateral extent of approximately 5 feet (ft) by 5 ft. Excavated material will be placed in the immediate vicinity of the test pit on the ground surface. If waste material is encountered, excavated soil will placed on plastic sheeting. The test pits will be completed to refusal or a maximum depth of 10 ft below ground surface (bgs). Due to the depth to groundwater in the Cantonment Area (predicted to be 100-200 ft bgs [TerranearPMC, LLC 2017]), groundwater is not anticipated to be encountered during test pit excavation.

During the excavation of each test pit, the field team will complete a Test Pit Log Form (Appendix C of the Work Plan) and will record observations of burn residue and waste, if encountered. Where visual observations suggest that additional excavation of the sidewall or bottom is warranted, additional excavation may be performed. If debris is observed in test pits, it will be left in place, noted on the field form, and covered when the test pit is closed. No field screening of soils will be performed. Photographs of the pits will be collected, with appropriate YTC approval, and cataloged for inclusion in the RI report. One soil sample will be collected from each test pit, as described in Section 14.3.

Following the completion of activities at each test pit, soil from the test pits will be returned to the excavations and regraded to match the original land surface.

14.3 Soil Sampling Tasks

One representative soil sample will be collected from the sidewall or bottom of each test pit. The depth and specific location of soil sample collection within each test pit will be determined in the field. Samples will be collected from the contents of the excavator bucket, and sampling personnel will not enter excavations. If no debris is encountered, samples will be collected from sidewall soil dug from a depth of 5 ft bgs. If debris is encountered, or olfactory or visual indicators suggest a potential for impacts to soil, the soil sample will be collected from the depth interval that appears to have the greatest impact. Samples will be managed as described in Section 14.8 and will be submitted to the laboratory for analyses described in Section 14.9.

Soil samples will be collected in accordance with SOP 025 provided in Appendix A of the Programmatic QAPP (EA 2018b) and in accordance with the Terra Core® sampling instructions provided in Appendix C of the Work Plan. The equipment to be used for sample collection will include disposable sampling scoops and a Terra Core® or equivalent sampling device for VOC and TPH-GRO samples. Sample containers will be provided by the analytical laboratory, and will be pre-preserved for those constituents that require chemical preservation, as detailed in Worksheet #19 and #30.

VOC and TPH-GRO samples will be collected first using the Terra-Core® (or equivalent) sampling methodology. The Terra Core® handle will be plunged into the contents of the excavator bucket until the sampler is filled. The sample volume will then be released into pre-tared 40-milliliter (mL) volatile organic analyte (VOA) vials. Following the collection of samples for VOC and TPH-GRO analysis, the soil in center of the excavator bucket will be homogenized with the sampling scoop and transferred to the remaining sample bottles. New scoops and Terra Core® samplers will be used for the collection of each soil sample.

Field logbook documentation will be completed during the planned soil sampling activities as detailed in Section 14.7.

14.4 Equipment Decontamination Tasks

The excavator bucket will be decontaminated prior to arrival at the site. Dry decontamination methods (brushing and hand spraying/wiping) will be used to remove visible material between test pits in accordance with SOP 005.

14.5 Investigation-Derived Waste

IDW will be generated during the soil sampling and will consist of disposable sampling equipment (e.g., scoops), dry decontamination materials (e.g., wipes), and personal protective equipment (e.g., nitrile gloves). Disposable sampling equipment, dry decontamination materials, and personal protective equipment will be placed into trash bags and disposed of as sanitary waste. Soil from the test pits will be returned to the excavations and regraded to match the original land surface.

14.6 Field Quality Control Tasks

Field QC tasks will be overseen by EA's Field Team Leader and/or QC Manager. Requirements for calibration, maintenance, testing, and inspection of field equipment are summarized in Worksheet #22 and related forms are provided in Appendix B of the Programmatic QAPP (EA 2018b).

Field QC samples are intended to provide an indication of the consistency of sample collection and analyses are over the course of the program. The analytical laboratory will analyze QC samples in accordance with the documents and procedures listed in Worksheet #28 of the Programmatic QAPP (EA 2018b).

Field and laboratory QC samples are listed on Worksheet #20 and will include the following:

- ***Field Duplicates*—** Soil field duplicate samples will be collected at a rate of 5 percent of project samples (1 per 20 field samples). Duplicate samples will be taken at the same time as the primary samples, using identical recovery techniques, and treated in an identical manner during storage, transportation, and analysis. The purpose of these samples is to check the reproducibility of laboratory and field procedures.

- ***Matrix Spike (MS)/Matrix Spike Duplicate (MSD)***—MS/MSD samples will be collected at a rate of 5 percent of project samples (1 set per 20 field samples). The sample location will be selected by the field staff and up to three times the normal sample volume will be collected to accommodate the extra volume required to prepare the MS/MSD samples at the laboratory. MS/MSD samples are required by the laboratory to evaluate the matrix effect of the sample upon the analytical methodology.

- ***Trip Blanks***—A minimum of one, laboratory-supplied, trip blank will accompany each cooler containing soil samples sent to the laboratory for VOC or TPH-GRO analysis. Trip blanks will be supplied by the laboratory in unopened, 40-mL VOA vials filled with laboratory grade, analyte-free water.

14.7 Documentation and Records

A bound field logbook will be used to record information about each field activity, including field personnel at the site, daily weather conditions, site conditions, tasks completed, general field notes, samples collected, field screening results, and deviations from this QAPP and other plans as detailed in SOP 059. Field activities will be recorded daily with black or blue waterproof ballpoint pens. Each page of field notes will be numbered and dated, and initials of crew members will be defined. Errors will be crossed out with a single line, initialed, and dated, and correct data entered adjacent to the error.

Pertinent information will be logged in the field logbook as follows:

- Date and time of sample collection
- Weather conditions
- Location number and name
- Location of sampling point
- Sample identification number
- Type of sample
- Condition of monitoring well

- Field observations, especially those such as floating immiscible layer or sheen on water surfaces

- References, such as maps or photographs of the sampling site

- Collection of QA/QC samples.

The following field logbook procedures will be followed to ensure that:

- The cover of each field logbook lists the project name, location, activities, name of contact and phone number, start/end date, and time of logbook entries.

- The date and start/end time of activities, personnel onsite, site conditions (including presence of airborne particulates [soot, dust, etc. from heavy truck traffic], and presence of unusual odors) and visitors onsite (as well as arrival and departure times) for each day are recorded.

- The weather entry for each day includes cloud cover (partly cloudy, full sun, etc.), precipitation (type and intensity), wind direction, temperature, wind speed, and humidity.

- Information such as the type of personal protective equipment, identification of contract documents, serial numbers of equipment utilized, serial/tracking number of shipments, deviances from the site plan, and times onsite and offsite are listed in field logbooks and/or appropriate field forms.

- No pages are removed from the field logbooks.

- Specific times are listed for each activity observed at the site in the field logbook.

- When author releases a specific field logbook that the new author prints his/her name, and signs the field logbook prior to making any entries in the field logbook.

Field sheets will be maintained by the sampling team to provide a daily record of significant events, observations, and measurements taken during the field investigation. The field sheets are intended to provide sufficient data and observations to enable the field team to reconstruct events that occur during the project. Field sheets will include daily field logs, test pit field forms, and soil sampling logs. Additional field forms including health and safety forms (provided in the APP) and contractor QC forms/checklists (provided in Appendix B of the Programmatic QAPP [EA 2018b]) will be completed for this project.

Photographs will be used to document test pits during field activities. Before taking photographs, a camera pass or other appropriate approval will be obtained from YTC, if required.

Hardcopy data (field notebooks, photographs, hard copies of chain-of-custody records, air bills, etc.) will be kept in the project files.

14.8 Sample Management Tasks

Sample management is the process by which field samples are handled once collected. This process encompasses sample labeling, preservation, documentation, and shipment to the laboratory. Samples will be placed in an iced cooler and maintained at less than 6 degrees Celsius (°C) (but not frozen) immediately upon collection.

14.8.1 Sample Identification

Samples will be uniquely identified, labeled, and documented in the field at the time of collection. Weatherproof sample labels with sample identification numbers will be affixed to each sample container, with the exception of those pre-tared for volatile analytes such as TPH-GRO and VOCs. Sample labels will indicate the site location, sample name, date, time, sampler's initials, parameters to be analyzed, preservative, and pertinent comments.

The sample identification number will uniquely identify the sample in relation to a specified sampling location. A sample identification system has been developed to provide uniform classification and to assist project personnel with interpretation of data reports and field notes.

Each soil sample will be named with the site name (SWMU57) followed by a unique identification code for sample location followed by an eight-digit date code corresponding to year-month-date of sampling, followed by the approximate depth of sampling in feet:

- For example, a soil sample collected from Test Pit 79 sampled on 23 September 2018 from a depth of approximately 5.5 feet will be labeled SWMU57-TP79-20180923-5.5.

QC samples will also be named with the site name (SWMU57) followed by a unique identification code for sample type followed by an eight-digit date code corresponding to year-month-date of sampling):

- Field duplicate samples will be given a unique sample ID and sample time independent of the primary sample to disguise the duplicate sample from the analytical lab.

- Trip blank samples will be denoted with the prefixes EB and TB, respectively. If more than one equipment blank or trip blank sample is submitted daily, samples will be defined with a sample number (-1, -2, etc.). For example, two trip blanks submitted on 23 September 2018 will be labeled SMWU57-TB-1-20180923 and SWMU57-TB-2-20180923.

14.8.2 Sample Custody

Procedures to ensure the custody and integrity of the samples begin at the time of sampling and continue through transport, sample receipt, preparation, analysis and storage, data generation and reporting, and sample disposal. Records concerning the custody and condition of the samples are maintained in field and laboratory records.
Sample custody documentation provides a written record of sample collection and analysis, and sample custody procedures provide for specific identification of samples associated with an exact location, the recording of pertinent information associated with the sample, and a chain-of-custody record that serves as physical evidence of sample custody. Samples will be labeled, packed and shipped to the analytical laboratory, and tracked by secure chain-of-custody protocol in accordance with SOP 001 and SOP 004 as detailed in Worksheet #26 and #27 of the Programmatic QAPP (EA 2018b).

Additional guidelines for sample handling, custody, and disposal are presented in Worksheet #26 and #27 of the Programmatic QAPP (EA 2018b).

14.9 Laboratory Analysis Tasks

Samples will be submitted to ALS Environmental of Kelso, Washington, a DoD ELAP and State of Washington accredited laboratory, for the analysis of the following parameters:

- VOCs by SW8260C
- SVOCs by SW8270D
- PAHs by SW8270D SIM
- TPH-GRO by NWTPH-Gx
- TPH-DRO and TPH-RRO by NWTPH-Dx
- Organochlorine pesticides by SW8081B
- PCBs as Aroclors by SW8082A
- Chlorinated herbicides by SW8151A
- TAL metals by SW6010C, SW6020A, and SW7471B.

Project quantitation limits, action limits, and the selected screening criteria for each of the methods, matrices, and analytes that will be evaluated are presented in Worksheet #15. The analytical laboratory will process and analyze samples according to the sample chain-of-custody records, and the requirements of the Programmatic QAPP (EA 2018b). The analytical SOPs are provided in Worksheet #23 of the Programmatic QAPP.

Following the receipt at the laboratory, samples will be tracked using laboratory sample logs. Air bills for overnight shipping will be retained. The analytical laboratory will generate portable document format reports and electronic data deliverables of the sample results, as specified in the Programmatic QAPP (EA 2018b).

14.10 Laboratory Quality Control Tasks

The project laboratory will be responsible for conducting laboratory QC procedures and reporting laboratory QC results in accordance with laboratory SOPs. Laboratory QC samples will be prepared and analyzed according to the analytical method requirements, the laboratory's QA Plan, as well as the Site-Specific and Programmatic QAPP documents. Laboratories that perform analytical work under this project must adhere to a QA program that is used to monitor and control laboratory QC activities. Each laboratory must have a written QA manual that describes the QA program in detail. The laboratory QA Manager is responsible for ensuring that laboratory internal QC checks are conducted in accordance with applicable methods and protocols, the laboratory's QA manual (Appendix C of the Programmatic QAPP, EA 2018b), and the requirements of this QAPP.

Details regarding laboratory QC are provided in Worksheet #28 of the Programmatic QAPP (EA 2018b). Internal and continuing calibration verification will be conducted for applicable equipment as summarized in Worksheets #24 and #25 of the Programmatic QAPP. Measurement performance criteria are specified in Worksheet #12 and Worksheet #28 of the Programmatic QAPP.

Worksheet #15 presents project screening levels and laboratory reference limits for analytes included in the monitoring program.

14.11 Data Review and Validation Tasks

Review activities for analytical data and other project inputs are summarized in Worksheets #34, #35, and #36 of the Programmatic QAPP (EA 2018b). Analytical data will be verified by the laboratory QC Manager prior to providing the data to EA; the data will then be reviewed by the EA Data Manager/Chemist for completeness upon receipt. Overall data quality will be reviewed to determine if the data are suitable for use, as described in Worksheets #35 and #36 of the Programmatic QAPP (EA 2018b). Results of this evaluation will be summarized in the project report. Corrective action for field or laboratory procedures will be taken as needed in consultation with USEPA.

14.12 Data Management Tasks

Project files will be maintained in the EA Seattle, Washington office. Examples of documents in the project file include project correspondence, field records and the field logbook(s), laboratory data packages, and deliverables. Hard copy and electronic data will be archived in project files for the duration of the project or a minimum of 5 years, whichever is longer.

Worksheet #29 of the Programmatic QAPP (EA 2018b) discusses data management.

14.13 Assessment/Audit Tasks

SOPs will be reviewed prior to the performance of tasks. Technical system audits will be performed as required (Worksheets #31, #32, and #33 of the Programmatic QAPP, EA 2018b). Independent technical review and deliverable checks will be performed to assess the quality of field and reporting tasks. The project development team will perform interdisciplinary checks to ensure minimal interference between tasks. The EA Project Manager will be responsible for responding to the assessment findings, including corrective actions.

The Laboratory QA Manager will conduct assessments of the laboratory procedures and data as described in the laboratory's QA Manual.

14.14 Reporting and Evaluation Tasks

A data package will be generated for this project by the analytical laboratory that will include a case narrative, chain-of-custody record, QC summary data, sample results, standards data, raw QC data, and bench sheets for each analytical method.

The field investigation activities and findings will be summarized in an RI Report. The RI Report will synthesize the new and existing information and present a refined conceptual site model and lateral extent of subsurface debris. The RI will also evaluate the newly generated soil data relative to criteria for unrestricted and industrial land uses (i.e., MTCA Method A Soil Cleanup Levels for Unrestricted Uses, USEPA Regional Screening Levels (RSLs) for residential soil, MTCA Method A Soil Cleanup Levels for Industrial Properties, and USEPA Regional Screening Levels for industrial soil). Data generated as part of the RI effort will be used to support the evaluation of potential cleanup actions in a focused FS for the Former Landfill Complex. Ultimately, a Decision Document will be prepared identifying a selected remedy for the Former Landfill Complex in accordance with Washington Administrative Code Chapter 173-340.

The RI report will be prepared in draft form for Army and USACE review, and will be followed by a draft final report for regulatory review. A final report will be prepared after incorporation of regulatory and/or additional Army/USACE comments.

14.15 Project Schedule

The project schedule is presented on the following page.

Project Schedule

Activity	Responsible Party	Frequency	Deliverable(s)	Completion Date
Test Pits and Soil Sampling	EA	Once in Fall 2018	Draft RI Report	January 2019
			Draft Final RI Report	14 days after receipt of comments on the Draft RI Report
			Final RI Report	14 days after receipt of comments on the Draft Final RI Report

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

Analytical methods, analytes, screening criteria, and achievable laboratory limits including limits of quantitation (LOQs), limits of detection (LODs), and detection limits (DLs) are presented in Table 15-1. Matrix effects or necessary dilutions may affect the laboratory limits actually reported for project samples.

For each target analyte in soil, the screening criteria presented in Table 15-1 are based on the following criteria:

- Washington Model Toxics Control Act (MTCA) Method A Soil Cleanup Levels for Unrestricted Land Use (July 2015)
- USEPA RSLs (May 2018).

The PAL is the lowest of the available screening criteria discussed above. Ideally, the practical quantitation limit (PQL) goal is been established at one-tenth of the value of the PAL. In some cases, however, the achievable laboratory limit does not support a PQL established at one-tenth of the value of the PAL. For these analytes, the limit of quantitation (LOQ) has been used as the PQL. For a small subset of the target analytes, the LOQ or PQL goal exceeds the PAL (shown as highlighted and in bold font in Table 15-1). The laboratory will report nondetectable results as less than the LOD. There is only one compound (N-nitrosodimethylamine) for which the LOD and the LOQ are higher than the PAL.

The DL is the smallest analyte concentration that can be demonstrated to be different from zero or a blank concentration at the 99 percent level of confidence. Although a result at or above the DL indicates that the analyte is present, the absence of a result at or above the DL is inconclusive (i.e., one cannot confidently state whether the analyte is present or absent), because the false negative rate at the DL is 50 percent. The detection limit shall be used to determine the LOD for each analyte and matrix as well as for all preparatory and cleanup methods routinely used on samples.

The LOD is the smallest amount or concentration of a substance that must be present in a sample in order to be detected at a 99 percent confidence level. If a sample has a true concentration at the LOD, there is a minimum probability of 99 percent of reporting a “detection” (a measured value greater than or equal to the DL) and a 1 percent chance of reporting a non-detect (a false negative). Due to the false negative rate at the LOD (1 percent), the laboratory will report non-detectable values as less than the LOD.

The LOQ is the lowest concentration of a substance that produces a quantitative result within specified limits of precision and bias. The LOQ is typically larger than the LOD (but may be equal to the LOD, depending upon the acceptance limits for precision and bias). Quantitative concentration results within specified limits of precision and bias can only be achieved at or above the LOQ; however, the analytical laboratory may identify analytes between the DL and the LOQ. In these instances, the laboratory will report concentration values between the DL and the LOQ as estimated values.

Compounds for which the LOQ or PQL goal are higher than the PAL will be approached on a case-by-case basis in collaboration with stakeholders. The following information will be presented in the RI Report, as follows:

1. The potential for the compound to be present at the site will be evaluated based on previous detections in the media of concern (soil).
2. The potential for the compound to be present at the site will be evaluated based on previous known historical operations.
3. The potential for the compound to be present at the site due to migration from upgradient sources will be evaluated.

Table 15-1 Reference Limits and Project Screening Levels for Soil

Analyte	Analytical Method	CASRN	Units	MTCA Unrestricted Land Use [(a)]	EPA Residential Soil RSL [(b)]	EPA Industrial Soil RSL [(b)]	PAL [(c)]	PQL Goal [(d)]	Laboratory Limits[(e)]		
									LOQ	LOD	DL
Total Petroleum Hydrocarbons (TPH)											
TPH as gasoline range—benzene present	NWTPH-Gx	NS	mg/kg	30	NS	NS	30	5.0	5.0	2.5	1.0
TPH as gasoline range—no detectable benzene	NWTPH-Gx	NS	mg/kg	100	NS	NS	100	10	5.0	2.5	1.0
TPH as diesel range	NWTPH-Dx	NS	mg/kg	2,000	NS	NS	2,000	200	25	3.3	1.6
TPH as heavy oil range	NWTPH-Dx	NS	mg/kg	2,000	NS	NS	2,000	200	25	8.3	2.9
Volatile Organic Compounds											
Acetone	SW8260C	67-64-1	mg/kg	NS	61,000	670,000	61,000	6,100	0.020	0.0040	0.0029
Benzene	SW8260C	71-43-2	mg/kg	0.030	1.2	5.1	0.030	0.0050	0.0050	0.00020	0.000054
Bromobenzene	SW8260C	108-86-1	mg/kg	NS	290	1,800	290	29	0.0050	0.00030	0.000088
Bromochloromethane	SW8260C	74-97-5	mg/kg	NS	150	630	150	15	0.0050	0.00050	0.00024
Bromodichloromethane	SW8260C	75-27-4	mg/kg	NS	0.29	1.3	0.29	0.029	0.0050	0.00050	0.00016
Bromoform	SW8260C	75-25-2	mg/kg	NS	19	86	19	1.9	0.0050	0.00050	0.00014
Bromomethane (Methyl bromide)	SW8260C	74-83-9	mg/kg	NS	6.8	30	6.8	0.68	0.0050	0.00050	0.00020
2-Butanone (Methyl ethyl ketone)	SW8260C	78-93-3	mg/kg	NS	27,000	190,000	27,000	2,700	0.020	0.0010	0.00090
n-Butylbenzene	SW8260C	104-51-8	mg/kg	NS	3,900	58,000	3,900	390	0.020	0.00020	0.000069
sec-Butylbenzene	SW8260C	135-98-8	mg/kg	NS	7,800	120,000	7,800	780	0.020	0.00020	0.000074
tert-Butylbenzene	SW8260C	98-06-6	mg/kg	NS	7,800	120,000	7,800	780	0.020	0.00050	0.00014
Carbon disulfide	SW8260C	75-15-0	mg/kg	NS	770	3,500	770	77	0.0050	0.00030	0.000092
Carbon tetrachloride	SW8260C	56-23-5	mg/kg	NS	0.65	2.9	0.65	0.065	0.0050	0.00030	0.000094
Chlorobenzene	SW8260C	108-90-7	mg/kg	NS	280	1,300	280	28	0.00050	0.00020	0.000065
Chloroethane (Ethyl chloride)	SW8260C	75-00-3	mg/kg	NS	14,000	57,000	14,000	1,400	0.0050	0.0010	0.00074
Chloroform	SW8260C	67-66-3	mg/kg	NS	0.32	1.4	0.32	0.032	0.0050	0.00040	0.00011
Chloromethane (Methyl chloride)	SW8260C	74-87-3	mg/kg	NS	110	460	110	11	0.0050	0.00050	0.00018
2-Chlorotoluene	SW8260C	95-49-8	mg/kg	NS	1,600	23,000	1,600	160	0.020	0.00040	0.00012
4-Chlorotoluene	SW8260C	106-43-4	mg/kg	NS	1,600	23,000	1,600	160	0.020	0.00040	0.000088
Dibromochloromethane	SW8260C	124-48-1	mg/kg	NS	8.3	39	8.3	0.83	0.0050	0.00050	0.00018
1,2-Dibromo-3-chloropropane	SW8260C	96-12-8	mg/kg	NS	0.0053	0.064	0.0053	0.020	**0.020**	0.0014	0.00040
Dibromochloromethane	SW8260C	106-93-4	mg/kg	0.0050	0.036	0.16	0.0050	0.020	**0.020**	0.00030	0.000094
1,2-Dibromoethane (Ethylene dibromide)	SW8260C	74-95-3	mg/kg	NS	24	99	24	2.4	0.0050	0.00050	0.00028

Analyte	Analytical Method	CASRN	Units	MTCA Unrestricted Land Use [(a)]	EPA Residential Soil RSL [(b)]	EPA Industrial Soil RSL [(b)]	PAL [(c)]	PQL Goal [(d)]	Laboratory Limits[(e)]		
									LOQ	LOD	DL
1,2-Dichlorobenzene	SW8260C	95-50-1	mg/kg	NS	1,800	9,300	1,800	180	0.0050	0.00030	0.000077
1,3-Dichlorobenzene	SW8260C	541-73-1	mg/kg	NS	NS	NS	NS	0.050	0.0050	0.00030	0.000094
1,4-Dichlorobenzene	SW8260C	106-46-7	mg/kg	NS	2.6	11	2.6	0.265	0.0050	0.00030	0.000086
Dichlorodifluoromethane	SW8260C	75-71-8	mg/kg	NS	87	370	87	8.7	0.0050	0.00040	0.00012
1,1-Dichloroethane	SW8260C	75-34-3	mg/kg	NS	3.6	16	3.6	0.36	0.0050	0.00040	0.00012
1,2-Dichloroethane	SW8260C	107-06-2	mg/kg	NS	0.46	2.0	0.46	0.046	0.0050	0.00020	0.000070
1,1-Dichloroethene	SW8260C	75-35-4	mg/kg	NS	230	1000	230	23	0.0050	0.00050	0.00025
1,2-Dichloroethene (cis)	SW8260C	156-59-2	mg/kg	NS	160	2300	160	16	0.0050	0.00040	0.00012
1,2-Dichloroethene (trans)	SW8260C	156-60-5	mg/kg	NS	1,600	23,000	1,600	160	0.0050	0.00040	0.00012
1,2-Dichloropropane	SW8260C	78-87-5	mg/kg	NS	2.5	11	2.5	0.25	0.0050	0.00050	0.00013
1,3-Dichloropropane	SW8260C	142-28-9	mg/kg	NS	1,600	23,000	1,600	160	0.0050	0.00040	0.00012
2,2-Dichloropropane	SW8260C	594-20-7	mg/kg	NS	NS	NS	NS	0.0050	0.0050	0.00030	0.000098
1,1-Dichloropropene	SW8260C	563-58-6	mg/kg	NS	NS	NS	NS	0.0050	0.0050	0.00050	0.00013
1,3-Dichloropropene (cis)	SW8260C	10061-01-5	mg/kg	NS	NS	NS	NS	0.0050	0.0050	0.00050	0.00013
1,3-Dichloropropene (trans)	SW8260C	10061-02-6	mg/kg	NS	NS	NS	NS	0.0050	0.0050	0.00040	0.00011
1,3-Dichloropropene (total)	SW8260C	542-75-6	mg/kg	NS	NS	NS	NS	0.010	0.010	0.00090	0.00024
Ethylbenzene	SW8260C	100-41-4	mg/kg	6.0	5.8	25	5.8	0.58	0.0050	0.00030	0.000094
Hexachlorobutadiene	SW8260C	87-68-3	mg/kg	NS	1.2	5.3	1.2	0.12	0.020	0.00080	0.00040
2-Hexanone	SW8260C	591-78-6	mg/kg	NS	200	1,300	200	20	0.020	0.0020	0.00093
Isopropylbenzene (Cumene)	SW8260C	98-82-8	mg/kg	NS	1,900	9,900	1,900	190	0.020	0.00030	0.000081
4-Isopropyltoluene	SW8260C	99-87-6	mg/kg	NS	NS	NS	NS	0.020	0.020	0.00020	0.000064
4-Methyl-2-pentanone (Methyl isobutyl ketone)	SW8260C	108-10-1	mg/kg	NS	33,000	140,000	33,000	3,300	0.020	0.0010	0.0018
Methylene chloride	SW8260C	75-09-2	mg/kg	0.020	57	1000	0.020	0.010	0.010	0.00050	0.00016
Naphthalene	SW8260C	91-20-3	mg/kg	5.0	3.8	17	3.8	0.38	0.020	0.00050	0.00013
n-Propylbenzene	SW8260C	103-65-1	mg/kg	NS	3,800	24,000	3,800	380	0.020	0.00050	0.00013
Styrene	SW8260C	100-42-5	mg/kg	NS	6,000	35,000	6,000	600	0.0050	0.00050	0.00014
1,1,1,2-Tetrachloroethane	SW8260C	630-20-6	mg/kg	NS	2.0	8.8	2.0	0.20	0.0050	0.00040	0.00011
1,1,2,2-Tetrachloroethane	SW8260C	79-34-5	mg/kg	NS	0.60	2.7	0.60	0.060	0.0050	0.00050	0.00013
Tetrachloroethene (PCE)	SW8260C	127-18-4	mg/kg	0.050	24	100	0.050	0.0050	0.0050	0.00050	0.00016
Toluene	SW8260C	108-88-3	mg/kg	7.0	4,900	47,000	7.0	0.70	0.0050	0.00050	0.00015
1,2,3-Trichlorobenzene	SW8260C	87-61-6	mg/kg	NS	63	930	63	6.3	0.020	0.00050	0.00019
1,2,4-Trichlorobenzene	SW8260C	120-82-1	mg/kg	NS	24	110	24	2.4	0.020	0.00050	0.00013
1,1,1-Trichloroethane	SW8260C	71-55-6	mg/kg	2.0	8,100	36,000	2.0	0.20	0.0050	0.00040	0.00011
1,1,2-Trichloroethane	SW8260C	79-00-5	mg/kg	NS	1.1	5.0	1.1	0.11	0.0050	0.00050	0.00015
Trichloroethene (TCE)	SW8260C	79-01-6	mg/kg	0.030	0.94	6.0	0.030	0.0050	0.0050	0.00050	0.00015
Trichlorofluoromethane	SW8260C	75-69-4	mg/kg	NS	23000	350,000	23,000	2,300	0.0050	0.00030	0.000085

Analyte	Analytical Method	CASRN	Units	MTCA Unrestricted Land Use (a)	EPA Residential Soil RSL (b)	EPA Industrial Soil RSL (b)	PAL (c)	PQL Goal (d)	Laboratory Limits(e) LOQ	LOD	DL
1,2,3-Trichloropropane	SW8260C	96-18-4	mg/kg	NS	0.0051	0.11	0.0051	0.0050	0.0050	0.0014	0.00045
1,2,4-Trimethylbenzene	SW8260C	95-63-6	mg/kg	NS	300	1800	300	30	0.020	0.00020	0.000054
1,3,5-Trimethylbenzene	SW8260C	108-67-8	mg/kg	NS	270	1,500	270	27	0.0020	0.00030	0.000092
Vinyl chloride	SW8260C	75-01-4	mg/kg	NS	0.059	1.7	0.059	0.0059	0.0050	0.00050	0.00018
m- and p-Xylenes	SW8260C	179601-23-1	mg/kg	NS	NS	NS	NS	0.0050	0.0050	0.00040	0.00010
o-Xylene	SW8260C	95-47-6	mg/kg	NS	650	2,800	650	65	0.0050	0.00030	0.000081
Xylenes (total)	SW8260C	1330-20-7	mg/kg	9.0	580	2,500	9.0	0.90	0.0010	0.00040	0.00018
Semivolatile Organic Compounds											
Aniline	SW8270D	62-53-3	mg/kg	NS	95	400	95	9.5	1.0	0.033	0.022
Benzoic acid	SW8270D	65-85-0	mg/kg	NS	250,000	3,300,000	250,000	25,000	2.0	0.83	0.14
Benzyl alcohol	SW8270D	100-51-6	mg/kg	NS	6,300	82,000	6,300	630	0.33	0.33	0.017
Bis(2-chloroethoxy) methane	SW8270D	111-91-1	mg/kg	NS	190	2500	190	19	0.33	0.017	0.011
Bis(2-chloroethyl) ether	SW8270D	111-44-4	mg/kg	NS	0.23	1.0	0.23	0.33	**0.33**	0.017	0.012
Bis(2-chloroisopropyl) ether	SW8270D	39638-32-9	mg/kg	NS	NS	NS	NS	0.33	0.33	0.017	0.014
Bis(2-ethylhexyl) phthalate	SW8270D	117-81-7	mg/kg	NS	39	160	39	3.9	0.33	0.017	0.019
Butyl benzyl phthalate	SW8270D	85-68-7	mg/kg	NS	290	1,200	290	29	0.33	0.017	0.016
2-Chloronaphthalene	SW8270D	91-58-7	mg/kg	NS	4,800	60,000	4,800	480	0.33	0.017	0.010
4-Chloro-3-methylphenol	SW8270D	59-50-7	mg/kg	NS	6,300	82,000	6,300	630	0.33	0.033	0.017
4-Chloroaniline	SW8270D	106-47-8	mg/kg	NS	2.7	11	2.7	0.33	0.33	0.033	0.014
2-Chlorophenol	SW8270D	95-57-8	mg/kg	NS	390	5,800	390	39	0.33	0.017	0.0099
4-Chlorophenyl phenyl ether	SW8270D	7005-72-3	mg/kg	NS	NS	NS	NS	0.33	0.33	0.017	0.016
Dibenzofuran	SW8270D	132-64-9	mg/kg	NS	73	1,000	73	7.3	0.33	0.017	0.012
3,3'-Dichlorobenzidine	SW8270D	91-94-1	mg/kg	NS	1.2	5.1	1.2	0.33	0.33	0.017	0.027
2,4-Dichlorophenol	SW8270D	120-83-2	mg/kg	NS	190	2,500	190	19	0.33	0.033	0.016
Diethyl phthalate	SW8270D	84-66-2	mg/kg	NS	51,000	660,000	51,000	5,100	0.33	0.017	0.014
Dimethyl phthalate	SW8270D	131-11-3	mg/kg	NS	NS	NS	NS	0.33	0.33	0.017	0.016
2,4-Dimethylphenol	SW8270D	105-67-9	mg/kg	NS	1,300	16,000	1,300	130	0.33	0.067	0.015
2,4-Dinitrophenol	SW8270D	51-28-5	mg/kg	NS	130	1,600	130	13	2.0	0.83	0.11
2,4-Dinitrotoluene	SW8270D	121-14-2	mg/kg	NS	1.7	7.4	1.7	0.33	0.33	0.067	0.015
2,6-Dinitrotoluene	SW8270D	606-20-2	mg/kg	NS	0.36	1.5	0.36	0.33	0.33	0.033	0.016
Di-n-butyl phthalate	SW8270D	84-74-2	mg/kg	NS	6,300	82,000	6,300	630	0.33	0.017	0.012
Di-n-octyl phthalate	SW8270D	117-84-0	mg/kg	NS	630	8,200	630	63	0.33	0.020	0.024
1,2-Diphenylhydrazine	SW8270D	122-66-7	mg/kg	NS	0.68	2.9	0.68	0.33	0.33	0.017	0.014
Hexachlorobenzene	SW8270D	118-74-1	mg/kg	NS	0.21	0.96	0.21	0.33	**0.33**	0.017	0.015
Hexachlorobutadiene	SW8270D	87-68-3	mg/kg	NS	1.2	5.3	1.2	0.33	0.33	0.033	0.014
Hexachlorocyclopentadiene	SW8270D	77-47-4	mg/kg	NS	1.8	7.5	1.8	0.33	0.33	0.33	0.012
Hexachloroethane	SW8270D	67-72-1	mg/kg	NS	1.8	8.0	1.8	0.33	0.33	0.033	0.022

Analyte	Analytical Method	CASRN	Units	MTCA Unrestricted Land Use (a)	EPA Residential Soil RSL (b)	EPA Industrial Soil RSL (b)	PAL (c)	PQL Goal (d)	Laboratory Limits(e)		
									LOQ	LOD	DL
Isophorone	SW8270D	78-59-1	mg/kg	NS	570	2,400	570	57	0.33	0.017	0.014
2-Methyl-4,6-dinitrophenol	SW8270D	534-52-1	mg/kg	NS	5.1	66	5.1	2.0	2.0	0.33	0.14
1-Methylnaphthalene	SW8270D	90-12-0	mg/kg	NS	18	73	18	1.8	0.010	0.0050	0.0039
2-Methylphenol	SW8270D	95-48-7	mg/kg	NS	3,200	41,000	3,200	320	0.33	0.017	0.017
4-Methylphenol	SW8270D	106-44-5	mg/kg	NS	6,300	82,000	6,300	630	0.33	0.033	0.017
2-Nitroaniline	SW8270D	88-74-4	mg/kg	NS	630	8,000	630	63	0.33	0.033	0.017
3-Nitroaniline	SW8270D	99-09-2	mg/kg	NS	NS	NS	NS	0.33	0.33	0.067	0.018
4-Nitroaniline	SW8270D	100-01-6	mg/kg	NS	27	110	27	2.7	2.0	0.18	0.18
2-Nitrophenol	SW8270D	88-75-5	mg/kg	NS	NS	NS	NS	0.33	0.33	0.033	0.014
4-Nitrophenol	SW8270D	100-02-7	mg/kg	NS	NS	NS	NS	2.0	2.0	0.33	0.15
Nitrobenzene	SW8270D	98-95-3	mg/kg	NS	5.1	22	5.1	0.51	0.33	0.030	0.026
N-Nitrosodimethylamine	SW8270D	62-75-9	mg/kg	NS	0.002	0.034	0.0020	2.0	**2.0**	**0.033**	**0.025**
N-Nitrosodiphenylamine	SW8270D	86-30-6	mg/kg	NS	110	470	110	11	0.33	0.33	0.018
N-Nitrosodi-n-propylamine	SW8270D	621-64-7	mg/kg	NS	0.078	0.33	0.078	0.33	**0.33**	0.033	0.019
Pentachlorophenol	SW8270D	87-86-5	mg/kg	NS	1.0	4.0	1.0	2.0	**2.0**	0.17	0.13
Phenol	SW8270D	108-95-2	mg/kg	NS	19,000	250,000	19,000	1,900	0.33	0.020	0.019
1,2,4-Trichlorobenzene	SW8270D	120-82-1	mg/kg	NS	24	110	24	2.4	0.33	0.017	0.011
2,4,5-Trichlorophenol	SW8270D	95-95-4	mg/kg	NS	6,300	82,000	6,300	630	0.33	0.033	0.018
2,4,6-Trichlorophenol	SW8270D	88-06-2	mg/kg	NS	49	210	49	4.9	0.33	0.067	0.014
Polycyclic Aromatic Hydrocarbons											
Acenaphthene	SW8270D SIM	83-32-9	mg/kg	NS	3,600	45,000	3,600	360	0.0050	0.0010	0.00076
Acenaphthylene	SW8270D SIM	208-96-8	mg/kg	NS	NS	NS	NS	0.0050	0.0050	0.0010	0.00059
Anthracene	SW8270D SIM	120-12-7	mg/kg	NS	18,000	230,000	18,000	1,800	0.0050	0.0010	0.00058
Benzo(a)anthracene	SW8270D SIM	56-55-3	mg/kg	NS	1.1	21	1.1	0.11	0.0050	0.0010	0.00072
Benzo(b)fluoranthene	SW8270D SIM	205-99-2	mg/kg	NS	1.1	21	1.1	0.11	0.0050	0.0010	0.00092
Benzo(k)fluoranthene	SW8270D SIM	207-08-9	mg/kg	NS	11	210	11	1.1	0.0050	0.0010	0.00087
Benzo(g,h,i)perylene	SW8270D SIM	191-24-2	mg/kg	NS	NS	NS	NS	0.0050	0.0050	0.0010	0.00085
Benzo(a)pyrene	SW8270D SIM	50-32-8	mg/kg	0.10	0.11	2.1	0.10	0.010	0.0050	0.0010	0.00076
Chrysene	SW8270D SIM	218-01-9	mg/kg	NS	110	2,100	110	11	0.0050	0.0010	0.00080
Dibenz(a,h)anthracene	SW8270D SIM	53-70-3	mg/kg	NS	0.11	2.1	0.11	0.011	0.0050	0.0010	0.00080
Fluoranthene	SW8270D SIM	206-44-0	mg/kg	NS	2,400	30,000	2,400	240	0.0050	0.0010	0.00098
Fluorene	SW8270D SIM	86-73-7	mg/kg	NS	2,400	30,000	2,400	240	0.0050	0.0010	0.00061
Indeno(1,2,3-cd)pyrene	SW8270D SIM	193-39-5	mg/kg	NS	1.1	21	1.1	0.11	0.0050	0.0010	0.00087
1-Methylnaphthalene	SW8270D SIM	90-12-0	mg/kg	NS	18	73	18	1.8	0.010	0.0050	0.0039
2-Methylnaphthalene	SW8270D SIM	91-57-6	mg/kg	NS	240	3,000	240	24	0.0050	0.0010	0.00039
Phenanthrene	SW8270D SIM	85-01-8	mg/kg	NS	NS	NS	NS	0.0050	0.0050	0.0020	0.0014
Organochlorine Pesticides											

Analyte	Analytical Method	CASRN	Units	MTCA Unrestricted Land Use [(a)]	EPA Residential Soil RSL [(b)]	EPA Industrial Soil RSL [(b)]	PAL [(c)]	PQL Goal [(d)]	Laboratory Limits[(e)] LOQ	LOD	DL
Aldrin	SW8081B	309-00-2	mg/kg	NS	0.039	0.18	0.039	0.0050	0.0050	0.0012	0.00034
alpha-BHC	SW8081B	319-84-6	mg/kg	NS	0.086	0.36	0.086	0.0086	0.0050	0.0012	0.00035
beta-BHC	SW8081B	319-85-7	mg/kg	NS	0.30	1.3	0.30	0.030	0.0050	0.0012	0.00050
delta-BHC	SW8081B	319-86-8	mg/kg	NS	NS	NS	NS	0.0050	0.0050	0.0012	0.00037
gamma-BHC (Lindane)	SW8081B	58-89-9	mg/kg	0.010	0.57	2.5	0.010	0.0050	0.0050	0.0012	0.00045
alpha-Chlordane	SW8081B	5103-71-9	mg/kg	NS	NS	NS	NS	0.0050	0.0050	0.0033	0.0012
gamma-Chlordane	SW8081B	5566-34-7	mg/kg	NS	NS	NS	NS	0.0050	0.0050	0.0012	0.00060
4,4'-DDD	SW8081B	72-54-8	mg/kg	NS	1.9	9.6	1.9	0.19	0.0050	0.0033	0.0010
4,4'-DDE	SW8081B	72-55-9	mg/kg	NS	2.0	9.3	2.0	0.20	0.0050	0.0033	0.0016
4,4'-DDT	SW8081B	50-29-3	mg/kg	3.0	1.9	8.5	1.9	0.19	0.0050	0.0033	0.00085
Dieldrin	SW8081B	60-57-1	mg/kg	NS	0.034	0.14	0.034	0.0050	0.0050	0.0012	0.00048
Endosulfan I	SW8081B	959-98-8	mg/kg	NS	NS	NS	NS	0.0050	0.0050	0.0033	0.0017
Endosulfan II	SW8081B	33213-65-9	mg/kg	NS	NS	NS	NS	0.0050	0.0050	0.0033	0.00086
Endosulfan sulfate	SW8081B	1031-07-8	mg/kg	NS	NS	NS	NS	0.0050	0.0050	0.0012	0.00057
Endrin	SW8081B	72-20-8	mg/kg	NS	19	250	19	1.9	0.0050	0.0012	0.00045
Endrin aldehyde	SW8081B	7421-93-4	mg/kg	NS	NS	NS	NS	0.0050	0.0050	0.0033	0.0014
Endrin ketone	SW8081B	53494-70-5	mg/kg	NS	NS	NS	NS	0.0050	0.0050	0.0012	0.00055
Heptachlor	SW8081B	76-44-8	mg/kg	NS	0.13	0.63	0.13	0.013	0.0050	0.0033	0.00083
Heptachlor epoxide	SW8081B	1024-57-3	mg/kg	NS	0.070	0.33	0.070	0.0070	0.0050	0.0012	0.00039
Methoxychlor	SW8081B	72-43-5	mg/kg	NS	320	4,100	320	32	0.0050	0.0012	0.00061
Toxaphene	SW8081B	8001-35-2	mg/kg	NS	0.49	2.1	0.49	0.25	0.25	0.074	0.037
Polychlorinated Biphenyls (PCBs) as Aroclors											
Aroclor 1016	SW8082A	12674-11-2	mg/kg	NS	4.1	27	4.1	0.41	0.10	0.038	0.0085
Aroclor 1221	SW8082A	11104-28-2	mg/kg	NS	0.20	0.83	0.20	0.20	0.20	0.038	0.0085
Aroclor 1232	SW8082A	11141-16-5	mg/kg	NS	0.17	0.72	0.17	0.10	0.10	0.038	0.0085
Aroclor 1242	SW8082A	53469-21-9	mg/kg	NS	0.23	0.95	0.23	0.10	0.10	0.038	0.0085
Aroclor 1248	SW8082A	12672-29-6	mg/kg	NS	0.23	0.95	0.23	0.10	0.10	0.038	0.0085
Aroclor 1254	SW8082A	11097-69-1	mg/kg	NS	0.24	0.97	0.24	0.10	0.10	0.038	0.0085
Aroclor 1260	SW8082A	11096-82-5	mg/kg	NS	0.24	0.99	0.24	0.10	0.10	0.038	0.0085
Total PCBs	SW8082A	1336-36-3	mg/kg	1.0	NS	NS	1.0	0.20	0.20	0.038	0.0085
Chlorinated Herbicides											
2,4-D	SW8151A	94-75-7	mg/kg	NS	700	9,600	700	70	0.067	0.067	0.034
2,4-DB	SW8151A	94-82-6	mg/kg	NS	1,900	25,000	1,900	190	0.050	0.0083	0.0054
Dalapon	SW8151A	75-99-0	mg/kg	NS	1,900	25,000	1,900	190	0.067	0.067	0.020
Dicamba	SW8151A	1918-00-9	mg/kg	NS	1,900	25,000	1,900	190	0.067	0.067	0.035
Dichlorprop	SW8151A	120-36-5	mg/kg	NS	NS	NS	NS	0.067	0.067	0.067	0.040
Dinoseb	SW8151A	88-85-7	mg/kg	NS	63	820	63	6.3	0.167	0.167	0.083

Analyte	Analytical Method	CASRN	Units	MTCA Unrestricted Land Use (a)	EPA Residential Soil RSL (b)	EPA Industrial Soil RSL (b)	PAL (c)	PQL Goal (d)	Laboratory Limits(e)		
									LOQ	LOD	DL
MCPA	SW8151A	94-74-6	mg/kg	NS	32	410	32	12	12	12	9.9
MCPP	SW8151A	93-65-2	mg/kg	NS	63	820	63	12	12	12	7.6
2,4,5-T	SW8151A	93-76-5	mg/kg	NS	630	8,200	630	63	0.067	0.067	0.033
2,4,5-TP (Silvex)	SW8151A	93-72-1	mg/kg	NS	510	66,00	510	51	0.067	0.067	0.033
Total Metals											
Antimony	SW6020A	7440-36-0	mg/kg	NS	31	470	31	3.1	0.050	0.050	0.020
Arsenic	SW6020A	7440-38-2	mg/kg	20	0.68	3.0	0.68	0.50	0.50	0.50	0.20
Barium	SW6020A	7440-39-3	mg/kg	NS	15,000	220,000	15.000	1,500	0.050	0.050	0.020
Beryllium	SW6020A	7440-41-7	mg/kg	NS	160	2,300	160	16	0.020	0.020	0.0050
Cadmium	SW6020A	7440-43-9	mg/kg	NS	71	980	71	7.1	0.020	0.020	0.0090
Calcium	SW6010C	7440-70-2	mg/kg	NS	NS	NS	NS	4.0	4.0	2.0	1.0
Cobalt	SW6020A	7440-48-4	mg/kg	NS	23	350	23	2.3	0.020	0.020	0.0090
Copper	SW6020A	7440-50-8	mg/kg	NS	3,100	47,000	3,100	310	0.10	0.10	0.040
Iron	SW6010C	7439-89-6	mg/kg	NS	55,000	820,000	55,000	5,500	4.0	4.0	2.0
Lead	SW6020A	7439-92-1	mg/kg	250	400	800	250	25	0.050	0.050	0.020
Magnesium	SW6010C	7439-95-4	mg/kg	NS	NS	NS	NS	2.0	2.0	0.40	0.20
Manganese	SW6010C	7439-96-5	mg/kg	NS	1,800	26,000	1,800	290	0.20	0.10	0.040
Mercury	SW7471B	7439-97-6	mg/kg	2.0	11	46	2.0	0.20	0.020	0.0050	0.0020
Nickel	SW6020A	7440-02-0	mg/kg	NS	1,500	22,000	1,500	150	0.20	0.10	0.040
Potassium	SW6010C	7440-09-7	mg/kg	NS	NS	NS	NS	40	40	40	10
Selenium	SW6020A	7782-49-2	mg/kg	NS	390	5,800	390	39	1.0	0.50	0.20
Silver	SW6020A	7440-22-4	mg/kg	NS	390	5,800	390	39	0.020	0.020	0.0050
Sodium	SW6010C	7440-23-5	mg/kg	NS	NS	NS	NS	40	40	10	5.0
Thallium	SW6020A	7440-28-0	mg/kg	NS	0.78	12	0.78	0.078	0.020	0.0050	0.0020
Vanadium	SW6020A	7440-62-2	mg/kg	NS	390	5,800	390	39	0.20	0.20	0.080
Zinc	SW6020A	7440-66-6	mg/kg	NS	23,000	350,000	23,000	2,300	0.50	0.50	0.20

a. Washington Model Toxics Control Act (MTCA) Method A Soil Cleanup Levels for Unrestricted Land Use (July 2015).
b. U.S. Environmental Protection Agency (USEPA) Regional Screening Level (RSL) for residential and industrial soil and target cancer risk of 10^{-6} and target hazard quotient of 1.0 (May 2018).
c. PALs refer to the lowest applicable screening level d.
d. Practical quantitation limit (PQL) goal is established at 1/10th of the PAL; however, if this is not analytically achievable, the PQL goal is set at the LOQ. .
e. LOQ/LOD/DL shown in bold and shaded are greater than the associated PAL.

NOTES:
CASRN = Chemical Abstracts Service Registry Number.
DL = Detection limit.
mg/kg = Milligram(s) per kilogram.
LOD = Limit of detection.
LOQ = Limit of quantitation.
NS = Not specified.
PAL = Project action level.
SIM = Selected ion monitoring.

Worksheet #17: Sample Design and Rationale

This worksheet documents the overall process for the design and rationale of the field testing, sampling, field monitoring, and offsite laboratory analysis to be conducted for data collection and data evaluation purposes.

Describe and provide a rationale for choosing the sampling approach:

RI activities are being conducted to refine the lateral extent of subsurface debris and further characterize soil contamination associated with the buried waste. The sampling rationale and approach is described in Section 3 of the Work Plan and Worksheets #11 and #14 and 16 of this QAPP.

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.

Twenty test pits will be completed at the site. One soil sample will be collected from each test pit and analyzed for VOCs, SVOCs, PAHs, TPH-GRO, TPH-DRO, TPH-RRO, organochlorine pesticides, PCBs, chlorinated herbicides, and metals (target analyte lists are presented in Worksheet #15). Test pit and soil sampling data needs are presented in Table 17-1. Soil sampling locations and analytes are listed in Worksheet #18.

Field methodologies will be consistent with the SOPs listed in Worksheet #21 and included in Appendix A of the Programmatic QAPP (EA 2018b). Field activities will be conducted in accordance with the APP (EA 2018a). A dedicated field logbook will be maintained for site activities in accordance with SOP 059. Field forms will be used during onsite work (Appendix B of the Programmatic QAPP and Appendix C of the Work Plan). Photographs will be taken to document field activities, as appropriate.

If the field conditions encountered during the investigation warrant changes to the field tasks or planning documents, the EA Field Team Leader and/or QC Manager will notify the EA Project Manager immediately upon discovery. Field changes will be communicated as presented in Worksheet #6 of the Programmatic QAPP (EA 2018b). Specifically, once notified, the EA Project Manager will notify the USACE-Seattle City District Project Manager and JBLM Public Works – Environmental Division Program Manager within 24 hours verbally or via email. Based on a review of the proposed change, and if required by the USACE and JBLM, a field change request memorandum will be submitted within 1 week to the USACE Project Manager and JBLM Program Manager for review and approval. It should be noted that unanticipated field changes may require a QAPP addendum, amendment, and/or revision. This requirement will be determined in consultation with the USACE Project Manager and JBLM Program Manager following notification of the proposed change. If required, the QAPP addendum, amendment, and/or revision will be submitted to the USACE, JBLM, and regulators for review, comment, and approval.

Table 17-1 Data Needs for Test Pits and Soil Sampling

Location	Parameter	Equipment and/or Method	Rationale for Analysis and Data Use
Test Pits 70-89	Observations of burn residue, waste, or other indications of impacts (e.g., olfactory or visual indicators)	Backhoe, test pit log, digital camera	Delineate the extent of buried waste
One soil sample from each test pit; specific locations to be determined in the field	VOCs	SW8260C	Characterize the extent of potential chemical contaminants associated with buried waste
	SVOCs	SW8270D	
	PAHs	SW8270D Selected Ion Monitoring	
	TPH-GRO	NWTPH-Gx	
	TPH-DRO and TPH-RRO	NWTPH-Dx	
	Organochlorine pesticides	SW8081B	
	PCBs	SW8082A	
	Chlorinated herbicides	SW8151A	
	Metals	SW6010C, SW6020A, SW7471B	

NOTES:
DRO = Diesel range organics.
GRO = Gasoline range organics.
PAH = Polycyclic aromatic hydrocarbon.
PCB = Polychlorinated biphenyl.
RRO = Residual range organics.
SVOC = Semivolatile organic compound.
TPH = Total petroleum hydrocarbons
VOC = Volatile organic compound.

Worksheet #18: Sample Locations and Methods

Sample ID	X Coordinate[(a)]	Y Coordinate[(a)]	Matrix	Depth (ft)	Type[(b)]	Analytical Groups	Sampling Method / SOP	Comments
SWMU57-TP70-YYYYMMDD-##	694921.0617	5173217.519	Soil	TBD	Grab/Composite	VOCs SVOCs TPH-GRO TPH-DRO TPH-RRO Organochlorine pesticides PCBs Chlorinated herbicides Metals	Disposable scoops, Terra Core®; SOP 025, Terra Core procedures	None
SWMU57-TP71-YYYYMMDD-##	694983.0851	5173217.519	Soil	TBD	Grab/Composite			
SWMU57-TP72-YYYYMMDD-##	694828.0266	5173163.806	Soil	TBD	Grab/Composite			
SWMU57-TP73-YYYYMMDD-##	694890.05	5173163.806	Soil	TBD	Grab/Composite			
SWMU57-TP74-YYYYMMDD-##	694952.0734	5173163.806	Soil	TBD	Grab/Composite			
SWMU57-TP75-YYYYMMDD-##	694859.0383	5173110.092	Soil	TBD	Grab/Composite			
SWMU57-TP76-YYYYMMDD-##	694921.0617	5173110.092	Soil	TBD	Grab/Composite			
SWMU57-TP77-YYYYMMDD-##	694828.0266	5173056.378	Soil	TBD	Grab/Composite			
SWMU57-TP78-YYYYMMDD-##	694890.05	5173056.378	Soil	TBD	Grab/Composite			
SWMU57-TP79-YYYYMMDD-##	695006.0621	5173055.574	Soil	TBD	Grab/Composite			
SWMU57-TP80-YYYYMMDD-##	694859.0383	5173002.664	Soil	TBD	Grab/Composite			
SWMU57-TP81-YYYYMMDD-##	694921.0617	5173002.664	Soil	TBD	Grab/Composite			
SWMU57-TP82-YYYYMMDD-##	694975.8539	5173002.664	Soil	TBD	Grab/Composite			
SWMU57-TP83-YYYYMMDD-##	694828.0266	5172948.95	Soil	TBD	Grab/Composite			
SWMU57-TP84-YYYYMMDD-##	694890.05	5172948.95	Soil	TBD	Grab/Composite			
SWMU57-TP85-YYYYMMDD-##	695014.0968	5172948.95	Soil	TBD	Grab/Composite			
SWMU57-TP86-YYYYMMDD-##	694859.0383	5172895.236	Soil	TBD	Grab/Composite			
SWMU57-TP87-YYYYMMDD-##	694921.0617	5172895.236	Soil	TBD	Grab/Composite			
SWMU57-TP88-YYYYMMDD-##	694827.2231	5172837.505	Soil	TBD	Grab/Composite			
SWMU57-TP89-YYYYMMDD-##	694890.05	5172841.523	Soil	TBD	Grab/Composite			

a. Coordinate system is World Geodetic System 1984 Universal Transverse Mercator Zone 10N, meters. Coordinates are for the center point of the associated test pit.
b. Terra Core® samples (VOCs, TPH-GRO) will be grab samples; remaining samples will be composites from the contents of the excavator bucket.

NOTES: TBD = To be determined.

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

Laboratory: ALS Environmental – Kelso Facility
1317 South 13th Avenue, Kelso, Washington 98626
Contact: Kurt Clarkson (Project Manager)
kurt.clarkson@alsglobal.com
Phone (360) 501-3356

List Required Accreditations/Certifications: DoD ELAP Certificate Number (No.) L18-128 (valid to 30 June 2020) and Scope of Testing
Ecology Laboratory ID C544 (valid to 8 July 2019) (presented in Appendix C of the Programmatic QAPP)

Sample Delivery Method: Hand delivery or courier service such as Federal Express or United Parcel Service.

Analyte/ Group	Matrix	Method	Container(s) (number, size, and type per sample) [(a)]	Preservation	Preparation Holding Time	Analytical Holding Time	Data Package Turnaround
VOCs	Soil	SW8260C	Terra Core® kit: (3) 40-mL VOA vials with Teflon®-lined lid pre-tared with 5-mL reagent water (1 MeOH preserved vial and 2 deionized water/stir bar preserved vials) and (1) 2-ounce (oz) jar for total solids	Cool to ≤6°C	14 days from sample collection until analysis	14 days from sample collection until analysis	15 working days
SVOCs	Soil	SW8270D	(1) 8-oz glass jar with Teflon®-lined lid	Cool to ≤6°C	14 days from sample collection until analysis	40 days from sample collection until analysis	
PAHs	Soil	SW8270D SIM	(1) 8-oz glass jar with Teflon®-lined lid	Cool to ≤6°C	14 days from sample collection until analysis	40 days from sample collection until analysis	
TPH-GRO	Soil	NWTPH-Gx	Terra Core kit: (3) 40-mL VOA vials with Teflon®-lined lid pre-tared with 5-mL reagent water (1 MeOH preserved vial and 2 reagent water/stir bar preserved vials) and (1) 2-oz jar for total solids	Reagent water or MeOH, cool to ≤6°C	14 days from sample collection until analysis	14 days from sample collection until analysis	

Analyte/ Group	Matrix	Method	Container(s) (number, size, and type per sample) [a]	Preservation	Preparation Holding Time	Analytical Holding Time	Data Package Turnaround
TPH-DRO, TPH-RRO	Soil	NWTPH-Dx	(1) 8-oz glass jar with Teflon®-lined lid	Cool to ≤6°C	14 days from sample collection until analysis	40 days from sample collection until analysis	15 working days
Organochlorine pesticides	Soil	SW8081B	(1) 8-oz glass jar with Teflon®-lined lid	Cool to ≤6°C	14 days from sample collection until analysis	40 days from sample collection until analysis	
PCBs	Soil	SW8082A	(1) 4- or 8-oz glass jar with Teflon®-lined lid	Cool to ≤6°C	14 days from sample collection until analysis	40 days from sample collection until analysis	
Metals with the exception of mercury	Soil	SW6010C SW6020A	(1) 4- or 8-oz glass jar with Teflon®-lined lid	Cool to ≤6°C	6 months from sample collection until analysis	6 months from sample collection until analysis	
Mercury	Soil	SW7471B	(1) 4- or 8-oz glass jar with Teflon®-lined lid	Cool to ≤6°C	28 days from sample collection until analysis	28 days from sample collection until analysis	

a. If multiple analyses are planned for a single sample, fewer glass jars may be collected after consultation with the analytical laboratory point-of-contact and the project chemist.

Laboratory: ALS Environmental – Middletown Facility
34 Dogwood Lane, Middletown, PA 17057
Contact: Kurt Clarkson (Project Manager), located at the ALS Kelso facility
kurt.clarkson@alsglobal.com
Phone (360) 501-3356

List Required Accreditations/Certifications: DoD ELAP Certificate No. L18-61 (valid to 28 February 2020) and Scope of Testing (presented in Appendix C of the Programmatic QAPP)

Sample Delivery Method: Hand delivery or overnight shipping via Federal Express or United Parcel Service to ALS Kelso facility for shipment to the ALS Middletown facility.

Analyte/ Group	Matrix	Analytical Method	Container(s) (number, size, and type per sample)	Preservation	Preparation Holding Time	Analytical Holding Time	Data Package Turnaround
Chlorinated herbicides	Soil	SW8151A	(1) 4- or 8-oz glass jar with Teflon®-lined lid	Cool to ≤6°C	14 days from sample collection until analysis	40 days from sample collection until analysis	15 working days unless otherwise specified in project planning documents

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Worksheet #20: Field Quality Control Summary

Matrix	Analytical Group	No. of Samples[(a)]	No. of Field Duplicates[(b)]	Number of MS/MSD Pairs[(c)]	Number of Equipment Blanks[(d)]	Number of Trip Blanks[(e)]
Spring (March) Sampling Event						
Soil	VOCs	20	1	1	0	1 per cooler
Soil	SVOCs	20	1	1	0	Not applicable
Soil	PAHs	20	1	1	0	Not applicable
Soil	TPH-GRO	20	1	1	0	1 per cooler
Soil	TPH-DRO, RRO	20	1	1	0	Not applicable
Soil	Organochlorine pesticides	20	1	1	0	Not applicable
Soil	PCBs	20	1	1	0	Not applicable
Soil	Chlorinated herbicides	20	1	1	0	Not applicable
Soil	TAL Metals	20	1	1	0	Not applicable

a. 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 regarding sample numbers.
b. Minimum 5 percent (1 per 20 samples)
c. Minimum 5 percent (1 per 20 samples) MS/MSD pairs require extra volume (i.e., triple volume for each analysis). These will be collected in separate containers; however, because they are not separate samples, they are not included in the total number of samples.
d. Equipment blanks will not be collected because only disposable sampling equipment will be used for the collection of soil samples.
e. Trip blanks will be shipped at a rate of 1 per cooler (1 in each cooler that contains aqueous VOC or TPH-GRO samples).

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Worksheet #21: Field Standard Operating Procedures

SOP Reference Number	Responsible Organization	Title, Revision Date and/or Number	Equipment Type or Instrument	Comments
SOP 001	EA	SOP for Sample Labels, Revision 0, December 2014	Sample labels.	Field SOPs are provided in Appendix A of the Programmatic QAPP.
SOP 002	EA	SOP for Chain-of-Custody Form, Revision 0, December 2014	Chain-of-custody record.	
SOP 004	EA	SOP for Sampling Packing and Shipping, Revision 0, December 2014	Coolers and shipping materials (bags, tape, ice).	
SOP 016	EA	SOP for Surface Water, Groundwater, and Soil/Sediment Field Logbooks, Revision 0, December 2014	Log books and appropriate field forms.	
SOP 025	EA	SOP for Soil Sampling, Revision 0, December 2014	Sampler (push tube, split-spoon, core barrel, or similar), stainless steel bowl, spoon, spoon, trowel, knife, spatula, log books and appropriate field forms.	
SOP 039	EA	SOP for Sample Preservation and Container Requirements, Revision 1, December 2014	Sampling supplies from laboratory.	
SOP 059	EA	SOP for Field Logbook, Revision 1, December 2014	Field logbook.	

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

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[(a)]
Digital camera	None	Protect in case. Keep instrument clean, see manufacturer's specifications, and keep battery charged for operation.	Field test in accordance with the manual	Inspect for external damage	Check for operation	None	If not operating, replace/recharge batteries and/or replace.	Field personnel	Equipment manual
Global positioning survey equipment	Calibrate in accordance with the manual	Protect in hard case. Keep instrument clean, see manufacturer's specifications, and keep battery charged for operation.	Field test in accordance with the manual	Inspect for external damage	Daily check shots 'pre' and 'post' use	Field checks: horizontal: 1.0 meter; vertical 2.0 meters between known and measured points For post-processed data: horizontal quality – 0.15 meter; vertical quality – 0.15 meter	If daily QC checks do not meet acceptance criteria, return equipment to vendor for repair or work with the vender to rectify the issue.	Field personnel	Equipment manual
Terra Core®, or equivalent, sampling device and sample kit.	None	Keep in sample kit until in use.	None	Inspect for external damage. Inspect vials to ensure methanol volume is correct.	Before use	None	Replace sampler and/or sample kit.	Field personnel	Equipment instructions provided by laboratory.

a. Field SOPs are provided in Appendix A of the Programmatic QAPP. Calibration logs are provided in Appendix B of the Programmatic QAPP.

The Field Team Leader will be responsible for ensuring that these instruments are calibrated before each field-sampling event. Field equipment must be inspected and calibrated before use according to the criteria given in the referenced SOPs. If problems occur with field instruments or equipment that cannot be resolved by the field team personnel, they should contact the Field Team Leader. If field equipment fails inspection, it is the Field Team Leader's responsibility to investigate and resolve the problem. The Equipment Facility Manager can also be contacted by the field crew or the field team leader to help resolve problems with field equipment and supply or obtain any spare or replacement parts or equipment.

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Worksheets #23 through 37: Presented in Programmatic Quality Assurance Project Plan

Worksheets #23 through #37 cover various aspects of the analytical and data quality management program and are presented in the Programmatic QAPP (EA 2018b).

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3. REFERENCES

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Appendix B

Relevant Figures from the Site Inspection Report

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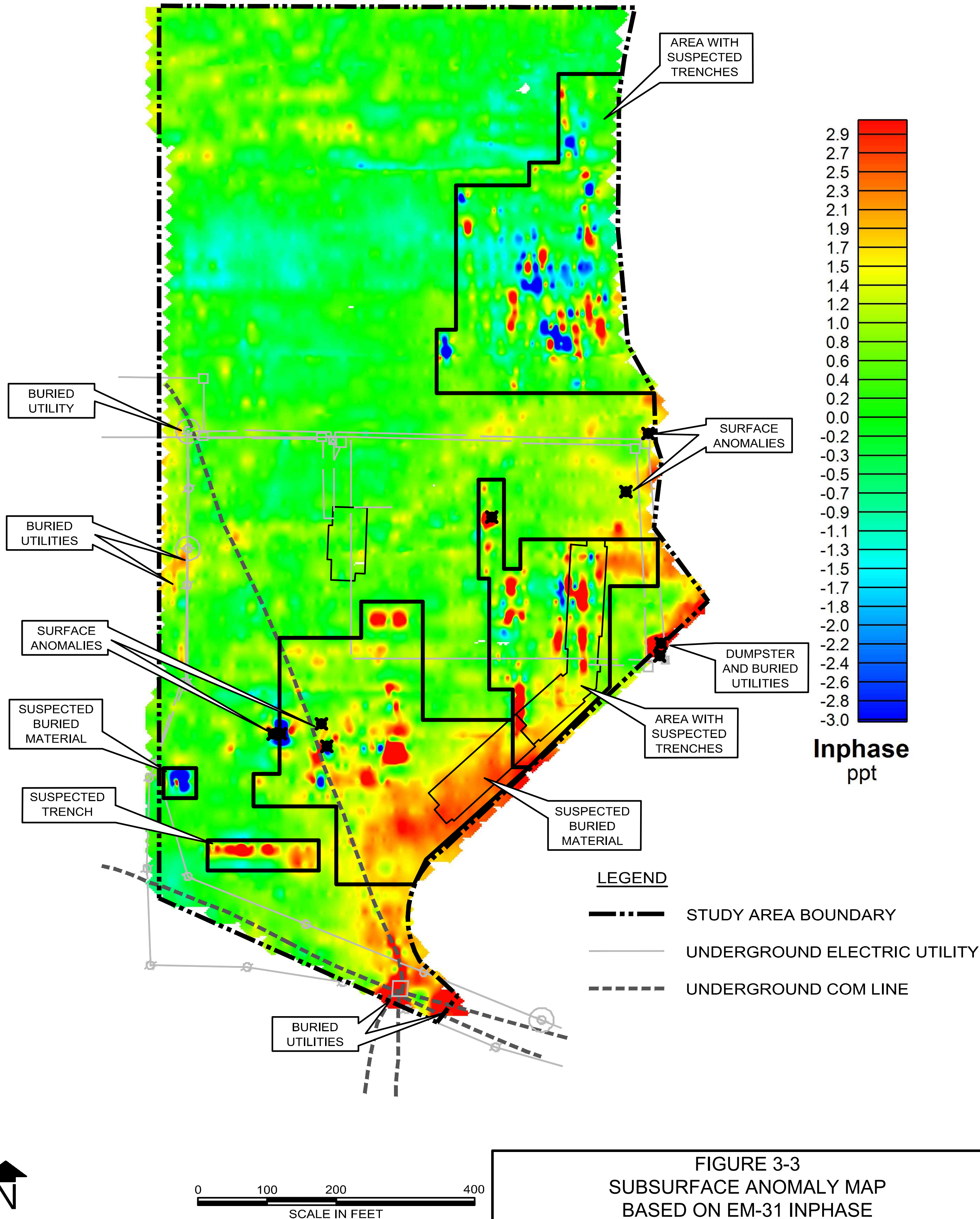
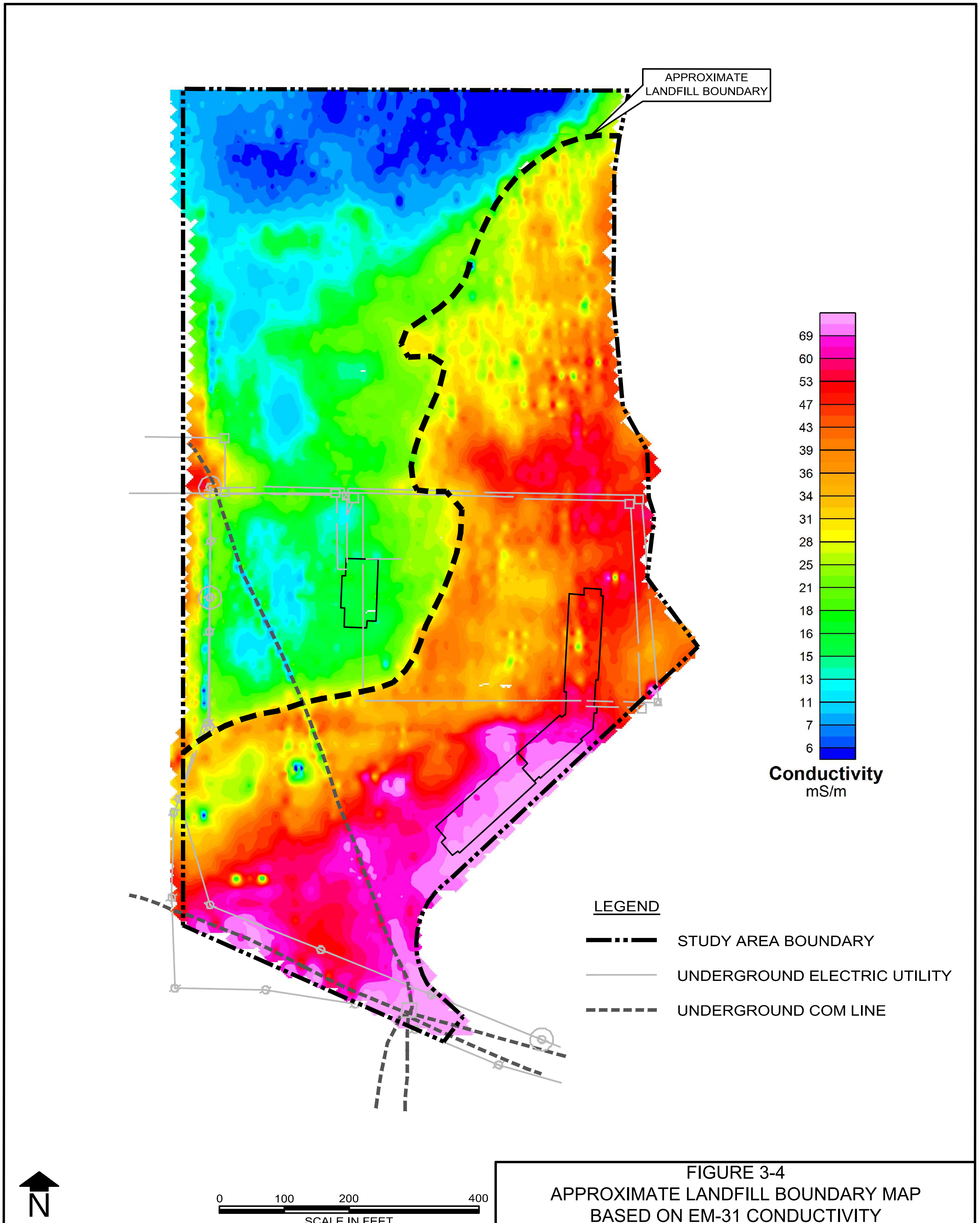


TerranearPMC

222 VALLEY CREEK BLVD.
SUITE 210
EXTON, PA 19341-2843
(610) 862-5000 PHONE
(610) 862-5050 FAX

FIGURE 3-3
SUBSURFACE ANOMALY MAP
BASED ON EM-31 INPHASE
SITE INSPECTION FORMER LANDFILL COMPLEX
YAKIMA TRAINING CENTER, WASHINGTON

PROJECT #:	TASK #:	DRAWING #:	SCALE:	DATE:	DRAWN BY:
46040	01	01A101	1" = 200'	06/15/16	DST



TerranearPMC

222 VALLEY CREEK BLVD.
SUITE 210
EXTON, PA 19341-2843
(610) 862-5000 PHONE
(610) 862-5050 FAX

FIGURE 3-4
APPROXIMATE LANDFILL BOUNDARY MAP
BASED ON EM-31 CONDUCTIVITY
SITE INSPECTION FORMER LANDFILLL COMPLEX
YAKIMA TRAINING CENTER, WASHINGTON

PROJECT #:	TASK #:	DRAWING #:	SCALE:	DATE:	DRAWN BY:
46040	01	01A101	1" = 200'	06/15/16	DST

Appendix C

Field Forms and Procedures

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SOIL TEST PIT LOG FORM

Project: Yakima Training Center Former Landfill Complex Date: _________________

Location: Yakima Washington Training Center Time:_________________

Test Pit Name: _______________________________ Coordinate System:_____________________

Approx. Northing: ____________________________ Approx. Easting: ______________________

Company Name: EA Engineering, Science, and Technology, Inc, PBC ___________________________

Test Pit Logged By:____

Weather Conditions:____

Method of Excavation: Excavated with a backhoe ____

Surface Slope (approx. %):__________ Surface Conditions: __________________________________

Depth Interval (feet)	Layer Description		Comments	Sample Interval/ ID
	Material type:			
	Layer Thickness (ft):			
	Soil/rock conditions:			
	Material type:			
	Layer Thickness (ft):			
	Soil/rock conditions:			
	Material type:			
	Layer Thickness (ft):			
	Soil/rock conditions:			
	Material type:			
	Layer Thickness (ft):			
	Soil/rock conditions:			
	Material type:			
	Layer Thickness (ft):			
	Soil/rock conditions:			
	Material type:			
	Layer Thickness (ft):			
	Soil/rock conditions:			

Material Types: clay, silt, sand, gravel, rock.
Soil Conditions: dry, organic, roots, moist, wet, water seepage, hard, soft, odor.
Take photographs of test pit.

Terra Core® Soil Sampling Instructions

Soil Sample Collection Equipment

EPA 5035A recommends the use of hermetically sealed samplers or field preserved methanol vials for the collection of soil and sediment samples requiring analysis for VOCs (Volatile Organic Compounds).

In Canada this relates to the analysis of VOCs (including THMs, VPH and other volatile compounds), BTEX (Benzene, Toluene, Ethylbenzene and Xylenes) and, F1 (CCME Petroleum Hydrocarbons C6-C10).

Terra Core® sampling kits are available from ALS for purchase and are invoiced at the time orders are placed. This sampling device may also be purchased directly from the supplier (Please note that there is no option for refund for returned sampling supplies and equipment). If you wish to order sampling kits or wish to apply the cost of supplies to a particular project, please advise your Account Manager when you place your order.

Sample Container and Kit Ordering Information

Sampling Option	Item	Description/Quantity	Cost ($)
Complete Terra Core® Kit	Terra Core® Soil Sampler, tared vials with 10mL of Methanol, 125 mL glass soil jar	1 Sampler, 2 vials, 1 jar	$5.00
Without Terra Core® Sampler	Tared vials with 10mL of Methanol + jar for moisture determination	2 vials, 1 jar	$3.00

Quality Assurance

- Each lot of pre-weighed, pre-preserved 40 mL vials is verified by ALS for tare weight accuracy, methanol volume, and purity.
- Each batch of methanol-preserved soil samples requires an additional set of vials pre-charged with methanol for a travel blank. The travel blank should not be opened in the field.
- Methanol is volatile, so please ensure the methanol vials are kept cool, upright and not subject to extreme temperature and humidity variations during storage and in the field.
- Methanol is regulated under the Transportation of Dangerous Goods Act (TDG). Limited Quantity labels must be placed on the outside of the cooler if shipping methanol vials by air or ground. TDG training requirements, as listed in the TDG Act, do not apply if the volume of each container is less than or equal to 1 L, each cooler or package is less than or equal to 30 kg, and total amount of dangerous goods in the shipment does not exceed 150 kg.
- Only use the methanol provided by the laboratory for sample preservation.

Continued on reverse side...

9936 67 Avenue • Edmonton, AB T6E 0P5
+1 780 413 5227
www.alsglobal.com

... continued from reverse side

Sample Instructions

- Please check the black 10 mL fill line to ensure methanol volume is correct. Have your sample vials labeled and ready to go. It is very important that the vial is labeled with an appropriate pen as the addition of a label will change the tare weight of the vial and result in inaccurate weight determination. Use of an additional label would also result in slow sample processing and potential barcode reading errors.
- The Terra Core® is designed to deliver approximately 5 grams of typical mineral soil, but an alternative sampling device to deliver 5 gram aliquot of soil may be used.
- Different amounts of soil are required in order to meet all of the Alberta Tier 1 reporting guidelines. The table below should be used as a guideline:

Analytes of Interest	Soil Required (plugs)	Soil Type
BTEX F1	1	Typical mineral soil
BTEX F1	2	Peat
VOCs	2	Typical mineral soil

If you are unsure of the amount of soil required to meet your required reporting limits, please contact your ALS Account Manager.

- With the plunger of the Terra Core® seated in the handle, push the Terra Core® into the representative soil sample.
- Remove soil or debris from the outside of the Terra Core® sampler with a tissue. The soil plug should be squared-off to the lip of the sampler.
- Rotate the plunger that was seated in the handle top 90 degrees and place the mouth of the sampler into the 40 mL glass vial. Push down on the plunger to slowly release the plug of soil into the vial (avoid splashing the core into the methanol).
- Wipe any soil from the threads of the vial and tighten the cap on the vial securely to ensure no leakage.
- Sample into the second vial reusing the same plunger following the procedure above.
- Stand the 2 x 40 mL vials in the bubble wrap bags supplied and place in the cooler at 4°C. The vials must always be kept upright to ensure that there is no methanol lost.
- The holding time for field methanol preserved soil samples is 40 days.

- Collect a sample for moisture in the glass soil jar provided.
- Contact your ALS Account Manager or Technical Sales Representative with any questions.

Complete Terra Core® Kit from ALS

Methanol Preservation Hold Time: 40 days
Cost: $5.00 each kit

[1]Kit Includes:

- 2 x 40 mL pre-preserved, pre-weighed, pre-labeled glass vials
- 1 Terra Core® Sampler for a 5-gram sample core
- 1 x 125 mL glass soil jar for moisture

[1] $5.00 will be billed in advance or charged to a project identified at the time of ordering for each kit ordered.