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Relative Risk Site Evaluations for Yakima Training Center

R.M. Smith
G. Whelan

November 1996

Prepared for the U.S. Department of Defense
Environmental and Natural Resources Division
Directorate of Public Works
Fort Lewis, WA 98443

Pacific Northwest National Laboratory
Operated for the U.S. Department of Energy
under Contract DE-AC06-76RLO 1830

PNNL-11460

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Summary

All 20 U.S. Army Yakima Training Center (YTC) sites evaluated were given a "low" relative risk. At Solid Waste Management Unit (SWMU) 22, a "minimum" soils contaminant hazard factor was assigned even though 6,700 mg/kg TPH-diesel was found in surface soil. SWMU 22 is physically located on top of and with the fence surrounding Area of Concern (AOC) 4. Because the diesel is most likely associated with AOC 4, and plans are to clean up AOC 4, any further actions regarding these contaminated soils should be addressed as part of the planned actions for AOC 4. Contaminant hazard factors of "moderate" were assigned to the soil pathway for SWMUs 4 and 7 because dieldrin and arsenic, respectively, were found in surface soil samples at concentrations exceeding standards. A "moderate" contaminant hazard factor was also assigned to the sediment pathway for AOC 1 because arsenic detected in sediments in "Larry's Swimming Pool" exceeded the standard. All other contaminant hazard factors were rated as "minimal." The receptor factor for all sites and pathways was rated "limited," except for SWMU 54 in which the groundwater receptor factor was rated "potential." A "potential" rating was assigned to the groundwater pathway at this site to be conservative. The site is located on the south side of the syncline axis where the unconfined aquifer may be present and there are no monitoring wells at the site to confirm or deny the presence of groundwater contamination.

1.0 Introduction

The Defense Environmental Restoration Program (DERP) is continually faced with the problem of allocating limited congressionally authorized annual funds to achieve environmental restoration objectives. The quantity of work identified by individual military bases greatly exceeds the level of funding allocated in a single year. Therefore, the Department of Defense (DoD) has implemented a Relative Risk Site Evaluation (RRSE) process as a way to categorize sites based on their relative risk to human health and the environment. Limited funds can then be allocated to individual bases in accordance with the relative hazard of each site.

The U.S. Army's Yakima Training Center (YTC), a FORSCOM Installation managed by Fort Lewis, identified 20 sites that had not been evaluated for RRSE. This report documents the process by which those sites were evaluated by PNNL at the request of DoD and the resultant evaluations. The evaluation process is presented in Section 2.0, a summary of the RRSE results are presented in Section 3.0, the detailed RRSE worksheets for each site are in Section 4.0, the cited references are in Section 5.0. Analytical data upon which the evaluations were made are presented in the Appendices. Appendix A includes a summary of data for each site sampled and Appendix B includes the laboratory data sheets for the data summarized in Appendix A.

2.0 Evaluation Process

The assessment process used is a risk assessment approach of defining exposure pathways. An exposure pathway describes how a contaminant may move from its source to a receptor. An exposure pathway is important only if it is complete. A complete exposure pathway has five primary elements:

- a chemical source
- a mechanism of release
- an environmental medium
- an exposure point
- a feasible route of exposure (e.g., ingestion)

An example exposure pathway is shown in Figure 1. An exposure pathway is complete if there is a reasonable likelihood that a receptor may take in contaminants through inhalation, ingestion, or dermal contact with contaminated media. There will be no exposure, and thus no risk, if the exposure pathway is incomplete. For this RRSE, contaminant sources, release mechanisms, and migration pathways for each source area were assessed using information from previous investigations, operations history, and physical and chemical properties of the constituents of concern as related to their environmental behavior.

The specific approach used in performing the RRSE for the 20 sites at YTC is presented in DoD guidance (DoD, 1994). Adherence to the guidance was followed except in cases where no contamination data existed. In those cases, conservative assumptions about site history, operating conditions, and physical and chemical properties of the constituents of concern were applied to provide a quantifiable rationale for any conclusion about possible contaminant releases and their environmental behavior.

The evaluations involved the following three tasks:

1. Determine what data were needed to perform the RRSE for each site. This included site inspections, review of site records to establish each site history and documented or suspected site conditions, and review of installation general environmental reports that pertain to individual sites. A meeting with Ft. Lewis personnel was held on 3 September 1996 to discuss the sites and collect documented information about the sites. The site specific reports cited in this report (Section 5.0) were obtained in this meeting. On 10 September 1996, PNNL personnel met with YTC and Ft. Lewis subcontractor personnel at YTC to inspect each site.

2. Based on findings from the first task, it was determined that additional field work was required to collect data at six sites. Soil samples were collected at locations where it was believed that the maximum contaminant concentrations would be found if any contaminants had been released from a source. The work included trenching to determine the presence or absence of underground storage tanks (USTs) and contaminated soil, and surface soil sampling to determine if contaminants were present at sites where the maximum release point was at ground surface. Samples were analyzed using portable field instruments or laboratory analyses when necessary.

3. Using the data compiled in the first two tasks, the third task was to perform the RRSE. This included completing relative risk evaluation worksheets for soils, surface water/sediment, and groundwater; calculating contaminant hazard factors, migration pathway factors, and receptor factors for each medium; determining the media-specific risk rating; and finally, determining the overall site relative risk category. The RRSE worksheets are presented in Section 4.0 of this report.

The DoD RRSE process results in an assessment of risk for each site that could range from qualitative to very quantitative, depending on the data available for a site. A quantitative assessment was performed for those sites and specific pathways in which site-specific contaminant concentrations were available. Contaminant concentrations were compared to EPA Region 9 preliminary remediation goals for groundwater and soils. A contaminant hazard factor was assigned based on the ratio of the contaminant concentration divided by the EPA remediation goal for that contaminant. The qualitative assessments involved no specific contaminant data, but through the use of conservative assumptions about facility operations and physical and chemical behaviors of constituents of concern, judgments were made about the completeness of specific exposure pathways. In this way, if a specific exposure pathway was considered incomplete, the health risk through that pathway would be zero.

The most recently compiled Region 9 PRGs, published on August 1, 1996, were used in this report. Because these standards are revised annually, some PRG values can change. For example, significant changes from 1995 to 1996 occurred for arsenic, manganese and benzene. The manganese PRG increased by approximately 10 times while the arsenic and benzene PRGs decreased by factors of approximately 60 and 300, respectively. The revision for benzene did not cause any pathways at any sites to move into a higher contaminant hazard factor, but the revisions to manganese and arsenic PRGs had significant impacts on the contaminant hazard factors for the soils pathway for several sites. The revision to the manganese PRG eliminated manganese from being a significant hazard at any site at YTC. The revision to the arsenic PRG resulted in several sites receiving a moderate soil or sediment contaminant hazard factor, where a minimal contaminant hazard factor would have been assigned prior to the revision. This issue is discussed in more detain in Section 3.0

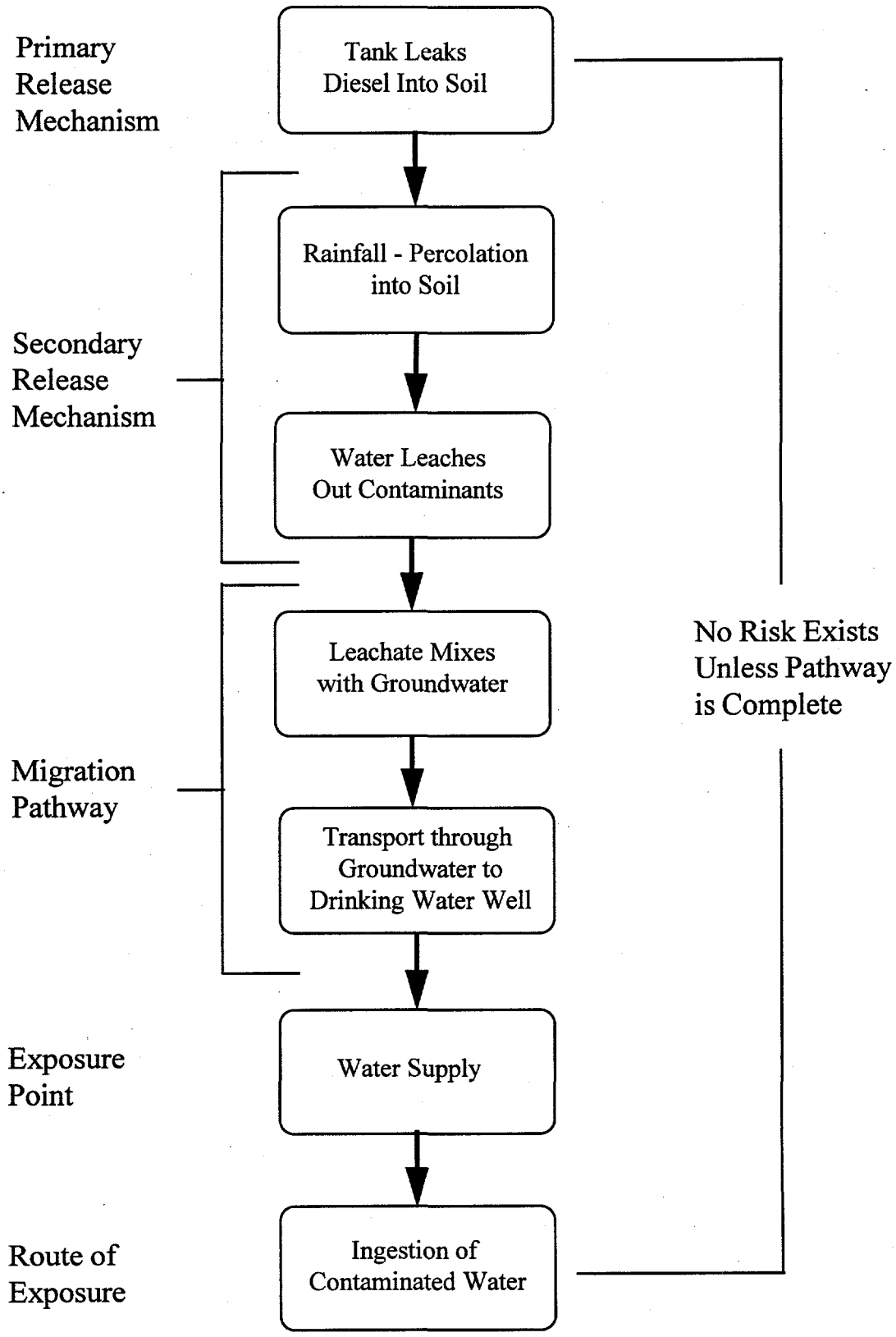


Figure 1. Elements of an Example Exposure Pathway

3.0 Results of the Relative Risk Site Evaluation

The Environmental and Natural Resources Division of the Directorate of Public Works at Fort Lewis requested that 20 regulated sites at YTC be evaluated under the RRSE process. Site locations are presented on Figure 2 and the results of the evaluation are summarized in Table 1. Detailed discussions of site data and rationale for the ratings are presented in the RRSE worksheets in Section 4.0 Figures 3, 4, 5, and 6 are provided in support of geology and hydrology discussions presented in the worksheets.

The results presented in Table 1 indicate that all of the 20 sites evaluated were given a low relative risk. The contaminant hazard factors (CHFs) for all three pathways (i.e., groundwater, surface water/sediment, and soil) were rated as "minimal" for every site, even those in which no analytical data were available, except for SWMUs 4 and 7, which received moderate contaminant hazard factors for the soil pathway, and AOC 1, which received a moderate rating for the sediment pathway. For sites in which data were not available, additional supporting information such as site operations, source positions, pathway considerations, and chemical and physical behaviors of constituents of concern were used to judge the likelihood of contamination reaching the pathways. Surface soils at SWMUs 4 and 7 contained dieldrin at 2 times higher than the standard and arsenic at 12.4 times higher than the standard, respectively. Sediments in "Larry's Swimming Pool," downstream of AOC 1, contained arsenic at 14.2 times the standard. The high arsenic ratios were a direct result of the lower PRG value published in the 1996 EPA guidance. Arsenic would not have been considered a significant hazard using the 1995 guidance. The levels of arsenic found in these soils and sediments is approximately 2 times higher than that found in soils across the YTC and in sediments found in the Yakima River upstream of the YTC. Therefore, much of the concentration is likely due to background and/or area wide application of arsenic containing pesticides. Most of the soils and sediments sampled in the area exceed the new arsenic standard.

At SWMU 22, a "minimum" soils CHF was assigned even though 6,700 mg/kg TPH-diesel was found at the site. SWMU 22 is physically located on top of and within the fence surrounding AOC 4. As a result, the diesel contamination was located in an area that was part of both source areas, but because the area was contaminated from a large diesel spill at AOC 4 before SWMU 22 even existed, the elevated level of diesel contamination was attributed to AOC 4. Any further actions regarding these contaminated soils should be addressed as part of the planned actions for AOC 4.

The receptor factor (RF) for all sites and pathways was "limited", except for SWMU 54 in which the groundwater RF was rated "potential." A "potential" rating was assigned to the groundwater pathway at this site to be conservative. The site is located on the south side of the syncline axis where the unconfined aquifer may be present, and there are no monitoring wells at the site to confirm or deny the presence of groundwater contamination.

Based on the discussions presented in Section 4.0, the sites evaluated in this report have low relative risk from the standpoint of the RRSE process. In addition, it is recommended that the discussions be provided to regulatory personnel in the form of "No Further Action" requests. These sites do not pose an unacceptable risk to human health and the environment and should be removed from further consideration. The only result that might warrant additional investigation is arsenic in soils and sediments around the site and surrounding areas.

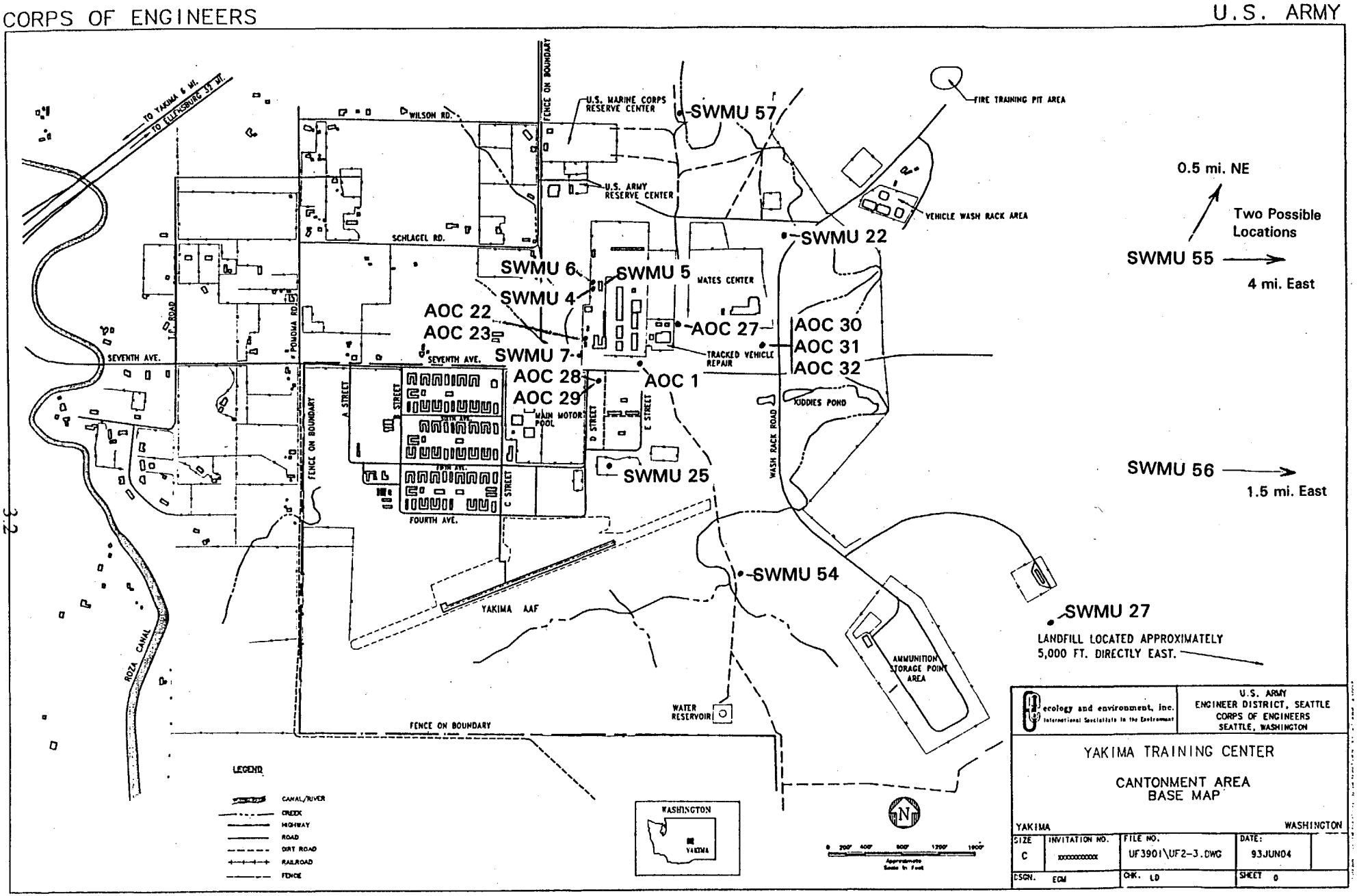


Figure 2. Location of Source Areas.

Table 1. Summary of Relative Risks.

SOURCE AREA	Groundwater			Surface Water			Soils			Overall Rating
	CHF[a]	MPF[a]	RF[a]	CHF	MPF	RF	CHF	MPF	RF	
SWMU 4 - Former Hazardous Waste Storage Area	Min	Con	Lim	Mim	Con	Lim	Mod	Con	Lim	Low
SWMU 5 - Former Pesticide Handling Area	Min	Con	Lim	Min	Con	Lim	Min	Con	Lim	Low
SWMU 6 - Former Transformer Storage Area	Min	Con	Lim	Min	Con	Lim	Min	Con	Lim	Low
SWMU 7 - Former Containers Next to Fence	Min	Con	Lim	Min	Con	Lim	Mod	Con	Lim	Low
SWMU 22 - Former PCS Stockpile Area	Min	Con	Lim	Min	Con	Lim	Min[b]	Con	Lim	Low
SWMU 25 - Old Petroleum, Oil, Lubricant Yard	Min	Con	Lim	Min	Con	Lim	Min	Con	Lim	Low
SWMU 27 - Former Ammunition Storage Point Burn Pits	Min	Con	Lim	Min	Con	Lim	Min	Con	Lim	Low
SWMU 54 - Former Cantonment Landfill	Min	Con	Pot[c]	Min	Con	Lim	Min	Con	Lim	Low
SWMU 55 - Two Former Landfill Pits	Min	Con	Lim	Min	Con	Lim	Min	Con	Lim	Low
SWMU 56 - Former Landfill Pit	Min	Con	Lim	Min	Con	Lim	Min	Con	Lim	Low
SWMU 57 - Former Landfill/Burn Pit	Min	Con	Lim	Min	Con	Lim	Min	Con	Lim	Low
AOC 1 - Former Central Vehicle Wash Rack	Min	Con	Lim	Mod	Con	Lim	Min	Con	Lim	Low
AOC 22 - Building 810-1 UST (inactive)	Min	Con	Lim	Min	Con	Lim	Min	Con	Lim	Low
AOC 23 - Building 810-2 UST (inactive)	Min	Con	Lim	Min	Con	Lim	Min	Con	Lim	Low
AOC 27 - Building 845 UST Diesel Tracked Vehicle Repair	Min	Con	Lim	Min	Con	Lim	Min	Con	Lim	Low
AOC 28 - Building T-1470 UST (inactive)	Min	Con	Lim	Min	Con	Lim	Min	Con	Lim	Low
AOC 29 - Building T-1470 UST (inactive)	Min	Con	Lim	Min	Con	Lim	Min	Con	Lim	Low
AOC 30 - Building T-2020 UST (inactive)	Min	Con	Lim	Min	Con	Lim	Min	Con	Lim	Low
AOC 31 - Building T-2020 UST (inactive)	Min	Con	Lim	Min	Con	Lim	Min	Con	Lim	Low
AOC 32 - Building T-2020 UST (inactive)	Min	Con	Lim	Min	Con	Lim	Min	Con	Lim	Low

[a] Min = minimal rating; Con = confined rating; Lim = limited rating; Mod = moderate rating; and Pot = potential rating.

[b] TPH-diesel was measured at 6,700 mg/kg in a composite soil sample. This contamination is attributed to AOC 4 not SWMU 22.

[c] This site was the only one that was assigned a "potential" groundwater RF because it was the only site beneath which the unconfined aquifer may exist.

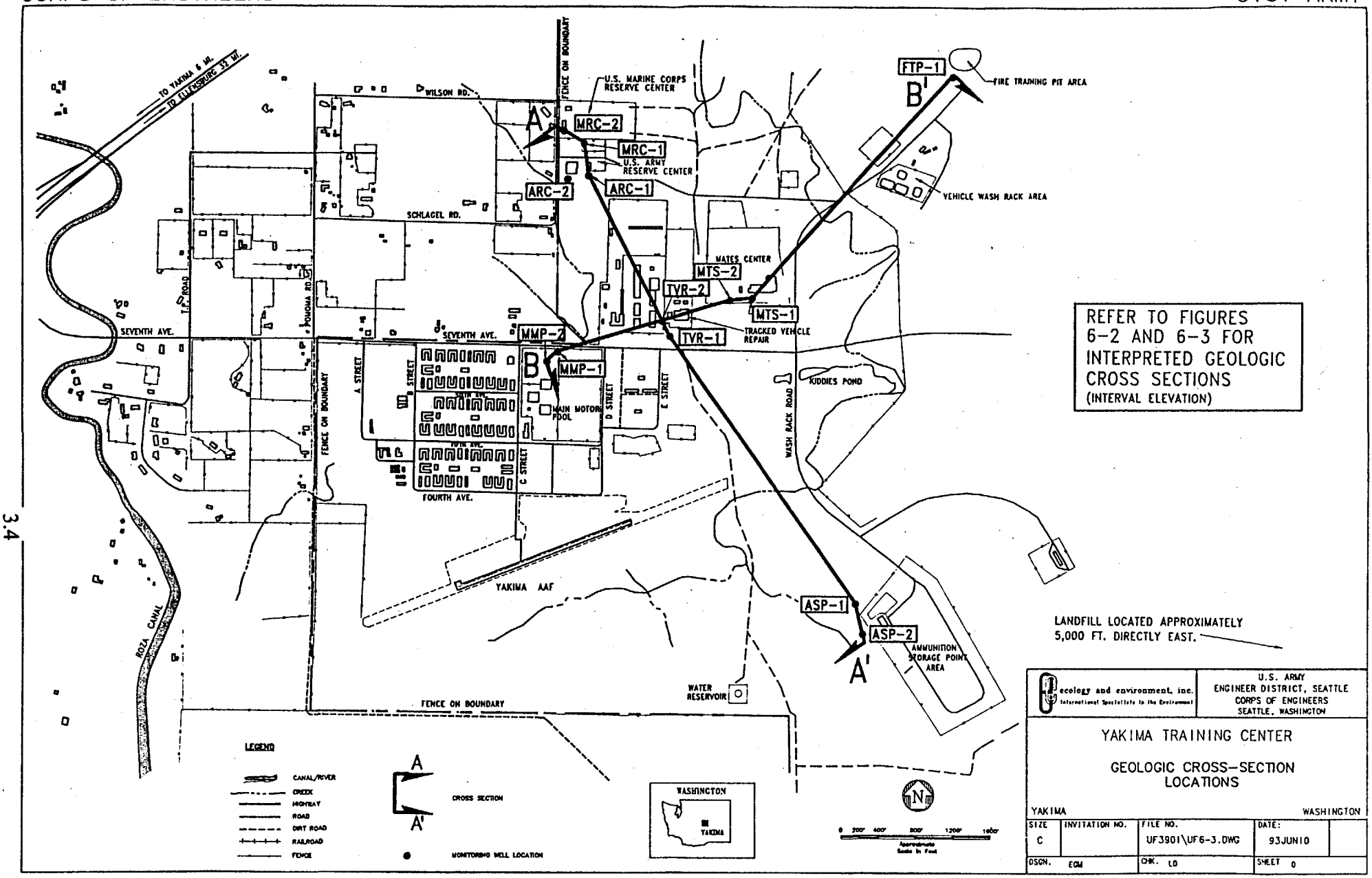


Figure 3. Location of Geologic Cross Sections (Ecology & Environment, 1993).

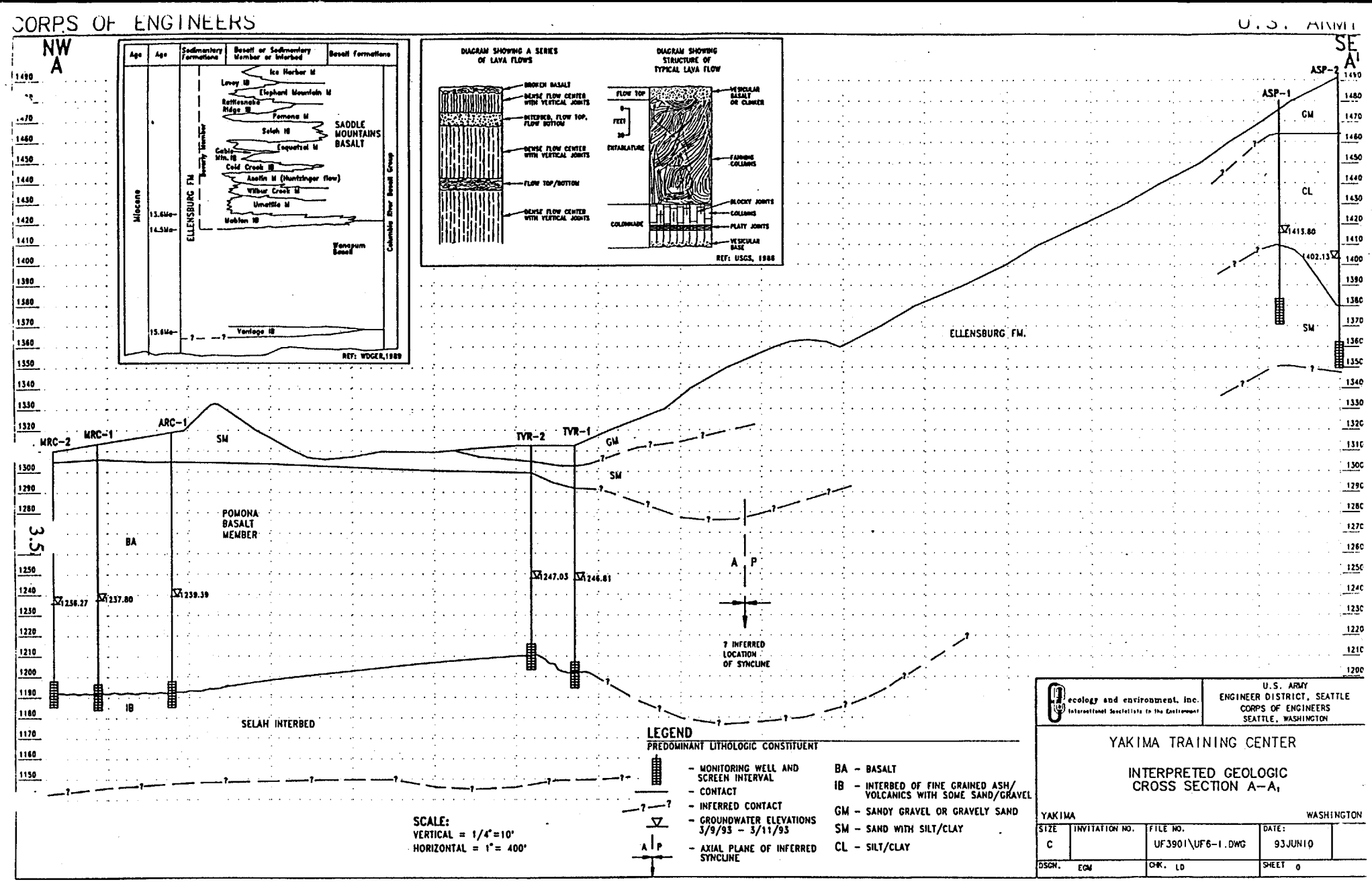


Figure 4. Geologic Cross Section A-A' (Ecology & Environment, 1993).

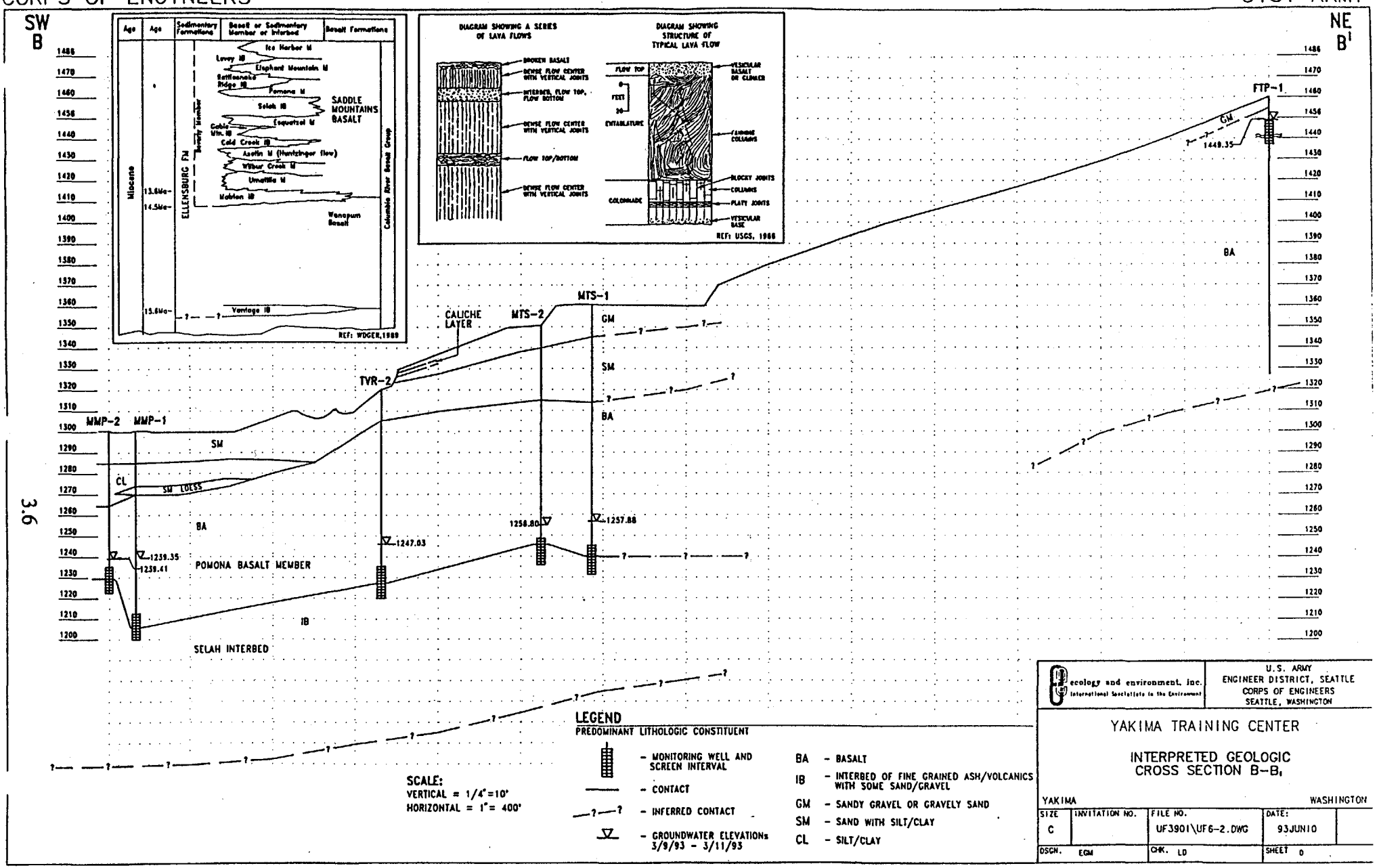
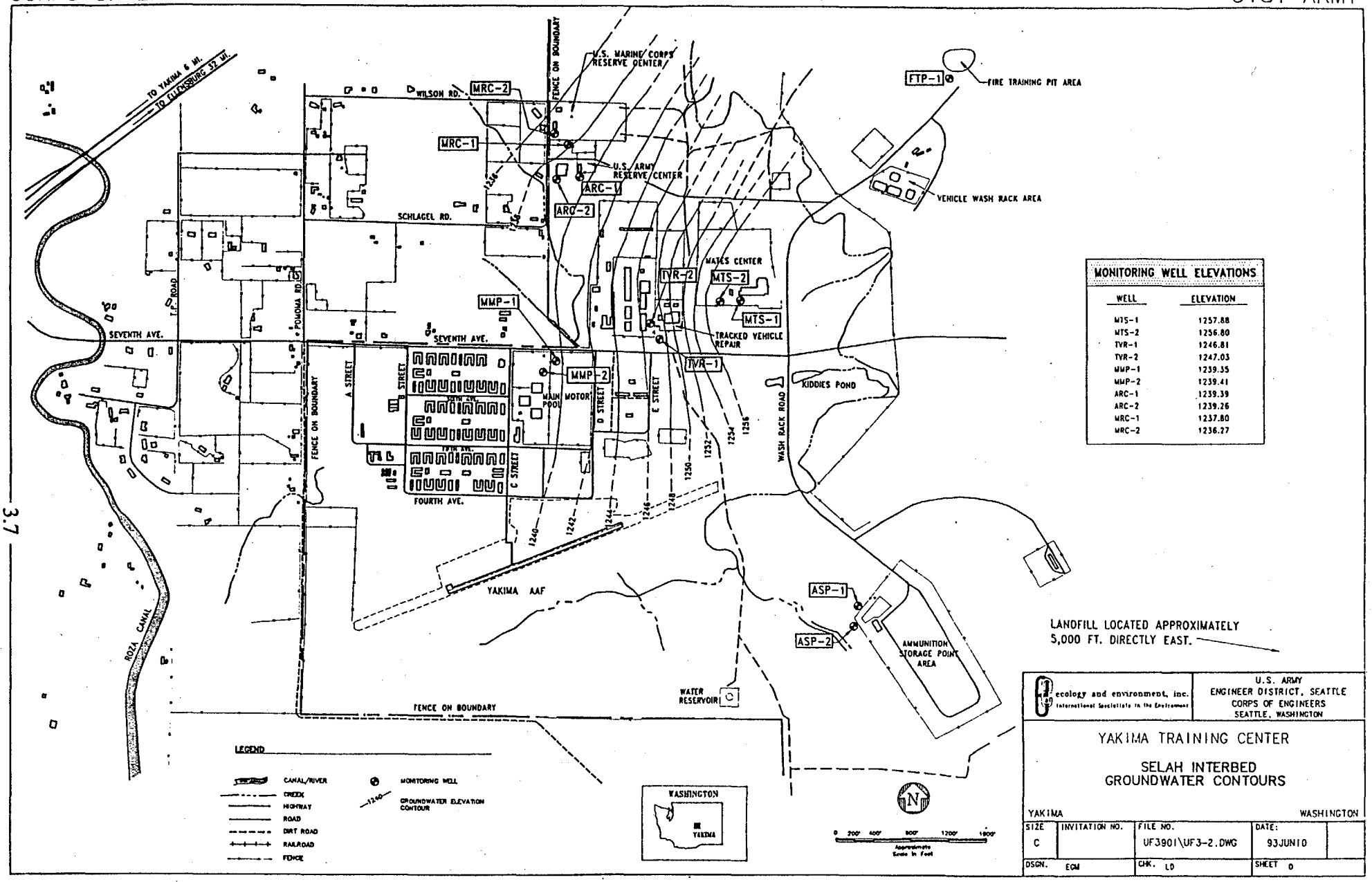


Figure 5. Geologic Cross Section B-B' (Ecology & Environment, 1993).



3.7

Figure 6. Groundwater Levels for the First Confined Aquifer (Ecology & Environment, 1993).

4.0 Relative Risk Site Evaluation Worksheets

Worksheets for the 20 sites included in this report are provided in this section. Some of the sites are close to each other and have similar characteristics; therefore, they are addressed in the same worksheet. Examples of these sites are:

- AOCs 22 and 23 - Two, 1,000-gallon underground storage tanks
- AOCs 28 and 29 - Two, 12,000-gallon underground storage tanks
- AOCs 30, 31, and 32 - Three, 600-gallon above ground storage tanks

Relative Risk Evaluation Worksheet

Site Background Information

Installation/Site Name for FUDS: Ft. Lewis-Yakima Training Center
Location (State): Washington
Site (Name/RMIS ID/Project for FUDS: SWMU 4
Stage): RFA
Point of Contact (Name/Phone): Paula Wofford (206)-967-5337
Order): N

Date Entered (day, month, year): 13 September 1996
Media Evaluated (GW, SW/Sediment, Soil): None
Phase of Execution (SI, RI, FS, Removal, RD/RA, or equiv. RCRA

Agreement Status (Y/N, if yes, type agreement e.g., FFA, Permit,

Site Summary

Brief Site Description (Include site type, materials disposed of, dates of operation, and other relevant information):

SWMU 4 - Former Hazardous Waste Storage Area

The area consists of an asphalt-covered area delineated by yellow painted lines within which hazardous wastes were stored before shipment to Ft. Lewis for disposal. The site is located approximately 500 feet north of building 810 along the western margin of the materials yard and west of the former pesticide storage area (SWMU 5). A fence on the western margin of the materials yard delineates the western boundary of the site (Ogdan, 1995).

The area served as the 90-day storage area for YTC from at least 1989 through 1994, when the 90-day storage of wastes was moved to SWMU 3 (SAIC, 1995). It is unknown when operations began at the site, but it was definitely in use after 1989 when the area was paved. The area was described as an asphalt pad with an inflatable boom and sandbags, 8-inches high and capable of retaining 400 gallons of liquid (SAIC, 1995). The types of wastes stored at the site included containers of fuel, pesticides, solvents, batteries, antifreeze, paint wastes, paint thinner, rags, transformers, oily debris, waste MEK, hydrochloric acid, sodium hydroxide, and cleaning compound (SAIC, 1995). The batteries were stored on pallets, but the acid had been removed and stored in plastic drums. There is no record that any spills occurred at the site nor that any waste containers leaked. The asphalt is in good condition within the painted yellow lines and, currently, miscellaneous equipment is stored at the site.

There is no curbing around the site and water could drain to the west or north off of the site onto adjacent soil areas. In September 1996, weeds were growing along the fence and did not appear stressed. A recent YTC project resulted in the placement of basalt rock (2 to 5 inches in diameter) cover over the area extending from the fence to the west approximately 100 feet. This cover is 6 inches thick near the fence to nearly 8 feet thick at its western boundary. This cover has effectively covered the area that might be impacted by runoff of contaminated water from the site.

Brief Description of Pathways (Groundwater, Surface Water/Sediment, Soil):

Groundwater Pathway: Groundwater beneath YTC occurs in three distinct locations: 1) in the unsaturated upper Ellensburg formation sediments between ground surface and the water table or top of Pomoma basalt, which ever is present; 2) in the saturated Ellensburg formation sediments below the water table and above the Pomona basalt, which is the unconfined aquifer; and 3) below the Pomona basalt in the Selah interbed (Ellensburg formation), which is the first confined aquifer. If contaminants reach these locations, their behavior and ultimately the relative risk of the source area, differs greatly.

Groundwater in the unsaturated zone is retained in the unconsolidated sediments by capillary forces and moves very slowly in response to additions of water at the ground surface such as precipitation or anthropogenic sources. Because of low precipitation, 6 to 9 inches per year, and control of water sources at YTC, groundwater movement in the unsaturated zone is very slow.

The unconfined aquifer in the vicinity of the Cantonment Area appears to be perched or limited to upland areas on the southern limb of the syncline in which the Cantonment Area is located. For example, only one of four wells completed in the unconfined aquifer at the active landfill contained water in 1993 when wells were sampled for the site investigation report (Ecology and Environment, 1993). One of the wells, MW-1 drilled in 1988, encountered the top of basalt at 103 feet below ground surface, with dense basalt encountered at 116 feet. Groundwater was found only in the basalt flow top and water levels fluctuated approximately 7 feet between a winter high to summer low. During the summer, only two feet of water was present in the well. Both monitoring wells at the Ammunition Storage Point Area encountered the unconfined aquifer. Wells located north of the axis of the syncline, estimated to be just south and parallel with Seventh Avenue, did not encounter water on top of the Pomona Basalt. Ecology and Environment (1993) cite other references that indicate that private wells located west of the YTC, closer to the Yakima River, withdraw water from the unconfined aquifer from as shallow as 20 feet below ground surface. The unconfined aquifer was thought to be in hydraulic communication with the Yakima River at that location. Groundwater found on top of the first basalt layer appears to be localized to upland areas on the south side of the syncline, near its axis, and is not present in the Cantonment Area. The only exception to this pattern appears to be in the immediate vicinity of the storm drainage ditch adjacent to Seventh Avenue. This supply of water apparently results in a locally saturated condition near wells TVR-1 and TVR-2, located north of the intersection of E Street and Seventh Avenue (Ecology and Environment, 1993).

The first confined aquifer is located in the Ellensburg formation sediments, namely the Selah interbed, beneath the Pamona basalt, generally 100 feet or deeper below ground surface. The Pomona basalt is greater than 60 feet thick in all wells that have been drilled though it on base, and water encountered below it was found to be under confined conditions in all cases. Groundwater flow in this confined aquifer was to the west, down the axis of the syncline (Ecology and Environment, 1993). Based on the confined aquifer properties reported by Ecology and Environment (1993), hydraulic conductivity of 1.48×10^{-5} ft/sec and hydraulic gradient of 4.4×10^{-3} ft/ft, the lateral flow velocity is approximately 2 feet per year. The nearest source of contamination to residential property is approximately 400 feet, therefore, the estimated travel-time for a contaminant to reach a residential water well is in excess of 200 years.

Groundwater is not considered a completed pathway because the site is covered by asphalt. If soils were contaminated prior to placement of the asphalt cover, the cover effectively stopped that pathway. If any spills did occur after the asphalt was placed, they would be contained inside the

boom area and cleaned up accordingly. Any residual contamination is likely to be in small quantities and would have washed onto adjacent soils or into the storm drains for the area.

Surface Water/Sediment Pathway: There nearest surface water stream is the irrigation ditch approximately 200 feet west of the site. There is no surface contamination nor is there a completed surface water pathway at this site. Prior to placement of the basalt rock cover over the area west of the site, there were no erosion features indicating that there was no significant runoff from the site. It is assumed that any runoff from the site would have infiltrated into the soil before reaching the irrigation ditch.

Soil: The soil pathway is important only if runoff from the site was contaminated and deposited hazardous constituents in the soils adjacent to the asphalt. Those soils were sampled and analyzed for VOCs, SVOCs, pesticides and PCBs, and metals. None of the analytes exceeded the risk-based Region 9 PRG concentrations.

Brief Description of Receptors (Human and Ecological):

The site is managed as an industrial area with the base restricted to authorized personnel. The site is asphalt covered and there is no indication that hazardous constituents were released from the site. If adjacent soils were contaminated from runoff from the site, they are now covered by the basalt rock cover and not available to receptors.

Groundwater

Contaminant Hazard Factor (CHF): Minimal - There are no monitoring wells located specifically for this site, but because the controlled nature of operations at the site; the wastes were stored in containers and stored on asphalt; booms were used to control any releases; and routine shipment of wastes offsite; the release of wastes to adjacent soils would have been minimized. There are no records of any spills or releases at this site. In order for contaminants to reach groundwater, they would have to be leached through approximately 100 feet of basalt rock to the confined aquifer. This pathway is not considered complete.

Contaminant	Maximum Concentration (µg/L)	Standard (µg/L)	Ratio
The groundwater pathway is not considered complete at this site, *therefore, no samples were* collected. No monitoring wells are present at this site.			

Migration Pathway Factor: Confined - Waste release to the soil is considered highly unlikely and the potential for contaminant migration from the source is limited because of the depth to groundwater, low precipitation and lack of water in the area.

Receptor Factor: Limited - The likelihood that the groundwater pathway is completed is extremely small, therefore, there can be no groundwater receptors for the site.

Groundwater Category: Low

Surface Water/Sediment

Contaminant Hazard Factor (CHF): Minimal - There is no surface water associated with this site.

Contaminant	Maximum Concentration (μg/L)	Standard (μg/L)	Ratio
No surface water associated with the site, therefore, no samples could be collected.			

Migration Pathway Factor: Confined - The information indicates that the potential for surface water migration from the source is limited because there are no surface water bodies associated with the site.

Receptor Factor: Limited - There are no surface water bodies associated with the site.

Surface Water/Sediment Category: Low

Soil

Contaminant Hazard Factor (CHF): Moderate - Soils were sampled along the western margin of the asphalt pad showed that two hazardous materials were found at this location adjacent to the site and could have been released from the site because this location is in an area where runoff from the site would have reached surface soils. The constituents found at concentrations exceeding the standard were the metal beryllium and the pesticide dieldrin. Ecology and Environment (1993) reported that the background beryllium concentration in subsurface soil was 0.76 mg/kg. In addition, beryllium concentrations in stream sediments ranged from 0.63 to 0.88 mg/kg. Therefore, the beryllium concentration found at SWMU 4 is considered background. There is no natural source of dieldrin, but it could have been deposited at the site either from use of insecticides on the base, drift from adjacent properties where it could have been applied by private land owners, or from runoff from SWMU 4.

Contaminant	Maximum Concentration (mg/kg)	Standard (mg/kg)	Ratio
VOCs	All below detection limits	Below standards	--
SVOCs	All below detection limits	Below standards	--
Pesticides	Eight pesticides detected, but all well below standards except dieldrin	Below standards	--
Dieldrin	0.0571	0.028	2.0
PCBs	All below detection limits	Below standards	--
Metals	21 metals detected, but all well below standards except Be	Below standards	--
Beryllium	0.380	0.140	2.7
		Total	4.7

Migration Pathway Factor: Confined - Soil analyses indicate that the soils adjacent to the site, at the location that would most likely be contaminated if a release had occurred, contain beryllium at background levels and dieldrin at two times the standard. Dieldrin is highly sorptive on soils found at the site and would not leach readily from the site. Surface runoff is not significant at the site and therefore, soils would not be mobilized off the site by surface erosion.

Receptor Factor: Limited - The area is restricted to authorized personnel and in an area removed from routine traffic.

Soil Category: Low

Relative Risk Evaluation Worksheet

Site Background Information

Installation/Site Name for FUDS: Ft. Lewis-Yakima Training Center
Location (State): Washington
Site (Name/RMIS ID/Project for FUDS: SWMU 5
Point of Contact (Name/Phone): Paula Wofford

Date Entered (day, month, year): 13 September 1996
Media Evaluated (GW, SW/Sediment, Soil): None
Phase of Execution (SI, RI, FS, Removal, RD/RA, or equiv. RCRA Stage): RFA
Agreement Status (Y/N, if yes, type agreement e.g., FFA, Permit, Order): N

Site Summary

Brief Site Description (Include site type, materials disposed of, dates of operation, and other relevant information):

SWMU 5 - Building 815, Former Pesticide Handling Area

The area consisted of a building (815) where pesticides were stored and the surrounding asphalt covered mixing area where applicator vehicles were filled with pesticide formulations. After use, pesticide applicator equipment was rinsed at the site (SAIC, 1995). There are no pesticides stored at the site and pesticide handling is now done in a new facility located south and west of the area.

The site is located approximately 500 feet north of building 810 in the middle of the asphalt covered parking and materials yard. Building 815 burned in 1992 and only the concrete foundation remains.

The site was used for pesticide handling from 1965 through 1990 (SAIC, 1995). Pesticides were stored in a separate room on the north end of the building and the rest of the building was used to store supplies and equipment for light maintenance of heavy equipment (personal communication, Dan Bowers (U.S. Army/YTC), 10 September 1996). Mr. Bowers stated that 98% of the time, pesticide equipment was filled and rinsed on the asphalt covered area on the south side of the building. When equipment maintenance activities conflicted, the unpaved area on the west side of the building was used to service pesticide application equipment.

Pesticides stored and formulations prepared at the site in 1982 include KROVAR II, Roundup, Ureabor, Cytrol, Diquat, Casoron G-4, Casoron G-10, DMA, Tordon 10K, Diazinon, D-TOX 4E (Diazinon), Baygon 1, 5 chenagro, Lindane 25% WP, Titan aerosol, P.O.W. wasp spray, Diazinon 2% dust, Malathion 57%, Lindane 75%, Lindane 1.7E, Pivalyl bait, and Pivalyl 4% concentrate (SAIC, 1995). Other pesticides used at the site in 1995 that could have been used at SWMU 5 include Rodeo (Glysophosphate), Tordon 22K (picloram), Oust, Krovar I DF, Trimec, Banvel, Arsenal, Treflan, Casoron (norsac), Surefire, and Roundup (SAIC, 1995).

Runoff from the paved area entered the storm drains which eventually discharged into the Yakima River.

Brief Description of Pathways (Groundwater, Surface Water/Sediment, Soil):

Groundwater Pathway: The groundwater pathway is not complete because the site was paved and runoff entered the storm drains.

Surface Water/Sediment Pathway: Runoff from the paved area around the building entered the storm drains that discharged into the ditch adjacent to Seventh Avenue, which eventually discharged into the Yakima River. Any spilled pesticides would have been washed into this system and been diluted with other sources of runoff from the base and assumed to be no longer present at the site. All pesticide containers have been removed from the site so there is no source remaining at the site.

Soil: The entire area is paved with the exception of a small area on the west side of the building. This small area is not large enough to be considered a significant source of contamination, especially considering that most of the pesticide handling was performed in front of the building (south side) where the area is paved.

Brief Description of Receptors (Human and Ecological):

The site is managed as an industrial area with the base restricted to authorized personnel. No pesticides are stored at the site and any spilled pesticides or rinsate of equipment would have been washed into the storm drain system and no longer be present at the site.

Groundwater

Contaminant Hazard Factor (CHF): Minimal - There are no monitoring wells located specifically for this site. Most of the site was paved with very little opportunity for pesticides to reach the groundwater. Therefore, no groundwater samples were collected.

Contaminant	Maximum Concentration (µg/L)	Standard (µg/L)	Ratio
The site was paved, offering little opportunity for leaching of pesticides to groundwater, therefore, no samples were collected. There are no monitoring wells at this site.			

Migration Pathway Factor: Confined - Most of the site is paved leaving little opportunity for pesticides to reach groundwater.

Receptor Factor: Limited - The groundwater pathway is not considered complete, therefore, no receptors using groundwater can be impacted by the site.

Groundwater Category: Low

Surface Water/Sediment

Contaminant Hazard Factor (CHF): Minimal - Stormwater runoff and rinse water entered the storm drains and would no longer be present at the site. There are no more pesticides at the site now that the site has been removed from service. Therefore, no surface water/sediment samples were collected.

Contaminant	Maximum Concentration (µg/L)	Standard (µg/L)	Ratio
No pesticide source remains at the site and no surface water is present, therefore, no samples were collected.			

Migration Pathway Factor: Confined - The source of pesticides associated with the site is no longer present.

Receptor Factor: Limited - There is no contaminant source for surface water to transport from the site.

Surface Water/Sediment Category: Low

SWMU 5

Soil

Contaminant Hazard Factor (CHF): Minimal - The site is paved with the exception of a small area on the west site of the building, therefore, no soil samples were collected.

Contaminant	Maximum Concentration (mg/kg)	Standard (mg/kg)	Ratio
Most of the site is paved, so no soil samples were collected.			

Migration Pathway Factor: Confined - The site is mostly paved.

Receptor Factor: Limited - The area is industrial and restricted to authorized personnel.

Soil Category: Low

Relative Risk Evaluation Worksheet

Site Background Information

Installation/Site Name for FUDS: Ft. Lewis-Yakima Training Center
Location (State): Washington
Site (Name/RMIS ID/Project for FUDS: SWMU 6
Point of Contact (Name/Phone): Paula Wofford

Date Entered (day, month, year): 13 September 1996
Media Evaluated (GW, SW/Sediment, Soil): None
Phase of Execution (SI, RI, FS, Removal, RD/RA, or equiv. RCRA Stage): RFA
Agreement Status (Y/N, if yes, type agreement e.g., FFA, Permit, Order): N

Site Summary

Brief Site Description (Include site type, materials disposed of, dates of operation, and other relevant information):

SWMU 6 - Former Transformer Storage Area

The area consists of a gravel covered area approximately 15 feet square, located just north of the former hazardous waste storage area (SWMU 4), inside the fence on the western edge of the building 810 materials yard (Ogden, 1995). The area was used to store transformers for an unknown period of time, and it is assumed that transformers containing PCBs were stored at the site. All transformers that contained PCBs were reportedly removed from the site in 1987 (SAIC, 1995). In addition, in 1992, it was reported that PCBs were stored at the site in a plastic overpack drum (SAIC, 1995). There is no reported spill of PCB containing fluids at the site, but during an inspection of the site on 11 September 1996, the surface gravels were stained with dark, petroleum based material. A composite surface soil sample was collected at that time and the results are reported in the following discussion.

The site is unvegetated and no materials or vehicles were stored at the site in September 1996, but it is likely that vehicles have been parked at the site because it is surrounded with parked vehicles and equipment. A recent YTC project resulted in the placement of basalt rock (2 to 5 inches in diameter) cover over the area extending from the fence to the west approximately 100 feet. This cover is 6 inches thick near the fence to nearly 8 feet thick at its western boundary. This cover has effectively covered the area that might be impacted by runoff of contaminated water from the site.

Brief Description of Pathways (Groundwater, Surface Water/Sediment, Soil):

Groundwater Pathway: Groundwater beneath YTC occurs in three distinct locations: 1) in the unsaturated upper Ellensburg formation sediments between ground surface and the water table or top of Pomoma basalt, which ever is present; 2) in the saturated Ellensburg formation sediments below the water table and above the Pomona basalt, which is the unconfined aquifer; and 3) below the Pomona basalt in the Selah interbed

(Ellensburg formation), which is the first confined aquifer. If contaminants reach these locations, their behavior and ultimately the relative risk of the source area, differs greatly.

Groundwater in the unsaturated zone is retained in the unconsolidated sediments by capillary forces and moves very slowly in response to additions of water at the ground surface such as precipitation or anthropogenic sources. Because of low precipitation, 6 to 9 inches per year, and control of water sources at YTC, groundwater movement in the unsaturated zone is very slow.

The unconfined aquifer in the vicinity of the Cantonment Area appears to be perched or limited to upland areas on the southern limb of the syncline in which the Cantonment Area is located. For example, only one of four wells completed in the unconfined aquifer at the active landfill contained water in 1993 when wells were sampled for the site investigation report (Ecology and Environment, 1993). One of the wells, MW-1 drilled in 1988, encountered the top of basalt at 103 feet below ground surface, with dense basalt encountered at 116 feet. Groundwater was found only in the basalt flow top and water levels fluctuated approximately 7 feet between a winter high to summer low. During the summer, only two feet of water was present in the well. Both monitoring wells at the Ammunition Storage Point Area encountered the unconfined aquifer. Wells located north of the axis of the syncline, estimated to be just south and parallel with Seventh Avenue, did not encounter water on top of the Pomona Basalt. Ecology and Environment (1993) cite other references that indicate that private wells located west of the YTC, closer to the Yakima River, withdraw water from the unconfined aquifer from as shallow as 20 feet below ground surface. The unconfined aquifer was thought to be in hydraulic communication with the Yakima River at that location. Groundwater found on top of the first basalt layer appears to be localized to upland areas on the south side of the syncline, near its axis, and is not present in the Cantonment Area. The only exception to this pattern appears to be in the immediate vicinity of the storm drainage ditch adjacent to Seventh Avenue. This supply of water apparently results in a locally saturated condition near wells TVR-1 and TVR-2, located north of the intersection of E Street and Seventh Avenue (Ecology and Environment, 1993).

The first confined aquifer is located in the Ellensburg formation sediments, namely the Selah interbed, beneath the Pamona basalt, generally 100 feet or deeper below ground surface. The Pomona basalt is greater than 60 feet thick in all wells that have been drilled though it on base, and water encountered below it was found to be under confined conditions in all cases. Groundwater flow in this confined aquifer was to the west, down the axis of the syncline (Ecology and Environment, 1993). Based on the confined aquifer properties reported by Ecology and Environment (1993), hydraulic conductivity of 1.48×10^{-5} ft/sec and hydraulic gradient of 4.4×10^{-3} ft/ft, the lateral flow velocity is approximately 2 feet per year.

At SWMU 6, groundwater could become contaminated with PCBs only if surface spilled transformer fluids were leached through the Ellensburg formation sediments to the top of basalt and then through the basalt rock. PCBs are highly sorptive on soils (Callahan, et al., 1979) and do not leach from the soils that they contact. Based on regional wells surrounding the site, it is likely that the unconfined aquifer is not present at the site. Because of low precipitation, long flow path, and the highly sorptive character of PCBs, the groundwater pathway is not considered complete for PCBs at this site.

Surface Water/Sediment Pathway: There nearest surface water stream is the irrigation ditch approximately 200 feet west of the site. There is no surface contamination nor is there a completed surface water pathway at this site. Prior to placement of the basalt rock cover over the area west

of the site, there were no erosion features indicating that there was no significant runoff from the site. It is assumed that any runoff from the site would have infiltrated into the soil before reaching the irrigation ditch.

Soil: A composite soil sample was collected at the site and analyzed for PCBs. This sample included soil from the stained ground discussed in the site description. The results indicate that no PCBs are present in the surface soils at the site. Because the source of contamination would have been a surface spill and the fact that PCBs are highly sorptive, if PCBs were released at the site, they would have been present in the soil sample.

Brief Description of Receptors (Human and Ecological):

The site is managed as an industrial area with the base restricted to authorized personnel. The site would get only occasional foot traffic, resulting in little or no exposure to contaminants if present. Soil analyses showed that PCBs were not found in surface soils where they would have been retained if spills of PCB-containing fluids had occurred.

Groundwater

Contaminant Hazard Factor (CHF): Minimal - No wells are present at the site, but the highly sorptive characteristic of PCBs and long path to groundwater, preclude the groundwater from being contaminated by PCBs from this site. Therefore, no groundwater samples were collected.

Contaminant	Maximum Concentration (µg/L)	Standard (µg/L)	Ratio
Because no PCBs were found in surface soils, groundwater is probably not contaminated from this site, therefore, no groundwater samples were collected. There are no monitoring wells at this site.			

Migration Pathway Factor: Confined - The groundwater pathway is not completed.

Receptor Factor: Limited - The groundwater pathway is not completed, therefore, receptors using groundwater downgradient from the site would not be exposed to PCBs from this site via the groundwater pathway.

Groundwater Category: Low

Surface Water/Sediment

Contaminant Hazard Factor (CHF): Minimal - There is no surface water associated with this site.

Contaminant	Maximum Concentration (μg/L)	Standard (μg/L)	Ratio
No surface water associated with the site, therefore, no samples were collected.			

Migration Pathway Factor: Confined - The information indicates that the potential for surface water migration from the source is limited because there are no surface water bodies associated with the site, and there are no erosional features on the site to indicate that surface runoff is significant.

Receptor Factor: Limited - There are no surface water bodies associated with the site.

Surface Water/Sediment Category: Low

SWMU 6

Soil

Contaminant Hazard Factor (CHF): Minimal - A composite surface soil sample was collected from the site and indicated that no PCB contamination was found in surface soils. The surface soil staining is likely from storage of vehicles or equipment at the site.

Contaminant	Maximum Concentration (mg/kg)	Standard (mg/kg)	Ratio
PCBs	All below detection limit		--

Migration Pathway Factor: Confined - Even if there were PCBs in surface soils, the gravel cover would prevent resuspension of surface material and erosion does not appear to be an important factor because the site is flat, gravel covered, and low rainfall is insufficient to yield significant runoff. In addition, there are no erosion features at the site.

Receptor Factor: Limited - The area is restricted to authorized personnel and in an area removed from routine traffic.

Soil Category: Low

Relative Risk Evaluation Worksheet

Site Background Information

Installation/Site Name for FUDS: Ft. Lewis-Yakima Training Center
Location (State): Washington
Site (Name/RMIS ID/Project for FUDS: SWMU 7
Point of Contact (Name/Phone): Paula Wofford

Date Entered (day, month, year): 13 September 1996
Media Evaluated (GW, SW/Sediment, Soil): None
Phase of Execution (SI, RI, FS, Removal, RD/RA, or equiv. RCRA Stage): RFA
Agreement Status (Y/N, if yes, type agreement e.g., FFA, Permit, Order): N

Site Summary

Brief Site Description (Include site type, materials disposed of, dates of operation, and other relevant information):

SWMU 7 - Former Container/Drum Storage Area Next to Fence

The area consists of a vacant, weed covered site adjacent to and on the west side of the fence surrounding building 810 and its associated materials yard. The area is along the entry road to building 810 and runs approximately 40 feet along the fence and extends approximately 15 feet away from the fence (personal communication, Dan Bowers, 10 September 1996). According to Mr. Bowers, up to 150 drums were stored at the location for an unknown period of time. SAIC (1995) reported that YTC personnel indicated that all drums were removed in 1993. The drums contained various materials including waste motor oil, lead-based paint, cleaning compound, and investigative derived wastes, soil, and purge water. The drums were placed on bare soil (SAIC, 1995). During an inspection of the site in 1992, 2, 5-gallon containers of cleaning compound were found to be corroded and leaking, The two containers and visibly contaminated soil beneath the containers were placed in a plastic 55-gallon overpack drum (SAIC, 1995). It is assumed that if additional containers had been found to be leaking, they would have been treated in the same manner. Because there is no report of additional leaking containers or stained soil, it is assumed there were no other leaking drums.

The investigative derived wastes were found to be non-hazardous and the soils were dumped on the ground and the water was disposed into the sanitary sewer (SAIC, 1995).

No drums or waste materials are currently present at the site and surface soils do not show any evidence of staining or other indications that spills may have occurred at the site. The general area is used as a laydown yard for re-usable materials such as timbers, concrete, telephone poles, coal, wood chips, and barbed wire (SAIC, 1995).

A composite soil sample was collect at the site on 11 September 1996 by Battelle Pacific Northwest National Laboratory and analyzed for VOCs, SVOCs, pesticides and PCBs, and metals. The results indicate that the site was uncontaminated.

Brief Description of Pathways (Groundwater, Surface Water/Sediment, Soil):

Groundwater Pathway: Groundwater beneath YTC occurs in three distinct locations: 1) in the unsaturated upper Ellensburg formation sediments between ground surface and the water table or top of Pomoma basalt, which ever is present; 2) in the saturated Ellensburg formation sediments below the water table and above the Pomona basalt, which is the unconfined aquifer; and 3) below the Pomona basalt in the Selah interbed (Ellensburg formation), which is the first confined aquifer. If contaminants reach these locations, their behavior and ultimately the relative risk of the source area, differs greatly.

Groundwater in the unsaturated zone is retained in the unconsolidated sediments by capillary forces and moves very slowly in response to additions of water at the ground surface such as precipitation or anthropogenic sources. Because of low precipitation, 6 to 9 inches per year, and control of water sources at YTC, groundwater movement in the unsaturated zone is very slow.

The unconfined aquifer in the vicinity of the Cantonment Area appears to be perched or limited to upland areas on the southern limb of the syncline in which the Cantonment Area is located. For example, only one of four wells completed in the unconfined aquifer at the active landfill contained water in 1993 when wells were sampled for the site investigation report (Ecology and Environment, 1993). One of the wells, MW-1 drilled in 1988, encountered the top of basalt at 103 feet below ground surface, with dense basalt encountered at 116 feet. Groundwater was found only in the basalt flow top and water levels fluctuated approximately 7 feet between a winter high to summer low. During the summer, only two feet of water was present in the well. Both monitoring wells at the Ammunition Storage Point Area encountered the unconfined aquifer. Wells located north of the axis of the syncline, estimated to be just south and parallel with Seventh Avenue, did not encounter water on top of the Pomona Basalt. Ecology and Environment (1993) cite other references that indicate that private wells located west of the YTC, closer to the Yakima River, withdraw water from the unconfined aquifer from as shallow as 20 feet below ground surface. The unconfined aquifer was thought to be in hydraulic communication with the Yakima River at that location. Groundwater found on top of the first basalt layer appears to be localized to upland areas on the south side of the syncline, near its axis, and is not present in the Cantonment Area. The only exception to this pattern appears to be in the immediate vicinity of the storm drainage ditch adjacent to Seventh Avenue. This supply of water apparently results in a locally saturated condition near wells TVR-1 and TVR-2, located north of the intersection of E Street and Seventh Avenue (Ecology and Environment, 1993). The close proximity of SWMU 7 to this location could aid in the transport of contaminants that reach groundwater beneath the site.

The first confined aquifer is located in the Ellensburg formation sediments, namely the Selah interbed, beneath the Pamona basalt, generally 100 feet or deeper below ground surface. The Pomona basalt is greater than 60 feet thick in all wells that have been drilled though it on base, and water encountered below it was found to be under confined conditions in all cases. Groundwater flow in this confined aquifer was to the west, down the axis of the syncline (Ecology and Environment, 1993). Based on the confined aquifer properties reported by Ecology and Environment (1993), hydraulic conductivity of 1.48×10^{-5} ft/sec and hydraulic gradient of 4.4×10^{-3} ft/ft, the lateral flow velocity is approximately 2 feet per year.

At SWMU 7, groundwater could become contaminated only if surface fluids were leached through the Ellensburg formation sediments to the top of basalt to the local saturated zone associated with the drainage ditch along Seventh Avenue, or through basalt rock to the confined aquifer.

Because of low precipitation, long flow path, and minimal amount of leaked material at the site, the groundwater pathway is not likely completed, even if contaminants had been found in surface soils. The surface soils were uncontaminated.

Surface Water/Sediment Pathway: There nearest surface water stream is the storm water ditch adjacent to Seventh Avenue, approximately 100 feet south of the site. There are no erosional features at the site indicating that surface runoff is insignificant. There is no surface contamination nor is there a completed surface water pathway at this site.

Soil: Surface soils were found to be uncontaminated, therefore, the soils pathway is incomplete.

Brief Description of Receptors (Human and Ecological):

The site is managed as an industrial area with the base restricted to authorized personnel. The area is additionally inside another fenced area with access controlled through a locked gate. The public would not have access to the area and base personnel would have access only on an as-needed basis.

Groundwater

Contaminant Hazard Factor (CHF): Minimal - No groundwater monitoring wells are in the area, but the lack of surface contamination, cleanup of previously reported leaks, removal of waste drums eliminating any further source, low precipitation, and long flow path to groundwater, make it highly unlikely that groundwater would be contaminated at the site. Therefore, the groundwater pathway is considered incomplete.

Contaminant	Maximum Concentration (μg/L)	Standard (μg/L)	Ratio
Groundwater is likely not contaminated from this site because surface soils were uncontaminated, therefore, not samples were collected. No monitoring wells at this site.			

Migration Pathway Factor: Confined - The groundwater pathway is considered incomplete.

Receptor Factor: Limited - The groundwater pathway is considered incomplete, therefore, there could be no groundwater receptors of hazardous materials from this site.

Groundwater Category: Low

Surface Water/Sediment

Contaminant Hazard Factor (CHF): Minimal - There is no surface water associated with this site. Precipitation falling on the site is expected to infiltrate rather than run off the site. There are no erosional features at the site.

Contaminant	Maximum Concentration (μg/L)	Standard (μg/L)	Ratio
No surface water associated with the site, therefore, no samples were collected			

Migration Pathway Factor: Confined - The information indicates that the potential for surface water migration from the source is limited because there are no surface water bodies associated with the site, and no erosional features indicate that surface runoff is insignificant. The surface water pathway is considered incomplete.

Receptor Factor: Limited - There are no surface water bodies associated with the site.

Surface Water/Sediment Category: Low

SWMU 7

Soil

Contaminant Hazard Factor (CHF): Moderate - Soil samples were analyzed for VOCs, SVOCs, and metals. The results indicated that two constituents, arsenic and beryllium, were present in surface soils at concentrations in excess of their respective standards. Ecology and Environment (1993) reported that the background beryllium concentration in subsurface soil was 0.76 mg/kg. In addition, beryllium concentrations in stream sediments ranged from 0.63 to 0.88 mg/kg. Therefore, the beryllium concentration found at SWMU 7 is considered background. Ecology and Environment (1993) also reported that background arsenic concentrations ranged from 0.89 mg/kg in surface soils to 3.1 mg/kg in a subsurface soil sample. Arsenic levels exceeding that at SWMU 7 were found in sediments in Larry's Swimming Pool. Therefore, the detected arsenic could be natural in the soil or from past use of arsenic containing pesticides. Reported surface spills were cleaned up in the past and all sources of contamination have been removed from the site.

Contaminant	Maximum Concentration (mg/kg)	Standard (mg/kg)	Ratio
VOCs	All below detection limit	Below standard	--
SVOCs	All below detection limit	Below standard	--
Metals	All below standards except arsenic and beryllium	Below standard	--
Arsenic	4.7	0.38	12.4
Beryllium	0.47	0.14	3.4
		Total	15.8

Migration Pathway Factor: Confined - Soil analyses indicate that surface soils at the site contain arsenic at 12.4 times the standard and beryllium at background levels, but more than three times above the beryllium standard. Arsenic sorbs well onto sediments and is not considered mobile under conditions found at the YTC. Surface runoff is not significant at the site and therefore, soils would not be expected to be transported off the site by surface erosion. Therefore, neither of these constituents is considered to be mobile.

Receptor Factor: Limited - The area is restricted to authorized personnel and in an area removed from routine traffic. The area is inside a fenced area to which access is gained through a locked gate.

Soil Category: Low

Relative Risk Evaluation Worksheet

Site Background Information

Installation/Site Name for FUDS: Ft. Lewis-Yakima Training Center
Location (State): Washington
Site (Name/RMIS ID/Project for FUDS: SWMU 22
Point of Contact (Name/Phone): Paula Wofford

Date Entered (day, month, year): 13 September 1996
Media Evaluated (GW, SW/Sediment, Soil): None
Phase of Execution (SI, RI, FS, Removal, RD/RA, or equiv. RCRA Stage): RFA
Agreement Status (Y/N, if yes, type agreement e.g., FFA, Permit, Order): N

Site Summary

Brief Site Description (Include site type, materials disposed of, dates of operation, and other relevant information):

SWMU 22 - Former PCS (Petroleum Contaminated Soil) Stockpile Area

The area consists of a generally level area where 564 cubic yards of petroleum contaminated soil had been stored for an estimated 1.5 years during 1992 and 1993 (SAIC, 1995). In 1993, the soils were relocated to a stockpile area near the current landfill (SWMU 51) (Ogdan, 1995). The site is located inside the fenced area of POL-2 (AOC 4) on the north and east sides of but outside the berm surrounding four, 20,000 gallon above ground tanks that contain diesel and gasoline. The area is unvegetated for the most part with occasional weed growth. The soil stockpiled at the site was obtained from various spills and training activities at YTC. The soil was placed directly on the ground without liners. It is likely that this location served as a convenient collection point for PCS because the underlying soil had already been contaminated from a major diesel spill in 1990.

SAIC (1995) and Ogden (1995) reported that in November 1990, an estimated 1,600 gallons of diesel spilled from a vent pipe when one of the above ground tanks was inadvertently overfilled when diesel being offloaded at POL-1 was mistakenly diverted to POL-2. The spilled diesel was retained inside the bermed area which consisted of a plastic liner covered with bentonite clay. During remediation of the spill, clean soil was placed in the pool of diesel to soak it up. Either during this process or during subsequent removal of the petroleum soaked soil, the liner was ripped. At some time prior to or during remediation activities, an unspecified quantity of fuel spilled onto the ground surrounding the berm. The liner was reported repaired, but its integrity has not been tested. The area associated with the tanks and surrounding contaminated area is considered AOC 4. SWMU 22 was placed on top of a portion of the area that had already been contaminated with diesel.

Based on the fact that soil surrounding the bermed area was contaminated with liquid diesel prior to placement of PCS in the area, it is likely that the major source of any petroleum contamination at the PCS site is due to activities associated with AOC 4 and not from the PCS. A site inspection of the area on 10-11 September 1996 indicated that surface soils in one area outside the bermed area contained residual diesel based on odor. This area was included in a composite soil sample collected from the site. The results showed that the soil was contaminated with

diesel. YTC personnel have indicated that a project to re-construct the bermed area and clean up contaminated soil inside and surrounding the berm has been planned for completion in the next year.

The RRSE rating given SWMU 22 is based on the fact that the diesel contamination probably came from AOC 4. The area within the fence is contaminated above Washington State cleanup levels and should be cleaned up when POL-2 area is reconstructed within the year.

Brief Description of Pathways (Groundwater, Surface Water/Sediment, Soil):

Groundwater Pathway: Groundwater beneath YTC occurs in three distinct locations: 1) in the unsaturated upper Ellensburg formation sediments between ground surface and the water table or top of Pomoma basalt, which ever is present; 2) in the saturated Ellensburg formation sediments below the water table and above the Pomona basalt, which is the unconfined aquifer; and 3) below the Pomona basalt in the Selah interbed (Ellensburg formation), which is the first confined aquifer. If contaminants reach these locations, their behavior and ultimately the relative risk of the source area, differs greatly.

Groundwater in the unsaturated zone is retained in the unconsolidated sediments by capillary forces and moves very slowly in response to additions of water at the ground surface such as precipitation or anthropogenic sources. Because of low precipitation, 6 to 9 inches per year, and control of water sources at YTC, groundwater movement in the unsaturated zone is very slow. Because of the slow migration rate through the unsaturated zone, natural biodegradation can reduce fuel contaminants significantly.

The unconfined aquifer in the vicinity of the Cantonment Area appears to be perched or limited to upland areas on the southern limb of the syncline in which the Cantonment Area is located. For example, only one of four wells completed in the unconfined aquifer at the active landfill contained water in 1993 when wells were sampled for the site investigation report (Ecology and Environment, 1993). One of the wells, MW-1 drilled in 1988, encountered the top of basalt at 103 feet below ground surface, with dense basalt encountered at 116 feet. Groundwater was found only in the basalt flow top and water levels fluctuated approximately 7 feet between a winter high to summer low. During the summer, only two feet of water was present in the well. Both monitoring wells at the Ammunition Storage Point Area encountered the unconfined aquifer. Wells located north of the axis of the syncline, estimated to be just south and parallel with Seventh Avenue, did not encounter water on top of the Pomona Basalt. Ecology and Environment (1993) cite other references that indicate that private wells located west of the YTC, closer to the Yakima River, withdraw water from the unconfined aquifer from as shallow as 20 feet below ground surface. The unconfined aquifer was thought to be in hydraulic communication with the Yakima River at that location. Groundwater found on top of the first basalt layer appears to be localized to upland areas on the south side of the syncline, near its axis, and is not present in the Cantonment Area. The only exception to this pattern appears to be in the immediate vicinity of the storm drainage ditch adjacent to Seventh Avenue. This supply of water apparently results in a locally saturated condition near wells TVR-1 and TVR-2, located north of the intersection of E Street and Seventh Avenue (Ecology and Environment, 1993).

The first confined aquifer is located in the Ellensburg formation sediments, namely the Selah interbed, beneath the Pamona basalt, generally 100 feet or deeper below ground surface. The Pomona basalt is greater than 60 feet thick in all wells that have been drilled though it on base, and

water encountered below it was found to be under confined conditions in all cases. Groundwater flow in this confined aquifer was to the west, down the axis of the syncline (Ecology and Environment, 1993). Based on the confined aquifer properties reported by Ecology and Environment (1993), hydraulic conductivity of 1.48×10^{-5} ft/sec and hydraulic gradient of 4.4×10^{-3} ft/ft, the lateral flow velocity is approximately 2 feet per year.

Based on the preceding discussion, it is likely that there is no unconfined aquifer beneath SWMU 22 with approximately 50 feet of upper Ellensburg formation sediments on top of approximately 80 feet of Pomona Basalt. It is highly unlikely that any fuels spilled at the site would reach groundwater because of the long distance to groundwater, low rainfall, and limited quantities of fuel spilled outside the bermed area. The amount of fuel that would have been leached from the PCS would have been significantly less that spilled from AOC 4.

Surface Water/Sediment Pathway: There nearest surface water stream is the storm water ditch adjacent to Seventh Avenue, approximately 0.25 miles from the site. There are no surface water bodies associated with the site. Surface runoff is likely to be small given the low rainfall, level ground, and coarse grained surface sediments with their expected high infiltration rate. There were no surface erosion features at the site, indicating that surface runoff from the unvegetated site is insignificant.

Soil: Surface soils are contaminated in a small portion of the site. Contamination present is likely residual petroleum components from a surface diesel spill in 1990. Volatile components have evaporated from surface soils and are no longer a risk. No BTEX compounds were detected. The remaining petroleum constituents will be cleaned up when a POL-2 area project to construct a new secondary containment around the above ground tanks is completed.

Brief Description of Receptors (Human and Ecological): The site is managed as an industrial area with the base restricted to authorized personnel. The area is fenced and access is through a locked gate which is controlled by POL area personnel.

Groundwater

Contaminant Hazard Factor (CHF): Minimal - The PCS has been removed and is not a source of groundwater contamination. Surface soils are contaminated with diesel from AOC 4 and will be addressed with that site. The minimal amount of petroleum that could have leached from the PCS make it highly unlikely that groundwater would be contaminated from SWMU 22. The groundwater pathway is not considered complete for SWMU 22.

Contaminant	Maximum Concentration (µg/L)	Standard (µg/L)	Ratio
It is highly unlikely that groundwater would be contaminated, therefore, no samples were collected. No monitoring wells at this site.			

Migration Pathway Factor: Confined - The PCS has been removed. The extent of the remaining contaminated soil, although not attributed to SWMU 22, should be addressed during the AOC 4 reconstruction. Most of the spilled diesel, at AOC 4, is assumed to have been retained inside the lined bermed area and only a small quantity of fuel leaked into surrounding soils. Therefore, it is unlikely that groundwater would be contaminated from these soils. The groundwater pathway is not complete for SWMU 22.

Receptor Factor: Limited - There are no completed pathways to groundwater. Therefore, groundwater uses downgradient of SWMU 22 can not serve as an exposure point for receptors.

Groundwater Category: Low

Surface Water/Sediment

Contaminant Hazard Factor (CHF): Minimal - There is no surface water associated with this site. There are no surface erosion features indicating the lack of any significant runoff.

Contaminant	Maximum Concentration (µg/L)	Standard (µg/L)	Ratio
No surface water associated with the site, therefore, no samples were collected.			

Migration Pathway Factor: Confined - No surface runoff in evidence. In addition, surface contamination is not attributed to SWMU 22.

Receptor Factor: Limited - This is not a completed pathway

Surface Water/Sediment Category: Low

SWMU 22

Soil

Contaminant Hazard Factor (CHF): Minimal - While surface soils are contaminated with non-volatile diesel components, the PCS has been removed and the residual contamination is likely due to activities associated with AOC 4. The soil CHF is minimal for SWMU 22 and any soil hazard is attributed to AOC 4. The CHF associated with the diesel contamination would be moderate.

Contaminant	Maximum Concentration (mg/kg)	Standard (mg/kg)	Ratio
VOCs	All below detection limits	Below standards	--
BTEX	All below detection limits	Below standards	--
TPH-diesel	6,700	200 (MTCA)	33.5
TPH-gas	Below detection limit		--
		Total	33.5

Migration Pathway Factor: Confined - The PCS has been removed and there is no completed pathway.

Receptor Factor: Limited - There is no completed pathway for SWMU 22.

Soil Category: Low

Relative Risk Evaluation Worksheet

Site Background Information

Installation/Site Name for FUDS: Ft. Lewis-Yakima Training Center
Location (State): Washington
Site (Name/RMIS ID/Project for FUDS: SWMU 25
Point of Contact (Name/Phone): Paula Wofford

Date Entered (day, month, year): 13 September 1996
Media Evaluated (GW, SW/Sediment, Soil): Soil
Phase of Execution (SI, RI, FS, Removal, RD/RA, or equiv. RCRA Stage): RFA
Agreement Status (Y/N, if yes, type agreement e.g., FFA, Permit, Order): N

Site Summary

Brief Site Description (Include site type, materials disposed of, dates of operation, and other relevant information):

SWMU 25 - Old Petroleum, Oil, Lubricant Yard

The area was used in the past as a fueling area called POL 1 and latter as a collection area to store waste antifreeze before it was shipped to Ft. Lewis DRMO for disposal. Currently, the area is used as the Post's 90-day hazardous waste storage area, but this usage is not considered part of the site investigation of this RRSE.

The site is located east of the intersection of 5th Avenue and D Street, in a fenced and locked yard adjacent to building 450, now called the GSA Building.

Fueling operations began in 1951 when three, 12,000 gallon USTs were installed and had been discontinued by at least 1987 when the new POL-1 area was opened. It is assumed that the USTs were removed at that time. The time period in which the area was used for antifreeze storage is unknown, but prior to 1989, it was reported (SAIC, 1995) that it was common practice to dispose of waste antifreeze in SWMU 35, former waste oil UST. The area was being used to store waste antifreeze in 1991 at the time of the preliminary assessment (Shapiro and Associates, 1991), but not in 1995 during the visual site inspection (SAIC, 1995).

Past use of the area included fuel distribution and storage of oil and lubricants. Three, 12,000 gallon USTs were located at the middle of the southern fence line with the tanks oriented with the long axis of the tanks parallel with the fence. The first tank was approximately 20 feet from the fence, with the other two tanks located further from the fence, extending into the middle of the yard. The tanks contained diesel or MOGAS. SAIC (1995) indicated that two tanks contained MOGAS and one contained diesel, but Ogdan (1995) indicated that two tanks contained diesel and one contained MOGAS. According to Dan Bowers (U.S. Army/YTC, personal communication, September 1996), the tank nearest the fence, was found to be in poor condition during its use and was patched. It continued to be used after that time. This tank was the only one of the three which was reported to have leaked. In the past, a pit was located within the fenced yard in which drums of oil and lubricants were stored (SAIC, 1995).

The site is now used as the Post's 90-day hazardous waste storage area. Locking storage containers in which various hazardous wastes stored are placed around the perimeter of the yard inside the fenced area. On 9 September 1996, approximately 150 empty drums were stored in two areas, one in the SW corner of the yard and the other in the SE corner. The drums were new and in excellent shape. When materials are placed in the drums, they are moved into the storage containers.

As part of the investigation of the site for this report. One trench was excavated perpendicular to the longitudinal axis of the tanks in order to determine if the soils in the tank pit were contaminated. The ground was soft for the surface 10 feet, indicating that the soils in the trench were probably backfill material. Below this depth, it was difficult to dig. Petroleum contaminated soil was found at the suspected location of the tank that was patched, but the areas where the other tanks would have been placed was uncontaminated. Specific results and their significance are presented in the soils discussion.

Brief Description of Pathways (Groundwater, Surface Water/Sediment, Soil):

Groundwater Pathway: Groundwater beneath YTC occurs in three distinct locations: 1) in the unsaturated upper Ellensburg formation sediments between ground surface and the water table or top of Pomoma basalt, which ever is present; 2) in the saturated Ellensburg formation sediments below the water table and above the Pomona basalt, which is the unconfined aquifer; and 3) below the Pomona basalt in the Selah interbed (Ellensburg formation), which is the first confined aquifer. If contaminants reach these locations, their behavior and ultimately the relative risk of the source area, differs greatly.

Groundwater in the unsaturated zone is retained in the unconsolidated sediments by capillary forces and moves very slowly in response to additions of water at the ground surface such as precipitation or anthropogenic sources. Because of low precipitation, 6 to 9 inches per year, and control of water sources at YTC, groundwater movement in the unsaturated zone is very slow.

The unconfined aquifer in the vicinity of the Cantonment Area appears to be perched or limited to upland areas on the southern limb of the syncline in which the Cantonment Area is located. For example, only one of four wells completed in the unconfined aquifer at the active landfill contained water in 1993 when wells were sampled for the site investigation report (Ecology and Environment, 1993). One of the wells, MW-1 drilled in 1988, encountered the top of basalt at 103 feet below ground surface, with dense basalt encountered at 116 feet. Groundwater was found only in the basalt flow top and water levels fluctuated approximately 7 feet between a winter high to summer low. During the summer, only two feet of water was present in the well. Both monitoring wells at the Ammunition Storage Point Area encountered the unconfined aquifer. Wells located north of the axis of the syncline, estimated to be just south and parallel with Seventh Avenue, did not encounter water on top of the Pomona Basalt. Ecology and Environment (1993) cite other references that indicate that private wells located west of the YTC, closer to the Yakima River, withdraw water from the unconfined aquifer from as shallow as 20 feet below ground surface. The unconfined aquifer was thought to be in hydraulic communication with the Yakima River at that location. Groundwater found on top of the first basalt layer appears to be localized to upland areas on the south side of the syncline, near its axis, and is not present in the Cantonment Area. The only exception to this pattern appears to be in the immediate vicinity of the storm drainage ditch adjacent to Seventh Avenue. This supply of water apparently results in a locally saturated condition near wells TVR-1 and TVR-2, located north of the intersection of E Street and Seventh Avenue (Ecology and Environment, 1993).

The first confined aquifer is located in the Ellensburg formation sediments, namely the Selah interbed, beneath the Pamona basalt, generally 100

feet or deeper below ground surface. The Pomona basalt is greater than 60 feet thick in all wells that have been drilled though it on base, and water encountered below it was found to be under confined conditions in all cases. Groundwater flow in this confined aquifer was to the west, down the axis of the syncline (Ecology and Environment, 1993). Based on the confined aquifer properties reported by Ecology and Environment (1993), hydraulic conductivity of 1.48×10^{-5} ft/sec and hydraulic gradient of 4.4×10^{-3} ft/ft, the lateral flow velocity is approximately 2 feet per year.

In the vicinity of SWMU-25, groundwater is first encountered in a confined aquifer approximately 80 ft below ground surface, beneath 25 ft of unconsolidated sand, silt, and clay units and 55 ft of dense basalt rock (Pamona Member) (SAIC, 1995). There is no indication that groundwater is found on top of the basalt but could be found in isolated perched zones. Ecology and Environment, Inc. (1993) drilled 13 monitoring wells in the vicinity of the Cantonment Area and found no water on top of the basalt in any of the wells near Seventh Avenue, near the axis of the syncline, or on the north side of the syncline. Groundwater was encountered in the unconsolidated sediments of the upper Ellensburg formation on upland margins of the Cantonment Area south of Seventh Avenue, where the surfacial sediments thicken, and down the syncline to the west toward the Yakima River. Within 0.25 miles of the site, the nearest private residence could be using water located in an unconfined aquifer on top of the basalt, but the unconfined aquifer is not present beneath the Cantonment Area. At some point west of the Base's western boundary, the unconfined aquifer exists and is in hydraulic connection with the Yakima River.

Groundwater flow in the first aquifer beneath the cantonment area (a confined aquifer) is to the west down the axis of the syncline in which the Cantonment Area is located.

Therefore, the groundwater pathway is important only if enough fuel leaked from the USTs to have reached the unconfined aquifer off-base, at least 0.25 miles, or migrated 70 ft down to the confined aquifer through 55 ft of basalt rock. This is highly unlikely because the soils excavated did not contain sufficient mass of fuel contamination to travel to the aquifer beneath the site. Therefore, the groundwater pathway is considered incomplete.

Surface Water/Sediment Pathway: There nearest surface water stream is the storm water ditch adjacent to and on the north side of Seventh Avenue. Because the USTs and drums of lubricants were either below ground surface or in pits, the likelihood of surface runoff is insignificant.

Soil: The entire area has been regraded and covered with gravel since the area was used as a fuel dispensing area. In addition, USTs, lubricant drums, and drums containing waste antifreeze have been removed, eliminating any continued source of such contaminants. Therefore, any surface contamination would be from recent activities and not from previous uses. Any contaminated soils would be buried beneath recontoured fill or at the depth of the USTs where any leaks may have occurred. This contamination would be a problem only if leached to the groundwater system, which is highly unlikely given the low annual precipitation and the management of the area as a 90-day storage facility. In addition, the base plans to resurface the area with an asphalt cap to facilitate current activities. This will further eliminate opportunities for contaminants to be mobilized.

Given the conditions of sandy soils, warm climate, and dry conditions, in situ biodegradation of any spilled fuels would further reduce the hazards associated with contaminated soils.

Brief Description of Receptors (Human and Ecological):

The site is managed as an industrial area with the base restricted to authorized personnel and the fenced area further limited to hazardous waste personnel. The minimal contaminants at the site are below ground and no receptors are identified. In addition, the site will be covered with asphalt within the year. The nearest groundwater source is approximately 1200 ft south where a drinking water well is located.

Groundwater

Contaminant Hazard Factor (CHF): Minimal - There are no monitoring wells located specifically for this site but the nearest downgradient monitoring wells indicate that the only hazardous constituents detected in downgradient well DW-2, 1,200 ft northeast of the site was manganese and this constituent was only slightly elevated above background. The elevated manganese is probably due to variations in background manganese levels in the soil. No fuel related constituents were detected. In addition, only low concentrations of fuel contaminants were found in the soils in the tank pits.

Contaminant	Maximum Concentration (µg/L)	Standard (µg/L)	Ratio
None detected in downgradient drinking water wells.			

Migration Pathway Factor: Confined - The information indicates that the potential for contaminant migration from the source is limited because of the depth to groundwater, the isolation of the groundwater by the dense basalt rock layer, low precipitation and lack of water in the area, and the fact that the site will be paved with asphalt within the year.

Receptor Factor: Limited - The groundwater downgradient from SWMU-25 is not contaminated. With only low concentrations of fuel related contaminants present in the soils in the tank pits where the highest concentrations should be found, there is little chance that the groundwater beneath the site would be contaminated above regulatory limits. Therefore, no receptors could be impacted by this site.

Groundwater Category: Low

Surface Water/Sediment

Contaminant Hazard Factor (CHF): Minimal - There is no surface water associated with this site.

Contaminant	Maximum Concentration (µg/L)	Standard (µg/L)	Ratio
No surface water associated with the site, therefore, no samples were collected.			

Migration Pathway Factor: Confined - The information indicates that the potential for surface water migration from the source is limited because there are no surface water bodies associated with the site.

Receptor Factor: Limited - There are no surface water bodies associated with the site, therefore, there are no completed pathways to a receptor.

Surface Water/Sediment Category: Low

Soil

Contaminant Hazard Factor (CHF): Minimal - The calculated CHF using data from the only sample in which fuel was detected was 0.28.

Contaminant	Maximum Concentration (mg/kg)	Standard (mg/kg)	Ratio
TPH	53	200 (MTCA)	0.25
TPH-Gas	2.97	100 (MTCA)	0.03
Benzene	0.012	190	--
Toluene	0.005	870	--
Ethylbenzene	0.005	3,400	--
Xylene (total)	0.022	980	--
		Total	0.28

Migration Pathway Factor: Confined - Soil concentrations are below regulatory limits stated in the Model Toxics Control Act for Washington State. The contaminated soils are approximately 10 feet below ground surface and it is planned to cover the site with asphalt as part of the upgrade for the 90-day storage site.

Receptor Factor: Limited - The soils are buried, low concentration, and will be covered with asphalt within the year.

Soil Category: Low

Relative Risk Evaluation Worksheet

Site Background Information

Installation/Site Name for FUDS: Ft. Lewis-Yakima Training Center
Location (State): Washington
Site (Name/RMIS ID/Project for FUDS: SWMU 27
Point of Contact (Name/Phone): Paula Wofford

Date Entered (day, month, year): 13 September 1996
Media Evaluated (GW, SW/Sediment, Soil): None
Phase of Execution (SI, RI, FS, Removal, RD/RA, or equiv. RCRA Stage): RFA
Agreement Status (Y/N, if yes, type agreement e.g., FFA, Permit, Order): N

Site Summary

Brief Site Description (Include site type, materials disposed of, dates of operation, and other relevant information):

SWMU 27 - Temporary ASP. Former Ammunition Storage Burn Pits

The area consists of two, unlined trenches in which ammunition packing materials including pentachlorophenol (PCP) preserved wooden boxes were burned. The trenches have been backfilled and the only visual indication that they existed is a pile of soil at one end of a trench and vegetation differences between the disturbed area of the trenches and the native sagebrush. Only one trench could be identified in a site visit on 11 September 1996. The site is abandoned and no activities are currently conducted at the site.

The site is located approximately 1,500 ft east of the Ammunition Storage Point office just beyond the end of a dirt access road extending from Wash Rack Road to an earthen bunkered temporary ammunition storage point. The location of the site differs from that depicted in SAIC (1995) and Ogden (1995). This true location was identified by Dan Bowers (U.S. Army/YTC, personal communication, 10 September 1996) during a site visit. Mr. Bowers works in the Ammunition Storage Point office and observed burning operations at SWMU-27 while it was active. In addition, a soil pile left from excavating the trenches and vegetation differences delineating the disturbed area was observed during the site visit. The area is approximately 0.75 miles from the nearest drinking water well on base and 1.5 miles from the western base boundary.

It is unknown when operations began but Dan Bowers (personal communication, 10 September 1996) indicated that they were in service in 1974 when he began work at the base. Burn operations were discontinued in 1985 (SAIC, 1995).

The trenches were constructed using a bulldozer so that their profile is curved with the deepest point in the center and shallow on either end. The trenches were approximately 150 ft long (supported by disturbed vegetation pattern), 20 to 30 ft wide, and 15 to 20 ft deep (Doug Bowers, U.S. Army/YTC, personal communication, 10 September 1996). As personnel used ammunition on the range, packing materials were returned to the burn pits where they accumulated until the pits were full. Periodically, the accumulated material was burned in an open burn. After operations ceased in 1985, the trenches were backfilled. The only hazardous material noted in previous reports was the PCP treated wooden ammunition boxes.

Given the nature of the fires, likely reaching temperatures in excess of 1,500°F (DeHaan, 1991), any PCP in the wood is likely to have either degraded or evaporated and dispersed into the atmosphere and would not be present in the ash. The boiling point of PCP is 588°F (MSDS for pentachlorophenol). Temperatures reaching this level, would result in the evaporation of PCP at the very least, and probably result in its degradation (MSDS for pentachlorophenol). Therefore, it is likely that only insignificant quantities of PCP remain, if any, in the ash buried deep in the trenches.

Brief Description of Pathways (Groundwater, Surface Water/Sediment, Soil):

Groundwater Pathway: In the vicinity of SWMU-25, groundwater is first encountered in a confined aquifer approximately 80 ft below ground surface, beneath 25 ft of unconsolidated sand, silt, and clay units and 55 ft of dense basalt rock (Pamona Member) (SAIC, 1995). There is no indication that groundwater is found on top of the basalt but could be found in isolated perched zones. Ecology and Environment, Inc. (1993) drilled 13 monitoring wells in the vicinity of the Cantonment Area and found no water on top of the basalt in any of the wells near Seventh Avenue, near the axis of the syncline, or on the north side of the syncline. Groundwater was encountered in the unconsolidated sediments of the upper Ellensburg formation on upland margins of the Cantonment Area south of Seventh Avenue, where the surfacial sediments thicken, and down the syncline to the west toward the Yakima River. Within 0.25 miles of the site, the nearest private residence could be using water located in an unconfined aquifer on top of the basalt, but the unconfined aquifer is not present beneath the Cantonment Area. At some point west of the Base's western boundary, the unconfined aquifer exists and is in hydraulic connection with the Yakima River.

Groundwater beneath YTC occurs in three distinct locations: 1) in the unsaturated upper Ellensburg formation sediments between ground surface and the water table or top of Pomoma basalt, which ever is present; 2) in the saturated Ellensburg formation sediments below the water table and above the Pomona basalt, which is the unconfined aquifer; and 3) below the Pomona basalt in the Selah interbed (Ellensburg formation), which is the first confined aquifer. If contaminants reach these locations, their behavior and ultimately the relative risk of the source area, differs greatly.

Groundwater in the unsaturated zone is retained in the unconsolidated sediments by capillary forces and moves very slowly in response to additions of water at the ground surface such as precipitation or anthropogenic sources. Because of low precipitation, 6 to 9 inches per year, and control of water sources at YTC, groundwater movement in the unsaturated zone is very slow.

The unconfined aquifer in the vicinity of the Cantonment Area appears to be perched or limited to upland areas on the southern limb of the syncline in which the Cantonment Area is located. For example, only one of four wells completed in the unconfined aquifer at the active landfill contained water in 1993 when wells were sampled for the site investigation report (Ecology and Environment, 1993). One of the wells, MW-1 drilled in 1988, encountered the top of basalt at 103 feet below ground surface, with dense basalt encountered at 116 feet. Groundwater was found only in the basalt flow top and water levels fluctuated approximately 7 feet between a winter high to summer low. During the summer, only two feet of water was present in the well. Both monitoring wells at the Ammunition Storage Point Area encountered the unconfined aquifer. Wells located north of the axis of the syncline, estimated to be just south and parallel with Seventh Avenue, did not encounter water on top of the Pomona Basalt. Ecology and Environment (1993) cite other references that indicate that private wells located west of the YTC, closer to the Yakima River, withdraw water from the unconfined aquifer from as shallow as 20 feet below ground surface. The unconfined aquifer was thought

to be in hydraulic communication with the Yakima River at that location. Groundwater found on top of the first basalt layer appears to be localized to upland areas on the south side of the syncline, near its axis, and is not present in the Cantonment Area. The only exception to this pattern appears to be in the immediate vicinity of the storm drainage ditch adjacent to Seventh Avenue. This supply of water apparently results in a locally saturated condition near wells TVR-1 and TVR-2, located north of the intersection of E Street and Seventh Avenue (Ecology and Environment, 1993).

The first confined aquifer is located in the Ellensburg formation sediments, namely the Selah interbed, beneath the Pamona basalt, generally 100 feet or deeper below ground surface. The Pomona basalt is greater than 60 feet thick in all wells that have been drilled though it on base, and water encountered below it was found to be under confined conditions in all cases. Groundwater flow in this confined aquifer was to the west, down the axis of the syncline (Ecology and Environment, 1993). Based on the confined aquifer properties reported by Ecology and Environment (1993), hydraulic conductivity of 1.48×10^{-5} ft/sec and hydraulic gradient of 4.4×10^{-3} ft/ft, the lateral flow velocity is approximately 2 feet per year.

SWMU-27 is located in an upslope position on the southern side of the syncline. Two groundwater monitoring wells, ASP-1 and ASP-2, are located at the northwest corner of the ammunition storage point area, 2,000 ft west of SWMU-27 and represent the geologic and hydrologic conditions at the site. Neither of the wells reached the top of basalt in the area. The deepest well, ASP-2, was drilled to 140 ft, penetrating the surfacial unconsolidated sediments that ranged from sandy gravel to silty clay units (Ecology and Environment, 1993). Groundwater was first encountered at 90 ft below ground surface in ASP-2 and at 67 ft below ground surface in ASP-1. Other wells drilled by Ecology and Environment, Inc. (1993) in the vicinity of the Cantonment Area along the axis of the syncline and north of it, contained no water on top of the basalt. Within 1.5 miles of the site, the nearest private residence could be using water located in an unconfined aquifer on top of the basalt, but the unconfined aquifer is not present beneath the Cantonment Area. At some point west of the Base's western boundary, the unconfined aquifer exists and is in hydraulic connection with the Yakima River.

The groundwater pathway would be important only if sufficient precipitation falls to leach PCP, if any remains, from ash remaining in the burn pits. With low annual precipitation, the upland position of the site to encourage runoff rather than ponding, buried position of the ash (at least 5 ft deep), deep position of the groundwater, and long flow path to receptors on base or off, minimize the opportunity for groundwater to be contaminated with PCP. In addition, it is likely that very little PCP remained with the ash, eliminating the PCP hazard at the site.

Surface Water/Sediment Pathway: There nearest surface water stream is the storm water ditch adjacent to Seventh Avenue, approximately 0.75 miles from the site. There is no surface contamination nor is there a completed surface water pathway at this site.

Soil: The entire area has been regraded and covered with clean soil since the area was used to burn materials. According to Doug Bowers (personal communication, 11 September 1996), the ash is buried at least 5 ft deep, eliminating the possibility of a completed pathway from inhalation or ingestion.

Brief Description of Receptors (Human and Ecological):

The site is managed as an industrial area with the base restricted to authorized personnel. The minimal contaminants at the site are below ground and in an area well away from routine travel. In addition, site operations have likely dispersed or destroyed the PCP in the ammunition boxes. The nearest groundwater source is approximately 0.75 miles where a drinking water well is located. It is approximately 1.5 miles to the nearest domestic well which would draw water from the unconfined aquifer above the basalt.

Groundwater

Contaminant Hazard Factor (CHF): Minimal - There are no monitoring wells located specifically for this site. PCP has not been detected in any monitoring wells at the Yakima Training Center. PCP would likely have been dispersed to the atmosphere with the wood smoke and not available for leaching to the groundwater. It is highly unlikely that groundwater would be contaminated by PCP contaminated ash located 60 ft or greater above the water table.

Contaminant	Maximum Concentration (µg/L)	Standard (µg/L)	Ratio
The groundwater pathway is considered incomplete, therefore no samples were collected. No monitoring wells at this site.			

Migration Pathway Factor: Confined - The information indicates that the potential for contaminant migration from the source is limited because of the depth to groundwater, low precipitation and lack of water in the area, and that any PCP that was not incinerated in the fire, probably evaporated and was dispersed over a large area in low concentrations.

Receptor Factor: Potential - All groundwater in the vicinity of the cantonment area must have as a minimum a "potential" receptor factor because groundwater in the area is currently used as a drinking water supply. It would only be designated as "identified" if it were contaminated. The groundwater downgradient from SWMU-27 is not contaminated with PCP.

Groundwater Category: Low

Surface Water/Sediment

Contaminant Hazard Factor (CHF): Minimal - There is no surface water associated with this site.

Contaminant	Maximum Concentration (μg/L)	Standard (μg/L)	Ratio
No surface water associated with the site, therefore, no samples were collected.			

Migration Pathway Factor: Confined - The information indicates that the potential for surface water migration from the source is limited because there are no surface water bodies associated with the site.

Receptor Factor: Limited - There are no surface water bodies associated with the site.

Surface Water/Sediment Category: Low

SWMU 27

Soil

Contaminant Hazard Factor (CHF): Minimal - Ash residues are buried 5 ft or more below ground surface. The ash probably contains little or no PCP. There are likely no contaminated surface soils because clean soil was used to backfill the trenches. Therefore, no samples were collected.

Contaminant	Maximum Concentration (mg/kg)	Standard (mg/kg)	Ratio
Surface soils would not be contaminated, therefore, no samples were collected.			

Migration Pathway Factor: Confined - There is a low possibility for PCP to be present at the site because of its release or destruction during burning operations. Low precipitation and long travel path to the groundwater precludes the PCP from leaching to a point of exposure. The buried nature of the ash in a remote area also minimizes the likelihood that the ash will be excavated.

Receptor Factor: Limited - There is little or no potential for receptors to access the buried ash. The area is restricted to authorized personnel and in an area removed from routine traffic.

Soil Category: Low

Relative Risk Evaluation Worksheet

Site Background Information

Installation/Site Name for FUDS: Ft. Lewis-Yakima Training Center
Location (State): Washington
Site (Name/RMIS ID/Project for FUDS: SWMU 54
Point of Contact (Name/Phone): Paula Wofford

Date Entered (day, month, year): 13 September 1996
Media Evaluated (GW, SW/Sediment, Soil): None
Phase of Execution (SI, RI, FS, Removal, RD/RA, or equiv. RCRA Stage): RFA
Agreement Status (Y/N, if yes, type agreement e.g., FFA, Permit, Order): N

Site Summary

Brief Site Description (Include site type, materials disposed of, dates of operation, and other relevant information):

SWMU 54 - Former Cantonment Landfill, Original Landfill, Pre-1954

The site consists of 10,000 ft^2 landfill area, 100 feet by 100 ft, in which base refuse was disposed (SAIC, 1995).

The exact location of the landfill is unknown, but its position has been narrowed down to a ridge approximately 0.5 miles south of Seventh Avenue along a dirt road extending from Seventh Avenue to the water reservoir. This location is approximately 0.25 miles northeast of the Ammunition Storage Point Area. At the time of a site inspection on 10 September 1996, the site appeared to be recently disturbed and was free of vegetation.

Little is known about how and when the landfill was used, but it was operating before 1954 when SWMU 57, the replacement landfill, was activated. Historically, the Cantonment Area landfills used at YTC are as follows (Shapiro, 1991):

SWMU 54 (former cantonment landfill) -	pre-1954
SWMU 57 (former landfill/burn pit) -	1954 -1968
SWMU 55 (two former landfill pits) -	1968 -1969; possible landfill use from 1969 - 1974
SWMU 56 (former landfill pit) -	1969 - used one month
SWMU 51 (active landfill) -	1969 - present

The identified time periods in which these landfills were in use differs somewhat from the dates presented in SAIC (1995) and Ogden (1995). The major difference is the time in which the current landfill was activated as presented in Corps of Engineers (1989) and Shapiro (1991).

The contents of all of the landfills except the current landfill (SWMU 51) are only speculation, but it can be assumed they would be similar to those disposed in the current landfill (SAIC, 1995). The types of wastes that were likely disposed at the landfill are municipal wastes and hazardous waste from vehicle maintenance. Specific hazardous wastes could include tank batteries, paint cans, and waste oil and containers (SAIC, 1995). While there are no references to burning the wastes disposed to this landfill, the wastes were probably burned on a regular basis as was the practice at the replacement landfill, SWMU 57 (Shapiro, 1991)

Closure operations likely consisted of covering the debris with native soil because the area has been graded level with the surrounding ground surface. The area is currently not used.

Brief Description of Pathways (Groundwater, Surface Water/Sediment, Soil):

Groundwater Pathway: Groundwater beneath YTC occurs in three distinct locations: 1) in the unsaturated upper Ellensburg formation sediments between ground surface and the water table or top of Pomoma basalt, which ever is present; 2) in the saturated Ellensburg formation sediments below the water table and above the Pomona basalt, which is the unconfined aquifer; and 3) below the Pomona basalt in the Selah interbed (Ellensburg formation), which is the first confined aquifer. If contaminants reach these locations, their behavior and ultimately the relative risk of the source area, differs greatly.

Groundwater in the unsaturated zone is retained in the unconsolidated sediments by capillary forces and moves very slowly in response to additions of water at the ground surface such as precipitation or anthropogenic sources. Because of low precipitation, 6 to 9 inches per year, and control of water sources at YTC, groundwater movement in the unsaturated zone is very slow.

The unconfined aquifer in the vicinity of the Cantonment Area appears to be perched or limited to upland areas on the southern limb of the syncline in which the Cantonment Area is located. For example, only one of four wells completed in the unconfined aquifer at the active landfill contained water in 1993 when wells were sampled for the site investigation report (Ecology and Environment, 1993). One of the wells, MW-1 drilled in 1988, encountered the top of basalt at 103 feet below ground surface, with dense basalt encountered at 116 feet. Groundwater was found only in the basalt flow top and water levels fluctuated approximately 7 feet between a winter high to summer low. During the summer, only two feet of water was present in the well. Both monitoring wells at the Ammunition Storage Point Area encountered the unconfined aquifer. Wells located north of the axis of the syncline, estimated to be just south and parallel with Seventh Avenue, did not encounter water on top of the Pomona Basalt. Ecology and Environment (1993) cite other references that indicate that private wells located west of the YTC, closer to the Yakima River, withdraw water from the unconfined aquifer from as shallow as 20 feet below ground surface. The unconfined aquifer was thought to be in hydraulic communication with the Yakima River at that location. Groundwater found on top of the first basalt layer appears to be localized to upland areas on the south side of the syncline, near its axis, and is not present in the Cantonment Area. The only exception to this pattern appears to be in the immediate vicinity of the storm drainage ditch adjacent to Seventh Avenue. This supply of water apparently results in a locally saturated condition near wells TVR-1 and TVR-2, located north of the intersection of E Street and Seventh Avenue (Ecology and Environment, 1993).

The first confined aquifer is located in the Ellensburg formation sediments, namely the Selah interbed, beneath the Pamona basalt, generally 100 feet or deeper below ground surface. The Pomona basalt is greater than 60 feet thick in all wells that have been drilled though it on base, and water encountered below it was found to be under confined conditions in all cases. Groundwater flow in this confined aquifer was to the west, down the axis of the syncline (Ecology and Environment, 1993). Based on the confined aquifer properties reported by Ecology and Environment (1993), hydraulic conductivity of 1.48×10^{-5} ft/sec and hydraulic gradient of 4.4×10^{-3} ft/ft, the lateral flow velocity is approximately 2 feet per year.

SWMU-54 is located in an upslope position on the southern side of the syncline axis. The nearest monitoring wells are approximately 1,000 feet southeast of the area at the Ammunition Storage Point Area. These wells are assumed to be upgradient of the landfill and would not reflect the groundwater chemistry beneath the landfill, but they are useful for describing the geology and groundwater conditions in the area. Based on data from those wells, it is likely that the unconfined aquifer exists beneath the landfill. Regional interpretations of groundwater movement in this aquifer indicate that flow is to the west, northwest down the axis of the syncline in which the Cantonment Area is located. It is unclear how water moves through the Cantonment Area, if at all, when no water is found on top of basalt in the Cantonment Area. It is likely that the axis of the syncline is located somewhere between Seventh Avenue and the Ammunition Storage Point Area, and south of most of the SWMUs and AOC at YTC.

The nearest drinking water well is DW-3 located 1,000 feet north of SWMU 54 (Shapiro, 1991). This well was not sampled in 1993 as part of the site investigation report (Ecology and Environment, 1993), but sample results reported in Shapiro (1991), indicate that the water quality was good with all analytical parameters below drinking water limits.

The groundwater pathway is important only if sufficient precipitation falls to leach waste material from the landfill. With low annual precipitation, the upland position of the site to prevent ponding of runoff from adjacent areas, buried position of the waste, and deep position of the groundwater, it is unlikely that groundwater would be contaminated from this landfill.

Surface Water/Sediment Pathway: The nearest surface water stream is the storm water ditch adjacent to Seventh Avenue, approximately 0.5 miles from the site. Wastes were covered with native soil, therefore, it is assumed that surface contamination is unlikely nor is there a completed surface water pathway at this site. There are no erosional features to indicate that surface runoff is significant.

Soil: The entire area has been covered with clean soil since the area was used. A site inspection on 10 September 1996 revealed that the wastes were buried and no materials were exposed at the ground surface. Therefore the soil pathway is incomplete.

Brief Description of Receptors (Human and Ecological):

The site is managed as an industrial area with the base restricted to authorized personnel. The minimal contaminants at the site are below ground and in an area well away from routine travel. The nearest groundwater source is approximately 1,000 feet north where a drinking water well is located. The only analysis of this well available, indicated that it was not contaminated with hazardous constituents. Therefore, no completed pathway leading to a receptor could be identified.

Groundwater

Contaminant Hazard Factor (CHF): Minimal - There are no monitoring wells located specifically for this site, but with low annual precipitation, the upland position of the site to prevent ponding of runoff from adjacent areas, buried position of the waste, and deep position of the groundwater, it is unlikely that groundwater would be contaminated from this landfill.

Contaminant	Maximum Concentration (μg/L)	Standard (μg/L)	Ratio
Because it is unlikely that groundwater would be contaminated from this site, no samples were collected. No monitoring wells at this site.			

Migration Pathway Factor: Confined - The information indicates that the potential for contaminant migration from the source is limited because of the depth to groundwater, low precipitation for leaching of wastes constituents to groundwater, and the long flow path to groundwater.

Receptor Factor: Potential - Because there is good chance that the unconfined aquifer is present beneath SWMU 54, there is a slight chance that hazardous constituents could leach into the groundwater, the groundwater in the vicinity of the cantonment area must have as a minimum a "potential" receptor factor because groundwater in the area is currently used as a drinking water supply. It would only be designated as "identified" if it were contaminated. This rating is assigned as a highly conservative estimate in the absence of site specific data.

Groundwater Category: Low

Surface Water/Sediment

Contaminant Hazard Factor (CHF): Minimal - There is no surface water associated with this site.

Contaminant	Maximum Concentration (µg/L)	Standard (µg/L)	Ratio
No surface water associated with the site, therefore, no samples were collected.			

Migration Pathway Factor: Confined - The information indicates that the potential for surface water migration from the source is limited because there are no surface water bodies associated with the site and there are no erosional features indicating that runoff is insignificant.

Receptor Factor: Limited - There are no surface water bodies associated with the site.

Surface Water/Sediment Category: Low

SWMU 54

Soil

Contaminant Hazard Factor (CHF): Minimal - A clean soil cover was placed over the landfill, therefore, it is assumed that there are no contaminated surface soils.

Contaminant	Maximum Concentration (mg/kg)	Standard (mg/kg)	Ratio
Surface soils would be clean, therefore, no samples were collected.			

Migration Pathway Factor: Confined - Low precipitation and long travel path to the groundwater precludes hazardous constituents in the landfill from leaching to a point of exposure. The buried nature of the waste in a remote area also minimizes the likelihood that the waste will be excavated.

Receptor Factor: Limited - There is little or no potential for receptors to access the buried waste. The area is restricted to authorized personnel and in an area removed from routine traffic.

Soil Category: Low

Relative Risk Evaluation Worksheet

Site Background Information

Installation/Site Name for FUDS: Ft. Lewis-Yakima Training Center
Location (State): Washington
Site (Name/RMIS ID/Project for FUDS: SWMU 55
Point of Contact (Name/Phone): Paula Wofford

Date Entered (day, month, year): 13 September 1996
Media Evaluated (GW, SW/Sediment, Soil): None
Phase of Execution (SI, RI, FS, Removal, RD/RA, or equiv. RCRA Stage): RFA
Agreement Status (Y/N, if yes, type agreement e.g., FFA, Permit, Order): N

Site Summary

Brief Site Description (Include site type, materials disposed of, dates of operation, and other relevant information):

SWMU 55 - Two Former Landfill Pits, Landfill Pits, 1968-1969

The area reportedly consists of two, unlined landfill pits and a landfill (SAIC, 1995), but Shapiro (1991) describes the site as only two landfill pits.

The three major reports that summarize waste site data for YTC also disagree as to the location of SWMU 55. Shapiro (1991) places the site approximately 1 mile northeast of SWMU 57. SAIC (1995) places the landfill in the same area in the text of the report, but then identifies a site located approximately 4 miles east of the Cantonment Area on a ridge a half mile north of Cold Creek Road. This is the same location identified in Ogden (1995). Because of the discrepancy in site location and description, there could be two separate waste sites, one consisting of two landfill pits 1 mile northeast of SWMU 57 and a landfill located 4 miles out of the Cantonment Area along Cold Creek Road. Another reason to question the distant location of SWMU 55 is exactly that, it was too far from the Cantonment Area to be used on a regular basis. SAIC (1995) reported that SWMU 56, located approximately 2.5 miles from the Cantonment Area, was used for only one month in 1969 because it was too far from the Cantonment Area. As a result, the current landfill was constructed closer to the Cantonment Area. The distant location of SWMU 55 is approximately 4 miles from the Cantonment Area while the near location is only 1 mile away. It seems likely that the distant location for SWMU 55 would have the same disadvantages for disposal of Cantonment wastes on a regular basis. Because of the construction debris found during construction of the machine gun range, the distant location was presumably used for disposal of construction wastes.

Whatever the case, neither of the sites has been located because no permanent markers were placed at the site(s) when it (they) was closed. During construction of a National Guard machine gun range in 1996, concrete debris was uncovered by construction activities in the same area thought to be where the landfill was located (SAIC, 1995). In addition, two linear depressions coincide with the locations where the concrete debris was discovered, suggesting that they represent the pits. The area is approximately 4 miles from the nearest drinking water well located in the Cantonment Area (Ecology and Environment, 1993).

The two pits are reportedly (SAIC, 1995) about 6 ft deep, 9 ft wide, and unknown length. The pits were used in 1968 and 1969 and received an estimated 16,000 cubic yards of general base refuse consisting of municipal type wastes, construction debris, and probably industrial wastes from shops on the base (SAIC, 1995). It is reported that a landfill was constructed in the same general area in 1969 and was used for disposal of similar wastes as disposed in the pits until 1974 (SAIC, 1995). The type of wastes disposed at this location is speculation but is based on the assumption that wastes were similar to those disposed in SWMU 51, the active landfill, which began receiving wastes in 1969 after SWMU 56 was closed (SAIC, 1995).

Historically, the Cantonment Area landfills used at YTC are as follows (Shapiro, 1991):

SWMU 54 (former cantonment landfill) -	pre-1954
SWMU 57 (former landfill/burn pit) -	1954 -1968
SWMU 55 (two former landfill pits) -	1968 -1969; possible landfill use from 1969 - 1974
SWMU 56 (former landfill pit) -	1969 - used one month
SWMU 51 (active landfill) -	1969 - present

The identified time periods in which these landfills were in use differs somewhat from the dates presented in SAIC (1995) and Ogden (1995). The major difference is the time in which the current landfill was activated as presented in Corps of Engineers (1989) and Shapiro (1991).

From the previous information, SWMU 51, the current landfill, could have been active during the time SWMU 55 was in operation. Therefore, it is likely that the close proximity of SWMU 51 to the Cantonment Area and the distant, 4 miles to SWMU 55 could have resulted in SWMU 51 receiving most of the wastes generated on base at that time. The landfill pits were closed by the time the current landfill was activated, so they likely received all of the Cantonment Area wastes.

The pits and the landfill are unlined. Closure operations likely consisted of covering the debris with native soil as the pits were filled and the area graded level. The area is currently used for machine gun training.

Brief Description of Pathways (Groundwater, Surface Water/Sediment, Soil):

Groundwater Pathway: Groundwater beneath YTC occurs in three distinct locations: 1) in the unsaturated upper Ellensburg formation sediments between ground surface and the water table or top of Pomoma basalt, which ever is present; 2) in the saturated Ellensburg formation sediments below the water table and above the Pomona basalt, which is the unconfined aquifer; and 3) below the Pomona basalt in the Selah interbed (Ellensburg formation), which is the first confined aquifer. If contaminants reach these locations, their behavior and ultimately the relative risk of the source area, differs greatly.

Groundwater in the unsaturated zone is retained in the unconsolidated sediments by capillary forces and moves very slowly in response to additions of water at the ground surface such as precipitation or anthropogenic sources. Because of low precipitation, 6 to 9 inches per year, and

control of water sources at YTC, groundwater movement in the unsaturated zone is very slow.

The unconfined aquifer in the vicinity of the Cantonment Area appears to be perched or limited to upland areas on the southern limb of the syncline in which the Cantonment Area is located. For example, only one of four wells completed in the unconfined aquifer at the active landfill contained water in 1993 when wells were sampled for the site investigation report (Ecology and Environment, 1993). One of the wells, MW-1 drilled in 1988, encountered the top of basalt at 103 feet below ground surface, with dense basalt encountered at 116 feet. Groundwater was found only in the basalt flow top and water levels fluctuated approximately 7 feet between a winter high to summer low. During the summer, only two feet of water was present in the well. Both monitoring wells at the Ammunition Storage Point Area encountered the unconfined aquifer. Wells located north of the axis of the syncline, estimated to be just south and parallel with Seventh Avenue, did not encounter water on top of the Pomona Basalt. Ecology and Environment (1993) cite other references that indicate that private wells located west of the YTC, closer to the Yakima River, withdraw water from the unconfined aquifer from as shallow as 20 feet below ground surface. The unconfined aquifer was thought to be in hydraulic communication with the Yakima River at that location. Groundwater found on top of the first basalt layer appears to be localized to upland areas on the south side of the syncline, near its axis, and is not present in the Cantonment Area. The only exception to this pattern appears to be in the immediate vicinity of the storm drainage ditch adjacent to Seventh Avenue. This supply of water apparently results in a locally saturated condition near wells TVR-1 and TVR-2, located north of the intersection of E Street and Seventh Avenue (Ecology and Environment, 1993).

The first confined aquifer is located in the Ellensburg formation sediments, namely the Selah interbed, beneath the Pamona basalt, generally 100 feet or deeper below ground surface. The Pomona basalt is greater than 60 feet thick in all wells that have been drilled though it on base, and water encountered below it was found to be under confined conditions in all cases. Groundwater flow in this confined aquifer was to the west, down the axis of the syncline (Ecology and Environment, 1993). Based on the confined aquifer properties reported by Ecology and Environment (1993), hydraulic conductivity of 1.48×10^{-5} ft/sec and hydraulic gradient of 4.4×10^{-3} ft/ft, the lateral flow velocity is approximately 2 feet per year.

SWMU-55 is located in an upslope position on the northern side of the syncline. No monitoring wells have been drilled in the vicinity so only regional considerations of the hydrogeology can be used to infer conditions beneath the site. The position of the landfill on a ridge located north of the central axis of the syncline would indicate that unconsolidated sediments of the upper Ellensburg formation could be up to 100 ft thick on top of the first basalt strata. It is likely that no groundwater is present on top of the basalt, but this has not been demonstrated via well drilling. If groundwater is present on top of the basalt, it would flow down the axis of the syncline toward the Cantonment Area. The general direction of flow of the first confined aquifer is to the west. The groundwater pathway is important only if sufficient precipitation falls to leach constituents from the pits. Low annual precipitation, the upland position of the site and likely deep position of the groundwater, buried position of the refuse, and long flow path to receptors, minimize the opportunity for groundwater to be contaminated.

Surface Water/Sediment Pathway: There nearest surface water stream is Selah Creek, located approximately 1 mile north of the area. There are no sources of water in the vicinity. Because the refuse is buried, it is assumed that surface contamination is not present and the surface water pathway is not completed at this site.

Soil: The entire area has been regraded and covered with clean soil since its closure in 1974. The soil pathway is not complete.

Brief Description of Receptors (Human and Ecological):

The site is managed as an industrial area, machine gun range with the base restricted to authorized personnel. The minimal contaminants at the site are below ground and in an area well away from routine travel. The nearest groundwater source is approximately 4 miles to where a drinking water well is located in the Cantonment Area. It is even further to the nearest domestic well.

Groundwater

Contaminant Hazard Factor (CHF): Minimal - There are no monitoring wells located at this site, so no groundwater data are available specifically for this site. But groundwater around the active landfill, SWMU 51, has been monitored. The active landfill has been used for more than 20 years and likely received similar wastes to this landfill. Groundwater data showed that a contaminant hazard factor of 23 was applied to SWMU 51, with most of the factor due to lead (14) and manganese (7) (Paula Wofford, personal communication, 3 September 1996; RRSE worksheet for SWMU 51; Ecology & Environment, 1993). The same CHF could be applied to SWMU 55, but it was decided that this CHF does not accurately reflect the hazard at the current landfill because only one of four monitoring wells could be sampled, the others were dry, and the well that was sampled was pumped dry during purging. The sampling crew had to wait an additional 90 minutes before enough water entered the well to collect a sample and it was turbid. Placement of a turbid sample in an acid preserved bottle are the likely cause for the high metal results reported at the site. Finally, the major reason for not accepting the CHF is that the well sampled was the upgradient well which should have reflected the natural background.

Contaminant	Maximum Concentration (μg/L)	Standard (μg/L)	Ratio
Because it is unlikely that groundwater would be contaminated from this site, no samples were collected. No monitoring wells at this site.			

Migration Pathway Factor: Confined - The information indicates that the potential for contaminant migration from the source is assumed to be limited because of the depth to groundwater and low precipitation and lack of water in the area to serve as a driving force for leaching to groundwater.

Receptor Factor: Limited - The distance to the nearest drinking water well downgradient of the site is approximately 4 miles (or one mile depending on the actual location of the site) which is considered too great a distance to be impacted by the small quantities of waste that are thought to have been disposed at the site.

Groundwater Category: Low

Surface Water/Sediment

Contaminant Hazard Factor (CHF): Minimal - There is no surface water associated with this site.

Contaminant	Maximum Concentration (μg/L)	Standard (μg/L)	Ratio
No surface water associated with the site, therefore, no samples were collected.			

Migration Pathway Factor: Confined - The information indicates that the potential for surface water migration from the source is limited because there are no surface water bodies associated with the site.

Receptor Factor: Limited - There are no surface water bodies associated with the site.

Surface Water/Sediment Category: Low

Soil

Contaminant Hazard Factor (CHF): Minimal - Based on landfill closure practices, the pits were probably covered with clean native soil from the area. Therefore, surface soils would not be contaminated.

Contaminant	Maximum Concentration (mg/kg)	Standard (mg/kg)	Ratio
Clean surface soil would have been placed over the pits, therefore, no samples were collected.			

Migration Pathway Factor: Confined - There is a low possibility for wastes to leach from the site due to the low precipitation in the area and long path to groundwater. The area is remote which minimizes the likelihood that the wastes will be excavated.

Receptor Factor: Limited - There is little or no potential for receptors to access the buried waste. The area is restricted to authorized personnel and in an area removed from routine traffic.

Soil Category: Low

Relative Risk Evaluation Worksheet

Site Background Information

Installation/Site Name for FUDS: Ft. Lewis-Yakima Training Center
Location (State): Washington
Site (Name/RMIS ID/Project for FUDS: SWMU 56
Point of Contact (Name/Phone): Paula Wofford

Date Entered (day, month, year): 13 September 1996
Media Evaluated (GW, SW/Sediment, Soil): None
Phase of Execution (SI, RI, FS, Removal, RD/RA, or equiv. RCRA Stage): RFA
Agreement Status (Y/N, if yes, type agreement e.g., FFA, Permit, Order): N

Site Summary

Brief Site Description (Include site type, materials disposed of, dates of operation, and other relevant information):

SWMU 56 - Former Landfill Pit

The site reportedly consists of a pit into which Cantonment Area wastes were disposed.

The site is located approximately 0.5 miles east of the current landfill (SWMU 51). The area identified by SAIC (1995) and Shapiro (1991) was on the edge of a hill and had different vegetation than the surrounding area. Plastic was observed in a hole excavated by a burrowing animal. Ogden (1995) reported that the exact location of the landfill pit is unknown.

The pit was reportedly used for one month during 1969 until it was decided that the distance was too great to haul wastes (SAIC, 1995). Historically, the Cantonment Area landfills used at YTC are as follows (Shapiro, 1991):

SWMU 54 (former cantonment landfill) -	pre-1954
SWMU 57 (former landfill/burn pit) -	1954 -1968
SWMU 55 (two former landfill pits) -	1968 -1969; possible landfill use from 1969 - 1974
SWMU 56 (former landfill pit) -	1969 - used one month
SWMU 51 (active landfill) -	1969 - present

The identified time periods in which these landfills were in use differs somewhat from the dates presented in SAIC (1995) and Ogden (1995). The major difference is the time in which the current landfill was activated as presented in Corps of Engineers (1989) and Shapiro (1991).

The size of the landfill is also unknown, but according to SAIC (1995), if the pit was used during the summer when exercises were underway, as much as 2,500 cubic yards of waste could have been disposed at the site. Based on the facts that the landfill was reportedly covered with soil,

the typical procedure for closing landfills, and that the landfill could not be located, indicates that the wastes are buried. The site is unmonitored.

Brief Description of Pathways (Groundwater, Surface Water/Sediment, Soil):

Groundwater Pathway: Groundwater beneath YTC occurs in three distinct locations: 1) in the unsaturated upper Ellensburg formation sediments between ground surface and the water table or top of Pomoma basalt, which ever is present; 2) in the saturated Ellensburg formation sediments below the water table and above the Pomona basalt, which is the unconfined aquifer; and 3) below the Pomona basalt in the Selah interbed (Ellensburg formation), which is the first confined aquifer. If contaminants reach these locations, their behavior and ultimately the relative risk of the source area, differs greatly.

Groundwater in the unsaturated zone is retained in the unconsolidated sediments by capillary forces and moves very slowly in response to additions of water at the ground surface such as precipitation or anthropogenic sources. Because of low precipitation, 6 to 9 inches per year, and control of water sources at YTC, groundwater movement in the unsaturated zone is very slow.

The unconfined aquifer in the vicinity of the Cantonment Area appears to be perched or limited to upland areas on the southern limb of the syncline in which the Cantonment Area is located. For example, only one of four wells completed in the unconfined aquifer at the active landfill contained water in 1993 when wells were sampled for the site investigation report (Ecology and Environment, 1993). One of the wells, MW-1 drilled in 1988, encountered the top of basalt at 103 feet below ground surface, with dense basalt encountered at 116 feet. Groundwater was found only in the basalt flow top and water levels fluctuated approximately 7 feet between a winter high to summer low. During the summer, only two feet of water was present in the well. Both monitoring wells at the Ammunition Storage Point Area encountered the unconfined aquifer. Wells located north of the axis of the syncline, estimated to be just south and parallel with Seventh Avenue, did not encounter water on top of the Pomona Basalt. Ecology and Environment (1993) cite other references that indicate that private wells located west of the YTC, closer to the Yakima River, withdraw water from the unconfined aquifer from as shallow as 20 feet below ground surface. The unconfined aquifer was thought to be in hydraulic communication with the Yakima River at that location. Groundwater found on top of the first basalt layer appears to be localized to upland areas on the south side of the syncline, near its axis, and is not present in the Cantonment Area. The only exception to this pattern appears to be in the immediate vicinity of the storm drainage ditch adjacent to Seventh Avenue. This supply of water apparently results in a locally saturated condition near wells TVR-1 and TVR-2, located north of the intersection of E Street and Seventh Avenue (Ecology and Environment, 1993).

The first confined aquifer is located in the Ellensburg formation sediments, namely the Selah interbed, beneath the Pamona basalt, generally 100 feet or deeper below ground surface. The Pomona basalt is greater than 60 feet thick in all wells that have been drilled though it on base, and water encountered below it was found to be under confined conditions in all cases. Groundwater flow in this confined aquifer was to the west, down the axis of the syncline (Ecology and Environment, 1993). Based on the confined aquifer properties reported by Ecology and Environment (1993), hydraulic conductivity of 1.48×10^{-5} ft/sec and hydraulic gradient of 4.4×10^{-3} ft/ft, the lateral flow velocity is approximately 2 feet per year.

SWMU 56 is located in an upslope position on the southern side of the syncline. No monitoring wells have been drilled in the vicinity so only

regional considerations of the hydrogeology can be used to infer conditions beneath the site. The position of the landfill on a ridge located south of the central axis of the syncline would indicate that unconsolidated sediments of the upper Ellensburg formation could be up to 100 ft thick on top of the first basalt strata. It is likely that little or no groundwater is present on top of the basalt such as is the condition at the current landfill, 0.5 miles west of the site, but this has not been demonstrated via well drilling. If groundwater is present on top of the basalt, it would flow down the axis of the syncline toward the Cantonment Area. The general direction of flow of the first confined aquifer is to the west. The groundwater pathway is important only if sufficient precipitation falls to leach constituents from the pit. Low annual precipitation, the upland position of the site and likely deep position of the groundwater, and buried position of the refuse, minimize the opportunity for groundwater to be contaminated.

Surface Water/Sediment Pathway: There nearest surface water stream is the storm water ditch adjacent to Seventh Avenue, approximately 2 miles from the site. There is probably no surface contamination because the wastes were covered nor is there a completed surface water pathway at this site.

Soil: The entire area has been reportedly covered with clean soil since the area was used.

Brief Description of Receptors (Human and Ecological): The site is managed as an industrial area with the base restricted to authorized personnel. The minimal contaminants at the site are below ground and in an area well away from routine travel. The nearest groundwater source is approximately 2 miles where a drinking water well is located. It is approximately 3.5 miles to the nearest domestic well which would draw water from the unconfined aquifer above the basalt.

Groundwater

Contaminant Hazard Factor (CHF): Minimal - There are no monitoring wells located specifically for this site, but with the minimal amount of waste disposed at the site, low rainfall, long travel path to groundwater, it is highly unlikely that groundwater would be contaminated from this site.

Contaminant	Maximum Concentration (μg/L)	Standard (μg/L)	Ratio
Because it is highly unlikely that groundwater would be contaminated from this site, there would be no reason to collect samples from this site, even if the site could be located. No monitoring wells at this site.			

Migration Pathway Factor: Confined - The information indicates that the potential for contaminant migration from the source is limited because of low site inventory, great depth to groundwater, and low precipitation and lack of water to serve as a leaching source.

Receptor Factor: Limited - The distance to the nearest drinking water well downgradient of the site is approximately 4 miles (or one mile depending on the actual location of the site) which is considered too great a distance to be impacted by the small quantities of waste that are thought to have been disposed at the site.

Groundwater Category: Low

Surface Water/Sediment

Contaminant Hazard Factor (CHF): Minimal - There is no surface water associated with this site.

Contaminant	Maximum Concentration (μg/L)	Standard (μg/L)	Ratio
No surface water associated with the site, therefore, no samples were collected.			

Migration Pathway Factor: Confined - The information indicates that the potential for surface water migration from the source is limited because there are no surface water bodies associated with the site.

Receptor Factor: Limited - There are no surface water bodies associated with the site.

Surface Water/Sediment Category: Low

Soil

Contaminant Hazard Factor (CHF): Minimal - Wastes are buried below ground surface. The site was probably covered with clean surface soils not contaminated.

Contaminant	Maximum Concentration (mg/kg)	Standard (mg/kg)	Ratio
Clean fill would have been placed on the pit, therefore, there was no reason to collect samples even if the site could be located.			

Migration Pathway Factor: **Confined** - There is a low possibility for wastes to leach from the site due to the low precipitation in the area and long path to groundwater. The area is remote which minimizes the likelihood that the wastes will be excavated.

Receptor Factor: Limited - There is little or no potential for receptors to access the buried waste. The area is restricted to authorized personnel and in an area removed from routine traffic.

Soil Category: Low

SWMU 56

Relative Risk Evaluation Worksheet

Site Background Information

Installation/Site Name for FUDS: Ft. Lewis-Yakima Training Center
Location (State): Washington
Site (Name/RMIS ID/Project for FUDS: SWMU 57
Point of Contact (Name/Phone): Paula Wofford

Date Entered (day, month, year): 13 September 1996
Media Evaluated (GW, SW/Sediment, Soil): None
Phase of Execution (SI, RI, FS, Removal, RD/RA, or equiv. RCRA Stage): RFA
Agreement Status (Y/N, if yes, type agreement e.g., FFA, Permit, Order): N

Site Summary

Brief Site Description (Include site type, materials disposed of, dates of operation, and other relevant information):

SWMU 57 - Former Landfill/Burn Pit, 1954-1968

The area consists of a former landfill in which wastes were burned regularly. The exact location of the site is unknown, but its location has been narrowed down to an area approximately 800 feet north of building 810.

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The landfill was activated in 1954 when the original landfill (SWMU 54) was closed. The landfill was used until 1968 when SWMU 55 was activated (Shapiro, 1991). Historically, the Cantonment Area landfills used at YTC are as follows (Shapiro, 1991):

SWMU 54 (former cantonment landfill) -	pre-1954
SWMU 57 (former landfill/burn pit) -	1954 -1968
SWMU 55 (two former landfill pits) -	1968 -1969; possible landfill use from 1969 - 1974
SWMU 56 (former landfill pit) -	1969 - used one month
SWMU 51 (active landfill) -	1969 - present

The identified time periods in which these landfills were in use differs somewhat from the dates presented in SAIC (1995) and Ogden (1995). The major difference is the time in which the current landfill was activated as presented in Corps of Engineers (1989) and Shapiro (1991).

Wastes disposed at this site consisted of municipal wastes and hazardous waste from vehicle maintenance activities. Specific hazardous wastes included tank batteries, paint cans, and empty oil containers (SAIC, 1995). In addition, concrete, piping, scrap lumber, and tree stumps were observed on the lower portion of the hill, presumably delineating the lower limit of the landfill. Wastes were disposed in east/west oriented trenches where they were burned when the trenches were filled, which occurred every day or two during the summer when exercises were underway. During peak summer activities at the YTC, 500 to 600 cubic yards of wastes were generated weekly; this dropped to 5 cubic yards in

the winter.

When the landfill was closed, the trenches were covered with clean soil. The only evidence of the landfill location are some small soil piles, lack of sagebrush, and debris along the lower margins of the area.

Brief Description of Pathways (Groundwater, Surface Water/Sediment, Soil):

Groundwater Pathway: Groundwater beneath YTC occurs in three distinct locations: 1) in the unsaturated upper Ellensburg formation sediments between ground surface and the water table or top of Pomoma basalt, which ever is present; 2) in the saturated Ellensburg formation sediments below the water table and above the Pomona basalt, which is the unconfined aquifer; and 3) below the Pomona basalt in the Selah interbed (Ellensburg formation), which is the first confined aquifer. If contaminants reach these locations, their behavior and ultimately the relative risk of the source area, differs greatly.

Groundwater in the unsaturated zone is retained in the unconsolidated sediments by capillary forces and moves very slowly in response to additions of water at the ground surface such as precipitation or anthropogenic sources. Because of low precipitation, 6 to 9 inches per year, and control of water sources at YTC, groundwater movement in the unsaturated zone is very slow.

The unconfined aquifer in the vicinity of the Cantonment Area appears to be perched or limited to upland areas on the southern limb of the syncline in which the Cantonment Area is located. For example, only one of four wells completed in the unconfined aquifer at the active landfill contained water in 1993 when wells were sampled for the site investigation report (Ecology and Environment, 1993). One of the wells, MW-1 drilled in 1988, encountered the top of basalt at 103 feet below ground surface, with dense basalt encountered at 116 feet. Groundwater was found only in the basalt flow top and water levels fluctuated approximately 7 feet between a winter high to summer low. During the summer, only two feet of water was present in the well. Both monitoring wells at the Ammunition Storage Point Area encountered the unconfined aquifer. Wells located north of the axis of the syncline, estimated to be just south and parallel with Seventh Avenue, did not encounter water on top of the Pomona Basalt. Ecology and Environment (1993) cite other references that indicate that private wells located west of the YTC, closer to the Yakima River, withdraw water from the unconfined aquifer from as shallow as 20 feet below ground surface. The unconfined aquifer was thought to be in hydraulic communication with the Yakima River at that location. Groundwater found on top of the first basalt layer appears to be localized to upland areas on the south side of the syncline, near its axis, and is not present in the Cantonment Area. The only exception to this pattern appears to be in the immediate vicinity of the storm drainage ditch adjacent to Seventh Avenue. This supply of water apparently results in a locally saturated condition near wells TVR-1 and TVR-2, located north of the intersection of E Street and Seventh Avenue (Ecology and Environment, 1993).

The first confined aquifer is located in the Ellensburg formation sediments, namely the Selah interbed, beneath the Pamona basalt, generally 100 feet or deeper below ground surface. The Pomona basalt is greater than 60 feet thick in all wells that have been drilled though it on base, and water encountered below it was found to be under confined conditions in all cases. Groundwater flow in this confined aquifer was to the west, down the axis of the syncline (Ecology and Environment, 1993). Based on the confined aquifer properties reported by Ecology and Environment

(1993), hydraulic conductivity of 1.48×10^{-5} ft/sec and hydraulic gradient of 4.4×10^{-3} ft/ft, the lateral flow velocity is approximately 2 feet per year.

SWMU 57 is located at the top of a hill on the north side of the syncline. No wells have been drilled to monitor the landfill specifically, but wells have been drilled on all sides of the landfill except to the north. Wells at the bottom of the hill below the landfill to the west in the Army and Marine Reserve Centers, indicate that the top of the Pomona basalt is 3 to 5 feet below ground surface and no unconfined aquifer is present. The unconfined aquifer does not appear on top of the basalt until some unknown distance to the west of the wells beyond the YTC boundary. Therefore, the groundwater pathway would consist of leaching of landfill constituents (largely ash) by natural precipitation down to the top of basalt, where the water could either flow along the basalt until it entered the unconfined aquifer to the west, or migrate through approximately 100 feet or more of basalt rock to the confined aquifer. At this point, contaminants would then migrate to the west in accordance with the direction of groundwater flow. This pathway is not likely and considered insignificant. Four groundwater monitoring wells located downgradient from the landfill, ARC-1, ARC-1, MRC-1, and MRC-2, were sampled as part of the site investigation (Ecology & Environment, 1993) and found to be free of contamination above regulatory limits.

Migration of contamination along the top of basalt would be important only if sufficient precipitation fell to leach waste from the landfill. With low annual precipitation, the upland position of the site elevating it above the top of basalt, buried position of the wastes, and long flow path to reach the unconfined aquifer (at least 2,000 feet) contribute to making the unconfined aquifer pathway highly unlikely.

Surface Water/Sediment Pathway: There nearest surface water stream is an irrigation canal located 0.5 miles west of the landfill. No surface runoff is evident from this site. Therefore, the surface water pathway is not a completed pathway.

Soil: The entire area has been regraded and covered with clean soil.

Brief Description of Receptors (Human and Ecological):

The site is managed as an industrial area with the base restricted to authorized personnel. The minimal contaminants at the site are below ground and in an area well away from routine travel.

Groundwater

Contaminant Hazard Factor (CHF): Minimal - Monitoring wells downgradient of the site indicate that there is no unconfined aquifer on top of basalt and the confined groundwater is not contaminated above regulatory limits.

Contaminant	Maximum Concentration (μg/L)	Standard (μg/L)	Ratio
No monitoring wells are located at this site, but wells located downgradient from the landfill are uncontaminated.			

Migration Pathway Factor: Confined - The likelihood that contaminants would reach the confined aquifer are very remote and the unconfined aquifer is not present at the site. Therefore, the groundwater pathway is considered incomplete.

Receptor Factor: Limited - The distance to the nearest drinking water well downgradient of the site is at least 2,000 feet away and because the groundwater pathway is not complete, there would be no receptors using groundwater that could be impacted by the site.

Groundwater Category: Low

Surface Water/Sediment

Contaminant Hazard Factor (CHF): Minimal - There is no surface water associated with this site.

Contaminant	Maximum Concentration (μg/L)	Standard (μg/L)	Ratio
No surface water associated with the site, therefore, no samples were collected.			

Migration Pathway Factor: Confined - The information indicates that the potential for surface water migration from the source is limited because there are no surface water bodies associated with the site; there is no evidence, such as erosion channels, to indicate that any surface runoff occurs at the site.

Receptor Factor: Limited - There are no surface water bodies associated with the site.

Surface Water/Sediment Category: Low

Soil

Contaminant Hazard Factor (CHF): Minimal - Wastes are buried below ground surface. There is no hazardous surface debris to indicate the presence of erosion and possible exposure of wastes.

Contaminant	Maximum Concentration (mg/kg)	Standard (mg/kg)	Ratio
Wastes would have been covered with clean soil, therefore, no surface soil samples were collected.			

Migration Pathway Factor: Confined - Low precipitation and long travel path to the groundwater precludes hazardous constituents from leaching to a point of exposure. The buried nature of the waste and access limited to authorized personnel on base minimize the likelihood of casual intrusion into the waste.

Receptor Factor: Limited - There is little or no potential for receptors to access the buried waste. The area is restricted to authorized personnel and in an area removed from routine traffic.

Soil Category: Low

Relative Risk Evaluation Worksheet

Site Background Information

Installation/Site Name for FUDS: Ft. Lewis-Yakima Training Center
Location (State): Washington
Site (Name/RMIS ID/Project for FUDS: AOC 1
Point of Contact (Name/Phone): Paula Wofford

Date Entered (day, month, year): 13 September 1996
Media Evaluated (GW, SW/Sediment, Soil): None
Phase of Execution (SI, RI, FS, Removal, RD/RA, or equiv. RCRA Stage): RFA
Agreement Status (Y/N, if yes, type agreement e.g., FFA, Permit, Order): N

Site Summary

Brief Site Description (Include site type, materials disposed of, dates of operation, and other relevant information):

AOC 1 - Former Central Vehicle Wash Rack

The area consists of flat area with a concrete pad and water supply downspout on the corner of Seventh Avenue (Cold Creek Road) and E Street (SAIC, 1995). The site was used mainly to wash Army vehicles following their return from field exercises from 1966 to 1980 (Shapiro, 1991). The overhead fill point is now used as a potable water supply (Ogden, 1995), and is monitored once a month for contamination. Such monitoring data indicate that the water supply is uncontaminated (personal communication, Bob Smith, U.S. Army Corps of Engineers, 10 September 1996).

The wash water discharged into the nearby stormwater drainage system that is adjacent to Seventh Avenue. Specifically, the wash rack sits on a concrete pad with the sediments being washed off into the nearby drainage ditch. SAIC (1995) notes that the AOC-1 discharge was authorized under an NPDES permit (WA0021962 Outfall serial #002, Shapiro, 1991) for discharge to the Yakima River. The water passed through a pond, where "Larry's Swimming Pool" is currently located. Currently the pool water consists of water retained from storm events or runoff from activities uphill from the site. SAIC (1995) noted that during the Site Inspection by Ecology & Environment (1993) of "Larry's Swimming Pool," the site was sampled and contained arsenic, lead, manganese, and zinc.

Brief Description of Pathways (Groundwater, Surface Water/Sediment, Soil):

Groundwater Pathway: Groundwater beneath YTC occurs in three distinct locations: 1) in the unsaturated upper Ellensburg formation sediments between ground surface and the water table or top of Pomoma basalt, which ever is present; 2) in the saturated Ellensburg formation sediments below the water table and above the Pomona basalt, which is the unconfined aquifer; and 3) below the Pomona basalt in the Selah interbed (Ellensburg formation), which is the first confined aquifer. If contaminants reach these locations, their behavior and ultimately the relative risk of the source area, differs greatly.

Groundwater in the unsaturated zone is retained in the unconsolidated sediments by capillary forces and moves very slowly in response to additions of water at the ground surface such as precipitation or anthropogenic sources. Because of low precipitation, 6 to 9 inches per year, and control of water sources at YTC, groundwater movement in the unsaturated zone is very slow.

The unconfined aquifer in the vicinity of the Cantonment Area appears to be perched or limited to upland areas on the southern limb of the syncline in which the Cantonment Area is located. For example, only one of four wells completed in the unconfined aquifer at the active landfill contained water in 1993 when wells were sampled for the site investigation report (Ecology and Environment, 1993). One of the wells, MW-1 drilled in 1988, encountered the top of basalt at 103 feet below ground surface, with dense basalt encountered at 116 feet. Groundwater was found only in the basalt flow top and water levels fluctuated approximately 7 feet between a winter high to summer low. During the summer, only two feet of water was present in the well. Both monitoring wells at the Ammunition Storage Point Area encountered the unconfined aquifer. Wells located north of the axis of the syncline, estimated to be just south and parallel with Seventh Avenue, did not encounter water on top of the Pomona Basalt. Ecology and Environment (1993) cite other references that indicate that private wells located west of the YTC, closer to the Yakima River, withdraw water from the unconfined aquifer from as shallow as 20 feet below ground surface. The unconfined aquifer was thought to be in hydraulic communication with the Yakima River at that location. Groundwater found on top of the first basalt layer appears to be localized to upland areas on the south side of the syncline, near its axis, and is not present in the Cantonment Area. The only exception to this pattern appears to be in the immediate vicinity of the storm drainage ditch adjacent to Seventh Avenue, in the vicinity of AOC 1 and "Larry's Swimming Pool." This supply of water apparently results in a locally saturated condition near wells TVR-1 and TVR-2, located north of the intersection of E Street and Seventh Avenue (Ecology and Environment, 1993).

The first confined aquifer is located in the Ellensburg formation sediments, namely the Selah interbed, beneath the Pamona basalt, generally 100 feet or deeper below ground surface. The Pomona basalt is greater than 60 feet thick in all wells that have been drilled though it on base, and water encountered below it was found to be under confined conditions in all cases. Groundwater flow in this confined aquifer was to the west, down the axis of the syncline (Ecology and Environment, 1993). Based on the confined aquifer properties reported by Ecology and Environment (1993), hydraulic conductivity of 1.48×10^{-5} ft/sec and hydraulic gradient of 4.4×10^{-3} ft/ft, the lateral flow velocity is approximately 2 feet per year.

While there may be perched water on top of basalt in the vicinity of the drainage ditch, most of the water would have collected in the runoff and passed through the system to the Yakima River.

Surface Water/Sediment Pathway: The road-side ditch approximately 10 feet south of AOC 1 was used as the drainage system for overland runoff from the wash rack. The wash water eventually flowed through "Larry's Swimming Pool" to the Yakima River. There was no evidence of sediment build up in the ditch, so flow was sufficient to keep the sediment suspended and moving down stream. Some sediment may have accumulated in "Larry's Swimming Pool."

Soil: The wash rack has a concrete base and runoff entered the drainage ditch near the lower end of the pad. The only soil that may have been contaminated is the surrounding flat parking area where vehicles were parked, awaiting their turn to be washed. POL contamination would have dripped onto the ground surface just as any other vehicle parking lot on base.

Brief Description of Receptors (Human and Ecological): The possible exposure point for this site is "Larry's Swimming Pool" which is not used for recreational activities as the name may indicate, but is merely a ponded area in the drainage system. The overhead fill point of the former main vehicle wash rack is now used as a potable water supply (Ogden, 1995) and is monitored once a month for contamination; there is no indication of contamination in the water supply. Any contaminants that may have washed from the vehicles would have washed down the drainage system long ago and no longer be present.

The site is managed as an industrial area with the base restricted to authorized personnel.

Groundwater

Contaminant Hazard Factor (CHF): Minimal - Most of the water used at the site flowed down the stormwater system. Only small quantities of water would seep through the sediments to the top of basalt. The nearest drinking water well, DW-2, contained levels of manganese that did not indicate a hazard. Ecology & Environment (1993) reported quantifiable levels of manganese in drinking water wells DW-1, DW-2, and DW-4 at 26, 56, and 26 ug/L. The largest value was chosen for the CHF analysis.

Contaminant	Maximum Concentration (µg/L)	Standard (µg/L)	Ratio
Manganese from DW-2	56	180	0.31

Migration Pathway Factor: Confined - Quantifiable levels of manganese in the groundwater does not signify that AOC 1 or "Larry's Swimming Pool" as the source. In fact, AOC 1 is most likely not the source of manganese in the wells because the total depths of DW-1, DW-2, and DW-4 below the land surface are 600 ft, 542 ft, and 430 ft, which places these locations well beneath the beginning of the basalt layer at 20 ft. The Pomona Basalt has a low permeability, which acts as an aquitard (SAIC, 1995). Access to these wells from this location is unlikely. There is no indication that there is contamination associated with the groundwater pathway from AOC 1. Based on Strenge et al. (1989), none of these metals exhibit a distribution coefficient (Kd) less than 10 mL/g, except arsenic which is approximately 6 mL/g. These Kds are based on a literature review and are not necessarily representative of the pool sediments, but they do demonstrate that there will be little mobility associated with these metals. Ecology & Environment (1993) also concluded that there is a low potential for release to the groundwater.

The groundwater pathway is also considered insignificant because of the stormwater drainage adjacent to the site and because the site was underlain with a concrete pad. Most of the water would have run off into the storm drain system.

Receptor Factor: Limited - There is a nearby well that pumps freshwater over to the former main vehicle wash rack. The overhead fill point is now used as a potable water supply (Ogden, 1995), which is monitored once a month for contamination; there is no indication of contamination. Because of the confined nature of the subsurface system, there is no potentially threatened water supply downgradient from the source. The groundwater pathway is insignificant, therefore there can be no groundwater receptors.

Groundwater Category: Low

Surface Water/Sediment

Contaminant Hazard Factor (CHF): Moderate - Although "Larry's Swimming Pool" is not considered part of AOC 1 (i.e., former main vehicle wash rack) (personal communication, Richard Wilson, Ogden Government Services, Fort Lewis, 10 September 1996), AOC 1 runoff did move through the pool, and its monitored data are used in the CHF to estimate a conservative or worst-case assessment. Because this pool collected runoff water from places other than AOC 1, the contamination in the pool cannot be solely attributed to the wash rack. The calculated CHF is moderate. The rating is almost totally due to arsenic sorbed on sediments in the "pool." The ratio for arsenic is high due to a recent (August 1, 1996) change in the arsenic PRG value from 22 mg/kg to 0.38 mg/kg. Background levels of arsenic in the soils and sediments in streams around the YTC and the Yakima River are two times lower than that found in "Larry's Swimming Pool." These background levels also exceed the new arsenic standard.

Sediment Contaminant	Maximum Concentration (mg/kg)	Standard (mg/kg)	Ratio
Arsenic	5.4	0.38	14.2
Barium	240	5,300	0.05
Cadmium	7.5	38	0.20
Chromium	18	210	0.09
Lead	41	400	0.10
Manganese	21	3,200	0.01
Nickel	34	1,500	0.02
Vanadium	75	540	0.14
Zinc	340	23,000	0.02
		Total	14.8

Migration Pathway Factor: Confined - AOC 1 runoff was directed into the storm drainage ditch and "Larry's Swimming Pool" and eventually made its way to the Yakima River. Past discharges have long since passed through the system, except possibly at "Larry's Swimming Pool" where contaminated sediments could have accumulated. Currently the sediment contamination in the pool is at relatively low levels, with the exception of arsenic, as shown above, and any significant contamination that may have made its way to the Yakima River has probably done so. Because the sediment washed from the vehicles went to the ditch and no longer resides at AOC-1, the potential for contaminant migration from AOC 1 is limited to practically nonexistent. Ecology & Environment (1993) concluded that there is a low potential for release to the surface water.

Receptor Factor: Limited - Measured contaminant levels in sediments associated with the site are below regulatory levels, with the exception of arsenic. Site access is controlled with minimal human exposure because of the marshy nature of the pool. The AOC 1 site itself it not contaminated.

Surface Water/Sediment Category: Low

Soil

Contaminant Hazard Factor (CHF): Minimal - The site is underlain with a concrete pad and runoff exits the site directly into the adjacent drainage ditch.

Contaminant	Maximum Concentration (mg/kg)	Standard (mg/kg)	Ratio
Soils at the site are covered with concrete, therefore, no samples were collected.			

Migration Pathway Factor: Confined - There are no contaminated soils.

Receptor Factor: Limited - There are no contaminated soils.

Soil Category: Low

Relative Risk Evaluation Worksheet

Site Background Information

Installation/Site Name for FUDS: Ft. Lewis-Yakima Training Center
Location (State): Washington
Site (Name/RMIS ID/Project for FUDS: AOC 22 and 23
Point of Contact (Name/Phone): Paula Wofford

Date Entered (day, month, year): 13 September 1996
Media Evaluated (GW, SW/Sediment, Soil): None
Phase of Execution (SI, RI, FS, Removal, RD/RA, or equiv. RCRA Stage): RFA
Agreement Status (Y/N, if yes, type agreement e.g., FFA, Permit, Order): N

Site Summary

Brief Site Description (Include site type, materials disposed of, dates of operation, and other relevant information):

AOC 22 and 23 - USTs - Diesel, MOGAS - Building 810

The area consists of two, 1,000 gallon underground storage tanks; one contained diesel, and one contained MOGAS. The tanks were removed in 1985.

This area is located northwest of Building 810 on the western margin of the materials yard. A new structure has been built over the location where the tanks were located. In the summer of 1996, part of the site was covered with a concrete pad that served as the floor of a covered pesticide area. The rest of the site is covered with new gravel (personal communication, Dan Bowers, U.S. Army/YTC, 10 September 1996).

The tanks were first installed in 1951, closed in 1979, and removed "in-house" in 1985. The tanks were removed before underground storage tank regulations were in effect. Ogden (1995) noted that the tanks were filled with water at the time of removal, and no oil residue was visible; the tanks were probably cleaned when taken out of service in 1979. It was also noted that the tanks were in good shaped with no indication of leaks when they were removed. No petroleum odor was associated with the soil or tanks during removal (personal communication, Dan Bowers, 10 September 1996).

Brief Description of Pathways (Groundwater, Surface Water/Sediment, Soil):

Groundwater Pathway: Groundwater beneath YTC occurs in three distinct locations: 1) in the unsaturated upper Ellensburg formation sediments between ground surface and the water table or top of Pomoma basalt, which ever is present; 2) in the saturated Ellensburg formation sediments below the water table and above the Pomona basalt, which is the unconfined aquifer; and 3) below the Pomona basalt in the Selah interbed (Ellensburg formation), which is the first confined aquifer. If contaminants reach these locations, their behavior and ultimately the relative risk of

the source area, differs greatly.

Groundwater in the unsaturated zone is retained in the unconsolidated sediments by capillary forces and moves very slowly in response to additions of water at the ground surface such as precipitation or anthropogenic sources. Because of low precipitation, 6 to 9 inches per year, and control of water sources at YTC, groundwater movement in the unsaturated zone is very slow.

The unconfined aquifer in the vicinity of the Cantonment Area appears to be perched or limited to upland areas on the southern limb of the syncline in which the Cantonment Area is located. For example, only one of four wells completed in the unconfined aquifer at the active landfill contained water in 1993 when wells were sampled for the site investigation report (Ecology and Environment, 1993). One of the wells, MW-1 drilled in 1988, encountered the top of basalt at 103 feet below ground surface, with dense basalt encountered at 116 feet. Groundwater was found only in the basalt flow top and water levels fluctuated approximately 7 feet between a winter high to summer low. During the summer, only two feet of water was present in the well. Both monitoring wells at the Ammunition Storage Point Area encountered the unconfined aquifer. Wells located north of the axis of the syncline, estimated to be just south and parallel with Seventh Avenue, did not encounter water on top of the Pomona Basalt. Ecology and Environment (1993) cite other references that indicate that private wells located west of the YTC, closer to the Yakima River, withdraw water from the unconfined aquifer from as shallow as 20 feet below ground surface. The unconfined aquifer was thought to be in hydraulic communication with the Yakima River at that location. Groundwater found on top of the first basalt layer appears to be localized to upland areas on the south side of the syncline, near its axis, and is not present in the Cantonment Area. The only exception to this pattern appears to be in the immediate vicinity of the storm drainage ditch adjacent to Seventh Avenue. This supply of water apparently results in a locally saturated condition near wells TVR-1 and TVR-2, located north of the intersection of E Street and Seventh Avenue (Ecology and Environment, 1993).

The first confined aquifer is located in the Ellensburg formation sediments, namely the Selah interbed, beneath the Pamona basalt, generally 100 feet or deeper below ground surface. The Pomona basalt is greater than 60 feet thick in all wells that have been drilled though it on base, and water encountered below it was found to be under confined conditions in all cases. Groundwater flow in this confined aquifer was to the west, down the axis of the syncline (Ecology and Environment, 1993). Based on the confined aquifer properties reported by Ecology and Environment (1993), hydraulic conductivity of 1.48×10^{-5} ft/sec and hydraulic gradient of 4.4×10^{-3} ft/ft, the lateral flow velocity is approximately 2 feet per year.

AOCs 22 and 23 are located on the north side of the syncline and, therefore, there is no groundwater on top of basalt beneath the site. Therefore, the small size of the tanks, their good condition when removed and no indication that they leaked, and the fact that there was no petroleum odors in the soil around the tanks when they were removed, all indicate that it would be highly unlikely that groundwater would be contaminated from these two AOCs. The groundwater pathway is not completed at this site.

Surface Water/Sediment Pathway: There nearest surface water stream is the irrigation ditch approximately 200 feet west of the site. With the site resurfaced with new gravel, it is assumed that there is no surface contamination nor is there a completed surface water pathway at this site. There are no erosion features indicating that surface runoff from the site is insignificant. It is assumed that any runoff from the site would have infiltrated into the soil before reaching the irrigation ditch.

Soil: The entire area has been regraded and covered with clean gravel or concrete.

Brief Description of Receptors (Human and Ecological):

The site is managed as an industrial area with the base restricted to authorized personnel. The minimal contaminants at the site are below ground and in an area well away from routine travel. There are no drinking water wells downgradient and near the site.

Groundwater

Contaminant Hazard Factor (CHF): Minimal - Ogden (1995) noted that the tanks were filled with water at the time of removal, and no oil residue was visible, indicating that the tanks were probably cleaned when taken out of service in 1979. It was also noted that the tanks were in good shape with no indication of leaks when they were removed, and no petroleum odor was associated with the soil or tanks during removal. Therefore, it is highly probable that the soil surrounding the tanks was not contaminated to a large degree which would indicate that the groundwater would not be contaminated. Even if the tank had leaked, there is no groundwater on top of basalt.

Contaminant	Maximum Concentration (µg/L)	Standard (µg/L)	Ratio
Because soils were not contaminated, the groundwater should not be contaminated from this site, therefore, no samples were collected. No monitoring wells at this site.			

Migration Pathway Factor: **Confined** - The groundwater pathway is not completed.

Receptor Factor: Limited - The distance to the nearest drinking water well downgradient of the site is at least 2,000 feet away and because the groundwater pathway is not complete, there would be no receptors using groundwater that could be impacted by the site.

Groundwater Category: **Low**

Surface Water/Sediment

Contaminant Hazard Factor (CHF): Minimal - There is no surface water associated with this site.

Contaminant	Maximum Concentration (µg/L)	Standard (µg/L)	Ratio
No surface water associated with the site, therefore, no samples were collected.			

Migration Pathway Factor: Confined - The information indicates that the potential for surface water migration from the source is limited because there are no surface water bodies associated with the site.

Receptor Factor: Limited - There are no surface water bodies associated with the site.

Surface Water/Sediment Category: Low

AOC 22 & 23

Soil

Contaminant Hazard Factor (CHF): Minimal - There are no contaminated soils. The entire area has been regraded and covered with clean gravel or concrete.

Contaminant	Maximum Concentration (mg/kg)	Standard (mg/kg)	Ratio
The tanks were buried and there were no indications of leaks when they were removed, therefore, no surface soil samples were collected.			

Migration Pathway Factor: Confined - All available data indicate that soils are not contaminated.

Receptor Factor: Limited - All available data indicate that soils are not contaminated.

Soil Category: Low

Relative Risk Evaluation Worksheet

Site Background Information

Installation/Site Name for FUDS: Ft. Lewis-Yakima Training Center
Location (State): Washington
Site (Name/RMIS ID/Project for FUDS: AOC 27
Point of Contact (Name/Phone): Paula Wofford

Date Entered (day, month, year): 13 September 1996
Media Evaluated (GW, SW/Sediment, Soil): None
Phase of Execution (SI, RI, FS, Removal, RD/RA, or equiv. RCRA Stage): RFA
Agreement Status (Y/N, if yes, type agreement e.g., FFA, Permit, Order): N

Site Summary

Brief Site Description (Include site type, materials disposed of, dates of operation, and other relevant information):

AOC 27 - Building 845, UST (inactive) Diesel Tracked Vehicle Repair

The site consisted of a single, 12,000 gallon UST that contained diesel.

The tank was installed in 1968 and was removed in 1987 as part of a base-wide campaign to remove USTs at YTC. The exact location of the UST is unknown, but according to Rich Wilson (personal communication, 10 September 1996), the tank was located between the road and the eastern fence surrounding the Tracked Vehicle Repair shop. This location places it between two vehicle storage yards, one at Tracked Vehicle Repair and one at the MATES Center. This is a heavily used industrial area with the road receiving considerable use. The identified tank location is soil covered with no observable use.

Because the tank was removed before UST regulations were in effect, there are no closure records for this tank.

Brief Description of Pathways (Groundwater, Surface Water/Sediment, Soil):

Groundwater Pathway: Groundwater beneath YTC occurs in three distinct locations: 1) in the unsaturated upper Ellensburg formation sediments between ground surface and the water table or top of Pomoma basalt, which ever is present; 2) in the saturated Ellensburg formation sediments below the water table and above the Pomona basalt, which is the unconfined aquifer; and 3) below the Pomona basalt in the Selah interbed (Ellensburg formation), which is the first confined aquifer. If contaminants reach these locations, their behavior and ultimately the relative risk of the source area, differs greatly.

Groundwater in the unsaturated zone is retained in the unconsolidated sediments by capillary forces and moves very slowly in response to additions of water at the ground surface such as precipitation or anthropogenic sources. Because of low precipitation, 6 to 9 inches per year, and control of water sources at YTC, groundwater movement in the unsaturated zone is very slow.

The unconfined aquifer in the vicinity of the Cantonment Area appears to be perched or limited to upland areas on the southern limb of the syncline in which the Cantonment Area is located. For example, only one of four wells completed in the unconfined aquifer at the active landfill contained water in 1993 when wells were sampled for the site investigation report (Ecology and Environment, 1993). One of the wells, MW-1 drilled in 1988, encountered the top of basalt at 103 feet below ground surface, with dense basalt encountered at 116 feet. Groundwater was found only in the basalt flow top and water levels fluctuated approximately 7 feet between a winter high to summer low. During the summer, only two feet of water was present in the well. Both monitoring wells at the Ammunition Storage Point Area encountered the unconfined aquifer. Wells located north of the axis of the syncline, estimated to be just south and parallel with Seventh Avenue, did not encounter water on top of the Pomona Basalt. Ecology and Environment (1993) cite other references that indicate that private wells located west of the YTC, closer to the Yakima River, withdraw water from the unconfined aquifer from as shallow as 20 feet below ground surface. The unconfined aquifer was thought to be in hydraulic communication with the Yakima River at that location. Groundwater found on top of the first basalt layer appears to be localized to upland areas on the south side of the syncline, near its axis, and is not present in the Cantonment Area. The only exception to this pattern appears to be in the immediate vicinity of the storm drainage ditch adjacent to Seventh Avenue, in the vicinity of AOC 1 and "Larry's Swimming Pool." This supply of water apparently results in a locally saturated condition near wells TVR-1 and TVR-2, located north of the intersection of E Street and Seventh Avenue (Ecology and Environment, 1993).

The first confined aquifer is located in the Ellensburg formation sediments, namely the Selah interbed, beneath the Pamona basalt, generally 100 feet or deeper below ground surface. The Pomona basalt is greater than 60 feet thick in all wells that have been drilled though it on base, and water encountered below it was found to be under confined conditions in all cases. Groundwater flow in this confined aquifer was to the west, down the axis of the syncline (Ecology and Environment, 1993). Based on the confined aquifer properties reported by Ecology and Environment (1993), hydraulic conductivity of 1.48×10^{-5} ft/sec and hydraulic gradient of 4.4×10^{-3} ft/ft, the lateral flow velocity is approximately 2 feet per year.

At the AOC 27 site, it is likely that there is no unconfined aquifer at the site. Over the normal use of the tank, it is likely that minor spills and overfills would have occurred, but these small quantities of fuels would not reach the groundwater. There are no records for this tank to indicate that it had leaked.

Surface Water/Sediment Pathway: The site is flat with no physical evidence to indicate that surface runoff is significant. This pathway is considered incomplete.

Soil: There are no records to indicated that significant soil contamination existed around the tank.

Brief Description of Receptors (Human and Ecological): The site is managed as an industrial area and access to the base is limited to authorized personnel. The site is unvegetated. There are no credible exposure scenarios for this site.

Groundwater

Contaminant Hazard Factor (CHF): Minimal - The groundwater pathway is considered incomplete. There is no evidence to suggest that the tank would have served as a source of groundwater contamination. The tank has reportedly been removed.

Contaminant	Maximum Concentration (μg/L)	Standard (μg/L)	Ratio
Because there is no indication that the tank leaked, the groundwater is probably not contaminated from this site, therefore, no samples were collected. No wells at this site.			

Migration Pathway Factor: Confined - The groundwater pathway is considered incomplete.

Receptor Factor: Limited - The groundwater pathway is considered incomplete, therefore, no receptors of groundwater could be impacted by this site.

Groundwater Category: Low

AOC 27

Surface Water/Sediment

Contaminant Hazard Factor (CHF): Minimal - There is no surface water at this site.

Contaminant	Maximum Concentration (μg/L)	Standard (μg/L)	Ratio
There is no surface water at this site, therefore, no samples were collected.			

Migration Pathway Factor: Confined - There is no surface water at the site.

Receptor Factor: Limited - There is no surface water at the site

Surface Water/Sediment Category: Low

Soil

Contaminant Hazard Factor (CHF): Minimal - There are not data to indicate that the tank leaked. The tank has been removed eliminating any possible future source of contamination.

Contaminant	Maximum Concentration (mg/kg)	Standard (mg/kg)	Ratio
Surface soils would not be contaminated from a subsurface leak, if one had occurred, therefore, no surface soils were collected.			

Migration Pathway Factor: Confined - There are no data to indicate that the soils are contaminated. The tank has been removed and covered with clean soils.

Receptor Factor: Limited - The site is managed as an industrial area with access limited to authorized personnel. The site was likely backfilled with clean soil.

Soil Category: Low

Relative Risk Evaluation Worksheet

Site Background Information

Installation/Site Name for FUDS: Ft. Lewis-Yakima Training Center
Location (State): Washington
Site (Name/RMIS ID/Project for FUDS: AOC 28 and 29
Point of Contact (Name/Phone): Paula Wofford

Date Entered (day, month, year): 13 September 1996
Media Evaluated (GW, SW/Sediment, Soil): None
Phase of Execution (SI, RI, FS, Removal, RD/RA, or equiv. RCRA Stage): RFA
Agreement Status (Y/N, if yes, type agreement e.g., FFA, Permit, Order): N

Site Summary

Brief Site Description (Include site type, materials disposed of, dates of operation, and other relevant information):

AOC 28 & 29 - Building T-1470, UST (inactive)

The area consists of two, 12,000 gallon underground storage tanks which were delineated on a 1954 U.S. Army Corps of Engineers blue print near former building T-1470 (Ogden, 1995). The contents of the tanks are unknown, but presumably contained MOGAS and/or diesel. The tanks are presumed to be removed, but their existence at the site is unknown.

The area is due south of Building 810, across Seventh Avenue, and approximately 150 yards northwest of former Building 442. The approximate location of the tanks was determined from a surface concrete pad, which was obviously associated with the pump stands when the station was in use. On 11 September 1996, two trenches were excavated in the area to hunt for the tanks; no tanks were found at the location. Initially during the site investigation, an initial trench was excavated but hit basalt at an approximate depth of five feet. At approximately 3.5 to 4 feet, the backhoe excavated an old out-of-service water line -- the contents of which (i.e., water) discharged into the excavation hole. This water remained in the excavation hole without draining for the time associated with the site inspection (i.e., approximately 1.5 hours). Because basalt was encountered so close to the surface, it was clear that a tank had not been buried in that location so a second excavation was undertaken to locate the actual UST location. The second excavation was correlated more closely to blueprint information, and the second excavation discovered "soft" soil where the tanks were most likely located. The soil that was removed was void of any indication of petroleum residue, both physically and visually. Ten to 12 feet below the surface, "firm" ground was discovered, most likely identifying the extent of the former tank's location.

Brief Description of Pathways (Groundwater, Surface Water/Sediment, Soil):

Groundwater Pathway: Groundwater beneath YTC occurs in three distinct locations: 1) in the unsaturated upper Ellensburg formation sediments between ground surface and the water table or top of Pomoma basalt, which ever is present; 2) in the saturated Ellensburg formation sediments

below the water table and above the Pomona basalt, which is the unconfined aquifer; and 3) below the Pomona basalt in the Selah interbed (Ellensburg formation), which is the first confined aquifer. If contaminants reach these locations, their behavior and ultimately the relative risk of the source area, differs greatly.

Groundwater in the unsaturated zone is retained in the unconsolidated sediments by capillary forces and moves very slowly in response to additions of water at the ground surface such as precipitation or anthropogenic sources. Because of low precipitation, 6 to 9 inches per year, and control of water sources at YTC, groundwater movement in the unsaturated zone is very slow.

The unconfined aquifer in the vicinity of the Cantonment Area appears to be perched or limited to upland areas on the southern limb of the syncline in which the Cantonment Area is located. For example, only one of four wells completed in the unconfined aquifer at the active landfill contained water in 1993 when wells were sampled for the site investigation report (Ecology and Environment, 1993). One of the wells, MW-1 drilled in 1988, encountered the top of basalt at 103 feet below ground surface, with dense basalt encountered at 116 feet. Groundwater was found only in the basalt flow top and water levels fluctuated approximately 7 feet between a winter high to summer low. During the summer, only two feet of water was present in the well. Both monitoring wells at the Ammunition Storage Point Area encountered the unconfined aquifer. Wells located north of the axis of the syncline, estimated to be just south and parallel with Seventh Avenue, did not encounter water on top of the Pomona Basalt. Ecology and Environment (1993) cite other references that indicate that private wells located west of the YTC, closer to the Yakima River, withdraw water from the unconfined aquifer from as shallow as 20 feet below ground surface. The unconfined aquifer was thought to be in hydraulic communication with the Yakima River at that location. Groundwater found on top of the first basalt layer appears to be localized to upland areas on the south side of the syncline, near its axis, and is not present in the Cantonment Area. The only exception to this pattern appears to be in the immediate vicinity of the storm drainage ditch adjacent to Seventh Avenue. This supply of water apparently results in a locally saturated condition near wells TVR-1 and TVR-2, located north of the intersection of E Street and Seventh Avenue (Ecology and Environment, 1993).

The first confined aquifer is located in the Ellensburg formation sediments, namely the Selah interbed, beneath the Pamona basalt, generally 100 feet or deeper below ground surface. The Pomona basalt is greater than 60 feet thick in all wells that have been drilled though it on base, and water encountered below it was found to be under confined conditions in all cases. Groundwater flow in this confined aquifer was to the west, down the axis of the syncline (Ecology and Environment, 1993). Based on the confined aquifer properties reported by Ecology and Environment (1993), hydraulic conductivity of 1.48×10^{-5} ft/sec and hydraulic gradient of 4.4×10^{-3} ft/ft, the lateral flow velocity is approximately 2 feet per year.

The excavations at the site showed that basalt was 5 feet below ground surface and dry; no unconfined aquifer was encountered. Because no tanks were found at the most likely position of the tanks, it is believed that they have been removed. No soil contamination was encountered, indicating that groundwater is probably not contaminated from this site either.

Surface Water/Sediment Pathway: There nearest surface water stream is the storm water ditch adjacent to Seventh Avenue, approximately 200 feet from the site. There is no surface contamination nor is there a completed surface water pathway at this site.

Soil: The entire area has been regraded. No contaminated soil was encountered in any of the excavations at the site, therefore, the soil pathway is incomplete.

Brief Description of Receptors (Human and Ecological):

The site is managed as an industrial area with the base restricted to authorized personnel. No contaminants were detected at the site and, if they were, they would probably be below ground and in an area away from routine travel. There is no unconfined groundwater at the site and the depth to the unconfined aquifer would precludes its being contaminated from this site.

Groundwater

Contaminant Hazard Factor (CHF): Minimal - The tanks have apparently be removed eliminating any future source. Because soils were found to be uncontaminated, it is likely that the groundwater would also be uncontaminated. There is no unconfined aquifer present, and it is highly improbable that the confined aquifer would be contaminated from this site.

Contaminant	Maximum Concentration (µg/L)	Standard (µg/L)	Ratio
Groundwater is probably not contaminated because the soils were not contaminated, therefore, no samples were collected. No monitoring wells at this site.			

Migration Pathway Factor: Confined - The groundwater pathway is not completed.

Receptor Factor: The groundwater pathway is incomplete, therefore there can be no groundwater receptors.

Groundwater Category: Low

Surface Water/Sediment

Contaminant Hazard Factor (CHF): Minimal - There is no surface water associated with this site.

Contaminant	Maximum Concentration (µg/L)	Standard (µg/L)	Ratio
No surface water associated with the site, therefore, no samples were collected.			

Migration Pathway Factor: Confined - The information indicates that the potential for surface water migration from the source is limited because there are no surface water bodies associated with the site.

Receptor Factor: Limited - There are no surface water bodies associated with the site.

Surface Water/Sediment Category: Low

Soil

Contaminant Hazard Factor (CHF): Minimal - There are no contaminated soils.

Contaminant	Maximum Concentration (mg/kg)	Standard (mg/kg)	Ratio
No fuel contamination detected in the trenches, therefore, no samples were collected.			

Migration Pathway Factor: Confined - There are no contaminated soils.

Receptor Factor: Limited - There are no contaminated soils.

Soil Category: Low

Relative Risk Evaluation Worksheet

Site Background Information

Installation/Site Name for FUDS: Ft. Lewis-Yakima Training Center
Location (State): Washington
Site (Name/RMIS ID/Project for FUDS: AOC 30, 31, and 32
Point of Contact (Name/Phone): Paula Wofford

Date Entered (day, month, year): 13 September 1996
Media Evaluated (GW, SW/Sediment, Soil): None
Phase of Execution (SI, RI, FS, Removal, RD/RA, or equiv. RCRA Stage): RFA
Agreement Status (Y/N, if yes, type agreement e.g., FFA, Permit, Order): N

Site Summary

Brief Site Description (Include site type, materials disposed of, dates of operation, and other relevant information):

AOCs 30, 31, and 32 - Building T-2020, USTs (inactive)

Ogden (1995) notes that AOC-30, AOC-31, and AOC-32 were three 600 gallon tanks that are indicated on a 1954 blue print of the cantonment area. The tanks reportedly contained heating oil.

The tanks are denoted on the blue print as solid lines, suggesting that the tanks were above ground, as other tanks on the blue print, which are below ground, are denoted by dashed lines. Based on the blue print and a site investigation (10 September 1996), the location or former location of the tanks could not be identified. The exact location of where the tanks might have been was difficult to discern from the blue prints and from the site inspection. The blue prints showed that the tanks were located just north of the northeast corner of the parking lot, which is just north of Seventh Avenue and west of Wash Rack Road. The distances in the blue print of the parking lot, roads, and other "landmarks" did not exactly match with the current conditions. The nearby parking lot stores and contains old vehicles, and the lot is impacted by normal roadway contamination from vehicle traffic and storage (site inspection, 10 September 1996). In the general vicinity of where the tanks might have been stored, there were no signs contamination or subsurface disturbances, although the entire area appears to have been impacted by human activities.

The time period in which the tanks was used is unknown.

Brief Description of Pathways (Groundwater, Surface Water/Sediment, Soil):

Groundwater Pathway: Given the small volume of fuels stored at the site and the long distance to groundwater, it is highly improbable that the groundwater would be contaminated at the site. Any released fuels would have spilled on the ground and remained in near surface soils. The groundwater pathway is considered incomplete.

Surface Water/Sediment Pathway: There nearest surface water stream is the storm water ditch adjacent to Seventh Avenue, approximately 300 feet from the site. Because the location of the site can not be determined precisely, the importance of the surface water pathway can not be judged.

Soil: The site can not be located, but no surface contamination was noted in the area where the tanks were thought to be located.

Brief Description of Receptors (Human and Ecological): The site is managed as an industrial area with the base restricted to authorized personnel. Operations of the tanks would have resulted in minimal release of contaminants.

Groundwater

Contaminant Hazard Factor (CHF): Minimal - Small quantities of fuel at the site would have precluded spills large enough to reach groundwater, therefore, the groundwater pathway is considered incomplete.

Contaminant	Maximum Concentration (µg/L)	Standard (µg/L)	Ratio
The groundwater pathway is incomplete, therefore, no samples were collected. No monitoring wells at this site.			

Migration Pathway Factor: **Confined** - The groundwater pathway is incomplete.

Receptor Factor: Limited - The groundwater pathway is incomplete.

Groundwater Category: Low

Surface Water/Sediment

Contaminant Hazard Factor (CHF): Minimal - There is no surface water associated with this site.

Contaminant	Maximum Concentration (µg/L)	Standard (µg/L)	Ratio
No surface water associated with the site, therefore, no samples were collected.			

Migration Pathway Factor: Confined - The information indicates that the potential for surface water migration from the source is limited because there are no surface water bodies associated with the site.

Receptor Factor: Limited - There are no surface water bodies associated with the site.

Surface Water/Sediment Category: Low

AOC 30, 31, & 32

Soil

Contaminant Hazard Factor (CHF): Minimal - The actual site could not be located, but the general area was free of any evidence of petroleum contamination. There are no contaminated soils.

Contaminant	Maximum Concentration (mg/kg)	Standard (mg/kg)	Ratio
No samples were collected because the site could not be located specifically, nor was there any evidence of contamination in the general area.			

Migration Pathway Factor: Confined - There are no contaminated soils.

Receptor Factor: Limited - There are no contaminated soils.

Soil Category: Low

5.0 References

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APPENDIX A

SUMMARY OF ANALYTICAL DATA FOR

SOIL SAMPLES COLLECTED ON

11 SEPTEMBER 1996

Analyses for Surface Soil Samples Collected 11 September 1996

SITE	COLLECT DATE	METHOD NAME	METHOD NUMBER	ANALYSIS DATE	CONSTITUENT	CONC.	EPA REGION 9 PRG	UNITS	QUAL	LAB COMMENTS	SOIL CRDL	SOIL MDL
SWMU-4	11-Sep-96	ABN	8270	27-Sep-96	2,4-Dichlorophenol	ND	200,000	ug/kg	DU (10x)		3,000	85
SWMU-4	11-Sep-96	ABN	8270	27-Sep-96	o-Cresol	ND	--	ug/kg	DU (10x)		3,300	82
SWMU-4	11-Sep-96	ABN	8270	27-Sep-96	2-Nitrophenol	ND	--	ug/kg	DU (10x)		3,000	85
SWMU-4	11-Sep-96	ABN	8270	27-Sep-96	Benzothiazole	ND	--	ug/kg	DU (10x)		3,000	72
SWMU-4	11-Sep-96	ABN	8270	27-Sep-96	Bis(2-ethylhexyl) phthalate	ND	140,000	ug/kg	DU (10x)		3,000	1,200
SWMU-4	11-Sep-96	ABN	8270	27-Sep-96	Decane	ND	--	ug/kg	DU (10x)		3,300	1,500
SWMU-4	11-Sep-96	ABN	8270	27-Sep-96	Dodecane	ND	--	ug/kg	DU (10x)		3,300	650
SWMU-4	11-Sep-96	ABN	8270	27-Sep-96	m+p cresol	ND	--	ug/kg	DU (10x)		3,300	77
SWMU-4	11-Sep-96	ABN	8270	27-Sep-96	Naphthalene	ND	24,000	ug/kg	DU (10x)		3,300	92
SWMU-4	11-Sep-96	ABN	8270	27-Sep-96	Pentachlorophenol	ND	2,500	ug/kg	DU (10x)		13,000	83
SWMU-4	11-Sep-96	ABN	8270	27-Sep-96	Phenol	ND	39,000,000	ug/kg	DU (10x)		3,000	82
SWMU-4	11-Sep-96	ABN	8270	27-Sep-96	Tetradecane	ND	--	ug/kg	DU (10x)		3,300	120
SWMU-4	11-Sep-96	ABN	8270	27-Sep-96	Tributyl phosphate	ND	--	ug/kg	DU (10x)		3,000	110
SWMU-4	11-Sep-96	ABN	8270	27-Sep-96	Tris-2-chloroethyl phosphate	ND	--	ug/kg	DU (10x)		13,000	180
SWMU-4	11-Sep-96	ICP4	6010	26-Sep-96	Aluminum	16,000,000	77,000,000	ug/kg			20,000	10,000
SWMU-4	11-Sep-96	ICP4	6010	26-Sep-96	Antimony	5,700	31,000	ug/kg	L	MOL	10,000	1,700
SWMU-4	11-Sep-96	ICP4	6010	21-Oct-96	Arsenic	ND	380	ug/kg	U		500	240
SWMU-4	11-Sep-96	ICP4	6010	26-Sep-96	Barium	83,000	5,300,000	ug/kg			1,000	120
SWMU-4	11-Sep-96	ICP4	6010	26-Sep-96	Beryllium	380	140	ug/kg			200	43
SWMU-4	11-Sep-96	ICP4	6010	26-Sep-96	Boron	ND	5,900,000	ug/kg	U		30,000	3,100
SWMU-4	11-Sep-96	ICP4	6010	26-Sep-96	Cadmium	1,000	38,000	ug/kg			500	200
SWMU-4	11-Sep-96	ICP4	6010	26-Sep-96	Calcium	9,100,000	--	ug/kg	B		10,000	1,400
SWMU-4	11-Sep-96	ICP4	6010	26-Sep-96	Chromium	21,000	30,000	ug/kg	B	MOL	1,000	390
SWMU-4	11-Sep-96	ICP4	6010	26-Sep-96	Cobalt	9,600	4,600,000	ug/kg			2,000	380
SWMU-4	11-Sep-96	ICP4	6010	26-Sep-96	Copper	26,000	2,800,000	ug/kg		MOL	2,000	550
SWMU-4	11-Sep-96	ICP4	6010	26-Sep-96	Iron	28,000,000	--	ug/kg	B		3,000	1,900
SWMU-4	11-Sep-96	ICP4	6010	21-Oct-96	Lead	53,000	400,000	ug/kg			300	170
SWMU-4	11-Sep-96	ICP4	6010	26-Sep-96	Magnesium	6,500,000	--	ug/kg			10,000	860
SWMU-4	11-Sep-96	ICP4	6010	26-Sep-96	Manganese	440,000	3,200,000	ug/kg			500	140
SWMU-4	11-Sep-96	ICP4	6010	26-Sep-96	Nickel	23,000	1,500,000	ug/kg	B		2,500	890
SWMU-4	11-Sep-96	ICP4	6010	26-Sep-96	Potassium	1,200,000	--	ug/kg			100,000	3,100
SWMU-4	11-Sep-96	ICP4	6010	21-Oct-96	Selenium	ND	8,500,000	ug/kg	U		500	390
SWMU-4	11-Sep-96	ICP4	6010	26-Sep-96	Silicon	880,000	--	ug/kg			150,000	6,000
SWMU-4	11-Sep-96	ICP4	6010	26-Sep-96	Silver	ND	8,500,000	ug/kg	U		1,000	160
SWMU-4	11-Sep-96	ICP4	6010	26-Sep-96	Sodium	590,000	--	ug/kg			30,000	15,000
SWMU-4	11-Sep-96	ICP4	6010	26-Sep-96	Strontium	38,000	100,000,000	ug/kg	B		2,000	16
SWMU-4	11-Sep-96	ICP4	6010	21-Oct-96	Thallium	ND	140,000	ug/kg	U		500	430
SWMU-4	11-Sep-96	ICP4	6010	26-Sep-96	Tin	21,000	100,000,000	ug/kg	B		10,000	1,600
SWMU-4	11-Sep-96	ICP4	6010	26-Sep-96	Vanadium	75,000	12,000,000	ug/kg			1,000	160
SWMU-4	11-Sep-96	ICP4	6010	26-Sep-96	Zinc	400,000	100,000,000	ug/kg	B		1,000	980
SWMU-4	11-Sep-96	PEST/PCB	8080	10-Oct-96	4,4'-DDD	51.4	7,900	ug/kg			0.67	0.12
SWMU-4	11-Sep-96	PEST/PCB	8080	12-Oct-96	4,4'-DDE	71.2	5,600	ug/kg	D (10x)		3.3	0.42
SWMU-4	11-Sep-96	PEST/PCB	8080	10-Oct-96	4,4'-DDT	686	5,600	ug/kg	D (100x)		67	4.3
SWMU-4	11-Sep-96	PEST/PCB	8080	10-Oct-96	Aldrin	ND	110	ug/kg	U		0.33	0.17
SWMU-4	11-Sep-96	PEST/PCB	8080	10-Oct-96	Alpha-BHC	ND	71	ug/kg	U		0.33	0.064
SWMU-4	11-Sep-96	PEST/PCB	8080	10-Oct-96	Aroclor-1016	ND	340	ug/kg	U		17	0.92
SWMU-4	11-Sep-96	PEST/PCB	8080	10-Oct-96	Aroclor-1221	ND	340	ug/kg	U		17	9.0

Analyses for Surface Soil Samples Collected 11 September 1996

SITE	COLLECT DATE	METHOD NAME	METHOD NUMBER	ANALYSIS DATE	CONSTITUENT	CONC.	EPA REGION 9 PRG	UNITS	QUAL	LAB COMMENTS	SOIL CRDL	SOIL MDL
SWMU-4	11-Sep-96	PEST/PCB	8080	10-Oct-96	Aroclor-1232	ND	340	ug/kg	U		17	3.7
SWMU-4	11-Sep-96	PEST/PCB	8080	10-Oct-96	Aroclor-1242	ND	340	ug/kg	U		17	2.4
SWMU-4	11-Sep-96	PEST/PCB	8080	10-Oct-96	Aroclor-1248	ND	340	ug/kg	U		17	0.74
SWMU-4	11-Sep-96	PEST/PCB	8080	10-Oct-96	Aroclor-1254	ND	340	ug/kg	U		6.7	0.71
SWMU-4	11-Sep-96	PEST/PCB	8080	10-Oct-96	Aroclor-1260	ND	340	ug/kg	U		6.7	0.84
SWMU-4	11-Sep-96	PEST/PCB	8080	10-Oct-96	Beta-BHC	ND	250	ug/kg	U		0.33	0.052
SWMU-4	11-Sep-96	PEST/PCB	8080	10-Oct-96	Chlordane	ND	1,500	ug/kg	U		3.33	0.93
SWMU-4	11-Sep-96	PEST/PCB	8080	10-Oct-96	Delta-BHC	ND	--	ug/kg	U		0.67	0.083
SWMU-4	11-Sep-96	PEST/PCB	8080	12-Oct-96	Dieldrin	57.1	28	ug/kg	D (10x)		3.3	0.42
SWMU-4	11-Sep-96	PEST/PCB	8080	10-Oct-96	Endosulfan I	ND	390,000	ug/kg	U		0.33	0.11
SWMU-4	11-Sep-96	PEST/PCB	8080	10-Oct-96	Endosulfan II	6.89	390,000	ug/kg			0.33	0.16
SWMU-4	11-Sep-96	PEST/PCB	8080	10-Oct-96	Endosulfan sulfate	6.01	--	ug/kg			3.33	0.22
SWMU-4	11-Sep-96	PEST/PCB	8080	10-Oct-96	Endrin	10.7	20,000	ug/kg			0.67	0.097
SWMU-4	11-Sep-96	PEST/PCB	8080	10-Oct-96	Endrin aldehyde	ND	--	ug/kg	U		0.67	0.015
SWMU-4	11-Sep-96	PEST/PCB	8080	10-Oct-96	Gamma-BHC (Lindane)	1.26	340	ug/kg			0.33	0.071
SWMU-4	11-Sep-96	PEST/PCB	8080	10-Oct-96	Heptachlor	ND	99	ug/kg	U		0.33	0.038
SWMU-4	11-Sep-96	PEST/PCB	8080	10-Oct-96	Heptachlor epoxide	ND	49	ug/kg	U		0.67	0.054
SWMU-4	11-Sep-96	PEST/PCB	8080	10-Oct-96	Methoxychlor	ND	330,000	ug/kg	U		3.3	0.35
SWMU-4	11-Sep-96	PEST/PCB	8080	10-Oct-96	Toxaphene	ND	400	ug/kg	U		33	13
SWMU-4	11-Sep-96	VOB	8260	19-Sep-96	1,1,1-Trichloroethane	ND	1,200,000	ug/kg	U		1	0.22
SWMU-4	11-Sep-96	VOB	8260	19-Sep-96	1,1,2-Trichloroethane	ND	650	ug/kg	U		3	0.13
SWMU-4	11-Sep-96	VOB	8260	19-Sep-96	1,1-Dichloroethane	ND	500,000	ug/kg	U		1	0.38
SWMU-4	11-Sep-96	VOB	8260	19-Sep-96	1,2-Dichloroethane	ND	250	ug/kg	U		1	0.27
SWMU-4	11-Sep-96	VOB	8260	19-Sep-96	1,4-Dichlorobenzene	ND	3,600	ug/kg	U		1	0.22
SWMU-4	11-Sep-96	VOB	8260	19-Sep-96	1-Butanol	ND	6,500,000	ug/kg	U		100	47
SWMU-4	11-Sep-96	VOB	8260	19-Sep-96	2-Butanone (Methylethyl Ketone)	ND	7,100,000	ug/kg	U		10	1.8
SWMU-4	11-Sep-96	VOB	8260	19-Sep-96	Acetone	ND	2,100,000	ug/kg	U		10	4.1
SWMU-4	11-Sep-96	VOB	8260	19-Sep-96	Benzene	ND	630	ug/kg	U		1	0.39
SWMU-4	11-Sep-96	VOB	8260	19-Sep-96	Carbon disulfide	ND	7,500	ug/kg	U		1	0.68
SWMU-4	11-Sep-96	VOB	8260	19-Sep-96	Carbon tetrachloride	ND	230	ug/kg	U		1	0.61
SWMU-4	11-Sep-96	VOB	8260	19-Sep-96	Chloroform	ND	250	ug/kg	U		1	0.32
SWMU-4	11-Sep-96	VOB	8260	19-Sep-96	cis-1,2-Dichloroethylene	ND	31,000	ug/kg	U		1	0.45
SWMU-4	11-Sep-96	VOB	8260	19-Sep-96	Propionitrile	ND	--	ug/kg	U		10	2.0
SWMU-4	11-Sep-96	VOB	8260	19-Sep-96	Hexone	ND	77,000	ug/kg	U		10	0.57
SWMU-4	11-Sep-96	VOB	8260	19-Sep-96	Methylenechloride	ND	7,800	ug/kg	U		1	0.41
SWMU-4	11-Sep-96	VOB	8260	19-Sep-96	Tetrachloroethene	ND	5,400	ug/kg	U		1	0.54
SWMU-4	11-Sep-96	VOB	8260	19-Sep-96	Tetrahydrofuran	ND	--	ug/kg	U		10	1.2
SWMU-4	11-Sep-96	VOB	8260	19-Sep-96	Toluene	ND	790,000	ug/kg	U		2	0.75
SWMU-4	11-Sep-96	VOB	8260	19-Sep-96	trans-1,2-Dichloroethylene	ND	78,000	ug/kg	U		1	0.47
SWMU-4	11-Sep-96	VOB	8260	19-Sep-96	Trichloroethene	ND	3,200	ug/kg	U		1	0.56
SWMU-4	11-Sep-96	VOB	8260	19-Sep-96	Vinyl chloride	ND	16	ug/kg	U		5	0.72
SWMU-4	11-Sep-96	VOB	8260	19-Sep-96	Xylenes (total)	ND	320,000	ug/kg	U		2	1.1
SWMU-4	11-Sep-96	VOGC	8020	24-Sep-96	1,1,1-Trichloroethane	ND	1,200,000	ug/kg	U		0.2	0.048
SWMU-4	11-Sep-96	VOGC	8020	24-Sep-96	1,1,2-Trichloroethane	ND	650	ug/kg	U		0.2	0.043
SWMU-4	11-Sep-96	VOGC	8020	24-Sep-96	1,1-Dichloroethane	ND	500,000	ug/kg	U		0.2	0.031
SWMU-4	11-Sep-96	VOGC	8020	24-Sep-96	1,2-Dichloroethane	ND	250	ug/kg	U		0.2	0.041
SWMU-4	11-Sep-96	VOGC	8020	24-Sep-96	1,4-Dichlorobenzene	ND	3,600	ug/kg	U		0.2	0.079

Analyses for Surface Soil Samples Collected 11 September 1996

SITE	COLLECT DATE	METHOD NAME	METHOD NUMBER	ANALYSIS DATE	CONSTITUENT	CONC.	EPA REGION 9 PRG	UNITS	QUAL	LAB COMMENTS	SOIL CRDL	SOIL MDL
SWMU-4	11-Sep-96	VOGC	8020	24-Sep-96	Benzene	ND	630	ug/kg	U		0.2	0.077
SWMU-4	11-Sep-96	VOGC	8020	24-Sep-96	Carbon tetrachloride	ND	230	ug/kg	U		0.5	0.048
SWMU-4	11-Sep-96	VOGC	8020	24-Sep-96	Chloroform	ND	250	ug/kg	U		0.2	0.093
SWMU-4	11-Sep-96	VOGC	8020	24-Sep-96	cis-1,2-Dichloroethylene	ND	31,000	ug/kg	U		0.2	0.034
SWMU-4	11-Sep-96	VOGC	8020	24-Sep-96	Ethylbenzene	ND	23,000	ug/kg	U		0.2	0.14
SWMU-4	11-Sep-96	VOGC	8020	24-Sep-96	Methylenechloride	ND	7,800	ug/kg	U		0.2	0.080
SWMU-4	11-Sep-96	VOGC	8020	24-Sep-96	Tetrachloroethene	ND	5,400	ug/kg	U		0.2	0.044
SWMU-4	11-Sep-96	VOGC	8020	24-Sep-96	Toluene	ND	790,000	ug/kg	U		0.2	0.071
SWMU-4	11-Sep-96	VOGC	8020	24-Sep-96	trans-1,2-Dichloroethylene	ND	78,000	ug/kg	U		0.2	0.070
SWMU-4	11-Sep-96	VOGC	8020	24-Sep-96	Trichloroethene	ND	3,200	ug/kg	U		0.2	0.092
SWMU-4	11-Sep-96	VOGC	8020	24-Sep-96	Vinyl chloride	ND	16	ug/kg	U		1.0	0.65
SWMU-4	11-Sep-96	VOGC	8020	24-Sep-96	Xylenes (total)	ND	320,000	ug/kg	U		0.6	0.13

Analyses for Surface Soil Samples Collected 11 September 1996

SITE	COLLECT DATE	METHOD NAME	METHOD NUMBER	ANALYSIS DATE	CONSTITUENT	CONC.	EPA REGION 9 PRG	UNITS	QUAL	LAB COMMENTS	SOIL CRDL	SOIL MDL
SWMU-6	11-Sep-96	PCB	8080	22-Sep-96	Aroclor-1016	ND	340	ug/kg	U		17	0.92
SWMU-6	11-Sep-96	PCB	8080	22-Sep-96	Aroclor-1221	ND	340	ug/kg	U		17	9.0
SWMU-6	11-Sep-96	PCB	8080	22-Sep-96	Aroclor-1232	ND	340	ug/kg	U		17	3.7
SWMU-6	11-Sep-96	PCB	8080	22-Sep-96	Aroclor-1242	ND	340	ug/kg	U		17	2.4
SWMU-6	11-Sep-96	PCB	8080	22-Sep-96	Aroclor-1248	ND	340	ug/kg	U		17	0.74
SWMU-6	11-Sep-96	PCB	8080	22-Sep-96	Aroclor-1254	ND	340	ug/kg	U		6.7	0.71
SWMU-6	11-Sep-96	PCB	8080	22-Sep-96	Aroclor-1260	ND	340	ug/kg	U		6.7	0.84

Analyses for Surface Soil Samples Collected 11 September 1996

SITE	COLLECT DATE	METHOD NAME	METHOD NUMBER	ANALYSIS DATE	CONSTITUENT	CONC.	EPA REGION 9 PRG	UNITS	QUAL	LAB COMMENTS	SOIL CRDL	SOIL MDL
SWMU-7	11-Sep-96	ABN	8270	27-Sep-96	2,4-Dichlorophenol	ND	200,000	ug/kg	DU (10x)		3,000	85
SWMU-7	11-Sep-96	ABN	8270	27-Sep-96	o-Cresol	ND	--	ug/kg	DU (10x)		3,300	82
SWMU-7	11-Sep-96	ABN	8270	27-Sep-96	2-Nitrophenol	ND	--	ug/kg	DU (10x)		3,000	85
SWMU-7	11-Sep-96	ABN	8270	27-Sep-96	Benzothiazole	ND	--	ug/kg	DU (10x)		3,000	72
SWMU-7	11-Sep-96	ABN	8270	27-Sep-96	Bis(2-ethylhexyl) phthalate	ND	32,000	ug/kg	DU (10x)		3,000	1,200
SWMU-7	11-Sep-96	ABN	8270	27-Sep-96	Decane	ND	--	ug/kg	DU (10x)		3,300	1,500
SWMU-7	11-Sep-96	ABN	8270	27-Sep-96	Dodecane	ND	--	ug/kg	DU (10x)		3,300	650
SWMU-7	11-Sep-96	ABN	8270	27-Sep-96	m+p cresol	ND	--	ug/kg	DU (10x)		3,300	77
SWMU-7	11-Sep-96	ABN	8270	27-Sep-96	Naphthalene	ND	24,000	ug/kg	DU (10x)		3,300	92
SWMU-7	11-Sep-96	ABN	8270	27-Sep-96	Pentachlorophenol	ND	2,500	ug/kg	DU (10x)		13,000	83
SWMU-7	11-Sep-96	ABN	8270	27-Sep-96	Phenol	ND	39,000,000	ug/kg	DU (10x)		3,000	82
SWMU-7	11-Sep-96	ABN	8270	27-Sep-96	Tetradecane	ND	--	ug/kg	DU (10x)		3,300	120
SWMU-7	11-Sep-96	ABN	8270	27-Sep-96	Tributyl phosphate	ND	--	ug/kg	DU (10x)		3,000	110
SWMU-7	11-Sep-96	ABN	8270	27-Sep-96	Tris-2-chloroethyl phosphate	ND	--	ug/kg	DU (10x)		13,000	180
SWMU-7	11-Sep-96	ICP4	6010	26-Sep-96	Aluminum	15,000,000	77,000,000	ug/kg			20,000	10,000
SWMU-7	11-Sep-96	ICP4	6010	26-Sep-96	Antimony	6,900	31,000	ug/kg	BL	MOL	10,000	1,700
SWMU-7	11-Sep-96	ICP4	6010	21-Oct-96	Arsenic	4,700	380	ug/kg			500	240
SWMU-7	11-Sep-96	ICP4	6010	26-Sep-96	Barium	110,000	5,300,000	ug/kg			1,000	120
SWMU-7	11-Sep-96	ICP4	6010	26-Sep-96	Beryllium	470	140	ug/kg			200	43
SWMU-7	11-Sep-96	ICP4	6010	26-Sep-96	Boron	ND	5,900,000	ug/kg	U		30,000	3,100
SWMU-7	11-Sep-96	ICP4	6010	26-Sep-96	Cadmium	220	38,000	ug/kg	L		500	200
SWMU-7	11-Sep-96	ICP4	6010	26-Sep-96	Calcium	15,000,000	--	ug/kg	B		10,000	1,400
SWMU-7	11-Sep-96	ICP4	6010	26-Sep-96	Chromium	16,000	30,000	ug/kg	B	MOL	1,000	390
SWMU-7	11-Sep-96	ICP4	6010	26-Sep-96	Cobalt	11,000	4,600,000	ug/kg			2,000	380
SWMU-7	11-Sep-96	ICP4	6010	26-Sep-96	Copper	24,000	2,800,000	ug/kg		MOL	2,000	550
SWMU-7	11-Sep-96	ICP4	6010	26-Sep-96	Iron	28,000,000	--	ug/kg	B		3,000	1,900
SWMU-7	11-Sep-96	ICP4	6010	21-Oct-96	Lead	11,000	400,000	ug/kg			300	170
SWMU-7	11-Sep-96	ICP4	6010	26-Sep-96	Magnesium	6,200,000	--	ug/kg			10,000	860
SWMU-7	11-Sep-96	ICP4	6010	26-Sep-96	Manganese	560,000	3,200,000	ug/kg			500	140
SWMU-7	11-Sep-96	ICP4	6010	26-Sep-96	Nickel	18,000	1,500,000	ug/kg	B		2,500	890
SWMU-7	11-Sep-96	ICP4	6010	26-Sep-96	Potassium	2,100,000	--	ug/kg			100,000	3,100
SWMU-7	11-Sep-96	ICP4	6010	21-Oct-96	Selenium	ND	8,500,000	ug/kg	U		500	390
SWMU-7	11-Sep-96	ICP4	6010	26-Sep-96	Silicon	2,200,000	--	ug/kg			150,000	6,000
SWMU-7	11-Sep-96	ICP4	6010	26-Sep-96	Silver	ND	8,500,000	ug/kg	U		1,000	160
SWMU-7	11-Sep-96	ICP4	6010	26-Sep-96	Sodium	510,000	--	ug/kg			30,000	15,000
SWMU-7	11-Sep-96	ICP4	6010	26-Sep-96	Strontium	64,000	100,000,000	ug/kg	B		2,000	16
SWMU-7	11-Sep-96	ICP4	6010	21-Oct-96	Thallium	ND	140,000	ug/kg	U		500	430
SWMU-7	11-Sep-96	ICP4	6010	26-Sep-96	Tin	19,000	100,000,000	ug/kg	B		10,000	1,600
SWMU-7	11-Sep-96	ICP4	6010	26-Sep-96	Vanadium	63,000	12,000,000	ug/kg			1,000	160
SWMU-7	11-Sep-96	ICP4	6010	26-Sep-96	Zinc	56,000	100,000,000	ug/kg	B		1,000	980
SWMU-7	11-Sep-96	VOGC	8020	24-Sep-96	1,1,1-Trichloroethane	ND	1,200,000	ug/kg	U		0.2	0.048
SWMU-7	11-Sep-96	VOGC	8020	24-Sep-96	1,1,2-Trichloroethane	ND	650	ug/kg	U		0.2	0.043
SWMU-7	11-Sep-96	VOGC	8020	24-Sep-96	1,1-Dichloroethane	ND	500,000	ug/kg	U		0.2	0.031
SWMU-7	11-Sep-96	VOGC	8020	24-Sep-96	1,2-Dichloroethane	ND	250	ug/kg	U		0.2	0.041
SWMU-7	11-Sep-96	VOGC	8020	24-Sep-96	1,4-Dichlorobenzene	ND	3,600	ug/kg	U		0.2	0.079
SWMU-7	11-Sep-96	VOGC	8020	24-Sep-96	Benzene	ND	630	ug/kg	U		0.2	0.077
SWMU-7	11-Sep-96	VOGC	8020	24-Sep-96	Carbon tetrachloride	ND	230	ug/kg	U		0.5	0.048

Analyses for Surface Soil Samples Collected 11 September 1996

SITE	COLLECT DATE	METHOD NAME	METHOD NUMBER	ANALYSIS DATE	CONSTITUENT	CONC.	EPA REGION 9 PRG	UNITS	QUAL	LAB COMMENTS	SOIL CRDL	SOIL MDL
SWMU-7	11-Sep-96	VOGC	8020	24-Sep-96	Chloroform	ND	250	ug/kg	U		0.2	0.093
SWMU-7	11-Sep-96	VOGC	8020	24-Sep-96	cis-1,2-Dichloroethylene	ND	31,000	ug/kg	U		0.2	0.034
SWMU-7	11-Sep-96	VOGC	8020	24-Sep-96	Ethylbenzene	ND	23,000	ug/kg	U		0.2	0.14
SWMU-7	11-Sep-96	VOGC	8020	24-Sep-96	Methylenechloride	ND	7,800	ug/kg	U		0.2	0.080
SWMU-7	11-Sep-96	VOGC	8020	24-Sep-96	Tetrachloroethene	ND	5,400	ug/kg	U		0.2	0.44
SWMU-7	11-Sep-96	VOGC	8020	24-Sep-96	Toluene	ND	790,000	ug/kg	U		0.2	0.071
SWMU-7	11-Sep-96	VOGC	8020	24-Sep-96	trans-1,2-Dichloroethylene	ND	78,000	ug/kg	U		0.2	0.070
SWMU-7	11-Sep-96	VOGC	8020	24-Sep-96	Trichloroethene	ND	3,200	ug/kg	U		0.2	0.092
SWMU-7	11-Sep-96	VOGC	8020	24-Sep-96	Vinyl chloride	ND	16	ug/kg	U		1	0.65
SWMU-7	11-Sep-96	VOGC	8020	24-Sep-96	Xylenes (total)	ND	320,000	ug/kg	U		0.6	0.13

Analyses for Surface Soil Samples Collected 11 September 1996

SITE	COLLECT DATE	METHOD NAME	METHOD NUMBER	ANALYSIS DATE	CONSTITUENT	CONC.	EPA REGION 9 PRG	UNITS	QUAL	LAB COMMENTS	SOIL CRDL	SOIL MDL
SWMU-22	11-Sep-96	TPHD	8015 Mod	07-Oct-96	TPH-Diesel	6,700,000	--	ug/kg	D (10x)	MOL&SOL&MSOL	25000	25000
SWMU-22	11-Sep-96	TPHG	8015 Mod	24-Sep-96	TPH-Gasoline	ND	--	ug/kg	U		5000	42
SWMU-22	11-Sep-96	VOGC	8020	24-Sep-96	1,1,1-Trichloroethane	ND	1,200,000	ug/kg	U		0.02	0.048
SWMU-22	11-Sep-96	VOGC	8020	24-Sep-96	1,1,2-Trichloroethane	ND	650	ug/kg	U		0.2	0.043
SWMU-22	11-Sep-96	VOGC	8020	24-Sep-96	1,1-Dichloroethane	ND	500,000	ug/kg	U		0.2	0.031
SWMU-22	11-Sep-96	VOGC	8020	24-Sep-96	1,2-Dichloroethane	ND	250	ug/kg	U		0.2	0.041
SWMU-22	11-Sep-96	VOGC	8020	24-Sep-96	1,4-Dichlorobenzene	ND	3,600	ug/kg	U		0.2	0.079
SWMU-22	11-Sep-96	VOGC	8020	24-Sep-96	Benzene	ND	630	ug/kg	U		0.2	0.077
SWMU-22	11-Sep-96	VOGC	8020	24-Sep-96	Carbon tetrachloride	ND	230	ug/kg	U		0.5	0.048
SWMU-22	11-Sep-96	VOGC	8020	24-Sep-96	Chloroform	ND	250	ug/kg	U		0.2	0.093
SWMU-22	11-Sep-96	VOGC	8020	24-Sep-96	cis-1,2-Dichloroethylene	ND	31,000	ug/kg	U		0.2	0.034
SWMU-22	11-Sep-96	VOGC	8020	24-Sep-96	Ethylbenzene	ND	23,000	ug/kg	U		0.2	0.14
SWMU-22	11-Sep-96	VOGC	8020	24-Sep-96	Methylenechloride	ND	7,800	ug/kg	U		0.2	0.080
SWMU-22	11-Sep-96	VOGC	8020	24-Sep-96	Tetrachloroethene	ND	5,400	ug/kg	U		0.2	0.44
SWMU-22	11-Sep-96	VOGC	8020	24-Sep-96	Toluene	ND	790,000	ug/kg	U		0.2	0.071
SWMU-22	11-Sep-96	VOGC	8020	24-Sep-96	trans-1,2-Dichloroethylene	ND	78,000	ug/kg	U		0.2	0.070
SWMU-22	11-Sep-96	VOGC	8020	24-Sep-96	Trichloroethene	ND	3,200	ug/kg	U		0.2	0.092
SWMU-22	11-Sep-96	VOGC	8020	24-Sep-96	Vinyl chloride	ND	16	ug/kg	U		1	0.65
SWMU-22	11-Sep-96	VOGC	8020	24-Sep-96	Xylenes (total)	ND	320,000	ug/kg	U		0.6	0.13

Analyses for Subsurface Soil Samples Collected 11 September 1996

SITE	COLLECT DATE	METHOD NAME	METHOD NUMBER	ANALYSIS DATE	CONSTITUENT	CONC.	EPA REGION 9 PRG	UNITS	QUAL	LAB COMMENTS	SOIL CRDL	SOIL MDL
SWMU-25-1	11-Sep-96				TPH	53000		ug/kg			25000	
SWMU-25-1	11-Sep-96				Gasoline	2970		ug/kg			1000	
SWMU-25-1	11-Sep-96				Benzene	12		ug/kg			1	
SWMU-25-1	11-Sep-96				Toluene	5		ug/kg			1	
SWMU-25-1	11-Sep-96				Ethylbenzene	5		ug/kg			5	
SWMU-25-1	11-Sep-96				Xylene (total)	22		ug/kg			5	
SWMU-25-2	11-Sep-96				TPH	ND		ug/kg			25000	
SWMU-25-2	11-Sep-96				Gasoline	ND		ug/kg			1000	
SWMU-25-2	11-Sep-96				Benzene	ND		ug/kg			1	
SWMU-25-2	11-Sep-96				Toluene	ND		ug/kg			1	
SWMU-25-2	11-Sep-96				Ethylbenzene	ND		ug/kg			5	
SWMU-25-2	11-Sep-96				Xylene (total)	ND		ug/kg			5	
SWMU-25-3	11-Sep-96				TPH	ND		ug/kg			25000	
SWMU-25-3	11-Sep-96				Gasoline	ND		ug/kg			1000	
SWMU-25-3	11-Sep-96				Benzene	ND		ug/kg			1	
SWMU-25-3	11-Sep-96				Toluene	ND		ug/kg			1	
SWMU-25-3	11-Sep-96				Ethylbenzene	ND		ug/kg			5	
SWMU-25-3	11-Sep-96				Xylene (total)	ND		ug/kg			5	

Notes:

1. All concentrations are expressed on a dry weight basis.

2. "ND" indicates that the compound was not detected above the Method Detection Limit (MDL) or the Contract Required Detection Limit (CRDL).

3. Qualifiers :

"L" indicates that the analytical result is below the CRDL and at or above the MDL.

"U" indicates that the compound was analyzed for but not detected.

"B" indicates that the analyte was found in the associated blank as well as in the sample.

"D" indicates that the sample was diluted; dilution factor provided.

4. Lab Comments:

"MOL" indicates that a matrix spike recovery for a constituent of the sample was out of limit.

"SOL" indicates that a surrogate was out of limit.

"MSOL" indicates that the matrix spike surrogate was out of limit.

APPENDIX B

LABORATORY DATA SHEETS FOR

SOIL SAMPLES COLLECTED ON

11 SEPTEMBER 1996

DATA CHEM LABORATORIES
A Sorenson Company

FORM A (TYPE I)
SINGLE METHOD ANALYSES

SAMPLE ANALYSIS DATA SHEET

S968C0Y8

Client Name.....: Battelle PNL
Client Ref Number....: Not Provided
Sampling Site.....: Not Provided
Release Number.....: Not Provided

Date Received.....: 12-SEP-96 00:00
DCL Report Group.....: 96B-0250-07

DCL Preparation Group: G968K01T
Date Prepared.....: 18-SEP-96 00:00
Preparation Method...: 3550
Aliquot Weight/Volume: 30 grams
Net Weight/Volume....: Not Required

Date Printed.....: 06-DEC-96 14:41
Client Sample Name: SWMU-4
DCL Sample Name...: 96B02316

Matrix.....: SOIL
Date Sampled.....: 11-SEP-96 14:10
Reporting Units...: ug/Kg
Report Basis.....: ☐ As Received ☒ Dried
Percent Moisture..: 8.1

DCL Analysis Group: G968K01T
Analysis Method...: 8270B
Instrument Type...: GC/MS
Instrument ID.....: 5972-U
Column Type.....: DB5, 30m x.32mm
☒ Primary
☐ Confirmation

Analytical Results

Analyte	Date Analyzed	MDL	Result	Comment	Qual.	Dilution	CRDL
o-Cresol	27-SEP-96 23:51	82	ND		DU	10	330
m+p Cresol	27-SEP-96 23:51	77	ND		DU	10	330
Decane	27-SEP-96 23:51	1500	ND		DU	10	330
Dodecane	27-SEP-96 23:51	650	ND		DU	10	330
Tetradecane	27-SEP-96 23:51	120	ND		DU	10	330
Naphthalene	27-SEP-96 23:51	92	ND		DU	10	330
Pentachlorophenol	27-SEP-96 23:51	83	ND		DU	10	1300
Phenol	27-SEP-96 23:51	82	ND		DU	10	300
Tributyl Phosphate	27-SEP-96 23:51	110	ND		DU	10	300
Tris-2-Chloroethyl Phosphate	27-SEP-96 23:51	180	ND		DU	10	1300
Benzothiazole	27-SEP-96 23:51	72	ND		DU	10	300
Bis(2-ethylhexyl)phthalate	27-SEP-96 23:51	1200	ND		DU	10	300
2,4-Dichlorophenol	27-SEP-96 23:51	85	ND		DU	10	300
2-Nitrophenol	27-SEP-96 23:51	85	ND		DU	10	300

Surrogate Recoveries

Analyte	Result	Spiked Amount	Percent Recovery
2,4,6-Tribromophenol	3060	3330	91.9
2-Fluorobiphenyl	3130	3330	93.9
2-Fluorophenol	2920	3330	87.7
Nitrobenzene-d5	2610	3330	78.2
Phenol-d5	3000	3330	90.0
Terphenyl-d14	4480	3330	134.

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DATA CHEM LABORATORIES
A Sorenson Company

FORM A (TYPE I)
SINGLE METHOD ANALYSES

SAMPLE ANALYSIS DATA SHEET

S968C0YH

Client Name.....: Battelle PNL
Client Ref Number....: Not Provided
Sampling Site.....: Not Provided
Release Number.....: Not Provided

Date Received.....: 12-SEP-96 00:00
DCL Report Group.....: 96B-0250-08

DCL Preparation Group: G968H00G
Date Prepared.....: 19-SEP-96 00:00
Preparation Method...: SW 3051
Aliquot Weight/Volume: 1.0 g
Net Weight/Volume....: Not Required

Date Printed.....: 04-DEC-96 11:05
Client Sample Name: SWMU-4
DCL Sample Name...: 96B02316

Matrix.....: SOIL
Date Sampled.....: 11-SEP-96 14:10
Reporting Units...: µg/Kg
Report Basis.....: ☐ As Received ☒ Dried
Percent Moisture..: 8.1

DCL Analysis Group: G968H00G
Analysis Method...: SW 6010
Instrument Type...: ICP
Instrument ID.....:
Column Type.....: Not Applicable

Analytical Results

Analyte	Date Analyzed	MDL	Result	Comment	Qual.	Dilution	CRDL
Aluminum	26-SEP-96 14:23	10000	16000000			1.0	20000
Antimony	26-SEP-96 14:23	1700	5700	MOL	L	1.0	10000
Barium	26-SEP-96 14:23	120	83000			1.0	1000
Beryllium	26-SEP-96 14:23	43.	380			1.0	200
Cadmium	26-SEP-96 14:23	200	1000			1.0	500
Calcium	26-SEP-96 14:23	1400	9100000		B	1.0	10000
Chromium	26-SEP-96 14:23	390	21000	MOL	B	1.0	1000
Cobalt	26-SEP-96 14:23	380	9600			1.0	2000
Copper	26-SEP-96 14:23	550	26000	MOL		1.0	2000
Iron	26-SEP-96 14:23	1900	28000000		B	1.0	3000
Magnesium	26-SEP-96 14:23	860	6500000			1.0	10000
Manganese	26-SEP-96 14:23	140	440000			1.0	500
Nickel	26-SEP-96 14:23	890	23000		B	1.0	2500
Potassium	26-SEP-96 14:23	3100	1200000			1.0	100000
Silver	26-SEP-96 14:23	160	ND		U	1.0	1000
Sodium	26-SEP-96 14:23	15000	590000			1.0	30000
Tin	26-SEP-96 14:23	1600	21000		B	1.0	10000
Vanadium	26-SEP-96 14:23	160	75000			1.0	1000
Zinc	26-SEP-96 14:23	980	400000		B	1.0	1000
Strontium	26-SEP-96 14:23	16.	38000		B	1.0	2000
Boron	26-SEP-96 14:23	3100	ND		U	1.0	30000
Silicon	26-SEP-96 14:23	6000	880000			1.0	150000

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DATA CHEM LABORATORIES
A Sorenson Company

FORM A (TYPE I)
SINGLE METHOD ANALYSES

SAMPLE ANALYSIS DATA SHEET

S968C0YK

Client Name.....: Battelle PNL
Client Ref Number....: Not Provided
Sampling Site.....: Not Provided
Release Number.....: Not Provided

Date Received.....: 12-SEP-96 00:00
DCL Report Group.....: 96B-0250-09

DCL Preparation Group: G968H00F
Date Prepared.....: 19-SEP-96 00:00
Preparation Method...: IS-SW-3050
Aliquot Weight/Volume: 1.0 g
Net Weight/Volume....: Not Required

Date Printed.....: 04-DEC-96 16:00
Client Sample Name: SWMU-4
DCL Sample Name...: 96B02316

Matrix.....: SOIL
Date Sampled.....: 11-SEP-96 14:10
Reporting Units...: ug/Kg
Report Basis.....: ☐ As Received ☒ Dried
Percent Moisture..: 8.1

DCL Analysis Group: G968H00F
Analysis Method...: IP-SW-6010T
Instrument Type...: ICP-T
Instrument ID.....: TJA ICAP 61E
Column Type.....: Not Applicable

Analytical Results

Analyte	Date Analyzed	MDL	Result	Comment	Qual.	Dilution	CRDL
Arsenic	21-OCT-96 20:24	240	ND		U	1.0000	500
Lead	21-OCT-96 20:24	170	53000			1.0000	300
Selenium	21-OCT-96 20:24	390	ND		U	1.0000	500
Thallium	21-OCT-96 20:24	430	ND		U	1.0000	500

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DATA CHEM LABORATORIES
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FORM A (TYPE I)
SINGLE METHOD ANALYSES

SAMPLE ANALYSIS DATA SHEET

S968C0YB

Client Name.....: Battelle PNL
Client Ref Number....: Not Provided
Sampling Site.....: Not Provided
Release Number.....: Not Provided

Date Received.....: 12-SEP-96 00:00
DCL Report Group.....: 96B-0250-03

DCL Preparation Group: G968K01R
Date Prepared.....: 18-SEP-96 00:00
Preparation Method...: 3550
Aliquot Weight/Volume: 0.03 Kg
Net Weight/Volume....: Not Required

Date Printed.....: 04-DEC-96 10:15
Client Sample Name: **SWMU-4**
DCL Sample Name...: **96B02316**

Matrix.....: SOIL
Date Sampled.....: 11-SEP-96 14:10
Reporting Units...: ug/Kg
Report Basis.....: ☐ As Received ☒ Dried
Percent Moisture..: 8.1

DCL Analysis Group: G968K01R
Analysis Method...: SW 8080
Instrument Type...: GC/EC
Instrument ID.....: EC-7
Column Type.....: DB-17
☒ Primary
☐ Confirmation

Analytical Results

Analyte	Date Analyzed	MDL	Result	Comment	Qual.	Dilution	CRDL
Aldrin	10-OCT-96 18:29	0.17	ND		U	1	0.33
alpha-BHC	10-OCT-96 18:29	0.064	ND		U	1	0.33
beta-BHC	10-OCT-96 18:29	0.052	ND		U	1	0.33
delta-BHC	10-OCT-96 18:29	0.083	ND		U	1	0.67
Lindane	10-OCT-96 18:29	0.071	1.26			1	0.33
Chlordane	10-OCT-96 18:29	0.93	ND		U	1	3.33
4,4'-DDD	10-OCT-96 18:29	0.12	51.4			1	0.67
4,4'-DDE	12-OCT-96 12:13	0.042	71.2		D	10	0.33
4,4'-DDT	10-OCT-96 15:05	0.043	686.		D	100	0.67
Dieldrin	12-OCT-96 12:13	0.042	57.1		D	10	0.33
Endosulfan I	10-OCT-96 18:29	0.11	ND		U	1	0.33
Endosulfan II	10-OCT-96 18:29	0.16	6.89			1	0.33
Endosulfan Sulfate	10-OCT-96 18:29	0.22	6.01			1	3.33
Endrin	10-OCT-96 18:29	0.097	10.7			1	0.67
Endrin aldehyde	10-OCT-96 18:29	0.015	ND		U	1	0.67
Heptachlor	10-OCT-96 18:29	0.038	ND		U	1	0.33
Heptachlor epoxide	10-OCT-96 18:29	0.054	ND		U	1	0.67
Methoxychlor	10-OCT-96 18:29	0.35	ND		U	1	3.3
Toxaphene	10-OCT-96 18:29	13.	ND		U	1	33
Aroclor 1016	10-OCT-96 18:29	0.92	ND		U	1	17
Aroclor 1221	10-OCT-96 18:29	9.0	ND		U	1	17
Aroclor 1232	10-OCT-96 18:29	3.7	ND		U	1	17
Aroclor 1242	10-OCT-96 18:29	2.4	ND		U	1	17
Aroclor 1248	10-OCT-96 18:29	0.74	ND		U	1	17
Aroclor 1254	10-OCT-96 18:29	0.71	ND		U	1	6.7
Aroclor 1260	10-OCT-96 18:29	0.84	ND		U	1	6.7

Surrogate Recoveries

Analyte	Result	Spiked Amount	Percent Recovery
Decachlorobiphenyl	3.27	6.70	48.9
Tetrachloro-m-xylene	5.73	6.70	85.5

Sample Comments

Endosulfan II/4,4'-DDD unconfirmed due to conf. column co-elution

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DATA CHEM LABORATORIES
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FORM A (TYPE I)
SINGLE METHOD ANALYSES

SAMPLE ANALYSIS DATA SHEET

S968C0YC

Client Name.....: Battelle PNL
Client Ref Number....: Not Provided
Sampling Site.....: Not Provided
Release Number.....: Not Provided

Date Received.....: 12-SEP-96 00:00
DCL Report Group.....: 96B-0250-06

DCL Preparation Group: Not Applicable
Date Prepared.....: Not Applicable
Preparation Method...: Not Applicable
Aliquot Weight/Volume: 5.0 g
Net Weight/Volume....: Not Required

Date Printed.....: 06-DEC-96 14:33
Client Sample Name: SWMU-4
DCL Sample Name...: 96B02316

Matrix.....: SOIL
Date Sampled.....: 11-SEP-96 14:10
Reporting Units...: ug/Kg
Report Basis.....: ☐ As Received ☒ Dried
Percent Moisture..: 8.1

DCL Analysis Group: G9691030
Analysis Method...: SW 8260
Instrument Type...: GC/MS
Instrument ID.....: 5972-O
Column Type.....: DB 624
☒ Primary
☐ Confirmation

Analytical Results

Analyte	Date Analyzed	MDL	Result	Comment	Qual.	Dilution	CRDL
Acetone	19-SEP-96 10:35	4.1	ND		U		10
Benzene	19-SEP-96 10:35	.39	ND		U		1
Carbon Tetrachloride	19-SEP-96 10:35	.61	ND		U		1
Chloroform	19-SEP-96 10:35	.32	ND		U		1
p-Dichlorobenzene	19-SEP-96 10:35	.22	ND		U		1
1,1-Dichloroethane	19-SEP-96 10:35	.38	ND		U		1
1,2-Dichloroethane	19-SEP-96 10:35	.27	ND		U		1
cis-1,2-Dichloroethylene	19-SEP-96 10:35	.45	ND		U		1
trans-1,2-Dichloroethylene	19-SEP-96 10:35	.55	ND		U		1
Methylene Chloride	19-SEP-96 10:35	.41	ND		U		1
Methyl Ethyl Ketone	19-SEP-96 10:35	1.8	ND		U		10
4-Methyl-2-Pentanone	19-SEP-96 10:35	.57	ND		U		10
Tetrachloroethylene	19-SEP-96 10:35	.54	ND		U		1
Tetrahydrofuran	19-SEP-96 10:35	1.2	ND		U		10
Toluene	19-SEP-96 10:35	.75	ND		U		2
1,1,1-Trichloroethane	19-SEP-96 10:35	.22	ND		U		1
1,1,2-Trichloroethane	19-SEP-96 10:35	.13	ND		U		3
Trichloroethylene	19-SEP-96 10:35	.56	ND		U		1
Vinyl Chloride	19-SEP-96 10:35	.72	ND		U		5
Total Xylene	19-SEP-96 10:35	1.1	ND		U		2
1-Butanol	19-SEP-96 10:35	47	ND		U		100
Propionitrile	19-SEP-96 10:35	2.0	ND		U		10
Carbon Disulfide	19-SEP-96 10:35	.68	ND		U		1
1,2-Dichloroethane, d4	19-SEP-96 10:35		53.				
Toluene, d8	19-SEP-96 10:35		53.				
4-BromoFluorobenzene	19-SEP-96 10:35		52.				

Surrogate Recoveries

Analyte	Result	Spiked Amount	Percent Recovery
1,2-Dichloroethane-d4	48.7	50.0	97.4
4-Bromofluorobenzene	47.4	50.0	94.9
Toluene-d8	49.1	50.0	98.2

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DATA CHEM LABORATORIES
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FORM A (TYPE I)
SINGLE METHOD ANALYSES

SAMPLE ANALYSIS DATA SHEET

S968C0Y6

Client Name.....: Battelle PNL
Client Ref Number....: Not Provided
Sampling Site.....: Not Provided
Release Number.....: Not Provided

Date Received.....: 12-SEP-96 00:00
DCL Report Group.....: 96B-0250-01

DCL Preparation Group: Not Applicable
Date Prepared.....: Not Applicable
Preparation Method...: 5035
Aliquot Weight/Volume: 5.0 g
Net Weight/Volume....: Not Required

Date Printed.....: 04-DEC-96 11:10
Client Sample Name: SWMU-4
DCL Sample Name...: 96B02316

Matrix.....: SOIL
Date Sampled.....: 11-SEP-96 14:10
Reporting Units...: µg/Kg
Report Basis.....: ☐ As Received ☒ Dried
Percent Moisture..: 8.1

DCL Analysis Group: G969F008
Analysis Method...: SW 8010/8020
Instrument Type...: GC/P+T
Instrument ID.....: GC/VOA 06
Column Type.....: DB-624
☒ Primary
☐ Confirmation

Analytical Results

Analyte	Date Analyzed	MDL	Result	Comment	Qual.	Dilution	CRDL
Benzene	24-SEP-96 21:15	0.077	ND		U		0.2
Carbon Tetrachloride	24-SEP-96 21:15	0.048	ND		U		0.5
Chloroform	24-SEP-96 21:15	0.093	ND		U		0.2
p-Dichlorobenzene	24-SEP-96 21:15	0.079	ND		U		0.2
1,1-Dichloroethane	24-SEP-96 21:15	0.031	ND		U		0.2
1,2-Dichloroethane	24-SEP-96 21:15	0.041	ND		U		0.2
cis-1,2-Dichloroethylene	24-SEP-96 21:15	0.034	ND		U		0.2
trans-1,2-Dichloroethylene	24-SEP-96 21:15	0.070	ND		U		0.2
Ethyl Benzene	24-SEP-96 21:15	0.14	ND		U		0.2
Methylene Chloride	24-SEP-96 21:15	0.080	ND		U		0.2
Tetrachloroethylene	24-SEP-96 21:15	0.044	ND		U		0.2
Toluene	24-SEP-96 21:15	0.071	ND		U		0.2
1,1,1-Trichloroethane	24-SEP-96 21:15	0.048	ND		U		0.2
1,1,2-Trichloroethane	24-SEP-96 21:15	0.043	ND		U		0.2
Trichloroethylene	24-SEP-96 21:15	0.092	ND		U		0.2
Vinyl Chloride	24-SEP-96 21:15	0.65	ND		U		1.0
Xylene	24-SEP-96 21:15	0.13	ND		U		0.6
P-Chlorofluorobenzene	24-SEP-96 21:15		11.				
H-Chlorofluorobenzene	24-SEP-96 21:15		10.				

Surrogate Recoveries

Analyte	Result	Spiked Amount	Percent Recovery
P-Chlorofluorobenzene	9.45	10.0	94.5

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FORM A (TYPE I)
SINGLE METHOD ANALYSES

SAMPLE ANALYSIS DATA SHEET

S968C0YD

Client Name.....: Battelle PNL
Client Ref Number....: Not Provided
Sampling Site.....: Not Provided
Release Number.....: Not Provided

Date Received.....: 12-SEP-96 00:00
DCL Report Group.....: 96B-0250-02

DCL Preparation Group: G968K01Q
Date Prepared.....: 18-SEP-96 00:00
Preparation Method...: 3550
Aliquot Weight/Volume: 0.03 Kg
Net Weight/Volume....: Not Required

Date Printed.....: 04-DEC-96 10:47
Client Sample Name: SWMU-6
DCL Sample Name...: 96B02317

Matrix.....: SOIL
Date Sampled.....: 11-SEP-96 13:40
Reporting Units...: ug/Kg
Report Basis.....: [X] As Received [ ] Dried

DCL Analysis Group: G968K01Q
Analysis Method...: SW 8080
Instrument Type...: GC/EC
Instrument ID.....: EC-17
Column Type.....: DB-17
[X] Primary
[ ] Confirmation

Analytical Results

Analyte	Date Analyzed	MDL	Result	Comment	Qual.	Dilution	CRDL
Aroclor 1016	22-SEP-96 15:19	0.92	ND		U	1	17
Aroclor 1221	22-SEP-96 15:19	9.0	ND		U	1	17
Aroclor 1232	22-SEP-96 15:19	3.7	ND		U	1	17
Aroclor 1242	22-SEP-96 15:19	2.4	ND		U	1	17
Aroclor 1248	22-SEP-96 15:19	0.74	ND		U	1	17
Aroclor 1254	22-SEP-96 15:19	0.71	ND		U	1	6.7
Aroclor 1260	22-SEP-96 15:19	0.84	ND		U	1	6.7

Surrogate Recoveries

Analyte	Result	Spiked Amount	Percent Recovery
Decachlorobiphenyl	4.27	6.70	63.8
Tetrachloro-m-xylene	6.57	6.70	98.0

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DATA CHEM LABORATORIES
A Sorenson Company

FORM A (TYPE I)
SINGLE METHOD ANALYSES

SAMPLE ANALYSIS DATA SHEET

S968C0Y9

Client Name.....: Battelle PNL
Client Ref Number....: Not Provided
Sampling Site.....: Not Provided
Release Number.....: Not Provided

Date Received.....: 12-SEP-96 00:00
DCL Report Group.....: 96B-0250-07

DCL Preparation Group: G968K01T
Date Prepared.....: 18-SEP-96 00:00
Preparation Method...: 3550
Aliquot Weight/Volume: 30 grams
Net Weight/Volume....: Not Required

Date Printed.....: 06-DEC-96 14:41
Client Sample Name: SWMU-7
DCL Sample Name...: 96B02318

Matrix.....: SOIL
Date Sampled.....: 11-SEP-96 14:45
Reporting Units...: ug/Kg
Report Basis.....: ☐ As Received ☒ Dried
Percent Moisture..: 6.6

DCL Analysis Group: G968K01T
Analysis Method...: 8270B
Instrument Type...: GC/MS
Instrument ID.....: 5972-U
Column Type.....: DB5, 30m x.32mm
☒ Primary
☐ Confirmation

Analytical Results

Analyte	Date Analyzed	MDL	Result	Comment	Qual.	Dilution	CRDL
o-Cresol	27-SEP-96 23:18	82	ND		DU	10	330
m+p Cresol	27-SEP-96 23:18	77	ND		DU	10	330
Decane	27-SEP-96 23:18	1500	ND		DU	10	330
Dodecane	27-SEP-96 23:18	650	ND		DU	10	330
Tetradecane	27-SEP-96 23:18	120	ND		DU	10	330
Naphthalene	27-SEP-96 23:18	92	ND		DU	10	330
Pentachlorophenol	27-SEP-96 23:18	83	ND		DU	10	1300
Phenol	27-SEP-96 23:18	82	ND		DU	10	300
Tributyl Phosphate	27-SEP-96 23:18	110	ND		DU	10	300
Tris-2-Chloroethyl Phosphate	27-SEP-96 23:18	180	ND		DU	10	1300
Benzothiazole	27-SEP-96 23:18	72	ND		DU	10	300
Bis(2-ethylhexyl)phthalate	27-SEP-96 23:18	1200	ND		DU	10	300
2,4-Dichlorophenol	27-SEP-96 23:18	85	ND		DU	10	300
2-Nitrophenol	27-SEP-96 23:18	85	ND		DU	10	300

Tentatively Identified Compound Results

Analyte(Retention Time)	Date Analyzed	Result	Comment	Qual.	Dilution
Aldol Condensation Product(5.06)	27-SEP-96 23:18	1500		DJB	10

Surrogate Recoveries

Analyte	Result	Spiked Amount	Percent Recovery
2,4,6-Tribromophenol	2770	3330	83.1
2-Fluorobiphenyl	3050	3330	91.4
2-Fluorophenol	2960	3330	88.9
Nitrobenzene-d5	2610	3330	78.4
Phenol-d5	2980	3330	89.5
Terphenyl-d14	3720	3330	112.

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FORM A (TYPE I)
SINGLE METHOD ANALYSES

SAMPLE ANALYSIS DATA SHEET

S968C0YJ

Client Name.....: Battelle PNL
Client Ref Number....: Not Provided
Sampling Site.....: Not Provided
Release Number.....: Not Provided

Date Received.....: 12-SEP-96 00:00
DCL Report Group.....: 96B-0250-08

DCL Preparation Group: G968H00G
Date Prepared.....: 19-SEP-96 00:00
Preparation Method...: SW 3051
Aliquot Weight/Volume: 1.0 g
Net Weight/Volume....: Not Required

Date Printed.....: 04-DEC-96 11:05
Client Sample Name: SWMU-7
DCL Sample Name...: 96B02318

Matrix.....: SOIL
Date Sampled.....: 11-SEP-96 14:45
Reporting Units...: µg/Kg
Report Basis.....: ☐ As Received ☒ Dried
Percent Moisture..: 6.6

DCL Analysis Group: G968H00G
Analysis Method...: SW 6010
Instrument Type...: ICP
Instrument ID.....:
Column Type.....: Not Applicable

Analytical Results

Analyte	Date Analyzed	MDL	Result	Comment	Qual.	Dilution	CRDL
Aluminum	26-SEP-96 14:44	10000	15000000			1.0	20000
Antimony	26-SEP-96 14:44	1700	6900	MOL	BL	1.0	10000
Barium	26-SEP-96 14:44	120	110000			1.0	1000
Beryllium	26-SEP-96 14:44	43.	470			1.0	200
Cadmium	26-SEP-96 14:44	200	220		L	1.0	500
Calcium	26-SEP-96 14:44	1400	15000000		B	1.0	10000
Chromium	26-SEP-96 14:44	390	16000	MOL	B	1.0	1000
Cobalt	26-SEP-96 14:44	380	11000			1.0	2000
Copper	26-SEP-96 14:44	550	24000	MOL		1.0	2000
Iron	26-SEP-96 14:44	1900	28000000		B	1.0	3000
Magnesium	26-SEP-96 14:44	860	6200000			1.0	10000
Manganese	26-SEP-96 14:44	140	560000			1.0	500
Nickel	26-SEP-96 14:44	890	18000		B	1.0	2500
Potassium	26-SEP-96 14:44	3100	2100000			1.0	100000
Silver	26-SEP-96 14:44	160	ND		U	1.0	1000
Sodium	26-SEP-96 14:44	15000	510000			1.0	30000
Tin	26-SEP-96 14:44	1600	19000		B	1.0	10000
Vanadium	26-SEP-96 14:44	160	63000			1.0	1000
Zinc	26-SEP-96 14:44	980	56000		B	1.0	1000
Strontium	26-SEP-96 14:44	16.	64000		B	1.0	2000
Boron	26-SEP-96 14:44	3100	ND		U	1.0	30000
Silicon	26-SEP-96 14:44	6000	2200000			1.0	150000

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DATA CHEM LABORATORIES
A Sorenson Company

FORM A (TYPE I)
SINGLE METHOD ANALYSES

SAMPLE ANALYSIS DATA SHEET

S968C0YL

Client Name.....: Battelle PNL
Client Ref Number....: Not Provided
Sampling Site.....: Not Provided
Release Number.....: Not Provided

Date Received.....: 12-SEP-96 00:00
DCL Report Group.....: 96B-0250-09

DCL Preparation Group: G968H00F
Date Prepared.....: 19-SEP-96 00:00
Preparation Method...: IS-SW-3050
Aliquot Weight/Volume: 1.0 g
Net Weight/Volume....: Not Required

Date Printed.....: 04-DEC-96 16:00
Client Sample Name: SWMU-7
DCL Sample Name...: 96B02318

Matrix.....: SOIL
Date Sampled.....: 11-SEP-96 14:45
Reporting Units...: ug/Kg
Report Basis.....: ☐ As Received ☒ Dried
Percent Moisture..: 6.6

DCL Analysis Group: G968H00F
Analysis Method...: IP-SW-6010T
Instrument Type...: ICP-T
Instrument ID.....: TJA ICAP 61E
Column Type.....: Not Applicable

Analytical Results

Analyte	Date Analyzed	MDL	Result	Comment	Qual.	Dilution	CRDL
Arsenic	21-OCT-96 20:38	240	4700			1.0000	500
Lead	21-OCT-96 20:38	170	11000			1.0000	300
Selenium	21-OCT-96 20:38	390	ND		U	1.0000	500
Thallium	21-OCT-96 20:38	430	ND		U	1.0000	500

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DATA CHEM LABORATORIES
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FORM A (TYPE I)
SINGLE METHOD ANALYSES

SAMPLE ANALYSIS DATA SHEET

S968C0Y7

Client Name.....: Battelle PNL
Client Ref Number....: Not Provided
Sampling Site.....: Not Provided
Release Number.....: Not Provided

Date Received.....: 12-SEP-96 00:00
DCL Report Group.....: 96B-0250-01

DCL Preparation Group: Not Applicable
Date Prepared.....: Not Applicable
Preparation Method...: 5035
Aliquot Weight/Volume: 5.0 g
Net Weight/Volume....: Not Required

Date Printed.....: 04-DEC-96 11:10
Client Sample Name: SWMU-7
DCL Sample Name...: 96B02318

Matrix.....: SOIL
Date Sampled.....: 11-SEP-96 14:45
Reporting Units...: µg/Kg
Report Basis.....: ☐ As Received ☒ Dried
Percent Moisture..: 6.6

DCL Analysis Group: G969F008
Analysis Method...: SW 8010/8020
Instrument Type...: GC/P+T
Instrument ID.....: GC/VOA 06
Column Type.....: DB-624
☒ Primary
☐ Confirmation

Analytical Results

Analyte	Date Analyzed	MDL	Result	Comment	Qual.	Dilution	CRDL
Benzene	24-SEP-96 22:02	0.077	ND		U		0.2
Carbon Tetrachloride	24-SEP-96 22:02	0.048	ND		U		0.5
Chloroform	24-SEP-96 22:02	0.093	ND		U		0.2
p-Dichlorobenzene	24-SEP-96 22:02	0.079	ND		U		0.2
1,1-Dichloroethane	24-SEP-96 22:02	0.031	ND		U		0.2
1,2-Dichloroethane	24-SEP-96 22:02	0.041	ND		U		0.2
cis-1,2-Dichloroethylene	24-SEP-96 22:02	0.034	ND		U		0.2
trans-1,2-Dichloroethylene	24-SEP-96 22:02	0.070	ND		U		0.2
Ethyl Benzene	24-SEP-96 22:02	0.14	ND		U		0.2
Methylene Chloride	24-SEP-96 22:02	0.080	ND		U		0.2
Tetrachloroethylene	24-SEP-96 22:02	0.044	ND		U		0.2
Toluene	24-SEP-96 22:02	0.071	ND		U		0.2
1,1,1-Trichloroethane	24-SEP-96 22:02	0.048	ND		U		0.2
1,1,2-Trichloroethane	24-SEP-96 22:02	0.043	ND		U		0.2
Trichloroethylene	24-SEP-96 22:02	0.092	ND		U		0.2
Vinyl Chloride	24-SEP-96 22:02	0.65	ND		U		1.0
Xylene	24-SEP-96 22:02	0.13	ND		U		0.6
P-Chlorofluorobenzene	24-SEP-96 22:02		12.				
H-Chlorofluorobenzene	24-SEP-96 22:02		10.				

Surrogate Recoveries

Analyte	Result	Spiked Amount	Percent Recovery
P-Chlorofluorobenzene	9.93	10.0	99.3

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DATA CHEM LABORATORIES
A Sorenson Company

FORM A (TYPE I)
SINGLE METHOD ANALYSES

SAMPLE ANALYSIS DATA SHEET

S968C0YF

Client Name.....: Battelle PNL
Client Ref Number....: Not Provided
Sampling Site.....: Not Provided
Release Number.....: Not Provided

Date Received.....: 12-SEP-96 00:00
DCL Report Group.....: 96B-0250-04

DCL Preparation Group: G968H00K
Date Prepared.....: 16-SEP-96 00:00
Preparation Method...: Wa. method
Aliquot Weight/Volume: 20 grams
Net Weight/Volume....: Not Required

Date Printed.....: 04-DEC-96 10:48
Client Sample Name: SWMU-22
DCL Sample Name...: 96B02315

Matrix.....: SOIL
Date Sampled.....: 11-SEP-96 15:00
Reporting Units...: ug/kg
Report Basis.....: ☒ As Received ☐ Dried

DCL Analysis Group: G968H00K
Analysis Method...: 8015 MOD
Instrument Type...: GC/FID
Instrument ID.....: ch #13
Column Type.....: DB-5MS
☒ Primary
☐ Confirmation

Analytical Results

Analyte	Date Analyzed	MDL	Result	Comment	Qual.	Dilution	CRDL
TPH-Diesel	07-OCT-96 13:02	25000	6700000	MOL&SOL&M	D	10	25000

Surrogate Recoveries

Analyte	Result	Spiked Amount	Percent Recovery
o-Terphenyl	204.	100.	204.

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DATA CHEM LABORATORIES
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FORM A (TYPE I)
SINGLE METHOD ANALYSES

SAMPLE ANALYSIS DATA SHEET

S968C0YG

Client Name.....: Battelle PNL
Client Ref Number....: Not Provided
Sampling Site.....: Not Provided
Release Number.....: Not Provided

Date Received.....: 12-SEP-96 00:00
DCL Report Group.....: 96B-0250-05

DCL Preparation Group: Not Applicable
Date Prepared.....: Not Applicable
Preparation Method...: 3810
Aliquot Weight/Volume: 5.0 g
Net Weight/Volume....: Not Required

Date Printed.....: 04-DEC-96 10:48
Client Sample Name: SWMU-22
DCL Sample Name...: 96B02315

Matrix.....: SOIL
Date Sampled.....: 11-SEP-96 15:00
Reporting Units...: ug/kg
Report Basis.....: ☒ As Received ☐ Dried

DCL Analysis Group: G968R01Z
Analysis Method...: 8015 MOD
Instrument Type...: GC/HS
Instrument ID.....: GC/VOA 05
Column Type.....: DB-624
☒ Primary
☐ Confirmation

Analytical Results

Analyte	Date Analyzed	MDL	Result	Comment	Qual.	Dilution	CRDL
TPH-Gasoline	24-SEP-96 18:41	42	ND		U		5000

Surrogate Recoveries

Analyte	Result	Spiked Amount	Percent Recovery
Bromobenzene	3910	4000	97.8

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Client Name.....: Battelle PNL
Client Ref Number....: Not Provided
Sampling Site.....: Not Provided
Release Number.....: Not Provided

Date Received.....: 12-SEP-96 00:00
DCL Report Group.....: 96B-0250-01

DCL Preparation Group: Not Applicable
Date Prepared.....: Not Applicable
Preparation Method...: 5035
Aliquot Weight/Volume: 5.0 g
Net Weight/Volume....: Not Required

Date Printed.....: 04-DEC-96 10:21
Client Sample Name: SWMU-22
DCL Sample Name...: 96B02315

Matrix.....: SOIL
Date Sampled.....: 11-SEP-96 15:00
Reporting Units...: µg/Kg
Report Basis.....: [X] As Received [ ] Dried

DCL Analysis Group: G969F008
Analysis Method...: SW 8010/8020
Instrument Type...: GC/P+T
Instrument ID.....: GC/VOA 06
Column Type.....: DB-624
[X] Primary
[ ] Confirmation

Analytical Results

Analyte	Date Analyzed	MDL	Result	Comment	Qual.	Dilution	CRDL
Benzene	24-SEP-96 20:28	0.077	ND		U		0.2
Carbon Tetrachloride	24-SEP-96 20:28	0.048	ND		U		0.5
Chloroform	24-SEP-96 20:28	0.093	ND		U		0.2
p-Dichlorobenzene	24-SEP-96 20:28	0.079	ND		U		0.2
1,1-Dichloroethane	24-SEP-96 20:28	0.031	ND		U		0.2
1,2-Dichloroethane	24-SEP-96 20:28	0.041	ND		U		0.2
cis-1,2-Dichloroethylene	24-SEP-96 20:28	0.034	ND		U		0.2
trans-1,2-Dichloroethylene	24-SEP-96 20:28	0.070	ND		U		0.2
Ethyl Benzene	24-SEP-96 20:28	0.14	ND		U		0.2
Methylene Chloride	24-SEP-96 20:28	0.080	ND		U		0.2
Tetrachloroethylene	24-SEP-96 20:28	0.044	ND		U		0.2
Toluene	24-SEP-96 20:28	0.071	ND		U		0.2
1,1,1-Trichloroethane	24-SEP-96 20:28	0.048	ND		U		0.2
1,1,2-Trichloroethane	24-SEP-96 20:28	0.043	ND		U		0.2
Trichloroethylene	24-SEP-96 20:28	0.092	ND		U		0.2
Vinyl Chloride	24-SEP-96 20:28	0.65	ND		U		1.0
Xylene	24-SEP-96 20:28	0.13	ND		U		0.6
P-Chlorofluorobenzene	24-SEP-96 20:28		9.9				
H-Chlorofluorobenzene	24-SEP-96 20:28		8.0				

Surrogate Recoveries

Analyte	Result	Spiked Amount	Percent Recovery
P-Chlorofluorobenzene	9.89	10.0	98.9

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Anatek Labs, Inc.

September 30, 1996

Yakima Training Center
BLDG 810 - DENR
Yakima, WA 98901

Project Manager: Leighann Ogan
Delivery Order #: Credit Card
Project #:
Date Sampled: 9/11/96

Laboratory Project #: 22643

Sample	Analyte	Line Item	Result	Units	PQL
BLDG450-S1	TPH	76	53	mg/Kg	25
	Gasoline	74	2.97	mg/Kg	1
	Benzene	47	0.012	mg/Kg	0.001
	Toluene	47	0.005	mg/Kg	0.001
	Ethylbenzene	47	0.005	mg/Kg	0.005
	Xylene(total)	47	0.022	mg/Kg	0.005
BLDG450-S2	TPH	76	ND	mg/Kg	25
	Gasoline	74	ND	mg/Kg	1
	Benzene	47	ND	mg/Kg	0.001
	Toluene	47	ND	mg/Kg	0.001
	Ethylbenzene	47	ND	mg/Kg	0.005
	Xylene(total)	47	ND	mg/Kg	0.005
BLDG450-S3	TPH	76	ND	mg/Kg	25
	Gasoline	74	ND	mg/Kg	1
	Benzene	47	ND	mg/Kg	0.001
	Toluene	47	ND	mg/Kg	0.001
	Ethylbenzene	47	ND	mg/Kg	0.005
	Xylene(total)	47	ND	mg/Kg	0.005

Mike Pearson
Laboratory Director

Soil Samples Collected on 11 September 1996 at SWMU 25

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