JANUARY 2017

CY 2017

Groundwater Monitoring Plan

Fire Training Pit (FTP) and Tracked Vehicle Repair/Old Mobilization and Training Equipment Site (TVR/Old MATES)

Joint Base Lewis-McChord and Yakima Training Center Yakima, Washington

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CY 2017
GROUNDWATER MONITORING PLAN

FIRE TRAINING PIT (FTP) AND TRACKED VEHICLE REPAIR/OLD MOBILIZATION AND TRAINING EQUIPMENT SITE (TVR/OLD MATES)

JOINT BASE LEWIS-MCCHORD AND YAKIMA TRAINING CENTER
YAKIMA, WASHINGTON

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Prepared for:
U.S. ARMY CORPS OF ENGINEERS, SEATTLE DISTRICT
AND
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ABBREVIATIONS AND ACRONYMS

µg/L	microgram per liter
ALS	ALS Environmental Laboratories
APP	Accident Prevention Plan
BETX	benzene, ethylbenzene, toluene, and xylenes
bgs	below ground surface
BRAC	Base Realignment and Closure
CFR	*Code of Federal Regulations*
COC	chain-of-custody
cPAH	carcinogenic polycyclic aromatic hydrocarbon
DNAPL	dense non-aqueous phase liquid
E&E	Ecology and Environment, Inc.
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ERP	Environmental Restoration Program
FTP	fire training pit
HRS	Hazard Ranking System
IRP	Installation Restoration Program
JBLM	Joint Base Lewis-McChord
LNAPL	light non-aqueous phase liquid
LUC	land use control
MATES	Mobilization and Training Equipment Site
mg/L	milligram per liter
MMP	Main Motor Pool
MTCA	Model Toxics Control Act
MW	monitoring well
PAIC	Pomona Artesian Irrigation Company
PDB	passive diffusion bag
PPE	personal protective equipment
PQL	practical quantification limit(s)
QA	quality assurance

ABBREVIATIONS AND ACRONYMS (Continued)

QAPP	Quality Assurance Project Plan
QC	quality control
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
SAIC	Science Applications International Corporation
SAP	Sampling and Analysis Plan
SI	Site Investigation
SSHP	Site Safety and Health Plan
SSI	site screening inspection
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TCE	trichloroethylene
TCLP	toxicity characteristic leaching procedure
TEC	toxicity equivalency concentration
TEF	toxicity equivalency factor
TPH	total petroleum hydrocarbons
TPH-D	total petroleum hydrocarbons – diesel range
TPH-G	total petroleum hydrocarbons – gasoline range
TPH-O	total petroleum hydrocarbons – heavy oil range
TtEC	Tetra Tech EC, Inc.
TVR	tracked vehicle repair
USACE	U.S. Army Corps of Engineers
UST	underground storage tank
VOA	volatile organic analysis
VOC	volatile organic compound
WAC	*Washington Administrative Code*
YTC	Yakima Training Center

1. INTRODUCTION

This Groundwater Monitoring Plan was prepared for Joint Base Lewis-McChord (JBLM) Public Works, Joint Base Lewis-McChord, Washington by Tetra Tech EC., Inc. (TtEC). This plan presents the scope of work, sampling and analysis plan (SAP), and quality assurance (QA) plan for semiannual groundwater sampling conducted at Yakima Training Center's (YTC) Former Fire Training Pit (FTP) and the Tracked Vehicle Repair/Old Mobilization and Training Equipment Site area (TVR/Old MATES). In addition, monitoring of land-use controls (LUCs) will be conducted annually and the results will be incorporated into the annual groundwater monitoring report. Groundwater sampling activities at the sites are completed in accordance with *Washington Administrative Code* (WAC) 173-350-500(4). Site-specific health and safety procedures are outlined in the Accident Prevention Plan (APP)/Site Safety and Health Plan (SSHP) (SES 2014).

1.1 YTC BACKGROUND

YTC is an active United States Army sub-installation of JBLM located approximately 5 miles northeast of the City of Yakima (Figure 1). YTC has been used for training military artillery, infantry, and engineering units since 1941. Expansion of YTC occurred in the early 1950s with the acquisition of additional land and permanent construction of the Cantonment area in the southwest portion of YTC. An expansion of YTC to the north occurred in the early 1990s. Currently the YTC is 327,231 acres.

In October 2010, as part of a Base Realignment and Closure (BRAC) action, Fort Lewis and neighboring McChord Air Force Base near Tacoma, Washington merged to create JBLM. All base services, including those related to the former Fort Lewis Environmental Restoration Program (ERP), now the JBLM ERP, are provided by the Army-led Joint Base. The JBLM Installation Restoration Program (IRP) personnel are conducting groundwater monitoring at YTC.

1.2 SITE GEOLOGY AND HYDROGEOLOGY

YTC is located within the Yakima Fold Belt, which is characterized by southeast-trending anticlines and synclines. Most of the YTC Cantonment area is located within the synclinal valley between the anticlinal Yakima Ridge and Umtanum Ridge.

In general, YTC is underlain by a thick sequence of basalt flows known as the Columbia River Basalt Group. From youngest to oldest, the four formations that comprise the Columbia River Basalt Group are the Saddle Mountain Basalt, Wanapum Basalt, Grande Ronde Basalt, and Imnaha Basalt (Schuster et al. 1997). Portions of the YTC Cantonment area have sedimentary rocks/deposits of the Ellensburg Formation and/or quaternary deposits on top of the basalt flows (Schuster et al. 1997).

1.3 SITE DESCRIPTIONS

Figure 2 was revised as requested by Ecology following their review of the 2015 monitoring report. Ecology requested the figure identify drinking water wells that had been installed over the past decade west of the YTC boundary, approximately 1,500 to 3,000 feet northwest of the TVR/Old 6 MATES trichloroethylene (TCE) plume. These residential wells are shown in blue.

1.3.1 Former Fire Training Pit

The former FTP is located in the northeast portion of the Cantonment area (Figure 2). The FTP was used to practice extinguishing fires two or three times a year from an unknown start date until 1987 with a single training event in 1990 (Shapiro & Associates 1991). Practice events consisted of saturating an open, unlined earthen pit with water, adding and igniting 500 to 1,000 gallons of waste JP-4 aviation fuel, diesel fuel, or motor gasoline and then extinguishing the fire (Shapiro & Associates 1991). Although reports of the releases differ slightly (E&E 1993, SAIC 1995), petroleum products were released to site soils as a result of past fire training practices. During the 1990s, the site was used for storing stockpiles of waste sand filter material and sediments from the adjacent vehicle wash rack treatment system (E&E 1993) as well as storing fuel bladders (Shannon & Wilson 2001). Currently the site is vacant and not being used by YTC (Figure 3).

1.3.2 TVR/Old MATES

TCE was detected during a 1993 site investigation conducted by Ecology and Environment, Inc. (E&E) in two monitoring wells (TVR-1 and TVR-2) installed near the TVR facility, two monitoring wells installed near the Old MATES (Building 951), and the Marie Well, a domestic drinking water well located southwest of both Buildings 845 and 951. TCE had been detected in the Marie Well before it was decommissioned in the late 1990s; however, TCE and other volatile organic compounds (VOCs) have not been detected in the Main Motor Pool (MMP) monitoring wells (MMP-1 and MMP-2) located in the vicinity of the former Marie Well. TCE and other VOCs have not been detected in either of the currently active water supply wells (Pomona and PAIC wells) located in the vicinity of monitoring wells TVR-6 and TVR-7 (Figure 4). TCE concentrations reported for the 2015 spring and fall sampling event are provided in the 2015 Annual Groundwater Monitoring Report (TtEC 2016).

Vehicle maintenance has been conducted and de-greasing solvents have been used at both facilities since about 1968 at Building 845 and 1975 at Building 951 (Shapiro & Associates 1991). Four 250-gallon underground storage tanks (USTs) used for waste oil were in use at Building 845 from 1975 until 1991 (Shapiro & Associates 1991, Pegasus 1993, SAIC 1995). A fifth waste oil UST (650 gallons) was used at Building 845 from 1980 until 1991 (Shapiro & Associates 1991, Pegasus 1993, SAIC 1995). One 2,000-gallon waste oil UST removed from Building 951 in 1995 was apparently in operation since 1968 (Shapiro & Associates 1991, SAIC 1995). All six of these former waste oil USTs have been removed. Three of the five waste oil

tanks at Building 845 and the 2,000-gallon waste oil UST at Building 951 were "clean closed" with soil concentrations below cleanup levels promulgated under the Model Toxics Control Act (MTCA) (CEcon Corporation 1994, SAIC 1995). However, as discussed in the investigation chronology section below, soil contamination from waste oil USTs 845-3 and 845-4 remained under adjacent structures following tank removal activities. It should be noted that a down gradient monitoring well (TVR-2) is located as close to the UST 845-3/4 excavation as possible. In addition, it should also be noted that a former floor drain from Building 845 discharged immediately adjacent to the current location of monitoring well (MW) TVR-1 (Cory 2004).

1.4 INVESTIGATION CHRONOLOGY

1.4.1 Facility-Wide Investigations

A facility-wide preliminary assessment of YTC was completed in the early 1990s by Shapiro & Associates, Inc. The preliminary assessment documented the aforementioned site uses, identified potential receptors, and concluded that sites such as the two sites covered by this report could potentially be releasing hazardous substances to groundwater as a result of historical activities.

A Site Screening Inspection (SSI) and Hazard Ranking System (HRS) Score for YTC were completed in January 1993 by Resource Applications, Inc. A HRS score was calculated, however, was not high enough for YTC to be considered for inclusion on the Comprehensive Environmental Response, Compensation, and Liability Act National Priority List.

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

The final Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) Report was completed in September 1995 by SAIC. The RFA for the entire installation was a result of a RCRA Part B Permit Application for the Range 14 open burning/open detonation area. The 1995 RFA indicated a high potential for releases to soil and possibly groundwater at the former FTP. As a result, remedial action to remediate contaminated soil and the petroleum product in well FTP 1 was recommended. Although the 1995 RFA did not explicitly address TCE in groundwater in the TVR/Old MATES area, the RFA recommended a corrective action for soil contamination that remained under a building adjacent to waste oil USTs 845-3 (Solid Waste Management Unit [SWMU] 43) and 845-4 (SWMU 44). RCRA corrective actions that were recommended or implied by the RFA need to satisfy MTCA regulations in accordance with WAC 173-303-646(3).

1.4.2 Fire Training Pit

The uppermost geologic unit at the former FTP site is the Pomona Flow of the Saddle Mountain Basalt Formation (E&E 1993, Schuster et al. 1997, Shannon & Wilson 2001). In general, this unit is present at a depth of approximately 5 to 10 feet below ground surface (bgs) at the site (E&E 1993, Shannon & Wilson 2001). Basalt apparently extends to an approximate depth of 150 feet bgs without significant interbeds at the site (E&E 1993, Shannon & Wilson 2001).

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

The former FTP was one of the YTC facilities/sites investigated in the September 1993 E&E Site Investigation (SI) Report. MW FTP 1 was installed and four grab surface or near surface soil samples and two composite surface soil samples were collected during the E&E SI. Significant groundwater was not encountered during the drilling of the FTP 1 borehole to a depth of approximately 140 feet. However, when it came time to decommission the FTP 1 borehole, several gallons of petroleum product were discovered on top of a column of water. As a result, FTP 1 was completed to a depth of approximately 20 feet in the perched groundwater located at the fractured top of the uppermost basalt flow.

A RCRA Facility Investigation Report to further delineate the nature and extent of contamination at the former FTP site was completed in November 2001 by Shannon & Wilson. Monitoring wells FTP 13 through 16 were installed during 1999 in the perched groundwater located at the fractured top of the uppermost basalt flow. Groundwater monitoring events were conducted in July 1999, November 2000, and May 2001. The Shannon & Wilson report claimed that light non-aqueous phase liquid (LNAPL) and dense non-aqueous phase liquid (DNAPL) were present in FTP 1 during each groundwater monitoring event. However, the thicknesses of LNAPL and DNAPL were not accurately quantified. Review of the field notes and observations from the January 2004 Groundwater Monitoring event indicted the DNAPL claim was in error (the LNAPL claim might have been in error as well). Nine other soil borings were also advanced during the investigation.

An interim remedial action was completed in 2003 to remove soil contamination caused by the former FTP site that exceeded MTCA Method A/Standard Method B cleanup levels. Soil was excavated during three separate mobilizations – July 2003, September 2003, and October 2003. The total excavation area was approximately 5,000 square feet and extended downward until the underlying basalt was encountered. A total of 1,351 tons of soil was disposed of off site in

November 2003. All contaminant concentrations in confirmation soil samples were reported below MTCA Method A/Standard Method B cleanup levels, except for gasoline- and diesel-range total petroleum hydrocarbons (TPH-G and TPH-D, respectively) in samples 13 and 14 collected from the soil/basalt interface. The excavation was backfilled with clean soil. The cleanup action was documented in a January 2004 Bay West report.

The terrestrial ecological pathway was closed as described in the April 2006 terrestrial ecological evaluation by Pacific Northwest National Laboratory.

The Fort Lewis contractor personnel conducted groundwater monitoring events in January 2004, March and August 2005, March and August 2006, March and September 2007, and March and September 2008. Between March 2005 and March 2007, four-inch diameter socks containing oxygen release compound from Regensis were hung in the water column between 11 to 18 feet bgs by Fort Lewis contractor personnel in FTP-1. When the socks were hung in FTP-1, depth to water ranged from 11.54 feet bgs in August 2006 to 15.59 feet bgs in March 2007.

Groundwater monitoring events have been conducted during the first and third quarters each year since 2005. Typically the first quarter sampling event is conducted in March, designated the "wet" season sampling event. The third quarter sampling event ("dry" season) is conducted in September.

1.4.3 TVR/Old MATES

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

The six E&E MWs "were completed within a fractured basalt zone confined aquifer, identified as the Selah Interbed [of the Ellensburg Formation] beneath the Pomona basalt flow" (E&E 1993). This was the first encountered groundwater during drilling. In general, depth to groundwater in these six MWs ranged from 60 to 100 feet bgs (E&E 1993). The direction of groundwater flow is to the west towards the Yakima River (E&E 1993).

In October 1991, Pegasus Environmental Management Services (Pegasus) evacuated, excavated, removed, cleaned, and disposed of five waste oil USTs at Building 845 (TVR). Pegasus noted visible surface contamination associated with three of the UST excavations. Soil samples from all excavations were analyzed for TPH, benzene, toluene, ethylbenzene, and xylenes (BETX), Toxicity Characteristic Leaching Procedure (TCLP) VOCs, and TCLP metals. TPH concentrations exceeding 10,000 mg/kg were detected in samples collected from all five UST excavations. TCLP TCE and TCLP tetrachloroethylene were detected at 20 milligrams per liter

(mg/L) and 17 mg/L, respectively, in samples collected from USTs 845-5 and 845-6 excavations respectively. No TCLP VOCs were detected in samples collected from USTs 845-3 (SWMU 43) and 845-4 (SWMU 44) excavations. No additional corrective action was taken by Pegasus due to contract limitations. CEcon Corporation was contracted to excavate and remove contaminated soil left in place following the tank removal activities by Pegasus. CEcon Corporation removed about 1,000 cubic yards of soil while excavating contaminated soil from the five Building 845 waste oil tank sites in October 1993. Confirmation samples collected by CEcon Corporation verified that no further action was required for USTs 845-2 (SWMU 42), 845-5 (SWMU 45), and 845-6 (SWMU 46). However, some TPH contaminated soil was left in place on the north and east sidewalls of the UST 845-3/4 (SWMUs 43/44) excavation because existing structures (Building 845 lube rack and oil-water separator) prevented further excavation in those directions (over 400 cubic yards of soil had already been removed). Although all confirmation samples collected by CEcon Corporation were analyzed for all potential contaminants suspected at the time, no confirmation samples were analyzed for VOCs.

TVR, Old MATES, and MMP were among the facilities/site investigated in the September 1993 E&E SI. Groundwater samples were collected from the two TVR MWs, the two MATES MWs, and the two MMP MWs as well as drinking water wells including the Pomona Well, PAIC Well, and Marie Well. In addition, soil samples were collected from each MW borehole during drilling and analyzed for VOCs, semivolatile organic compounds (SVOCs), pesticides/ polychlorinated biphenyls, metals, and TPH. Based on the presence of TCE in groundwater at TVR and Old MATES and the absence of any contamination in corresponding soil samples, the SI Report concluded that TCE contamination in groundwater "may indicate migration from an unidentified source at the YTC facility."

In January 2004, Fort Lewis contractor personnel conducted a groundwater monitoring event. Between October and November 2004, Fort Lewis contractor personnel installed MWs MTS-3, MTS-4, TVR-3, and TVR-4. In October 2005, Fort Lewis contractor personnel installed MWs TVR-5, TVR-6, TVR-7, and 815-2. Groundwater monitoring events for the TVR Old MATES site have been scheduled to coincide with the FTP events during the first and third quarters each year since 2005.

Groundwater samples have been collected from monitoring wells using disposable passive diffusion bag (PDB) samplers since 2005. PDB samplers are sealed, low-density polyethylene bags filled with de-ionized water. A dedicated string and harness are used to position the PDB samplers approximately 2 to 4 feet above the bottom of the monitoring wells' screens. It is recommended that PDBs stay deployed in monitoring wells for a minimum of two weeks to allow VOC concentrations inside the bag and in the aquifer to reach equilibrium (Vroblesky 2001). From 2005 to 2010, PDBs were deployed during the previous groundwater monitoring event allowing the bags to stay in the monitoring wells for approximately 6 months. Beginning in 2010, PDBs were deployed during the second and fourth quarter sampling events for another

YTC groundwater monitoring site, allowing the PDBs to stay in the wells for approximately 3 months.

1.5 POTENTIAL GROUNDWATER RECEPTORS

The nearest potential groundwater receptors to the FTP and TVR/Old MATES sites are the Pomona Well and PAIC Well. A third well, the Marie Well, was decommissioned in the late 1990s and is no longer a potential receptor (Figure 4). Before being decommissioned, the Marie Well served as an emergency supply backup well to the Pomona Well for the YTC Cantonment Area Water System. The Pomona and PAIC wells are domestic water supply wells located approximately 1 mile southwest of the FTP site and approximately 250 feet southwest of MW TVR-1. The Pomona Well is an artesian well used by YTC as a primary production source for the Cantonment Area Water System. The Pomona Well is completed in the Wanapum and/or Grande Ronde Formation (Hong West 1996) with open borehole completion between depths of approximately 353 and 407 feet bgs (Fain 2000, Cory 2004). Sources of information provided incorrect information about the well construction details of the Pomona Well (including a typo in Table 2-1 of the current Water System Plan) (Cory 2004). A downhole video survey conducted by YTC in 1995 is considered to be the most accurate source of construction detail information for the Pomona Well to date. In addition to indicating the open interval referenced above, the video survey also indicated that water was entering the Pomona Well at approximately 401 feet bgs (Fain 2000).

The PAIC Well is an artesian well used by PAIC as the sole production well for the PAIC Water System serving approximately 60 homes and businesses located west of YTC (Wilson 2004). It appears that the PAIC Well was constructed in an identical fashion as the Pomona Well. Both wells were installed by the PAIC in 1913, by the same driller, within 100 feet of each other (Fain 2000). Well logs from pump tests conducted in 1940 indicate identical (although very generic) well construction details for the Pomona Well and PAIC Well (Fain 2000). The construction details reported during the 1940 pump testing indicated 10-inch diameter casings were installed to a depth of 60 feet bgs, and 6 and 5/8-inch diameter casings were installed from 60 feet bgs to 430 bgs for both wells. Since the video survey of the Pomona Well showed the 1940 well log and other sources of post-drilling anecdotal information to be incorrect with respect to the actual well construction details of the Pomona Well, it is reasonable to assume that the video survey is also a more accurate representation of well construction details for the PAIC Well than the 1940 well log. Again, the basis for assuming nearly identical well construction details for the Pomona Well and PAIC Well are: both wells are artesian, both wells have similar production capacities, both wells were installed at the same time and location by the same well driller for the same water system, and both wells have identical 1940 well logs.

Given the distance of both the Pomona Well and PAIC Well from the FTP site and the hydraulic separation between the perched groundwater and the aquifer(s) the water supply wells are completed in, it is unlikely that these potential receptors are being impacted by the FTP site. It is

also unlikely that either water supply well would be impacted by TCE contamination in the TVR/Old MATES area given the relatively low TCE concentrations in MWs and the hydraulic separation between the Selah Interbed and the aquifer(s) the water supply wells are completed in. Existing water quality data from the Pomona and PAIC Well supports this conclusion.

2. FIELD SAMPLING PLAN

This SAP is designed to present all the required planning documentation to support groundwater monitoring in accordance with Washington State Department of Ecology (Ecology) regulations (WAC 173-340-820 and applicable Ecology guidance [1995, 2001]).

2.1 PROJECT PERSONNEL AND RESPONSIBILITIES

The project team includes representatives from Ecology, JBLM Public Works' ERP, YTC Public Works, TtEC and ALS Environmental Laboratories (ALS) of Kelso, Washington (Table 1).

2.2 PRIOR COORDINATION

Before beginning each groundwater monitoring event, JBLM contractor personnel will ensure that a contract delivery order with ALS is established, will notify YTC and Ecology personnel about the planned activities, and will coordinate with YTC and PAIC regarding access to the Pomona Well and PAIC Well, respectively.

2.3 GROUNDWATER MEASUREMENT, SAMPLING, AND ANALYSIS

JBLM contractor personnel or their contractor will conduct groundwater sampling events semiannually typically during March and September. Monitoring well locations for the FTP are presented on Figure 3. Monitoring well and production well locations for the TVR/Old MATES are presented on Figure 4. Monitoring well construction details are presented in Table 2. A summary of the planned monitoring frequency and analytical methods for the FTP and TVR/Old MATES site is presented in Tables 3 and 4, respectively. Field Sampling Forms are contained in Appendix B. Standard Operating Procedures are included in Appendix C.

2.3.1 Fire Training Pit

During each groundwater monitoring event, an electronic water level indicator will be used to measure depth to water in each monitoring well except FTP 1. If LNAPL is present, an electronic interface probe will be used to measure LNAPL thickness and depth to water in FTP 1. All measurements will be recorded to the nearest 0.01-foot from the top of the PVC casing (notch or mark on casing or north end).

For each MW scheduled to be sampled, water will be purged from the MW by hand bailing prior to sampling. Dedicated, disposable Teflon bailers will be used to purge and sample each MW. Each MW will be purged until three well volumes are removed or until the MW is bailed dry, whichever occurs first. After each MW has recharged, groundwater samples will be collected.

Groundwater samples collected from all MWs scheduled for sampling will be analyzed for TPH-G using Method NWTPH-G and diesel and heavy oil range TPH (TPH-D and TPH-O, respectively) using Method NWTPH-Dx. In addition, samples collected from MW FTP 1 will be

analyzed for VOCs using U.S. Environmental Protection Agency (EPA) Method 8260C and SVOCs using EPA Method 8270C. VOCs will be collected first before the other analytes. All 40-mL volatile organic analysis (VOAs) used for VOC and TPH-G analyses will be filled to a positive meniscus so that these containers do not contain any headspace. VOAs containing preservative will not be allowed to overflow during sampling.

Table 4 presents the appropriate sample containers, preservation, and holding times for scheduled analyses. Sample containers will be provided by the analytical laboratory prior to sampling.

2.3.2 TVR/Old MATES

During each groundwater monitoring event, an electronic water level indicator will be used to measure depth to water in each MW. All measurements will be recorded to the nearest 0.01-foot from the measuring point on the top of the PVC casing (notch or mark or north end).

For each MW scheduled to be sampled, groundwater samples will be collected using disposable PDB samplers. PDB samplers are sealed, low-density polyethylene bags filled with de-ionized water. A dedicated string/harness will be used to position the PDB sampler at approximately 2 to 5 feet above the bottom of the MW screen. PDB samplers will be installed during the previous quarter when contractor personnel are onsite conducting sampling activities for other groundwater monitoring sites.

PDB trip blanks will be collected when PDBs are received and deployed at the site and the results will be used with the sample data from the subsequent sampling round when the well PDBs are retrieved and sampled.

During each groundwater monitoring event, JBLM or their contractor will collect a sample from the Pomona Well and the PAIC Well.

All primary groundwater samples will be analyzed for VOCs using EPA Method 8260C. All 40-mL VOAs for VOC analyses will be filled to a positive meniscus so that these containers do not contain any headspace.

Table 4 presents the appropriate sample containers, preservation, and holding times for scheduled analyses. Sample containers will be provided by the analytical laboratory prior to sampling.

2.4 CHANGES TO THE 2007 GROUNDWATER MONITORING PLAN

There were no changes to the TVR Old/MATES sampling events in this 2017 plan compared to the previous 2016 plan. Only Figure 2 was revised at Ecology's request to show the location of off-site drinking water wells.

2.5 FIELD RECORDKEEPING

JBLM contractor personnel will utilize the following forms to document each Groundwater monitoring event: Field Checklist, Daily Field Report, and Groundwater Monitoring Form. The Field Checklist is designed to assist with planning and coordination prior to a field event. The Daily Field Report is used to document field activities on a daily basis. The Groundwater Monitoring Form is used to record and maintain monitoring, purging, sampling, and waste disposal data. Once completed, JBLM will maintain the original signed forms for at least 3 years after copies of the forms are included in an annual monitoring report.

2.6 EQUIPMENT DECONTAMINATION PROCEDURES

Monitoring wells at the FTP are sampled using dedicated, disposable Teflon bailers, groundwater level indicators and interface probes used to measure water levels will be decontaminated using Alconox and deionized water spray and will be wiped clean and dry prior to or after sampling a well. Monitoring wells at the TVR Old/MATES site are sampled using dedicated, disposable PDBs and do not have any sampling equipment that needs to be decontaminated prior to or after sampling a well. Personal decontamination is discussed in the APP/SSHP (SES 2014).

2.7 INVESTIGATION-DERIVED WASTE

Investigation-derived waste generated during each groundwater monitoring event will be handled and disposed of as follows:

- Purge water and decontamination water from FTP 1 through FTP 16 will be collected in 5-gallon buckets and disposed of on-site at a Main Vehicle Washrack catch basin for subsequent treatment with an oil/water separator.
- Personal protective equipment (PPE) and disposable equipment, including PDBs used at the TVR Old/MATES site, will be disposed of in a YTC dumpster or roll off box as part of the normal YTC solid waste stream.

2.8 SAMPLE LABELING, HANDLING, AND SHIPMENT

Sample labels will clearly indicate the site location, sample name, date, time, sampler's initials, parameters to be analyzed, preservative added (if any), and any pertinent comments. Sample nomenclature will consist of the MW name (e.g., FTP-1).

Sample packaging and shipping procedures are based on EPA specifications and United States Department of Transportation regulations as specified in 49 *Code of Federal Regulations* (CFR) 173.6 and 49 CFR 173.24. All samples will be shipped as “Environmental Samples” and not as hazardous material. Samples will either be shipped via ground transportation to local (Washington State) laboratory or transported directly to the lab by the field technician as soon as reasonably possible after sample collection. The following are general packaging procedures:

- Sample labels will be securely attached to each sample container.

- Plastic bubble-wrap bags, sheets, or Styrofoam packing material will be used to protect sample containers.
- Insulated plastic or metal-clad plastic coolers will be used as shipping containers.
- All samples will be chilled with ice.
- The original chain-of-custody form (see also below) will be placed inside the cooler in a sealed plastic bag.
- Two signed custody seals will be placed over the lid of the cooler and covered with clear plastic tape.
- The cooler will be securely taped shut with strapping tape and drains will be taped shut.
- The cooler will then be shipped, sent by courier, or hand delivered to ALS for analysis.

2.9 CHAIN-OF-CUSTODY DOCUMENTATION

Chain-of-custody (COC) procedures are employed to maintain and document sample possession. A sample is considered under a person's custody if it is in that person's physical possession, within visual sight of that person after taking physical possession, secured by that person so that the sample cannot be tampered with, or secured by that person in an area that is restricted to authorized personnel only.

The originator (the sampler) will fill in all requested information on the custody record and will sign and date the record in the first “relinquished by” box. Original signed custody records listing the samples in the cooler will accompany all shipments of samples (note: it is possible that more than one custody form will be needed per cooler to list all the samples contained in the cooler). The originator of the custody record will keep the bottom copy (usually pink) in the project files.

2.10 PROJECT REPORTING

After completion of each fall groundwater monitoring event, an annual Groundwater Monitoring Report will be prepared that includes:

- Brief site chronology
- Brief discussion of sampling methodology including any deviations from this SAP
- Two FTP and two TVR/Old MATES site maps (one for each groundwater monitoring event) showing relevant surface features, sampling locations, the estimated potentiometric surface contours based on measurements obtained during the groundwater monitoring event, and contaminant concentrations obtained during the groundwater monitoring event
- A summary table of historical and recent contaminant concentrations and comparison with MTCA Method A or Standard Method B cleanup levels for each site

- Statistical summary of key analytes detected in MW FTP 1 and multiple MWs for the TVR Old/MATES site
- Plot showing key contaminant concentrations in MW FTP 1 over time
- Copies of original field forms
- Laboratory certificates of analysis with chain-of-custody records
- Brief discussion of QA/quality control (QC) review and verification process including implications for project data as described in Quality Assurance Project Plan (QAPP)

A draft copy of the report will be submitted to Ecology's Project Manager. Comments provided by Ecology will be addressed and a final report will be produced. If no comments received are received from Ecology within 3 months following submittal of the draft report, the draft report will be considered "Final."

2.10.1 Analysis of Data

Gasoline range, diesel range and heavy oil range total petroleum hydrocarbons (TPH-G, TPH-D, and TPH-O, respectively) concentrations will be analyzed in samples collected from FTP monitoring wells. TCE concentration will be analyzed in samples collected from the TVR/Old MATES site. Summary statistics will be calculated using Microsoft Excel's Descriptive Statistics tool. Shapiro Wilkes test for normality and linear regression analysis will be performed on the data using a Microsoft Excel add in, Analyse-It®. The Mann - Kendall correlation test will be performed on non-parametric TCE data using Analyse-It.

All concentration measurements not known to be in error are considered valid; suspect "outliers" are not removed from the data set and will be included in the analyses. Non-detect data, which represent concentration measurements below the practical quantification limits (PQL) but above the minimum detection limit for each constituent, will be evaluated at the reporting limit value: e.g., if the reporting limit is 0.5 µg/L then the concentration value is set at 0.5 µg/L. PQLs for all of the contaminants of concern for both the TVR/ Old MATES and FTP sites are presented in Table 4. All of the PQLs are below or equal to MTCA A and B cleanup levels for the constituent.

2.10.2 Shapiro Wilk Test for Normality

Prior to analyzing data for trends, the data was tested for normal distribution. The null and alternate hypotheses are a summary of a test's objectives which, in this case, is to test for the data's distribution. The null hypothesis, or what is assumed to be true before given evidence that it may be false, for all tests for normality is that a dataset is normally distributed. The alternate hypothesis, then, is that a dataset is not normally distributed (Helsel and Hirsch 2002). A significance level, or alpha level, of 0.05 will be used when determining whether historical data from monitoring wells was normally distributed or not. P values, generated using the Shapiro Wilk Test for Normality, will then be compared to the alpha level. The alpha level is the

"cutoff" point for the test statistic in making a decision whether the data was normally distributed or not. P values show the strength of the test in determining whether the data were normally distributed or not. P values range from 0 to 1. The closer a P value is to 1, the better the dataset is normally distributed. P values equal to or below 0.05 (alpha level) were not considered normally distributed.

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

2.10.3 Linear Regression and Mann-Kendall Correlation Analyses

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

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

2.10.4 Total Toxic Equivalent Concentrations of cPAHs

During YTC's 5-year review conducted by the U.S. Army Corps of Engineers (USACE) in 2011, it was noted that the updated 2007 groundwater monitoring plan states that total carcinogenic polycyclic hydrocarbons (cPAHs) for the FTP would be evaluated using the total toxic equivalent concentration of benzo(a)pyrene method outlined in WAC 173-340-708(8)(e) Concentrations of cPAHs, which include benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluroanthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene are typically reported by the lab. The measured concentration of each cPAH is then multiplied by its corresponding toxicity equivalency factor (TEF) in Table 708-2 (WAC 173-340-900) to obtain the TEF of benzo(a)pyrene for each cPAH. The TEFs for each cPAH are then added together to obtain the toxic equivalent concentration (TEC) of benzo(a)pyrene for that sample. If the TEC for the six cPAHs listed above are equal to or greater than 0.1, then the cPAHs are above the MTCA Method A cleanup level of 0.1 µg/L for cPAHs. The cPAHs that are not detected at their laboratory PQL do not have a TEF calculated.

2.11 PROJECT SCHEDULE

The planned schedule for fieldwork and reporting is presented below:

- First quarter sampling event will be conducted in February or March of each year.
- Third quarter PDBs will be deployed in MWs in May or June.
- Third quarter sampling event will be conducted in August or September of each year.
- First quarter PDBs will be deployed in MWs in November or December.
- Draft Groundwater Monitoring Report will be submitted to JBLM by 01 December.
- Final Groundwater Monitoring Report will be submitted to Ecology 30 days after Ecology's comments on draft.
- Annual LUC inspections will be conducted in December.

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3. QUALITY ASSURANCE PROJECT PLAN

The following QAPP is designed to show plans for compliance with QA/QC portions of a SAP per WAC 173-340-820 as well as general agreement with Ecology guidance (2001). It should also be noted that some elements of a typical QAPP are not repeated if included elsewhere in this SAP.

The purpose of QA/QC procedures for this site is to provide assurance that field and analytical procedures produce data of acceptable quality to support site-specific decisions such as evaluation of site compliance with MTCA regulations.

3.1 FIELD QUALITY CONTROL SAMPLES

3.1.1 Fire Training Pit

A duplicate sample will be collected from one MW during either the first or third quarter sampling event and will be analyzed for TPH-G, TPH-D, and TPH-O. A trip blank provided by the project laboratory for each sampling event will be analyzed for total VOCs.

3.1.2 TVR/Old MATES

A duplicate sample will be collected from one MW during each sampling event and will be analyzed for total VOCs. A trip blank provided by the project laboratory for each sampling event will be analyzed for total VOCs.

3.2 LABORATORY QUALITY CONTROL

The project laboratory will be responsible for conducting laboratory QC procedures and reporting laboratory QC results in accordance with its standard operating procedures. It is expected at a minimum that the project laboratory will perform and report the following laboratory QC once per batch of VOC or SVOC samples for select analytes (the standard EPA Contract Laboratory Program analytes): method blank, blank spike, matrix spike, and matrix spike duplicate. Field QC samples will be labeled the same sample number as the parent sample and will be provided to the laboratory blind. It is expected at a minimum that the project laboratory will perform and report the following laboratory QC once per batch of TPH-G or NWTPH-Dx samples: blank and blank spike. Also, it is expected that the laboratory will perform and report results of surrogate recovery for every VOC, SVOC, TPH-G, and NWTPH-Dx sample.

3.3 PRACTICAL QUANTIFICATION LIMITS

Contaminants of potential concern at FTP are TPH-G, TPH-D, TPH-O, benzene, total cPAHs, total naphthalenes, and bis-(2-ethylhexyl) phthalate. Contaminants of potential concern at TVR/Old MATES are TCE and cis-1,2-dichloroethylene. Table 4 presents a comparison of MTCA Method A/B groundwater cleanup levels with PQL expectations for each contaminant of

potential concern. Although TPH-G, TPH-D, TPH-O, and total cPAHs do not satisfy the Ecology rule of thumb to ideally have PQLs at least 10 times lower than the regulatory limit (Ecology 2001), all PQLs are within an acceptable range (Ecology 1995). Although total cPAHs have an expected PQL above the MTCA Method A cleanup level, the expected PQLs for total cPAHs are appropriate and could be used as the cleanup standard in accordance with WAC 173-340-720(7)(c). Thus, it is expected that the current project laboratory will be able to achieve PQLs of appropriate sensitivity for comparisons between project data and MTCA cleanup levels.

It should also be noted that some samples (i.e., those collected from FTP 1) might need to be diluted prior to analysis, which will result in higher PQLs.

3.4 QA/QC REVIEW AND VERIFICATION

The overall data quality will be reviewed and verified by JBLM contractor personnel to determine the appropriateness of project-related data. Project data as well as QA/QC data (i.e., field QC results, lab QC results, PQLs, and holding times) will be evaluated in terms of precision, accuracy, representativeness, comparability, completeness, and sensitivity. Results of this evaluation will be summarized in the project report. Corrective action for field or laboratory procedures will be taken as needed in consultation with Ecology.

4. REFERENCES

Bay West. 2004. Closure Report for Remedial Action – Various IRP Sites at YTC, January.

Bussey, T. 2007. Updated Groundwater Monitoring Plan for FTP and TVR/Old MATES, November.

CEcon Corporation. 1994. Field Report for DACA67-92-D-1018/0002 – Remove, Transport, Treat and Dispose of Contaminated Soil – Yakima Training Center, April.

Cory, B. 2004. YTC water system operator, personal correspondence regarding YTC Cantonment Area Water System, PAIC Water System, and Building 845 historical operations, January.

E&E (Ecology and Environment Inc.) 1993. Site Investigation Report – Yakima Training Center, September.

Ecology (Washington State Department of Ecology). 1995. Guidance on Sampling and Data Analysis Methods, January. Ecology Publication No. 94-49.

Ecology. 2001. Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies, February. Ecology Publication No. 01-03-003.

EPA (U.S. Environmental Protection Agency). 2002. Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers, EPA Publication No. 542-S-02-001, May.

Fain, L. 2000. Transmittal of Cantonment Area well logs and video survey report for Pomona Well to Rich Wilson, August.

Gray & Osborne. 2003. Yakima Training Center Small Water System Management Plan, December.

Helsel, D.R., and R. M. Hirsch. 2002. *Chapter A3 Statistical Methods in Water Resources*. Book 4 - Hydrologic Analysis and Interpretation. Techniques of Water – Resources Investigations of the United States Geological Survey.

HongWest & Associates. 1996. Delineation Report for Yakima Training Center Wellhead Protection Plan, April.

Pacific Northwest National Laboratory. 2006. Terrestrial Ecological Evaluations Yakima Training Center Sites, April.

Pegasus Environmental Management Services Inc. 1993. Final Field Report for Yakima Firing Center WO#0003 – Contract #DACA67-91-D-1011, January.

Resource Applications Inc. 1993. Hazard Ranking System (HRS2) Score for the Yakima Training Center, January.

Resource Applications Inc. 1993. Site Screening Inspection (SSI) for the Yakima Training Center, January.

Schuster, J.E., C.W. Gulick, S.P. Reidel, K.R. Fecht, and S. Zurenko. 1997. Geologic Map of Washington – Southeast Quadrant. Washington Division of Geology and Earth Resources Geologic Map GM-45.

SAIC (Science Applications International Corporation). 1995. Final RCRA Facility Assessment Report – U.S. Army Yakima Training Center, September.

SES (Sealaska Environmental Services). 2014. Accident Prevention Plan, Environmental Remediation Program Services Joint Base Lewis McChord and Yakima Training Center, Washington. September.

Shannon & Wilson. 2001. Fire Training Pit (SWMU-59) RCRA Facility Investigation Report, November.

Shapiro & Associates Inc. 1991. Draft Preliminary Assessment of Yakima Firing Center, February.

TtEC (Tetra Tech EC, Inc.). 2016. Final 2015 Annual Groundwater Monitoring Report, Fire Training Pit (FTP) and Tracked Vehicle Repair/Old Mobilization and Training Equipment Site (TVR/Old MATES), Joint Base Lewis-McChord and Yakima Training Center, Yakima, Washington. JBLM Public Works – Environmental Division. August.

Vroblesky, D.A. 2001. User's Guide for Polyethylene-Based Passive Diffusion Bag Samplers to Obtain Volatile Organic Compounds Concentrations in Wells- Water-Resources Investigations Report 01-4060 US Geological Survey.

Wilson, M. 2004. DOH Drinking Water Regional Engineer for Yakima County, information from Washington State Department of Health – Drinking Water Division files, personal correspondence, January.

Yakima Health District. 1995. Final Report on Yakima Training Center Project, March.

TABLES

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Table 1 - Project Personnel Roles and Responsibilities
FTP and TVR / Old MATES, Yakima Training Center, Washington 98901

Organization	Name	Title	Responsibilities
Joint Base Lewis-McChord Public Works	Meseret Ghebresllassie	Installation Restoration Program Manager	Final review, report signatory
Seattle District USACE	William Graney	Contracting Officer's Representative	Report review
U.S. Army Environmental Command	David Mays	USAEC Program Manager	Report review
Yakima Training Center Public Works	Margaret Taaffe	Chief, Environmental Division	Report review
Washington Department of Ecology	Greg Caron	Central Region Section Site Manager (hazardous waste and toxics reduction program)	Regulation overview
Sealaska Environmental Services, LLC	Scott Elkind	Project Manager	Project oversight
Tetra Tech EC, Inc.	Brent Jones	IRP Program Lead	Overall project performance, document review
	Mark Ingersoll	IRP Task Manager	Budget, schedule, quality, task performance, primary POC
	Dana Ramquist	Field Operations Lead/SSHO	Safety performance, technical task execution
	Keir Craigie	Data Quality Manager	Ensure data quality, data validation
ALS Environmental Laboratories	Gregory Salata	Project Point of Contact	Final analytical report signatory

Abbreviations and Acronyms:
FTP - fire training pit
IRP - Installation Restoration Program
MATES - Mobilization and Training Equipment Site
POC - point of contact
SSHO - Site Safety and Health Officer
USACE - U.S. Army Corps of Engineers

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Table 2 - Monitoring Well Construction Details

FTP and TVR / Old MATES, Yakima Training Center, Washington 98901

Well ID	Elevation at TOC (ft AMSL)	Ground Surface Elevation (ft AMSL)	Easting UTM (m)	Northing UTM (m)	Total Depth (ft)	Screen Interval (ft bgs)	Date Installed
Fire Training Pit Monitoring Wells							
FTP 1	1467.72	1464.59	695828.3	5173198.0	21.0	8-18	28-Jun-99
FTP 13	1473.07	1470.96	695878.5	5173153.0	25.0	10-20	7-Sep-99
FTP 14	1457.48	1455.35	695771.4	5173185.2	22.0	12-22	8-Sep-99
FTP 15	1460.88	1458.72	695783.1	5173228.9	20.0	10-20	9-Sep-99
FTP 16	1444.81	1442.68	695722.0	5173050.7	30.0	20-30	22-Sep-99
TVR / Old Mates Monitoring Wells							
815-2	1304.28	1301.86	694687.7	5172445.5	132.0	115-130	12-Oct-05
MMP-1	1301.37	1298.39	694553.4	5172215.3	100.5	88-98	2-Mar-93
MMP-2	1301.31	1298.55	694529.6	5172207.9	75.5	64-74	3-Mar-93
MRC-2	1312.11	1309.64	694558.9	5172939.9	113.5	101-111	1-Mar-93
MTS-1	1361.02	1359.05	695196.9	5172404.6	127.0	115-125	24-Feb-93
MTS-2	1351.88	1348.79	695135.9	5172405.4	113.0	101-111	25-Feb-93
MTS-3	1362.36	1362.62	695366.1	5172439.6	72.0	62-72	27-Oct-04
MTS-4	1331.88	1332.14	695078.6	5172347.7	97.0	82-97	28-Oct-04
TVR-1	1320.17	1317.32	694936.0	5172286.6	105.0	93-103	25-Feb-93
TVR-2	1317.56	1314.18	694910.0	5172337.7	95.0	83-93	26-Feb-93
TVR-3	1310.60	1310.86	694872.9	5172282.5	158.0	143-158	29-Oct-04
TVR-5	1302.04	1299.42	694704.2	5172275.0	142.0	132-142	18-Oct-05
TVR-6	1310.06	1310.30	694866.4	5172214.0	139.0	139-149	20-Oct-05
TVR-7	1310.95	1311.63	694882.5	5172255.6	140.0	140-150	22-Oct-05

Abbreviations and Acronyms:

ft AMSL = feet above mean sea level
ft bgs = feet below ground surface
m = meters
TOC = top of casing

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Table 3 - Groundwater Sampling Schedule
FTP and TVR / Old MATES, Yakima Training Center, Washington 98901

Table 3a - Fire Training Pit (FTP) Sampling Schedule

	1st Quarter Sampling Event					3rd Quarter Sampling Event				
Well ID	DTW Measured	TPH-G	TPH-D / TPH-O	VOCs	SVOCs	DTW Measured	TPH-G	TPH-D / TPH-O	VOCs	SVOCs
FTP 1	X	X	X	X	X	X	X	X	X	X
FTP 13	X					X				
FTP 14	X	X	X			X	X	X		
FTP 15	X	X	X			X	X	X		
FTP 16	X	X	X			X	X	X		
Duplicate		X	X				X	X		
Total	5	5	5	1	1	5	5	5	1	1

Table 3b - TVR / Old MATES Sampling Schedule

	1st Quarter Sampling Event		2nd Quarter	3rd Quarter Sampling Event		4th Quarter
Well ID	DTW Measured	VOCs	PDB Installed	DTW Measured	VOCs	PDB Installed
815-2	X	X	X	X	X	X
MMP-1	X	X	-	X	-	-
MMP-2	-	-	-	-	-	-
MRC-2	-	-	-	-	-	-
MTS-1	X	X	X	X	X	X
MTS-2	X	X	X	X	X	X
MTS-3	X	-	-	X	-	-
MTS-4	X	X	X	X	X	X
Pomona	-	X	-	-	X	-
PAIC	-	X	-	-	X	-
TVR-1	X	X	X	X	X	X
TVR-2	X	X	-	X	-	-
TVR-3	X	X	X	X	X	X
TVR-5	X	X	X	X	X	X
TVR-6	X	X	X	X	X	X
TVR-7	X	X	X	X	X	X
Duplicate	-	X	-	-	X	-
Trip Blank	-	X	-	-	X	-
Total	12	14	9	12	13	9

Notes:
First quarter (January through March) sampling event is typically conducted in March.
Second quarter (April through June) PDB installation event is typically conducted in June.
Third quarter (July through September) sampling event is typically conducted in September.
Fourth quarter (October through December) PDB installation event is typically conducted in December.

Abbreviations and Acronyms:
DTW = depth to Water
TPH-G = gasoline range total petroleum hydrocarbons analyzed using method NWTPH-Gx.
TPH-D / TPH-O = diesel and heavy oil range total petroleum hydrocarbons are analyzed using method NWTPH-Dx.
VOCs = volatile organic compounds are analyzed using EPA Method 8260C.
SVOCs = semivolatile organic compounds are analyzed using EPA Method 8270D.

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Table 4a - Sample Preparation and PQLs
FTP and TVR / Old MATES, Yakima Training Center, Washington 98901

Analytical Method	Container Description	Preservation	Holding Time	Typical Lab PQLs µg/L	MTCA Method A Cleanup Level µg/L	Laboratory PQL (µg/L)	Labortory MDL (µg/L)	Laboratory QC limits 1/
EPA Method 8260C (VOCs)	Two 40ml glass VOA vials with Teflon septa lids	Cool to 4ºC, HCl preserved, no headspace	14 days	0.5 to 1.5	TCE = 5.0	0.5	0.1	77 - 123
					Benzene = 5.0	0.5	0.1	77 - 121
NWTPH-Gx (TPH-G)	Two 40ml glass VOA vials with Teflon septa lids	Cool to 4ºC, HCl preserved, no headspace	14 days	100	800	250	25	80 - 119
NWTPH-Dx (TPH-D, TPH-HO)	Two 1L amber glass jars	Cool to 4ºC, HCl preserved	1 month	250, 500	500	110	20	46 - 140
EPA Method 8270D (SVOCs)	Two 1L amber glass jars	Cool to 4ºC	1 month	0.5 - 2	Benzo(a)pyrene = 0.1	10	0.5 2/	46 - 159

Notes:

1/ Laboratory QC limits are the lower and upper control limits from the DoD QSM 5.0 (July 2013) except for the TPH methods which are the laboratory limits

2/ Benzo(a)pyrene has not been historically detected in groundwater and the laboratory MDL has been acceptable for project needs

Abbreviations and Acronyms:

PQL = practical quantification limit
µg/L = micrograms per liter
MTCA = Model Toxics Control Act - Chapter 173-340 WAC
VOCs = volatile organic compounds
ml = milliliters
HCl = hydrochloric acid
TCE = trichloroethylene
TPH-G = gasoline range total petroleum hydrocarbons
TPH-D / TPH-O = diesel and oil range total petroleum hydrocarbons
SVOCs = semivolatile organic compounds

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Table – 4b. Organic Analysis by Gas Chromatography/Mass Spectrometry

(From Table 3 QSM 5.0, Appendix B)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Tune Check	Prior to ICAL and prior to each 12-hour period of sample analysis.	Specific ion abundance criteria of BFB or DFTPP from method.	Retune instrument and verify.	Flagging is not appropriate	No samples will be analyzed without a valid tune.
Performance Check (Method 8270 only)	At the beginning of each 12-hour period, prior to analysis of samples.	Degradation ≤ 20% for DDT. Benzidine and pentachlorophenol will be present at their normal responses, and will not exceed a tailing factor of 2.	Correct problem, then repeat performance checks.	Flagging is not appropriate	No samples will be analyzed until performance check is within criteria. The DDT breakdown and benzidine/pentachlorophenol tailing factors are considered overall system checks to evaluate injector port inertness and column performance and are required regardless of the reported analyte list.
Initial Calibration (ICAL) for all Analytes (including surrogates)	At instrument setup, prior to sample analysis.	Each analyte must meet one of the three options below: Option 1: RSD for each analyte ≤ 15%; Option 2: linear least squares regression for each analyte: $r^2 \geq 0.99$; Option 3: non-linear least squares regression (quadratic) for each analyte: $r^2 \geq 0.99$	Correct problem, then repeat ICAL.	Flagging is not appropriate	Minimum 5 levels for linear and 6 levels for quadratic. No samples will be analyzed until ICAL has passed. If the specific version of a method requires additional evaluation (e.g., RFs or low calibration standard analysis and recovery criteria) these additional requirements must also be met.
Retention Time Window Position Establishment	Once per ICAL and at the beginning of the analytical sequence.	Position will be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA	NA	Required for each analyte and surrogate.

Table – 4b. Organic Analysis by Gas Chromatography/Mass Spectrometry

(From Table 3 QSM 5.0, Appendix B)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Evaluation of RRT	With each sample.	RRT of each reported analyte within ± 0.06 RRT units.	Correct problem, then rerun ICAL.	NA	RRTs may be updated based on the daily CCV. RRTs will be compared with the most recently updated RRTs.
ICV	Once after each ICAL, analysis of a second source standard prior to sample analysis.	All reported analytes within ± 20% of true value.	Correct problem. Rerun ICV. If that fails, repeat ICAL.	Flagging is not appropriate.	No samples will be analyzed until calibration has been verified with a second source.
CCV	Daily before sample analysis; after every 12 hours of analysis time; and at the end of the analytical batch run.	All reported analytes and surrogates within ± 20% of true value. All reported analytes and surrogates within ± 50% for end of analytical batch CCV.	Recalibrate, and reanalyze all affected samples since the last acceptable CCV; or Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and re-calibrate; then reanalyze all affected samples since the last acceptable CCV.	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since last acceptable calibration verification.	Results may not be reported without a valid CCV. Flagging is only appropriate in cases where the samples cannot be reanalyzed. If the specific version of a method requires additional evaluation (e.g., average RFs) these additional requirements must also be met.
IS	Every field sample, standard and QC sample.	Retention time within ± 10 seconds from retention time of the midpoint standard in the ICAL; EICP area within - 50% to +100% of ICAL midpoint standard.	Inspect mass spectrometer and GC for malfunctions and correct problem. Reanalysis of samples analyzed while system was malfunctioning is mandatory.	If corrective action fails in field samples, data must be qualified and explained in the case narrative. Apply Q-flag to analytes associated with the non-compliant IS. Flagging is not appropriate for failed standards.	

Table – 4b. Organic Analysis by Gas Chromatography/Mass Spectrometry

(From Table 3 QSM 5.0, Appendix B)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
MB	One per preparatory batch.	No analytes detected > $^1/_2$ LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater. Common contaminants must not be detected > LOQ.	Correct problem. If required, reprep and reanalyze MB and all samples processed with the contaminated blank.	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch.	Results may not be reported without a valid method blank. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
LCS	One per preparatory batch.	A laboratory must use the QSM Appendix C Limits for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch.	Must contain all surrogates and all analytes to be reported. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
MS	One per preparatory batch.	A laboratory must use the QSM Appendix C Limits for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified.	Examine the project-specific requirements. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met and explain in the case narrative.	Must contain all surrogates and all analytes to be reported. If MS results are outside the limits, the data will be evaluated to determine the source(s) of difference, i.e., matrix effect or analytical error.
MSD or MD	One per preparatory batch.	A laboratory must use the QSM Appendix C Limits for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified. MSD or MD: RPD of all analytes ≤ 20% (between MS and MSD or sample and MD).	Examine the project-specific requirements. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met and explain in the case narrative.	MSD: Must contain all surrogates and all analytes to be reported. The data will be evaluated to determine the source of difference.

Table – 4b. Organic Analysis by Gas Chromatography/Mass Spectrometry

(From Table 3 QSM 5.0, Appendix B)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Surrogate Spike	All field and QC samples.	QC acceptance criteria specified by the project, if available; otherwise use QSM Appendix C limits or in-house LCS limits if analyte(s) are not listed.	Correct problem, then reprep and reanalyze all failed samples for all surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary.	Apply Q-flag to all associated analytes if acceptance criteria are not met and explain in the case narrative.	Alternative surrogates are recommended when there is obvious chromatographic interference.

Abbreviations and Acronyms:

BFB – 4-bromofluorobenzene
CCV – continuing calibration verification
DDT - dichlorodiphenyltrichloroethane
DFTPP – decafluorotriphenylphosphine
EICP – Emission inductively coupled plasma
ICAL – Initial calibration
IS – internal standards
LCS - laboratory control sample
LOQ - limit of quantification
MB - method blank
MS – matrix Spike
MSD – matrix spike duplicate
NA – not applicable
QC – quality control
QSM – Quality Systems Manual
RRT – relative retention times
RSD – relative standard deviation

Table 4c - Sample PQLs and MDLs

FTP and TVR / Old MATES, Yakima Training Center, Washington 98901

VOCs	CAS Number	PQL (µg/L)	MDL (µg/L)	Spike/Surrogate Recovery Limits 1/	Duplicate % RPD limits
Dichlorodifluoromethane	75-71-8	0.5	0.2	29 - 149	≤ 30
Chloromethane	74-87-3	0.5	0.2	50 - 136	≤ 30
Vinyl Chloride	75-01-4	0.5	0.1	56 - 135	≤ 30
Bromomethane	74-83-9	0.5	0.3	53 - 143	≤ 30
Chloroethane	75-00-3	0.5	0.2	59 - 139	≤ 30
Trichlorofluoromethane	75-69-4	0.5	0.2	62 - 140	≤ 30
1,1-Dichloroethene	75-35-4	0.5	0.2	70 - 131	≤ 30
Acetone	67-64-1	20	10	36 - 164	≤ 30
Carbon Disulfide	75-15-0	0.5	0.2	63 - 132	≤ 30
Methylene Chloride	75-09-2	2	0.2	70 - 128	≤ 30
Methyl t-butyl ether	1634-04-4	0.5	0.3	73 - 125	≤ 30
Trans-1,2-Dichloroethene	156-60-5	0.5	0.2	74 - 125	≤ 30
1,1-Dichloroethane	75-34-3	0.5	0.2	76 - 125	≤ 30
2,2-Dichloropropane	594-20-7	0.5	0.2	67 - 133	≤ 30
cis-1,2-Dichloroethene	156-59-2	0.5	0.2	77 - 123	≤ 30
2-Butanone	78-93-3	20	4	51 - 148	≤ 30
Bromochloromethane	74-97-5	0.5	0.2	78 - 125	≤ 30
Chloroform	67-66-3	0.5	0.2	78 - 123	≤ 30
1,1,1-Trichloroethane	71-55-6	0.5	0.2	73 - 130	≤ 30
Carbon Tetrachloride	56-23-5	0.5	0.2	70 - 135	≤ 30
1,1-Dichloropropene	563-58-6	0.5	0.2	76 - 125	≤ 30
Benzene	71-43-2	0.5	0.1	77 - 121	≤ 30
1,2-Dichloroethane	107-06-2	0.5	0.15	73 - 128	≤ 30
Trichloroethene	79-01-6	0.5	0.1	77 - 123	≤ 30
1,2-Dichloropropane	78-87-5	0.5	0.2	76 - 123	≤ 30
Chlorodibromomethane	74-95-3	0.5	0.5	74 - 126	≤ 30
Dichlorobromomethane	75-27-4	0.5	0.3	75 - 127	≤ 30
cis-1,3-Dichloropropene	10061-01-5	0.5	0.2	74 - 126	≤ 30
4-Methyl-2-Pentanone	108-10-1	20	10	65 - 135	≤ 30
Toluene	108-88-3	0.5	0.1	77 - 121	≤ 30
trans-1,3-Dichloropropene	10061-02-6	0.5	0.2	71 - 130	≤ 30
1,1,2-Trichloroethane	79-00-5	0.5	0.4	78 - 121	≤ 30
Tetrachloroethene	127-18-4	0.5	0.2	73 - 128	≤ 30
2-Hexanone	591-78-6	20	10	53 - 145	≤ 30
1,3-Dichloropropane	142-28-9	0.5	0.3	77 - 121	≤ 30
Dibromochloromethane	124-48-1	0.5	0.5	74 - 126	≤ 30
Ethylene dibromide	106-93-4	2	0.2	78 - 122	≤ 30
Chlorobenzene	108-90-7	0.5	0.2	79 - 120	≤ 30
Ethylbenzene	100-41-4	0.5	0.1	76 - 122	≤ 30
1,1,1,2-Tetrachloroethane	630-20-6	0.5	0.2	78 - 125	≤ 30
m, p-Xylene	179601-23-1	0.5	0.2	77 - 124	≤ 30
o-Xylene	95-47-6	0.5	0.2	77 - 123	≤ 30
Styrene	100-42-5	0.5	0.2	76 - 124	≤ 30
Bromoform	75-25-2	0.5	0.5	67 - 132	≤ 30
Isopropylbenzene	98-82-8	2	0.2	68 - 134	≤ 30
1,1,2,2-Tetrachloroethane	79-34-5	0.5	0.2	70 - 124	≤ 30
Bromobenzene	108-86-1	2	0.2	78 - 121	≤ 30

Table 4c - Sample PQLs and MDLs

FTP and TVR / Old MATES, Yakima Training Center, Washington 98901

VOCs	CAS Number	PQL (µg/L)	MDL (µg/L)	Spike/Surrogate Recovery Limits 1/	Duplicate % RPD limits
n-Propylbenzene	103-65-1	2	0.2	73 - 125	≤ 30
1,2,3-Trichloropropane	96-18-4	0.5	0.5	73 - 125	≤ 30
2-Chlorotoluene	95-49-8	2	0.2	75 - 122	≤ 30
1,3,5-Trimethylbenzene	108-67-8	2	0.2	73 - 124	≤ 30
4-Chlorotoluene	106-43-4	2	0.2	72 - 124	≤ 30
Tert-Butylbenzene	98-06-6	2	0.2	73 - 125	≤ 30
1,2,4-Trimethylbenzene	95-63-6	2	0.2	75 - 123	≤ 30
Sec-Butylbenzene	135-98-8	2	0.1	73 - 126	≤ 30
p-Isopropyltoluene	99-87-6	2	0.2	73 - 127	≤ 30
1,3-Dichlorobenzene	541-73-1	0.5	0.2	77 - 121	≤ 30
1,4-Dichlorobenzene	106-46-7	0.5	0.2	75 - 120	≤ 30
n-Butylbenzene	104-51-8	2	0.1	70 - 128	≤ 30
1,2-Dichlorobenzene	95-50-1	0.5	0.2	78 - 121	≤ 30
1,2-Dibromo-3-Chloropropane	96-12-8	2	0.8	61 - 132	≤ 30
1,2,4-Trichlorobenzene	120-82-1	2	0.3	67 - 129	≤ 30
Hexachlorobutadiene	87-68-3	2	0.3	61 - 135	≤ 30
Naphthalene	91-20-3	2	0.3	62 - 129	≤ 30
1,2,3-Trichlorobenzene	87-61-6	2	0.4	66 - 130	≤ 30
Dibromofluoromethane (Surr)				78 - 119	
1,2-Dichloroethane-d4 (Surr)				71 - 136	
Toluene-d8 (Surr)				85 - 116	
4-Bromofluorobenzene (Surr)				79 - 119	
SVOCs					
N-Nitrosodimethylamine	62-75-9	25	5	23 - 120	≤ 30
Bis(2-Chloroethyl)Ether	111-44-4	10	0.5	31 - 120	≤ 30
Phenol	108-95-2	10	0.5	34 - 121	≤ 30
2-Chlorophenol	95-57-8	10	0.5	34 - 121	≤ 30
1,3-Dichlorobenzene	541-73-1	10	0.5	30 - 115	≤ 30
1,4-Dichlorobenzene	106-46-7	10	0.5	31 - 115	≤ 30
1,2-Dichlorobenzene	95-50-1	10	0.5	33 - 117	≤ 30
Benzyl Alcohol	100-51-6	10	0.5	29 - 122	≤ 30
Bis(2-chloroisopropyl) ether	39638-32-9	10	0.5	33 - 131	≤ 30
2-Methylphenol	95-48-7	10	0.5	32 - 122	≤ 30
Hexachloroethane	67-72-1	10	2	28 - 117	≤ 30
N-Nitrosodi-n-propylamine	621-64-7	10	2	36 - 120	≤ 30
4-Methylphenol	106-44-5	10	0.5	42 - 126	≤ 30
Nitrobenzene	98-95-3	10	0.57	34 - 122	≤ 30
Isophorone	78-59-1	10	1	30 - 122	≤ 30
2-Nitrophenol	88-75-5	10	0.5	36 - 123	≤ 30
2,4-Dimethylphenol	105-67-9	10	2	30 - 127	≤ 30
Bis(2-Chloroethoxy)Methane	111-91-1	10	0.5	36 - 121	≤ 30
2,4-Dichlorophenol	120-83-2	10	0.5	40 - 122	≤ 30
Benzoic Acid	65-85-0	25	25	0 - 125	≤ 30
1,2,4-Trichlorobenzene	120-82-1	10	0.5	34 - 118	≤ 30
Naphthalene	91-20-3	10	0.5	35 - 123	≤ 30
4-Chloroaniline	106-47-8	10	2	17 - 106	≤ 30
Hexachlorobutadiene	87-68-3	10	0.5	32 - 123	≤ 30

Table 4c - Sample PQLs and MDLs

FTP and TVR / Old MATES, Yakima Training Center, Washington 98901

VOCs	CAS Number	PQL (µg/L)	MDL (µg/L)	Spike/Surrogate Recovery Limits 1/	Duplicate % RPD limits
4-Chloro-3-Methylphenol	59-50-7	10	0.5	45 - 122	≤ 30
2-Methylnaphthalene	91-57-6	10	0.5	38 - 122	≤ 30
2,4,6-Trichlorophenol	88-06-2	10	1	39 - 126	≤ 30
2,4,5-Trichlorophenol	95-95-4	10	0.5	41 - 124	≤ 30
2-Chloronaphthalene	91-58-7	10	0.5	41 - 114	≤ 30
Acenaphthene	83-32-9	10	0.5	40 - 123	≤ 30
2-Nitroaniline	88-74-4	25	0.5	44 - 127	≤ 30
Acenaphthylene	208-96-8	10	0.5	32 - 132	≤ 30
Dimethylphthalate	131-11-3	10	2	48 - 124	≤ 30
2,6-Dinitrotoluene	606-20-2	10	0.5	46 - 124	≤ 30
3-Nitroaniline	99-09-2	25	1	33 - 119	≤ 30
2,4-Dinitrophenol	51-28-5	25	25	23 - 143	≤ 30
Dibenzofuran	132-64-9	10	0.5	44 - 120	≤ 30
4-Nitrophenol	100-02-7	25	10	30 - 132	≤ 30
2,4-Dinitrotoluene	121-14-2	10	1	48 - 126	≤ 30
Fluorene	86-73-7	10	0.5	43 - 125	≤ 30
4-Chlorophenyl-Phenylether	7005-72-3	10	0.5	45 - 121	≤ 30
Diethylphthalate	84-66-2	10	0.5	50 - 124	≤ 30
4-Nitroaniline	100-01-6	25	4	30 - 120	≤ 30
4,6-Dinitro-2-Methylphenol	534-52-1	25	10	29 - 132	≤ 30
N-Nitrosodiphenylamine	86-30-6	10	0.5	38 - 127	≤ 30
1,2-Diphenylhydrazine	122-66-7	10	0.5	41 - 125	≤ 30
4-Bromophenyl phenyl ether	101-55-3	10	0.5	46 - 124	≤ 30
Hexachlorobenzene	118-74-1	10	0.53	45 - 122	≤ 30
Pentachlorophenol	87-86-5	25	5	25 - 133	≤ 30
Phenanthrene	85-01-8	10	0.5	50 - 121	≤ 30
Anthracene	120-12-7	10	0.61	47 - 123	≤ 30
Carbazole	86-74-8	10	0.5	50 - 123	≤ 30
Di-N-Butylphthalate	84-74-2	10	0.65	51 - 128	≤ 30
Fluoranthene	206-44-0	10	0.63	50 - 127	≤ 30
Pyrene	129-00-0	10	0.73	47 - 127	≤ 30
Butylbenzylphthalate	85-68-7	10	0.5	48 - 132	≤ 30
3,3'-Dichlorobenzidine	91-94-1	25	2	22 - 121	≤ 30
Benzo(a)anthracene	56-55-3	10	0.59	49 - 126	≤ 30
Chrysene	218-01-9	10	0.79	50 - 124	≤ 30
Bis(2-Ethylhexyl) Phthalate	117-81-7	10	1.9	41 - 133	≤ 30
Di-n-octyl phthalate	117-84-0	10	0.63	45 - 140	≤ 30
Benzo(b)fluoranthene	205-99-2	10	0.58	45 - 132	≤ 30
Benzo(k)fluoranthene	207-08-9	10	0.83	47 - 132	≤ 30
Benzo(a)pyrene	50-32-8	10	0.5	45 - 129	≤ 30
Indeno(1,2,3-cd)pyrene	193-39-5	10	0.68	45 - 133	≤ 30
Dibenzo(a,h)anthracene	53-70-3	10	0.75	45 - 134	≤ 30
Benzo(ghi)perylene	191-24-2	10	0.81	43 - 134	≤ 30
2-Fluorophenol (Surr)				35 - 115	
Phenol-d5 (Surr)				33 - 122	
Nitrobenzene-d5 (Surr)				37 - 122	
2-Fluorobiphenyl (Surr)				44 - 115	

Table 4c - Sample PQLs and MDLs
FTP and TVR / Old MATES, Yakima Training Center, Washington 98901

VOCs	CAS Number	PQL (µg/L)	MDL (µg/L)	Spike/Surrogate Recovery Limits 1/	Duplicate % RPD limits
2,4,6-Tribromophenol (Surr)				39 - 132	
Terphenyl-d14 (Surr)				54 - 127	
Petroleum Hydrocarbons					
Diesel Range Organics		110	20	46 - 140	≤ 30
Residual Range Organics		110	50	45 - 159	≤ 30
o-Terphenyl (Surr)				50 - 150	
n-Triacontane (Surr)				50 - 150	
Gasoline Range Organics		250	25	80 - 119	≤ 30
1,4-Difluorobenzene (Surr)				50 - 150	

Notes:

1/ Laboratory QC limits are the lower and upper control limits from the DoD QSM 5.0 (July 2013) except for the TPH methods which are the laboratory limits

Abbreviations and Acronyms:

PQL = practical quantification limit
µg/L = micrograms per liter
VOCs = volatile organic compounds
TPH-G = gasoline range total petroleum hydrocarbons
TPH-D / TPH-O = diesel and oil range total petroleum hydrocarbons
SVOCs = semivolatile organic compounds
Surr = surrogate compound
MDL = method detection limit

Table 5 - Difference in Depth to Water Elevations Between MMP-1 and MMP-2
FTP and TVR / Old MATES, Yakima Training Center, Washington 98901

	DTW (ft/bgs)		Difference (ft)	Groundwater Elevation (ft/AMSL)		Difference (ft)
Date	MMP-1	MMP-2	-	MMP-1	MMP-2	-
TOC	-		-	1301.37	1301.31	-
23-Mar-05	66.24	66.25	0.01	1235.13	1235.06	0.07
23-Aug-05	58.33	59.75	1.42	1243.04	1241.56	1.48
21-Mar-06	64.27	64.54	0.27	1237.1	1236.77	0.33
1-Aug-06	53.77	55.69	1.92	1247.6	1245.62	1.98
21-Mar-07	62.02	62.13	0.11	1239.35	1239.18	0.17
19-Sep-07	56.08	57.12	1.04	1245.29	1244.19	1.1
18-Mar-08	61.12	61.27	0.15	1240.25	1240.04	0.21
19-Sep-08	55.87	56.95	1.08	1245.5	1244.36	1.14
23-Mar-09	62.83	62.92	0.09	1238.54	1238.39	0.15
23-Sep-09	58.47	59.23	0.76	1242.9	1242.08	0.82
15-Mar-10	63.37	63.48	0.11	1238	1237.83	0.17
28-Sep-10	52.67	54.22	1.55	1248.7	1247.09	1.61
21-Mar-11	59.02	59.17	0.15	1242.35	1242.14	0.21
21-Sep-11	47.02	50.44	3.42	1254.35	1250.87	3.48
28-Mar-12	57.83	57.83	0	1243.54	1243.48	0.06

Notes:

Difference is the absolute value of the change in elevation between MMP-1 and MMP-2.

Abbreviations and Acronyms:

ft/bgs = feet below ground surface
ft = feet
ft/AMSL = feet above mean sea level
TOC = top of casing elevation in ft/AMSL
- = not applicable

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Table 6 - Depth to Water Measurements, TCE and cis-DCE Analytical Results MRC-2
FTP and TVR / Old MATES, Yakima Training Center, Washington 98901

Well ID TOC	Date	DTW (ft/bgs)	Groundwater Elevation (ft / amsl)	TCE (µg/L)	cis-DCE (µg/L)
MRC-2	1-Mar-93		1236.27	5U	5U
1312.11	28-Feb-95	-	-	-	-
	1997	-	-	-	-
	1-Aug-99	-	-	-	-
	1-Jan-04	-	-	-	-
	23-Mar-05	81.82	1230.29	-	-
	23-Aug-05	76.09	1236.02	-	-
	21-Mar-06	-	-	-	-
	1-Aug-06	-	-	-	-
	21-Mar-07			0.5U [2]	0.5U [2]
	19-Sep-07	-	-	-	-
	18-Mar-08	74.59	1237.52	0.5U	0.5U
	19-Sep-08	67.90	1244.21	-	-
	23-Mar-09	75.90	1236.21	0.5U	0.5U
	23-Sep-09	-	-	-	-
	16-Mar-10	77.38	1234.73	1U	1U
	28-Sep-10	67.00	1245.11	-	-
	21-Mar-11	73.20	1238.91	0.5U	0.5U
	21-Sep-11	63.07	1249.04	-	-
	28-Mar-12	72.42	1239.69	0.5U	0.5U

Abbreviations and Acronyms:

DTW = depth to water
TCE = richloroethylenet
cis-DCE = cis 1,2-dichloroetheylene
ft/bgs = feet below ground surface
ft/AMSL = feet above mean sea level
TOC = top of casing elevation in ft/AMSL
µg/L = micrograms per liter
- = not applicable, no data

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FIGURES

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JBLM Yakima Training Center Boundary

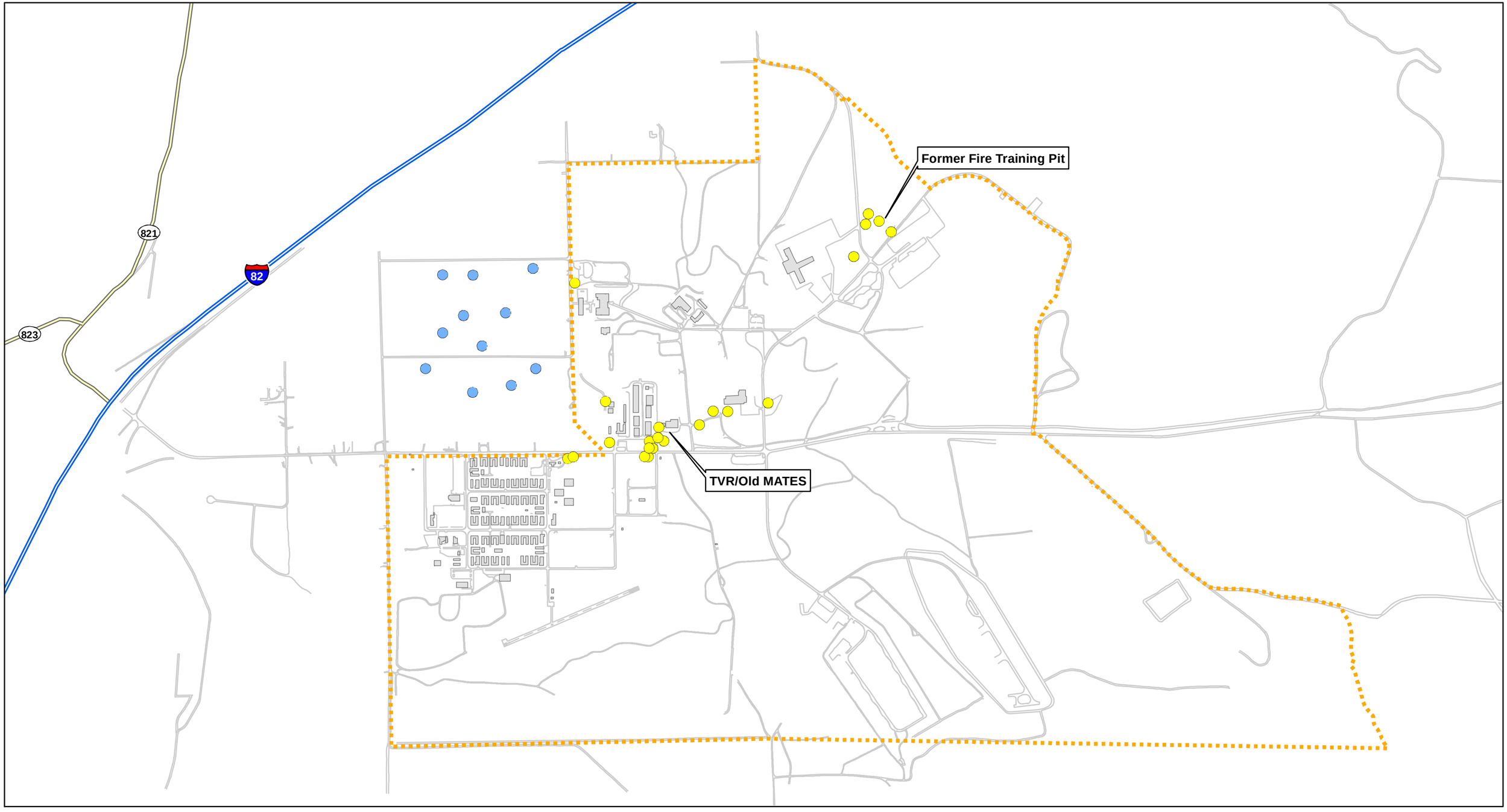
N

0 1 2 4 6 8 Miles

MAP DATA:
ELLIPSOID: GRS 80
COORDINATE SYSTEM: UTM, Zone 10
HORIZONTAL DATUM: WGS 84

JBLM Yakima Training Center Location Map

Figure 1



Monitoring Well

Residential Drinking Water Wells

Cantonment Boundary

Building

N

0 1,550 3,100 6,200

Feet

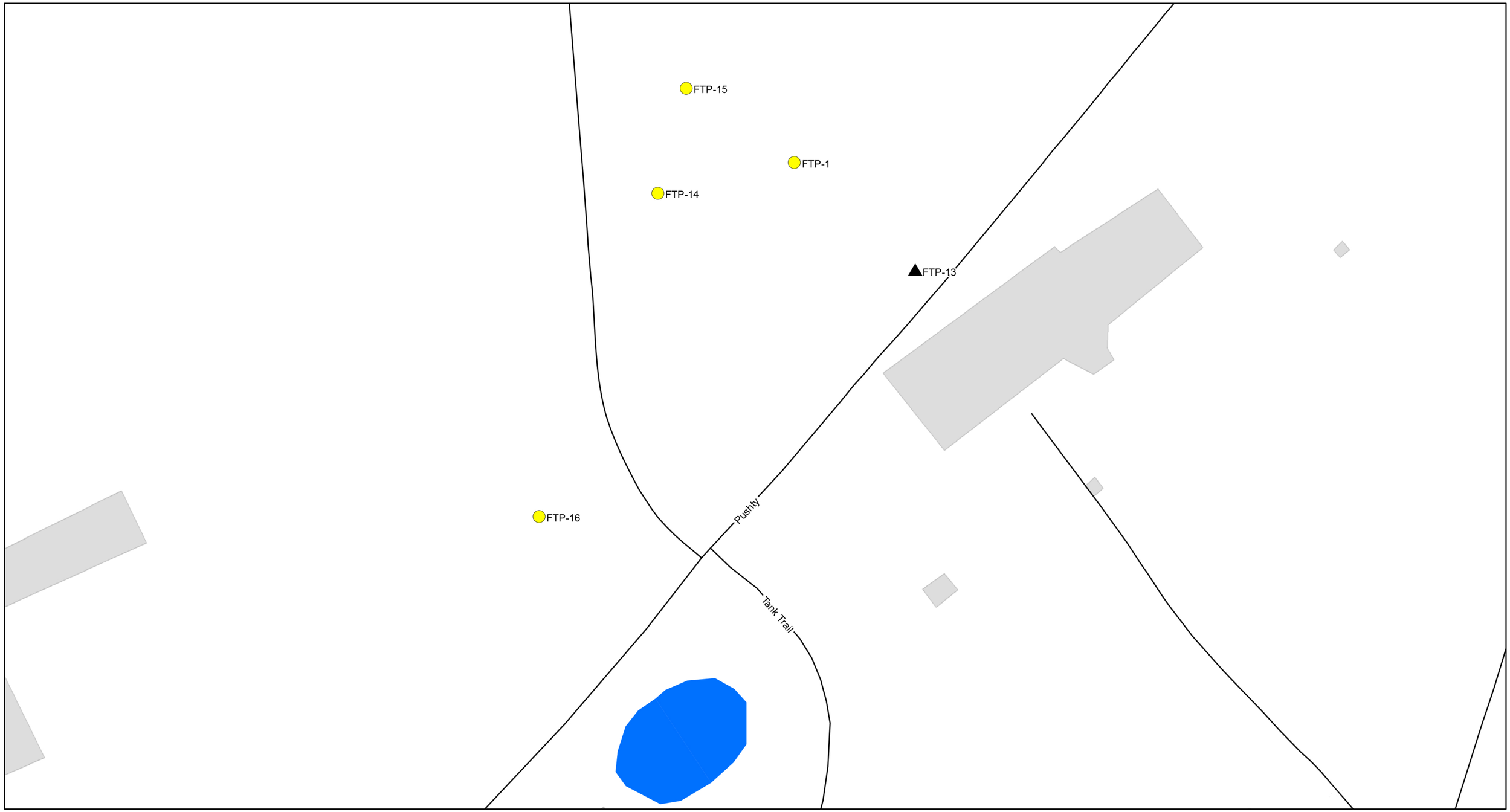
1 inch = 1,250 feet

MAP DATA:
COORDINATE SYSTEM: UTM, Zone 10
HORIZONTAL DATUM: WGS 84

PROJECT LOCATION MAP

Figure 2

R:\Projects_2014\JBLM\YTC\maps\Fig2_Project_Location.mxd



Sample Location / Identification

Monitoring Well
DTW and Sample

Monitoring Well
DTW Only

0 155 310 620

Feet

1 inch = 125 feet

MAP DATA:

ELLIPSOID: GRS 80

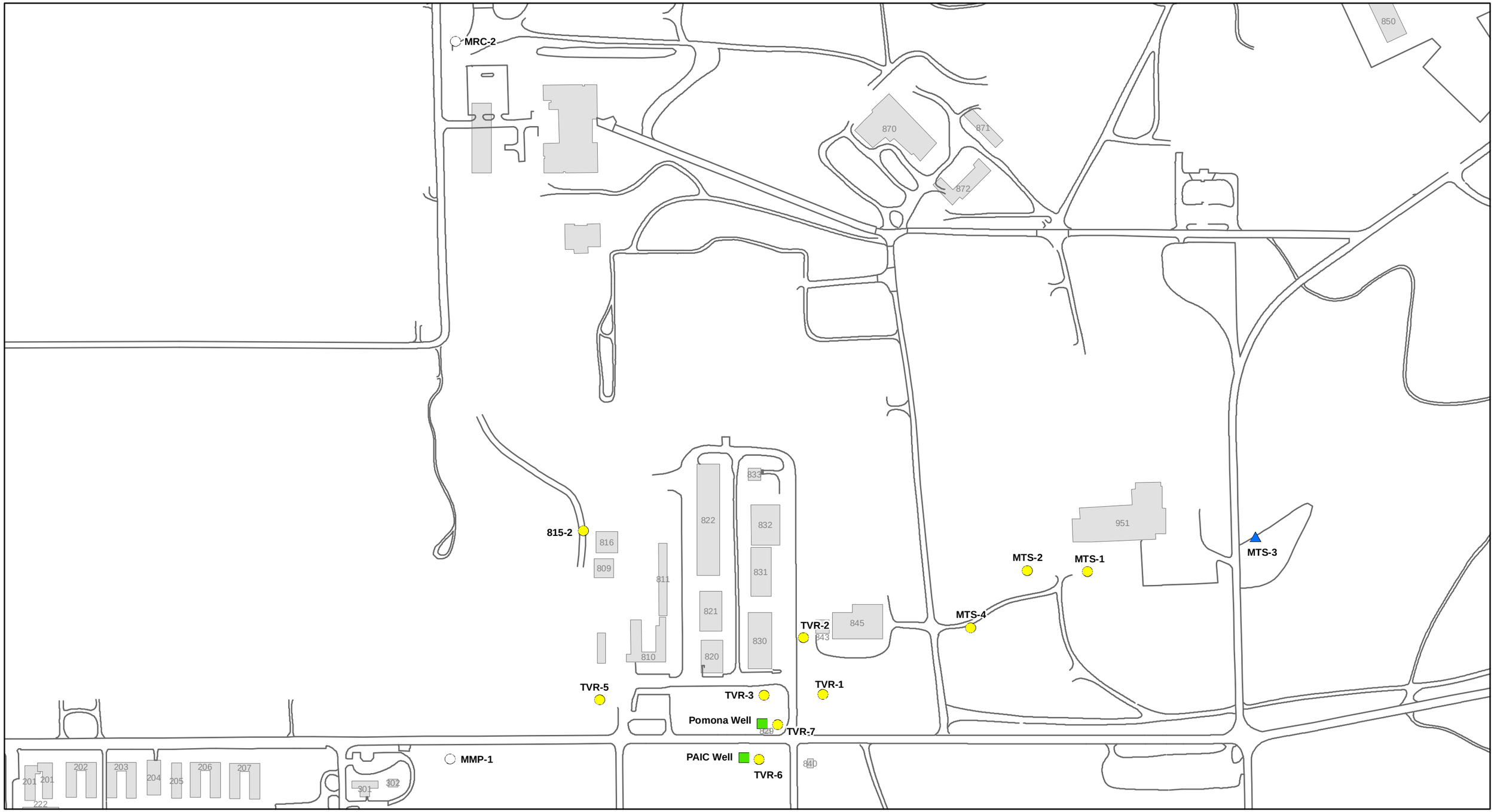
COORDINATE SYSTEM: UTM, Zone 10

HORIZONTAL DATUM: WGS 84

FORMER FIRE TRAINING PIT
SAMPLE LOCATIONS

Figure

3



Monitoring Well - DTW and Sample
Monitoring Well - DTW Only
Production Well - Sample Only
Monitoring Well Removed from Program
Building

N

0 375 750 1,500
Feet

1 inch = 300 feet

MAP DATA:
COORDINATE SYSTEM: UTM, Zone 10
HORIZONTAL DATUM: WGS 84

TVR/Old MATES AREA
SAMPLE LOCATIONS

Figure
4

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APPENDIX A

BORING LOGS AND WELL COMPLETION DIAGRAMS

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ENVIRONMENTAL BOREHOLE LOG

Date Started 6/17/99	Location Fire Training Pit		Depth Water First Encountered (ft) 14.0
Date Completed 6/28/99	Drilling Company Andrews Drilling		Drilling Method HSA/Air Rotary
Total Depth (ft) 20.0	Sampling Method Split-spoon/Drill cuttings		Hammer: Weight (lbs) 300 Drop (in) 30
Borehole Diam. (in) 8	Ground Elev. (ft) 1475.8	Monument Elev. (ft) NA	PVC Elev. (ft) NA

Depth (ft)	Sample Number	Interval	Blow Count Blows/Ft	Recovery(%)	PID (ppm)	Time	Depth (ft)	Lithologic Description	Soil Log	Well Log	Depth (ft)
								Ground Surface			
	FTP-FBI-02		33	0	0	0219 (6/17)		Medium dense, brown, medium to fine, silty SAND/sandy SILT; trace of basalt; dry; occasional gravels; SM.			
	FTP-FBI-03		21	67	0	0253 (6/17)	4.0	Very dense, light to medium brown, slightly silty, fine to medium sandy GRAVEL to gravelly SAND; dry to moist; GP-SP.			
5		G	50/4"	0	0	0300	5.5	BASALT: Grey to black, slightly vesicular, moderately weathered, slight petroleum odor at 8.0 feet, wet at 14 feet.			5
			50/6"	0	0	0310 (6/17)					
10		G									10
15		G								▽	15
20							20.0	BOTTOM OF BORING COMPLETED 6/28/1999			20
25								Note: Refusal at 5.5 feet bgs with HSA drill rig on 6/17/99; completed boring to 20 feet bgs with air rotary drill rig on 6/28/99.			25

Typ: EET Rev: AMJ Log: AMJ/JMH ENV_MASTER 21-14118.GPJ SHAN_WIL.GDT 7/13/01

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification unless otherwise noted.

LEGEND

I	2-inch O.D. Split Spoon Sample	▽	Ground Water Level ATD
III	3-inch O.D. Split Spoon Sample	▼	Ground Water Level in Well

RCRA Field Investigation
Yakima Training Center
Yakima, Washington

LOG OF BORING FTP-FB1

August 2001 21-1-14118-020

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. D-2

WATER SAMPLING LOG

Project: JBLM – Yakima Training Center
Well No.: _____Date Well Purged:_____Date Well Sampled:_____

Well Data

Measuring Point (MP): Top of Casing
Depth to Water Below MP:_____Purge Method:_____

Water Sample Data

Sample Number:_____Time Sample Collected:_____
Sampling Method:_____
Sampling Personnel:_____
Remarks:_____

Checklist

☐ Well capped and locked (pre-sampling)

☐ Water level measured

☐ Appropriate sample containers filled and capped

☐ Samples placed in cooler with blue ice

☐ PDB deployed (if applicable)

☐ Well capped and locked (post-sampling)

Liters Out	Time	PH	Temp	DO	Spec. Cond.	ORP	Turb

DAILY EQUIPMENT INSPECTION

PROJECT_____

MANUFACTURER TYPE _____

UNIT #_____MODEL _____ DATE _____

ENGINE HRS/MILEAGE _____ /_____ SHIFT _____

Check appropriate column and describe correction needed.

	If Good (✔)	NA	Correction Needed
Steering Mechanisms[1] *	_____	_____	_____
Service Brakes [2]	_____	_____	_____
Emergency Brakes[1]			
Parking Brake[1]	_____	_____	_____
Transmission & Controls	_____	_____	_____
Suspension & Springs	_____	_____	_____
Hydraulic Leaks	_____	_____	_____
Exhaust System	_____	_____	_____
Warning Gauges	_____	_____	_____
Windshield[1] & Wipers	_____	_____	_____
Lights (Head & Tail)	_____	_____	_____
Brake Lights[1]	_____	_____	_____
Mirrors	_____	_____	_____
Seat and Seat Belts[1] (w/ ROPS)	_____	_____	_____
Tires/Tread[1]	_____	_____	_____
Regular Horn	_____	_____	_____
Audible Back-up Alarm[1]	_____	_____	_____
Steps, Hand-holds	_____	_____	_____
Fire Extinguisher	_____	_____	_____
Engine Coolant	_____	_____	_____
Engine Oil	_____	_____	_____
Hydraulics & Operating Controls	_____	_____	_____
Fenders/Mudflaps	_____	_____	_____
Heater/defroster	_____	_____	_____
All items in cab or bed secured	_____	_____	_____
Cleanliness inside and outside	_____	_____	_____

Remarks:

[1] Items required to be operational by OSHA 1926.602 before use.

[2] Service brake must be capable of stopping and holding equipment fully loaded. _____

_____ _____

Operator Name (Printed) Operator Signature

Review : Superintendent _____

Date Repairs or adjustments completed:_____

Equipment Supervisor/Mechanic:_____

DAILY BRIEFING SIGN-IN SHEET

Date: _____ Office/Project Name/Location: _____

Shift/Department: _____ Person Conducting Meeting/Briefing: _____

1. AWARENESS (e.g., special EHS concerns, pollution prevention, recent incidents, etc.):

2. OTHER ISSUES (ESQ Plan changes, action items, attendee comments, etc.):

3. ATTENDEES (Print Name):

1.	21.
2.	22.
3.	23.
4.	24.
5.	25.
6.	26.
7.	27.
8.	28.
9.	29.
10.	30.
11.	31.
12.	32.
13.	33.
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15.	35.
16.	36.
17.	37.
18.	38.
19.	39.
20.	40.

Give completed documentation to SSHO.

OPERATOR/DRIVER TASK OBSERVATION CHECKLIST

Project Name _____ Project Number _____
Operator's Name _____ Observer's Name _____
Date of observation Type/make of equipment operated

Operating Safety Observations		S	U	N	Comments
A.	**Pre-use inspection prior to staring**				
1.	Conducts daily pre-use inspection.				
2.	Mounts & dismounts carefully-3 point contact.				
3.	Uses the seat belt all times while seated. Sounds horn before staring engine.				
4.	Checks equipment warning devices.				
5.	Checks hydraulic systems (if so equipped). Ensures system is filled and free from leakage.				
6.	Checks air system (if so equipped). Ensures all connections are tight.				
7.	Checks engine oil level. Ensures all plugs, filler caps, and other fittings are secure and not leaking.				
8.	Checks for broken, missing, excessively worn or damaged parts, and reports immediately.				
9.	Checks tires. Looks for serious cuts, bulges, irregularities and abnormal wear. Checks inflation pressures and keeps valve caps in place. Checks for tires rubbing.				
10.	For dump trucks, checks front wheel seal oil levels.				
11.	Checks fuel level and for fuel system leaks.				
12.	Coolant check—Should never open a hot system or pour cold coolant into radiator if the engine is very hot.				
13.	For safe visibility, cleans the windshield, mirrors and light lenses.				
14.	For articulating machines, checks to ensure that the steering frame lock or link have been removed and properly stored.				
15.	Checks for and maintains safe access to the cab (3 point contact). For safe mounting, clears the steps, grab rails, and floor and seat of mud and water.				
16.	Secures tools and keeps the floor free of debris.				
17.	For safe operation wipes steering wheel, foot pedals, hand levers and knobs clean of oil and grease.				
18.	Checks first aid kit and fire extinguisher. Reports missing items to the foreman or supervisor.				
19.	Checks equipment for warning tags.				
B.	**Starting**				
1.	Mounts & dismounts carefully-3 point contact.				
2.	Uses the seat belt at all times while seated. Sounds horn before starting engine.				
3.	Checks equipment warning devices.				
4.	Uses job specific PPE (e.g., hard hats, safety shoes, safety glasses, overalls, gloves, traffic vests, and ear protection).				
5.	Ensures the bowl, bucket, etc. is on the ground.				
6.	For starting, checks all controls to be sure they are in proper position.				
7.	Does not crank an electric starter for more than 30 seconds, Allows two minutes to cool prior to next attempt.				
8.	For steering safety, tests before moving. Turns the wheels to full left and full right.				
9.	Checks service and parking breaks for proper operation.				
10.	Checks the backup alarm.				
11.	Ensures head lamps and safety lighting are in working order.				

Operating Safety Observations		S	U	NA	Comments
C.	**Operation**				
1.	Before moving, places the bucket, bowl, blade, etc., into the transport position and secures all accessory equipment.				
2.	Obeys traffic & other posted/published site safety practices & rules.				
3.	Maintains control of equipment at all times.				
4.	Gives right-of-way to loaded machines or trucks.				
5.	Minimizes engine overspeed on downgrades & when shifting.				
6.	Does not transport passengers without proper provisions.				
7.	Does not engage in horseplay.				
8.	Crosses ditches at an angle, proceeding slowly.				
9.	Avoids large obstacles, deep holes & soft edges.				
10.	Slows down before turning.				
11.	Stays in gear on a downgrade.				
12.	When running across a hillside, proceeds slowly. Never turns sharply uphill or downhill.				
13.	Obeys flagmen & spotter signals.				
14.	Maintains safe stopping distance behind other equipment.				
15.	Shifting				
	a. Always stops the machine/truck and runs the engine at low idle speed to shift from forward into reverse.				
	b. Downshifts one speed range at a time.				
	c. Applies the retarder and/or service brakes to reduce speed before entering sharp turns, fill areas, and downgrades.				
	d. For machines, always leaves the shift lever in neutral position when stopped.				
16.	Braking				
	a. Avoids applying brake continuously on a downgrade unless system is so designed.				
	b. Uses the engine for additional brake force-or, if so equipped, the auxiliary retarder.				
	c. Anticipates grade and selects proper gear range accordingly.				
	d. Brakes firmly in one application. Avoids fanning the brake pedal.				
	e. Uses each brake system only for its intended purpose.				
17.	Turning				
	a. Does not cut corners too close when making sharp turns.				
	b. Maintains engine speed high enough for normal steering.				
	c. Downshifts when necessary or appropriate.				
	d. For machines, carries the load as low as conditions permit to maintain stability.				
18.	Hauling				
	a. Regulates speed to road conditions. Reduces speed before turning. Avoids over speeding the engine.				
	b. Downshifts when approaching a downgrade. Downshifts when necessary on an upgrade to avoid stalling the engine.				
	c. Obeys traffic rules and spotters.				
19.	Parking Precautions				
	a. Selects level ground whenever possible.				
	b. When parking on a grade, positions equipment at right angles to the slope; and sets parking brake if so equipped in addition to lowering bowl, bucket, etc.				
	c. Parks a reasonable distance from other equipment.				
	d. When parking on haul roads, picks the safest place, where the equipment is visible from both directions.				

Operating Safety Observations	S	U	NA	Comments
20. Demonstrates proficiency through smooth operation of controls (e.g., speed of operation appropriate for the conditions, not jerky or hesitant).				
21. Maintains eye contact with other operators, drivers, and ground personnel.				
22. Responds appropriately to signals from flaggers, spotters, operators directing equipment movements.				
23. Stops operation when ground personnel are out of line-of-sight.				
24. Positions and orients machine for safe operation (e.g., safe distance from edge of excavations, tracks perpendicular to excavation, clear distance maintained to fixed obstructions).				
25. Barricades, cones, tape set up to maintain clear zone within swing radius of counterweight.				
26. Maintains safe work area (e.g., windrow at edge of stockpiles, safe slopes).				
D. Shutdown				
1. Lowers the bowl, bucket, etc. to the ground. Lowers and secures the bed on dump trucks.				
2. Reduces engine speed. Sets parking brake.				
3. On machines, places transmission in neutral and locks shift lever if so equipped.				
4. Allows hot engine to cool gradually before stopping it.				
5. Secures equipment to prevent unauthorized starting and movement.				
6. Bleeds the air tanks, if so equipped.				
7. Dismounting—doesn't jump off, uses handrails and steps, and faces the machine/truck when getting off.				
8. Warning tags—attaches appropriate warning tags to steering wheel to prevent accidents.				
E. Overall Appraisal				
Overall appraisal of operator/driver				

S = Satisfactory
U = Unsatisfactory
NA = Non applicable
Note: For unsatisfactory observations also indicate the immediate corrective action taken (e.g., training, verbal or written warning, or reassignment).

EHS WEEKLY/MONTHLY CHECKLIST AND ACTION ITEM REPORT

Inspection Type: ☐ **Weekly** ☐ **Monthly**

Project/Location:	**Inspector/s:**	**Time/Date:**
TOPIC	**OBSERVATIONS**	**FINDING (Y/N)**
Work Conditions		
1. Housekeeping		
2. Walking/Working Surfaces		
3. Aisles and Passageways		
4. Platforms/Scaffolding		
5. Ladders		
6. Stairs, Guardrails, Toe-boards		
7. Exits/Egress		
8. Roadways		
9. Ventilation		
10. Lighting		
11. Noise Exposure		
12. Ergonomics		
13. Site Perimeter and Control Zones Identified		
Equipment		
14. Hand/Portable Tool Condition, Storage and Use		
15. Machine, Conditions/Guarding		
16. Mobile/Heavy Equipment a. Physical inspection of equipment b. Review of daily inspection reports c. Review of equipment deficiency corrections logs/records		
Material Handling Equipment		
17. Hoisting and Rigging		
18. Lifting Aids Used When Possible		
19. Proper Lifting Techniques Used		
Electrical Safety		
20. Power Cords		
21. GFCI		
22. Generators		
23. Breaker Box Access/Clearance		
Hazardous Materials		

24. Hazardous Chemical List Current		
25. MSDS		
26. Labeling		
27. Signs/Postings/Color Coding		
28. Proper Storage and Segregation of Hazardous Materials		
29. Compressed Gas Storage and Use		
Emergency Systems		
30. Emergency phone numbers posted		
31. Evacuation routes, rally points shown on site map		
32. Fire extinguishers inspected monthly		
33. Eyewashes and showers periodically inspected, units flushed, and fluids periodically changed		
34. First Aid Kits/Stations		
35. Emergency Rescue Equipment		
Protective Equipment		
36. PPE used, stored, and maintained in accordance with EHS plan		
37. Respirator use, storage, and maintenance		
Hazardous Waste Storage Area(s)/Satellite Accumulation Area		
38. Designated, secured area with "Hazardous Waste" signage. For SAA area is marked "SAA". (SAA)		
39. Containers:		
a. DOT-spec. containers (for wastes to go off-site only)		
b. Intact/in good condition		
c. Waste compatible with containers (e.g., no evidence of corrosion, softening, bulging) (SAA)		
d. Marked "Hazardous Waste"/ visible Accumulation Date. *For SAA, marked "Hazardous Waste"*		
e. Securely closed and stored to prevent rupture/leaking, except when add/remove waste. (SAA)		
f. For SAA only, Stored "at the point of generation" and meets		

quantity limits (Federal: 55 gal; check state requirements).		
40. Reactive/ignitable wastes stored at least fifty (50) feet from property.		
41. Liquid wastes within secondary containment (BMP, check Waste Management Plan to determine state requirements).		
42. Incompatible wastes separated by a dike, wall, berm or other device.		
43. Stored for less than 90 days. *(CERCLA projects may have storage variance).*[1]		
44. Container tracking log accurately reflects containers stored. (SAA)		
45. Area maintained in an orderly fashion and complies with state/EHS plan requirements. (e.g. good housekeeping, adequate aisle space)		
Hazardous Waste Tank Storage Area		
46. Daily written inspection is being conducted and is maintained on site. Inspections include: a. Overfill/spill control b. Aboveground points of tank; monitoring/leak detection c. Surrounding area Cathodic protection systems are inspected bimonthly (& 6 months after installation)		
Waste/Stockpiles		
47. Refer to: a. Attachment C – Hazardous Waste Less Than 90 Days For Hazardous Waste Stockpiles; b. Attachment C – Solid Waste For State Regulated/Non-Hazardous Stockpiles; and/or c. Attachment C – PCB for PCB Stockpiles, if applicable		
TSCA PCB Wastes		
48. Inspected every 30 days at a minimum. Refer to PESM PCB Checklist		
Point Source Discharges		

[1] If stored on-site 75 or more days, TSDF/transporter has been selected (EHS 1-4), pick-up date scheduled and PM/PESM are aware of 90-day limit.

49. Permit conditions are being met.		
50. Monitoring equipment is fully operational.		
51. Equipment calibrations and maintenance is up-to-date.		
52. Discharge sampling performed at required intervals.		
53. Review monitoring results *(Report permit exceedances)*		
54. DMR and Plant Logs properly completed, signed, and submitted (if required).		
55. Fugitive Dust – Appropriate BMPs are instituted for fugitive dust emissions.		
Stormwater and other NPDES Discharge Activities		
56. SWPPP reflects current activities and has been updated as necessary.		
57. BMPs in SWPPP/Soil Plan implemented.		
58. Visual observations indicate stormwater meets water quality criteria.		
59. Stormwater BMP inspections conducted and documented as required (weekly and before/after > 0.5" storm event).		
60. Monitoring/sampling performed at required intervals.		
61. Review monitoring results if required. (*Report permit exceedances)*		

Project/Location:	**Inspector/s:**		**Time/Date:**
ACTION ITEM	**RESPONSIBLE PARTY**	**SCHEDULE**	**DATE COMPLETED**
Other Conditions or Work Practices			
62.			
63.			
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65.			

66.			
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71.			
72.			
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75.			

Reviewed by: _____ _____

SS / Site Manager Date

cc: Project Manager (monthly only)
PESM (monthly only)

ENVIRONMENTAL BOREHOLE LOG

Date Started: 6/18/99	Location: Fire Training Pit	Depth Water First Encountered (ft): 14.0
Date Completed: 6/28/99	Drilling Company: Andrews Drilling	Drilling Method: HSA/Air Rotary
Total Depth (ft): 20.0	Sampling Method: Split-spoon/Drill cuttings	Hammer: Weight (lbs): 300 Drop (in): 30
Borehole Diam. (in): 8	Ground Elev. (ft): 1474.1 Monument Elev. (ft): NA	PVC Elev. (ft): NA

Depth (ft)	Sample Number	Interval	Blow Count Blows/Ft	Recovery(%)	PID (ppm)	Time	Depth (ft)	Lithologic Description	Soil Log	Well Log	Depth (ft)
								Ground Surface			
								Very dense, dark brown, slightly silty, medium to fine SAND; trace of fine gravels; moist; scattered cobbles; strong hydrocarbon odors at 4.5 feet; SM.			
5	FTP-FB2-04/05/06		50	61	0	0720 (6/18)					5
	FTP-FB2-07		34	100	85.6	0748	5.0				
			25/2"	67	270	0813		Very dense, gray to black, slightly silty, sandy vesiculated BASALT; petroleum odor; GM.			
			50/5"	0	33.6	0840 (6/18)	6.5				
								BASALT: Slightly weathered, gray to black with iron-oxide staining. Water encountered at 14 feet.			
10					0						10
					0					▽	
15					0						15
20							20.0				20
								BOTTOM OF BORING COMPLETED 6/28/1999			
								Notes: (1) Small amount of water was seeping into the hole upon removal of drilling rods. (2) Refusal at 6.5 feet bgs with HSA drill rig on 6/18/99; completed boring to 20 feet feet bgs on 6/28/99 by air rotary drilling. (3) Duplicate (FTP-FB2-05) and split (FTP-FB2-06) collected with sample FTP-FB2-04.			
25											25

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification unless otherwise noted.

LEGEND

2-inch O.D. Split Spoon Sample	Ground Water Level ATD
3-inch O.D. Split Spoon Sample	Ground Water Level in Well

RCRA Field Investigation
Yakima Training Center
Yakima, Washington

LOG OF BORING FTP-FB2

August 2001 21-1-14118-020

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. D-3

ENV_MASTER 21-14118.GPJ SHAN_WIL.GDT 7/13/01 Log: AMJ/JMH Rev: AMJ Typ: EET

ENVIRONMENTAL BOREHOLE LOG

Date Started 6/18/99	Location Fire Training Pit		Depth Water First Encountered (ft) N/A
Date Completed 6/28/99	Drilling Company Andrews Drilling		Drilling Method HSA/Air Rotary
Total Depth (ft) 20.0	Sampling Method Split-spoon/Drill cuttings		Hammer: Weight (lbs) 300 Drop (in) 30
Borehole Diam. (in) 8	Ground Elev. (ft) 1474.1	Monument Elev. (ft) NA	PVC Elev. (ft) NA

Depth (ft)	Sample Number	Interval	Blow Count Blows/Ft	Recovery(%)	PID (ppm)	Time	Depth (ft)	Lithologic Description	Soil Log	Well Log	Depth (ft)
								Ground Surface			
								Dense, brown, slightly silty, medium to fine SAND; trace fine gravel; moist; SM.			
5	FTP-FB3-02		41	83	5.7	0935 (6/18)					5
	FTP-FB3-03		50/5"	83	0	0953 (6/18)	6.0	BASALT: Black, moderately weathered, slightly vesicular, occasional saprolites and quartz; moist at 14.5 feet.			
10											10
15											15
20							20.0	BOTTOM OF BORING COMPLETED 6/28/1999			20
25								Note: Refusal at 6.5 feet bgs with HSA drill rig; completed boring to 20 feet bgs with an air rotary drill rig on 6/28/99.			25

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification unless otherwise noted.

LEGEND

- 2-inch O.D. Split Spoon Sample
- 3-inch O.D. Split Spoon Sample
- Ground Water Level ATD
- Ground Water Level in Well

RCRA Field Investigation
Yakima Training Center
Yakima, Washington

LOG OF BORING FTP-FB3

August 2001 21-1-14118-020

SHANNON & WILSON, INC.
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FIG. D-4

ENV_MASTER 21-14118.GPJ SHAN_WIL.GDT 7/13/01 Log: AMJ/JMH Rev: AMJ Typ: EET

ENVIRONMENTAL BOREHOLE LOG

Date Started 6/18/99	Location Fire Training Pit	Depth Water First Encountered (ft) 15.0
Date Completed 6/28/99	Drilling Company Andrews Drilling	Drilling Method HSA/Air Rotary
Total Depth (ft) 20.0	Sampling Method Split-spoon/Drill cuttings	Hammer: Weight (lbs) 300 Drop (in) 30
Borehole Diam. (in) 8	Ground Elev. (ft) 1475.9 / Monument Elev. (ft) NA	PVC Elev. (ft) NA

Depth (ft)	Sample Number	Interval	Blow Count Blows/Ft	Recovery(%)	PID (ppm)	Time	Depth (ft)	Lithologic Description	Soil Log	Well Log	Depth (ft)
								Ground Surface			
								Dense, brown, silty, medium to fine SAND; dry to moist; SM.			
	FTP-FB4-02/03/04		36	100	0	1050 (6/18)					
5	FTP-FB4-05	G	40 50/2"	94 0	0 0	1105 (6/18) 1114	5.4	BASALT: reddish-gray, slightly vesicular, moderately weathered, trace of silt; dry to moist.			5
10		G									10
15		G						--wet at 15 feet		▽	15
20							20.0	BOTTOM OF BORING COMPLETED 6/28/99			20
25								Note: Refusal at 5.5 feet below ground surface with HSA drill rig; completed boring to 20 feet bgs with an air rotary drill rig on 6/28/99.			25

Typ: EET Rev: AMJ Log: AMJ/JMH

ENV_MASTER 21-14118.GPJ SHAN_WIL.GDT 7/13/01

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification unless otherwise noted.

LEGEND

I	2-inch O.D. Split Spoon Sample	▽	Ground Water Level ATD
III	3-inch O.D. Split Spoon Sample	▼	Ground Water Level in Well

RCRA Field Investigation
Yakima Training Center
Yakima, Washington

LOG OF BORING FTP-FB4

August 2001 21-1-14118-020

SHANNON & WILSON, INC.
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FIG. D-5

ENVIRONMENTAL BOREHOLE LOG

Date Started 6/21/99	Location Fire Training Pit	Depth Water First Encountered (ft) N/A
Date Completed 6/29/99	Drilling Company Andrews Drilling	Drilling Method HSA/Air Rotary
Total Depth (ft) 20.0	Sampling Method Split-spoon/Drill cuttings	Hammer: Weight (lbs) 300 Drop (in) 30
Borehole Diam. (in) 8	Ground Elev. (ft) 1461.4 Monument Elev. (ft) NA	PVC Elev. (ft) NA

Depth (ft)	Sample Number	Interval	Blow Count Blows/Ft	Recovery(%)	PID (ppm)	Time	Depth (ft)	Lithologic Description	Soil Log	Well Log	Depth (ft)
								Ground Surface			
	FTP-FB5-02		50/4"	50	0	0940		Very dense, yellow to brown, silty SAND; dry to moist; occasional gravels, weathered basalt encountered at 4.0 feet; SM.			
			50/6"	50	0	0945 (6/21)	4.0	BASALT: Tan to light gray, moderately weathered; dry.			
5											5
							9.5	BASALT: Gray to black, slightly to moderately vesicular, occasional quartz and clay, infilling of vesicles; moist.			
10											10
15											15
20							20.0	BOTTOM OF BORING COMPLETED 6/29/1999			20
25											25

Note: (1) MS/MSD sample collected from 2.5- to 4-foot sample interval.
(2) Refusal at 4.0 feet with HSA drill rig on 6/21/99; completed boring to 20 feet bgs on 6/29/99 with an air rotary drill rig.

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification unless otherwise noted.

LEGEND

- 2-inch O.D. Split Spoon Sample
- 3-inch O.D. Split Spoon Sample
- Ground Water Level ATD
- Ground Water Level in Well

RCRA Field Investigation
Yakima Training Center
Yakima, Washington

LOG OF BORING FTP-FB5

August 2001 21-1-14118-020

SHANNON & WILSON, INC.
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FIG. D-6

ENV_MASTER 21-14118.GPJ SHAN_WIL.GDT 7/13/01 Log: AMJ/MH Rev: AMJ Typ: EET

ENVIRONMENTAL BOREHOLE LOG

Date Started: 6/21/99	Location: Fire Training Pit	Depth Water First Encountered (ft): N/A
Date Completed: 6/29/99	Drilling Company: Andrews Drilling	Drilling Method: HSA/Air Rotary
Total Depth (ft): 20.0	Sampling Method: Split-spoon/Drill cuttings	Hammer: Weight (lbs): 300 Drop (in): 30
Borehole Diam. (in): 8	Ground Elev. (ft): 1463.5	Monument Elev. (ft): NA / PVC Elev. (ft): NA

Depth (ft)	Sample Number	Interval	Blow Count Blows/Ft	Recovery(%)	PID (ppm)	Time	Depth (ft)	Lithologic Description	Soil Log	Well Log	Depth (ft)
								Ground Surface			
								Very dense, gray-brown, slightly silty, fine to medium SAND; trace of fine gravels; dry to moist; SM.			
	FTP-FB6-02		50/4"	39	14.6	0805 (6/21)	4.0				
5								BASALT: Tan to dark gray, slightly vesicular, slightly to moderately weathered; moist from 12.5 to 15.0 feet.			5
					56.5						
10					0						10
15					0						15
20							20.0	BOTTOM OF BORING COMPLETED 6/29/1999			20
25								Note: Refusal at 4.0 feet with HSA drill rig; completed boring to 20 feet bgs on 6/29/99 with air rotary drill rig.			25

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification unless otherwise noted.

LEGEND

- 2-inch O.D. Split Spoon Sample
- 3-inch O.D. Split Spoon Sample
- Ground Water Level ATD
- Ground Water Level in Well

RCRA Field Investigation
Yakima Training Center
Yakima, Washington

LOG OF BORING FTP-FB6

August 2001 21-1-14118-020

SHANNON & WILSON, INC.
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FIG. D-7

ENV_MASTER 21-14118.GPJ SHAN_WIL.GDT 7/13/01 Log: AMJ/MH Rev: AMJ Typ: EET

ENVIRONMENTAL BOREHOLE LOG

Date Started 6/21/99	Location Fire Training Pit		Depth Water First Encountered (ft) N/A
Date Completed 6/29/99	Drilling Company Andrews Drilling		Drilling Method HSA/Air Rotary
Total Depth (ft) 20.0	Sampling Method Split-spoon/Drill cuttings		Hammer: Weight (lbs) 300 Drop (in) 30
Borehole Diam. (in) 8	Ground Elev. (ft) 1467.4	Monument Elev. (ft) NA	PVC Elev. (ft) NA

Depth (ft)	Sample Number	Interval	Blow Count Blows/Ft	Recovery(%)	PID (ppm)	Time	Depth (ft)	Lithologic Description	Soil Log	Well Log	Depth (ft)
								Ground Surface			
	FTP-FB7-02/03/04		50/2"	17	14	0706 (6/21)		Very dense, brown, slightly silty, medium to fine SAND; trace fine gravel; SM.			
5	FTP-FB7-02/03/04		47/6"	100	12	0720 (6/21)	5.0	Dense, brown, slightly silty, gravelly SAND; dry to moist; bedrock at 7.0 feet; SP.			5
					0		7.0	BASALT: Gray to dark gray, slightly vesicular, fresh to slightly weathered; moist; petroleum odor from 13 to 15 feet.			
10					0						10
					330						
15					950						15
20							20.0	BOTTOM OF BORING COMPLETED 6/29/1999			20
								Note: Duplicate (FTP-FB7-03) and split (FTP-FB7-04) samples collected with sample FTP-FB7-02.			
25											25

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification unless otherwise noted.

LEGEND

2-inch O.D. Split Spoon Sample	Ground Water Level ATD
3-inch O.D. Split Spoon Sample	Ground Water Level in Well

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LOG OF BORING FTP-FB7

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FIG. D-8

ENV_MASTER 21-14118.GPJ SHAN_WIL.GDT 7/13/01 Log: AMJ/MH Rev: AMJ Typ: EET

ENVIRONMENTAL BOREHOLE LOG

Date Started 6/21/99	Location Fire Training Pit	Depth Water First Encountered (ft) N/A
Date Completed 6/29/99	Drilling Company Andrews Drilling	Drilling Method HSA/Air Rotary
Total Depth (ft) 20.0	Sampling Method Split-spoon/Drill cuttings	Hammer: Weight (lbs) 300 Drop (in) 30
Borehole Diam. (in) 8	Ground Elev. (ft) 1470.8 / Monument Elev. (ft) NA	PVC Elev. (ft) NA

Depth (ft)	Sample Number	Interval	Blow Count Blows/Ft	Recovery(%)	PID (ppm)	Time	Depth (ft)	Lithologic Description	Soil Log	Well Log	Depth (ft)
								Ground Surface			
							0.5	Very dense, slightly sandy, well-graded GRAVEL; dry; little to no fines; GW.			
	FTP-FB8-02		49/6"	1001	0	1220 (6/21)		Very dense, yellow to light brown, slightly silty, gravelly, medium to fine SAND; occasional basalt > 2.0 inches; SW-SP.			
5							4.0	Very dense, medium brown, mottled, slightly silty, medium sandy, coarse GRAVELS; dry; GP-GM.			5
	FTP-FB8-03		44	61	0	1254 (6/21)	6.5	BASALT: Dark gray to black, slightly to moderately vesicular, slightly weathered; moist at 12.5 feet; petroleum odor between 15 to 17 feet.			
		G			0						
10											10
		G			0						
15		G			426						15
		G			65.6						
		G			76						
		G			0						
20							20.0	BOTTOM OF BORING COMPLETED 6/29/1999			20
								Note: Refusal at 6.5 feet with HSA drill rig; completed boring to 20 feet bgs on 6/29/99 with an air rotary drill rig.			
25											25

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification unless otherwise noted.

LEGEND

2-inch O.D. Split Spoon Sample	Ground Water Level ATD
3-inch O.D. Split Spoon Sample	Ground Water Level in Well

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LOG OF BORING FTP-FB8

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FIG. D-9

ENV_MASTER 21-14118.GPJ SHAN_WIL.GDT 7/13/01 Log: AMJ/JMH Rev: AMJ Typ: EET

ENVIRONMENTAL BOREHOLE LOG

Date Started 6/8/99	Location Fire Training Pit	Depth Water First Encountered (ft) N/A
Date Completed 6/29/99	Drilling Company Andrews Drilling	Drilling Method HSA/Air Rotary
Total Depth (ft) 180.0	Sampling Method Split-spoon/Drill cuttings	Hammer: Weight (lbs) 300 Drop (in) 30
Borehole Diam. (in) 8	Ground Elev. (ft) 1470.1 Monument Elev. (ft) NA	PVC Elev. (ft) NA

Depth (ft)	Sample Number	Interval	Blow Count Blows/Ft	Recovery(%)	PID (ppm)	Time	Depth (ft)	Lithologic Description	Soil Log	Well Log	Depth (ft)
								Ground Surface			
5	1		50/5"			13:25		BASALT: Moderate strength, black, slightly weathered, slightly vesicular (Pomona Basalt member). --HSA refusal at 3.5 feet			5
10		G									10
15		G									15
20		G									20
25		G									25
30		G									30
35		G									35
40		G									40
45		G									45

CONTINUED NEXT PAGE

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification unless otherwise noted.

LEGEND

- 2-inch O.D. Split Spoon Sample
- 3-inch O.D. Split Spoon Sample
- Ground Water Level ATD
- Ground Water Level in Well

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LOG OF BORING FTP-12

August 2001 21-1-14118-020

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FIG. D-9
Sheet 1 of 4

ENV_MASTER 21-14118.GPJ SHAN_WIL.GDT 7/13/01 Log: AMJ/JMH Rev: AMJ Typ: EET

ENVIRONMENTAL BOREHOLE LOG

Date Started 6/8/99	Location Fire Training Pit		Depth Water First Encountered (ft) N/A
Date Completed 6/29/99	Drilling Company Andrews Drilling		Drilling Method HSA/Air Rotary
Total Depth (ft) 180.0	Sampling Method Split-spoon/Drill cuttings		Hammer: Weight (lbs) 300 Drop (in) 30
Borehole Diam. (in) 8	Ground Elev. (ft) 1470.1	Monument Elev. (ft) NA	PVC Elev. (ft) NA

Depth (ft)	Sample Number	Interval	Blow Count Blows/Ft	Recovery(%)	PID (ppm)	Time	Depth (ft)	Lithologic Description	Soil Log	Well Log	Depth (ft)
								Ground Surface			
								BASALT: (cont.)			
55											55
60											60
65											65
70											70
75											75
80											80
85											85
90											90
95											95

CONTINUED NEXT PAGE

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification unless otherwise noted.

LEGEND

- 2-inch O.D. Split Spoon Sample
- 3-inch O.D. Split Spoon Sample
- Ground Water Level ATD
- Ground Water Level in Well

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FIG. D-9
Sheet 2 of 4

ENV_MASTER 21-14118.GPJ SHAN_WIL.GDT 7/13/01 Log: AMJ/JMH Rev: AMJ Typ: EET

ENVIRONMENTAL BOREHOLE LOG

Date Started 6/8/99	Location Fire Training Pit		Depth Water First Encountered (ft) N/A
Date Completed 6/29/99	Drilling Company Andrews Drilling		Drilling Method HSA/Air Rotary
Total Depth (ft) 180.0	Sampling Method Split-spoon/Drill cuttings		Hammer: Weight (lbs) 300 Drop (in) 30
Borehole Diam. (in) 8	Ground Elev. (ft) 1470.1	Monument Elev. (ft) NA	PVC Elev. (ft) NA

Depth (ft)	Sample Number	Interval	Blow Count Blows/Ft	Recovery(%)	PID (ppm)	Time	Depth (ft)	Lithologic Description	Soil Log	Well Log	Depth (ft)
								Ground Surface			
		G						BASALT: (cont.)			
105		G									105
110		G									110
115		G									115
120		G									120
125		G									125
130		G									130
135		G									135
140		G									140
145		G									145

CONTINUED NEXT PAGE

NOTES

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3. Groundwater level, if indicated above, is for the date specified and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification unless otherwise noted.

LEGEND

⊥	2-inch O.D. Split Spoon Sample	▽	Ground Water Level ATD
⊥⊥	3-inch O.D. Split Spoon Sample	▼	Ground Water Level in Well

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LOG OF BORING FTP-12

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FIG. D-9
Sheet 3 of 4

ENV_MASTER 21-14118.GPJ SHAN_WIL.GDT 7/13/01 Log: AMJ/MH Rev: AMJ Typ: EET

ENVIRONMENTAL BOREHOLE LOG

Date Started 6/8/99	Location Fire Training Pit	Depth Water First Encountered (ft) N/A	
Date Completed 6/29/99	Drilling Company Andrews Drilling	Drilling Method HSA/Air Rotary	
Total Depth (ft) 180.0	Sampling Method Split-spoon/Drill cuttings	Hammer: Weight (lbs) 300	Drop (in) 30
Borehole Diam. (in) 8	Ground Elev. (ft) 1470.1	Monument Elev. (ft) NA	PVC Elev. (ft) NA

Depth (ft)	Sample Number	Interval	Blow Count Blows/Ft	Recovery(%)	PID (ppm)	Time	Depth (ft)	Lithologic Description	Soil Log	Well Log	Depth (ft)
								Ground Surface			
								BASALT: (cont.)			
155							155.0	Soft, brown, slightly gravelly, clayey SILT; moist; ML.			155
160											160
165							166.0	Dark brown to black, silty, sandy GRAVEL; moist to wet; GM.			165
170											170
175											175
180							180.0	BOTTOM OF BORING COMPLETED 6/29/1999			180
185											185
190											190
195											195

Log: AMJ/JMH Rev. AMJ Typ: EET

ENV_MASTER 21-14118.GPJ SHAN_WIL.GDT 7/13/01

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification unless otherwise noted.

LEGEND

- 2-inch O.D. Split Spoon Sample
- 3-inch O.D. Split Spoon Sample
- Ground Water Level ATD
- Ground Water Level in Well

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FIG. D-9
Sheet 4 of 4

ENVIRONMENTAL BOREHOLE LOG

Date Started 6/21/99	Location Fire Training Pit	Depth Water First Encountered (ft) 15.0
Date Completed 7/9/99	Drilling Company Andrews Drilling	Drilling Method HSA/Air Rotary
Total Depth (ft) 25.0	Sampling Method Split-spoon/Drill cuttings	Hammer: Weight (lbs) 300 Drop (in) 30
Borehole Diam. (in) 12	Ground Elev. (ft) 1470.9	Monument Elev. (ft) 1473.30 / PVC Elev. (ft) 1473.07

Depth (ft)	Sample Number	Interval	Blow Count Blows/Ft	Recovery(%)	PID (ppm)	Time	Depth (ft)	Lithologic Description	Soil Log	Well Log	Depth (ft)
								Ground Surface			
								Dense, medium brown, slightly silty, fine to medium SAND; dry to moist; occasional coarse gravels and fractured weathered basalt; SP-SM.			
	FTP13-02/ MS/MSD		74	100	0	0158 (6/21)					
5											5
	FTP13-03		52	100	0	0210 (6/21)					
							7.5	BASALT: Gray to reddish-brown, slightly to moderately vesiculated, slightly weathered, scattered silt and quartz infilling; moist at 20 feet.			
10		G									10
		G									
15										▽	15
		G									

CONTINUED NEXT PAGE

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification unless otherwise noted.

LEGEND

- 2-inch O.D. Split Spoon Sample
- 3-inch O.D. Split Spoon Sample
- ▽ Ground Water Level ATD
- ▼ Ground Water Level in Well

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FIG. D-11
Sheet 1 of 2

ENV_MASTER 21-14118.GPJ SHAN_WIL.GDT 7/13/01 Log: AMJ/JMH Rev: AMJ Typ: EET

ENVIRONMENTAL BOREHOLE LOG

Date Started 6/21/99	Location Fire Training Pit	Depth Water First Encountered (ft) 15.0
Date Completed 7/9/99	Drilling Company Andrews Drilling	Drilling Method HSA/Air Rotary
Total Depth (ft) 25.0	Sampling Method Split-spoon/Drill cuttings	Hammer: Weight (lbs) 300 Drop (in) 30
Borehole Diam. (in) 12	Ground Elev. (ft) 1470.9 / Monument Elev. (ft) 1473.30	PVC Elev. (ft) 1473.07

Depth (ft)	Sample Number	Interval	Blow Count Blows/Ft	Recovery(%)	PID (ppm)	Time	Depth (ft)	Lithologic Description	Soil Log	Well Log	Depth (ft)
								Ground Surface			
								BASALT: (cont.)			
25							25.0	BOTTOM OF BORING COMPLETED 7/9/1999			25
								Note: Refusal at 7.5 feet with HSA drill rig; completed boring to 25.0 feet with an air rotary drill rig on 07/09/99. Well installation completed 7/21/99.			
30											30
35											35

NOTES

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3. Groundwater level, if indicated above, is for the date specified and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification unless otherwise noted.

LEGEND

I	2-inch O.D. Split Spoon Sample	▽	Ground Water Level ATD
III	3-inch O.D. Split Spoon Sample	▼	Ground Water Level in Well

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LOG OF BORING FTP-13

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FIG. D-11
Sheet 2 of 2

ENV_MASTER 21-14118.GPJ SHAN_WIL.GDT 7/13/01 Log: AMJ/JMH Rev: AMJ Typ: EET

ENVIRONMENTAL BOREHOLE LOG

Date Started 6/21/99	Location Fire Training Pit	Depth Water First Encountered (ft) 15.4
Date Completed 7/8/99	Drilling Company Andrews Drilling	Drilling Method HSA/Air Rotary
Total Depth (ft) 30.0	Sampling Method Split-spoon/Drill cuttings	Hammer: Weight (lbs) 300 Drop (in) 30
Borehole Diam. (in) 10	Ground Elev. (ft) 1455.4	Monument Elev. (ft) 1457.65 PVC Elev. (ft) 1457.48

Depth (ft)	Sample Number	Interval	Blow Count Blows/Ft	Recovery(%)	PID (ppm)	Time	Depth (ft)	Lithologic Description	Soil Log	Well Log	Depth (ft)
								Ground Surface			
	FTP14-02		50/4"	17	0	1133		Very dense, light brown to medium brown, slightly silty, fine to medium SAND; trace gravels and weathered, vesiculated basalt; variations in color of sand in upper 3.0 feet; SM.			
5	FTP14-03		50/5"	67	0	1144	6.0	Loose, gray to brown, silty, sandy GRAVEL; dry; GM.			5
							7.5	BASALT: Gray to reddish-brown, slightly vesicular, occasional clay infilling in vesicles, moderately weathered; dry to moist.			
10											10
15											15
20											20

CONTINUED NEXT PAGE

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
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3. Groundwater level, if indicated above, is for the date specified and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification unless otherwise noted.

LEGEND

- 2-inch O.D. Split Spoon Sample
- 3-inch O.D. Split Spoon Sample
- Ground Water Level ATD
- Ground Water Level in Well

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LOG OF BORING FTP-14

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FIG. D-12
Sheet 1 of 2

ENV_MASTER 21-14118.GPJ SHAN_WIL.GDT 7/13/01 Log: AMJ/JMH Rev: AMJ Typ: EET

ENVIRONMENTAL BOREHOLE LOG

Date Started 6/21/99	Location Fire Training Pit	Depth Water First Encountered (ft) 15.4
Date Completed 7/8/99	Drilling Company Andrews Drilling	Drilling Method HSA/Air Rotary
Total Depth (ft) 30.0	Sampling Method Split-spoon/Drill cuttings	Hammer: Weight (lbs) 300 Drop (in) 30
Borehole Diam. (in) 10	Ground Elev. (ft) 1455.4 / Monument Elev. (ft) 1457.65	PVC Elev. (ft) 1457.48

Depth (ft)	Sample Number	Interval	Blow Count Blows/Ft	Recovery(%)	PID (ppm)	Time	Depth (ft)	Lithologic Description	Soil Log	Well Log	Depth (ft)
								Ground Surface			
		G						BASALT: (cont.)			
30							30.0	BOTTOM OF BORING COMPLETED 6/21/1999			30
								Note: Refusal at 6.0 feet with HSA drill rig; completed boring to 30 feet with an air rotary drill rig on 7/8/99. Well installation completed 07/21/99.			
35											35
40											40
45											45

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification unless otherwise noted.

LEGEND

I	2-inch O.D. Split Spoon Sample	▽	Ground Water Level ATD
III	3-inch O.D. Split Spoon Sample	▼	Ground Water Level in Well

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FIG. D-12
Sheet 2 of 2

ENV_MASTER 21-14118.GPJ SHAN_WIL.GDT 7/13/01 Log: AMJ/MH Rev: AMJ Typ: EET

ENVIRONMENTAL BOREHOLE LOG

Date Started 6/21/99	Location Fire Training Pit	Depth Water First Encountered (ft) N/A
Date Completed 7/9/99	Drilling Company Andrews Drilling	Drilling Method HSA/Air Rotary
Total Depth (ft) 25.0	Sampling Method Split-spoon/Drill cuttings	Hammer: Weight (lbs) 300 Drop (in) 30
Borehole Diam. (in) 10	Ground Elev. (ft) 1458.7	Monument Elev. (ft) 1461.28 PVC Elev. (ft) 1460.88

Depth (ft)	Sample Number	Interval	Blow Count Blows/Ft	Recovery(%)	PID (ppm)	Time	Depth (ft)	Lithologic Description	Soil Log	Well Log	Depth (ft)
								Ground Surface			
								Dense, light brown to brown, slightly silty, fine to medium SAND; trace gravels; change in color and increase in cohesiveness at 3.5 feet; SM.			
	FTP15-02		44	100	0	1038	4.0	BASALT: Dark gray to brown, slightly vesicular, slightly weathered; moist at 16.0 feet.			
5											5
10											10
15											15

CONTINUED NEXT PAGE

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification unless otherwise noted.

LEGEND

2-inch O.D. Split Spoon Sample	Ground Water Level ATD
3-inch O.D. Split Spoon Sample	Ground Water Level in Well

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LOG OF BORING FTP-15

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FIG. D-13
Sheet 1 of 2

ENV_MASTER 21-14118.GPJ SHAN_WIL.GDT 7/13/01 Log: AMJ/JMH Rev: AMJ Typ: EET

ENVIRONMENTAL BOREHOLE LOG

Date Started 6/21/99	Location Fire Training Pit	Depth Water First Encountered (ft) N/A
Date Completed 7/9/99	Drilling Company Andrews Drilling	Drilling Method HSA/Air Rotary
Total Depth (ft) 25.0	Sampling Method Split-spoon/Drill cuttings	Hammer: Weight (lbs) 300 Drop (in) 30
Borehole Diam. (in) 10	Ground Elev. (ft) 1458.7 Monument Elev. (ft) 1461.28	PVC Elev. (ft) 1460.88

Depth (ft)	Sample Number	Interval	Blow Count Blows/Ft	Recovery(%)	PID (ppm)	Time	Depth (ft)	Lithologic Description	Soil Log	Well Log	Depth (ft)
								Ground Surface			
		G						BASALT: (cont.)			
25							25.0	BOTTOM OF BORING COMPLETED 7/9/1999			25
								Note: Refusal at 4.0 feet with HSA drill rig; completed boring to 25 feet on 7/9/99 with an air rotary drill rig. Well installation completed 7/22/99.			
30											30
35											35

Log: AMJ/JMH Rev: AMJ Typ: EET

ENV_MASTER 21-14118.GPJ SHAN_WIL.GDT 7/13/01

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification unless otherwise noted.

LEGEND

- 2-inch O.D. Split Spoon Sample
- 3-inch O.D. Split Spoon Sample
- Ground Water Level ATD
- Ground Water Level in Well

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LOG OF BORING FTP-15

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FIG. D-13
Sheet 2 of 2

ENVIRONMENTAL BOREHOLE LOG

Date Started 7/20/99	Location Fire Training Pit		Depth Water First Encountered (ft) 28.0
Date Completed 7/22/99	Drilling Company Andrews Drilling		Drilling Method HSA/Air Rotary
Total Depth (ft) 30.0	Sampling Method Split-spoon/Drill cuttings		Hammer: Weight (lbs) 300 Drop (in) 30
Borehole Diam. (in) 10	Ground Elev. (ft) 1442.7	Monument Elev. (ft) NA	PVC Elev. (ft) NA

Depth (ft)	Sample Number	Interval	Blow Count Blows/Ft	Recovery(%)	PID (ppm)	Time	Depth (ft)	Lithologic Description	Soil Log	Well Log	Depth (ft)
								Ground Surface			
5	1							Loose, tan, slightly gravelly to gravelly, silty SAND; dry; moist at 11.0 feet; SM.			5
10	2										10
	3						12.5	BASALT: Moderate strength, dark gray, moderately vesicular, slightly weathered; moist; (Pomona Basalt member).			
15	4										15

CONTINUED NEXT PAGE

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification unless otherwise noted.

LEGEND

- 2-inch O.D. Split Spoon Sample
- 3-inch O.D. Split Spoon Sample
- Ground Water Level ATD
- Ground Water Level in Well

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August 2001 21-1-14118-020

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Geotechnical and Environmental Consultants

FIG. D-14
Sheet 1 of 2

ENV_MASTER 21-14118.GPJ SHAN_WIL.GDT 7/13/01 Log: AMJ/JMH Rev: AMJ Typ: EET

ENVIRONMENTAL BOREHOLE LOG

Date Started 7/20/99	Location Fire Training Pit	Depth Water First Encountered (ft) 28.0
Date Completed 7/22/99	Drilling Company Andrews Drilling	Drilling Method HSA/Air Rotary
Total Depth (ft) 30.0	Sampling Method Split-spoon/Drill cuttings	Hammer: Weight (lbs) 300 Drop (in) 30
Borehole Diam. (in) 10	Ground Elev. (ft) 1442.7 / Monument Elev. (ft) NA	PVC Elev. (ft) NA

Depth (ft)	Sample Number	Interval	Blow Count Blows/Ft	Recovery(%)	PID (ppm)	Time	Depth (ft)	Lithologic Description	Soil Log	Well Log	Depth (ft)
								Ground Surface			
								BASALT: (cont.)			
25	5	G									25
30							30.0	BOTTOM OF BORING COMPLETED 7/22/1999			30
								Note: Monitoring well installation completed on 7/22/1999.			
35											35

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification unless otherwise noted.

LEGEND

2-inch O.D. Split Spoon Sample	Ground Water Level ATD
3-inch O.D. Split Spoon Sample	Ground Water Level in Well

RCRA Field Investigation
Yakima Training Center
Yakima, Washington

LOG OF BORING FTP-16

August 2001 21-1-14118-020

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. D-14
Sheet 2 of 2

ENV_MASTER 21-14118.GPJ SHAN_WIL.GDT 7/13/01 Log: AMJ/JMH Rev: AMJ Typ: EET

FIELD BOREHOLE LOG

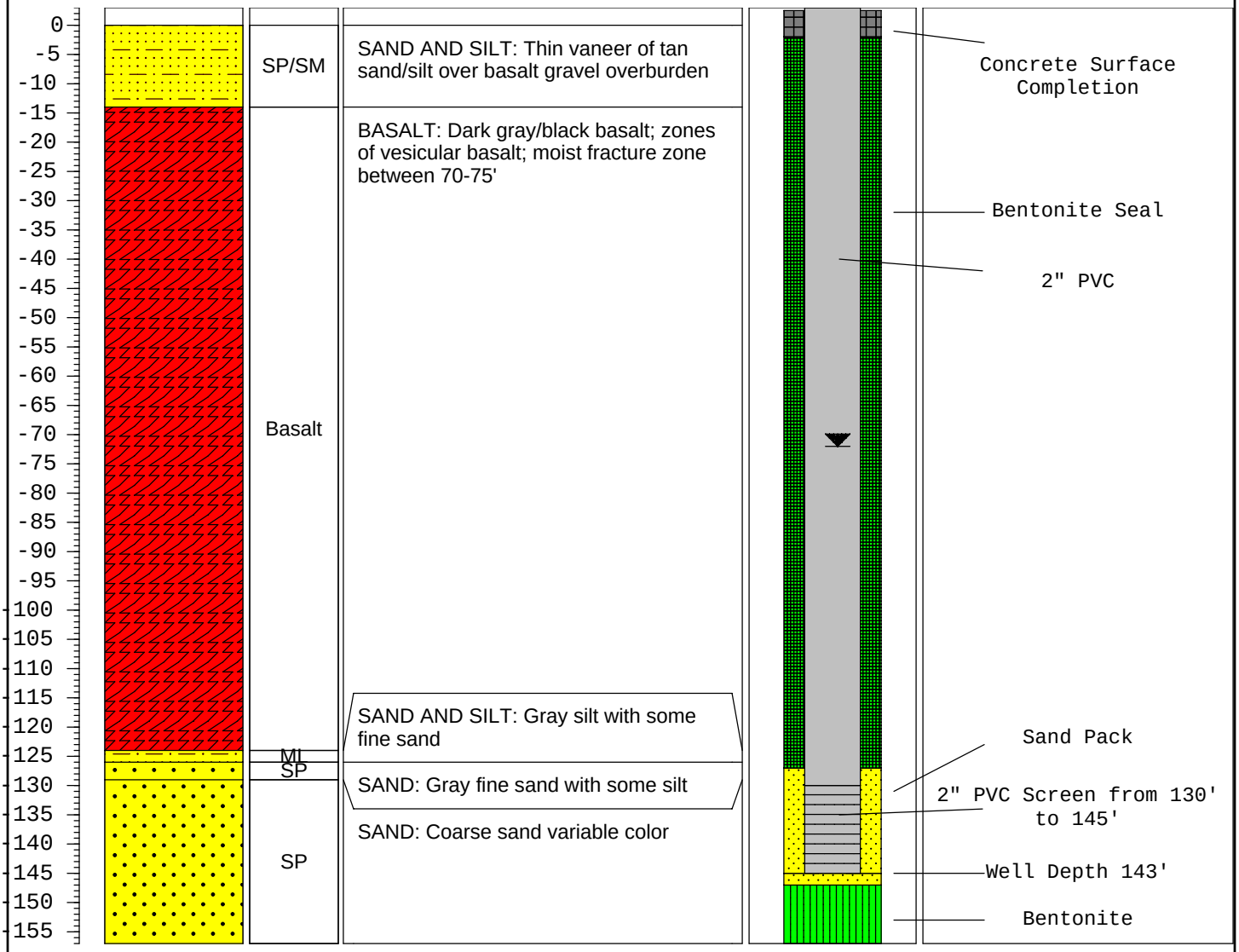
BOREHOLE/WELL ID: **815-1**

TOTAL DEPTH: **157'**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**YTC SWMU 5**	DRILLING CO.:	**Environmental West**
SITE LOCATION:	**Yakima Training Center**	DRILLER:	**Ron Sink**
LOGGED BY:	**Joe Thompson**	RIG TYPE:	**Schramm T300E**
DATES DRILLED:	**10/12/05**	METHOD OF DRILLING:	**Air Rotary**
		LOGGING METHOD:	**Cuttings**
		DRILL BIT:	**6" downhole hammer**

▼ Water level in completed well

DEPTH	SOIL/ROCK SYMBOL	USCS	SOIL/ROCK DESCRIPTION	BORING COMPLETION	WELL DESCRIPTION



NOTES: 7" Tubex temporary casing to 15'

FIELD BOREHOLE LOG

BOREHOLE/WELL ID: **815-2**

TOTAL DEPTH: **132'**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**YTC SWMU 5**	DRILLING CO.:	**Environmental West**
SITE LOCATION:	**Yakima Training Center**	DRILLER:	**Ron Sink**
LOGGED BY:	**Joe Thompson**	RIG TYPE:	**Schramm T300E**
DATES DRILLED:	**10-13-05 - 10-14-05**	METHOD OF DRILLING:	**Air Rotary**
		LOGGING METHOD:	**Cuttings**
		DRILL BIT:	**6" downhole hammer**

▼ Water level in completed well

DEPTH	SOIL/ROCK SYMBOL	USCS	SOIL/ROCK DESCRIPTION	BORING COMPLETION	WELL DESCRIPTION
0 to -130		SM	SAND AND SILT: Tan sand/silt soil and gravel fill overburden		Concrete Surface Completion
		Basalt	BASALT: Dark gray/black vesicular basalt; reddish-brown weathered basalt from 14-15'		Bentonite Seal
					2" PVC
					Sand Pack
		SP/SM	SAND AND SILT: Dark gray fine sand and silt		2" PVC Screen from 115' to 130'
		SW	SAND: Multi-colored coarse sand; poorly sorted; angular to sub-angular		Well Depth 127'

NOTES: 7" Tubex temporary casing to 10'

FIELD BOREHOLE LOG

BOREHOLE/WELL ID: **815-3**

TOTAL DEPTH: **117'**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**YTC SWMU 5**	DRILLING CO.:	**Environmental West**
SITE LOCATION:	**Yakima Training Center**	DRILLER:	**Ron Sink**
LOGGED BY:	**Joe Thompson/Troy Bussey**	RIG TYPE:	**Schramm T300E**
DATES DRILLED:	**10/14/05, 10/17/05**	METHOD OF DRILLING:	**Air Rotary**
		LOGGING METHOD:	**Cuttings**
		DRILL BIT:	**6" downhole hammer**

▼ Water level in completed well

DEPTH	SOIL/ROCK SYMBOL	USCS	SOIL/ROCK DESCRIPTION	BORING COMPLETION	WELL DESCRIPTION
0 to -115		SM	SILTY SAND: Tan silty-sand; dry		Concrete Surface Completion
			BASALT: Dark gray to black basalt with vesicles on top of unit; dry		Bentonite Seal
		Basalt			2" PVC
					Sand Pack
					2" PVC Screen from 106' to 116'
		SP/SM	SAND AND SILT: Brown to black coarse sand with some sandy-silt; wet		Well Depth 116'
					Borehole Cave-in

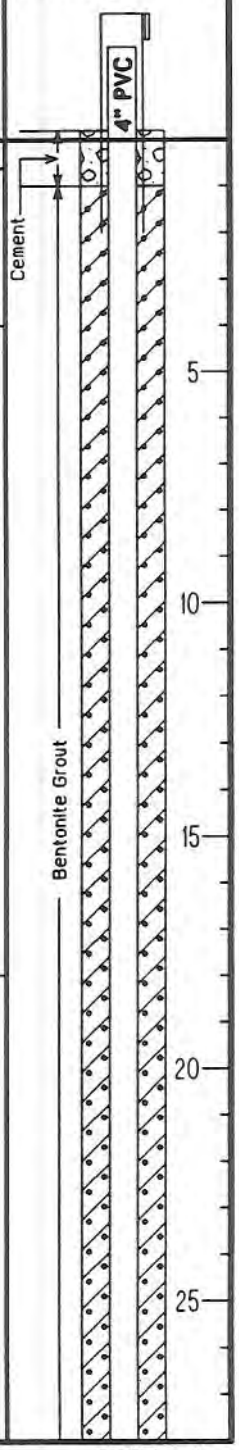
NOTES: 7" Tubex temporary casing to 10'

LOG OF MONITORING WELL MMP-1

Project Name: Yakima Training Center	Job #: UF 3020
Location: Yakima, Wa.	Water Level: 59.15 ' (BGS)
Well Number: MMP-1 Start Date/Time: 3/2/93; Finish Date/Time: 3/2/93;	Logged By: D. Anderson
Top of Casing Elevation: 1301.42' Surface Elevation: 1298.5' Total Depth: 100.5'	Drilling Contractor: Cascade Drilling Driller: Steve Butler

Elevation Depth (feet)	Graphic Log	Sample ID # Interval	Blow Count	OVA-Nu (ppm)	Recovery	USCS Symbol	Soil and Rock Description / Comment
						GM	Asphalt.
						SM	Silty Sand. Medium to coarse sand, tan and very dense.
						SM	Grades to silt/clay (10%), orange.
						SM	Grades to orange-brown.
5						GM:SM	Sandy GRAVEL/gravelly Sand. Fine to medium sand. Gravel to 3", subrounded to rounded basalt. Dense. Moist.
10			50 - -	na	5"		Split-spoon sample - 6" recovery, collect sample #93MMP001SB
15						SM	Silty clayey Sand with gravel. Fine to coarse sand. Gravel (30%) to 2" in diameter. Clay balls when rolled. Tan. Moist to dry.
20			50 - -	na	0"	CL:ML	Silt and Clay tan, very dense, indurated, microfractures with iron staining. Split-spoon sample - no recovery, collect samples:.br .in8 #93MMP002GB Triplicate .in8 #93MMP003GB ASC .in8 #93MMP003GB NPD
25							

Monitoring Well Data



LOG OF MONITORING WELL MMP-1

Project Name: Yakima Training Center	Job #: UF 3020
Location: Yakima, Wa.	WELL #: MMP-1

Elevation / Depth (feet)	Graphic Log	Sample ID # / Interval	Blow Count	OVA-Nu (ppm)	Recovery	USCS Symbol	Soil and Rock Description / Comment	Monitoring Well Data
						CL:ML		
						SM	Sand Loess with some clay/silt. Fine sand. Light brown.	
						BA	Basalt brown, weathered.	
33							Grades to brown-black, vesicular.	
38								
43							Basalt black, crystalline/massive, very dense, little or no vesicules. Dry.	
48						BA		
53								
58								

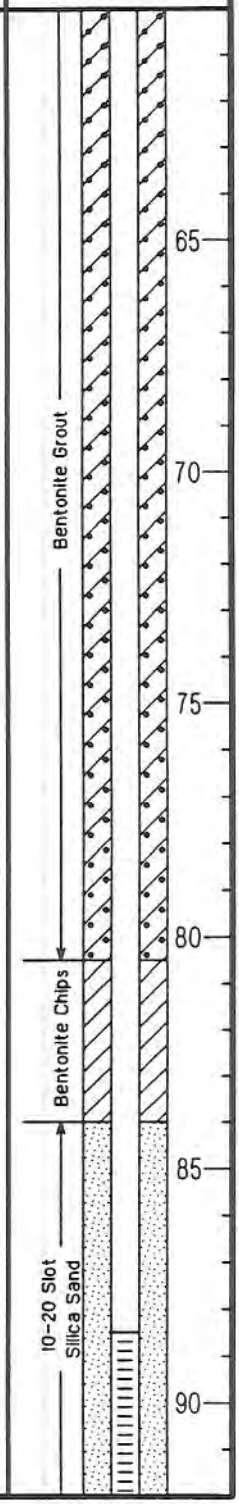
Bentonite Grout

3/9/93

LOG OF MONITORING WELL MMP-1

Project Name: Yakima Training Center	Job #: UF 3020
Location: Yakima, Wa.	WELL #: MMP-1

Elevation / Depth (feet)	Graphic Log	Sample ID # / Interval	Blow Count	OVA-Hw (ppm)	Recovery	USCS Symbol	Soil and Rock Description / Comment	Monitoring Well Data
65								
70								
75						BA		
80								
85								
90								



LOG OF MONITORING WELL MMP-1

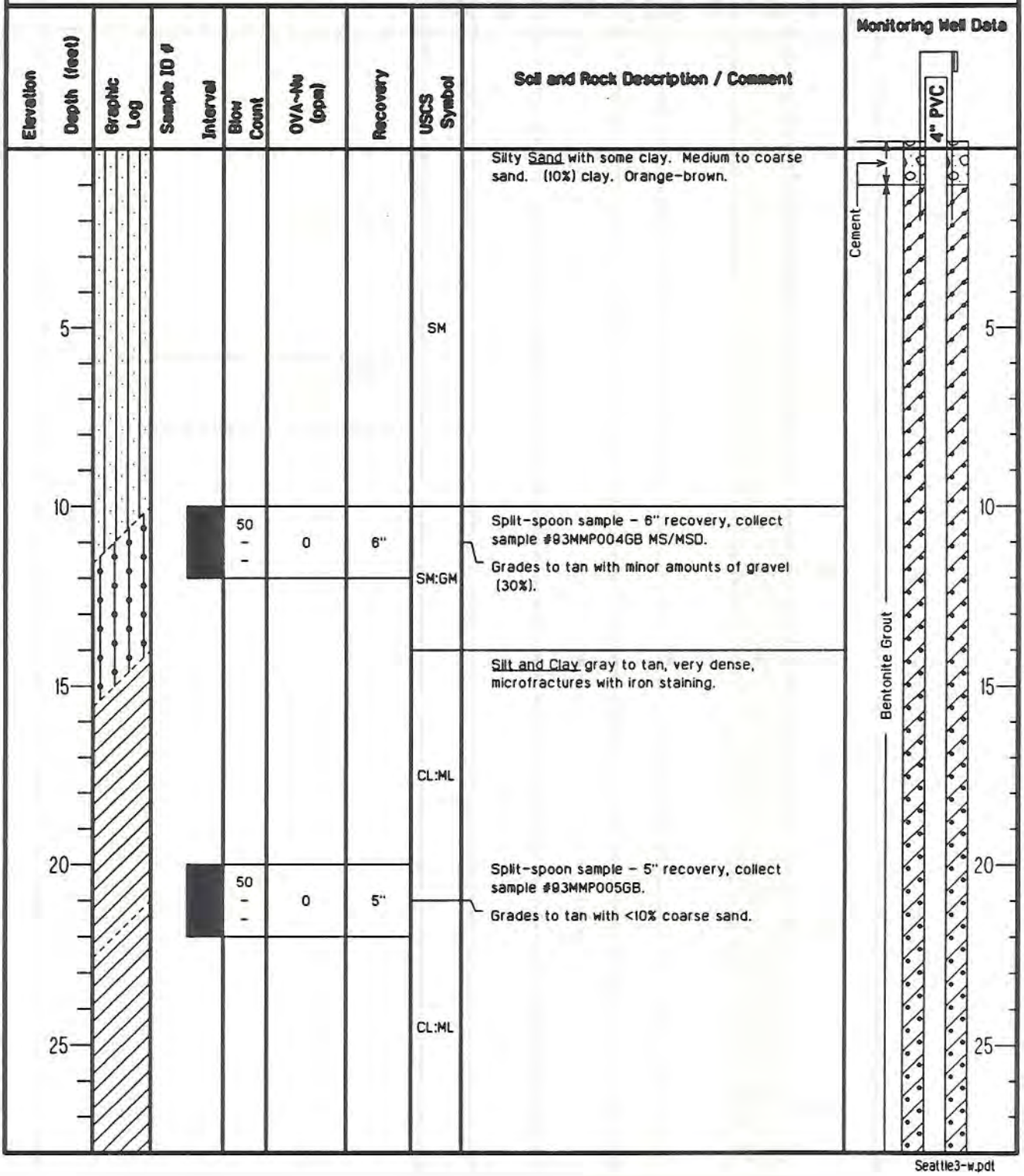
Project Name: Yakima Training Center	Job #: UF 3020
Location: Yakima, Wa.	WELL #: MMP-1

Elevation Depth (feet)	Graphic Log	Sample ID # Interval	Blow Count	OVA-Nu (ppm)	Recovery	USCS Symbol	Soil and Rock Description / Comment	Monitoring Well Data
						BA		
97						BA:SM?	Fracture zone in Basalt, vesicules, with some iron staining. Interbeds of green volcanic ash and yellow coarser rhyolite/ash?.	10-20 Slot Silica Sand
							Total Depth of boring 100.5'.	
102								
107								
112								
117								
122								

Seattle3-w.pdt

LOG OF MONITORING WELL MMP-2

Project Name: Yakima Training Center	Job #: UF 3020
Location: Yakima, Wa.	Water Level: 59.19' (BGS)
Well Number: MMP-2 Start Date/Time: 3/3/93; Finish Date/Time: 3/3/93;	Logged By: D. Anderson
Top of Casing Elevation: 1301.25' Surface Elevation: 1298.8' Total Depth: 75.5'	Drilling Contractor: Cascade Drilling Driller: Steve Butler



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LOG OF MONITORING WELL MMP-2

Project Name: Yakima Training Center

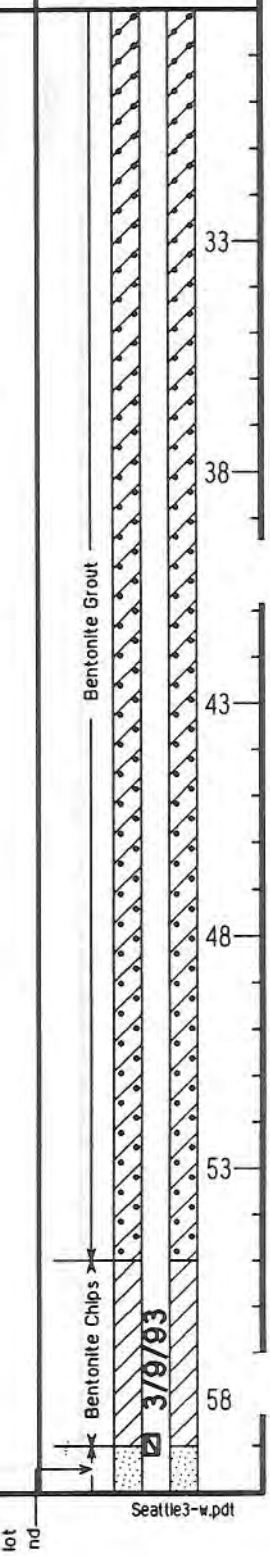
Job #: UF 3020

Location: Yakima, Wa.

WELL #: MMP-2

Elevation / Depth (feet)	Graphic Log	Sample ID # / Interval	Blow Count	OVA-Nu (ppm)	Recovery	USCS Symbol	Soil and Rock Description / Comment
33						CL:ML	
						ML:CL	Grades to gray.
38						BA	Basalt brown/black, some vesicules with iron staining. Dry.
							Grades to black, crystalline/massive.
43							
48						BA:ML	
53							
58							

Monitoring Well Data

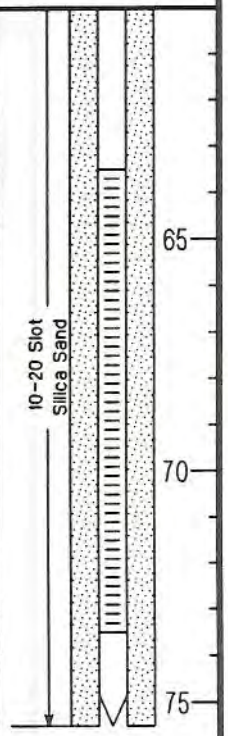


Seattle3-w.pdt

LOG OF MONITORING WELL MMP-2

Project Name: Yakima Training Center	Job #: UF 3020
Location: Yakima, Wa.	WELL #: MMP-2

Elevation / Depth (feet)	Graphic Log	Sample ID # / Interval	Blow Count	OVA-Nu (ppm)	Recovery	USCS Symbol	Soil and Rock Description / Comment	Monitoring Well Data
65						BA:ML		
70						BA:SM?	Fracture zone in Basalt, vesicules, with iron staining. Interbeds of green and yellow ash/volcanics.	
75								
80								
85								
90								

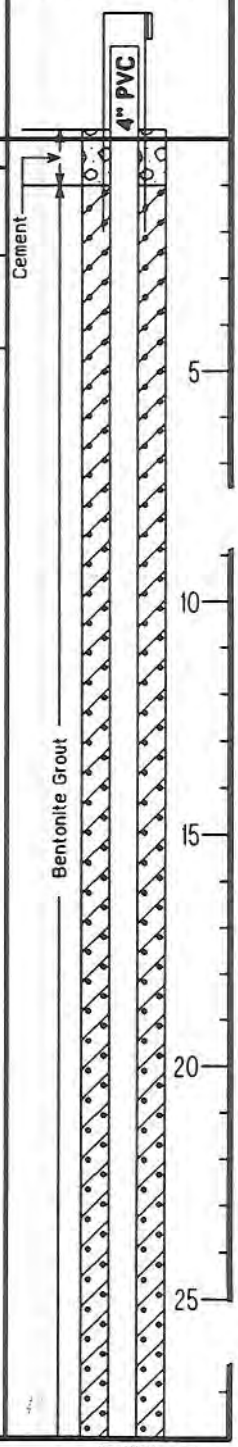


LOG OF MONITORING WELL MRC-2

Project Name: Yakima Training Center	Job #: UF 3020
Location: Yakima, Wa.	Water Level: 75.43' (BGS)
Well Number: MRC-2 Start Date/Time: 3/1/93; Finish Date/Time: ;	Logged By: D. Anderson
Top of Casing Elevation: 1313.97' Surface Elevation: 1311.7' Total Depth: 113.5'	Drilling Contractor: Cascade Drilling Driller: Steve Butler

Elevation / Depth (feet)	Graphic Log	Sample ID # / Interval	Blow Count	OVA-Hw (ppm)	Recovery	USCS Symbol	Soil and Rock Description / Comment
							Overburden silty, sandy GRAVEL.
						SM	Sand Loess, fine, little or no gravel, tan. Dry,
						SM:GM	Sandy GRAVEL, dark brown.
5							Basalt black to blue-gray, vesiculated, dense. Dry.
10							
15						BA	
20							
25							

Monitoring Well Data



LOG OF MONITORING WELL MRC-2

Project Name: Yakima Training Center	Job #: UF 3020
Location: Yakima, Wa.	WELL #: MRC-2

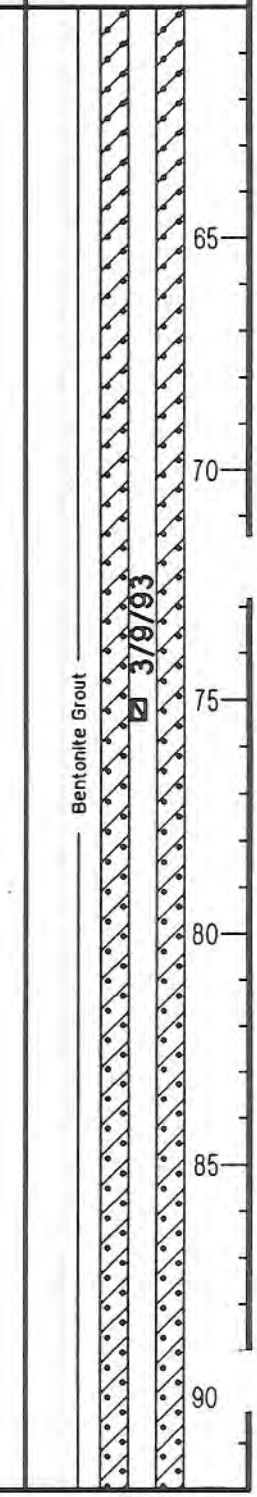
Elevation / Depth (feet)	Graphic Log	Sample ID # / Interval	Blow Count	OVA-Ns (ppm)	Recovery	USCS Symbol	Soil and Rock Description / Comment	Monitoring Well Data
33								Bentonite Grout
38								
43						BA		
48								
53								
58								

LOG OF MONITORING WELL MRC-2

Project Name: Yakima Training Center | Job #: UF 3020

Location: Yakima, Wa. | WELL #: MRC-2

Elevation / Depth (feet)	Graphic Log	Sample ID # / Interval	Blow Count	OVA-Nu (ppm)	Recovery	USCS Symbol	Soil and Rock Description / Comment	Monitoring Well Data
65								
70								
75						BA		
80								
85								
90								



LOG OF MONITORING WELL MRC-2

Project Name: Yakima Training Center	Job #: UF 3020
Location: Yakima, Wa.	WELL #: MRC-2

Elevation / Depth (feet)	Graphic Log	Sample ID # / Interval	Blow Count	OVA-Nu (ppm)	Recovery	USCS Symbol	Soil and Rock Description / Comment	Monitoring Well Data
97						BA		Bentonite Grout; Bentonite Chips
102								10-20 Slot Silica Sand
107								
112						BA:SM?	Fracture zone in Basalt, vesiculated, holes to 1/4". Iron staining – $FeCO_3$? Interbeds of coarse sand, with some ash/volcanics. Lots of water. A possible void was encountered during drilling below 111' BGS.	
							Total Depth of boring 113.5'.	
117								
122								

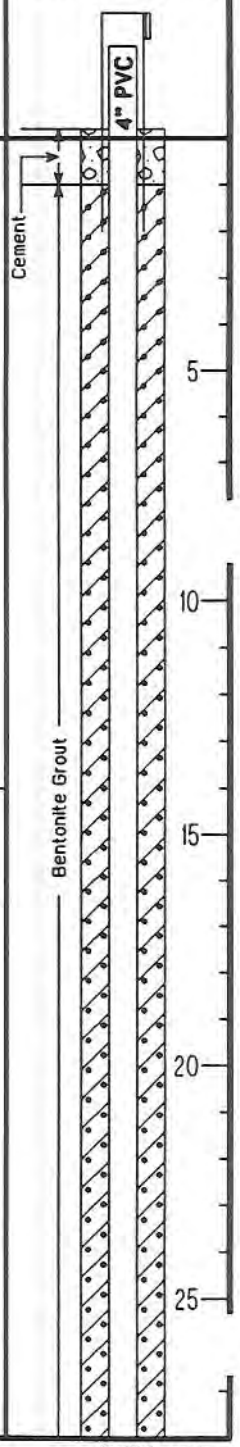
Seattle3-w.pdt

LOG OF MONITORING WELL MTS-1

Project Name: Yakima Training Center	Job #: UF 3020
Location: Yakima, Wa.	Water Level: 100.22 (BGS)
Well Number: MTS-1 Start Date/Time: 2/24/93; 1430 Finish Date/Time: 2/25/93;	Logged By: D. Anderson
Top of Casing Elevation: 1361.69' Surface Elevation: 1358.1' Total Depth: 127'	Drilling Contractor: Cascade Drilling Driller: Mike Colbert

Elevation / Depth (feet)	Graphic Log	Sample ID # / Interval	Blow Count	OVA-Nu (ppm)	Recovery	USCS Symbol	Soil and Rock Description / Comment
0							Silty GRAVEL. Overburden/fill? Gravel to 3" in diameter. Dark brown to black. Damp. Basalt gravel.
				1.4		GM	
5							
							Large basalt boulder.
							Collect sample #93MTS001GB from cuttings.
10						GM	
							Sand with clay/silt. Fine to coarse sand, Lt. brown to tan. Clay/ silt (10%). Moist to dry.
15			19 22 24	na	8"	SM:SC	Split-spoon sample - 8" recovery, collect sample #93MTS002SB
							Grades to fine to medium sand, orange to tan. Moist to dry.
20						SM:SC	
25						SM:SC	Grades to lt. gray/brown with gravel (10%) to 1". Dry.

Monitoring Well Data



Seattle3-w.pdt

LOG OF MONITORING WELL MTS-1

Project Name: Yakima Training Center	Job #: UF 3020
Location: Yakima, Wa.	WELL #: MTS-1

Elevation / Depth (feet)	Graphic Log	Sample ID # / Interval	Blow Count	OVA-Nu (ppm)	Recovery	USCS Symbol	Soil and Rock Description / Comment	Monitoring Well Data
33						SM:SC		Bentonite Grout
38						SM:SC	Silty, clayey Sand with (10%) gravel. Fine to coarse sand. Gravel to 1" diameter. Dark black/brown. Moist to dry.	
43								
48						BA	Basalt black, no vesicules, massive with some crystalline structure.	
53								
58								

LOG OF MONITORING WELL MTS-1

Project Name: Yakima Training Center	Job #: UF 3020
Location: Yakima, Wa.	WELL #: MTS-1

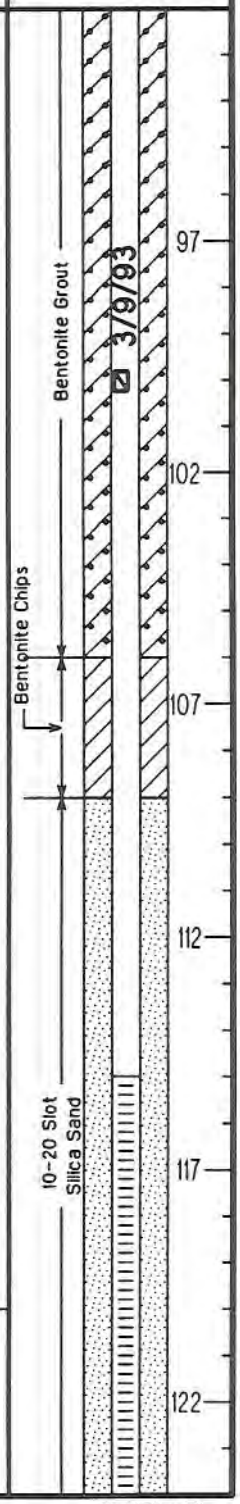
Elevation Depth (feet)	Graphic Log	Sample ID # Interval	Blow Count	OVA-Nu (ppm)	Recovery	USCS Symbol	Soil and Rock Description / Comment	Monitoring Well Data
65								Bentonite Grout
70								
75						BA		
80								
85								
90								

LOG OF MONITORING WELL MTS-1

Project Name: Yakima Training Center	Job #: UF 3020
Location: Yakima, Wa.	WELL #: MTS-1

Elevation / Depth (feet)	Graphic Log	Sample ID # / Interval	Blow Count	OVA-Nu (ppm)	Recovery	USCS Symbol	Soil and Rock Description / Comment
97							
102							
107						BA	
112							
117							
122						BA:SM?	Fracture zone in Basalt, wormhole or vesiculated, holes to 1/4", with some iron staining. Interbeds of white ash/volcanics.

Monitoring Well Data



LOG OF MONITORING WELL MTS-1

Project Name: Yakima Training Center

Job #: UF 3020

Location: Yakima, Wa.

WELL #: MTS-1

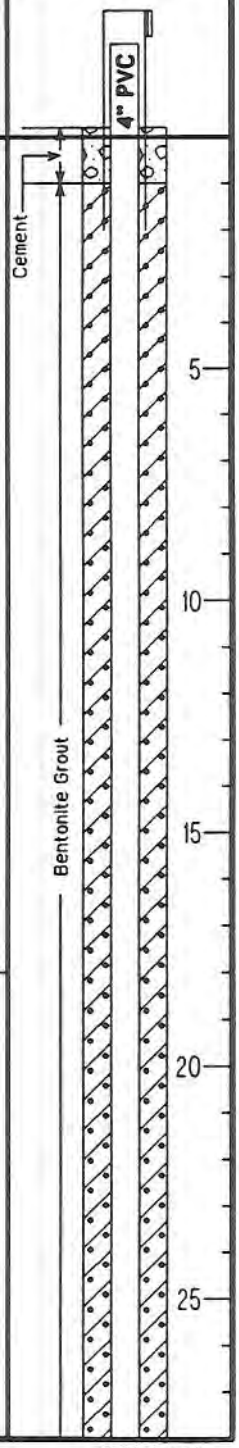
Elevation Depth (feet)	Graphic Log	Sample ID # Interval	Blow Count	OVA-Hs (ppm)	Recovery	USCS Symbol	Soil and Rock Description / Comment	Monitoring Well Data
						BA:SM?		10-20 Slot Silica Sand
							Total Depth of Boring 127'.	
129								129
134								134
139								139
144								144
149								149
154								154

LOG OF MONITORING WELL MTS-2

Project Name: Yakima Training Center	**Job #:** UF 3020
Location: Yakima, Wa.	**Water Level:** 92.0 ' (BGS)
Well Number: MTS-2 **Start Date/Time:** 2/25/93; **Finish Date/Time:** 2/25/93;	**Logged By:** D. Anderson
Top of Casing Elevation: 1351.84' **Surface Elevation:** 1348.8' **Total Depth:** 113'	**Drilling Contractor:** Cascade Drilling **Driller:** Mike Colbert

Elevation / Depth (feet)	Graphic Log	Sample ID # / Interval	Blow Count	OVA-Hw (ppm)	Recovery	USCS Symbol	Soil and Rock Description / Comment
5						GM	Silty sandy GRAVEL. Overburden/fill? Gravel (60%) to 6". Medium to coarse sand. Dark brown to black. Moist/damp. Very dense.
							Silty clayey Sand with gravel. Fine to coarse sand. Gravel to 2"., silt/clay (20%). Tan and dense. Moist to dry.
10			50 – –	na	5"	SM:SC	Split-spoon sample – 5" recovery, collect sample #93MTS003GB
							Grades to more clay/silt (40%), drier.
15						SM:SC-ML:CL	
20			50 – –	na	6"	ML:CL	Silt and Clay with minor sand and gravel (<10%). Lt. tan, very dense, fractures in silt/clay filled with iron staining. semi-consolidated to consolidated.
							Split-spoon sample – 6" recovery, collect sample #93MTS004SB
							Silty clayey Sand with gravel. Fine to coarse sand. Gravel (10%) is subrounded to rounded. Silt/clay (10%). Dark brown.
25						SM:SC	

Monitoring Well Data



LOG OF MONITORING WELL MTS-2

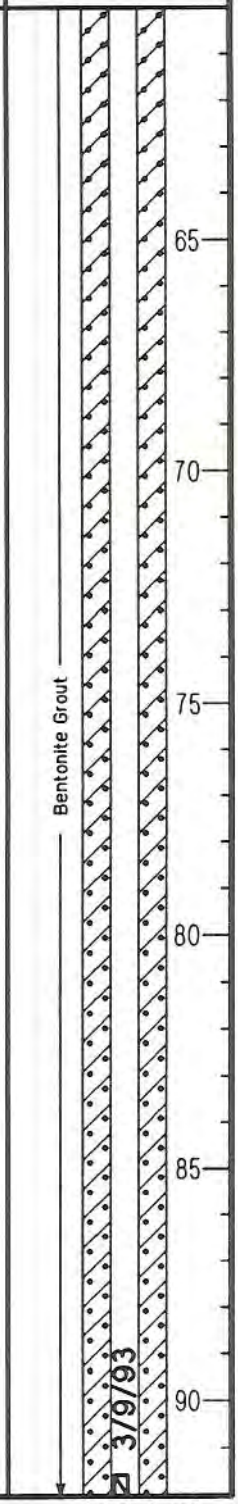
Project Name: Yakima Training Center	Job #: UF 3020
Location: Yakima, Wa.	WELL #: MTS-2

Elevation / Depth (feet)	Graphic Log	Sample ID # / Interval	Blow Count	OVA-Nu (ppm)	Recovery	USCS Symbol	Soil and Rock Description / Comment	Monitoring Well Data
33						SM:SC		Bentonite Grout
38						BA	Basalt black, vesicular, holes to 1/4". iron staining. Interbeds?, little or no ash/volcanics.	
							Grades to blue-gray black, no holes. Dry.	
							Grades to brown-black, vesicular, small holes. Dry.	
43							Grades to blue-gray black, some vesicules but generally massive. Dry.	
48								
53								
58								

LOG OF MONITORING WELL MTS-2

Project Name: Yakima Training Center	Job #: UF 3020
Location: Yakima, Wa.	WELL #: MTS-2

Elevation Depth (feet)	Graphic Log	Sample ID # Interval	Blow Count	OVA-Hu (ppm)	Recovery	USCS Symbol	Soil and Rock Description / Comment	Monitoring Well Data
65								
70								
75						BA		
80								
85								
90								

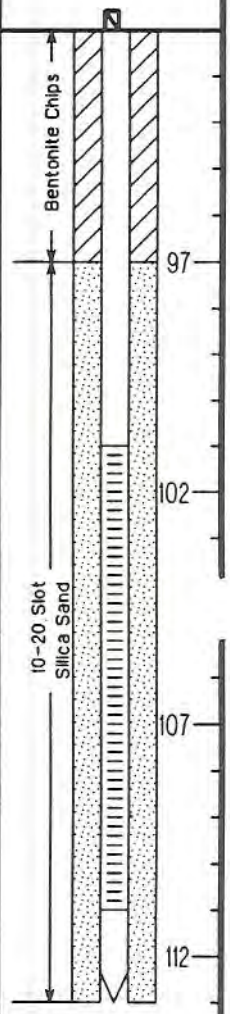


LOG OF MONITORING WELL MTS-2

Project Name: Yakima Training Center	Job #: UF 3020
Location: Yakima, Wa.	WELL #: MTS-2

Elevation / Depth (feet)	Graphic Log	Sample ID # / Interval	Blow Count	OVA-Nu (ppm)	Recovery	USCS Symbol	Soil and Rock Description / Comment
97						BA	
102							
107						BA	Fracture zone in Basalt, vesicular, with some iron staining. Interbeds little or no ash/volcanics.
112							Total Depth of Boring 113'.
117							
122							

Monitoring Well Data



Seattle3-w.pdt

FIELD BOREHOLE LOG

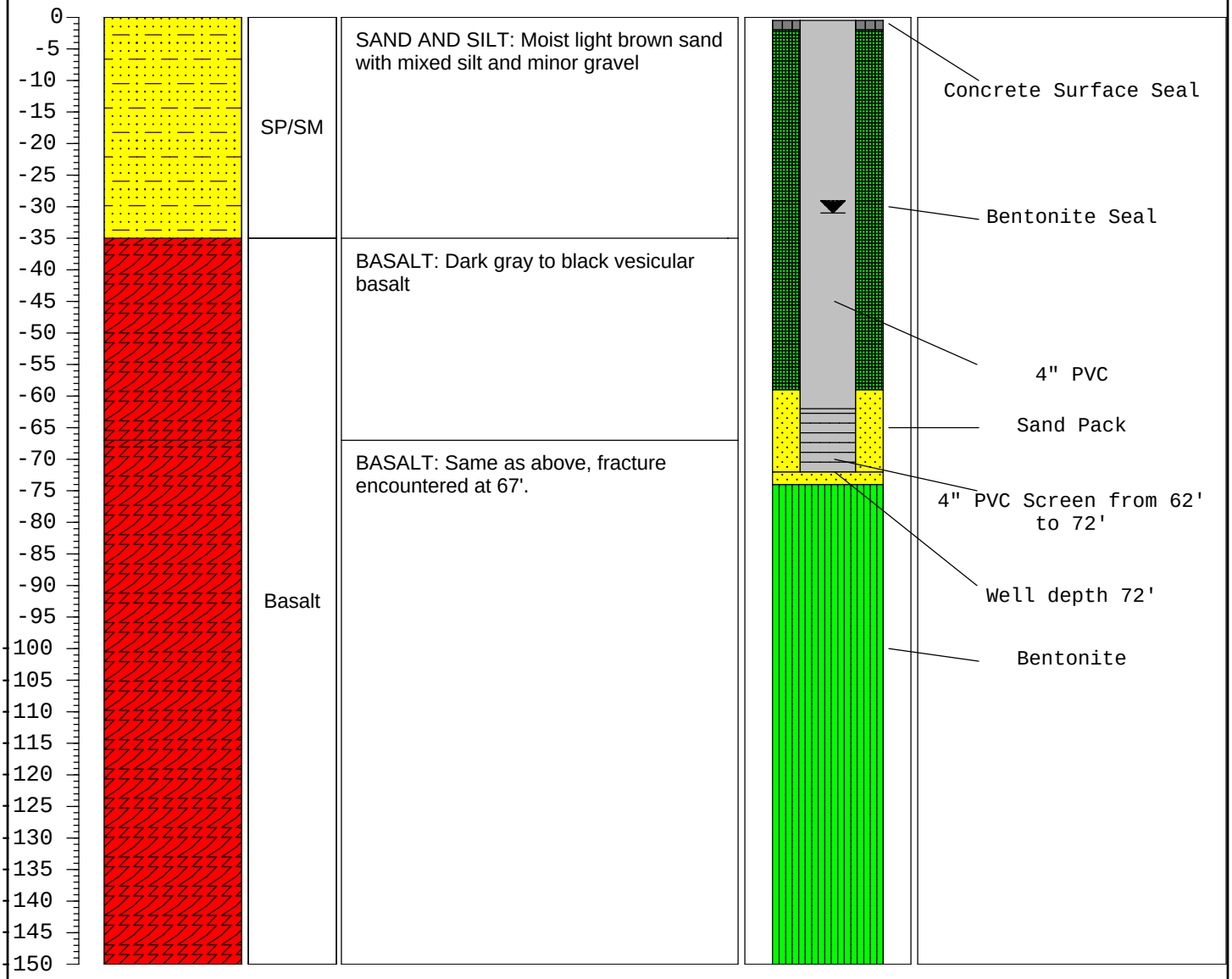
BOREHOLE/WELL ID: **MTS-3**

TOTAL DEPTH: **150'**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**YTC GW SI**	DRILLING CO.:	**Environmental West**
SITE LOCATION:	**Yakima Training Center**	DRILLER:	**Ron Sink**
LOGGED BY:	**Joe Thompson/Troy Bussey**	RIG TYPE:	**Shramm T300E**
DATES DRILLED:	**10/27/04**	METHOD OF DRILLING:	**Air Rotary**
		LOGGING METHOD:	**Cuttings**
		DRILL BIT:	**8-inch downhole**

▼ Water level in completed well

DEPTH	SOIL/ROCK SYMBOL	USCS	SOIL/ROCK DESCRIPTION	BORING COMPLETION	WELL DESCRIPTION
0 to 35		SP/SM	SAND AND SILT: Moist light brown sand with mixed silt and minor gravel		
35 to 150		Basalt	BASALT: Dark gray to black vesicular basalt BASALT: Same as above, fracture encountered at 67'.		



NOTES: Tubex 8" temporary casing from 0' bgs to 42' bgs.

FIELD BOREHOLE LOG

BOREHOLE/WELL ID: **MTS-4**

TOTAL DEPTH: **103'**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**YTC GW SI**	DRILLING CO.:	**Environmental West**
SITE LOCATION:	**Yakima Training Center**	DRILLER:	**Ron Sink**
LOGGED BY:	**Joe Thompson/Troy Bussey**	RIG TYPE:	**Shramm T300E**
DATES DRILLED:	**10/28/04**	METHOD OF DRILLING:	**Air Rotary**
		LOGGING METHOD:	**Cuttings**
		DRILL BIT:	**8" downhole**

▼ Water level in completed well

DEPTH	SOIL/ROCK SYMBOL	USCS	SOIL/ROCK DESCRIPTION	BORING COMPLETION	WELL DESCRIPTION
0 to -100		SM	SAND AND SILT: Tan to brown sand to silty-sand with some gravel		Concrete Surface Seal
		ML	CLAY AND SILT: Tan to green silt and clay; chlorite(?)		
		SW/SP	SAND AND SILT: Tan to brown sand with silt; some basalt near bottom of unit		Bentonite Seal
		Basalt	BASALT: Dark gray to black massive to vesicular basalt; multiple fractured zones; water encountered at 93' bgs		4" PVC Sand Pack 4" PVC Screen from 82' to 97' Well depth 97' Bentonite

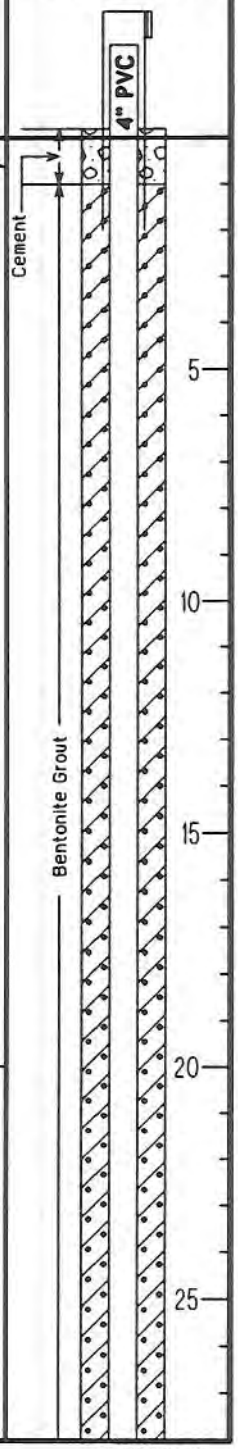
NOTES: Tubex 8" temporary casing from 0' bgs to 28' bgs.

LOG OF MONITORING WELL TVR-1

Project Name: Yakima Training Center	**Job #:** UF 3020
Location: Yakima, Wa.	**Water Level:** 70.39' (BGS)
Well Number: TVR-1 **Start Date/Time:** 2/25/93; **Finish Date/Time:** 2/26/93;	**Logged By:** D. Anderson
Top of Casing Elevation: 1320.11' **Surface Elevation:** 1317.2' **Total Depth:** 105.0'	**Drilling Contractor:** Cascade Drilling **Driller:** Mike Colbert

Elevation / Depth (feet)	Graphic Log	Sample ID #	Interval	Blow Count	OVA-Nu (ppm)	Recovery	USCS Symbol	Soil and Rock Description / Comment
								Asphalt
							GM	Sandy Gravel with silty clay, lt. brown, and saturated. Wet.
10				50 – –	0	0"	SM:SC	Clayey Sand with gravel, medium to coarse sand (70%). Gravel (20%) to 2" diameter. Clay (20%), moist and slightly plastic. Split-spoon refusal, collect sample #93TVR001GB from cuttings.
20				50 – –	0	8"	BA	Basalt dark brown, vesiculated. Some crystals in holes and iron staining. Dry. Split-spoon refusal ater 8", collect sample #93TVR002GB.
25							BA	Grades to blue-gray black, massive-crystalline, very dense. Dry.

Monitoring Well Data



LOG OF MONITORING WELL TVR-1

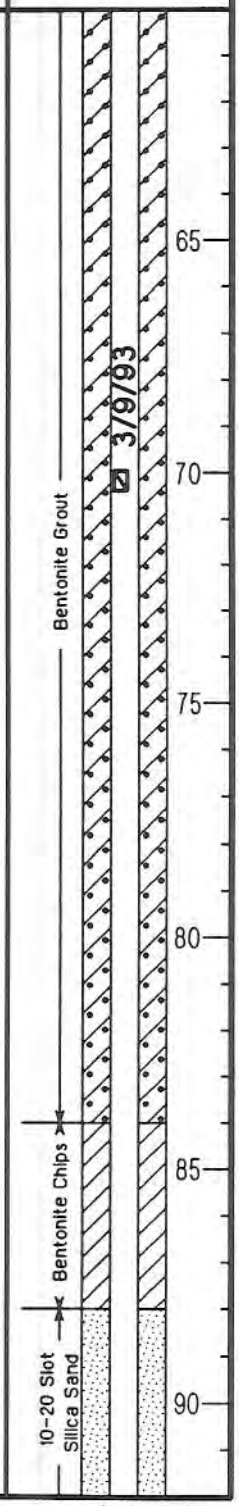
Project Name: Yakima Training Center	Job #: UF 3020
Location: Yakima, Wa.	WELL #: TVR-1

Elevation Depth (feet)	Graphic Log	Sample ID # Interval	Blow Count	OVA-No (ppm)	Recovery	USCS Symbol	Soil and Rock Description / Comment	Monitoring Well Data
33								Bentonite Grout
38								
43						BA		
48								
53								
58								

LOG OF MONITORING WELL TVR-1

Project Name: Yakima Training Center	Job #: UF 3020
Location: Yakima, Wa.	WELL #: TVR-1

Elevation / Depth (feet)	Graphic Log	Sample ID # / Interval	Blow Count	OVA-Nu (ppm)	Recovery	USCS Symbol	Soil and Rock Description / Comment	Monitoring Well Data
65								
70								
75						BA		
80								
85								
90								



LOG OF MONITORING WELL TVR-1

Project Name: Yakima Training Center	Job #: UF 3020
Location: Yakima, Wa.	WELL #: TVR-1

Elevation Depth (feet)	Graphic Log	Sample ID # Interval	Blow Count	OVA-Ne (ppm)	Recovery	USCS Symbol	Soil and Rock Description / Comment	Monitoring Well Data
97						BA		10-20 Slot Silica Sand
							Drilled to 100' on 2/25/93	
102						BA	Fracture zone in Basalt, vesicules, holes to 1/4". Interbeds of green/whitew ash/rhylolite?, and some quartz.	102
							Total Depth of Boring 105'.	
107								107
112								112
117								117
122								122

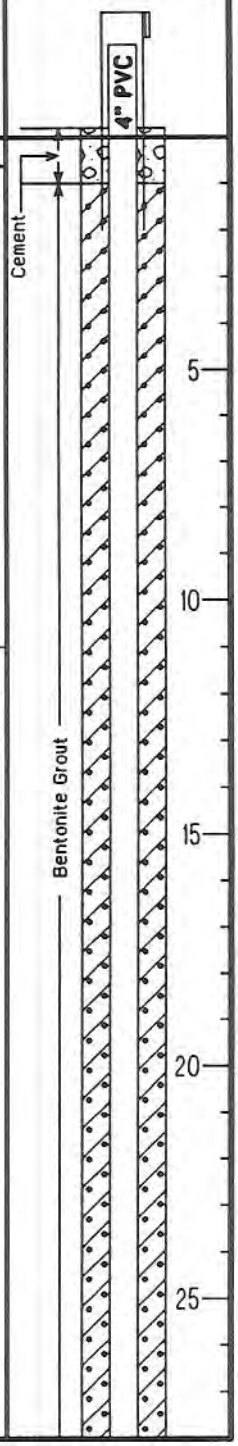
Seattle3-w.pdt

LOG OF MONITORING WELL TVR-2

Project Name: Yakima Training Center	**Job #:** UF 3020
Location: Yakima, Wa.	**Water Level:** 67.07' (BGS)
Well Number: TVR-2 **Start Date/Time:** 2/26/93; **Finish Date/Time:** 2/26/93;	**Logged By:** D. Anderson
Top of Casing Elevation: 1317.52' **Surface Elevation:** 1314.10' **Total Depth:** 95.0'	**Drilling Contractor:** Cascade Drilling **Driller:** Mike Colbert

Elevation / Depth (feet)	Graphic Log	Sample ID #	Interval	Blow Count	OVA-Hu (ppm)	Recovery	USCS Symbol	Soil and Rock Description / Comment
								Asphalt
							GM	Sandy Gravel with silty clay. Overburden. lt. brown. Wet- saturated. Fill?
5							SM:SC	Silty clayey Sand with gravel. fine to medium sand, 10% silt/clay. 10% gravel to 2" diameter. Tan to lt. brown. Dry to moist.
								Note: 1.0' caliche-cemented gravel layer approximately 10' above TVR2 in the bank cut.
10					0	6"		Split-spoon sample #93TVR003SB, 6" recovery.
							BA	Basalt black, massive-crystalline, no vesicules. Dry. No odor.
15							BA	Grades to brown-black. Vesicules encountered, very small. Some iron staining and yellow crystals in holes.
								Grades to blue-gray black, massive-crystalline, very hard.
20							BA	
25								

Monitoring Well Data



LOG OF MONITORING WELL TVR-2

Project Name: Yakima Training Center	Job #: UF 3020
Location: Yakima, Wa.	WELL #: TVR-2

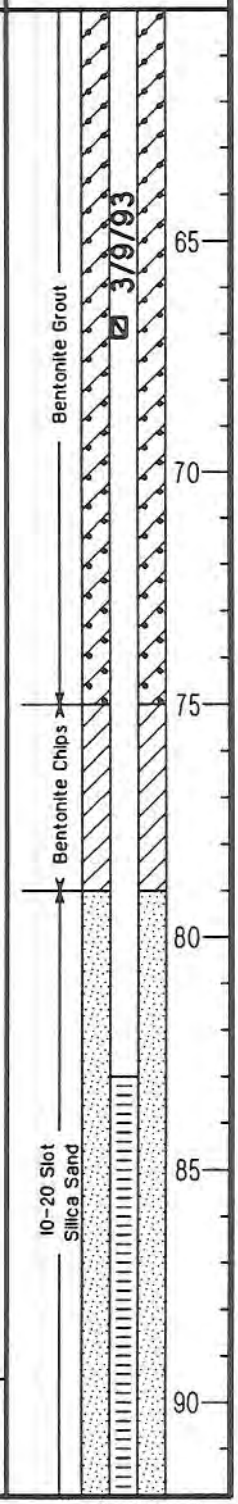
Elevation / Depth (feet)	Graphic Log	Sample ID # / Interval	Blow Count	OVA-Nu (ppm)	Recovery	USCS Symbol	Soil and Rock Description / Comment	Monitoring Well Data
33								Bentonite Grout
38								
43						BA		
48								
53								
58								

LOG OF MONITORING WELL TVR-2

Project Name: Yakima Training Center	Job #: UF 3020
Location: Yakima, Wa.	WELL #: TVR-2

Elevation / Depth (feet)	Graphic Log	Sample ID # / Interval	Blow Count	OVA-Hs (ppm)	Recovery	USCS Symbol	Soil and Rock Description / Comment
65							
70							
75						BA	
80							
85							
90						BA:SM?	Fracture zone in Basalt, vesicules, holes to 1/4". Some iron staining - $FeCO_3$. Interbeds of green-yellow ash/volcanics, with some white-yellow quartz.

Monitoring Well Data



LOG OF MONITORING WELL TVR-2

Project Name: Yakima Training Center	Job #: UF 3020
Location: Yakima, Wa.	WELL #: TVR-2

Elevation Depth (feet)	Graphic Log	Sample ID # Interval	Blow Count	OVA-Hw (ppm)	Recovery	USCS Symbol	Soil and Rock Description / Comment	Monitoring Well Data
						BA:SM?		10-20 Slot Silica Sand
							Total Depth of Boring 95'.	
97								97
102								102
107								107
112								112
117								117
122								122

FIELD BOREHOLE LOG

BOREHOLE/WELL ID: **TVR-3**

TOTAL DEPTH: **163'**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**YTC GW SI**	DRILLING CO.:	**Environmental West**
SITE LOCATION:	**Yakima Training Center**	DRILLER:	**Ron Sink**
LOGGED BY:	**Joe Thompson**	RIG TYPE:	**Shramm T300E**
DATES DRILLED:	**10/29/04**	METHOD OF DRILLING:	**Air Rotary**
		LOGGING METHOD:	**Cuttings**
		DRILL BIT:	**8" Downhole Hammer**

▼ Water level in completed well

DEPTH	SOIL/ROCK SYMBOL	USCS	SOIL/ROCK DESCRIPTION	BORING COMPLETION	WELL DESCRIPTION
0 to -20		SW/SP	SAND AND SILT: Tan to brown sand/silt mixture with varying basalt gravels intermixed		Concrete Surface Seal
-20 to -145		Basalt	BASALT: Dark gray to black basalt; minor vesicles throughout		Bentonite Seal; 4" PVC
-145 to -160		SP/SC	SAND: Coarse sand varying in color; saturated (10-15 gpm) contains some small gravel and baked clay clasts		Sand Pack; 4" PVC Screen from 143' to 158'; Well depth 158'; Bentonite

NOTES: 8" Tubex temporary casing to 28'

FIELD BOREHOLE LOG

BOREHOLE/WELL ID: **TVR-4**

TOTAL DEPTH: **52'**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**YTC GW SI**	DRILLING CO.:	**Environmental West**
SITE LOCATION:	**Yakima Training Center**	DRILLER:	**Ron Sink**
LOGGED BY:	**Joe Thompson**	RIG TYPE:	**Schramm T300E**
DATES DRILLED:	**11/8/04**	METHOD OF DRILLING:	**Air Rotary**
		LOGGING METHOD:	**Cuttings**
		DRILL BIT:	**8" downhole hammer**

▼ Water level in completed well

DEPTH	SOIL/ROCK SYMBOL	USCS	SOIL/ROCK DESCRIPTION	BORING COMPLETION	WELL DESCRIPTION
0 to -50		ML	SANDY SILT: Brown silt to sandy-silt soil overburden		Concrete Surface Seal
		Basalt	FILL: Basalt gravel fill		Bentonite Seal
		SM	SAND AND SILT: Tan to brown unconsolidated mixture of sands, silts, and minor clay		4" PVC
					Sand Pack
		Basalt	BASALT: Dark gray to black basalt; minor vesicles; reddish-brown basalt from 23-25' bgs; contains minor water (		4" PVC Screen from 16' to 26'
					Well depth 26'
					Bentonite

NOTES: 8" Tubex temporary casing from 0 to 27'

FIELD BOREHOLE LOG

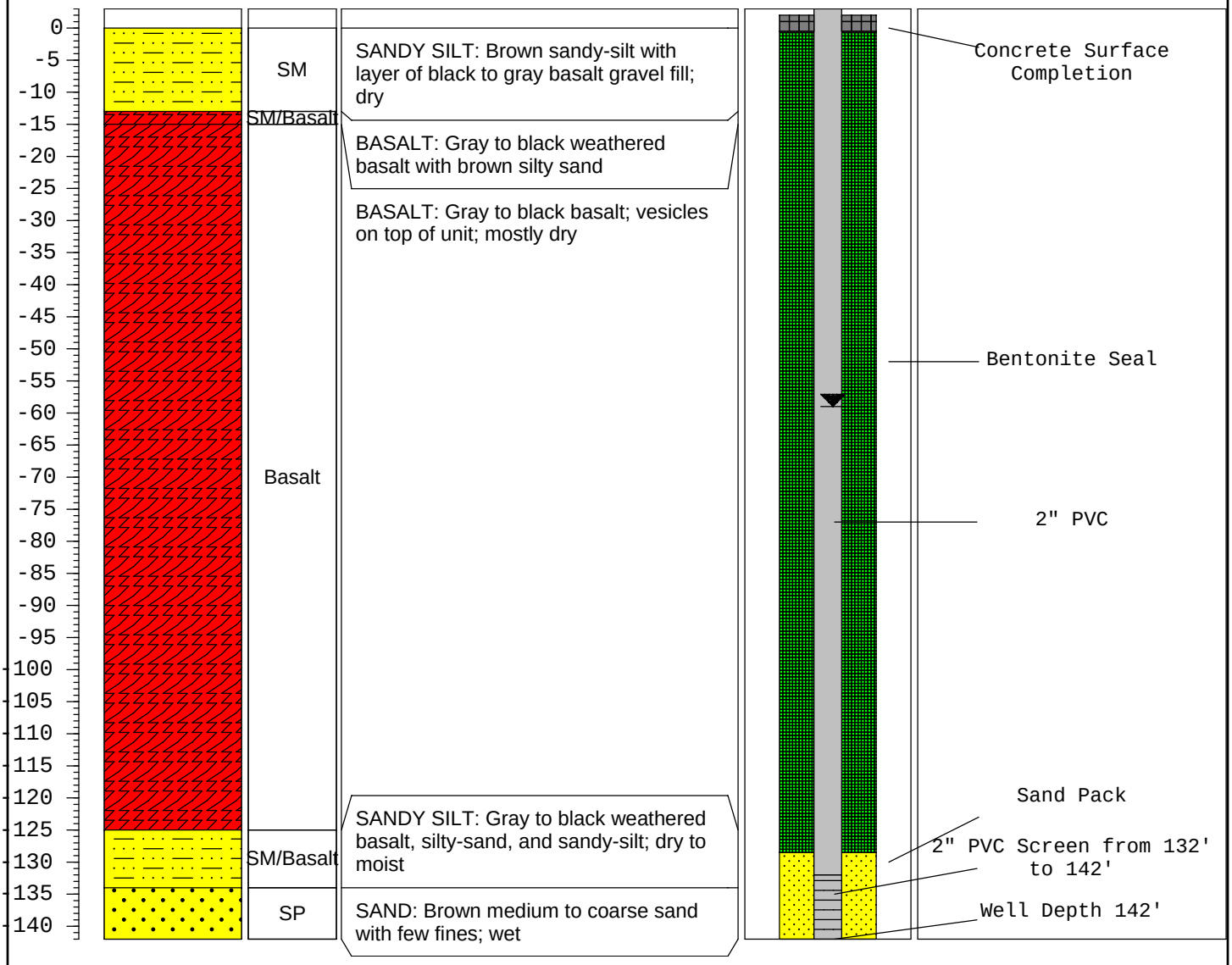
BOREHOLE/WELL ID: **TVR-5**

TOTAL DEPTH: **142'**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**YTC Multi-Site SI**	DRILLING CO.:	**Environmental West**
SITE LOCATION:	**Yakima Training Center**	DRILLER:	**Ron Sink**
LOGGED BY:	**Troy Bussey**	RIG TYPE:	**Schramm T300E**
DATES DRILLED:	**10/18/05**	METHOD OF DRILLING:	**Air Rotary**
		LOGGING METHOD:	**Cuttings**
		DRILL BIT:	**6" downhole hammer**

▼ Water level in completed well

DEPTH	SOIL/ROCK SYMBOL	USCS	SOIL/ROCK DESCRIPTION	BORING COMPLETION	WELL DESCRIPTION



NOTES: 7" Tubex Temporary casing to 15'

FIELD BOREHOLE LOG

BOREHOLE/WELL ID: **TVR-6**

TOTAL DEPTH: **151'**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**YTC Multi-Site SI**	DRILLING CO.:	**Environmental West**
SITE LOCATION:	**Yakima Training Center**	DRILLER:	**Ron Sink**
LOGGED BY:	**Troy Bussey**	RIG TYPE:	**Schramm T300E**
DATES DRILLED:	**10/20/05 - 10/21/05**	METHOD OF DRILLING:	**Air Rotary**
		LOGGING METHOD:	**Cuttings**
		DRILL BIT:	**6" downhole hammer**

▼ Water level in completed well

DEPTH	SOIL/ROCK SYMBOL	USCS	SOIL/ROCK DESCRIPTION	BORING COMPLETION	WELL DESCRIPTION
0 to -20		SM	SANDY SILT: Tan to reddish-brown sandy silt with layer of gray to black basalt gravel; dry		Concrete Surface Completion
-20 to -140		Basalt	BASALT: Dark gray to black basalt; weathered and vesicular on top of unit; dry		Bentonite Seal 2" PVC
-140 to -150		SP/GP	SAND PEBBLES: Light gray to brown to black medium sand to coarse gravel with few fines; wet		Sand Pack 2" PVC Screen from 139' to 149' Well Depth 149' Borehole Cave-in

NOTES: 7" Tubex temporary casing to 20'

FIELD BOREHOLE LOG

BOREHOLE/WELL ID: **TVR-7**

TOTAL DEPTH: **150'**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**YTC Multi-Site SI**	DRILLING CO.:	**Environmental West**
SITE LOCATION:	**Yakima Training Center**	DRILLER:	**Ron Sink**
LOGGED BY:	**Troy Bussey**	RIG TYPE:	**Schramm T300E**
DATES DRILLED:	**10-21-05 - 10-22-05**	METHOD OF DRILLING:	**Air Rotary**
		LOGGING METHOD:	**Cuttings**
		DRILL BIT:	**6" downhole hammer**

▼ Water level in completed well

DEPTH	SOIL/ROCK SYMBOL	USCS	SOIL/ROCK DESCRIPTION	BORING COMPLETION	WELL DESCRIPTION
0 to 20		SM/SC	SILTY SAND: Tan to brown silty fine sand and silty clay with layer of basalt gravel fill; dry to moist		Concrete Surface Completion
20 to 145		Basalt	BASALT: Dark gray to black basalt; weathered and vesicular on top of unit; dry		Bentonite Seal; 2" PVC
145 to 150		GP/SP	GRAVEL AND SAND: Dark gray to brown to black fine gravel with few fines grading to medium sand with some fines; wet		Sand Pack; 2" PVC Screen from 140' to 150'; Well Depth 150'

NOTES: 7" Tubex temporary casing to 20'

APPENDIX B
FIELD FORMS

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APPENDIX C

STANDARD OPERATING PROCEDURES

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Standard Operating Procedure 1
Low-Flow Groundwater Sampling

Required Equipment

1. Final project plans
2. Field logbook
3. Indelible black-ink pens and markers
4. Sample tags/labels and appropriate documentation
5. pH/conductivity/temperature meter, water level meter, turbidity meter, and dissolved oxygen meter
6. Flow-through box
7. Insulated cooler(s), chain-of-custody seals, Ziploc™ bags
8. Sample containers, coolers, blue ice or equivalent
9. Sampling equipment: Grundfos Redi-Flow submersible pump; Reel E-Z™ system, including control box; 3600 MultiQuip™ or equivalent portable generator
10. Decontamination equipment: two 15-gallon jugs of potable water (Lakewood Water District); Liquinox; and deionized water
11. Sample log forms (see Attachment 1)

Typical Procedures

Preparation

1. Record necessary data in field logbook.
2. Prepare sampling equipment including calibration of field meters prior to use.
3. Move equipment and supplies to sampling location.

Purging

1. Remove well cap and measure static water level. Also measure the total depth of the well if unknown.
2. Remove the pump from the pump holder and rinse the pump off with distilled water. Slowly lower the pump into the well to the required depth.

3. Connect the discharge hose and cable for the control box to the Reel E-Z™ system. Start the generator and set control box to 120 volts. Make sure the generator is kept downwind from the sampling system.

4. Place the discharge hose in the flow-through box. Place the probes for the calibrated field meters into the flow-through box. Place the bucket beneath flow-through box to catch purged water if applicable.

5. Turn on the pump and adjust the flow rate to about 1 to 2 liters per minute.

6. After about 4 liters of water has been purged from the well, reduce the flow rate to 1 liter per minute.

7. Start recording field parameters every 3 liters of water purged. Purging should continue at a constant rate until the dissolved oxygen and specific conductance stabilize. Stabilization is considered achieved when three sequential measurements are within 10 percent.

Sampling

1. After specified parameters have stabilized, reduce flow rate on control box to create a trickle of water.

2. Disconnect discharge hose from Reel E-Z™ system.

3. Connect Teflon® sampling tube to Reel E-Z™ system. Place the bucket beneath sampling tube to catch unsampled water if applicable.

4. Change sampling gloves.

5. Fill necessary sample bottles. Collect volatile organic compounds; benzene, toluene, ethylbenzene, and xylene; and total petroleum hydrocarbon-gasoline samples first if scheduled. When sampling for volatile organic compounds, keep the flow rate at a trickle of water. When sampling for other analytes, increase flow rate to approximately 1 liter per minute.

6. Ensure sample are properly labeled, and recorded on the Chain-of-custody.

7. Place samples in cooler on ice.

Decontamination

1. Place the pump in one of the 15-gallon drums containing potable water and a small amount of Liquinox or Alconox. Place discharge hose into same bucket.

2. Stand by with additional potable water.

3. Turn on system and pump water through the sampling system. Add more water as needed and pump for about 3 minutes.

4. Place the pump into a second 15-gallon drum of potable water and turn on system. Pump until the soapy water has filled the first bucket. Place the discharge hose into the second 15-gallon bucket of potable water and pump for approximately 1 minute.

5. Remove the pump from the decontamination bucket and place the pump in its holder on the Reel E-Z™ system.

6. Pour unsampled water, purge water, and decontamination water into a 55-gallon drum marked “development water,” if applicable, for transport to the onsite water storage tank.

Documentation

1. Fill out one sample log form for each sample collected. Record all necessary information in the field logbook.

SOP 1, Attachment 1 – Typical Water Sampling Log

WATER SAMPLING LOG

Project: McChord AFB RA-O Area D/ALGT
Well No.:_____ Job Number: 106-8672.06050
Date Well Purged:_____ Date Well Sampled:_____

Well Data

Diameter of Well Casing: 2"
Measuring Point (MP): Top of Casing
Total Depth of Well Below MP:_____
Depth to Water Below MP:_____
Length of Water Column in Well: N/A
Gallons per Foot: N/A Gallons in Well: N/A
Three Times Casing Volume: N/A Gallons Purged from Well:_____
Purge Method: LOW FLOW

Water Sample Data

Sample Number: AD-10-_____ Time Sample Collected:_____
Sampling Method: LOW FLOW
Sampling Personnel:_____
Remarks:_____

Liters Out	Time	PH	Temp	DO	Spec. Cond.	Redox	Turb

Well Casing Volumes

GAL/FOOT 1-1/4" = 0.077 2" = 0.16 3" = 0.37 4" = 0.65
1-1/2" = 0.10 2-1/2" = 0.24 3-1/2" = 0.50 6" = 1.46

Standard Operating Procedure 2
Groundwater Sampling - Bailer

Required Equipment

1. Final project plans
2. Field logbook
3. Indelible black-ink pens and markers
4. Sample tags/labels and appropriate documentation
5. Insulated cooler(s), chain-of-custody seals, Ziploc™ bags
6. Sample containers, coolers, blue ice or equivalent
7. Sampling equipment: 2-inch disposable Tephalon bailers, string
8. Sample log forms (see Attachment 1)

Typical Procedures

Preparation

1. Record necessary data in field logbook.
2. Prepare sampling equipment including calibration of field meters prior to use.
3. Move equipment and supplies to sampling location.

Purging

1. Remove well cap and measure static water level. Also measure the total depth of the well if unknown.
2. Tie string securely to Tephalon bailer and lower into well, allowing it to fill with water.
3. Retrieve bailer from well and pour purge water from bailer into 5-gallon bucket.
4. Deploy bailer back into well and allow to fill.
5. Repeat steps 1 through 4 until 3 casing volumes of water have been purged from the well.

Sampling

1. Once 3 casing volumes of water has been purged from well, deploy bailer, allow to fill and retrieve to collect sample.
2. Change sampling gloves.

3. Fill necessary sample bottles. Collect volatile organic compounds; benzene, toluene, ethylbenzene, and xylene; and total petroleum hydrocarbon-gasoline samples first if scheduled. When sampling for volatile organic compounds, keep the flow rate at a trickle of water. When sampling for other analytes, increase flow rate to approximately 1 liter per minute.

4. Ensure sample are properly labeled, and recorded on the Chain-of-custody.

5. Place samples in cooler on ice.

Decontamination

1. Place the disposable Tephalon bailer in trash, as they are one time use.

2. Pour unsampled water, purge water, and decontamination water into a 55-gallon drum marked “development water,” if applicable, for transport to the onsite water storage tank.

Documentation

1. Fill out one sample log form for each sample collected. Record all necessary information in the field logbook.

SOP 2, Attachment 1 – Typical Water Sampling Log

WATER SAMPLING LOG

Project: McChord AFB RA-O Area D/ALGT
Well No.:_____ Job Number: 106-8672.06050
Date Well Purged:_____ Date Well Sampled:_____

Well Data

Diameter of Well Casing: 2"
Measuring Point (MP): Top of Casing
Total Depth of Well Below MP:_____
Depth to Water Below MP:_____
Length of Water Column in Well: N/A
Gallons per Foot: N/A Gallons in Well: N/A
Three Times Casing Volume: N/A Gallons Purged from Well:_____
Purge Method: LOW FLOW

Water Sample Data

Sample Number: AD-10-_____ Time Sample Collected:_____
Sampling Method: LOW FLOW
Sampling Personnel:_____
Remarks:_____

Liters Out	Time	PH	Temp	DO	Spec. Cond.	Redox	Turb

Well Casing Volumes

GAL/FOOT 1-1/4" = 0.077 2" = 0.16 3" = 0.37 4" = 0.65
1-1/2" = 0.10 2-1/2" = 0.24 3-1/2" = 0.50 6" = 1.46

Standard Operating Procedure 3
Groundwater Sampling - PDB

Required Equipment

1. Final project plans
2. Field logbook
3. Indelible black-ink pens and markers
4. Sample tags/labels and appropriate documentation
5. Insulated cooler(s), chain-of-custody seals, Ziploc™ bags
6. Sample containers, coolers, blue ice or equivalent
7. Sampling equipment: PDBs and wiring harness
8. Sample log forms (see Attachment 1)

Typical Procedures

Preparation

1. Record necessary data in field logbook.
2. Prepare sampling equipment including calibration of field meters prior to use.
3. Move equipment and supplies to sampling location.

Purging

1. Remove well cap and measure static water level. Also measure the total depth of the well if unknown.
2. Remove PDB from well.

Sampling

1. Change sampling gloves.
2. Carefully cut corner of PDB, and immediately fill necessary sample bottles. Collect volatile organic compounds; benzene, toluene, ethylbenzene, and xylene; and total petroleum hydrocarbon-gasoline samples first if scheduled.
3. Ensure sample are properly labeled, and recorded on the Chain-of-custody.
4. Place samples in cooler on ice.
5. Deploy new PDB down well if applicable.

Decontamination

1. Place the PDB in trash, as they are one time use.

Documentation

1. Fill out one sample log form for each sample collected. Record all necessary information in the field logbook.

SOP 3, Attachment 1 – Typical Water Sampling Log

WATER SAMPLING LOG

Project: McChord AFB RA-O Area D/ALGT
Well No.:_____ Job Number: 106-8672.06050
Date Well Purged:_____ Date Well Sampled:_____

Well Data

Diameter of Well Casing: 2"
Measuring Point (MP): Top of Casing
Total Depth of Well Below MP:_____
Depth to Water Below MP:_____
Length of Water Column in Well: N/A
Gallons per Foot: N/A Gallons in Well: N/A
Three Times Casing Volume: N/A Gallons Purged from Well:_____
Purge Method: LOW FLOW

Water Sample Data

Sample Number: AD-10-_____ Time Sample Collected:_____
Sampling Method: LOW FLOW
Sampling Personnel:_____
Remarks:_____

Liters Out	Time	PH	Temp	DO	Spec. Cond.	Redox	Turb

Well Casing Volumes

GAL/FOOT 1-1/4" = 0.077 2" = 0.16 3" = 0.37 4" = 0.65
1-1/2" = 0.10 2-1/2" = 0.24 3-1/2" = 0.50 6" = 1.46