File 06940-252
8.2.3

ENSR INTERNATIONAL

9521 Willows Road NE
Redmond, WA 98052
(425) 881-7700
Fax (425) 883-4473
www.ensr.com

Soil Subsurface/Site Investigation Summary Report

ORIGINAL

Site Name:	Coupeville Bulk Plant 0138
Site Address:	101 NW Coveland Street
City, State Zip:	Coupeville, Washington 98239

Report Date:	March 18, 2005
ENSR Project No:	06940-252
Ecology Facility No:	2008
Client:	Union Oil Company of California (Unocal) 276 Tank Farm Road, PO Box 1069 San Luis Obispo, CA 93406
Unocal Project Manager:	Mr. Paul Lindquist
ENSR Project Manager:	Art Cowburn
Drilling Dates:	December 14-17, 2004 and January 24-26, 2005

Scope of Work:
Site History
Unocal bulk plant 0138 was constructed in 1927. The warehouse, office, garage, and loading platform were demolished and replaced with a new warehouse, loading rack, and pumps in 1958. In 1989, a subsurface investigation revealed the presence of soil and groundwater contamination by petroleum and solvents. The office heating oil underground storage tank (UST) and abandoned underground cargo lines and barrel filler lines were removed in 1990; including 50 cubic yards (cy) of clean overburden and 550cy of contaminated soils being stockpiled. Excavations were back-filled. It was determined at this time that contamination extended underneath the warehouse/office building thus prompting their removal in 1991. An additional 850cy of contaminated soils were removed and successfully remediated.

It was also determined at that time that contaminated soils remained at depths over 28 feet between the former loading rack and warehouse/office building within the excavated area. Six on-site and two-off site wells were installed. From 1991 to 1995, land farming was successfully implemented for the soil that could be excavated. Groundwater was monitored quarterly, but was discontinued in six wells due to absence of petroleum contaminants, the four remaining wells were to be sampled semi-annually. In 1992, the remaining above ground facilities including above ground tanks, pumps, loading rack and miscellaneous drive slabs were removed from the site.

In 2002, the site received a no further action (NFA) notification for soil from Washington State Department of Ecology (DOE). The terms include a restrictive covenant deed restriction along with the requirement for quarterly groundwater sampling of monitoring wells MW-5 and MW-9 for BTEX together with gasoline- (TPH-G) and diesel- (TPH-D) range petroleum hydrocarbons.

On January 10, 2004 monitoring wells MW-5 and MW-9 were sampled by ENSR to establish a baseline of indigenous microbe activity and nutrient concentrations.

On February 4, 5, and 6, 2004, Cascade Drilling of Woodinville, Washington performed drilling activities and ORC injection under ENSR supervision. A grid pattern consisting of a series of 25 injection points, were advanced in the vicinity of well MW-5, (Figure 2), spaced approximately eight to ten feet apart. A total of 22 points were advanced to a depth of 25 feet below ground surface (bgs). Groundwater monitoring conducted since the ORC injection in February 2004 has not produced favorable results.

Continued quarterly groundwater monitoring of the down gradient monitoring well MW-5 has consistently produced gasoline TPH ranges above the MTCA Method A cleanup levels. Concentrations of BTEX and TPH-G in well MW-9 were detected above laboratory detection limits during the April 2004 monitoring event for the first time since July 2002, and have not occurred since.

On December 15, 2004, this property was sold to a private developer who has scheduled new construction activities to begin mid-March 2005.

Soil contamination delineation via Geoprobe® at 20 on site locations
On December 14 through 17, 2004, Holt Drilling of Tacoma, Washington was contracted to advance 20, 28 to 40 feet bgs Geoprobe® borings (Figure 2) to assess the potential sources of soil contamination remaining onsite. The soil contamination is thought to be located in the area immediately around the down gradient monitoring well MW-5 and within the excavated area identified in 1991 to have contaminated soils remaining at depths greater than 28 feet (Figure 2). The identified area is in the northeast quadrant of the property and is approximately an area 160 feet by 180 feet between the loading rack slab and the warehouse/office, which were removed in 1991.

Soil contamination delineation via Hollow stem auger at 3 on site locations
On January 24, 2005, through January 26, 2005, Holt Drilling of Tacoma, Washington was contracted to advance three (3) soil borings, B11, B12 and B13 (Figure 2) to a minimum depth of 30 feet bgs or until drill cuttings indicated clean sand or purged aquifer were encountered. This scope of work was developed to further assess and delineate the potential sources of soil contamination remaining onsite based upon the results of borings advanced in December 2004. The three borings were advanced in the area immediately east of the former loading rack slab excavation and on the higher elevated area along the slope south of the drainage ditch and west of the former fuel AST's and the former product lines extending north to the slope.

Methods:
Soil borings B1 through B5 were drilled using a Geoprobe® hydraulically-powered direct push drill rig which uses static weight/dynamic percussion force to advance small-diameter tools into the subsurface was employed for this soil sampling event. A Macro Core® sampler was assembled with a cutting shoe, drive head and sample sleeves. The sampler was driven into the subsurface using the percussion of the direct push rig. The initial core sample collected in the sleeve and sampler. The sampler was then extracted from the boring and the sample sleeve removed. A new sleeve was placed in the sample tube. The sampler was advanced to the last depth of penetration by adding a series of drive rods, and the procedure was repeated at selected locations on site. The sample sleeves were cut open and soil samples were screened using a PID meter and ENSR standard hydrocarbon screening protocol (ENSR SOP 7116 Subsurface Soil Sampling by Geoprobe™ Methods). Soil Samples that were to be sent for confirmation analyses were removed from sample sleeves using the recently adopted EPA 5035A sampling protocol, and immediately delivered to the Environmental Services Northwest mobile lab onsite to be analyzed.

Soil borings B6 through B13 were drilled using a hollow stem auger drill rig, as the Geoprobe® could not penetrate the soil below 19 feet bgs because of dense clay and glacial till with gravel. Split spoon samples were collected from the borings at 1.5 or 5.0 feet increments. Soil samples were screened using a PID meter and ENSR standard hydrocarbon screening protocol (ENSR SOP 7115 Subsurface Soil Sampling by Split Spoon). The spoon was cleaned using Alconox and water between each sample event. Soil samples were collected from the interval with the highest field PID measurement. Selected samples were from the borings were placed into sample jars, using the recently adopted EPA 5035A sampling protocol, and placed on ice and delivered to the Environmental Services Northwest mobile laboratory onsite or North Creek Analytical laboratories for analysis.

Analytics:
The soil samples taken from both the December 2004 and January 2005 drilling events were analyzed for benzene, ethylbenzene, toluene, total xylenes (BETX) by EPA Method 8021B, total petroleum hydrocarbons (TPH) as gasoline (TPH-G) by Ecology Method NWTPH-Gx, TPH as diesel (TPH-D) by Ecology Method NWTPH-Dx with acid/silica gel cleanup step by Environmental Services Northwest laboratories.

Results:
Soil borings B2, B6, and B11 were the only borings to have contaminants above the MTCA Method A limits. All other samples were below the MTCA Method A limits for all analytes. A total of 13 borings were completed and 68 samples collected and analyzed.

Soil boring B2 at a depth of 14 feet bgs indicated the presence of benzene at 0.79 milligrams per kilogram (mg/kg), gasoline range hydrocarbons at 1,100 mg/kg, and diesel range hydrocarbons at 3,800 mg/kg.

Soil boring B6 at depths of 15.5 to 26 feet bgs indicated the presence of benzene, ethylbenzene, total xylenes, gasoline range hydrocarbons, and diesel range hydrocarbons. Benzene was detected at 0.93 mg/kg at a depth of 23-24.5 feet bgs. Concentrations of ethylbenzene ranged from 6.7 mg/kg to 35 mg/kg (18.5-20 feet bgs and 23.-24.5 feet bgs respectively). Total xylenes were detected in concentrations ranging from 23 mg/kg to 224 mg/kg (15.5-17 feet bgs and 23-24.5 feet bgs respectively). Gasoline range hydrocarbons were detected ranging from 680 mg/kg to 16,000 mg/kg (17-18.5 feet bgs and 23-24.5 feet bgs respectively). Diesel range hydrocarbons were detected ranging from 3,400 mg/kg to 16,000 mg/kg (24.5-26 feet bgs and 23-24.5 feet bgs respectively).

Soil boring B11 a depth of 19.5-21 feet bgs contained benzene at 0.0348 mg/kg, exceeding the MTCA Method A Clean up level by 0.0048 mg/kg.

Table 1 provides a summary of the analytical data for all soil borings. Copies of the laboratory reports are attached.

Discussion:
The contamination in groundwater at monitoring well MW-5 is thought to be a source of contaminated soil up-gradient from the well. Contaminated soils do remain at a limited concentrated source location, as confirmed by the 13 borings and 68 samples taken in total during both the December 2004 and January 2005 boring events. At soil boring locations B2, B6, and B11, the concentrations of the analytes (benzene, ethylbenzene, total xylenes, TPH-G and TPH-D) are generally below MTCA Method A limits except for boring B-2 at 14 feet bgs and boring B-6 from 15.5 feet bgs to 26 feet bgs.

The contaminants, which are found mostly in fine sandy, clayey silt and slightly silty sand, are thought to be migrating from the soil surrounding B2, B6, and B11 to the groundwater and down-grade to the monitoring well location of MW-5 through a layer of fine to medium grained sand that is

in the perched aquifer. In soil borings B1 through B13 this sand layer was encountered between 15.5 and 18.5 feet bgs to varying depths up to 30 feet bgs where boring operations were discontinued. The overall thickness of the sand layer is not known.

Geologic cross sections were constructed to further understand area of contamination using the boring logs in Appendix A (Figure 4). The cross sections illustrate that the area of contamination is concentrated around soil borings B2 and B6 at a depth of 15 to 26 feet bgs. The depth of the contamination increases to the east.

Figure 5 illustrates the south to north geologic cross section between soil borings B2 and B9. This cross section crosses the boundary of the 1991 excavation of the former loading rack slab. The area of suspect contamination begins at 15 feet bgs near B2 and is disk shaped, increasing in depth to the south.

Figure 6 illustrates the west to east geologic cross section between soil boring B7, B2 and B6. This area was not previously excavated. This cross section indicates that the suspect area of contamination begins near B2 in a flat, disk shape and then increases in depth to the east towards B9.

Soil Subsurface/Site Investigation Summary Report

Site Name: Coupeville Bulk Plant 0138
Site Address: 101 NW Coveland Street
City, State Zip: Coupeville, Washington 98239

The interpretations in this report represent our professional opinions and are based, in part, on the information supplied by the client. These opinions are based on currently available information and are arrived at in accordance with currently accepted hydrogeologic and engineering practices at this time and location. Other than this, no warranty is implied or intended.

Prepared by

Project Manager: Art Cowburn

Senior Project Manager: Akos Fekete

Attachments

Table 1 – Summary of Soil Analytical Data
Figure 1 – Site Location
Figure 2 – Site Plan – Soil Boring Locations and Historical Excavations
Figure 3 – Summary of Soil Boring Analytical Data
Figure 4 – Geologic Cross Section Locations
Figure 5 – Geologic Cross Section A–A'
Figure 6 – Geologic Cross Section B–B'
Appendix A – Boring Logs
Appendix B – Laboratory Report/COC
Appendix C - ENSR SOP 7116
Appendix D – ENSR SOP 7115

Distribution

□ Client File
□ Agency Project Manager
□ Third Parties (as requested)
□ Other _____

TABLE 1
SUMMARY OF SOIL ANALYTICAL DATA
BETX, MTBE, AND PETROLEUM HYDROCARBONS
FORMER UNOCAL BULK PLANT 0138
101 NW Coveland Street, Coupeville, Washington
06940-252

Soil Sample Number	Sample Depth (ft bgs)	Date Sampled	BETX[1] (mg/kg)				MTBE[2] (mg/kg)	Gasoline-range Hydrocarbons[3] (mg/kg)	Diesel-range Hydrocarbons[4] (mg/kg)	Heavy Oil-range Hydrocarbons[4] (mg/kg)
			B	E	T	X				
MTCA Cleanup Levels			0.03	6.00	7.00	9.00	0.10	100	2,000	2,000
B2 0-4	0-4	12/14/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B2 4-8	4-8	12/14/2004	<0.02	<0.05	<0.05	<0.05	-	<20	43	-
B2 8-12	8-12	12/14/2004	<0.02	<0.05	<0.05	<0.05	-	<20	22	-
B2 14	14	12/14/2004	0.79	5.3	0.46	<0.05	-	1100	3800	-
B2 15.5	15.5	12/14/2004	<0.02	<0.05	<0.05	<0.05	-	<20	55	-
B2 17	17	12/14/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B2 17.0 Dup	17	12/14/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B3 2	2	12/14/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B3 3	3	12/14/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B3 5	5	12/14/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B3 9	9	12/14/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B3 15	15	12/14/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B3 17	17	12/14/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B3 17 Dup	17	12/14/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B4 3	3	12/14/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B4 7	7	12/14/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B4 9	9	12/14/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B4 15	15	12/14/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B4 18	18	12/14/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B5 3	3	12/14/2004	<0.02	<0.05	<0.05	<0.05	-	<20	470	-
B5 5	5	12/14/2004	<0.02	<0.05	<0.05	<0.05	-	<20	47	-
B5 9	9	12/14/2004	<0.02	0.60	<0.05	1.6	-	<20	410	-
B5 15	15	12/14/2004	<0.02	0.33	<0.05	0.64	-	<20	250	-
B6 2	2	12/15/2004	<0.02	<0.05	<0.05	0.06	-	<20	150	-
B6 6.5	6.5	12/15/2004	<0.02	0.16	<0.05	0.52	-	<20	81	-
B6 8-9.5	8-9.5	12/15/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B6 9.5-11	9.5-11	12/15/2004	<0.02	0.22	<0.05	0.41	-	<20	<20	-
B6 11-12.5	11-12.5	12/15/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B6 12.5-14	12.5-14	12/15/2004	<0.02	0.53	<0.05	0.13	-	<20	270	-
B6 14-15.5	14-15.5	12/15/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B6 15.5-17	15.5-17	12/15/2004	<0.02	2.6	<0.05	23	-	1500	1600	-
B6 17-18.5	17-18.5	12/15/2004	<0.02	3.2	<0.05	41	-	2700	2900	-

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101 NW Coveland Street, Coupeville, Washington
06940-252

Soil Sample Number	Sample Depth (ft bgs)	Date Sampled	BETX[1] (mg/kg)				MTBE[2] (mg/kg)	Gasoline-range Hydrocarbons[3] (mg/kg)	Diesel-range Hydrocarbons[4] (mg/kg)	Heavy Oil-range Hydrocarbons[4] (mg/kg)
			B	E	T	X				
MTCA Cleanup Levels			0.03	6.00	7.00	9.00	0.10	100	2,000	2,000
B6 18.5-20	18.5-20	12/15/2004	<0.02	6.7	<0.05	68	-	680	410	-
B6 20-21.5	20-21.5	12/15/2004	<0.02	9.6	<0.05	98	-	6700	8200	-
B6 21.5-23	21.5-23	12/15/2004	<0.02	1.1	<0.05	7.4	-	800	600	-
B6 23-24.5	23-24.5	12/15/2004	0.93	35	2.5	224	-	16000	16000	-
B6 24.5-26	24.5-26	12/15/2004	<0.02	3.6	<0.05	26	-	3100	3400	-
B6 26-27.5	26-27.5	12/15/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B7 8-9.5	8-9.5	12/16/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B7 9.5-11	9.5-11	12/16/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B7 9.5-11	9.5-11	12/16/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B7 12.5-14	12.5-14	12/16/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B7 14-15.5	14-15.5	12/16/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B7 15.5-17	15.5-17	12/16/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B7 17-18.5	17-18.5	12/16/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B7 18.5-20	18.5-20	12/16/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B7 18.5-20	20-21.5	12/16/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B7 20-21.5	20-21.5	12/16/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B7 21.5-23	21.5-23	12/16/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B7 23-24.5	23-24.5	12/16/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B7 24.5-26	24.5-26	12/16/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B7 26-27.5	26-27.5	12/16/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B7 27.5-29	27.5-29	12/16/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B7 29-30.5	29-30.5	12/16/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B8 2.5-4	2.5-4	12/16/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B8 7.5-9	7.5-9	12/16/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B8 12.5-14	12.5-14	12/16/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B8 12.5-14	12.5-14	12/16/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B8 17.5-19	17.5-19	12/16/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B9 2.5-4	2.5-4	12/16/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B9 7.5-9	7.5-9	12/16/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B9 12.5-14	12.5-14	12/16/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B9 17.5-19	17.5-19	12/16/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-

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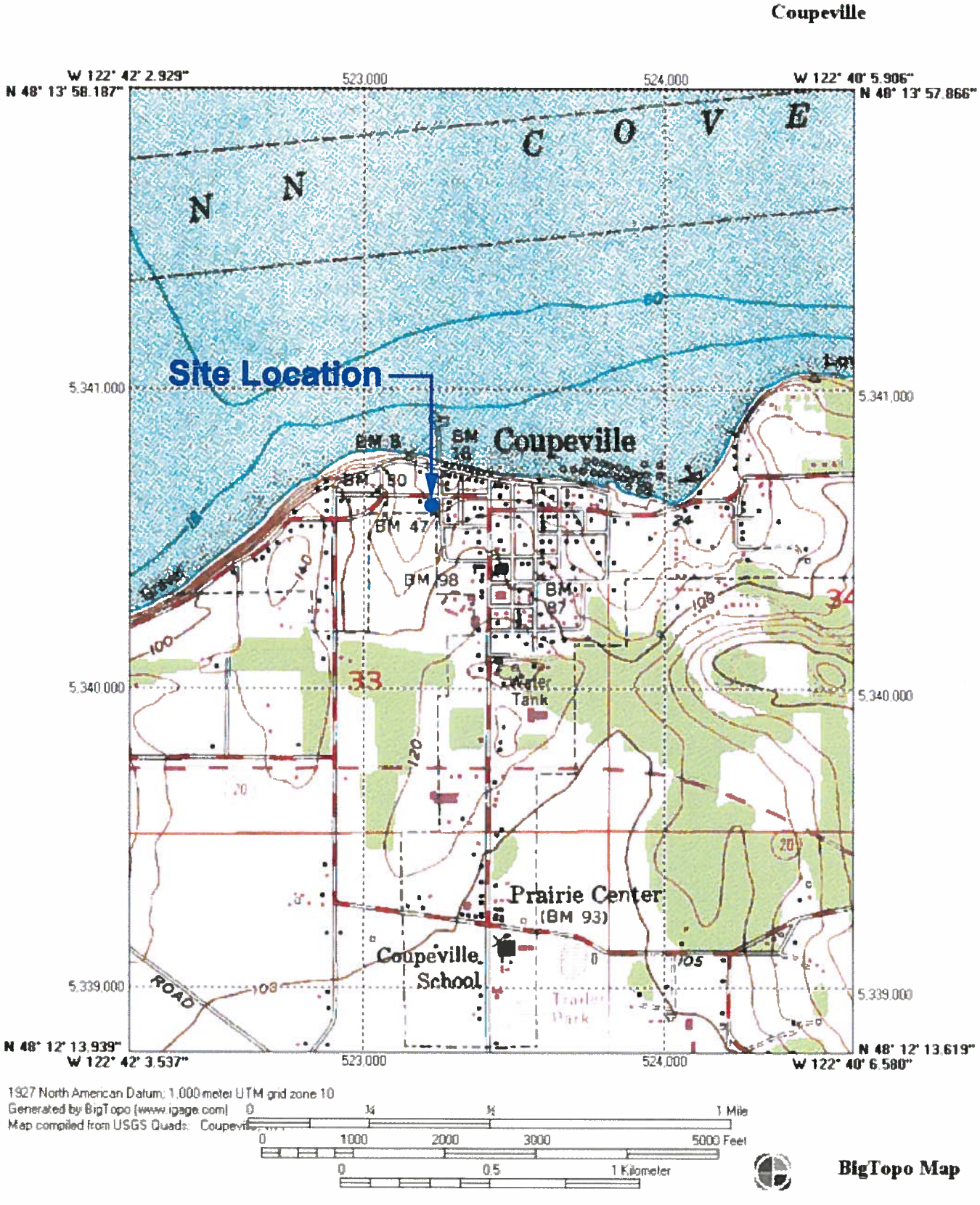
FORMER UNOCAL BULK PLANT 0138
101 NW Coveland Street, Coupeville, Washington
06940-252

Soil Sample Number	Sample Depth (ft bgs)	Date Sampled	BETX[1] (mg/kg)				MTBE[2] (mg/kg)	Gasoline-range Hydrocarbons[3] (mg/kg)	Diesel-range Hydrocarbons[4] (mg/kg)	Heavy Oil-range Hydrocarbons[4] (mg/kg)
			B	E	T	X				
MTCA Cleanup Levels			0.03	6.00	7.00	9.00	0.10	100	2,000	2,000
B10 2.5-4	2.5-4	12/16/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B10 7.5-9	7.5-9	12/16/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B10 12.5-14	12.5-14	12/16/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B10 17.5-19	17.5-19	12/16/2004	<0.02	<0.05	<0.05	<0.05	-	<20	<20	-
B11 19.5-21	19.5-21	1/24/2005	0.0348	<0.0412	<0.0412	<0.0824	<0.0824	<4.12	<10	<25
B11 22.5-24	22.5-24	1/25/2005	<0.0300	<0.0500	<0.0500	<0.100	<0.100	<5.00	<10	<25
B11 28.5-30	28.5-30	1/25/2005	<0.0224	<0.0373	<0.0373	<0.0746	<0.0746	<3.73	<10	<25
B12 6.0-7.5	6-7.5	1/25/2005	<0.212	<0.0354	<0.0354	<0.0708	<0.0708	53.4	514	<25
B12 28.5-30	28.5-30	1/25/2005	<0.0233	<0.0388	<0.0388	<0.0775	<0.0775	<3.88	<10	<25
B13 13.5-15	13.5-15	1/26/2005	<0.0231	<0.0385	<0.0385	<0.0770	<0.0770	3.85	<10	<25
B13 27-28.5	27-28.5	1/26/2005	<0.0225	<0.0376	<0.0376	<0.0751	<0.0751	3.76	<10	<25

Notes:
[1] B = Benzene, E = Ethylbenzene, **T** = **T**oluene, X = Total Xylenes. Analyzed by EPA Method 8021B.
[2] Methyl tert-butyl ether. Analyzed by EPA method 8260B.
[3] Gasoline-range hydrocarbons analyzed by NWTPH-G.
[4] Diesel-and heavy oil-range hydrocarbons analyzed by NWTPH-Dx Extended.
- Not Analyzed
ft bgs = feet below ground surface
mg/kg = milligrams per kilogram
MTCA = Model **T**oxics Control Act (2001 version)
Shading indicates that analyte was detected at a concentration exceeding the MTCA (2001 version) Method A Soil Cleanup Level for Unrestricted Land Uses, **T**able 740-1.
December 2004 Chemical analysis completed by Environmental Services Northwest.
January 2005 chemical analysis completed by North Creek Analytical.



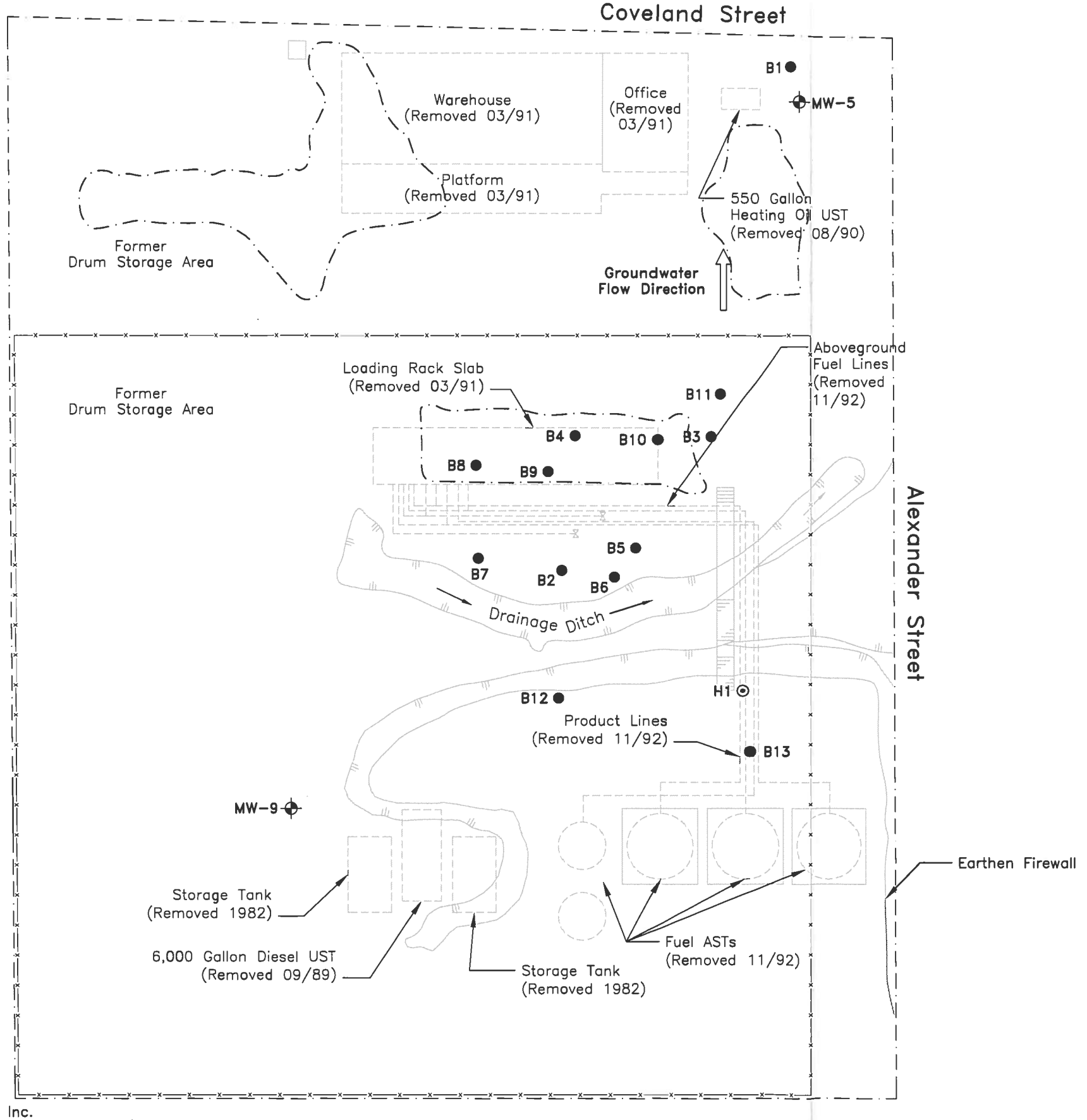
DRAWN:	K. Mongar
CHECKED:	A. Fekete
DATE:	December 9, 2003
FILENAME:	06940252120A
PROJECT NO:	06940-252-120

ENSR INTERNATIONAL

FIGURE 1

SITE LOCATION

Former Bulk Plant - Site #0138
101 NW Coveland Street
Coupeville, Washington



Legend

- MW-5 — Groundwater Monitoring Well
- AST — Aboveground Storage Tank
- UST — Underground Storage Tank
- Fence
- Property Line
- B6 — Soil Boring Location
- H1 — Hand Auger Boring Location
- Extent of 1992 Excavations

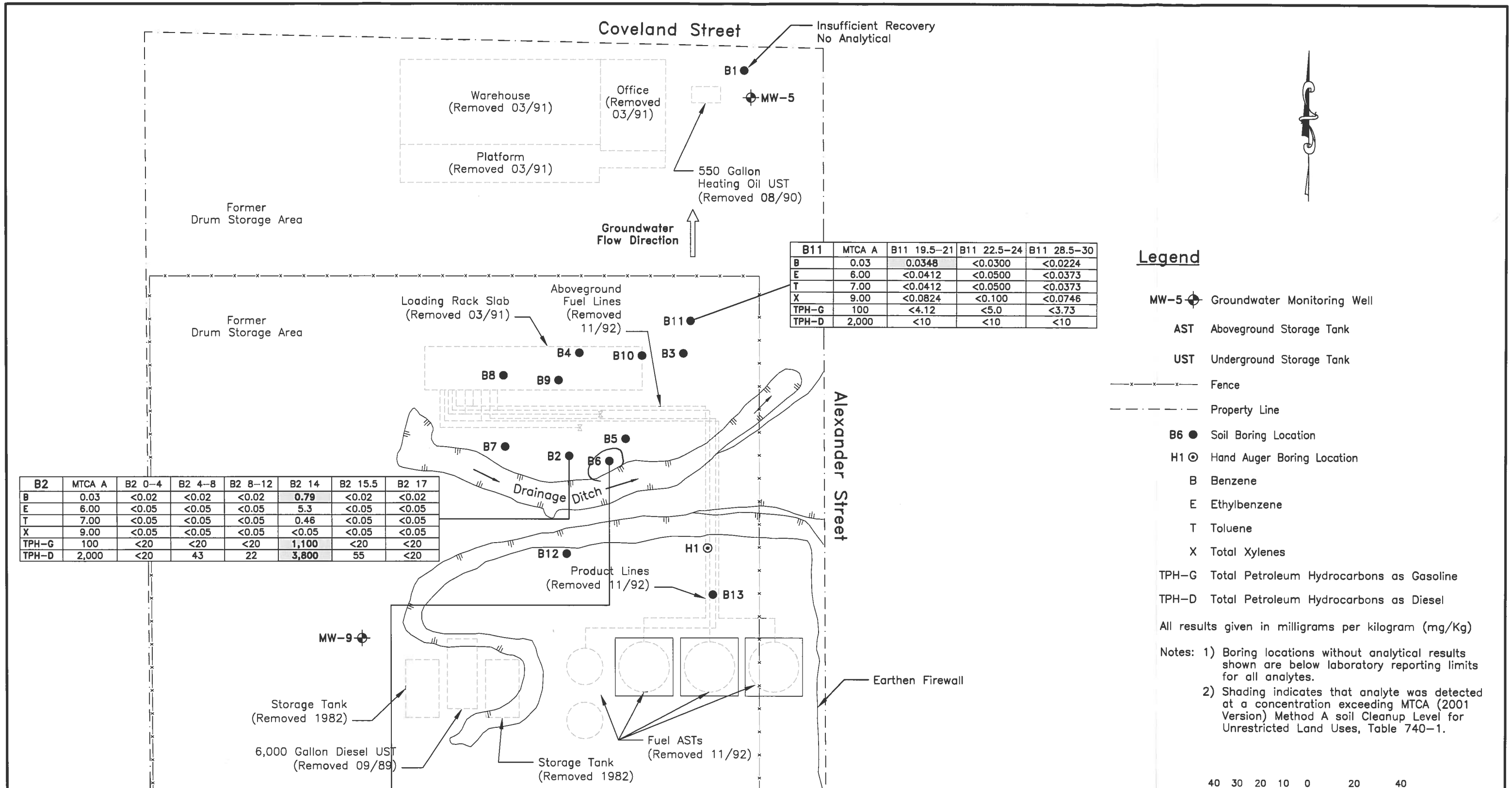
40 30 20 10 0 20 40
Approximate Scale in Feet

Source: GeoEngineers, Inc.
File #916120500T8B-PPT, 11/04/03, and
GeoEngineers, Inc.
"Soil Sampling Locations", no date, and
Thacher & Morrison, Inc.
File #T&M 6518 12/10/04

SCALE: 1" = 40' @11x17	DESIGN: A. Cowburn	CHECKED: A. Fekete	ENSR PROJECT NO:
FILENAME: 06940252120P	DRAWN: K. Mongar	DATE: February 21, 2005	06940-252-120

ENSR INTERNATIONAL

FIGURE 2
SITE PLAN – SOIL BORING LOCATIONS AND HISTORICAL EXCAVATIONS
Former Unocal Bulk Plant No. 0138
101 NW Coveland Street
Coupeville, Washington



B11	MTCA A	B11 19.5–21	B11 22.5–24	B11 28.5–30
B	0.03	0.0348	<0.0300	<0.0224
E	6.00	<0.0412	<0.0500	<0.0373
T	7.00	<0.0412	<0.0500	<0.0373
X	9.00	<0.0824	<0.100	<0.0746
TPH-G	100	<4.12	<5.0	<3.73
TPH-D	2,000	<10	<10	<10

B2	MTCA A	B2 0–4	B2 4–8	B2 8–12	B2 14	B2 15.5	B2 17
B	0.03	<0.02	<0.02	<0.02	**0.79**	<0.02	<0.02
E	6.00	<0.05	<0.05	<0.05	5.3	<0.05	<0.05
T	7.00	<0.05	<0.05	<0.05	0.46	<0.05	<0.05
X	9.00	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
TPH-G	100	<20	<20	<20	**1,100**	<20	<20
TPH-D	2,000	<20	43	22	**3,800**	55	<20

B6	MTCA A	B6 8–9.5	B6 9.5–11	B6 12.5–14	B6 14–15.5	B6 15.5–17	B6 17–18.5	B6 18.5–20	B6 20–21.5	B6 21.5–23	B6 23–24.5	B6 24.5–26	B6 26–27.5
B	0.03	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	**0.93**	<0.02	<0.02
E	6.00	<0.05	0.22	<0.05	0.53	2.6	3.2	**6.7**	**9.6**	1.1	**35**	3.6	<0.05
T	7.00	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	2.5	<0.05	<0.05
X	9.00	<0.05	0.41	<0.05	0.13	**23**	**41**	**68**	**98**	7.4	**224**	**26**	<0.05
TPH-G	100	<20	<20	<20	<20	**1,500**	**2,700**	**680**	**6,700**	**800**	**16,000**	**3,100**	<20
TPH-D	2,000	<20	<20	<20	270	1,600	**2,900**	410	**8,200**	600	**16,000**	**3,400**	<20

Legend

- MW-5 ⊕ Groundwater Monitoring Well
- AST Aboveground Storage Tank
- UST Underground Storage Tank
- Fence
- Property Line
- B6 ● Soil Boring Location
- H1 ⊙ Hand Auger Boring Location
- B Benzene
- E Ethylbenzene
- T Toluene
- X Total Xylenes
- TPH–G Total Petroleum Hydrocarbons as Gasoline
- TPH–D Total Petroleum Hydrocarbons as Diesel

All results given in milligrams per kilogram (mg/Kg)

Notes: 1) Boring locations without analytical results shown are below laboratory reporting limits for all analytes.
2) Shading indicates that analyte was detected at a concentration exceeding MTCA (2001 Version) Method A soil Cleanup Level for Unrestricted Land Uses, Table 740–1.

40 30 20 10 0 20 40
Approximate Scale in Feet

Source: GeoEngineers, Inc.
File #916120500T8B–PPT, 11/04/03

SCALE: 1" = 40' ⊕11x17	DESIGN: A. Cowburn	CHECKED: A. Fekete	ENSR PROJECT NO:
FILENAME: 06940252120M	DRAWN: K. Mongar	DATE: February 21, 2005	06940–252–120

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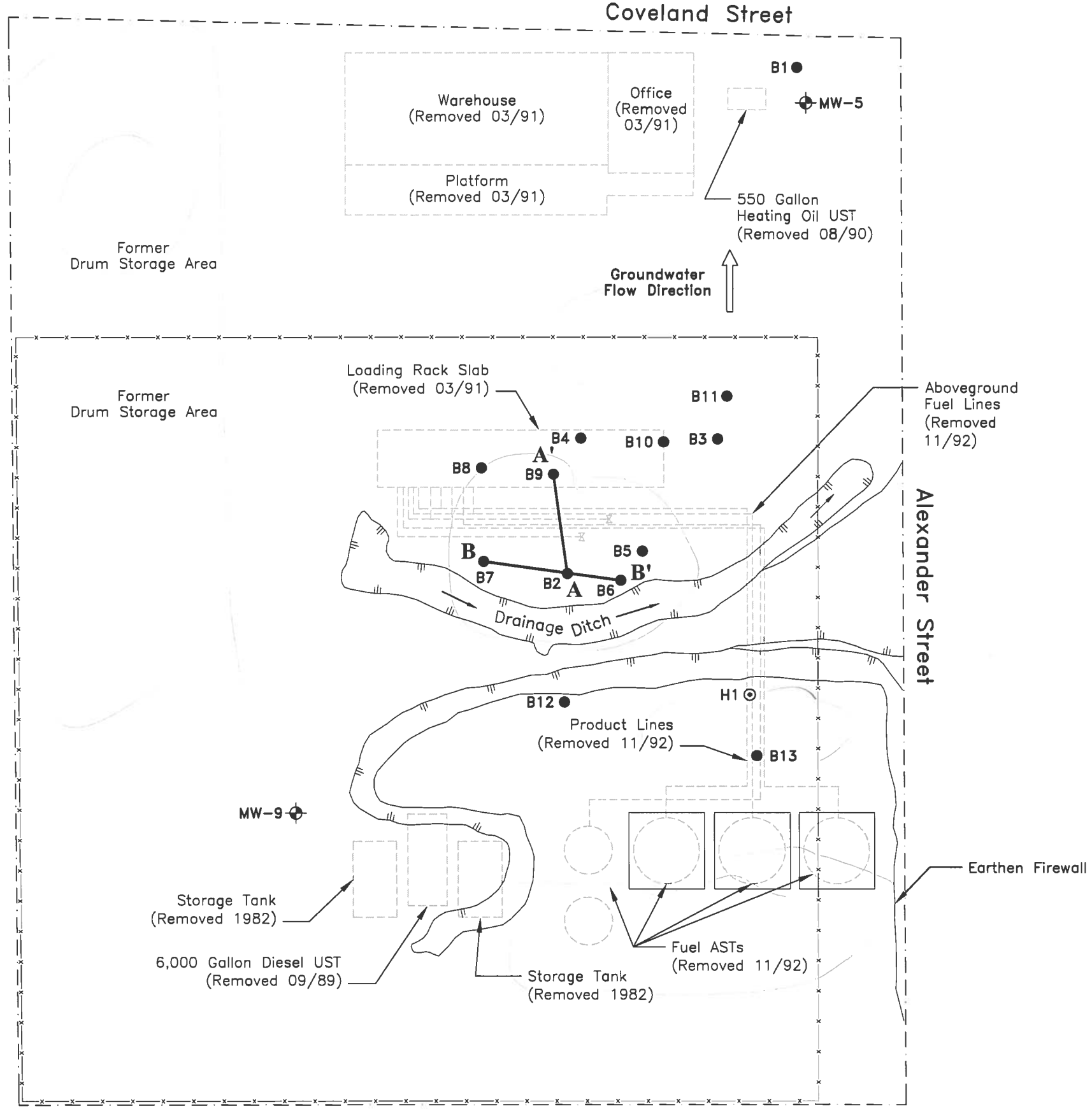
FIGURE 3
SUMMARY OF SOIL BORING ANALYTICAL DATA
Former Unocal Bulk Plant No. 0138
101 NW Coveland Street
Coupeville, Washington



Legend

- MW-5 — Groundwater Monitoring Well
- AST — Aboveground Storage Tank
- UST — Underground Storage Tank
- Fence
- Property Line
- B6 — Soil Boring Location
- H1 — Hand Auger Boring Location
- B — B' — Geologic Cross-Section

40 30 20 10 0 20 40
Approximate Scale in Feet

Source: GeoEngineers, Inc.
File #916120500T8B-PPT, 11/04/03

SCALE: 1" = 40' @11x17	DESIGN: A. Cowburn	CHECKED: A. Fekete	ENSR PROJECT NO:
FILENAME: 06940252120H	DRAWN: K. Mongar	DATE: February 21, 2005	06940-252-120

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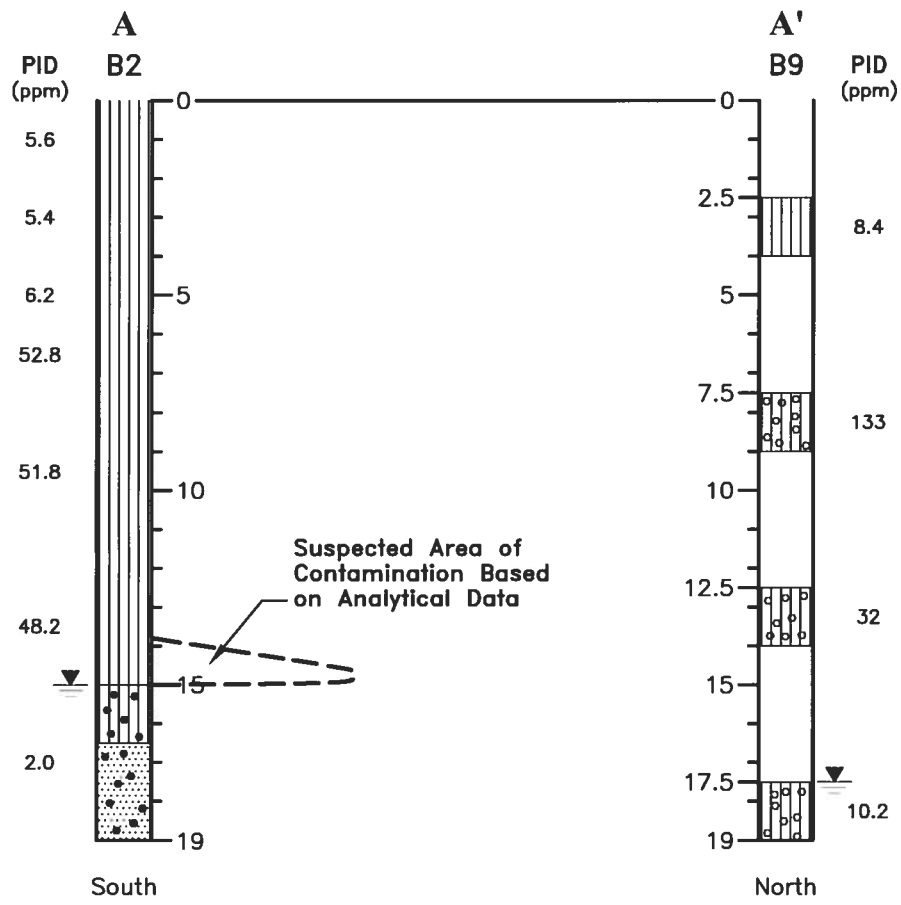
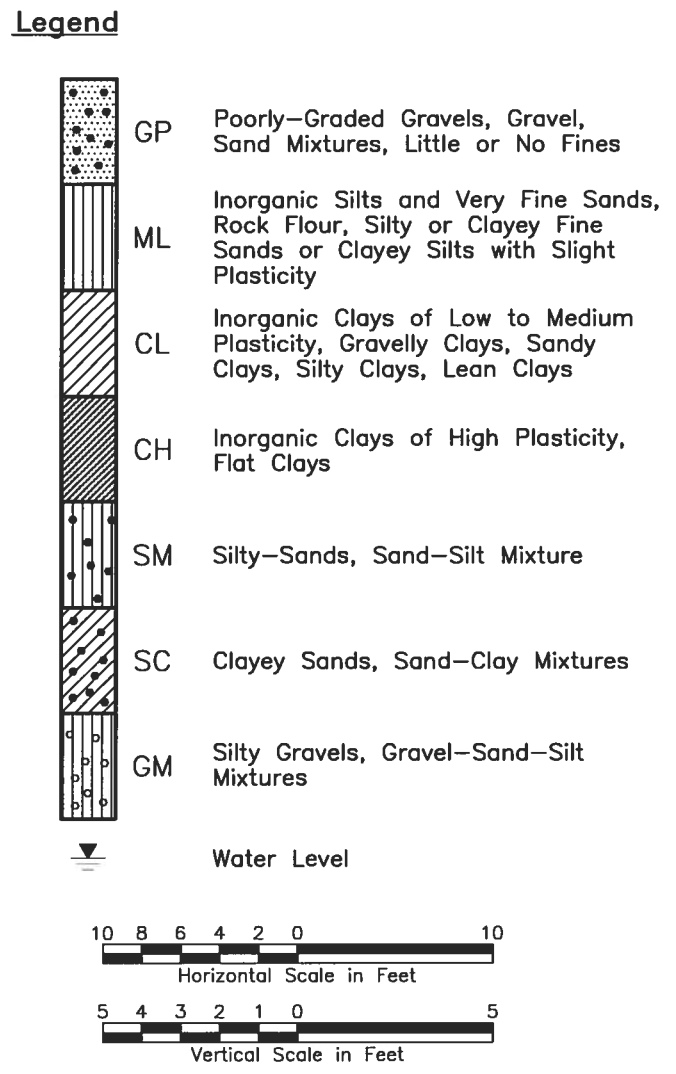
FIGURE 4
GEOLOGIC CROSS SECTION LOCATIONS
Former Unocal Bulk Plant No. 0138
101 NW Coveland Street
Coupeville, Washington



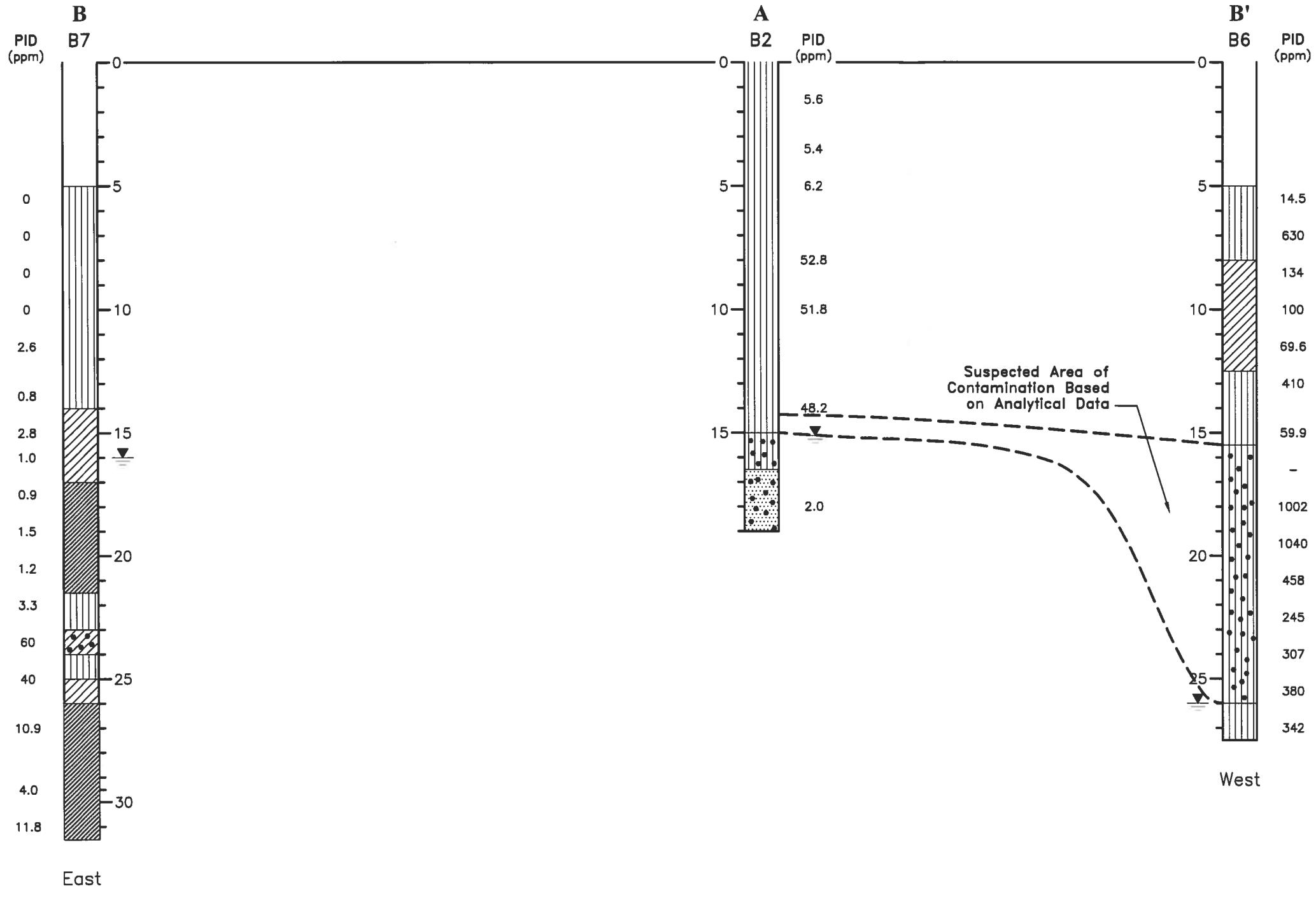


DRAWN: K. Mongar	DATE: February 21, 2005	PROJECT NO:	ENSR INTERNATIONAL
FILE NO: 06940252120J	CHECKED: A. Fekete	06940–252–120	

FIGURE 5

GEOLOGIC CROSS SECTION A–A'

Former Unocal Bulk Plant No. 0138
101 NW Coveland Street
Coupeville, Washington



Legend

- GP — Poorly–Graded Gravels, Gravel, Sand Mixtures, Little or No Fines
- ML — Inorganic Silts and Very Fine Sands, Rock Flour, Silty or Clayey Fine Sands or Clayey Silts with Slight Plasticity
- CL — Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays
- CH — Inorganic Clays of High Plasticity, Flat Clays
- SM — Silty–Sands, Sand–Silt Mixture
- SC — Clayey Sands, Sand–Clay Mixtures
- GM — Silty Gravels, Gravel–Sand–Silt Mixtures
- Water Level

5 4 3 2 1 0 5
Horizontal Scale in Feet

5 4 3 2 1 0 5
Vertical Scale in Feet

SCALE: as noted	DESIGN: A. Cowburn	CHECKED: A. Fekete	ENSR PROJECT NO:	ENSR INTERNATIONAL
FILENAME: 0694025212K	DRAWN: K. Mongar	DATE: February 21, 2005	06940–252–120	

FIGURE 6

GEOLOGIC CROSS SECTION B–B'

Former Unocal Bulk Plant No. 0138
101 NW Coveland Street
Coupeville, Washington

APPENDIX A

BORING LOGS

Project Number: 06940-252-120
Client: Unocal

Site Location: 101 NW Coveland Street
Coupeville, WA

ENSR INTERNATIONAL
9521 Willows Road
Redmond, Washington 98052
(425) 881 7700

Boring Log

Use: Soil Investigation
Boring Number: B1
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: GeoProbe
Inside Diameter: 2"
Outside Diameter:

Project Manager: Art Cowburn | Field Technician: L Ameson | Date Started:12/14/2004
Drilling Contractor: Holt Drilling | Driller: | Date Completed:12/14/2004

Depth	SPT Interval	Sample Depth	Sample Number	Blow Counts (18") 0-6	6-12	12-18	Pen (in)	Rec (in)	Sorting	Moisture	PID (ppm)	Field Identification
0	0-2										7.7	Brown, meduim grained SAND with gravel
1												
2	2-4										3.4	Light brown/tan SILT
3												
4	4-6										4.2	SILT with gravel and clay
5												
6	6-8											Brown CLAY
7												
8	8-10											Same as above 8.5 -9' trace silt
9												
10	10-12											Same as above
11												
12	12-14											Brown CLAY with medium sand and gravel
13												
14	14-16											Same as above
15												
16	16-18											Same as above
17												
18	18-20											Brown clay with Petroleum odor Refusal at 19' 9"
19												
20												

Project Number: 06940-252-120
Client: Unocal

Site Location: 101 NW Coveland Street
Coupeville, WA

ENSR INTERNATIONAL
9521 Willows Road
Redmond, Washington 98052
(425) 881 7700

Boring Log

Use: Soil Investigation
Boring Number: B2
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe
Inside Diameter: 2"
Outside Diameter:

Project Manager: Art Cowburn | Field Technician: T Crotwell | Date Started: 12/14/2004
Drilling Contractor: Holt Drilling | Driller: | Date Completed: 12/14/2004

Depth	SPT Interval	Sample Depth	Sample Number	Blow Counts (18") 0-6	6-12	12-18	Pen (in)	Rec (in)	Sorting	Moisture	PID (ppm)	Field Identification
0	0-2									Moist	5.6	Black to dark gray, slightly clayey SILT (A-4)/(ML)
1												
2	2-4										5.4	
3												
4	4-6										6.2	
5												
6	6-8										52.8	
7												
8	8-12									Moist	51.8	Dark gray, slightly clayey, SILT (A-4)/(ML) with Petroleum odor
9												
10												
11												
12												
13												
14												
15												
16	16-19											light gray GRAVEL from 14-16'
17												
18												
19												Refusal at 19'
20												

Project Number: 06940-252-120
Client: Unocal

Site Location: 101 NW Coveland Street
Coupeville, WA

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9521 Willows Road
Redmond, Washington 98052
(425) 881 7700

Boring Log

Use: Soil Investigation
Boring Number: B3
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe
Inside Diameter: 2"
Outside Diameter:

Project Manager: Art Cowburn | Field Technician: T Crotwell | Date Started: 12/14/2004
Drilling Contractor: Holt Drilling | Driller: | Date Completed: 12/14/2004

Depth	SPT Interval	Sample Depth	Sample Number	Blow Counts (18") 0-6	6-12	12-18	Pen (in)	Rec (in)	Sorting	Moisture	PID (ppm)	Field Identification
0	0-2										1.3	From 0.00 to 1.0' Black fine sandy clayey SILT (A-4)/(ML)
1												
2	2-4									Moist	2.1	Dry to moist with gravel
3												
4	4-6									Moist	2.8	From 1-4 Dark to light gray, fine sandy, slightly clayey, SILT
5												
6	6-8									Moist	2.1	Brown, slightly clayey silt (A-4)/(ML) gravel from 4.5-5.5' moist
7												
8	8-10										3.4	
9												Gravel from 10.5-11.0'
10	10-12										2.8	Clay from 11-12' More dense at 11'
11												
12	12-14										1.8	Gravel from 13.0-13.5' mixed with silt
13												
14	14-16										2.5	Change to SILT (A-4/ML) from 15.0-16.0'
15												
16												
17												
18												Refusal at 18' in GRAVEL
19												
20												

Project Number: 06940-252-120
Client: Unocal

Site Location: 101 NW Coveland Street
Coupeville, WA

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Boring Log

Use: Soil Investigation
Boring Number: B4
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe
Inside Diameter: 2"
Outside Diameter:

Project Manager: Art Cowburn | Field Technician: T Crotwell | Date Started: 12/14/2004
Drilling Contractor: Holt Drilling | Driller: | Date Completed: 12/14/2004

Depth	SPT Interval	Sample Depth	Sample Number	Blow Counts (18") 0-6	6-12	12-18	Pen (in)	Rec (in)	Sorting	Moisture	PID (ppm)	Field Identification
0	0-2										1.8	0.00 - 1.0 Brown, silty CLAY (A6)/CL with organics at surface
1												1.0 - 1.5 Asphalt fragments
2	2-4										2.6	1.5 - 2.0 Brown, silty CLAY (A-6)/CL with gravel
3												2.0 - 4.0 Gray, clayey SILT (A-4)/ML with gravel
4	4-6										2.6	
5												
6	6-8										2.9	Silty more clay to 8.0'
7												
8	8-10										2.8	
9												
10	10-12										3.2	
11												10.5 - 12.0 CLAY (A-6)/CL
12	12-14										1.7	Same as above
13												
14	14-16										2.4	14.0 - 14.5 GRAVEL layer
15												14.5 - 16.0 Clayey SILT
16												
17												
18												
19												
20												Refusal at 20'

Project Number: 06940-252-120
Client: Unocal

Site Location: 101 NW Coveland Street
Coupeville, WA

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Redmond, Washington 98052
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Boring Log

Use: Soil Investigation
Boring Number: B5
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe
Inside Diameter: 2"
Outside Diameter:

Project Manager: Art Cowburn | Field Technician: T Crotwell | Date Started: 12/14/2004
Drilling Contractor: Holt Drilling | Driller: | Date Completed:12/14/2004

Depth	SPT Interval	Sample Depth	Sample Number	Blow Counts (18") 0-6	6-12	12-18	Pen (in)	Rec (in)	Sorting	Moisture	PID (ppm)	Field Identification
0	0-2										198	1.0 - 1.5 Brown and tan, slightly clayey SILT (A-4)/ML with organics
1												
2	2-4										206	1.5 - 2.0 Gray and tan, fine to coarse SAND (A-2)/SM with gravel
3												
4	4-6										75.1	2.0 - 5.0 Brown and gray, slightly clayey SILT (A-4)/ML
5												
6	6-8										74.9	6.0 - 6.5 GRAVEL
7												6.5 - 8.0 SILT (A-4)/ML
8	8-10										80.5	Brown, slightly clayey to clayey SILT (A-4)/ML to gray and
9												
10	10-12										158	brown silty clay (A-6)/CL
11												
12	12-14										361	
13												
14												Refusal at 14'
15												
16												
17												
18												
19												
20												

Project Number: 06940-252-120
Client: Unocal

Site Location: 101 NW Coveland Street
Coupeville, WA

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9521 Willows Road
Redmond, Washington 98052
(425) 881 7700

Boring Log

Use: Soil Investigation
Boring Number: B6
Sheet: 1 of 2
Surface Elevation (ft-asl):
Equipment: Hollow Stem Auger
Inside Diameter: 2"
Outside Diameter: 2 3/8"

Project Manager: Art Cowburn | Field Technician: T Crotwell | Date Started: 12/15/2004
Drilling Contractor: Holt Drilling | Driller: | Date Completed: 12/15/2004

Depth	SPT Interval	Sample Depth	Sample Number	Blow Counts (18") 0-6	6-12	12-18	Pen (in)	Rec (in)	Sorting	Moisture	PID (ppm)	Field Identification
0												
1												Petroleum odor at approximately 1.5-2.0'. Light gray SILT
2												(A-4) odor contiues to 5'. SPT began at 5'
3												
4												
5	5-6.5			5	16	20					14.5	
6	6.5-8			10	19	25					630	Light-dark gray, fine sands, slightly clayey SILT (A-4) with gravel
7												
8	8-9.5			8	11	15				134		Same as above; slightly more clayey
9												
10	9.5-11			5	11	17					100	Same as above, slightly more gravel at 10.5'
11	11-12.5			6	14	18				Moist	69.6	Sand lens at 11.5'; slightly more clay. Light gray silty clay (A-6)/CL starting below 11.5'. Moist.
12	12.5-14			4	13	30					410	ghtly more dense. Gravel at interval from 13.5'. Slightly more sand 13.5-14' Mosit to w
13												
14	14-15.5			5	15	20				Moist	59.9	Sand lens approximately 14.5-15'. Wet to saturated within lens; moist elsewhere.
15	15.5-17			18	40	50/6				Moist		Light gray, slightly silty SAND (A-2-4). Mosit.
16												
17	17-18.5			12	27	35				Moist	1002	Same as above
18	18.5-20			11	30	39				Moist	1040	Same as above
19												
20	20-21.5			7	18	25				Moist	458	Same as above

Project Number: 06940-252-120
Client: Unocal

Site Location: 101 NW Coveland Street
Coupeville, WA

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Boring Log

Use: Soil Investigation
Boring Number: B6
Sheet: 2 of 2
Surface Elevation (ft-asl):
Equipment: Hollow Stem Auger
Inside Diameter: 2"
Outside Diameter: 2 3/8"

Project Manager: Art Cowburn | Field Technician: T Crotwell | Date Started: 12/15/2004
Drilling Contractor: Holt Drilling | Driller: | Date Completed: 12/15/2004

Depth	SPT Interval	Sample Depth	Sample Number	Blow Counts (18") 0-6	6-12	12-18	Pen (in)	Rec (in)	Sorting	Moisture	PID (ppm)	Field Identification
21												
	21.5-23			12	26	31				Moist	245	Same as above more clay from 22.5-23.0'. Moist.
22												
23	23-24.5			7	18	20					307	Same as above. Clay lens from 23.5-24.0'
24												
	24.5-26			5	13	27					380	
25												
26	26-27.5			14	31	41				Sat	342	Silt 26-26.5'; 27-27.5'. Saturated at 26.0'
												Boring terminated at 27.5' in SILT (A-4)/ML
27												
28												
29												
30												
31												
32												
33												
34												
35												
36												
37												
38												
39												
40												

Project Number: 06940-252-120
Client: Unocal

Site Location: 101 NW Coveland Street
Coupeville, WA

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Boring Log

Use: Soil Investigation
Boring Number: B7
Sheet: 1 of 2
Surface Elevation (ft-asl):
Equipment: Hollow Stem Auger
Inside Diameter: 2"
Outside Diameter: 2 3/8"

Project Manager: Art Cowburn | Field Technician: T Crotwell | Date Started: 12/16/2004
Drilling Contractor: Holt Drilling | Driller: | Date Completed: 12/16/2004

Depth	SPT Interval	Sample Depth	Sample Number	Blow Counts (18") 0-6	6-12	12-18	Pen (in)	Rec (in)	Sorting	Moisture	PID (ppm)	Field Identification
0												
1												Auger to 5.0' to begin continous SPTs
2												
3												
4												
5	5-6.5			0	0	1				W -> S	0	Brown and gray, fine sandy, clayey SILT (A-4)/ML wet to saturated
6												
	6.5-8			0	0	0				W -> S	0	Same as above; slightly more clay
7												
8	8-9.5			0	0	4				W -> S	0	Clayey silt (A-4)/ML silty clay (A-6)/ML
9												
	9.5-11			7	14	18				S->M	0	Saturated from 9.5-10', Moist 10-11.5' SILT (A-4); Brownish gray with gravel
10												
11	11-12.5			7	14	18				Wet	2.6	Brown and gray, fine sandy, clayey SILT (A-4)/ML gravel 11.5-12.0'; wet
12												
	12.5-14			4	6	11				M->W	0.8	Same as above; gravel 12.5-13.5'; moist to wet
13												
14	14-15.5			4	5	6					2.8	Brown and tan to gray, fine sandy, silty CLAY (A-6)/CL gravel 14-14.5' Wet 15-15.5'
15												
	15.5-17			4	8	10				W->S	1.0	Same as above; no gravel; wet to saturated
16												
17	17-18.5			3	1	7				Wet	0.9	Brown and gray, silty CLAY (A-7-5)/CH gravel 17.5-18.0' wet
18												
	18.5-20			1	2	4				Wet	1.5	Same as above, gravel from 18.5-19.5' wet
19												
20	20-21.5			7	20	25					1.2	Same as above; gravel 20.5-21.0' Wet; Harder drilling at 20.0'

Project Number: 06940-252-120
Client: Unocal

Site Location: 101 NW Coveland Street
Coupeville, WA

9521 Willows Road
Redmond, Washington 98052
(425) 881 7700

Boring Log

Use: Soil Investigation
Boring Number: B7
Sheet: 2 of 2
Surface Elevation (ft-asl):
Equipment: Hollow Stem Auger
Inside Diameter: 2"
Outside Diameter: 2 3/8"

Project Manager: Art Cowburn | Field Technician: T Crotwell | Date Started: 12/16/2004
Drilling Contractor: Holt Drilling | Driller: | Date Completed: 12/16/2004

Depth	SPT Interval	Sample Depth	Sample Number	Blow Counts (18") 0-6	6-12	12-18	Pen (in)	Rec (in)	Sorting	Moisture	PID (ppm)	Field Identification
21												
	21.5-23			19	29	40					3.3	Brown and gray, fine sandy, clayey SILT (A-4)/ML; wet.
22												
23	23-24.5			9	12	14				Wet	60	Gray, fine sand (A-2-4) with varying ammounts of silt/clay; wet
24												
	24.5-26			9	13	26				Wet	40	Gray silt (A-4)/ML to silty clay (A-6)/CL; wet
25												
26	26-27.5			7	9	9				Wet	10.9	Dark gray to gray silty CLAY (A-7-5)/CH; wet
27												
	27.5-29		4	3	7					4.0		Same as above
28												
29												
	29-31.5		3	4	6					11.8		Same as above
30												Boring terminated at 31.5' in CLAY (A-7-5)/CH
31												
32												
33												
34												
35												
36												
37												
38												
39												
40												

Project Number: 06940-252-120
Client: Unocal

Site Location: 101 NW Coveland Street
Coupeville, WA

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9521 Willows Road
Redmond, Washington 98052
(425) 881 7700

Boring Log

Use: Soil Investigation
Boring Number: B8
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Hollow Stem Auger
Inside Diameter: 2"
Outside Diameter: 2 3/8"

Project Manager: Art Cowburn | Field Technician: L Arneson | Date Started: 12/16/2004
Drilling Contractor: Holt Drilling | Driller: | Date Completed: 12/16/2004

Depth	SPT Interval	Sample Depth	Sample Number	Blow Counts (18") 0-6	6-12	12-18	Pen (in)	Rec (in)	Sorting	Moisture	PID (ppm)	Field Identification
0												
1												Auger to 2.5' to begin SPTs
2	2.5-4			1	1	1				Wet		Brown silty CLAY with gravel, layer of asphalt at bottom, wet
3												
4												
5												
6												
7	7.5-9			4	10	9					3.2	Brown SILT with trace sand
8												
9												
10												
11												
12	12.5-14			4	6	8				Wet	7.8	Brown silty CLAY, trace find sand with gravel, wet
13												
14												
15												
16												
17	17.5-19			3	5	10				Wet	19.6	Same as above
18												
19												
20												

Project Number: 06940-252-120
Client: Unocal

Site Location: 101 NW Coveland Street
Coupeville, WA

ENSR INTERNATIONAL
9521 Willows Road
Redmond, Washington 98052
(425) 881 7700

Boring Log

Use: Soil Investigation
Boring Number: B9
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Hollow Stem Auger
Inside Diameter: 2"
Outside Diameter: 2 3/8"

Project Manager: Art Cowburn | Field Technician: L Arneson | Date Started: 12/16/2004
Drilling Contractor: Holt Drilling | Driller: | Date Completed: 12/16/2004

Depth	SPT Interval	Sample Depth	Sample Number	Blow Counts (18") 0-6	6-12	12-18	Pen (in)	Rec (in)	Sorting	Moisture	PID (ppm)	Field Identification
0												
1												Auger to 2.5' to begin SPTs
2	2.5-4			4	9	12					8.4	Brown, clayey SILT (A-4)/ML with fine sands
3												
4												
5												
6												
7	7.5-9			6	9	12					133	Same as above; no sand, gravel
8												
9												
10												
11												
12	12.5-14			5	40	50/3					32	Same as above
13												
14												Driller commented that there "was something really dense until 16 feet"
15												
16												
17	17.5-19			17	23	19				Wet	10.2	Same as above
18												
19												
20												

Project Number: 06940-252-120
Client: Unocal

Site Location: 101 NW Coveland Street
Coupeville, WA

ENSR INTERNATIONAL
9521 Willows Road
Redmond, Washington 98052
(425) 881 7700

Boring Log

Use: Soil Investigation
Boring Number: B10
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Hollow Stem Auger
Inside Diameter: 2"
Outside Diameter: 2 3/8"

Project Manager: Art Cowburn | Field Technician: L Arneson | Date Started: 12/16/2004
Drilling Contractor: Holt Drilling | Driller: | Date Completed: 12/16/2004

Depth	SPT Interval	Sample Depth	Sample Number	Blow Counts (18") 0-6	6-12	12-18	Pen (in)	Rec (in)	Sorting	Moisture	PID (ppm)	Field Identification
0												
1												Auger to 2.5' to begin SPTs
2	2.5-4			3	11	14					9.5	Light brown to gray clayey SILT with gravel
3												
4												
5												
6												
7	7.5-9			3	7	9					10.4	Brown SILT with gravel
8												
9												
10												
11												
12	12.5-14			3	8	15					8.1	Same as above
13												
14												
15												
16												
17	17.5-19			0	4	8					9.2	Brown, fine to coarse SAND
18												
19												
20												

APPENDIX B

Laboratory Report / COC

ESN NORTHWEST
Environmental Services Network

December 20, 2004

Art Cowburn
ENSR
3521 Willows Road NE
Redmond, WA 98052

Dear Mr. Cowburn:

Please find enclosed the analytical data report for the Coupeville BP Project located in Coupeville, Washington. Mobile Laboratory services were conducted on December 14 –17, 2004. Soil samples were analyzed for Diesel and Oil by NWTPH-Dx/Dx Extended, Gasoline by NWTPH-Gx, and BTEX by Method 8021B.

The results of the analyses are summarized in the attached tables. All soil values are reported on a dry weight basis. Applicable detection limits and QA/QC data are included. An invoice for this analytical work is also enclosed.

ESN Northwest appreciates the opportunity to have provided analytical services for this project. If you have any further questions about the data report, please give me a call. It was a pleasure working with you on this project, and we are looking forward to the next opportunity to work together.

Sincerely,

Michael A. Korosec

Michael A. Korosec
President

677 Woodland Square Lp. SE, Suite D ▪ Lacey, Washington 98503 ▪ 360.459.4670 ▪ FAX 360.459.3432
Web Site: *www.esnnw.com* E-Mail: *info@esnnw.com*

ESN NORTHWEST CHEMISTRY LABORATORY

Coupeville BP PROJECT
Coupeville, Washingon
ENSR International
Client Project #06940-252

Analyses of BTEX (EPA Method 8021B) in Soil

Sample Number	Date Analyzed	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes (mg/kg)	Surrogate Recovery (%)
Method Blank	12/14/04	nd	nd	nd	nd	97
B2 0-4	12/14/04	nd	nd	nd	nd	108
B2 4-8	12/14/04	nd	nd	nd	nd	99
B2 8-12	12/14/04	nd	nd	nd	nd	98
B2-14	12/14/04	0.79	0.46	5.3	nd	107
B2-15.5	12/14/04	nd	nd	nd	nd	93
B2-17.0	12/14/04	nd	nd	nd	nd	100
B2-17.0 Dup.	12/14/04	nd	nd	nd	nd	106
B3-3	12/14/04	nd	nd	nd	nd	108
B3-5	12/14/04	nd	nd	nd	nd	89
B3-2	12/14/04	nd	nd	nd	nd	101
B3-9	12/14/04	nd	nd	nd	nd	106
B3-15	12/14/04	nd	nd	nd	nd	83
B3-17	12/14/04	nd	nd	nd	nd	86
B3-17 Dup.	12/14/04	nd	nd	nd	nd	85
B4-3	12/14/04	nd	nd	nd	nd	93
B4-7	12/14/04	nd	nd	nd	nd	103
B4-9	12/14/04	nd	nd	nd	nd	105
B4-15	12/14/04	nd	nd	nd	nd	91
B4-18	12/14/04	nd	nd	nd	nd	130
Method Detection Limits		0.02	0.05	0.05	0.05	

"nd" Indicates not detected at the listed detection limits.
"int" Indicates that interference prevents determination.

ACCEPTABLE RECOVERY LIMITS FOR SURROGATE (Chlorobenzene): 65% TO 135%

ANALYSES PERFORMED BY: T. McCall

ESN NORTHWEST CHEMISTRY LABORATORY

Coupeville BP PROJECT
Coupeville, Washingon
ENSR International
Client Project #06940-252

Analyses of BTEX (EPA Method 8021B) in Soil

Sample Number	Date Analyzed	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes (mg/kg)	Surrogate Recovery (%)
Method Blank	12/15/04	nd	nd	nd	nd	95
B5-3	12/15/04	nd	nd	nd	nd	104
B5-5	12/15/04	nd	nd	nd	nd	102
B5-9	12/15/04	nd	nd	0.60	1.6	100
B5-15	12/15/04	nd	nd	0.33	0.64	74
H1-2	12/15/04	nd	nd	nd	nd	107
H1-2	12/15/04	nd	nd	nd	nd	109
B6-2	12/15/04	nd	nd	nd	0.06	80
B6-6.5	12/15/04	nd	nd	0.16	0.52	95
B6-8-9.5	12/15/04	nd	nd	nd	nd	106
B6-9.5-11	12/15/04	nd	nd	0.22	0.41	87
B6-11-12.5	12/15/04	nd	nd	nd	nd	98
B6-12.5-14	12/15/04	nd	nd	0.53	0.13	88
B6-14-15.5	12/15/04	nd	nd	nd	nd	112
Method Detection Limits		0.02	0.05	0.05	0.05	

"nd" Indicates not detected at the listed detection limits.
"int" Indicates that interference prevents determination.

ACCEPTABLE RECOVERY LIMITS FOR SURROGATE (Chlorobenzene): 65% TO 135%

ANALYSES PERFORMED BY: T. McCall

ESN NORTHWEST CHEMISTRY LABORATORY

Coupeville BP PROJECT
Coupeville, Washingon
ENSR International
Client Project #06940-252

Analyses of BTEX (EPA Method 8021B) in Soil

Sample Number	Date Analyzed	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes (mg/kg)	Surrogate Recovery (%)
Method Blank	12/16/04	nd	nd	nd	nd	92
B6-15.5-17	12/16/04	nd	nd	2.6	23	89
B6-17-18.5	12/16/04	nd	nd	3.2	41	95
B6-18.5-20	12/16/04	nd	nd	6.7	68	85
B6-20-21.5	12/16/04	nd	nd	9.6	98	128
B6-21.5-23	12/16/04	nd	nd	1.1	7.4	111
B6-23-24.5	12/16/04	0.93	2.5	35	224	126
B6-24.5-26	12/16/04	nd	nd	3.6	26	127
B6-26-27.5	12/16/04	nd	nd	nd	nd	98
B7-8-9.5	12/16/04	nd	nd	nd	nd	82
B7-9.5-11	12/16/04	nd	nd	nd	nd	90
B7-9.5-11 Dup.	12/16/04	nd	nd	nd	nd	88
B7-12.5-14	12/16/04	nd	nd	nd	nd	84
B7-14-15.5	12/16/04	nd	nd	nd	nd	89
B7-15.5-17	12/16/04	nd	nd	nd	nd	81
B7-17-18.5	12/16/04	nd	nd	nd	nd	116
B7-18.5-20	12/16/04	nd	nd	nd	nd	120
B7-18.5-20 Dup.	12/16/04	nd	nd	nd	nd	113
B7-20-21.5	12/16/04	nd	nd	nd	nd	127
B7-21.5-23	12/16/04	nd	nd	nd	nd	124
B7-23-24.5	12/16/04	nd	nd	nd	nd	125
B7-24.5-26	12/16/04	nd	nd	nd	nd	123
B7-26-27.5	12/16/04	nd	nd	nd	nd	113
B7-27.5-29	12/16/04	nd	nd	nd	nd	120
B7-29-30.5	12/16/04	nd	nd	nd	nd	118
Method Detection Limits		0.02	0.05	0.05	0.05	

"nd" Indicates not detected at the listed detection limits.
"int" Indicates that interference prevents determination.

ACCEPTABLE RECOVERY LIMITS FOR SURROGATE (Chlorobenzene): 65% TO 135%

ANALYSES PERFORMED BY: T. McCall

ESN NORTHWEST CHEMISTRY LABORATORY

Coupeville BP PROJECT
Coupeville, Washingon
ENSR International
Client Project #06940-252

Analyses of BTEX (EPA Method 8021B) in Soil

Sample Number	Date Analyzed	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes (mg/kg)	Surrogate Recovery (%)
Method Blank	12/17/04	nd	nd	nd	nd	80
B8-2.5-4	12/17/04	nd	nd	nd	nd	79
B8-7.5-9	12/17/04	nd	nd	nd	nd	75
B8-12.5-14	12/17/04	nd	nd	nd	nd	99
B8-12.5-14 Dup.	12/17/04	nd	nd	nd	nd	90
B8-17.5-19	12/17/04	nd	nd	nd	nd	100
B9-2.5-4	12/17/04	nd	nd	nd	nd	86
B9-7.5-9	12/17/04	nd	nd	nd	nd	71
B9-12.5-14	12/17/04	nd	nd	nd	nd	79
B9-17.5-19	12/17/04	nd	nd	nd	nd	79
B10-2.5-4	12/17/04	nd	nd	nd	nd	81
B10-7.5-9	12/17/04	nd	nd	nd	nd	73
B10-12.5-14	12/17/04	nd	nd	nd	nd	88
B10-17.5-19	12/17/04	nd	nd	nd	nd	76
Method Detection Limits		0.02	0.05	0.05	0.05	

"nd" Indicates not detected at the listed detection limits.
"int" Indicates that interference prevents determination.

ACCEPTABLE RECOVERY LIMITS FOR SURROGATE (Chlorobenzene): 65% TO 135%

ANALYSES PERFORMED BY: T. McCall

ESN NORTHWEST CHEMISTRY LABORATORY

COUPEVILLE BP PROJECT
Coupeville, Washington
ENSR International
Client Project #06940-252

Analyses of Gasoline & Diesel (NWTPH-Gx/Dx) in Soil

Sample Number	Date Analyzed	Surrogate Recovery (%)	Gasoline (mg/kg)	Diesel (mg/kg)
Method Blank	12/14/04	102	nd	nd
B2 0-4	12/14/04	98	nd	nd
B2 4-8	12/14/04	116	nd	43
B2 8-12	12/14/04	120	nd	22
B2-14	12/14/04	int	1100	3800
B2-15.5	12/14/04	int	nd	55
B2-17.0	12/14/04	101	nd	nd
B2-17.0 Dup.	12/14/04	124	nd	nd
B3-3	12/14/04	102	nd	nd
B3-5	12/14/04	97	nd	nd
B3-2	12/14/04	107	nd	nd
B3-9	12/14/04	133	nd	nd
B3-15	12/14/04	104	nd	nd
B3-17	12/14/04	107	nd	nd
B3-17 Dup.	12/14/04	116	nd	nd
B4-3	12/14/04	100	nd	nd
B4-7	12/14/04	106	nd	nd
B4-9	12/14/04	118	nd	nd
B4-15	12/14/04	96	nd	nd
B4-18	12/14/04	125	nd	nd
Method Detection Limits			20	20

"nd" Indicates not detected at the listed detection limits.
"int" Indicates that interference prevents determination.

ACCEPTABLE RECOVERY LIMITS FOR SURROGATE : 65% TO 135%

ANALYSES PERFORMED BY: T. McCall

ESN NORTHWEST CHEMISTRY LABORATORY

COUPEVILLE BP PROJECT
Coupeville, Washington
ENSR International
Client Project #06940-252

Analyses of Gasoline & Diesel (NWTPH-Gx/Dx) in Soil

Sample Number	Date Analyzed	Surrogate Recovery (%)	Gasoline (mg/kg)	Diesel (mg/kg)
Method Blank	12/15/04	100	nd	nd
B5-3	12/15/04	int	nd	470
B5-5	12/15/04	int	nd	47
B5-9	12/15/04	int	nd	410
B5-15	12/15/04	int	nd	250
H1-2	12/15/04	91	nd	nd
H1-2	12/15/04	103	nd	nd
B6-2	12/15/04	int	nd	150
B6-6.5	12/15/04	int	nd	81
B6-8-9.5	12/15/04	117	nd	nd
B6-9.5-11	12/15/04	113	nd	nd
B6-11-12.5	12/15/04	124	nd	nd
B6-12.5-14	12/15/04	int	nd	270
B6-14-15.5	12/15/04	124	nd	nd
Method Detection Limits			20	20

"nd" Indicates not detected at the listed detection limits.
"int" Indicates that interference prevents determination.

ACCEPTABLE RECOVERY LIMITS FOR SURROGATE : 65% TO 135%

ANALYSES PERFORMED BY: T. McCall

ESN NORTHWEST CHEMISTRY LABORATORY

COUPEVILLE BP PROJECT
Coupeville, Washington
ENSR International
Client Project #06940-252

Analyses of Gasoline & Diesel (NWTPH-Gx/Dx) in Soil

Sample Number	Date Analyzed	Surrogate Recovery (%)	Gasoline (mg/kg)	Diesel (mg/kg)
Method Blank	12/16/04	102	nd	nd
B6-15.5-17	12/16/04	int	1500	1600
B6-17-18.5	12/16/04	int	2700	2900
B6-18.5-20	12/16/04	int	680	410
B6-20-21.5	12/16/04	int	6700	8200
B6-21.5-23	12/16/04	int	800	600
B6-23-24.5	12/16/04	int	16000	16000
B6-24.5-26	12/16/04	int	3100	3400
B6-26-27.5	12/16/04	123	nd	nd
B7-8-9.5	12/16/04	84	nd	nd
B7-9.5-11	12/16/04	132	nd	nd
B7-9.5-11 Dup.	12/16/04	105	nd	nd
B7-12.5-14	12/16/04	117	nd	nd
B7-14-15.5	12/16/04	108	nd	nd
B7-15.5-17	12/16/04	131	nd	nd
B7-17-18.5	12/16/04	110	nd	nd
B7-17-18.5 Dup.	12/16/04	116	nd	nd
B7-18.5-20	12/16/04	130	nd	nd
B7-20-21.5	12/16/04	121	nd	nd
B7-21.5-23	12/16/04	111	nd	nd
B7-23-24.5	12/16/04	126	nd	nd
B7-24.5-26	12/16/04	123	nd	nd
B7-26-27.5	12/16/04	125	nd	nd
B7-27.5-29	12/16/04	107	nd	nd
B7-29-30.5	12/16/04	129	nd	nd
Method Detection Limits			20	20

"nd" Indicates not detected at the listed detection limits.
"int" Indicates that interference prevents determination.

ACCEPTABLE RECOVERY LIMITS FOR SURROGATE : 65% TO 135%

ANALYSES PERFORMED BY: T. McCall

ESN NORTHWEST CHEMISTRY LABORATORY

COUPEVILLE BP PROJECT
Coupeville, Washington
ENSR International
Client Project #06940-252

Analyses of Gasoline & Diesel (NWTPH-Gx/Dx) in Soil

Sample Number	Date Analyzed	Surrogate Recovery (%)	Gasoline (mg/kg)	Diesel (mg/kg)
Method Blank	12/17/04	99	nd	nd
B8-2.5-4	12/17/04	124	nd	nd
B8-7.5-9	12/17/04	132	nd	nd
B8-12.5-14	12/17/04	111	nd	nd
B8-12.5-14 Dup.	12/17/04	106	nd	nd
B8-17.5-19	12/17/04	103	nd	nd
B9-2.5-4	12/17/04	94	nd	nd
B9-7.5-9	12/17/04	117	nd	nd
B9-12.5-14	12/17/04	110	nd	nd
B9-17.5-19	12/17/04	119	nd	nd
B10-2.5-4	12/17/04	107	nd	nd
B10-7.5-9	12/17/04	114	nd	nd
B10-12.5-14	12/17/04	110	nd	nd
B10-17.5-19	12/17/04	121	nd	nd
Method Detection Limits			20	20

"nd" Indicates not detected at the listed detection limits.
"int" Indicates that interference prevents determination.

ACCEPTABLE RECOVERY LIMITS FOR SURROGATE : 65% TO 135%

ANALYSES PERFORMED BY: T. McCall

ESN NORTHWEST Environmental Services Network

CHAIN-OF-CUSTODY RECORD

CLIENT: ENSR International

ADDRESS: 9521 Willows Rd Redmond WA 98052

PHONE: 425 861 7700 FAX:

CLIENT PROJECT #: 06940-252 PROJECT MANAGER: Art Cawburn

DATE: 12/14/04 PAGE 1 OF

PROJECT NAME: Coupeville BP

LOCATION: Coupeville, WA

COLLECTOR: L Medsker, A Cawburn DATE OF COLLECTION 12/14/04

Sample Number	Depth	Time	Sample Type	Container Type	VOA 8021B	VOA 8021B BTEX Only	VOA 8260	SEMI VOL 8270	TPH - HCID	TPH 8015 (gasoline)	TPH 8015 (diesel)	TPH 8015 (d & o)	PAH 8100	PAH 8270	PCBs 8082	Pesticides 8081	EPH	VPH	Methamphetamine	Pb	Hex Chrome	NOTES	Total Number of Containers	Laboratory Note Number
1. B2 0-4					X				X	X														
2. B2 4-8					X				X	X														
3. B2 8-12					X				X	X														
4. B2 14					X				X	X														
5. B2 15.5					X				X	X														
6. B2 17.0					X				X	X														
7. B3 - 3					X				X	X														
8. B3 - 5					X				X	X														
9. B3 - 2					X				X	X														
10. B3 - 9					X				X	X														
11. B3 - 15					X				X	X														
12. B3 - 17					X				X	X														
13. B4 - 3					X				X	X														
14. B4-7					X				X	X														
15. B4-9					X				X	X														
16. B4-15					X				X	X														
17. B4-18					X				X	X														
18. B5-3					X				X	X														

RELINQUISHED BY (Signature)	DATE/TIME	RECEIVED BY (Signature)	DATE/TIME
[signature]	12/14/04 830	[signature]	12/14/04 830
RELINQUISHED BY (Signature)	DATE/TIME	RECEIVED BY (Signature)	DATE/TIME

SAMPLE DISPOSAL INSTRUCTIONS

☐ ESN DISPOSAL @ $2.00 each ☐ Return ☐ Pickup

SAMPLE RECEIPT	
TOTAL NUMBER OF CONTAINERS	
CHAIN OF CUSTODY SEALS Y/N/NA	
SEALS INTACT? Y/N/NA	
RECEIVED GOOD COND./COLD	
NOTES:	

LABORATORY NOTES:

Turn Around Time: 24 HR 48 HR 5 DAY

ESN NORTHWEST | Environmental Services Network

CHAIN-OF-CUSTODY RECORD

CLIENT: ENSR International

ADDRESS: 9521 Willows Rd Redmond WA 98052

PHONE: 425-883-7100 FAX: _____

CLIENT PROJECT #: 00940-252 PROJECT MANAGER: Art Cowburn

DATE: 12/14/04 PAGE 2 OF 2

PROJECT NAME: Carnville BP

LOCATION: Carnville WA

COLLECTOR: L Medsker DATE OF COLLECTION _____

Sample Number	Depth	Time	Sample Type	Container Type	VOA 8021B	VOA 8021B BTEX Only	VOA 8260	SEMI VOL 8270	TPH - HCID	TPH 8015 (gasoline)	TPH 8015 (diesel)	TPH 8015 (d & o)	PAH 8100	PAH 8270	PCBs 8082	Pesticides 8081	EPH	VPH	Methamphetamine	Pb	Hex Chrome			NOTES	Total Number of Containers	Laboratory Note Number
1. B5-5					X				X	X																
2. B5-9					X				X	X																
3. B5-15					X				X	X																
4. H1-2					X				X	X																
5. B6-2					X				X	X																
6. B6-6.5					X				X	X																
7. B6-8-9.5					X				X	X																
8. B6-9.5-11					X				X	X																
9. B6 11-12.5					X				X	X																
10. B6-12.5-14					X				X	X																
11. B6 14-15.5					X				X	X																
12. B6 15.5-17					X				X	X																
13. B6 17-18.5					X				X	X																
14. B6 18.5-20					X				X	X																
15. B6 20-21.5					X				X	X																
16. B6 21.5 23					X				X	X																
17. B6 23 24.5					X				X	X																
18. B6 24.5-26					X				X	X																

RELINQUISHED BY (Signature)	DATE/TIME	RECEIVED BY (Signature)	DATE/TIME
[signature]	12/14/04 340	Jim McCall	12/14/04 340
RELINQUISHED BY (Signature)	DATE/TIME	RECEIVED BY (Signature)	DATE/TIME

SAMPLE DISPOSAL INSTRUCTIONS

☐ ESN DISPOSAL @ $2.00 each ☐ Return ☐ Pickup

SAMPLE RECEIPT	
TOTAL NUMBER OF CONTAINERS	
CHAIN OF CUSTODY SEALS Y/N/NA	
SEALS INTACT? Y/N/NA	
RECEIVED GOOD COND./COLD	
NOTES:	

LABORATORY NOTES:

Turn Around Time: 24 HR 48 HR 5 DAY

ESN NORTHWEST | Environmental Services Network

CHAIN-OF-CUSTODY RECORD

CLIENT: ENSR

ADDRESS: 9521 Willows Rd Redmond WA 98052

PHONE: 425 ~~736-4172~~ 881-7700 FAX:

CLIENT PROJECT #: 00940-252 PROJECT MANAGER: A Caulum

DATE: 12/15/04 PAGE OF

PROJECT NAME: Coupeville BP

LOCATION: Coupeville

COLLECTOR: L Medsker DATE OF COLLECTION

Sample Number	Depth	Time	Sample Type	Container Type	VOA 8021B	VOA 8021B BTEX Only	VOA 8260	SEMI VOL 8270	TPH - HCID	TPH 8015 (gasoline)	TPH 8015 (diesel)	TPH 8015 (d & o)	PAH 8100	PAH 8270	PCBs 8082	Pesticides 8081	EPH	VPH	Methamphetamine	Pb	Hex Chrome	NOTES	Total Number of Containers	Laboratory Note Number
1. B6 26-27.5					X				X															
2. B7 8-9.5					X				X	X														
3. B7 9.5-11					X				X	X														
4. B7 12.5-14					X				X	X														
5. B7 14-15.5					X				X	X														
6. B7 15.5-17					X				X	X														
7. B7 17-18.5					X				X	X														
8. B7 18.5-20					X				X	X														
9. B7 20-21.5					X				X	X														
10. B7 21.5-23					X				X	X														
11. B7 23-24.5					X				X	X														
12. B7 24.5-26					X				X	X														
13. B7 26-27.5					X				X	X														
14. B7 27.5-29					X				X	X														
15. B7 29-30.5					X				X	X														
16.																								
17.																								
18.																								

RELINQUISHED BY (Signature)	DATE/TIME	RECEIVED BY (Signature)	DATE/TIME
Lauren Medsker	12/15/04 445	Jana McCall	12/15/04 445
RELINQUISHED BY (Signature)	DATE/TIME	RECEIVED BY (Signature)	DATE/TIME

SAMPLE DISPOSAL INSTRUCTIONS

☐ ESN DISPOSAL @ $2.00 each ☐ Return ☐ Pickup

SAMPLE RECEIPT	
TOTAL NUMBER OF CONTAINERS	
CHAIN OF CUSTODY SEALS Y/N/NA	
SEALS INTACT? Y/N/NA	
RECEIVED GOOD COND./COLD	
NOTES:	

LABORATORY NOTES:

Turn Around Time: 24 HR 48 HR 5 DAY

ESN NORTHWEST | Environmental Services Network

CHAIN-OF-CUSTODY RECORD

CLIENT: ENSR International

ADDRESS: 9521 Willows Rd Redmond WA 98052

PHONE: 881-7700 FAX:

CLIENT PROJECT #: PROJECT MANAGER:

DATE: 12/16/04 PAGE 1 OF

PROJECT NAME: Coupeville BP

LOCATION: Coupeville, WA

COLLECTOR: L Medskar DATE OF COLLECTION 12/16/04

Sample Number	Depth	Time	Sample Type	Container Type	ANALYSES: VOA 8021B	VOA 8021B BTEX Only	VOA 8260	SEMI VOL 8270	TPH - HCID	TPH 8015 (gasoline)	TPH 8015 (diesel)	TPH 8015 (d & o)	PAH 8100	PAH 8270	PCBs 8082	Pesticides 8081	EPH	VPH	Methamphetamine	Pb	Hex Chrome			NOTES	Total Number of Containers	Laboratory Note Number
1. BS-2.5-4					X				X	X																
2. BS 7.5-9					X				X	X																
3. BS 12.5-14					X				X	X																
4. BS 17.5-19					X				X	X																
5. B9 2.5-4					X				X	X																
6. B9 7.5-9					X				X	X																
7. B9 12.5-14					X				X	X																
8. B9 17.5-19					X				X	X																
9. B10 2.5-4					X				X	X																
10. B10 7.5-9					X				X	X																
11. B10 12.5-14					X				X	X																
12. B10 17.5-19					X				X	X																
13.																										
14.																										
15.																										
16.																										
17.																										
18.																										

RELINQUISHED BY (Signature)	DATE/TIME	RECEIVED BY (Signature)	DATE/TIME
Laura Medskar		Dan McCall	12/16/04 EK
RELINQUISHED BY (Signature)	DATE/TIME	RECEIVED BY (Signature)	DATE/TIME

SAMPLE DISPOSAL INSTRUCTIONS

☐ ESN DISPOSAL @ $2.00 each ☐ Return ☐ Pickup

SAMPLE RECEIPT	
TOTAL NUMBER OF CONTAINERS	
CHAIN OF CUSTODY SEALS Y/N/NA	
SEALS INTACT? Y/N/NA	
RECEIVED GOOD COND./COLD	
NOTES:	

LABORATORY NOTES:

ML

Turn Around Time: 24 HR 48 HR 5 DAY

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Seattle 11720 North Creek Pkwy N, Suite 400, Bothell, WA 98011-8244
425.420.9200 fax 425.420.9210
Spokane East 11115 Montgomery, Suite B, Spokane, WA 99206-4776
509.924.9200 fax 509.924.9290
Portland 9405 SW Nimbus Avenue, Beaverton, OR 97008-7132
503.906.9200 fax 503.906.9210
Bend 20332 Empire Avenue, Suite F-1, Bend, OR 97701-5711
541.383.9310 fax 541.382.7588
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907.563.9200 fax 907.563.9210

08 February 2005

Art Cowburn
ENSR-Redmond
9521 Willows Road NE
Redmond, WA 98052

RE: UNOCAL #0138

Enclosed are the results of analyses for samples received by the laboratory on 01/26/05 14:15. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Jeff Gerdes
Project Manager

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425.420.9200 fax 425.420.9210
Spokane 11922 E. 1st Avenue, Spokane Valley, WA 99206-5302
509.924.9200 fax 509.924.9290
Portland 9405 SW Nimbus Avenue, Beaverton, OR 97008-7132
503.906.9200 fax 503.906.9210
Bend 20332 Empire Avenue, Suite F-1, Bend, OR 97701-5711
541.383.9310 fax 541.382.7588
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ENSR-Redmond	Project: UNOCAL #0138	
9521 Willows Road NE	Project Number: 06940-252	**Reported:**
Redmond, WA 98052	Project Manager: Art Cowburn	02/08/05 13:32

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
252 B11 19.5-21	B5A0646-01	Soil	01/24/05 16:45	01/26/05 14:15
252 B11 22.5-24	B5A0646-02	Soil	01/25/05 10:45	01/26/05 14:15
252 B11 28.5-30	B5A0646-03	Soil	01/25/05 10:45	01/26/05 14:15
252 B12 6.0-7.5	B5A0646-04	Soil	01/25/05 12:15	01/26/05 14:15
252 B12 28.5-30	B5A0646-05	Soil	01/25/05 14:25	01/26/05 14:15
252 B13 13.5-15	B5A0646-06	Soil	01/26/05 10:40	01/26/05 14:15
252 B13 27-28.5	B5A0646-07	Soil	01/26/05 10:40	01/26/05 14:15

North Creek Analytical - Bothell

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Jeff Gerdes, Project Manager

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509.924.9200 fax 509.924.9290
Portland 9405 SW Nimbus Avenue, Beaverton, OR 97008-7132
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Anchorage 2000 W International Airport Road, Suite A-10, Anchorage, AK 99502-1119
907.563.9200 fax 907.563.9210

ENSR-Redmond	Project: UNOCAL #0138	
9521 Willows Road NE	Project Number: 06940-252	**Reported:**
Redmond, WA 98052	Project Manager: Art Cowburn	02/08/05 13:32

Gasoline Hydrocarbons (Benzene to Naphthalene) and BTEX by NWTPH-G and EPA 8021B
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
252 B11 19.5-21 (B5A0646-01) Soil	**Sampled: 01/24/05 16:45**		**Received: 01/26/05 14:15**						
Gasoline Range Hydrocarbons	ND	4.12	mg/kg dry	1	5B06008	02/06/05	02/06/05	NWTPH-Gx/8021B	
Benzene	**0.0348**	0.0247	"	"	"	"	"	"	
Toluene	ND	0.0412	"	"	"	"	"	"	
Ethylbenzene	ND	0.0412	"	"	"	"	"	"	
Xylenes (total)	ND	0.0824	"	"	"	"	"	"	
Surrogate: 4-BFB (FID)	*97.8 %*	*50-150*			"	"	"	"	
Surrogate: 4-BFB (PID)	*93.9 %*	*53-142*			"	"	"	"	
252 B11 22.5-24 (B5A0646-02) Soil	**Sampled: 01/25/05 10:45**		**Received: 01/26/05 14:15**						
Gasoline Range Hydrocarbons	ND	5.00	mg/kg dry	1	5B06008	02/06/05	02/06/05	NWTPH-Gx/8021B	
Benzene	ND	0.0300	"	"	"	"	"	"	
Toluene	ND	0.0500	"	"	"	"	"	"	
Ethylbenzene	ND	0.0500	"	"	"	"	"	"	
Xylenes (total)	ND	0.100	"	"	"	"	"	"	
Surrogate: 4-BFB (FID)	*98.3 %*	*50-150*			"	"	"	"	
Surrogate: 4-BFB (PID)	*97.3 %*	*53-142*			"	"	"	"	
252 B11 28.5-30 (B5A0646-03) Soil	**Sampled: 01/25/05 10:45**		**Received: 01/26/05 14:15**						
Gasoline Range Hydrocarbons	ND	3.73	mg/kg dry	1	5B06008	02/06/05	02/06/05	NWTPH-Gx/8021B	
Benzene	ND	0.0224	"	"	"	"	"	"	
Toluene	ND	0.0373	"	"	"	"	"	"	
Ethylbenzene	ND	0.0373	"	"	"	"	"	"	
Xylenes (total)	ND	0.0746	"	"	"	"	"	"	
Surrogate: 4-BFB (FID)	*98.5 %*	*50-150*			"	"	"	"	
Surrogate: 4-BFB (PID)	*97.1 %*	*53-142*			"	"	"	"	

North Creek Analytical - Bothell

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Spokane 11922 E. 1st Avenue, Spokane Valley, WA 99206-5302
509.924.9200 fax 509.924.9290
Portland 9405 SW Nimbus Avenue, Beaverton, OR 97008-7132
503.906.9200 fax 503.906.9210
Bend 20332 Empire Avenue, Suite F-1, Bend, OR 97701-5711
541.383.9310 fax 541.382.7588
Anchorage 2000 W International Airport Road, Suite A-10, Anchorage, AK 99502-1119
907.563.9200 fax 907.563.9210

ENSR-Redmond	Project: UNOCAL #0138	
9521 Willows Road NE	Project Number: 06940-252	**Reported:**
Redmond, WA 98052	Project Manager: Art Cowburn	02/08/05 13:32

Gasoline Hydrocarbons (Benzene to Naphthalene) and BTEX by NWTPH-G and EPA 8021B
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
252 B12 6.0-7.5 (B5A0646-04) Soil Sampled: 01/25/05 12:15 Received: 01/26/05 14:15									
Gasoline Range Hydrocarbons	**53.4**	3.54	mg/kg dry	1	5B06008	02/06/05	02/06/05	NWTPH-Gx/8021B	G-01
Benzene	ND	0.0212	"	"	"	"	"	"	
Toluene	ND	0.0354	"	"	"	"	"	"	
Ethylbenzene	ND	0.0354	"	"	"	"	"	"	
Xylenes (total)	ND	0.0708	"	"	"	"	"	"	
Surrogate: 4-BFB (FID)	*125 %*	*50-150*			"	"	"	"	
Surrogate: 4-BFB (PID)	*105 %*	*53-142*			"	"	"	"	
252 B12 28.5-30 (B5A0646-05) Soil Sampled: 01/25/05 14:25 Received: 01/26/05 14:15									
Gasoline Range Hydrocarbons	ND	3.88	mg/kg dry	1	5B06008	02/06/05	02/06/05	NWTPH-Gx/8021B	
Benzene	ND	0.0233	"	"	"	"	"	"	
Toluene	ND	0.0388	"	"	"	"	"	"	
Ethylbenzene	ND	0.0388	"	"	"	"	"	"	
Xylenes (total)	ND	0.0775	"	"	"	"	"	"	
Surrogate: 4-BFB (FID)	*97.4 %*	*50-150*			"	"	"	"	
Surrogate: 4-BFB (PID)	*97.0 %*	*53-142*			"	"	"	"	
252 B13 13.5-15 (B5A0646-06) Soil Sampled: 01/26/05 10:40 Received: 01/26/05 14:15									
Gasoline Range Hydrocarbons	ND	3.85	mg/kg dry	1	5B06008	02/06/05	02/06/05	NWTPH-Gx/8021B	
Benzene	ND	0.0231	"	"	"	"	"	"	
Toluene	ND	0.0385	"	"	"	"	"	"	
Ethylbenzene	ND	0.0385	"	"	"	"	"	"	
Xylenes (total)	ND	0.0770	"	"	"	"	"	"	
Surrogate: 4-BFB (FID)	*96.9 %*	*50-150*			"	"	"	"	
Surrogate: 4-BFB (PID)	*96.5 %*	*53-142*			"	"	"	"	

North Creek Analytical - Bothell

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Jeff Gerdes

Jeff Gerdes, Project Manager

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425.420.9200 fax 425.420.9210
Spokane 11922 E. 1st Avenue, Spokane Valley, WA 99206-5302
509.924.9200 fax 509.924.9290
Portland 9405 SW Nimbus Avenue, Beaverton, OR 97008-7132
503.906.9200 fax 503.906.9210
Bend 20332 Empire Avenue, Suite F-1, Bend, OR 97701-5711
541.383.9310 fax 541.382.7588
Anchorage 2000 W International Airport Road, Suite A-10, Anchorage, AK 99502-1119
907.563.9200 fax 907.563.9210

ENSR-Redmond	Project: UNOCAL #0138	
9521 Willows Road NE	Project Number: 06940-252	**Reported:**
Redmond, WA 98052	Project Manager: Art Cowburn	02/08/05 13:32

Gasoline Hydrocarbons (Benzene to Naphthalene) and BTEX by NWTPH-G and EPA 8021B
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
252 B13 27-28.5 (B5A0646-07) Soil Sampled: 01/26/05 10:40 Received: 01/26/05 14:15									
Gasoline Range Hydrocarbons	ND	3.76	mg/kg dry	1	5B06008	02/06/05	02/06/05	NWTPH-Gx/8021B	
Benzene	ND	0.0225	"	"	"	"	"	"	
Toluene	ND	0.0376	"	"	"	"	"	"	
Ethylbenzene	ND	0.0376	"	"	"	"	"	"	
Xylenes (total)	ND	0.0751	"	"	"	"	"	"	
Surrogate: 4-BFB (FID)	*95.6 %*	*50-150*			"	"	"	"	
Surrogate: 4-BFB (PID)	*96.8 %*	*53-142*			"	"	"	"	

North Creek Analytical - Bothell

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Spokane 11922 E. 1st Avenue, Spokane Valley, WA 99206-5302
509.924.9200 fax 509.924.9290
Portland 9405 SW Nimbus Avenue, Beaverton, OR 97008-7132
503.906.9200 fax 503.906.9210
Bend 20332 Empire Avenue, Suite F-1, Bend, OR 97701-5711
541.383.9310 fax 541.382.7588
Anchorage 2000 W International Airport Road, Suite A-10, Anchorage, AK 99502-1119
907.563.9200 fax 907.563.9210

ENSR-Redmond	Project: UNOCAL #0138	
9521 Willows Road NE	Project Number: 06940-252	**Reported:**
Redmond, WA 98052	Project Manager: Art Cowburn	02/08/05 13:32

Semivolatile Petroleum Products by NWTPH-Dx with Acid/Silica Gel Clean-up
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
252 B11 19.5-21 (B5A0646-01) Soil Sampled: 01/24/05 16:45 Received: 01/26/05 14:15									
Diesel Range Hydrocarbons	ND	10.0	mg/kg dry	1	5A31060	01/31/05	02/01/05	NWTPH-Dx	
Lube Oil Range Hydrocarbons	ND	25.0	"	"	"	"	"	"	
Surrogate: 2-FBP	*57.7 %*	*50-150*			"	"	"	"	
Surrogate: Octacosane	*84.3 %*	*50-150*			"	"	"	"	
252 B11 22.5-24 (B5A0646-02) Soil Sampled: 01/25/05 10:45 Received: 01/26/05 14:15									
Diesel Range Hydrocarbons	ND	10.0	mg/kg dry	1	5A31060	01/31/05	02/01/05	NWTPH-Dx	
Lube Oil Range Hydrocarbons	ND	25.0	"	"	"	"	"	"	
Surrogate: 2-FBP	*56.8 %*	*50-150*			"	"	"	"	
Surrogate: Octacosane	*86.4 %*	*50-150*			"	"	"	"	
252 B11 28.5-30 (B5A0646-03) Soil Sampled: 01/25/05 10:45 Received: 01/26/05 14:15									
Diesel Range Hydrocarbons	ND	10.0	mg/kg dry	1	5A31060	01/31/05	02/01/05	NWTPH-Dx	
Lube Oil Range Hydrocarbons	ND	25.0	"	"	"	"	"	"	
Surrogate: 2-FBP	*61.7 %*	*50-150*			"	"	"	"	
Surrogate: Octacosane	*86.1 %*	*50-150*			"	"	"	"	
252 B12 6.0-7.5 (B5A0646-04) Soil Sampled: 01/25/05 12:15 Received: 01/26/05 14:15									
Lube Oil Range Hydrocarbons	ND	25.0	mg/kg dry	1	5A31060	01/31/05	02/01/05	NWTPH-Dx	
Surrogate: Octacosane	*80.5 %*	*50-150*			"	"	"	"	
252 B12 6.0-7.5 (B5A0646-04RE1) Soil Sampled: 01/25/05 12:15 Received: 01/26/05 14:15									
Diesel Range Hydrocarbons	**514**	50.0	mg/kg dry	5	5A31060	01/31/05	02/01/05	NWTPH-Dx	
Surrogate: 2-FBP	*65.8 %*	*50-150*			"	"	"	"	

North Creek Analytical - Bothell

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Jeff Gerdes

Jeff Gerdes, Project Manager

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425.420.9200 fax 425.420.9210
Spokane 11922 E. 1st Avenue, Spokane Valley, WA 99206-5302
509.924.9200 fax 509.924.9290
Portland 9405 SW Nimbus Avenue, Beaverton, OR 97008-7132
503.906.9200 fax 503.906.9210
Bend 20332 Empire Avenue, Suite F-1, Bend, OR 97701-5711
541.383.9310 fax 541.382.7588
Anchorage 2000 W International Airport Road, Suite A-10, Anchorage, AK 99502-1119
907.563.9200 fax 907.563.9210

ENSR-Redmond	Project: UNOCAL #0138	
9521 Willows Road NE	Project Number: 06940-252	**Reported:**
Redmond, WA 98052	Project Manager: Art Cowburn	02/08/05 13:32

Semivolatile Petroleum Products by NWTPH-Dx with Acid/Silica Gel Clean-up
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
252 B12 28.5-30 (B5A0646-05) Soil	**Sampled: 01/25/05 14:25**		**Received: 01/26/05 14:15**						
Diesel Range Hydrocarbons	ND	10.0	mg/kg dry	1	5A31060	01/31/05	02/01/05	NWTPH-Dx	
Lube Oil Range Hydrocarbons	ND	25.0	"	"	"	"	"	"	
Surrogate: 2-FBP	*56.9 %*	*50-150*			"	"	"	"	
Surrogate: Octacosane	*86.0 %*	*50-150*			"	"	"	"	
252 B13 13.5-15 (B5A0646-06) Soil	**Sampled: 01/26/05 10:40**		**Received: 01/26/05 14:15**						
Diesel Range Hydrocarbons	ND	10.0	mg/kg dry	1	5A31060	01/31/05	02/01/05	NWTPH-Dx	
Lube Oil Range Hydrocarbons	ND	25.0	"	"	"	"	"	"	
Surrogate: 2-FBP	*57.0 %*	*50-150*			"	"	"	"	
Surrogate: Octacosane	*83.0 %*	*50-150*			"	"	"	"	
252 B13 27-28.5 (B5A0646-07) Soil	**Sampled: 01/26/05 10:40**		**Received: 01/26/05 14:15**						
Diesel Range Hydrocarbons	ND	10.0	mg/kg dry	1	5A31060	01/31/05	02/01/05	NWTPH-Dx	
Lube Oil Range Hydrocarbons	ND	25.0	"	"	"	"	"	"	
Surrogate: 2-FBP	*58.9 %*	*50-150*			"	"	"	"	
Surrogate: Octacosane	*78.5 %*	*50-150*			"	"	"	"	

North Creek Analytical - Bothell

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Jeff Gerdes

Jeff Gerdes, Project Manager

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Spokane 11922 E. 1st Avenue, Spokane Valley, WA 99206-5302
509.924.9200 fax 509.924.9290
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ENSR-Redmond	Project: UNOCAL #0138	
9521 Willows Road NE	Project Number: 06940-252	**Reported:**
Redmond, WA 98052	Project Manager: Art Cowburn	02/08/05 13:32

Volatile Organic Compounds by EPA Method 8260B
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
252 B11 19.5-21 (B5A0646-01) Soil	**Sampled: 01/24/05 16:45**		**Received: 01/26/05 14:15**						
Methyl tert-butyl ether	ND	0.0824	mg/kg dry	1	5B04023	02/04/05	02/05/05	EPA 8260B	
Surrogate: Toluene-d8	*98.1 %*	*70-130*			"	"	"	"	
Surrogate: 4-BFB	*91.0 %*	*70-130*			"	"	"	"	
252 B11 22.5-24 (B5A0646-02) Soil	**Sampled: 01/25/05 10:45**		**Received: 01/26/05 14:15**						
Methyl tert-butyl ether	ND	0.100	mg/kg dry	1	5B04023	02/04/05	02/05/05	EPA 8260B	
Surrogate: Toluene-d8	*101 %*	*70-130*			"	"	"	"	
Surrogate: 4-BFB	*91.9 %*	*70-130*			"	"	"	"	
252 B11 28.5-30 (B5A0646-03) Soil	**Sampled: 01/25/05 10:45**		**Received: 01/26/05 14:15**						
Methyl tert-butyl ether	ND	0.0746	mg/kg dry	1	5B04023	02/04/05	02/05/05	EPA 8260B	
Surrogate: Toluene-d8	*101 %*	*70-130*			"	"	"	"	
Surrogate: 4-BFB	*91.1 %*	*70-130*			"	"	"	"	
252 B12 6.0-7.5 (B5A0646-04) Soil	**Sampled: 01/25/05 12:15**		**Received: 01/26/05 14:15**						
Methyl tert-butyl ether	ND	0.0708	mg/kg dry	1	5B04023	02/04/05	02/05/05	EPA 8260B	
Surrogate: Toluene-d8	*100 %*	*70-130*			"	"	"	"	
Surrogate: 4-BFB	*92.2 %*	*70-130*			"	"	"	"	
252 B12 28.5-30 (B5A0646-05) Soil	**Sampled: 01/25/05 14:25**		**Received: 01/26/05 14:15**						
Methyl tert-butyl ether	ND	0.0775	mg/kg dry	1	5B04023	02/04/05	02/05/05	EPA 8260B	
Surrogate: Toluene-d8	*102 %*	*70-130*			"	"	"	"	
Surrogate: 4-BFB	*86.0 %*	*70-130*			"	"	"	"	
252 B13 13.5-15 (B5A0646-06) Soil	**Sampled: 01/26/05 10:40**		**Received: 01/26/05 14:15**						
Methyl tert-butyl ether	ND	0.0770	mg/kg dry	1	5B04023	02/04/05	02/05/05	EPA 8260B	
Surrogate: Toluene-d8	*98.7 %*	*70-130*			"	"	"	"	
Surrogate: 4-BFB	*87.1 %*	*70-130*			"	"	"	"	

North Creek Analytical - Bothell

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Seattle 11720 North Creek Pkwy N, Suite 400, Bothell, WA 98011-8244
425.420.9200 fax 425.420.9210
Spokane 11922 E. 1st Avenue, Spokane Valley, WA 99206-5302
509.924.9200 fax 509.924.9290
Portland 9405 SW Nimbus Avenue, Beaverton, OR 97008-7132
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541.383.9310 fax 541.382.7588
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907.563.9200 fax 907.563.9210

ENSR-Redmond	Project: UNOCAL #0138	
9521 Willows Road NE	Project Number: 06940-252	**Reported:**
Redmond, WA 98052	Project Manager: Art Cowburn	02/08/05 13:32

Volatile Organic Compounds by EPA Method 8260B
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
252 B13 27-28.5 (B5A0646-07) Soil Sampled: 01/26/05 10:40 Received: 01/26/05 14:15									
Methyl tert-butyl ether	ND	0.0751	mg/kg dry	1	5B04023	02/04/05	02/05/05	EPA 8260B	
Surrogate: Toluene-d8	*102 %*	*70-130*			"	"	"	"	
Surrogate: 4-BFB	*90.3 %*	*70-130*			"	"	"	"	

North Creek Analytical - Bothell

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907.563.9200 fax 907.563.9210

ENSR-Redmond	Project: UNOCAL #0138	
9521 Willows Road NE	Project Number: 06940-252	**Reported:**
Redmond, WA 98052	Project Manager: Art Cowburn	02/08/05 13:32

Physical Parameters by APHA/ASTM/EPA Methods
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
252 B11 19.5-21 (B5A0646-01) Soil	**Sampled: 01/24/05 16:45 Received: 01/26/05 14:15**								
Dry Weight	**88.7**	1.00	%	1	5A28061	01/28/05	01/29/05	BSOPSPL003R08	
252 B11 22.5-24 (B5A0646-02) Soil	**Sampled: 01/25/05 10:45 Received: 01/26/05 14:15**								
Dry Weight	**94.4**	1.00	%	1	5A28061	01/28/05	01/29/05	BSOPSPL003R08	
252 B11 28.5-30 (B5A0646-03) Soil	**Sampled: 01/25/05 10:45 Received: 01/26/05 14:15**								
Dry Weight	**81.6**	1.00	%	1	5A28061	01/28/05	01/29/05	BSOPSPL003R08	
252 B12 6.0-7.5 (B5A0646-04) Soil	**Sampled: 01/25/05 12:15 Received: 01/26/05 14:15**								
Dry Weight	**86.7**	1.00	%	1	5A28061	01/28/05	01/29/05	BSOPSPL003R08	
252 B12 28.5-30 (B5A0646-05) Soil	**Sampled: 01/25/05 14:25 Received: 01/26/05 14:15**								
Dry Weight	**85.8**	1.00	%	1	5A28061	01/28/05	01/29/05	BSOPSPL003R08	
252 B13 13.5-15 (B5A0646-06) Soil	**Sampled: 01/26/05 10:40 Received: 01/26/05 14:15**								
Dry Weight	**90.2**	1.00	%	1	5A28061	01/28/05	01/29/05	BSOPSPL003R08	
252 B13 27-28.5 (B5A0646-07) Soil	**Sampled: 01/26/05 10:40 Received: 01/26/05 14:15**								
Dry Weight	**90.4**	1.00	%	1	5A28061	01/28/05	01/29/05	BSOPSPL003R08	

North Creek Analytical - Bothell

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Spokane 11922 E. 1st Avenue, Spokane Valley, WA 99206-5302
509.924.9200 fax 509.924.9290
Portland 9405 SW Nimbus Avenue, Beaverton, OR 97008-7132
503.906.9200 fax 503.906.9210
Bend 20332 Empire Avenue, Suite F-1, Bend, OR 97701-5711
541.383.9310 fax 541.382.7588
Anchorage 2000 W International Airport Road, Suite A-10, Anchorage, AK 99502-1119
907.563.9200 fax 907.563.9210

ENSR-Redmond	Project: UNOCAL #0138	
9521 Willows Road NE	Project Number: 06940-252	**Reported:**
Redmond, WA 98052	Project Manager: Art Cowburn	02/08/05 13:32

Gasoline Hydrocarbons (Benzene to Naphthalene) and BTEX by NWTPH-G and EPA 8021B - Quality Control

North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 5B06008: Prepared 02/06/05 Using EPA 5030B (P/T)										
Blank (5B06008-BLK1)										
Gasoline Range Hydrocarbons	ND	5.00	mg/kg							
Benzene	ND	0.0300	"							
Toluene	ND	0.0500	"							
Ethylbenzene	ND	0.0500	"							
Xylenes (total)	ND	0.100	"							
Surrogate: 4-BFB (FID)	*2.76*		"	*3.00*		*92.0*	*50-150*			
Surrogate: 4-BFB (PID)	*2.89*		"	*3.00*		*96.3*	*53-142*			
LCS (5B06008-BS1)										
Gasoline Range Hydrocarbons	50.9	5.00	mg/kg	50.0		102	75-125			
Benzene	0.621	0.0300	"	0.728		85.3	75-125			
Toluene	3.30	0.0500	"	3.62		91.2	75-125			
Ethylbenzene	0.821	0.0500	"	0.855		96.0	75-125			
Xylenes (total)	4.02	0.100	"	4.15		96.9	75-125			
Surrogate: 4-BFB (FID)	*3.52*		"	*3.00*		*117*	*50-150*			
Surrogate: 4-BFB (PID)	*2.70*		"	*3.00*		*90.0*	*53-142*			
LCS Dup (5B06008-BSD1)										
Gasoline Range Hydrocarbons	50.9	5.00	mg/kg	50.0		102	75-125	0.00	25	
Benzene	0.625	0.0300	"	0.728		85.9	75-125	0.642	25	
Toluene	3.25	0.0500	"	3.62		89.8	75-125	1.53	25	
Ethylbenzene	0.798	0.0500	"	0.855		93.3	75-125	2.84	25	
Xylenes (total)	4.06	0.100	"	4.15		97.8	75-125	0.990	25	
Surrogate: 4-BFB (FID)	*3.48*		"	*3.00*		*116*	*50-150*			
Surrogate: 4-BFB (PID)	*2.76*		"	*3.00*		*92.0*	*53-142*			
Matrix Spike (5B06008-MS1)					**Source: B5A0646-01**					
Gasoline Range Hydrocarbons	45.4	4.12	mg/kg dry	46.4	0.676	96.4	42-125			
Benzene	0.585	0.0247	"	0.676	0.0348	81.4	45-125			
Toluene	3.18	0.0412	"	3.37	0.0117	94.0	55-125			
Ethylbenzene	0.789	0.0412	"	0.794	0.00446	98.8	53-132			
Xylenes (total)	3.88	0.0824	"	3.85	0.0165	100	59-125			
Surrogate: 4-BFB (FID)	*3.13*		"	*2.79*		*112*	*50-150*			
Surrogate: 4-BFB (PID)	*2.60*		"	*2.79*		*93.2*	*53-142*			

North Creek Analytical - Bothell

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Seattle 11720 North Creek Pkwy N, Suite 400, Bothell, WA 98011-8244
425.420.9200 fax 425.420.9210
Spokane 11922 E. 1st Avenue, Spokane Valley, WA 99206-5302
509.924.9200 fax 509.924.9290
Portland 9405 SW Nimbus Avenue, Beaverton, OR 97008-7132
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907.563.9200 fax 907.563.9210

ENSR-Redmond	Project: UNOCAL #0138	
9521 Willows Road NE	Project Number: 06940-252	**Reported:**
Redmond, WA 98052	Project Manager: Art Cowburn	02/08/05 13:32

Gasoline Hydrocarbons (Benzene to Naphthalene) and BTEX by NWTPH-G and EPA 8021B - Quality Control

North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 5B06008: Prepared 02/06/05 Using EPA 5030B (P/T)										
Matrix Spike Dup (5B06008-MSD1)					**Source: B5A0646-01**					
Gasoline Range Hydrocarbons	45.0	4.12	mg/kg dry	46.4	0.676	95.5	42-125	0.885	40	
Benzene	0.580	0.0247	"	0.676	0.0348	80.7	45-125	0.858	40	
Toluene	3.17	0.0412	"	3.37	0.0117	93.7	55-125	0.315	40	
Ethylbenzene	0.788	0.0412	"	0.794	0.00446	98.7	53-132	0.127	40	
Xylenes (total)	3.86	0.0824	"	3.85	0.0165	99.8	59-125	0.517	40	
Surrogate: 4-BFB (FID)	*3.10*		"	*2.79*		*111*	*50-150*			
Surrogate: 4-BFB (PID)	*2.58*		"	*2.79*		*92.5*	*53-142*			

North Creek Analytical - Bothell

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509.924.9200 fax 509.924.9290
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ENSR-Redmond	Project: UNOCAL #0138	
9521 Willows Road NE	Project Number: 06940-252	**Reported:**
Redmond, WA 98052	Project Manager: Art Cowburn	02/08/05 13:32

Semivolatile Petroleum Products by NWTPH-Dx with Acid/Silica Gel Clean-up - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 5A31060: Prepared 01/31/05 Using EPA 3550B										
Blank (5A31060-BLK1)										
Diesel Range Hydrocarbons	ND	10.0	mg/kg							
Lube Oil Range Hydrocarbons	ND	25.0	"							
Surrogate: 2-FBP	*3.76*		"	*6.67*		*56.4*	*50-150*			
Surrogate: Octacosane	*7.25*		"	*8.33*		*87.0*	*50-150*			
LCS (5A31060-BS1)										
Diesel Range Hydrocarbons	64.2	10.0	mg/kg	66.7		96.3	61-120			
Surrogate: 2-FBP	*4.73*		"	*6.67*		*70.9*	*50-150*			
LCS Dup (5A31060-BSD1)										
Diesel Range Hydrocarbons	65.1	10.0	mg/kg	66.7		97.6	61-120	1.39	40	
Surrogate: 2-FBP	*4.99*		"	*6.67*		*74.8*	*50-150*			
Duplicate (5A31060-DUP1)					**Source: B5A0646-01**					
Diesel Range Hydrocarbons	6.14	10.0	mg/kg dry		7.42			18.9	50	
Lube Oil Range Hydrocarbons	11.6	25.0	"		14.8			24.2	50	
Surrogate: 2-FBP	*4.44*		"	*7.52*		*59.0*	*50-150*			
Surrogate: Octacosane	*8.28*		"	*9.39*		*88.2*	*50-150*			

North Creek Analytical - Bothell

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425.420.9200 fax 425.420.9210
Spokane 11922 E. 1st Avenue, Spokane Valley, WA 99206-5302
509.924.9200 fax 509.924.9290
Portland 9405 SW Nimbus Avenue, Beaverton, OR 97008-7132
503.906.9200 fax 503.906.9210
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541.383.9310 fax 541.382.7588
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907.563.9200 fax 907.563.9210

ENSR-Redmond	Project: UNOCAL #0138	
9521 Willows Road NE	Project Number: 06940-252	**Reported:**
Redmond, WA 98052	Project Manager: Art Cowburn	02/08/05 13:32

Volatile Organic Compounds by EPA Method 8260B - Quality Control

North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 5B04023: Prepared 02/04/05 Using EPA 5030B (P/T)										
Blank (5B04023-BLK1)										
Methyl tert-butyl ether	ND	0.100	mg/kg							
Surrogate: Toluene-d8	*1.01*		"	*1.00*		*101*	*70-130*			
Surrogate: 4-BFB	*0.870*		"	*1.00*		*87.0*	*70-130*			
LCS (5B04023-BS1)										
Methyl tert-butyl ether	1.71	0.100	mg/kg	1.50		114	75-125			
Surrogate: Toluene-d8	*1.01*		"	*1.00*		*101*	*70-130*			
Surrogate: 4-BFB	*0.888*		"	*1.00*		*88.8*	*70-130*			
LCS Dup (5B04023-BSD1)										
Methyl tert-butyl ether	1.68	0.100	mg/kg	1.50		112	75-125	1.77	20	
Surrogate: Toluene-d8	*1.03*		"	*1.00*		*103*	*70-130*			
Surrogate: 4-BFB	*0.895*		"	*1.00*		*89.5*	*70-130*			
Matrix Spike (5B04023-MS1)					**Source: B5A0646-01**					
Methyl tert-butyl ether	1.95	0.100	mg/kg dry	1.69	ND	115	50-150			
Surrogate: Toluene-d8	*1.17*		"	*1.13*		*104*	*70-130*			
Surrogate: 4-BFB	*0.984*		"	*1.13*		*87.1*	*70-130*			
Matrix Spike Dup (5B04023-MSD1)					**Source: B5A0646-01**					
Methyl tert-butyl ether	2.04	0.100	mg/kg dry	1.69	ND	121	50-150	4.51	25	
Surrogate: Toluene-d8	*1.19*		"	*1.13*		*105*	*70-130*			
Surrogate: 4-BFB	*1.03*		"	*1.13*		*91.2*	*70-130*			

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ENSR-Redmond	Project: UNOCAL #0138	
9521 Willows Road NE	Project Number: 06940-252	**Reported:**
Redmond, WA 98052	Project Manager: Art Cowburn	02/08/05 13:32

Physical Parameters by APHA/ASTM/EPA Methods - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 5A28061: Prepared 01/28/05 Using General Preparation										
Blank (5A28061-BLK1)										
Dry Weight	99.9	1.00	%							

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425.420.9200 fax 425.420.9210
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509.924.9200 fax 509.924.9290
Portland 9405 SW Nimbus Avenue, Beaverton, OR 97008-7132
503.906.9200 fax 503.906.9210
Bend 20332 Empire Avenue, Suite F-1, Bend, OR 97701-5711
541.383.9310 fax 541.382.7588
Anchorage 2000 W International Airport Road, Suite A-10, Anchorage, AK 99502-1119
907.563.9200 fax 907.563.9210

ENSR-Redmond	Project: UNOCAL #0138	
9521 Willows Road NE	Project Number: 06940-252	**Reported:**
Redmond, WA 98052	Project Manager: Art Cowburn	02/08/05 13:32

Notes and Definitions

G-01	Results reported for the gas range are primarily due to overlap from diesel range hydrocarbons.
DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

North Creek Analytical - Bothell

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Revised Chain of Custody

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9405 SW Nimbus Ave • Beaverton, OR 97008-7184 • 503-906-9200 • Fax 906-9210
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UNOCAL CHAIN OF CUSTODY REPORT B5A0646

Chain of Custody Record #:

UNOCAL INFORMATION

Facility Number: 0138
Site Address: 101 NW Coveland St
City, State, ZIP: Coupeville WA
Site Release Number:
Unocal Manager:
CERT INFO: (check one)

Name: ENSR International
Address: 9521 Willows Rd
Redmond WA 98052
Phone: 425 881 7700 Fax:
Project No.: Art Coulburn
Project Manager: 06940-252
Samples collected by: L Arneson

Name:
Address:
Phone:
Fax:
P.O. No.:

Quality Assurance Data Level: A [X] B
A: Standard Summary
B: Standard + Chromatograms

Laboratory Turnaround Days: [X] 5 3 2 1

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SAMPLE IDENTIFICATION	SAMPLING DATE / TIME	MATRIX (W, S, O)	NUMBER OF CONTAINERS	TPH-HCID	TPH-Gas	BTEX Only EPA 8021 Mod.	TPH-Gas + BTEX	TPH-Diesel	TPH-Diesel Extended	TPH-Diesel-Ext. w/SG cleanup	Halogen. Volatiles EPA 8260	Pesticides/PCBs or PCBs only	GC/MS Volatiles EPA 8260	GC/MS Semivols. EPA 8270	PAHs: 8270 SIM or 8310	Lead: Total or Dissolved	TCLP or RCRA Metals (8)	MTBE						NCA SAMPLE NUMBER
1. 252 B11 19.5-21 (7.5-9)	11/24/05 16:45	S	2				X			X								X						B5A0646-01
2. 252 B11 22.5-24	11/25/05 10:45	S	2				X			X								X						-02
3. 252 B11 28.5-30	11/25/05 10:46	S	2				X			X								X						-03
4. 252 B12 6.0-7.5	11/25/05 12:15	S	2				X			X								X						-04
5. 252 B12 28.5-30	11/25/05 14:25	S	2				X			X								X						-05
6. 252 B13 13.5-15	11/26/05 10:40	S	2				X			X								X						-06
7. 252 B13 27-28.5	11/26/05 10:40	S	2				X			X								X						-07
8. 252 B11 7.5-9 (PTY)	11/24/05 12:50	S	1																					-08
9. 252 B11 21-22.5	11/24/05 12:50	S	1			Grain Size Distribution																		-09
10. 252 B11 21-22.5	1/24/05 12:50	S	2																					-10

Relinquished by	Firm	Date/Time	Received by	Firm	Date/Time
1. Laura Arneson	ENSR	1/26/05 2:15	Tom Blum	NCA	1/26/05 14:15
2.					
3.					

Page ____ of ____

Comments:

Additional Comments:
3.5 w/10 TB — 1/24/05 12:50 -11
(PTY)

Page ____ of ____

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11720 North Creek Parkway N #400 • Bothell, WA 98011-8244 • 425-420-9200 • Fax 920-9210
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UNOCAL CHAIN OF CUSTODY REPORT B5A0646

Chain of Custody Record #:

UNOCAL INFORMATION

Facility Number: 0138
Site Address: 101 NW Coveland St
City, State, ZIP: Coupeville WA
Site Release Number:
Unocal Manager:
CERT INFO: (check one)

Name: ENSR International
Address: 9521 Willows Rd
Redmond WA 98052
Phone: 425 881 7700 Fax:
Project No.: Art Cowburn
Project Manager: 06940-252
Samples collected by: L Arneson

Name:
Address:
Phone:
Fax:
P.O. No.:

Quality Assurance Data Level: [A] [X]
A: Standard Summary
B: Standard + Chromatograms

Laboratory Turnaround Days: [5] [5] [3] [2] [1]

☐ AK ☐ OR ☐ WA ☒ NW Series

SAMPLE IDENTIFICATION	SAMPLING DATE / TIME	MATRIX (W, S, O)	NUMBER OF CONTAINERS	TPH-HCID	TPH-Gas	BTEX Only EPA 8021 Mod.	TPH-Gas + BTEX	TPH-Diesel	TPH-Diesel Extended	TPH-Diesel-Ext. w/SG cleanup	Halogen. Volatiles EPA 8260	Pesticides/PCBs or PCBs only	GC/MS Volatiles EPA 8260	GC/MS Semivols. EPA 8270	PAHs: 8270 SIM or 8310	Lead: Total or Dissolved	TCLP or RCRA Metals (8)	MTBE						NCA SAMPLE NUMBER
1. 252 B11 7.5-9	1124105 1500	S	2				X			X								X						B5A0646-01
2. 252 B11 22.5-24	1125105 1045	S	2				X			X								X						-02
3. 252 B11 28.5-30	1/25105 1045	S	2				X			X								X						-03
4. 252 B12 6.0-7.5	1125105	S	2				X			X								X						-04
5. 252 B12 28.5-30	1/25/05	S	2				X			X								X						-05
6. 252 B13 13.5-15	1126105 10:40	S	2				X			X								X						-06
7. 252 B13 27-28.5	1/26/05 1040	S	2				X			X								X						-07
8. 252 B11 7.5-9	1124105	S	1																					-08
9. 252 B11 21-22.5	1124105	S	1			Grain Size Distribution																		-09
10. 252 B11 21-22		S	2																					-10

Relinquished by	Firm	Date/Time	Received by	Firm	Date/Time
1. Laura Arneson	ENSR	1/26/05 215	Tom Blanchard	NCA	1/26/05 1415
2.					
3.					

Page ____ of ____

Comments:

Additional Comments:
3.5² w/o

Page ____ of ____

APPENDIX C

ENSR SOP 7116

ENSR INTERNATIONAL

SOP NUMBER: 7116

Subsurface Soil Sampling by Geoprobe™ Methods

Date:	2nd Qtr. 1995
Revision Number:	0
Author:	Charles Martin
Discipline:	Geosciences

1.0 INTRODUCTION

1.1 Purpose and Applicability

This Standard Operating Procedure (SOP) describes the methods available for collecting subsurface soil samples using commercially available Geoprobe™ Systems (or other similar vendor) soil probing equipment. Subsurface soil samples may be obtained using this system for purposes of determining subsurface soil conditions and for obtaining soil samples for physical and/or chemical evaluation.

The purpose of this SOP is to provide a description of a specific method or procedure to be used in the collection of subsurface soil samples using the Geoprobe™ system. Subsurface soil is defined as unconsolidated material which may consist of one or a mixture of the following materials: sand, gravel, silt, clay, peat (or other organic soils), and fill material. Subsurface soil sampling, conducted in accordance with this SOP will promote consistency in sampling and provide a basis for sample representativeness.

This SOP covers subsurface soil sampling using Geoprobe™ Systems equipment; specifically, the Macro-Core Soil Sampler, and the Large Bore Sampler. Use of this sampling equipment requires use of the Geoprobe™ hydraulically-powered percussion/probing machine. Geoprobe™ sampling is usually performed by subcontractors, although rental equipment is available for use by trained operators.

The Geoprobe™ sampling methods covered in this SOP are applicable to unconsolidated soil/fill materials and to a maximum recommended depth of approximately 30 feet. Sampling depths are greatly dependent upon soil density as the hydraulically-powered probing unit has power limitations. Sample recovery is also somewhat dependent on grain size as very coarse gravel, cobbles, and boulders will occasionally cause premature refusal of the sampler. It is generally preferable to have some prior knowledge of site soil conditions if sampling activities are proposed where equipment limitations may become a factor.

Other types of equipment and sampling methods are available for use in obtaining samples of unconsolidated materials; and include split-spoons, Shelby tubes, and

continuous core barrel samplers. Information on these and other soil sampling devices may be found in other ENSR SOPs, ASTM procedures, drilling handbooks, and respective state and/or federal agency technical guidance documents.

1.2 General Principles

Soil sampling using the Geoprobe™ System requires use of the hydraulically-powered percussion/probing machine and either the Macro-Core Soil Sampler or the Large Bore Sampler soil sampling devices. The percussion/probing machine is typically mounted onto the bed of a pickup truck or van so that a stable working platform is established. The percussion/probing machine, through its hydraulic operation, pushes and hammers the soil sampling equipment vertically into the ground within the targeted sampling interval. The soil sampler is then extracted from the ground to recover the sample.

The Macro-Core Sampler (Figure 1) consists of a 45-inch long by 1.5-inch diameter open-ended steel sampling tool with liners made of clear plastic (cellulose acetate butyrate), stainless steel, or teflon. The tool is designed for use in a continuous sampling capacity in an open borehole up to depths of approximately 24 feet. The borehole walls are required to stay open in order to collect a sample from the next depth interval. Once the sampling tool is removed from the ground, the inserted liner containing the soil sample is removed from the tool. The soil sample is then cut from or extracted from the liner. This sampling tool is most often used for soil profiling and collection of larger volume soil samples (1,300 ml).

The Large Bore Sampler (Figure 2) consists of a 22-inch long by a slightly over 1-inch diameter steel sampling tool and may be used for sampling to depths of approximately 30 feet. Various liner types are available for use with this sampler, and include: plastic, brass, stainless steel, and teflon. The metal liners are available in segmented 6-inch lengths. The sampler is designed for discrete interval sampling and is not affected significantly by borehole wall collapse. This sampler is similar to a piston sampler where a retractable drive (piston) point is withdrawn when the targeted sampling interval is achieved and the soil sample enters the sampler. Once the sampler is removed from the ground, the inserted liner containing the soil sample is extracted from the sampler and the soil sample is then cut from or extracted from the liner. The segmented liner materials and discrete interval sampling capability gives this device greater suitability for collection of smaller volume soil samples (320 ml).

1.3 Quality Assurance Planning Considerations

Sampling personnel should follow specific quality assurance guidelines as outlined in the site-specific Quality Assurance Project Plan (QAPP). Proper quality assurance requirements should be provided which will allow for collection of representative samples from representative sampling points. Quality assurance requirements outlined in the QAPP typically suggest the collection of a sufficient quantity of field duplicate, field blank, and other samples.

1.4 Health and Safety Considerations

The health and safety considerations for the site, including both potential physical and chemical hazards, will be addressed in the site-specific Health and Safety Plan (HASP). All field activities will be conducted in conformance to this HASP. In the absence of a site-specific HASP, work will be conducted according to the ENSR Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.

2.0 RESPONSIBILITIES

2.1 Project Geologist/Engineer

It will be the responsibility of the project geologist/sampling engineer to conduct subsurface soil sampling in a manner which is consistent with this SOP. The project geologist/sampling engineer will observe all activities pertaining to subsurface soil sampling to ensure that the SOP is followed, and to record all pertinent data onto a boring log. It is also the project geologist/sampling engineer's responsibility to indicate the specific targeted sampling depth or sampling interval to the drilling subcontractor. The project geologist/sampling engineer is also responsible for the collection of representative environmental or stratigraphic characterization samples once the sampling device has been retrieved and opened. Additional sample collection responsibilities include labeling, handling, and storage of samples until further chain-of-custody procedures are implemented.

2.2 Drilling Subcontractor

It will be the responsibility of the drilling subcontractor to provide the necessary Geoprobe™ equipment for obtaining subsurface soil samples. This generally includes the truck or ATV-mounted percussion/probing machine and one or more Macro-Core and Large Bore samplers in good operating condition, appropriate liners, and other necessary equipment for borehole preparation and sampling. It is the drilling subcontractor's responsibility to provide and maintain their own boring logs if

desired. Equipment decontamination materials should also be provided by the subcontractor and should meet project specifications.

3.0 REQUIRED MATERIALS

In addition to those materials provided by the subcontractor, the project geologist/sampling engineer will require:

- Project Sampling Plan, QAPP, and HASP
- Boring Logs
- Teaspoon or spatula
- Sample kit (bottles, labels, custody records and tape, cooler)
- Sample collection pan
- Folding rule or tape measure
- Utility knife
- Equipment decontamination materials (as required by QAPP)
- Health and safety equipment (as required by HASP)
- Field project notebook/pen

Sampling equipment which comes in direct contact with environmental samples during the sample collection process should be constructed of stainless steel, teflon, or glass, unless specified otherwise in the Project Sampling Plan or QAPP.

4.0 METHOD

4.1 General Method Description

Geoprobe™ soil sampling methods generally involve collection of soil samples by driving the sampling tool directly into the ground using the percussion/probing machine and without the aid of hollow-stem augers or other casing-installed drilling methods. Both the Macro-Core and Large Bore soil samplers consist of metal tubes of seamless construction which can not be split apart like split-spoons. Liner/sleeve inserts are required in order to extract an intact soil core/sample from the sampling device.

Both sampling devices operate by being directly pushed/hammered into the ground by the percussion/probing machine. The borehole is created as the sampling device is advanced downward. The Macro-Core Sampler collects samples continuously and requires that an open borehole be maintained for efficient sample recovery. The Large Bore Sampler contains a piston tip/drive point which allows for advancing the sampler to a designated depth for discrete interval sampling. The piston tip is retracted when the desired sampling interval is reached.

When the soil sampling device is retrieved from the borehole, the drive head, cutting shoe and/or piston assembly is removed, and the liner insert with sample is removed from the sampling device. The project geologist/sampling engineer is then given access to the sample for whatever purpose is required.

Table 1 summarizes the construction characteristics and sampling attributes of each type of sampler. The appropriate type of sampler should be selected based on project-specific sampling requirements.

4.2 Equipment Decontamination

Each sampling device must be decontaminated prior to its initial use and following collection of each soil sample, especially if sampling for analytical testing purposes is conducted. If sampling for soil logging only is conducted, thorough sampler decontamination between samples may not be necessary although sufficient cleansing is necessary for the sampler to operate properly. Site-specific requirements for equipment decontamination should be outlined in the Project Sampling Plan. Equipment decontamination procedures are also outlined within SOP 7600 - Decontamination of Equipment.

4.3 Sampling Procedures - Macro-Core Sampler

(Note: These procedures are excerpted from Geoprobe™ Systems literature. This SOP assumes that the subcontractor will perform sampling; therefore, detailed procedures regarding sample aquisition are not provided.)

4.3.1 Sampler Preparation

- Decontaminate the sampler parts (cutting shoe, sample tube, liners) before assembly.
- Assemble the sampler by first placing the liner over the inside end of the cutting shoe, then inserting the liner/shoe assembly into the sample tube, and then finally threading the cutting shoe into the sample tube. Tighten the cutting shoe with the shoe wrench.
- Thread the sampler onto the drive head.

4.3.2 Sampling

- Using the percussion/probing machine, drive the sampler into the ground until the drive head reaches the ground surface.
- For deeper samples, the borehole walls must remain stable. The cutting shoe is designed with a tapered surface to limit sidewall scraping. Add additional probe rods until the sampler reaches the

targeted sample interval, then drive the sampler through the desired sample interval.

- Use the machine hydraulics to pull the sampler from the borehole.

4.3.3 Sample Recovery

- Once the sampler has been removed from the borehole, the sampler must be unthreaded from the drive head, the cutting shoe unthreaded from the sampler, and the liner/shoe assembly removed from the sample tube.

- Disconnect the cutting shoe from the liner which contains the soil sample. The recovered soil sample may now be viewed, logged, and extracted from the liner for analysis (refer to Section 4.5 for sample containment procedures).

4.4 Sampling Procedures - Large Bore Sampler

(Note: These procedures are excerpted from Geoprobe™ Systems literature. This SOP assumes that the subcontractor will perform sampling; therefore, detailed procedures regarding sample aquisition are not provided. Additional detailed sampling procedures for this specific item of equipment is presented in Geoprobe™ Technical Bulletin No.93-660, appended to this SOP.)

4.4.1 Sampler Preparation

- Decontaminate the sampler parts (cutting shoe, piston rod/tip, sample tube, liners) before assembly.

- Assemble the sampler by first placing the liner on the cutting shoe, then threading the liner/shoe assembly into the sample tube, then connecting the piston tip to the piston rod, and then finally inserting the piston tip/rod assembly into the sample tube. Tighten the cutting shoe with the shoe wrench.

- Thread the sampler onto the drive head. Thread the stop-pin onto the drive head (stop-pin holds the piston tip/rod in place while driving the sampler to the desired sample interval).

4.4.2 Sampling

- Using the percussion/probing machine, drive the sampler into the ground until the upper portion of the targeted sampling interval is achieved.

- Unthread and remove the stop-pin from the drive head using extension rods. This will activate the piston tip/rod.

- Drive the sampler through the targeted sampling interval to collect the sample. The piston tip/rod will retract as the sample enters the sample tube.

- Use the machine hydraulics to pull the sampler from the ground.

4.4.3 Sample Recovery

- Once the sampler has been removed from the ground, the sampler must be unthreaded from the drive head, then the cutting shoe unthreaded from the sample tube, and the liner/shoe assembly removed from the sample tube.

- Disconnect the cutting shoe from the liner which contains the soil sample. The recovered soil sample may now be viewed, logged, and extracted from the liner for analysis (refer to Section 4.5 for sample containment procedures).

4.5 Sample Containment

4.5.1 General

- The soil sample can be removed from the liner following viewing and/or logging. Non-segmented plastic or teflon liners should be cut with a utility knife into approximate 6-inch lengths to facilitate sample extraction or to isolate specific sample zones targeted for analysis. Segmented metal liners can be manually separated.

- Once the liner has been separated, the soil sample may be extracted from the individual liner segments with a spoon or spatula. Except for volatile organic samples (see below), the soil sample should be placed into a sample collection pan and homogenized. Place the sample directly into the required sample container.

- Once filled, the sample container should be properly capped, cleaned and labeled. Sample chain-of-custody and preservation procedures should then be initiated.

- Perform equipment decontamination following containment of the sample.

4.5.2 Volatile Organic Samples

- Use of teflon liners is preferred when sampling for analysis of volatile organic compounds (VOC) because these liners are more inert. In order to limit the potential for loss of volatiles, the soil sample should be removed from the liner as soon as possible after sample recovery. VOC soil samples should be selected from a central point within the liner unless another specific sample zone has been targeted. The liner should be cut with a knife and the sample immediately extracted

and containerized. Clean and label the container and place it into a cooler immediately. Residual sample may then be used to fill other sample or logging requirements.

5.0 QUALITY CONTROL

Quality control requirements are dependent on project-specific sampling objectives. The QAPP will provide requirements for equipment decontamination (frequency and materials), sample preservation and holding times, sample container types, sample packaging and shipment, as well as requirements for the collection of various quality assurance samples such as trip blanks, field blanks, equipment blanks, and field duplicate samples.

6.0 DOCUMENTATION

Various forms are required to ensure that adequate documentation is made of sample collection activities. These forms include:

- Boring logs
- Field log books
- Sample collection records
- Chain-of-custody records
- Shipping labels

Boring logs (Figure 3) will provide visual and descriptive information for each sample collected and are often the most critical form of documentation generated during a soil sampling program. The field log book is kept as a general log of activities and should not be used in place of the boring log. Occasionally, sample collection records are used to supplement boring logs, especially for environmental samples which have been collected for laboratory analysis. Chain-of-custody forms are transmitted with the samples to the laboratory for sample tracking purposes. Shipping labels are required if sample coolers are to be transported to the laboratory by a third party (courier service). Original copies of these records should be maintained in the appropriate project files.

7.0 REFERENCES

Geoprobe™ Systems, August 1993, "1993-94 Equipment and Tools Catalog".

TABLE 1
Geoprobe Systems Soil Sampler Characteristics

Sampler Type	Length (in.)	Diameter (in.)	Volume (ml)	Sleeve Liner Type	Suitability[1]			
					Soil Logging	Physical Testing	Chemical-Inorganics	Chemical-Organics
Macro-Core	45	1.5	1,300	Acetate	A	A	A	B
				Stainless Steel	B	A	B	A
				Teflon	A	A	A	A
Large Bore	22	1.06	320	Acetate	A	A	A	B
				Brass	B	A	B	B
				Stainless Steel	B	A	B	A
				Teflon	A	A	A	A

[1] **A - Preferred suitability**
B - Acceptable suitability

Figure 1 – Soil Sampling Tools – Macro-Core Sampler - Parts

SOIL SAMPLING TOOLS - Macro-Core Sampler - Parts

Macro-Core Sampler

AT-720 Series

The sampler features a nickel-plated sample tube that is 48" long x 2.0" in diameter, a hardened tool steel cutting shoe that has a 1.5" diameter opening, and a tapered drive head that fits standard Geoprobe probe rods. The overall length assembled is 51.25". Sample recovery is 45" long x 1.50" diameter (1302 ml) in a PETG liner.

PARTS	
AT-720	MC Cutting Shoe
AT-721	MC Drive Head
AT-722	MC Sample Tube
AT-725	MC PETG (clear plastic) Liner
AT-726	MC Vinyl End Cap
AT-727	MC Shoe Wrench

KITS
Assembled Macro-Core Sampler*
Part No. AT-720K
Includes the following parts:
(1) **AT-720** MC Cutting Shoe
(1) **AT-721** MC Drive Head
(1) **AT-722** MC Sample Tube
*kit does not include liners and end caps

LINERS	
AT-725K	MC PETG Liners (pre-flared, clear plastic) Box of 66 only
AT-726K	MC Vinyl End Caps (fit AT-725 liners) Box of 66 pairs (66 red/66 black)

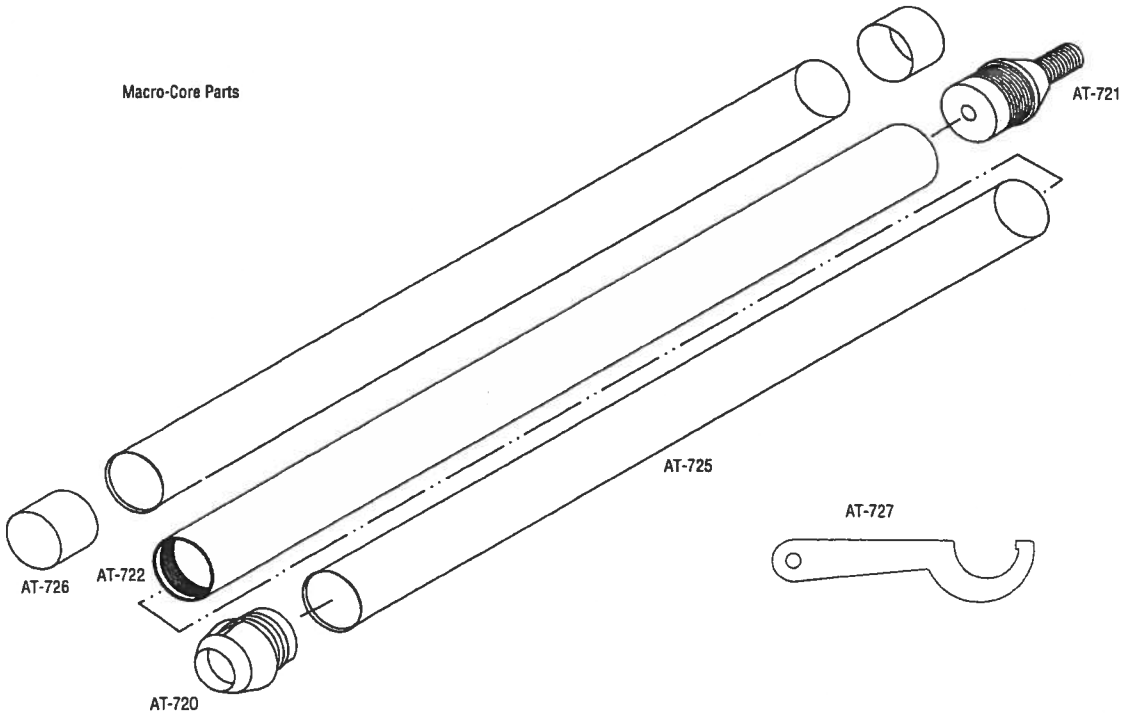


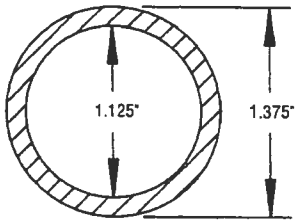
Figure 2 – Soil Sampling Tools – Probe Drive System/Large Bore

SOIL SAMPLING TOOLS - Probe Drive System/Large Bore

Large Bore Sampler

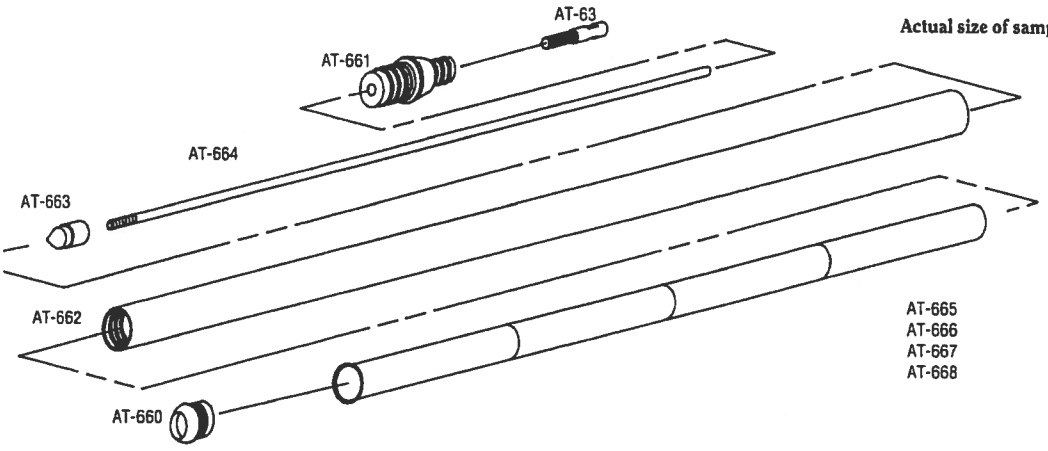
AT-660 Series

Features nickel plated sample tube, replaceable hardened tool steel cutting shoe and removable liner. Recovers core approximately 22" long x 1-1/16" diameter (320 ml). Uses STD Piston Stop-Pin. Recommended for sampling depths up to 30 feet. Liners available in brass, stainless steel, PTFE (Teflon), or PETG (clear plastic).



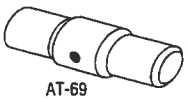
Actual size of sample tube

Large Bore Sampler Parts:



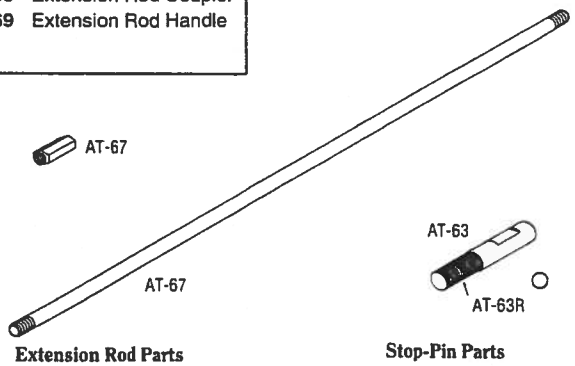
PARTS

Large Bore Sampler Parts		Liners		Also required:	
AT-660	LB Cutting Shoe	**AT-665**	LB PETG Liner	**AT-63**	STD Stop-Pin
AT-661	LB Drive Head	**AT-666**	LB Brass Liner	**AT-63R**	Stop-Pin O-rings
AT-662	LB Sample Tube	**AT-667**	LB Stainless Liner	**AT-67**	Extension Rod
AT-663	LB Piston Tip	**AT-668**	LB PTFE Liner	**AT-68**	Extension Rod Coupler
AT-664	LB Piston Rod			**AT-69**	Extension Rod Handle
AT-669	LB Shoe Wrench				



PARTS

Parts used with all Probe-Drive Samplers	
AT-63	STD Stop-Pin
AT-63R	Stop-Pin O-rings
AT-67	Extension Rod
AT-68	Extension Rod Coupler
AT-69	Extension Rod Handle



Extension Rod Parts

Stop-Pin Parts

Geoprobe Systems

Figure 3 – Boring Log

ENSR

BORING LOG

Sheet 1 of

Project No. _____ Date - Start _____ Finish _____ Boring _____

Project Name _____ Drilling Co. _____

Location _____ Drilling Method _____

Total Depth _____ Inspector _____ Reviewer _____

Remarks _____

Depth Feet	Sample				Graphic Log	Lithologic Description	Equipment Installed
	Type & No.	Blows per 6 In.	Depth Range	Rec.			

APPENDIX D

ENSR SOP 7115

SOP NUMBER: 7115

Subsurface Soil Sampling by Split Spoon

Date:	3rd Qtr. 1994
Revision Number:	3
Author:	Charles Martin
Discipline:	Geosciences

1.0 PURPOSE AND APPLICABILITY

1.1 Purpose and Applicability

This Standard Operating Procedure (SOP) describes the methods used in obtaining subsurface soil samples for physical and/or chemical analysis. Subsurface soil samples are obtained in conjunction with soil boring programs and provide information as to the physical and/or chemical makeup of the subsurface environment.

The purpose of this SOP is to provide a description of a specific method or procedure to be used in the collection of subsurface soil samples. Subsurface soil is defined as unconsolidated material which may consist of one or a mixture of the following materials: sand, gravel, silt, clay, peat (or other organic soils), and fill material. Subsurface soil sampling, conducted in accordance with this SOP will promote consistency in sampling and provide a basis for sample representativeness.

This SOP covers subsurface soil sampling by split-spoon only, as this is the means most often used for obtained samples of unconsolidated deposits. Other types of equipment are available for use in subsurface soil sampling, including thin-wall tube samplers (Shelby tubes), piston samplers, and continuous core barrel samplers. Information on the use of these other sampling devices may be found in several available drilling handbooks and respective state and/or federal agency technical guidance documents. The American Society for Testing and Materials (ASTM) also provides procedures for use of split-spoon and other sampling devices.

Deviations from this SOP to accommodate other regulatory requirements should be reviewed in advance of the field program, should be explained in the project work plan, and must be documented in the field project notebook when they occur.

1.2 General Principles

Split-spoon subsurface soil sampling generally requires use of a drilling rig and typically the hollow-stem auger or other common drilling method to generate a borehole in which to use the split-spoon sampler. The split-spoon sampler is

inserted through the augers (or other type of drill casing) then is driven into the subsurface soil with a weighted hammer. The sampler is then retrieved and opened to reveal the recovered soil sample. Soil samples may be collected at a continuous interval or at pre-selected vertically spaced intervals within the borehole.

1.3 Quality Assurance Planning Considerations

Sampling personnel should follow specific quality assurance guidelines as outlined in the site-specific Quality Assurance Project Plan (QAPP). Proper quality assurance requirements should be provided which will allow for collection of representative samples from representative sampling points. Quality assurance requirements outlined in the QAPP typically suggest the collection of a sufficient quantity of field duplicate, field blank, and other samples.

1.4 Health and Safety Considerations

Subsurface soil sampling may involve chemical hazards associated with the types of contaminants potentially encountered and will always involve potential physical hazards associated with use of drilling equipment. When sampling is performed in materials which may contain hazardous constituents, or when the quality assurance objectives of the project require the use of hazardous solvents, adequate Health and Safety measures must be taken to protect sampling personnel. These measures must be addressed in the project Health and Safety Plan (HASP). This plan must be approved by the project Health and Safety Officer before work commences, must be distributed to all personnel performing sampling, and must be adhered to as field activities are performed.

2.0 RESPONSIBILITIES

2.1 Drilling Subcontractor

It will be the responsibility of the drilling subcontractor to provide the necessary materials for obtaining subsurface soil samples. This generally includes one or more split-spoon samplers in good operating condition and sample containers used for stratigraphic characterization samples (sample containers for environmental samples should be provided by the designated analytical laboratory). It is the drilling subcontractor's responsibility to provide and maintain their own boring logs if desired. Equipment decontamination materials should also be supplied by the subcontractor and should meet project specifications.

2.2 Project Geologist/Sampling Engineer

It will be the responsibility of the project geologist/sampling engineer to conduct subsurface soil sampling in a manner which is consistent with this SOP. The project geologist/sampling engineer will observe all activities pertaining to subsurface soil sampling to ensure that the SOP is followed, and to record all pertinent data onto a boring log. It is also the project geologist/sampling engineer's responsibility to indicate the specific targeted sampling depth or sampling interval to the drilling subcontractor. The project geologist/sampling engineer is also responsible for the collection of representative environmental or stratigraphic characterization samples once the sampling device has been retrieved and opened. Additional sample collection responsibilities include labeling, handling, and storage of samples until further chain-of-custody procedures are implemented.

3.0 REQUIRED MATERIALS

In addition to those materials provided by the subcontractor, the project geologist/sampling engineer will require:

- Project Sampling Plan, QAPP, and HASP
- Boring logs
- Teaspoon or spatula (stainless steel is recommended)
- Sample kit (bottles, labels, custody records and tape, cooler)
- Sample collection pen
- Folding rule or tape measure
- Equipment decontamination materials
- Health and safety equipment (as required by HASP)
- Field project notebook/pen

4.0 METHOD

4.1 General Method Description

Split-spoon sampling devices are typically constructed of steel and are most commonly available in lengths of 18 and 24 inches and diameters of 1.5 to 3 inches. The split-spoon consists of a tubular body with two halves that split apart lengthwise, a drive head on the upper end with a ball-check valve for venting, and a hardened steel cutting shoe at the bottom. The soil sample enters the split-spoon through the cutting shoe as the device is driven into the ground. A replaceable plastic or metal basket is often inserted into the shoe to assist with retaining samples. Once the

sampler is retrieved, the drive head and cutting shoes are removed and the split-spoon halves are then separated, revealing the sample.

Sample depth intervals are usually defined on a project-specific basis with these requirements specified in the project sampling plan. Sampling intervals typically range from one (1) sample per five (5) feet of drilling to continuous sampling where the entire drilled interval is sampled.

Subsurface soil sampling is usually accomplished as part of a drilling program where a soil boring is advanced with drilling equipment to the designated depth prior to collection of a representative sample. The general procedures outlined briefly in the following section provide requirements for advancing drill casing/augers in preparation for sampling.

4.2 General Procedures - Borehole Preparation

4.2.1 Advancing Casing/Augers

Soil borings that are completed for soil sampling purposes are typically advanced using hollow-stem augers and sometimes drive-and-wash or other casing methods. The casing/augers must be of sufficient diameter to allow for soil sampling at a minimum. The casing/augers will be advanced according to project requirements to the required depth for sampling. If hollow-stem augers are used, a temporary plug shall be used in the lead auger to prevent the auger from becoming filled with drill cuttings while drilling is in progress.

4.2.2 Obstructions

For those borings which encounter obstructions, the casing/augers will be advanced past or through the obstruction if possible. Caution should be exercised when obstructions are encountered and an effort made to identify the obstruction before drilling is continued. If the obstruction is not easily drilled through or removed, the boring should be relocated to an adjacent location.

4.2.3 Use of Added Water

The use of added or recirculated water during drilling is permitted when necessary. Use of extraneous water should be minimized or avoided if possible as it may impact sample quality. Water usage should be documented in the field notebook. Sampling and analysis of added or

recirculated water may be required for quality assurance purposes (refer to QAPP). If a well is installed within the completed borehole, removal of the added water may be required.

4.3 Sampling Procedure

4.3.1 Equipment Decontamination

Each split-spoon must be decontaminated prior to its initial use and following collection of each soil sample. Site-specific requirements for equipment decontamination should be outlined within the Project Sampling Plan. Equipment decontamination procedures are also outlined within SOP 7600 - Decontamination of Equipment.

4.3.2 Standard Penetration Test

The drilling subcontractor will lower the split-spoon into the borehole. Samples are generally obtained using the Standard Penetration Test (SPT) in accordance with ASTM standards (ASTM D 1586-84). Following this method, the sampler will be driven using the 140-pound hammer with a vertical free drop of 30 inches using two turns of the rope on the cathead. The number of hammer blows required for every 6 inches of penetration will be recorded on the boring log. Blowcount information is used as an indicator of soil density for geotechnical as well as stratigraphic logging purposes. Once the split-spoon has been driven to its fullest extent, or to refusal, it will be removed from the borehole.

4.3.3 Sample Recovery

The split-spoon will be immediately opened upon removal from the casing/auger. The open sampler shall then be screened for volatile organics with a photoionization device (PID) if required by the Project Sampling Plan. If the Sampling Plan also requires individual soil sample headspace screening for volatile organic compounds, then a small portion of the split-spoon sample shall be removed and properly contained for that purpose.

Sample recovery will be determined by the project geologist/sampling engineer who will examine the soil core once the sampler is opened. The length of sample shall then be measured with a folding rule or tape measure. Any portion of the split-spoon contents which are not considered part of the true sample (i.e., heaved soils) will be discarded. If the sample recovery is considered inadequate for sample characterization or analytical testing

purposes, another sample should be collected from the next vertical interval if possible before drilling is reinitiated.

Adequate sample recovery for stratigraphic logging purposes and/or headspace organic vapor testing purposes should be approximately 6 inches. Adequate sample recovery for analytical testing purposes should be a minimum of 12 inches and is somewhat dependent on the type of analytical testing required. In some cases, continuous sampling over a short interval, and compositing of the sample, may be required to satisfy analytical testing requirements. Larger diameter samplers may be used if large volumes of soil are required for analytical testing.

4.3.4 Sample Containment - General

Once retrieved, the sample will be removed from the split-spoon with a teaspoon or spatula and placed into the appropriate sample container. The sample will be split if necessary to meet sampling program requirements. Sample splitting may be necessary to provide individual samples for headspace testing, visual characterization, physical testing, analytical testing, or simply for archiving purposes. In general, most sampling programs are structured around environmental characterization needs; therefore, sample portions required for analytical testing should be collected first. The Project Sampling Plan and QAPP provides specific sample container requirements for each type of sample and should be referred to for guidance.

Once filled, the sample containers should be properly capped, cleaned, and labeled, and chain-of-custody and sample preservation procedures initiated. Sampling equipment should then be properly decontaminated.

4.3.5 Sample Containment - Volatile Organic Analyses

Collection of subsurface soil samples for volatile organic analysis (VOA) is slightly more complex than collection of samples for other routine chemical or physical testing primarily because of the concern for the potential loss of volatiles during the sample collection procedure. To limit the potential for loss of volatiles, the soil sample needs to be obtained as quickly and as directly as possible from the split-spoon. This generally means that the VOA sample is to be collected and placed into the appropriate sample container first. The VOA sample should also be obtained from a discrete portion of the entire sample interval and not composited or homogenized. The remainder of the recovered sample can then be composited, homogenized or split to meet the other testing requirements. The boring log and/or sample logbook should be

filled out to indicate actual sample collection depths for both VOA samples and other portions of the sample which may have been composited over a larger vertical interval.

5.0 QUALITY CONTROL

Quality control requirements are dependent on project-specific sampling objectives. The QAPP will provide requirements for sample preservation and holding times, sample container types, sample packaging and shipment, as well as requirements for the collection of various quality assurance samples such as trip blanks, field blanks, equipment blanks, and field duplicate samples.

6.0 DOCUMENTATION

Various forms are required to ensure that adequate documentation is made of sample collection activities. These forms include:

- Boring logs
- Field log books
- Sample collection records
- Chain-of-custody records
- Shipping labels

Boring logs (Figure 1) will provide visual and descriptive information for each sample collected and are often the most critical form of documentation generated during a sampling program. The field log book is kept as a general log of activities. Chain-of-custody forms are transmitted with the samples to the laboratory for sample tracking purposes. Shipping labels are required if sample coolers are to be transported to the laboratory by a third party (courier service). Original copies of these records should be maintained in the appropriate project files.

7.0 REFERENCES

ASTM D 1586-84

Figure 1

Sheet 1 of __

BORING LOG

Project No. _____ Date – Start _____ Finish _____ Boring _____

Project Name _____ Drilling Co. _____

Location _____ Drilling Method _____

Total Depth _____ Inspector _____ Reviewer _____

Remarks _____

Depth Feet	Sample				Graphic Log	Lithologic Description	Equipment Installed
	Type & No.	Blows per 6 in.	Depth Range	Rec.			

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