ADDITIONAL INVESTIGATION REPORT

SNOQUALMIE MILL T-12 SITE

WEYERHAEUSER'S CASCADE DIVISION

SNOQUALMIE FALLS

PLYWOOD PLANT FIRE SITE

for

THE WEYERHAEUSER COMPANY

by

HDR ENGINEERING, INC.
BUILDING C - SUITE 200
11225 S.E. 6TH STREET
BELLEVUE, WASHINGTON 98004

DECEMBER 1989

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1.0 INTRODUCTION

This report summarizes additional investigation of spilled polychlorinated biphenyl (PCB) fluids in the soil underlying a former transformer location at the Snoqualmie Falls Mill plywood plant fire site. Field procedures and results from the investigation are presented.

1.1 PURPOSE

The purpose of this project was to obtain soil samples beneath former transformer T-12 to determine if PCB-related contaminants had penetrated beneath the clay layer, and to ascertain the thickness of this clay layer. An angled borehole was drilled to determine if contaminants had passed through the clay layer. This drilling method prevents downward migration of contaminants. Three vertical boreholes were drilled adjacent to T-12 to obtain a lithologic profile of the subsurface soils and to determine if contaminants had spread laterally. Additionally, six shallow monitoring wells, three surrounding each former transformer site and all completed above the clay layer, were abandoned. The results of this field effort were used to evaluate independent modeling of spill penetration depth using assumptions about soil permeability, spill volume and other factors.

1.2 BACKGROUND

In February, 1989, a fire erupted at the plywood manufacturing plant at the site. The intense heat and falling debris ruptured the secondary bushings around two askarel (PCB-bearing cooling fluid) filled transformers. HDR Engineering Inc. (HDR) sampled the soils adjacent to these transformers in February and detected elevated PCB concentrations (HDR, 1989a, 1989b, 1989c).

A subsequent investigation occurred in March and April, 1989 and consisted of the installation of six monitoring wells, soil boring, surface soil and groundwater sampling, and water elevation measurements. This investigation established that concentrated transformer fluids were not moving laterally through the shallow aquifer, and a low permeability clay layer was present four to six feet beneath the surface (HDR, 1989d, 1989f).

Two barrier systems were constructed to isolate soils in the vicinity of transformers T-12 and T-17 from the shallow, perched groundwater. Following completion of the barrier systems the isolated soils were excavated, sampled and analyzed for PCBs in June, 1989 (1989e). At Transformer site t-17, all contaminated soil was removed and all samples taken from the floor and sidewalls of the excavation were at or below the allowable concentrations listed in the PCB Spill Policy (40 CFR 761). Transformer site T-17 was subsequently closed in accordance with the PCB Spill Policy and backfilled.

Excavation and sampling of the T-12 site also occurred in June, 1989. Most of the contaminated soil was removed except for a 5 ft. by 5 ft. area where high concentrations of PCBs were detected in the clay layer. Spills occurring prior to the fire may have contacted and permeated into the clay. Wooden piling driven deep into the clay may have served as conduits for deeper penetration (HDR 1989g). Excavation activities at T-12 were discontinued to avoid breaking through the clay layer and possibly into the underlying aquifer system. A tarp was placed inside the excavation to separate the contaminated clay from the backfill placed above it.

1.3 HYDROGEOLOGY AND SITE CONDITIONS

The site is located near the town of Snoqualmie, Washington at the foot of the Cascade Mountains in King County. Topographically, the site is relatively flat at an elevation of approximately 410 feet above mean sea level (amsl). Climate in the project area is mild with monthly mean temperatures ranging from 41.5°F in November to 62.5°F in July. The site receives an annual precipitation of about 64 inches mostly in the form of rainfall.

Several surface water features are located in the vicinity of the T-12 location including the Snoqualmie River about one-half mile to the southwest, a log pond approximately 100 feet to the south and various shallow ditches which drain the local area. The log pond is one of many old cut-off river meanders located in the Snoqualmie River Valley. The approximate mean pool elevation of the adjacent log pond is 408 feet amsl. The mean pool elevation of the Snoqualmie River near the site is also about 408 amsl and is controlled by the Snoqualmie Falls Dam located one mile downstream at River Mile 40.3. At the Falls, the river plummets nearly 300 feet to the lower Snoqualmie River Valley. The Dam and its bedrock foundation create a hydraulic control for surface water and groundwater movement. About two miles upstream of the site at River Mile 43.3 is the confluence of the North, Middle and South Forks of the Snoqualmie River. These rivers collectively drain approximately 375 square miles.

Mapping by the Soil Conservation Service shows soils at the site to be Urban Land or soil that has been modified by disturbance of the natural layers with additions of fill material to accommodate industrial installations. Geologically, the fill is underlain by a silty sand to a depth of five feet. Results from the subsurface investigation have shown a clay layer extends from 5 to 15 feet in depth and is underlain by silty sands. Review of available Water Well Reports from the area indicate the valley is filled with alternating layers of silty sand, clay, glacial till and gravels with bedrock located below 500 feet in depth.

Shallow groundwater is present beneath the site in a perched condition at a depth of less than two or three feet. The silty sand formation beneath the clay is saturated and under a five foot static head condition. Twenty Water Well Reports were evaluated in a six square mile area surrounding the site. Twelve wells are located northeast and hydraulically up gradient of the site in a sparsely populated residential neighborhood. These wells range from 40 to 400 feet in depth and do not penetrate bedrock. Six wells located within the Town of Snoqualmie range in depth from 40 to 540 feet and are used for domestic, industrial and municipal water supply. These wells are either hydraulically up gradient or hydraulically separated from the site. Two domestic wells are located approximately 1.4 miles down gradient and northwest of the site, and downstream of Snoqualmie Falls. The deeper of these wells is 240 feet beneath the ground and recorded a June 1987 static water level of 125 feet. The stratigraphic record from the twenty Water Well Reports indicate deeper conductive layers are saturated and influenced by a static condition. The wells in yield low to moderate volumes of water.

2.0 SPILL MODELING ANALYSIS

HDR utilized a spill penetration model to guide field drilling and sampling activities. This model estimates the penetration depths of given fluids (in this case, askarel) based on the parameters of spill volume, elapsed time since the spill and soil permeability.

The spill penetration model employed by HDR was modified from a paper entitled "A Rapid Assessment Model for Spills on Soil of Oily Fluids that are Immiscible with Water" (Metcalfe and Zukovs - Proceedings of the National Water Wells Association's Conference on Petroleum Hydrocarbons and Organic Chemicals in Groundwater: Prevention, Detection and Restoration, 1986).

The model is directed primarily at recent spills, but can be adapted to spills occurring 20 years ago. Specifically, the model is designed to estimate the following:

1) the current depth of penetration of spilled fluids,
2) the potential for spilled fluids to reach the water table,
3) the time at which any spilled fluid will reach the water table, and
4) the ultimate subsurface configuration of the spilled fluids.

At the T-12 transformer site at Weyerhaeuser's Snoqualmie Mill, the PCB contamination has already reached the water table, which occurs as shallow as two to three feet beneath ground surface. Therefore, the model was utilized to assess the present depth of contamination and the subsurface configuration of the fluid.

The subsurface transport model uses the following assumptions:

1) soils are homogeneous and isotropic with respect to soil permeability,
2) the downward movement of the leading edge of contaminant fluid can be characterized as saturated Darcian flow, and thus, no reductions are required in the value of soil permeability for less than saturated conditions,
3) vertical migration in the saturated zone is due to gravitational forces only,
4) no lateral migration occurs in the unsaturated zone,
5) no dissolution or volatilization of contaminants occur from the fluid phase,
6) fluids penetrate the soil surface uniformly across the spill area,
7) soil contains water at its field capacity from ground surface to the water table, and
8) water table elevation does not fluctuate.

Use of this model was modified for site specific conditions at Snoqualmie. During excavation of soils around T-12, it was noticed the bulk of the spill attributed to the February, 1989 fire was spread throughout the backfill material near the surface, which was comprised primarily of silty sand and cobbles. However, as the excavation extended down to the top of the clay layer (approximately five feet beneath the surface), the contamination was confined to a small area around the wooden piling. If the entire extent of contamination was due to the fire, the concentration of PCB contamination in the clay layer beneath T-12 would be proportional to the contamination in the backfill material above it. However, the concentration of PCBs in the clay layer was limited to a small area directly beneath the transformer. This led to the assumption that either the transformer had been slowly leaking for several years or that small spills had occurred several times over the past few years.

Using a conservative assumption that the spill occurred twenty years ago, the model predicted the spill would have reached its ultimate penetration depth within one year. Elapsed time since the spill event was no longer an important variable.

The volume of the spill during the fire was estimated to be twenty gallons. However, since it is assumed additional contamination within the clay was caused by historical spills not resulting from the fire, a range of estimates of the total of spill volumes over the past twenty years ere used to delineate a range of penetration depths. Five spill volumes were evaluated: 20, 40, 60, 100, and 200 gallons.

Since the historical spills are concentrated in the clay layer, and since the subsurface transport model assumes homogeneous soils, another assumption was that the point of spill deposition was determined to be the top of the clay layer, not the ground surface.

The two constants used in these calculations were the area of the spill (determined during excavation down to the clay layer) and the soil permeability. The area of the spill was determined to be four square meters ($4m^2$); soil permeability ranged from 10^{-9} to 10^{-11} m^2/sec. The volume of the spill is divided by the area of the spill to determine the volumetric loading, i.e., the volume of the column above the spill area.

Based upon the calculations utilized in the spill penetration model, the following ranges of ultimate depths of penetration beneath the top of the clay layer for all five spill volumes are shown below:

20 gallon spill	depth from 3 - 10 feet
40 gallon spill	depth from 7 - 20 feet
60 gallon spill	depth from 10 - 29 feet
100 gallon spill	depth from 16 - 49 feet
200 gallon spill	depth from 29 - 92 feet

The range is based on varying the assumed clay permeability (Figure 2.1).

Another determination made by the model is the shape of the subsurface configuration. Given a low permeability, homogeneous soil, such as the clay found at the site, the shape of the subsurface zone of contamination would be "flask" shaped with the base of the fluid penetration depth approximately doubled (4 meters by 4 meters). Therefore the spill model can only be used as a rough guide, and cannot resolve differences in penetration depths within the clay layer based on the quality of the input assumptions.

HDR

Project WEYERHAEUSER - SNOQUALMIE

Subject SPILL PENETRATION DEPTH

Task

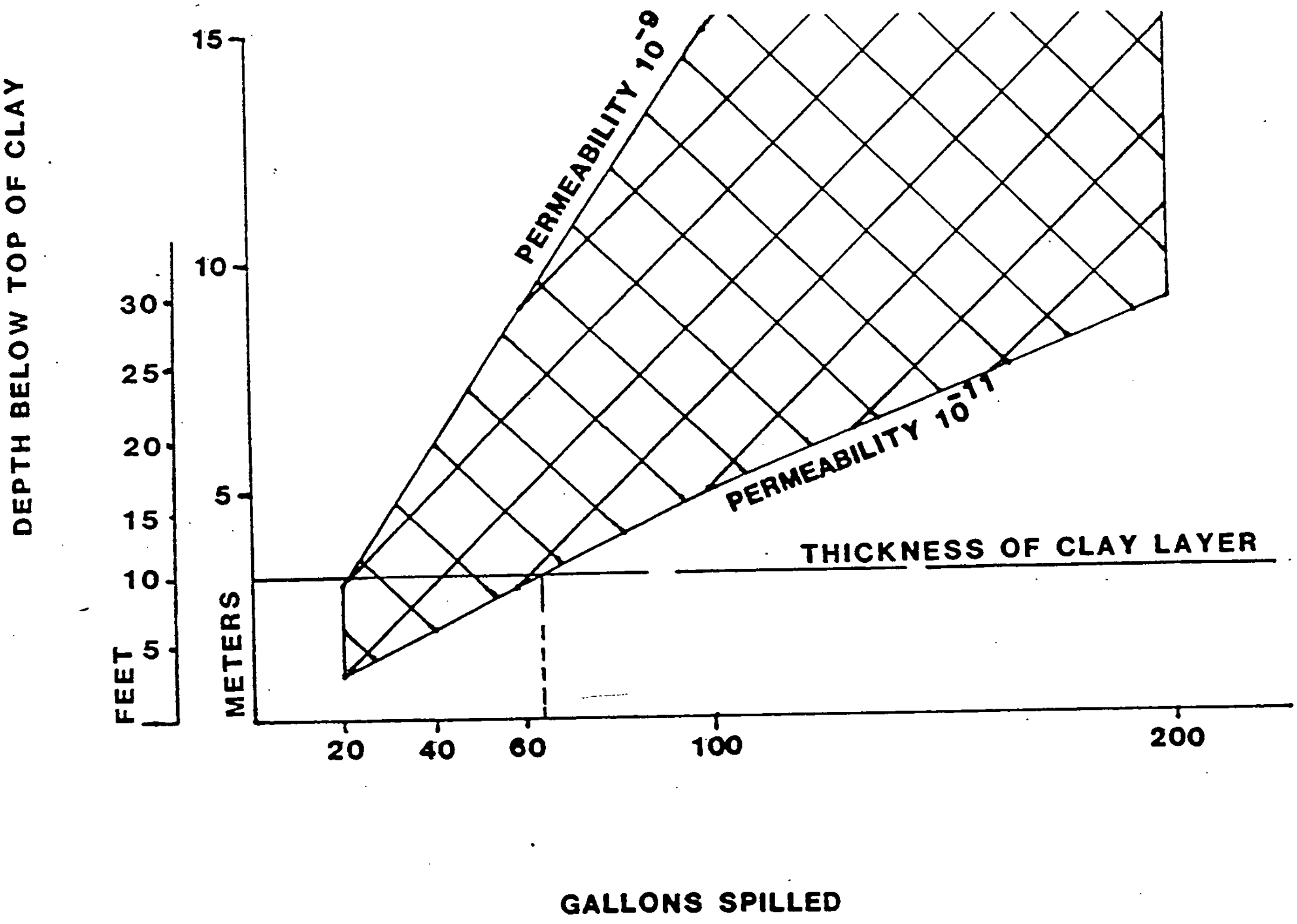


FIGURE 2.1

3.0 FIELD INVESTIGATION

3.1 DRILLING LOCATIONS AND METHODS

One angled and three vertical borings were drilled. Split spoon samples were taken for lithologic determination and for chemical analysis of polychlorinated biphenyl (PCB) and chlorinated benzenes. The locations of the borings were selected to obtain a representative picture of the underlying stratigraphy near the transformer site and to obtain samples of the soil beneath the transformer site. Borehole locations are shown in Figure 3.1.

The boreholes were installed using a hollow stem auger drill. A secondary surface casing was placed prior to drilling to: 1) minimize potential drawdown of surficial soil contamination during drilling, and 2) minimize the perched water from entering the borehole. The surface casings were placed using the following method: a pit was excavated into the clay layer using a backhoe; a ten-inch diameter galvanized culvert was set into the clay at the desired angle; and then the pit was backfilled around the culvert. The hollow stem auger (8-inch outside diameter) was advanced through the culvert and drilling was performed according to the standard hollow stem drilling method.

3.2 SOIL BORINGS

Three soil borings were drilled adjacent to the T-12 location. The purpose of these boreholes was to establish the lithologic profile and to determine if contaminants had spread laterally through the soil. The borings were placed to the southwest, west and northeast of T-12 (see Figure 3.1).

Continuous samples from the first borehole (BH-1, located southwest of T-12) were taken from contact with the clay layer to the base of the boring (depths of 10'-22') to establish a lithologic profile. Samples were taken with an 18-inch long, 2-inch diameter stainless steel split spoon (see Section 3.5). Soils within the split spoon were screened for organic vapors using an OVA (organic vapor analyzer), then classified in accordance with the USCS (United Soil Classification System). On the remaining vertical boreholes (BH-2 and BH-3), lithologic samples were taken at 5-foot intervals or anticipated changes in lithology.

All three borings indicated the presence of a clay layer approximately ten feet thick, located five to fifteen feet beneath the ground surface. This clay layer was interspersed with stringers of brown material, possibly acting as conduits within the clay layer. Beneath the clay layer, a silty sand strata exists. This silty sand also contains small pods of clay as well as an abundance of wood chips and other organic material. OVA readings greater than 1000 parts per million (ppm) were noticed in the silty sand strata directly beneath the clay interface.

After the terminus of each borehole was reached, the borehole was filled from the bottom to the top with a cement-bentonite grout mixture in accordance with accepted standards detailed in Chapter 173-160 of the Washington Administrative Code.

3.3 ANGLED BORING

The angled boring (BH-4) was placed approximately twenty feet due north of the piling. The ten-inch galvanized culvert was installed similar to those in the vertical borings except that it was placed at a 55° angle to the ground (or 35° off of vertical). A hollow stem auger rig, modified so it can drill at desired angles was used (Figure 3.2).

The purpose of the slanted boring was to sample the soils underneath the transformer site, without having to drill through the contaminated clay layer. The angled boring approached the area beneath the former transformer from the side, through clean fill, thus minimizing any downward transport of contaminants.

3.4 SAMPLING STRATEGY

The strategy of the sampling program was to determine the following: 1) if contaminants are evident beneath the clay layer; and 2) if so, at what concentrations do they occur and what is the lateral extent of contamination.

3.5 SAMPLING METHODS

Soil samples were obtained utilizing an 18-inch long, 2-inch diameter stainless steel split spoon sampler. The split spoon was driven into the base of the borehole at the desired depth. After the split spoon was retrieved, it was opened and the soil core was screened for organic vapors using the OVA. If the sample was to be retained for chemical analysis, it was immediately placed into prelabeled sample jars and put on ice. Otherwise the soil core was examined for lithologic determination and discarded into 55-gallon drums.

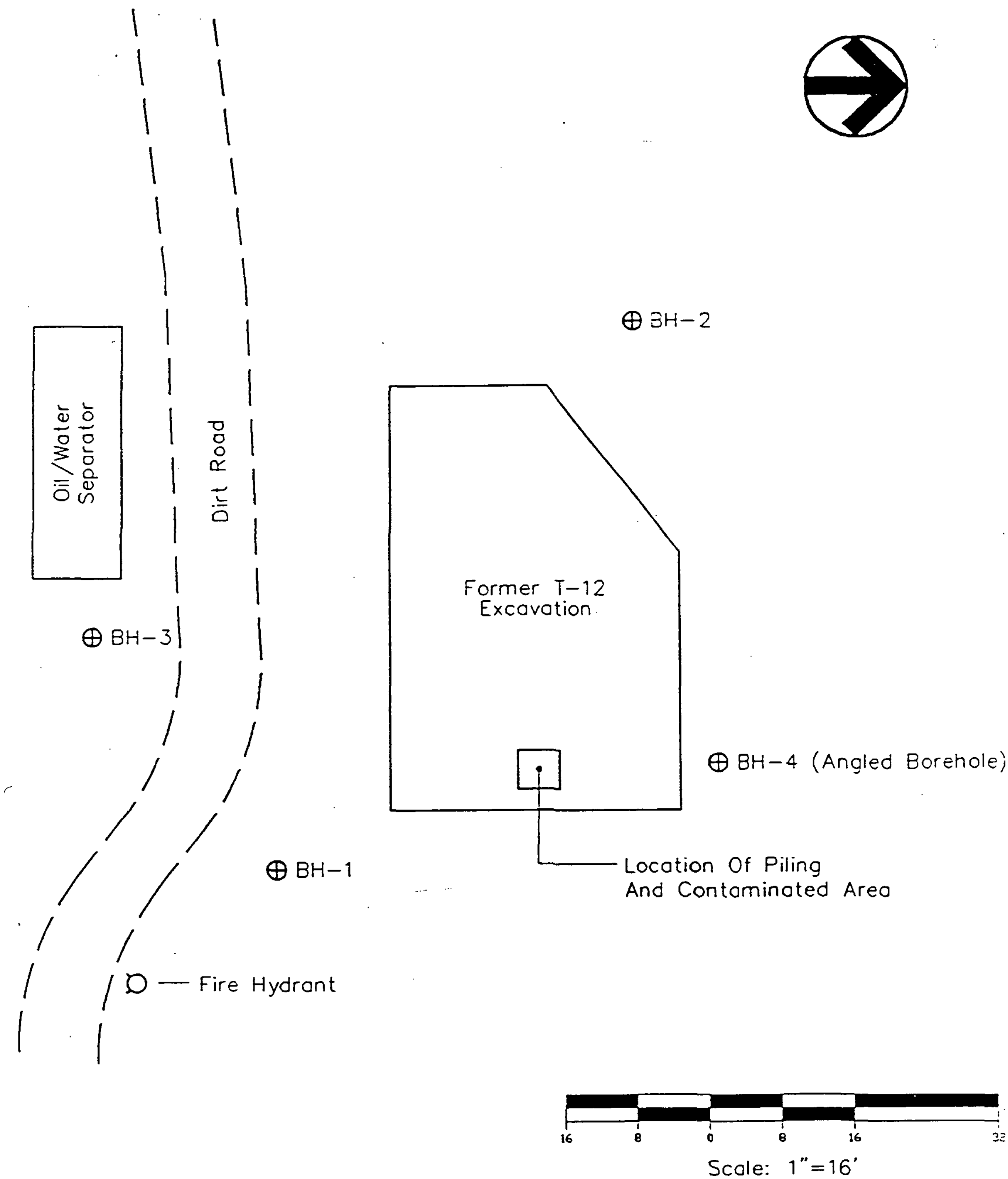
Sample handling, storage, labeling, shipping and tracking was performed in accordance with the procedures listed in the sampling plan (Sampling Plan, Additional Investigation Snoqualmie Mill T-12 Site, HDR 1989h)

Soil samples were sent to the ENSECO California Analytical Laboratory in West Sacramento, California; in addition, several samples were sent to the Weyerhaeuser Company laboratory as a quality assurance check. Samples were analyzed for PCBs using a modified EPA method 8080 and for chlorinated benzenes using EPA Method 8120.

3.6 EQUIPMENT DECONTAMINATION

A bermed decontamination pad was constructed using plastic sheeting. All downhole equipment associated with the drill rig was steam cleaned (2000 PSI and >212°) between boreholes. The decontamination water was put into 55-gallon drums and sealed. Cuttings obtained from the boreholes were shoveled into 55-gallon drums.

All soil sampling equipment, such as split spoons and sampling spoons, was decontaminated prior to sampling with procedures listed in the sampling plan (HDR 1989h). Decontamination procedures were used to prevent cross contamination between samples. Decontamination fluids were placed in 55-gallon drums following use and subsequently disposed by Olympus.



HDR

WEYERHAEUSER–SNOQUALMIE
Location Of Boreholes

Date: Oct.198

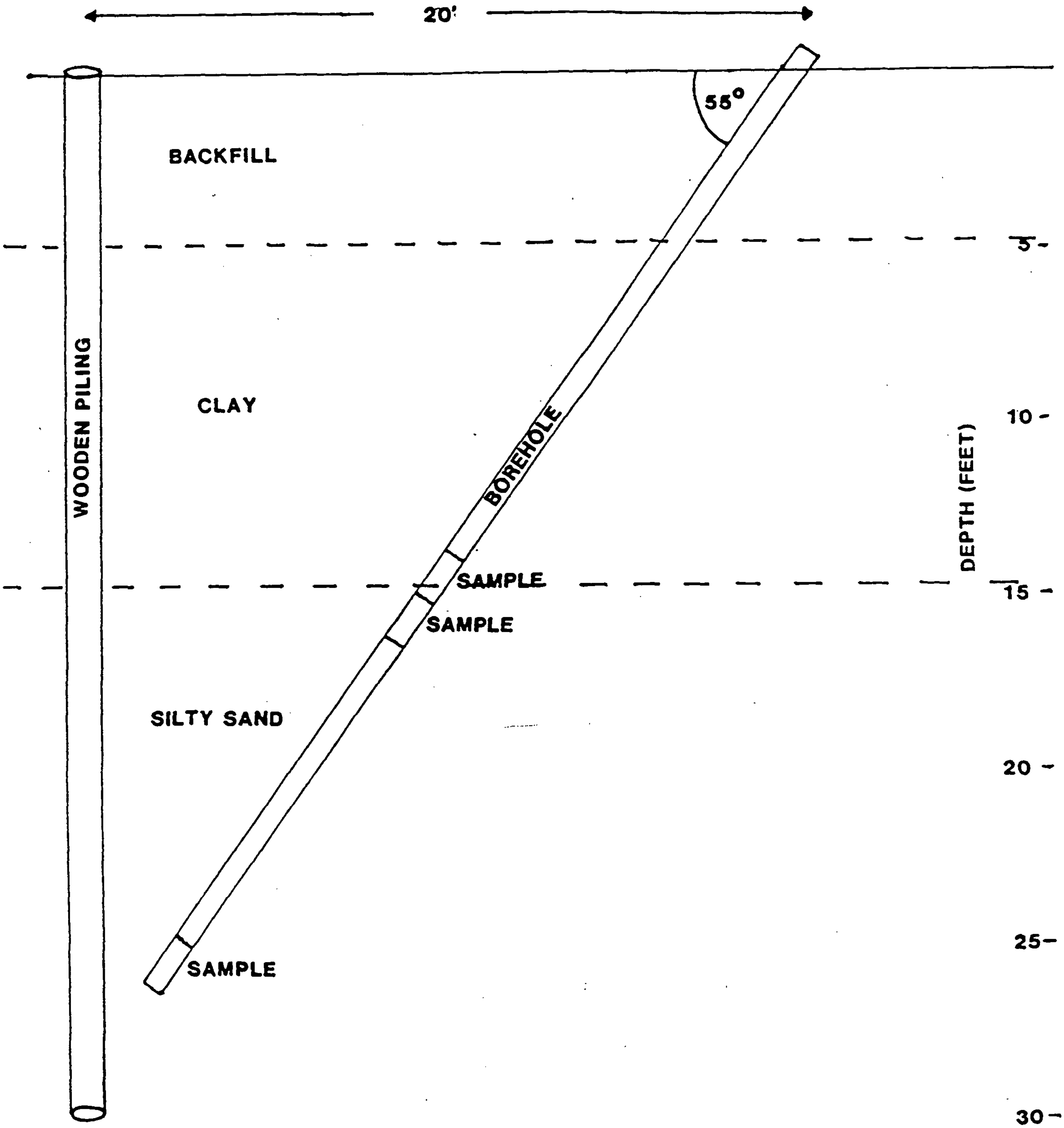
Figure 3-1

HDR

Project WEYERHAEUSER - SNOQUALMIE

Subject ANGLED BOREHOLE

Task



3.7 SAMPLING RESULTS/FIELD OBSERVATIONS

During the drilling of two of the boreholes (BH-1 and BH-4), high OVA readings and strong "mothball" odors were detected in the split spoons taken directly beneath the bottom of the clay layer. It is suspected the odors and readings are associated with the presence of chlorinated benzenes. Since chlorinated benzenes are less dense than water, it is probable that they would float to the top of the highly permeable silty sand and be held in place by the less permeable clay layer above it. These field observations indicate contaminants may have passed through the clay layer. However, laboratory results of samples taken beneath the clay layer indicated contaminants were not detected. Sampling results are shown in Table 3.1.

The PCBs analyzed were Aroclor-1260 (detection limit 50 ug/kg). The chlorinated benzenes analyzed included 1,2,4-Trichlorobenzene, 1,2,3-Trichlorobenzene and 1,3,5-Trichlorobenzene (detection limit 20 ug/kg) and 1,2,3,4-Tetrachlorobenzene, 1,2,3,5-Tetrachlorobenzene and 1,2,4,5-Tetrachlorobenzene (detection limit 10 ug/kg).

4.0 WELL ABANDONMENT

Six monitoring wells were installed in April, 1989 to determine the lateral extent of PCB contamination around T-12 and T-17 in the shallow, perched water layer above the clay. Subsequent groundwater monitoring in this zone indicated no significant evidence of contamination in the shallow aquifer. Therefore, the wells could be abandoned.

On September 20, 1989, all six wells were removed with a backhoe and a boom truck and placed on plastic sheeting. The area where the wells formerly existed were backfilled and graded. Also, the ten-inch culverts, used in association with the borehole investigation, were placed on the plastic sheeting. Olympus was hired to ultimately dispose of the wells and associated debris.

Well abandonment was performed within specifications listed in the Washington Administrative Code, Minimum Standards for Construction and Maintenance of Wells, Chapter 173-160-415. A letter informing the Department of Ecology was filed by Tacoma Pump of Graham, WA.

5.0 CONCLUSIONS

The analytical results from the subsurface soil sampling indicates the bulk of the contaminants are located in the clay layer directly beneath T-12. No contamination was found in samples from the three vertical borings or the angled boring, indicating the contaminants have not spread laterally or vertically. Additionally, the clay beneath T-12 has absorptive qualities, meaning the PCBs would readily adhere to the clay particles.

The absence of contamination under the clay layer, together with the results of the spill penetration analysis (Section 2.0), indicate that the original spill volume (at the clay surface) was approximately 60 gallons or less.

Weyerhaeuser has requested the clay beneath T-12 be further excavated down to approximately thirteen feet below grade. Any excavation below thirteen feet could break through the clay layer in provide a conduit for contamination into the lower aquifer. Based upon results of sample taken from the excavated material, calculations can be made of how much PCBs were taken from the area, and therefore, how much still remains.

TABLE 3.1

SAMPLE NUMBER (1)	ANALYTE	
(A)(B)(C) (D)	PCB (2)	CHLORINATED BENZENES (3)
BH1-01-SL-17.5-19-0	ND	ND
BH1-02-SL-20.5-22-0	ND	ND
BH2-03-SL-8-9.5-0	ND	ND
BH2-04-SL-15-16.5-0	ND	ND
BH2-05-SL-17.5-19-0	ND	ND
BH3-06-SL-14-15.5-0	ND	ND
BH3-06-SL-14-15.5-1	ND	ND
BH3-07-SL-15.5-17-0	ND	ND
BH3-08-SL-22.5-24-0	ND	ND
BH3-09-SL-27-28.5-0	ND	ND
BH4-10-SL-30.0-32-0	ND	ND
BH4-10-SL-30.5-32-1	ND	ND

(1) Sample number designation as follows:
  (A) Bore hole number
  (B) Series Number
  (C) Matrix (SL = soil)
  (D) Depth Range (linear distance from top of hole - ft.)

(2) Detection limit for PCBs = 50 ug/kg

(3) Detection limit for Chlorinated Benzenes = 20 ug/kg

6.0 REFERENCES

HDR Engineering, Inc. 1989a. Health and Safety Plan for Soil and Waste Sampling at Weyerhaeuser's Cascade Division Snoqualmie Falls Plywood Plant Fire Site. February, 1989.

HDR Engineering, Inc. 1989b. Sampling Plan for Weyerhaeuser's Cascade Division Snoqualmie Falls Plywood Plant Fire Site. February, 1989.

HDR Engineering, Inc. 1989c. Perched Groundwater System and Supplemental Surface Soil Investigations at Former Transformer Sites T-17 and T-12 - Weyerhaeuser's Cascade Division, Snoqualmie Falls Plywood Plant Fire Site. Draft Report. June, 1989.

HDR Engineering, Inc. 1989d. Groundwater Monitoring Well Installation and Sampling Plan - Weyerhaeuser's Cascade Division, Snoqualmie Falls, Plywood Plant Fire Site. March 1989.

HDR Engineering, Inc. 1989e. Snoqualmie Falls Plywood Plant Transformer Spill Cleanup - Groundwater Isolation and Soil Removal: Approach and Scheduling. May, 1989.

HDR Engineering, Inc. 1989f. Perched Groundwater Investigation Report. Draft Report. June, 1989.

HDR Engineering, Inc. 1989g. Snoqualmie Falls Plywood Plant Fire Site - Transformer Site Remediation: Spill Removal. Interim Report. August, 1989.

HDR Engineering, Inc. 1989h. Sampling Plan - Additional Investigation Snoqualmie Mill T-12 Site, Weyerhaeuser's Cascade Division, Snoqualmie Falls Plywood Plant Fire Site. September, 1989.

Metcalfe and Zukovs - Proceedings of the National Water Well Association's Conference on Petroleum Hydrocarbons and Organic Chemicals in Groundwater: Prevention, Detection and Restoration. A Rapid Assessment Model for Spills on Soil of Oily Fluids that Are Immiscible with Water. 1986.

United States Department of Agriculture; Soil Conservation Service. Soil Survey King County Area. 1973.

APPENDIX A

HDR

FIELD DRILLING LOG

Project Name : WEYERHAEUSER/SNOQ. Number : 06810-012-102	Boring Number: BH-1	Coordinates or Location:
Engineer : Bruce Williams Geologist : Mike Moore	Surface Elevation:	GWL Depth : 5.0' (Encountered) Depth : 10.0' (Static)

Drilling Methods: Hollow Stem Auger	Hole Diameter: 6"	Fluid Used: N/A	Date Started : 9/6/89 Completed : 9/7/89

Hazardous Waste Remarks: PCB'S & Chlorinated Benzenes	Safety Notes:

Depth (ft.)	Sample Type & No.	Sample Depth Interval	Blows Count	Recovery Length / %	Profile	USCS	Description	Borehole Completion Summary
0–3	Backhoe Cuttings						0'-3' Backfill	Bentonite Slurry
3–4	Backhoe Cuttings					GM	SILT: Gray, Cobbles	
4–5	Backhoe Cuttings					PT	PEAT: Dark Brown, Odoriferous	
5–10	Drill Cuttings					CL	CLAY: Gray	
10–11.5	Lith	10.0–11.5	1(12") 2(6")	1.50'			CLAY: Gray, Stringers Of Amber Brown Material, Small Pieces Of Black Hard Brittle Material, Dry	
11.5–12	Lith	11.5–13.0					CLAY: Gray, Mottled With Rusty Brown	

See Page 2-2

Notes: Clean Refers To Low Silt Content Not To The Lack Of Presences Of Contamination.
Lith=Lithology

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FIELD DRILLING LOG

Depth (ft.)	Sample Type & No.	Sample Depth Interval	Blows Count	Recovery Length / %	Profile	USCS	Description	Borehole Completion Summary
							See Page 1-2	
12	Lith	11.5–13.0	1, 2, 2	1.50'		CL	Brown Material, More Stringers Than Above, Dry	Bentonite Slurry
13	Lith	13.0–14.5	1, 2, 2	1.50'			CLAY: Blue-Gray, Trace Silt, Brown Stringers, Wood At 14.25', 1" Thick, Tracers Fine Sand, Dry	
14.5	Lith	14.5–16.0	•	1.50'			14.5–15.0–CLAY: (May Be Slough)	
15						SM	15.0–16.0–SILTY SAND: Gray, Fine Sand, Numerous Wood Fragments, Moist Not Saturated	
16	Lith	16.0–17.5	1, 3, 5	1.50'			SILTY SAND: Gray, Fine, Moist, Wood Fragments At 17.25'	
17.5	BH1-01	17.5–19.0	3, 2, 3	0.50'			SILTY SAND: Gray, Wet, Bad Recovery	
19	BH1-02	19.0–20.5	2, 3, 5	1.50'			SILTY SAND: Gray, Less Silt Than Above, Wood Fragments, Moth Ball Odor	
20.5	Lith	20.5–22.0		1.50'		CL	20.5–21.25–CLAY: Gray With Brown Streamers, Organic	Coarse Bentonite Plug
21.25						SM	21.25–22.0–SILTY SAND: Gray, Wet, Very Silty	
22								22.0' Bottom Of Borehole

• No Blow Counts, Weight Of Hammer Drove Spoon One Foot, One Count For Next Foot Driller Drove It Deeper To Drop The Plug Out.
Note: Sample From 16.0–17.5 Had A Chlorobenzene Odor: OVA = 450 PPM

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FIELD DRILLING LOG

Project Name : WEYERHAEUSER/SNOQ. Number : 06810-012-102	Boring Number: BH-2	Coordinates or Location:
Engineer : Bruce Williams Geologist : Mike Moore	Surface Elevation:	GWL Depth : 5.0' (Encountered) Depth : 10.0' (Static)

Drilling Methods: Hollow Stem Auger	Hole Diameter: 6"	Fluid Used: N/A	Date Started : 9/6/89 Completed : 9/7/89

Hazardous Waste Remarks: PCB'S & Chlorinated Benzenes	Safety Notes:

Depth (ft.)	Sample Type & No.	Sample Depth Interval	Blows Count	Recovery Length / %	Profile	USCS	Description	Borehole Completion Summary
0–5	Backhoe Cuttings						0'-5' Backfill, Some Peat	Bentonite Slurry
5–8	Drill Cuttings					CL	CLAY: Gray	
8–9.5	BH2-3	8.0-9.5	1 / 4 / 4	1.00'			CLAY: Gray, Brown Streaks, Slough In The Spoon Reads >1000 PPM. In The Clay Reads 10-20 PPM, Could Be Result Of Peat In Backfill	
9.5–12	Drill Cuttings							

See Page 2-2

Notes: Clean Refers To Low Silt Content Not To The Lack Of Presences Of Contamination.
Lith=Lithology

HDR

FIELD DRILLING LOG

Boring No.2

Depth (ft.)	Sample Type & No.	Sample Depth Interval	Blows Count	Recovery Length / %	Profile	USCS	Description	Borehole Completion Summary
							See Page 1-2	
12	Drill Cuttings					CL	NOTE: 2' Of Plug In Auger	Bentonite Slurry
13	Lith	13.0–14.5	1, 2, 2	1.50'			13.00-13.75-CLAY: Gray-Brown	
14						SM	13.75-14.50-SILTY SAND: Blue-Gray, 0 On The OVA, Very Fine Sand	
	Drill Cuttings							
15	Lith	15.0–16.5	2, 4, 4	1.50'			SILTY SAND: Gray, Fine Sand, Some Clay, Brown Rusty Streamers	
16.5	Lith	16.5–18.0	1, 3, 3	1.50'			SILTY SAND: Gray, Wood Fragments, OVA 20-100 PPM. (Probably Methane, Odorless)	
18	Lith	18.0–19.5	3, 4, 6	1.50'			SILTY SAND: Blue-Gray, Wood Fragments, OVA 20-60 PPM, Not Odoriferous	
19.5	BH2-4	19.5–21.0	2, 4, 4	1.50'			SILTY SAND: Gray, Wood Fragments, OVA 20-100 PPM, Wet	
21	Lith	21.0–22.5	3, 4, 7	1.50'			SILTY SAND: Gray, Wood Fragments, OVA 60-400 PPM.	
22.5–26.5	Drill Cuttings							
26.5	Lith	26.5–28.0	4, 5, 6	1.50'			SILTY SAND: Gray, Wood Fragments, OVA 200->1000 PPM	
28								28.0' Bottom Of Borehole

HDR

FIELD DRILLING LOG

Project Name : WEYERHAEUSER/SNOQ. Number : 06810-012-102	Boring Number: BH-3	Coordinates or Location:
Engineer : Bruce Williams Geologist : Mike Moore	Surface Elevation:	GWL Depth : 5.5' (Encountered) Depth : 8.0' (Static)
Drilling Methods: Hollow Stem Auger Hole Diameter: 6"	Fluid Used: N/A	Date Started : 9/11/89 Completed : 9/12/89
Hazardous Waste Remarks: PCB'S & Chlorinated Benzenes	Safety Notes:	

Depth (ft.)	Sample Type & No.	Sample Depth Interval	Blows Count	Recovery Length / %	Profile	USCS	Description	Borehole Completion Summary
0–2	Backhoe Cuttings						0'–2' Backfill	Bentonite Slurry
2–4	Backhoe Cuttings					SM	SILTY SAND: With Gravels And Boulders. Coagulated Cow's Blood	Bentonite Slurry
4–5	Backhoe Cuttings					PT	PEAT: Dark Brown, Organic, Rich	Bentonite Slurry
5–12	Drill Cuttings					CL	CLAY: Gray With Rusty Brown Streaks	Bentonite Slurry

See Page 2-3

Notes: Clean Refers To Low Silt Content Not To The Lack Of Presences Of Contamination.
Lith=Lithology

See Page 1-3

Depth (ft.)	Sample Type & No.	Sample Depth Interval	Blows Count	Recovery Length / %	Profile	USCS	Description	Borehole Completion Summary
12–14	Drill Cuttings					CL		Bentonite Slurry
14–15.5	Lith	14.0–15.5	-	1.50'			14.0–14.5–CLAY: Gray	
						SM	14.5–15.5–SILTY SAND: Gray, Wood Fragments, OVA Reading Greater Than 700 PPM	
15.5–17		15.5–17.0		1.50'			SILTY SAND: Gray, Fine To Medium Grained, Wood Fragments, OVA Readings 20–30 PPM	
17–22.5	Drill Cuttings							
22.5–24	Lith	22.5–24.0	1 / 1 / 1	1.50'			SILTY SAND: Gray, Very Fine Grained, Some Silt, Wet, OVA Readings 30–250 PPM	
24–27.5	Drill Cuttings							
27.5–28	Lith	27.5–29.0	1	1.50'			SILTY SAND: Gray, Very Fine Grained.	

See Page 3-3

Note: Drilled Down To 19.0', 4' Of Slough In Auger

Depth (ft.)	Sample Type & No.	Sample Depth Interval	Blows Count	Recovery Length / %	Profile	USCS	Description	Borehole Completion Summary
							See Page 2-3	
28–29	Lith	27.5–29.0	2 / 1	1.50'		SM	Wet. OVA Readings 60-200 PPM	Bentonite Slurry; 29.0' Bottom Of Borehole

HDR

FIELD DRILLING LOG

Project Name : WEYERHAEUSER/SNOQ. Number : 06810-012-102	Boring Number: BH-4	Coordinates or Location:
Engineer : Bruce Williams Geologist : Mike Moore	Surface Elevation:	GWL Depth : 5.0' (Encountered) Depth : 9.5' (Static)

Drilling Methods: Hollow Stem Auger	Hole Diameter: 6"	Fluid Used: N/A	Date Started : 9/13/89 Completed : 9/14/89

Hazardous Waste Remarks: PCB'S & Chlorinated Benzenes	Safety Notes:

Depth (ft.)	Sample Type & No.	Sample Depth Interval	Blows Count	Recovery Length / %	Profile	USCS	Description	Borehole Completion Summary
0–2	Backhoe Cuttings						0'–2' Backfill	Bentonite Slurry (Actual Depth)
2–5	Backhoe Cuttings					SM	SILTY SAND: Brown, With Several Large Cobbles And Boulders	(3.28') at 4
5–6	Backhoe Cuttings					PT	PEAT: Dark Brown-Black, Moist Rich, Very Organic, Wood Chips	
6–12	Drill Cuttings					CL	CLAY: Gray, Moist With Rusty Brown Streaks	(6.55') at 8; (9.83') at 12

See Page 2-3

Notes: This Was An Angled Borehole. Set 35° Perpendicular To The Ground. All Depths Are Borehole Depths. Depth Below Ground Surface Is Shown In Parenthesis.
Clean Refers To Low Silt Content Not To The Lack Of Presences Of Contamination.
Lith=Lithology

Depth (ft.)	Sample Type & No.	Sample Depth Interval	Blows Count	Recovery Length / %	Profile	USCS	Description	Borehole Completion Summary (Actual Depth)
							See Page 1-3	
12	Drill Cuttings					CL		Bentonite Slurry (9.83')
16								(13.10')
17	Lith	17.0–(13.92) (15.15) 18.5	1 / 1 / 1	1.50'			17.–18.0–CLAY: Gray, Moist, With Rusty Brown Stringers	
18		18.5–(15.15) (16.38) 20.0	1 / 2 / 2	1.50'		SM	18.0–18.5–SILTY SAND: Gray, Fine To Medium Grained	
							SILTY SAND: Gray, Fine To Medium Grained, Some Pods Of Clay, Wet	
20	Drill Cuttings							(16.38')
24								(19.66')
28							See Page 3-3	(22.93')

Notes: This Was An Angled Borehole, Set 35° Perpendicular To The Ground. All Depths Are Borehole Depths, Depth Below Ground

HDR

FIELD DRILLING LOG

Boring No. 4

Depth (ft.)	Sample Type & No.	Sample Depth Interval	Blows Count	Recovery Length / %	Profile	USCS	Description	Borehole Completion Summary (Actual Depth)
28							See Page 2-3	(22.93') Bentonite Slurry
28–30.5	Drill Cuttings					SM		
30.5–32	BH4-10	30.5- (24.98) (26.21) 32.0	1 / 1 / 1	1.50'		SM	SILTY SAND: Gray, Wet, Fine To Medium Grained, OVA Readings Greater Than 1000 PPM, Odor of Mothballs	32.0' Bottom Of Borehole (26.21')

Notes: This Was An Angled Borehole, Set 35° Perpendicular To The Ground. All Depths Are Borehole Depths, Depth Below Ground