94-01

January 21, 1999

Ms. Cheryl Marks
Hydrogeologist
Division of Waste Management
NC DENR
401 Oberlin Road, Suite 150
Raleigh, NC 27605

Carmen Johnson
Fac/Perm/Co ID # 94-01 Date 4/19/12 Doc ID# DIN

Subject: Proposed No. 3 Landfill, Weyerhaeuser Company
Plymouth, North Carolina
Alternate Liner Design - Revised Memorandum

Dear Cheryl:

In response to your telephone request on January 11, 1999, I am resubmitting our revised technical evaluation of a proposed alternate liner system for Weyerhaeuser's No. 3 Landfill. Our analysis demonstrates that the proposed liner system is protective of the groundwater. To assist in your review, we are including back-up data including TCLP test results, groundwater contours, HELP model outputs, boring logs, well construction diagrams, and hydraulic conductivity test results.

For reference we have also included hydrogeological data provided to you in our September 4, 1998, groundwater modeling report.

At this time we are considering a **double composite liner** consisting of the following elements, from top to bottom:

- 60 mil HDPE geomembrane
- Geosynthetic clay liner
- Drainage composite leak detection layer
- 60 mil HDPE geomembrane
- Geosynthetic clay liner

I have attached a Technical Memorandum that addresses protection of 2L Groundwater Standards using mass balance calculations. These calculations are based on assumptions we consider to be highly conservative. Leakage rates from our HELP model were based on an open landfill configuration that consisted of the following section:

- 24 inches of ash waste
- 18 inch aggregate drainage layer
- 60 mil HDPE geomembrane

RMT, Inc., North Carolina
100 Verdae Blvd. - 29607-3825
P.O. Box 16778 - 29606-6778
Greenville, SC
864/281-0030 - 864/281-0288 FAX

- Geocomposite drainage layer
- 60 mil HDPE geomember
- Geosynthetic clay liner (GCL)

In this model our primary liner was considered to be a single liner rather than a composite.

Our analysis concludes that the proposed liner is protective of 2L Groundwater Standards. We would appreciate your timely feedback so that we may proceed with our landfill permit submittal with some confidence that this alternate liner is acceptable to NC DENR.

Please feel free to contact me if I can provide any additional clarification or information.

Sincerely,

RMT, Inc., North Carolina

R. Kent Nilsson, P.E.
Project Manager

NORTH CAROLINA PROFESSIONAL SEAL No. 17543 ENGINEER R. KENT NILSSON 1/21/99

RMT, Inc.

Dan O. Madison, P.G.
Consulting Hydrogeologist

NORTH CAROLINA LICENSED SEAL 249 GEOLOGIST DAN O. MADISON, JR. 1/22/99

Attachments

cc: Joe Kloeker, Wynne Shaw, Mac Jones - Weyerhaeuser
D. Madison, J. Freitag, S. Korleski, E. Timmons, K. Huibregtse, D. Strom - RMT
Project File - 5101.01

JAN 1999 Received Solid Waste Section

Attachment 1

Technical Memorandum

Date: January 21, 1999

To: Wynne Shaw - Weyerhaeuser

cc: Mac Jones, Joe Kloeker - Weyerhaeuser
Kathy Huibregtse, Dan Madison, Kent Nilsson - RMT

From: Jon Freitag/Sharon Korleski

Project No: 00-05101.01

Subject: Mass Balance Calculations for Liner Design of Landfill No. 3

Summary of Calculations

Mass balance calculations were used to evaluate the effectiveness of one liner design of Landfill No. 3 at the Weyerhaeuser facility in Plymouth, North Carolina. The concentrations of the constituents measured in waste stream Toxicity Characteristic Leaching Procedure (TCLP) tests were used in the calculations. Other parameter values were assigned conservatively or based upon available data. The calculated leachate concentrations were adjusted to account for mixing in the top 1-foot of aquifer thickness once the leachate percolated to groundwater. This volumetric rate suggests that the leachate concentration must be five orders of magnitude higher than the NCAC 2L standard to cause an exceedance. Based upon this rate, none of the leachate concentrations were high enough to exceed this threshold.

Calculations

Mass balance calculations allow a constituent concentration in groundwater to be calculated based on the rate of constituent mass being moved into the aquifer and mixing with unaffected groundwater. Mass balance calculations were used to demonstrate that the liner design of Landfill No. 3 at the Weyerhaeuser facility in Plymouth, North Carolina, will be protective of groundwater quality.

The following equation was used to perform the mass balance calculations:

$$C_{GW} = \frac{(Q_R)(C_P) + (Q_{GW})(C_a)}{Q_R + Q_{GW}}$$

Where:

C_{GW}	-	Constituent concentration in groundwater
Q_R	-	Volumetric discharge through the landfill liner ($Q_R = rA_1$)
A_1	-	Phase 1 Landfill area (21.1 acres)
r	-	Recharge to the aquifer through the landfill liner
C_P	-	Constituent concentration in leachate
Q_{GW}	-	Volumetric discharge of groundwater moving beneath the landfill ($Q_{GW} = Kdh/dxA_2$)
K	-	Hydraulic conductivity of the shallow aquifer unit
dh/dx	-	Hydraulic gradient in the direction of groundwater flow
A_2	-	Cross sectional area perpendicular to groundwater flow ($A_2 = wb$)
w	-	Width of the Phase 1 Landfill
b	-	Mixing zone thickness (generally, equivalent to aquifer thickness)
C_a	-	Constituent concentration in groundwater upgradient from landfill

Parameter values were assigned conservatively and were obtained from existing data. Assignment of input parameters is discussed below.

Waste Characteristics

The pulp and paper production process results in various nonhazardous solid wastes, such as ash, dewatered secondary sludge, paper wastes, old corrugated container (OCC) rejects, green liquor dregs, slaker grits, lime mud, wood waste, and miscellaneous trash. Each of the above wastes was determined to be nonhazardous using the TCLP. Results of the TCLP tests indicate minor amounts of metals and volatile organic compounds leach from the waste. Analytical results from TCLP tests are presented in Table 1 (Attachment 1). Leachate constituent concentrations were assigned based on the TCLP data.

Landfill Footprint

The Phase 1 portion of Landfill No. 3 is located at the north end of the landfill. This phase has been designed to contain the production waste stream for a 5-year period. The design area of the Phase 1 landfill footprint is 21.1 acres. The landfill footprint is illustrated in Attachment 2.

Liner Leakage Rate

Recharge from the landfill liner was estimated using the United States Environmental Protection Agency (USEPA) Hydrologic Evaluation of Landfill Performance (HELP) model. The HELP model was developed by the US Army Engineer Waterways Experiment Station in Vicksburg, Mississippi (Schroeder, *et al.*, 1994, Version 3) to estimate the surface runoff, subsurface drainage, and leachate from various solid waste disposal facility designs. These calculated amounts are simulated by interpreting the combined effects of precipitation, surface storage, runoff, infiltration, percolation, evapotranspiration, soil moisture storage, and lateral drainage. Input parameters used in the HELP model are provided in Attachments 3 and 4. Our modeling assumed the liner was installed with "good" quality control, producing a maximum of four holes per acre. This HELP model resulted in an average annual percolation or leakage rate through the bottom of the landfill of 0.006 cubic feet/acre/year. This was used in the mass balance calculations for the liner design. The HELP model data are provided in Attachment 5.

Subsurface Conditions

The hydrogeologic setting is illustrated on the Data Point Location Map and Geologic Cross Sections, which are provided as Attachments 6 through 8. Raw historical groundwater levels in summary tables are provided in Attachment 9. Note that the "LF" designations on the tables and the hydrographs are the same "MW" designations on the site plans and associated documents. The "LFO" designations on the tables and the hydrographs are the same as the "OW" designations on the site plans and associated documents. The hydrogeologic setting consists of two aquifer units separated by an aquitard unit that appears to be laterally extensive throughout the site. The lower aquifer primarily consists of silty sand and exists under confined conditions. The shallow aquifer unit is unconfined and consists of silty sand with interbedded clay and clayey sand. Two shallow groundwater monitoring wells, OW-4 and OW-7, are located in the vicinity of the Phase 1 landfill. Boring logs and well construction diagrams for these two monitoring wells are provided in Attachments 10 and 11. The typical saturated thickness of the shallow aquifer unit, in the vicinity of the Phase 1 landfill, is approximately 10 feet. The base of the Phase 1 landfill will be positioned above the water table

in the shallow aquifer unit. Attachment 2 illustrates the locations of monitoring wells OW-4 and OW-7 in relation to the Phase 1 landfill footprint.

Groundwater Flow

The configuration of the water table in the shallow aquifer unit can generally be characterized as a groundwater divide with radial flow to the north, west, and east. The main axis of groundwater flow in the vicinity of the Phase 1 landfill is to the north. The hydraulic gradient along the main axis of flow, as mapped in 1993, is 0.013 ft/ft. The water table configuration as mapped in 1993 is illustrated in Attachment 2.

Hydraulic conductivity estimates for monitoring wells OW-4 and OW-7 were calculated from *in-situ* hydraulic conductivity tests. The geometeric mean of these estimates is 1.10×10^{-2} cm/sec. The hydraulic conductivity test data and results are provided as Attachment 12.

Mixing Zone Geometry

The mixing zone thickness was assigned conservatively as 10 percent of the typical aquifer saturated thickness. The width of the mixing zone is 500 feet, which is the maximum width of the Phase 1 landfill. The resulting cross sectional area, perpendicular to groundwater flow is 500 ft^2. Groundwater migrating into the mixing zone is assuming to be unaffected.

Mass Balance Calculations

Manganese was the most common constituent identified in the TCLP data and also exceeded its NCAC 2L standard by the greatest magnitude. This constituent was therefore used as an indicator of the effectiveness of the landfill liner design. Given the amount of leachate estimated to percolate through the liner and mixing within only the upper 1-foot of the aquifer, the resulting manganese concentration in groundwater would be 2.56×10^{-5} mg/L, compared to the NCAC 2L standard of 0.05 mg/L. Calculations are provided as Attachment 13.

The ratio of the leachate concentration to the NCAC 2L standard was calculated using the groundwater and leachate volumetric flow rates. This ratio demonstrates the leachate concentration must be approximately five orders of magnitude greater than the NCAC 2L standard in order for the standard to be exceeded in groundwater following mixing. For example, a leachate concentration of 29,000 mg/L (for manganese) would be required for the

0.05 mg/L, NCAC 2L standard to be exceeded after mixing. The leachate concentration: 2L standard ratio, when compared to the TCLP data collected from waste samples, indicate that leachate concentrations are not great enough to exceed NCAC 2L standards for any of the samples.

Attachments:

1 Table 1 - Summary of TCLP Laboratory Analyses
2 New Landfill - Phase 1
3 Table 2 - HELP Model Input Parameters
4 Table 3 - HELP Model Barrier and Drainage Layer Parameters
5 HELP Model Data
6 Data Point Location Map
7 Geologic Cross Sections - Sheet 1
8 Geologic Cross Sections - Sheet 2
9 Groundwater Elevation Data
10 Boring Logs
11 Well Construction Diagrams
12 Hydraulic Conductivity Test Results
13 Mass balance calculations

Table 1
Summary of TCLP Laboratory Analyses
April 1990

PARAMETER[1]	NCAC 2L Standards	LOCATION/SAMPLE DATE								LOCATION/SAMPLE DATE			
		Fly Ash 49119		Fly Ash 49134		DWT SLG 49121		DWT SLG 49136		COMP 3 49120		COMP 3 49135	
		4/5/90	Ratio	4/5/90	Ratio	4/5/90	Ratio	4/5/90	Ratio	4/5/90	Ratio	4/5/90	Ratio
Volatile Organics													
2-Butanone	0.17												
Methylene chloride	0.005					0.007 X	1.4E+00			0.002 XJ			
Toluene	1.0												
Inorganics													
Arsenic	0.05	0.02	4.0E-01			<0.003				0.086	1.7E+00		
Barium	2.0	0.24				0.31				1.5			
Cadmium	0.005	0.056	1.1E+01			<0.005				0.014	2.8E+00		
Chromium	0.05	0.03				<0.01				0.02			
Copper	1.0	0.05		<0.02		<0.02		<0.02		<0.02		0.07	
Iron	0.3	<0.1		<0.1		0.9	3.0E+00	0.4	1.3E+00	0.1		0.2	
Manganese	0.05	15	3.0E+02	0.006		0.92	1.8E+01	0.16	3.2E+00	6.6	1.3E+02	0.027	
Mercury	0.0011	<0.0002				<0.0002				<0.0002			
Nickel	0.1	0.3	3.0E+00	<0.02		0.08		<0.02		0.17	1.7E+00	<0.02	
Selenium	0.05	0.27	5.4E+00			<0.003				0.088	1.8E+00		
Zinc	2.1	3.2	1.5E+00	0.02		2.0		0.3		3.3	1.6E+00	20	9.5E+00
Chloride	250	69		66		11		8.1		32		44	
Fluoride	2.0	4.1	2.1E+00	0.67		<0.5		<0.5		<0.5		<0.5	
Nitrate	10	0.5		5.6		0.56		5.6		0.56		1.9	
Phenol	0.3	0.17		<0.012		0.23		0.013		<0.062		0.011	
Sulfate	250	810	3.2E+00	340	1.4E+00	<20		<10		160		140	

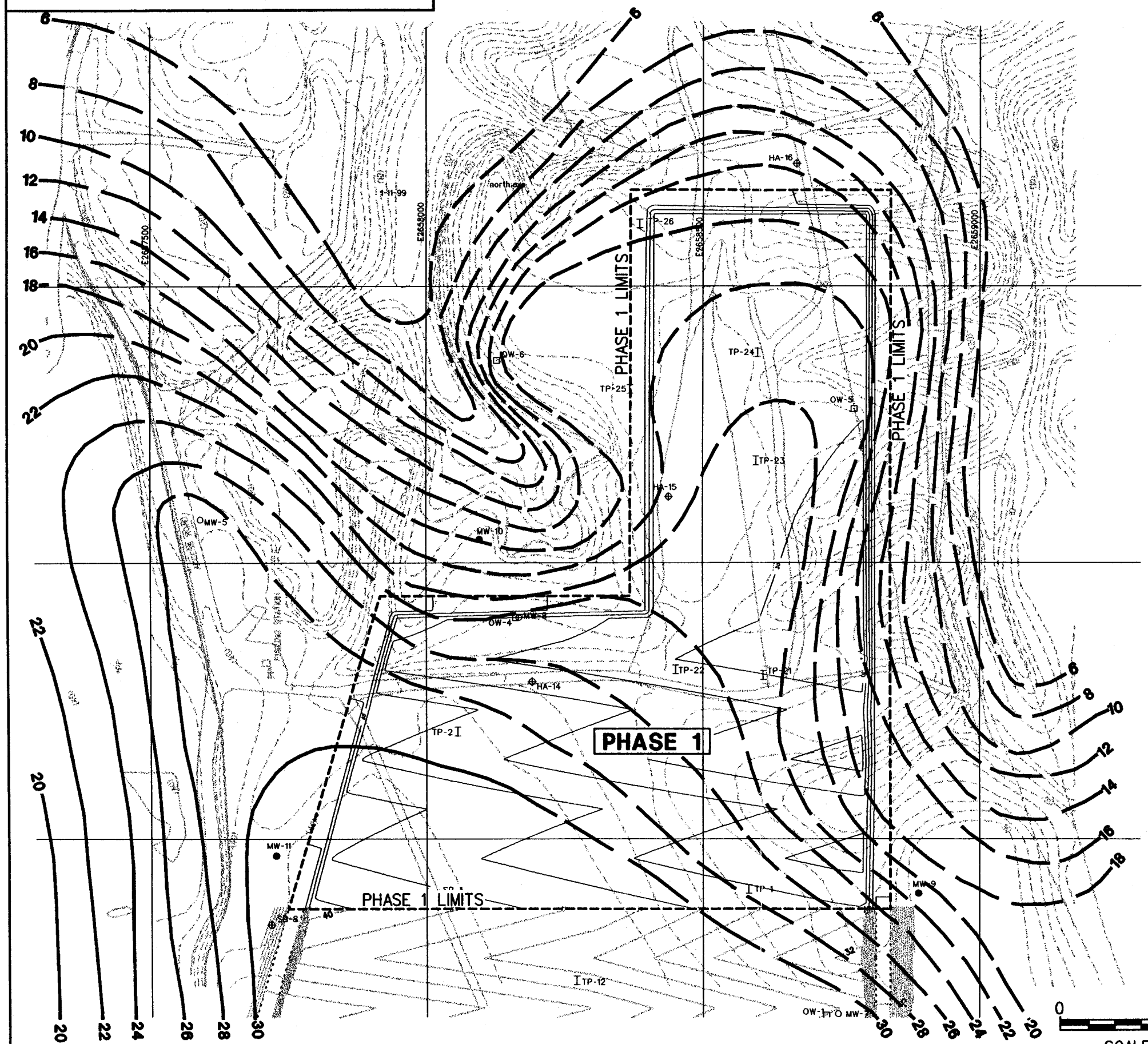
[1] Analytical results are reported in milligrams per liter (mg/L) unless otherwise noted.
J - Estimated concentration.
X - Recently removed from list of TCLP compounds. A screen was performed.
< - Concentration less than the Quantitation Limit or not validated if accompanied by "u" qualifier.
Shading indicates sample exceeds MCL.

Attachment 2

j:\cad\civil\weyerhae\5101001c\north.exp
dmc 1-15-99

Weyerhaeuser

PLYMOUTH, NORTH CAROLINA



LEGEND

32	EXISTING CNTOUR
32	NEW LINER CONTOUR
18	1993 WATER TABLE CONTOUR
	PHASE 1 LIMITS

0 200' 400'

SCALE: 1" = 200'

NEW LANDFILL
PHASE 1
FIGURE 11599

RMT

Drawn By:	D.M.C.
Approved By:	R.K.N.
Date:	
Proj. No.:	5101.01

Attachment 3

Table 2
HELP Model Input Parameters

Description	Parameter Used
Area Of Landfill	1 acre
Landfill Condition	open
Percentage Of Area Where Runoff Is Possible	0 percent
Evaporative Zone Depth	22 inches
Maximum Leaf Area Index For Vegetative Cover	0 (bare ground)
Start Of Growing Season (Julian Date)	94
End Of Growing Season (Julian Date)	311
Number Of Years For Synthetic Data Generation	20 years
Precipitation Input	Synthetic---Default
Temperature Input	Synthetic---User Input for Plymouth, NC
Solar Radiation Input	Synthetic---Default
Nearest City For Default Input	Raleigh, North Carolina
Depth Of Waste	2 feet
Leachate Collection System (LCS) Below Waste	18 inches of graded granular filter
Primary Liner	60-mil high density polyethylene (HDPE)
Leak Detection System	geocomposite
First Layer Of Secondary Composite Liner	60-mil high density polyethylene (HDPE)
Second Layer Of Secondary Composite Liner	geosynthetic clay liner (GCL)
SCS Runoff Curve Number	69

Attachment 4

Table 3
HELP Model Barrier and Drainage Layer Parameters

MATERIAL	THICK-NESS (inches)	SOIL TEXTURE	POROSITY	FIELD CAPACITY	WILTING POINT	INITIAL SOIL WATER CONTENT	EFFECTIVE SATURATED HYDRAULIC CONDUCT. (cm/sec)	SLOPE (%)	DRAIN LENGTH (feet)	FML PINHOLE DENSITY (holes/ac)	FML INSTALLA-TION DEFECTS (holes/ac)	FML PLACE-MENT QUALITY
WASTE	12	---	0.7625	0.2440	0.1360	0.1953	1.0E-05	---	---	---	---	---
WASTE	12	---	0.7625	0.2440	0.1360	0.4655	1.0E-05	---	---	---	---	---
LCS	18	21	0.3970	0.0320	0.0130	0.0322	3.0E-01	2	100	---	---	---
FML	0.06	35	0	0	0	0	2.0E-13	---	---	1	4	3—good
GEO-COMPOSITE	0.20	20	0.8500	0.010	0.005	0.010	1.0E+01	2	100	---	---	---
FML	0.06	35	0	0	0	0	2.0E-13	---	---	1	4	3—good
GCL	0.24	17	0.7500	0.7470	0.4000	0.7500	3.0E-09	---	---	---	---	---

Attachment 5

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******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**               HELP MODEL VERSION 3.01   (14 OCTOBER 1994)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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PRECIPITATION DATA FILE:      H:\DATA\COMMON\KORLESKS\HELP\DATA4.D4
TEMPERATURE DATA FILE:        H:\DATA\COMMON\KORLESKS\HELP\DATA7.D7
SOLAR RADIATION DATA FILE:    H:\DATA\COMMON\KORLESKS\HELP\DATA13.D13
EVAPOTRANSPIRATION DATA:      H:\DATA\COMMON\KORLESKS\HELP\DATA11.D11
SOIL AND DESIGN DATA FILE:    H:\DATA\COMMON\KORLESKS\HELP\DATA10.D10
OUTPUT DATA FILE:             H:\DATA\COMMON\KORLESKS\HELP\TESTOUT.OUT


TIME:  13:39      DATE:    8/31/1998


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     TITLE:  WEYERHAEUSER PLYMOUTH/OPEN LANDFILL/2' WASTE

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   0
          THICKNESS                    =     12.00   INCHES
          POROSITY                     =      0.7625 VOL/VOL
          FIELD CAPACITY               =      0.2440 VOL/VOL
```

```
WILTING POINT                  =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT     =      0.1953 VOL/VOL
EFFECTIVE SAT. HYD. COND.      =  0.999999975000E-05 CM/SEC


                          LAYER  2
                          --------

            TYPE 1 - VERTICAL PERCOLATION LAYER
                MATERIAL TEXTURE NUMBER   0
THICKNESS                      =     12.00   INCHES
POROSITY                       =      0.7625 VOL/VOL
FIELD CAPACITY                 =      0.2440 VOL/VOL
WILTING POINT                  =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT     =      0.4655 VOL/VOL
EFFECTIVE SAT. HYD. COND.      =  0.999999975000E-05 CM/SEC


                          LAYER  3
                          --------

             TYPE 2 - LATERAL DRAINAGE LAYER
               MATERIAL TEXTURE NUMBER  21
THICKNESS                      =     18.00   INCHES
POROSITY                       =      0.3970 VOL/VOL
FIELD CAPACITY                 =      0.0320 VOL/VOL
WILTING POINT                  =      0.0130 VOL/VOL
INITIAL SOIL WATER CONTENT     =      0.0322 VOL/VOL
EFFECTIVE SAT. HYD. COND.      =  0.300000012000      CM/SEC
SLOPE                          =      2.00   PERCENT
DRAINAGE LENGTH                =    100.0    FEET


                          LAYER  4
                          --------

             TYPE 4 - FLEXIBLE MEMBRANE LINER
               MATERIAL TEXTURE NUMBER  35
THICKNESS                      =      0.06   INCHES
POROSITY                       =      0.0000 VOL/VOL
FIELD CAPACITY                 =      0.0000 VOL/VOL
WILTING POINT                  =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT     =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.      =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY            =      1.00   HOLES/ACRE
FML INSTALLATION DEFECTS       =      4.00   HOLES/ACRE
```

```
FML PLACEMENT QUALITY          =  3 - GOOD


                          LAYER  5
                          --------

              TYPE 2 - LATERAL DRAINAGE LAYER
                MATERIAL TEXTURE NUMBER  20
THICKNESS                      =      0.20   INCHES
POROSITY                       =      0.8500 VOL/VOL
FIELD CAPACITY                 =      0.0100 VOL/VOL
WILTING POINT                  =      0.0050 VOL/VOL
INITIAL SOIL WATER CONTENT     =      0.0100 VOL/VOL
EFFECTIVE SAT. HYD. COND.      =   10.0000000000      CM/SEC
SLOPE                          =      2.00    PERCENT
DRAINAGE LENGTH                =    100.0     FEET


                          LAYER  6
                          --------

              TYPE 4 - FLEXIBLE MEMBRANE LINER
                MATERIAL TEXTURE NUMBER  35
THICKNESS                      =      0.06   INCHES
POROSITY                       =      0.0000 VOL/VOL
FIELD CAPACITY                 =      0.0000 VOL/VOL
WILTING POINT                  =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT     =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.      =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY            =      1.00   HOLES/ACRE
FML INSTALLATION DEFECTS       =      4.00   HOLES/ACRE
FML PLACEMENT QUALITY          =  3 - GOOD


                          LAYER  7
                          --------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER  17
THICKNESS                      =      0.24   INCHES
POROSITY                       =      0.7500 VOL/VOL
FIELD CAPACITY                 =      0.7470 VOL/VOL
WILTING POINT                  =      0.4000 VOL/VOL
INITIAL SOIL WATER CONTENT     =      0.7500 VOL/VOL
EFFECTIVE SAT. HYD. COND.      =  0.300000003000E-08 CM/SEC
```

Technical Memorandum

Date: September 30, 1998

To: Wynne Shaw - Weyerhaeuser

xc: Mac Jones, Joe Kloeker - Weyerhaeuser
Kathy Huibregtse, Dan Madison, Kent Nilsson - RMT
Project File - 00-05101.01

From: Jon Freitag/Sharon Korleski JK SK

Subject: Mass Balance Calculations for Liner Design of Landfill Number Three

Summary of Calculations

Mass balance calculations were used to evaluate the effectiveness of one liner design of Landfill Number Three at the Weyerhaeuser facility in Plymouth, North Carolina. The concentrations of the constituents measured in TCLP tests were used in the calculations. Other parameter values were assigned conservatively or based upon available data. The calculated leachate concentrations were adjusted to account for mixing in the top one foot of aquifer thickness once the leachate percolated to one groundwater. This volumetric rate suggests that the leachate concentration must be four times higher than the 21 standard to cause an exceedance. Based upon this rate, none of the leachate concentrations were high enough to exceed this threshold.

Calculations

Mass balance calculations allow a constituent concentration in groundwater to be calculated based on the rate of constituent mass being moved into the aquifer and mixing with unaffected groundwater. Mass balance calculations were used to demonstrate that the liner design of Landfill Number Three at the Weyerhaueser facility in Plymouth, North Carolina will be protective of groundwater quality.

The following equation was used to perform the mass balance calculations:

$$C_{GW} = \frac{(Q_R)(C_P) + (Q_{GW})(C_a)}{Q_R + Q_{GW}}$$

Where:	C_{GW}	-	Constituent concentration in groundwater
	Q_R	-	Volumetric discharge through the landfill liner ($Q_R = rA$)
	C_P	-	Constituent concentration in leachate
	Q_{GW}	-	Volumetric discharge of groundwater moving beneath the landfill ($Q_{GW} = KiA$)
	C_a	-	Constituent concentration in groundwater up gradient from landfill
	L	-	Maximum length of the landfill
	w	-	Maximum width of the landfill
	A	-	Landfill area (96 acres)
	r	-	Recharge to the aquifer through the landfill liner
	b	-	Mixing zone thickness (generally, equivalent to aquifer thickness)
	i	-	Hydraulic gradient in the direction of groundwater flow
	K	-	Hydraulic conductivity of soil unit beneath the liner

Parameter values were assigned conservatively with respect to leachate concentrations and mixing zone thickness. Leachate concentrations were assigned from TCLP data collected from waste samples. The mixing zone thickness assigned was approximately 10% of the typical aquifer saturated thickness.

Values for other parameters were assigned based on available data. The maximum area of the landfill foot-print design is anticipated to be approximately 110 acres. The hydraulic gradient was measured along the primary axis of groundwater flow in the water table configuration as mapped in 1993. Hydraulic conductivity was assigned as the geometric mean of hydraulic conductivity estimates calculated from slug tests performed on site monitoring wells. Recharge from the landfill liner was estimated using the USEPA Hydrologic Evaluation of Landfill Performance (HELP) model. The HELP model was developed by the U.S. Army Engineer Waterways Experiment Station in Vicksburg, Mississippi (Schroeder, et al., 1994, Version 3) to estimate the surface runoff, subsurface drainage, and leachate from various solid waste disposal facility designs. These calculated amounts are simulated by interpreting the combined effects of precipitation, surface storage, runoff, infiltration, percolation, evapotranspiration, soil moisture storage, and lateral drainage. Input parameters used in the HELP model are provided in Tables 1 and 2. Our modeling assumed the liner was installed with "good" quality control,

producing a maximum of 4 holes per acre. This HELP model resulted in an average annual percolation or leakage rate through the bottom of the landfill of 0.006 cubic feet/acre/year. This was used in the mass balance calculations for the liner design. The HELP model data are attached.

Manganese was the most common constituent identified in the TCLP data and also exceeded its NCAC 2L standard by the greatest magnitude. This constituent was therefore used as an indicator of the effectiveness of the landfill liner design. Given the amount of leachate estimated to percolate through the liner and mixing within only the upper 1 foot of the aquifer the resulting manganese concentration in groundwater would be 1.3×10^{-3} mg/L, compared to the NCAC 2L standard of 0.05 mg/L.

The ratio of the leachate concentration to the 2L standard was calculated using the groundwater and leachate volumetric flow rates. This ratio demonstrates the leachate concentration must be approximately four orders of magnitude greater than the 2L standard in order for the standard to be exceeded in groundwater following mixing. For example, a leachate concentration of 500 mg/L (for manganese) would be required for the 0.05 mg/L, NCAC 2L standard to be exceeded after mixing. The leachate concentration: 2L standard ratio, when compared to the TCLP data collected from sludge samples, indicate that leachate concentrations are not great enough to exceed NCAC 2L standards for any of the samples.

Attachments:
- HELP model data
- Mass balance calculations (3 pages)
- TCLP Summary Table
- Table 1
- Table 2

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**               HELP MODEL VERSION 3.01    (14 OCTOBER 1994)               **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
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PRECIPITATION DATA FILE:      H:\DATA\COMMON\KORLESKS\HELP\DATA4.D4
TEMPERATURE DATA FILE:        H:\DATA\COMMON\KORLESKS\HELP\DATA7.D7
SOLAR RADIATION DATA FILE:    H:\DATA\COMMON\KORLESKS\HELP\DATA13.D13
EVAPOTRANSPIRATION DATA:      H:\DATA\COMMON\KORLESKS\HELP\DATA11.D11
SOIL AND DESIGN DATA FILE:    H:\DATA\COMMON\KORLESKS\HELP\DATA10.D10
OUTPUT DATA FILE:             H:\DATA\COMMON\KORLESKS\HELP\TESTOUT.OUT


TIME:  13:39      DATE:    8/31/1998


******************************************************************************

     TITLE:  WEYERHAEUSER PLYMOUTH/OPEN LANDFILL/2' WASTE

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   0
          THICKNESS                  =      12.00   INCHES
          POROSITY                   =       0.7625 VOL/VOL
          FIELD CAPACITY             =       0.2440 VOL/VOL
```

```
WILTING POINT                  =       0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT     =       0.1953 VOL/VOL
EFFECTIVE SAT. HYD. COND.      =  0.999999975000E-05 CM/SEC


                          LAYER  2
                          --------

            TYPE 1 - VERTICAL PERCOLATION LAYER
                MATERIAL TEXTURE NUMBER   0
THICKNESS                      =      12.00   INCHES
POROSITY                       =       0.7625 VOL/VOL
FIELD CAPACITY                 =       0.2440 VOL/VOL
WILTING POINT                  =       0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT     =       0.4655 VOL/VOL
EFFECTIVE SAT. HYD. COND.      =  0.999999975000E-05 CM/SEC


                          LAYER  3
                          --------

             TYPE 2 - LATERAL DRAINAGE LAYER
               MATERIAL TEXTURE NUMBER  21
THICKNESS                      =      18.00   INCHES
POROSITY                       =       0.3970 VOL/VOL
FIELD CAPACITY                 =       0.0320 VOL/VOL
WILTING POINT                  =       0.0130 VOL/VOL
INITIAL SOIL WATER CONTENT     =       0.0322 VOL/VOL
EFFECTIVE SAT. HYD. COND.      =  0.300000012000      CM/SEC
SLOPE                          =       2.00   PERCENT
DRAINAGE LENGTH                =     100.0    FEET


                          LAYER  4
                          --------

             TYPE 4 - FLEXIBLE MEMBRANE LINER
               MATERIAL TEXTURE NUMBER  35
THICKNESS                      =       0.06   INCHES
POROSITY                       =       0.0000 VOL/VOL
FIELD CAPACITY                 =       0.0000 VOL/VOL
WILTING POINT                  =       0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT     =       0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.      =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY            =       1.00   HOLES/ACRE
FML INSTALLATION DEFECTS       =       4.00   HOLES/ACRE
```

```
FML PLACEMENT QUALITY          =  3 - GOOD


                              LAYER  5
                              --------

                 TYPE 2 - LATERAL DRAINAGE LAYER
                   MATERIAL TEXTURE NUMBER  20
THICKNESS                     =       0.20   INCHES
POROSITY                      =       0.8500 VOL/VOL
FIELD CAPACITY                =       0.0100 VOL/VOL
WILTING POINT                 =       0.0050 VOL/VOL
INITIAL SOIL WATER CONTENT    =       0.0100 VOL/VOL
EFFECTIVE SAT. HYD. COND.     =   10.0000000000      CM/SEC
SLOPE                         =       2.00    PERCENT
DRAINAGE LENGTH               =     100.0     FEET


                              LAYER  6
                              --------

                 TYPE 4 - FLEXIBLE MEMBRANE LINER
                   MATERIAL TEXTURE NUMBER  35
THICKNESS                     =       0.06   INCHES
POROSITY                      =       0.0000 VOL/VOL
FIELD CAPACITY                =       0.0000 VOL/VOL
WILTING POINT                 =       0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT    =       0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.     =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY           =       1.00    HOLES/ACRE
FML INSTALLATION DEFECTS      =       4.00    HOLES/ACRE
FML PLACEMENT QUALITY         =  3 - GOOD


                              LAYER  7
                              --------

                 TYPE 3 - BARRIER SOIL LINER
                   MATERIAL TEXTURE NUMBER  17
THICKNESS                     =       0.24   INCHES
POROSITY                      =       0.7500 VOL/VOL
FIELD CAPACITY                =       0.7470 VOL/VOL
WILTING POINT                 =       0.4000 VOL/VOL
INITIAL SOIL WATER CONTENT    =       0.7500 VOL/VOL
EFFECTIVE SAT. HYD. COND.     =  0.300000003000E-08 CM/SEC
```

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

SCS RUNOFF CURVE NUMBER	=	63.00	
FRACTION OF AREA ALLOWING RUNOFF	=	0.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	22.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	6.612	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	16.775	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	2.992	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	8.691	INCHES
TOTAL INITIAL WATER	=	8.691	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
RALEIGH NORTH CAROLINA

MAXIMUM LEAF AREA INDEX	=	0.00	
START OF GROWING SEASON (JULIAN DATE)	=	94	
END OF GROWING SEASON (JULIAN DATE)	=	311	
AVERAGE ANNUAL WIND SPEED	=	7.70	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	66.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	70.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	78.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	72.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR RALEIGH NORTH CAROLINA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.55	3.43	3.69	2.91	3.67	3.66
4.38	4.44	3.29	2.73	2.87	3.14

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR RALEIGH NORTH CAROLINA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
42.10	43.90	50.90	60.30	67.70	74.30
78.00	77.30	72.00	61.50	52.40	44.60

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR RALEIGH NORTH CAROLINA

STATION LATITUDE = 35.87 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.47	2.89	3.81	2.20	4.34	3.74
	4.24	5.43	2.40	2.87	3.05	2.80
STD. DEVIATIONS	2.11	1.24	1.51	1.52	2.22	1.98
	1.91	3.72	1.67	2.00	1.79	1.04
RUNOFF						
TOTALS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION						
TOTALS	1.589	1.931	2.699	2.180	3.236	3.122
	3.524	3.537	2.295	1.818	1.760	1.453
STD. DEVIATIONS	0.483	0.336	0.626	1.070	1.166	1.265

	1.228	1.058	1.061	0.758	0.507	0.247

LATERAL DRAINAGE COLLECTED FROM LAYER 3

TOTALS	0.6385	0.6289	0.4560	0.2443	0.2133	0.3204
	0.2221	0.3385	0.5094	0.2113	0.3368	0.3970
STD. DEVIATIONS	0.5802	0.6367	0.4012	0.2394	0.3223	0.3921
	0.2517	0.7083	0.9913	0.4182	0.4047	0.4381

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.8816	0.8606	0.7509	0.5254	0.4358	0.5292
	0.4572	0.5041	0.6715	0.4312	0.5587	0.6483
STD. DEVIATIONS	0.4780	0.5387	0.3817	0.2726	0.2756	0.4234
	0.3099	0.6256	0.8192	0.3468	0.3953	0.4392

LATERAL DRAINAGE COLLECTED FROM LAYER 5

TOTALS	0.8816	0.8606	0.7509	0.5254	0.4358	0.5292
	0.4572	0.5041	0.6715	0.4312	0.5587	0.6483
STD. DEVIATIONS	0.4780	0.5387	0.3817	0.2726	0.2756	0.4234
	0.3099	0.6256	0.8192	0.3468	0.3953	0.4392

PERCOLATION/LEAKAGE THROUGH LAYER 7

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ACROSS LAYER 4

AVERAGES	0.0757	0.0825	0.0490	0.0252	0.0271	0.0359
	0.0225	0.0446	0.0727	0.0272	0.0363	0.0411
STD. DEVIATIONS	0.0802	0.0982	0.0497	0.0271	0.0511	0.0459
	0.0270	0.1098	0.1694	0.0691	0.0500	0.0488

DAILY AVERAGE HEAD ACROSS LAYER 7

AVERAGES	0.0028	0.0030	0.0024	0.0017	0.0014	0.0018
	0.0015	0.0016	0.0022	0.0014	0.0018	0.0021

STD. DEVIATIONS	0.0015	0.0019	0.0012	0.0009	0.0009	0.0014
	0.0010	0.0020	0.0027	0.0011	0.0013	0.0014

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	INCHES		CU. FEET	PERCENT
PRECIPITATION	41.25	(8.104)	149735.7	100.00
RUNOFF	0.000	(0.0000)	0.00	0.000
EVAPOTRANSPIRATION	29.143	(3.4443)	105790.49	70.651
LATERAL DRAINAGE COLLECTED FROM LAYER 3	4.51652	(2.86126)	16394.961	10.94927
PERCOLATION/LEAKAGE THROUGH FROM LAYER 4	7.25447	(2.64756)	26333.740	17.58681
AVERAGE HEAD ACROSS TOP OF LAYER 4	0.045	(0.037)		
LATERAL DRAINAGE COLLECTED FROM LAYER 5	7.25447	(2.64756)	26333.734	17.58681
PERCOLATION/LEAKAGE THROUGH FROM LAYER 7	0.00000	(0.00000)	0.006	0.00000
AVERAGE HEAD ACROSS TOP OF LAYER 7	0.002	(0.001)		
CHANGE IN WATER STORAGE	0.335	(1.2481)	1216.52	0.812

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□

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	5.22	18948.600

RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 3	0.19100	693.34552
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.149147	541.40247
AVERAGE HEAD ACROSS LAYER 4	1.052	
DRAINAGE COLLECTED FROM LAYER 5	0.14915	541.40247
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00003
AVERAGE HEAD ACROSS LAYER 7	0.015	
SNOW WATER	1.80	6541.2695

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.7473
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1399

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FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	6.9288	0.5774
2	7.6950	0.6413
3	0.5879	0.0327
4	0.0000	0.0000
5	0.0020	0.0100
6	0.0000	0.0000
7	0.1800	0.7500
SNOW WATER	0.000	

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DESIGN SHEET

RMT

Mixing Calculations SHEET 1 OF 3

100 Verdae Boulevard P.O. Box 16778 Greenville, SC 29607-3825 Phone: 864-281-0030 FAX: 864-281-0288

PROJECT/PROPOSAL NAME	PREPARED By:	PREPARED Date:	CHECKED By:	CHECKED Date:	PROJECT/PROPOSAL NO.
Weyerhaeuser					

$r = 0.006\ ft^3/acre/yr\ ;\ 1.44 \times 10^{-7}\ ft/yr$ — HELP model - open configuration

$K = 6.55 \times 10^{-4}\ ft/min$ — Geometric mean of hydraulic conductivity estimates

$A_1 = 110\ acres\ ;\ 4.59 \times 10^{6}\ ft^2$ — Area of landfill footprint

$i = 0.012\ ft/ft$ — Hydraulic gradient (1993)

$A_2 = 2050\ ft^2\ (A = bw)$ — Cross sectional area perpendicular to

$w = 2050\ ft$ — Landfill width

$b = 1\ ft$ — Mixing zone thickness

$Q_R = r A_1$

$Q_R = 1.44 \times 10^{-7}\ ft/yr\ (4.59 \times 10^{6}\ ft^2)$

$Q_R = 0.66\ ft^3/yr\ ;\ 1.26 \times 10^{-6}\ ft^3/min$

$Q_{GW} = K i A_2$

$Q_{GW} = 6.55 \times 10^{-4}\ ft/min\ (0.012\ ft/ft)\ (2050\ ft^2)$

$Q_{GW} = 0.016\ ft^3/min$

DESIGN SHEET

RMT

Mixing Calculations SHEET 2 OF 3

100 Verdae Boulevard P.O. Box 16778 Greenville, SC 29607-3825 Phone: 864-281-0030 FAX: 864-281-0288

PROJECT/PROPOSAL NAME	PREPARED By:	PREPARED Date:	CHECKED By:	CHECKED Date:	PROJECT/PROPOSAL NO.

$$C_{GW} = \frac{(Q_R)(C_P) + (Q_{GW})(C_G)}{Q_R + Q_{GW}}$$

$$C_{GW} = \frac{Q_R(C_P)}{Q_R + Q_{GW}}$$

Assuming up-gradient groundwater is clean

$$\frac{C_{GW}}{C_P} = \frac{Q_R}{Q_R + Q_{GW}}$$

$$\frac{C_P}{C_{GW}} = \frac{Q_R + Q_{GW}}{Q_R}$$

$$\frac{C_P}{2L} = \frac{Q_R + Q_{GW}}{Q_R}$$

Assuming NCAC 2L standard is the maximum allowable concentration in groundwater.

$$\frac{C_P}{2L} = \frac{1.26\times10^{-6}\ ft^3/min + 0.016\ ft^3/min}{1.26\times10^{-6}\ ft^3/min}$$

$$\frac{C_P}{2L} = 1.27\times10^{4}$$

The landfill leachate concentration can be 4 orders of magnitude greater than the 2L standard for any given constituent.

DESIGN SHEET

Manganese Mixing Calc. SHEET 3 OF 3

100 Verdae Boulevard P.O. Box 16778 Greenville, SC 29607-3825 Phone: 864-281-0030 FAX: 864-281-0288

PROJECT/PROPOSAL NAME	PREPARED By:	PREPARED Date:	CHECKED By:	CHECKED Date:	PROJECT/PROPOSAL NO.
Weyerhaeuser	JAF	9-17-96			5101.01

Sample # 49119

- Contained some of the highest constituent concentrations from the TCLP data ✓
- Manganese - 15 ppm vs 2L of 0.05 ppm

$$C_{GW} = \frac{Q_R (C_P)}{Q_R + Q_{GW}}$$

$$C_{GW} = \frac{1.26 \times 10^{-6}\ ft^3/min\ (15\ ppm)}{1.26 \times 10^{-6}\ ft^3/min + 0.016\ ft^3/min}$$

$$C_{GW} = 0.0012\ ppm$$

Summary of TCLP Laboratory Analyses
April 1990

PARAMETER[1]	NCAC 2L Standards	LOCATION/SAMPLE DATE										LOCATION/SAMPLE DATE	
		Fly Ash 49119		Fly Ash 49134		DWT SLG 49121		DWT SLG 49136		COMP 3 49120		COMP 3 49135	
		4/5/90	Ratio	4/5/90	Ratio	4/5/90	Ratio	4/5/90	Ratio	4/5/90	Ratio	4/5/90	Ratio
Volatile Organics													
2-Butanone	0.17												
Methylene chloride	0.005					0.007 X	1.4E+00			0.002 XJ			
Toluene	1.0												
Inorganics													
Arsenic	0.05	0.02	4.0E-01			<0.003				0.086	1.7E+00		
Barium	2.0	0.24				0.31				1.5			
Cadmium	0.005	0.056	1.1E+01			<0.005				0.014	2.8E+00		
Chromium	0.05	0.03				<0.01				0.02			
Copper	1.0	0.05		<0.02		<0.02		<0.02		<0.02		0.07	
Iron	0.3	<0.1		<0.1		0.9	3.0E+00	0.4	1.3E+00	0.1		0.2	
Manganese	0.05	15	3.0E+02	0.006		0.92	1.8E+01	0.16	3.2E+00	6.6	1.3E+02	0.027	
Mercury	0.0011	<0.0002				<0.0002				<0.0002			
Nickel	0.1	0.3	3.0E+00	<0.02		0.08		<0.02		0.17	1.7E+00	<0.02	
Selenium	0.05	0.27	5.4E+00			<0.003				0.088	1.8E+00		
Zinc	2.1	3.2	1.5E+00	0.02		2.0		0.3		3.3	1.6E+00	20	9.5E+00
Chloride	250	69		66		11		8.1		32		44	
Fluoride	2.0	4.1	2.1E+00	0.67		<0.5		<0.5		<0.5		<0.5	
Nitrate	10	0.5		5.6		0.56		5.6		0.56		1.9	
Phenol	0.3	0.17		<0.012		0.23		0.013		<0.062		0.011	
Sulfate	250	810	3.2E+00	340	1.4E+00	<20		<10		160		140	

[1] Analytical results are reported in milligrams per liter (mg/L) unless otherwise noted.

J - Estimated concentration.

X - Recently removed from list of TCLP compounds. A screen was performed.

< - Concentration less than the Quantitation Limit or not validated if accompanied by "u" qualifier.

Shading indicates sample exceeds MCL.

Table 1
HELP Model Input Parameters

Description	Parameter Used
Area Of Landfill	1 acre
Landfill Condition	open
Percentage Of Area Where Runoff Is Possible	0 percent
Evaporative Zone Depth	22 inches
Maximum Leaf Area Index For Vegetative Cover	0 (bare ground)
Start Of Growing Season (Julian Date)	94
End Of Growing Season (Julian Date)	311
Number Of Years For Synthetic Data Generation	20 years
Precipitation Input	Synthetic---Default
Temperature Input	Synthetic---User Input for Plymouth, NC
Solar Radiation Input	Synthetic---Default
Nearest City For Default Input	Raleigh, North Carolina
Depth Of Waste	2 feet
Leachate Collection System (LCS) Below Waste	18 inches of graded granular filter
Primary Liner	60-mil high density polyethylene (HDPE)
Leak Detection System	geocomposite
First Layer Of Secondary Composite Liner	60-mil high density polyethylene (HDPE)
Second Layer Of Secondary Composite Liner	geosynthetic clay liner (GCL)
SCS Runoff Curve Number	69

Table 2
HELP Model Barrier and Drainage Layer Parameters

MATERIAL	THICK-NESS (inches)	SOIL TEXTURE	POROSITY	FIELD CAPACITY	WILTING POINT	INITIAL SOIL WATER CONTENT	EFFECTIVE SATURATED HYDRAULIC CONDUCT. (cm/sec)	SLOPE (%)	DRAIN LENGTH (feet)	FML PINHOLE DENSITY (holes/ac)	FML INSTALLA-TION DEFECTS (holes/ac)	FML PLACE-MENT QUALITY
WASTE	12	---	0.7625	0.2440	0.1360	0.1953	1.0E-05	---	---	---	---	---
WASTE	12	---	0.7625	0.2440	0.1360	0.4655	1.0E-05	---	---	---	---	---
LCS	18	21	0.3970	0.0320	0.0130	0.0322	3.0E-01	2	100	---	---	---
FML	0.06	35	0	0	0	0	2.0E-13	---	---	1	4	3 – good
GEO-COMPOSITE	0.20	20	0.8500	0.010	0.005	0.010	1.0E+01	2	100	---	---	---
FML	0.06	35	0	0	0	0	2.0E-13	---	---	1	4	3 – good
GCL	0.24	17	0.7500	0.7470	0.4000	0.7500	3.0E-09	---	---	---	---	---

December 21, 1998

Mr. Jim Coffey
Environmental Engineering Supervisor
Division of Waste Management
NC DENR
401 Oberlin Road, Suite 150
Raleigh, NC 27605

Subject: Proposed No. 3 Landfill, Weyerhaeuser Company
Plymouth, North Carolina
Alternate Liner Design

Dear Jim:

In a meeting we held at your office on August 10, 1998, we discussed alternative liner designs that we are considering for Weyerhaeuser's No. 3 Landfill. At that time you indicated that modeling would be required for any alternative liner other than two that have already been approved by the Agency. Modeling would need to demonstrate the proposed line is protective of the groundwater.

At this time we are considering a **double composite liner** consisting of the following elements, from top to bottom:

- 60 mil HDPE geomembrane
- Geosynthetic clay liner
- Drainage composite leak detection layer
- 60 mil HDPE geomembrane
- Geosynthetic clay liner

I have attached a technical memorandum that addresses protection of 2L Groundwater Standards using mass balance calculations. These calculations are based on assumptions we consider to be highly conservative. Leakage rates from our HELP model were based on an open landfill configuration that consisted of the following section:

- 24 inches of ash waste
- 18 inch aggregate drainage layer
- 60 mil HDPE geomembrane
- Geocomposite drainage layer
- 60 mil HDPE geomember
- Geosynthetic clay liner (GCL)

RMT, INC., NORTH CAROLINA
100 VERDAE BLVD. ■ 29607-3825
P.O. BOX 16778 ■ 29606-6778
GREENVILLE, SC
864/281-0030 ■ 864/281-0288 FAX

In this model our primary liner was considered to be a single liner rather than a composite.

Our analysis concludes that the proposed liner is protective of 2L Groundwater Standards. We would appreciate your timely feedback so that we may proceed with our landfill permit submittal with some confidence that this alternate liner is acceptable to NC DENR.

Please feel free to contact me if I can provide any additional clarification or information.

Sincerely,

RMT, Inc.

R. Kent Nilsson, P.E.
Project Manager

Attachment

cc: Ed Timmons, RMT
Debbie Strom, RMT
Project File - 5101.01

DEC 1998
Received
Solid Waste
Section

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INITIAL WATER IN EVAPORATIVE ZONE	=	6.612	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	16.775	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	2.992	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	8.691	INCHES
TOTAL INITIAL WATER	=	8.691	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

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NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
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AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	70.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	78.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	72.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR RALEIGH NORTH CAROLINA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.55	3.43	3.69	2.91	3.67	3.66
4.38	4.44	3.29	2.73	2.87	3.14

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR RALEIGH NORTH CAROLINA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
42.10	43.90	50.90	60.30	67.70	74.30
78.00	77.30	72.00	61.50	52.40	44.60

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR RALEIGH NORTH CAROLINA

STATION LATITUDE = 35.87 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.47	2.89	3.81	2.20	4.34	3.74
	4.24	5.43	2.40	2.87	3.05	2.80
STD. DEVIATIONS	2.11	1.24	1.51	1.52	2.22	1.98
	1.91	3.72	1.67	2.00	1.79	1.04
RUNOFF						
TOTALS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION						
TOTALS	1.589	1.931	2.699	2.180	3.236	3.122
	3.524	3.537	2.295	1.818	1.760	1.453
STD. DEVIATIONS	0.483	0.336	0.626	1.070	1.166	1.265

	1.228	1.058	1.061	0.758	0.507	0.247

LATERAL DRAINAGE COLLECTED FROM LAYER 3

TOTALS	0.6385	0.6289	0.4560	0.2443	0.2133	0.3204
	0.2221	0.3385	0.5094	0.2113	0.3368	0.3970
STD. DEVIATIONS	0.5802	0.6367	0.4012	0.2394	0.3223	0.3921
	0.2517	0.7083	0.9913	0.4182	0.4047	0.4381

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.8816	0.8606	0.7509	0.5254	0.4358	0.5292
	0.4572	0.5041	0.6715	0.4312	0.5587	0.6483
STD. DEVIATIONS	0.4780	0.5387	0.3817	0.2726	0.2756	0.4234
	0.3099	0.6256	0.8192	0.3468	0.3953	0.4392

LATERAL DRAINAGE COLLECTED FROM LAYER 5

TOTALS	0.8816	0.8606	0.7509	0.5254	0.4358	0.5292
	0.4572	0.5041	0.6715	0.4312	0.5587	0.6483
STD. DEVIATIONS	0.4780	0.5387	0.3817	0.2726	0.2756	0.4234
	0.3099	0.6256	0.8192	0.3468	0.3953	0.4392

PERCOLATION/LEAKAGE THROUGH LAYER 7

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ACROSS LAYER 4

AVERAGES	0.0757	0.0825	0.0490	0.0252	0.0271	0.0359
	0.0225	0.0446	0.0727	0.0272	0.0363	0.0411
STD. DEVIATIONS	0.0802	0.0982	0.0497	0.0271	0.0511	0.0459
	0.0270	0.1098	0.1694	0.0691	0.0500	0.0488

DAILY AVERAGE HEAD ACROSS LAYER 7

AVERAGES	0.0028	0.0030	0.0024	0.0017	0.0014	0.0018
	0.0015	0.0016	0.0022	0.0014	0.0018	0.0021

STD. DEVIATIONS	0.0015	0.0019	0.0012	0.0009	0.0009	0.0014
	0.0010	0.0020	0.0027	0.0011	0.0013	0.0014

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	INCHES		CU. FEET	PERCENT
PRECIPITATION	41.25	(8.104)	149735.7	100.00
RUNOFF	0.000	(0.0000)	0.00	0.000
EVAPOTRANSPIRATION	29.143	(3.4443)	105790.49	70.651
LATERAL DRAINAGE COLLECTED FROM LAYER 3	4.51652	(2.86126)	16394.961	10.94927
PERCOLATION/LEAKAGE THROUGH FROM LAYER 4	7.25447	(2.64756)	26333.740	17.58681
AVERAGE HEAD ACROSS TOP OF LAYER 4	0.045	(0.037)		
LATERAL DRAINAGE COLLECTED FROM LAYER 5	7.25447	(2.64756)	26333.734	17.58681
PERCOLATION/LEAKAGE THROUGH FROM LAYER 7	0.00000	(0.00000)	0.006	0.00000
AVERAGE HEAD ACROSS TOP OF LAYER 7	0.002	(0.001)		
CHANGE IN WATER STORAGE	0.335	(1.2481)	1216.52	0.812

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	5.22	18948.600

RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 3	0.19100	693.34552
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.149147	541.40247
AVERAGE HEAD ACROSS LAYER 4	1.052	
DRAINAGE COLLECTED FROM LAYER 5	0.14915	541.40247
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00003
AVERAGE HEAD ACROSS LAYER 7	0.015	
SNOW WATER	1.80	6541.2695

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.7473

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1399

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FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	6.9288	0.5774
2	7.6950	0.6413
3	0.5879	0.0327
4	0.0000	0.0000
5	0.0020	0.0100
6	0.0000	0.0000
7	0.1800	0.7500
SNOW WATER	0.000	

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Attachments 6, 7 and 8

Drawings Under Seperate Cover

Attachment 9

GROUND WATER ELEVATION DATA
WEYERHAEUSER LANDFILL
PLYMOUTH, NORTH CAROLINA
E096-007

SITE	DATE	MP ELEVATION	TIME	DEPTH TO WATER	WATER ELEV.
LF-01	8/16/89	37.59	0:00	4	33.59
LF-01	8/16/90	37.59	0:00	7.91	29.68
LF-01	11/20/90	37.59	0:00	11.42	26.17
LF-01	12/14/90	37.59	0:00	8.88	28.71
LF-01	1/14/91	37.59	0:00	8.17	29.42
LF-01	2/14/91	37.59	0:00	6.21	31.38
LF-01	3/20/91	37.59	0:00	5.42	32.17
LF-01	4/2/93	37.59	0:00	2.92	34.67
LF-01	6/4/93	37.59	0:00	6.21	31.38
LF-01	8/17/93	37.59	0:00	8.29	29.3
LF-01	9/20/93	37.59	0:00	8.88	28.71
LF-01	10/14/93	37.59	0:00	9.25	28.34
LF-01	11/29/93	37.59	0:00	9	28.59
LF-01	12/22/93	37.59	0:00	8.27	29.32
LF-01	1/10/94	37.59	0:00	8.12	29.47
LF-01	2/22/94	37.59	0:00	5.53	32.06
LF-01	5/23/94	37.59	0:00	7.05	30.54
LF-01	6/21/94	37.59	0:00	7.96	29.63
LF-01	7/27/94	37.59	0:00	9	28.59
LF-01	10/20/94	37.57	15:45	7.95	29.62
LF-01	2/28/95	37.57	13:28	4.92	32.65
LF-01	4/20/95	37.59	10:15	6.76	30.83
LF-01	1/26/96	37.59	13:30	7.05	30.54
LF-01	10/7/96	37.59	15:05	5.9	31.69
LF-01	11/5/96	37.59	17:22	4.65	32.94
LF-01	12/4/96	37.59	14:48	5.96	31.63
LF-01	1/8/97	37.59	14:11	4.25	33.34
LF-01	2/5/97	37.59	14:06	4.38	33.21
LF-01	3/6/97	37.59	15:17	4.31	33.28
LF-01	4/4/97	37.59	14:47	4.71	32.88
LF-01	5/9/97	37.59	0:00	5.21	32.38
LF-01	6/5/97	37.59	0:00	6.54	31.05
LF-01	6/5/97	37.59	10:01	6.54	31.05
LF-01	7/8/97	37.59	0:00	8.1	29.49
LF-01	7/8/97	37.59	9:56	8.1	29.49
LF-01	8/5/97	37.59	15:37	8.28	29.31
LF-01	9/9/97	37.59	10:07	9.07	28.52
LF-01	10/7/97	37.59	13:48	8.93	28.66

LF-01	11/4/97	37.59	10:18	8.83	28.76
LF-01	12/10/97	37.59	12:07	8.05	29.54
LF-01	4/17/98	37.59	13:05	4.38	33.21
LF-01A	11/20/90	37.62	0:00	31.54	6.08
LF-01A	12/14/90	37.62	0:00	28.5	9.12
LF-01A	1/14/91	37.62	0:00	28.42	9.2
LF-01A	2/14/91	37.62	0:00	28	9.62
LF-01A	3/20/91	37.62	0:00	27.67	9.95
LF-01A	4/2/93	37.62	0:00	23.79	13.83
LF-01A	6/4/93	37.62	0:00	25.54	12.08
LF-01A	8/17/93	37.62	0:00	27.54	10.08
LF-01A	9/20/93	37.62	0:00	28.25	9.37
LF-01A	10/14/93	37.62	0:00	28.5	9.12
LF-01A	11/29/93	37.62	0:00	28.45	9.17
LF-01A	12/22/93	37.62	0:00	28.33	9.29
LF-01A	1/10/94	37.62	0:00	28.69	8.93
LF-01A	2/22/94	37.62	0:00	27.8	9.82
LF-01A	5/23/94	37.62	0:00	27.3	10.32
LF-01A	6/21/94	37.62	0:00	27.93	9.69
LF-01A	7/27/94	37.62	0:00	28.57	9.05
LF-01A	10/20/94	37.58	15:44	28.72	8.86
LF-01A	2/28/95	37.62	13:29	27.26	10.36
LF-01A	4/20/95	37.62	10:20	27.15	10.47
LF-01A	1/26/96	37.62	13:33	28.1	9.52
LF-01A	10/7/96	37.62	15:06	26.55	11.07
LF-01A	11/5/96	37.62	17:20	26.06	11.56
LF-01A	12/4/96	37.62	14:49	26.47	11.15
LF-01A	1/8/97	37.62	14:09	26.13	11.49
LF-01A	2/5/97	37.62	14:05	25.9	11.72
LF-01A	3/6/97	37.62	15:16	25.91	11.71
LF-01A	4/4/97	37.62	14:45	25.9	11.72
LF-01A	5/9/97	37.62	0:00	26.08	11.54
LF-01A	6/5/97	37.62	0:00	26.74	10.88
LF-01A	6/5/97	37.62	10:00	26.74	10.88
LF-01A	7/8/97	37.62	0:00	27.58	10.04
LF-01A	7/8/97	37.62	9:54	27.58	10.04
LF-01A	8/5/97	37.62	15:36	27.99	9.63
LF-01A	9/9/97	37.62	10:05	28.46	9.16
LF-01A	10/7/97	37.62	13:47	28.55	9.07
LF-01A	11/4/97	37.62	10:16	28.74	8.88
LF-01A	12/10/97	37.62	12:06	28.32	9.3
LF-01A	4/17/98	37.62	13:04	25.04	12.58
LF-02	8/16/89	27.68	0:00	20.33	7.35
LF-02	8/16/90	27.68	0:00	21.79	5.89
LF-02	11/20/90	27.68	0:00	21.58	6.1
LF-02	12/14/90	27.68	0:00	21.71	5.97
LF-02	1/14/91	27.68	0:00	21.5	6.18
LF-02	2/14/91	27.68	0:00	21.21	6.47
LF-02	3/20/91	27.68	0:00	21.13	6.55

LF-02	4/2/93	27.68	0:00	18.88	8.8
LF-02	6/4/93	27.68	0:00	20.12	7.56
LF-02	8/17/93	27.68	0:00	21.46	6.22
LF-02	9/20/93	27.68	0:00	21.79	5.89
LF-02	10/14/93	27.68	0:00	21.83	5.85
LF-02	11/29/93	27.68	0:00	21.66	6.02
LF-02	1/10/94	27.68	0:00	22.04	5.64
LF-02	2/22/94	27.68	0:00	21.35	6.33
LF-02	5/23/94	27.68	0:00	21.62	6.06
LF-02	6/21/94	27.68	0:00	22	5.68
LF-02	7/27/94	27.68	0:00	22.49	5.19
LF-02	10/20/94	27.54	15:10	22.39	5.15
LF-02	2/28/95	27.68	12:54	21.08	6.6
LF-02	4/20/95	27.68	9:25	21.59	6.09
LF-02	1/26/96	27.68	13:00	21.84	5.84
LF-02	10/7/96	27.68	15:20	20.94	6.74
LF-02	11/5/96	27.68	17:05	20.73	6.95
LF-02	12/4/96	27.68	15:01	21	6.68
LF-02	1/8/97	27.68	14:43	19.69	7.99
LF-02	2/5/97	27.68	14:14	20.61	7.07
LF-02	3/6/97	27.68	14:28	20.57	7.11
LF-02	4/4/97	27.68	14:52	20.51	7.17
LF-02	5/9/97	27.68	0:00	20.59	7.09
LF-02	6/5/97	27.68	0:00	21.13	6.55
LF-02	6/5/97	27.68	10:40	21.13	6.55
LF-02	7/8/97	27.68	0:00	21.73	5.95
LF-02	7/8/97	27.68	10:56	21.73	5.95
LF-02	8/5/97	27.68	16:08	21.98	5.7
LF-02	9/9/97	27.68	10:46	22.22	5.46
LF-02	10/7/97	27.68	14:30	22.08	5.6
LF-02	11/4/97	27.68	10:46	22.08	5.6
LF-02	12/10/97	27.68	12:40	21.8	5.88
LF-02	4/17/98	27.68	14:25	19.89	7.79
LF-03	8/16/89	10.7	0:00	5.92	4.78
LF-03	8/16/90	10.7	0:00	6.12	4.58
LF-03	11/20/90	10.7	0:00	6.12	4.58
LF-03	12/14/90	10.7	0:00	6.21	4.49
LF-03	1/14/91	10.7	0:00	5.92	4.78
LF-03	2/14/91	10.7	0:00	5.96	4.74
LF-03	3/20/91	10.7	0:00	5.83	4.87
LF-03	4/2/93	10.7	0:00	4.92	5.78
LF-03	6/4/93	10.7	0:00	5.79	4.91
LF-03	8/17/93	10.7	0:00	6.29	4.41
LF-03	9/20/93	10.7	0:00	6.33	4.37
LF-03	10/14/93	10.7	0:00	6.38	4.32
LF-03	11/29/93	10.7	0:00	6.17	4.53
LF-03	1/10/94	10.7	0:00	6.5	4.2
LF-03	2/22/94	10.7	0:00	6.4	4.3
LF-03	5/23/94	10.7	0:00	6.75	3.95

LF-03	6/21/94	10.7	0:00	6.9	3.8
LF-03	7/27/94	10.7	0:00	7.12	3.58
LF-03	10/20/94	10.57	15:15	6.95	3.62
LF-03	2/28/95	10.7	13:04	6.32	4.38
LF-03	4/20/95	10.7	9:40	6.51	4.19
LF-03	10/7/96	10.7	15:27	6.2	4.5
LF-03	11/5/96	10.7	17:03	6.12	4.58
LF-03	12/4/96	10.7	15:08	6.22	4.48
LF-03	1/8/97	10.7	14:46	6.04	4.66
LF-03	2/5/97	10.7	14:25	6.02	4.68
LF-03	3/6/97	10.7	14:31	5.96	4.74
LF-03	4/4/97	10.7	15:00	5.99	4.71
LF-03	5/9/97	10.7	0:00	6.03	4.67
LF-03	6/5/97	10.7	0:00	6.34	4.36
LF-03	6/5/97	10.7	10:43	6.34	4.36
LF-03	7/8/97	10.7	0:00	6.71	3.99
LF-03	7/8/97	10.7	11:02	6.71	3.99
LF-03	8/5/97	10.7	16:11	6.76	3.94
LF-03	9/9/97	10.7	10:50	6.92	3.78
LF-03	10/7/97	10.7	14:38	6.9	3.8
LF-03	11/4/97	10.7	10:57	6.7	4
LF-03	12/10/97	10.7	12:44	6.48	4.22
LF-03	4/17/98	10.7	14:35	5.75	4.95
LF-04	8/16/89	12.09	0:00	7.79	4.3
LF-04	8/16/90	12.09	0:00	8.75	3.34
LF-04	11/20/90	12.09	0:00	8.13	3.96
LF-04	12/14/90	12.09	0:00	8.17	3.92
LF-04	1/14/91	12.09	0:00	7.75	4.34
LF-04	2/14/91	12.09	0:00	7.5	4.59
LF-04	3/20/91	12.09	0:00	7.33	4.76
LF-04	4/2/93	12.09	0:00	6.85	5.24
LF-04	6/4/93	12.09	0:00	7.46	4.63
LF-04	8/17/93	12.09	0:00	8.15	3.94
LF-04	9/20/93	12.09	0:00	8.29	3.8
LF-04	10/14/93	12.09	0:00	8.5	3.59
LF-04	11/29/93	12.09	0:00	8.08	4.01
LF-04	1/10/94	12.09	0:00	8.38	3.71
LF-04	2/22/94	12.09	0:00	8.05	4.04
LF-04	5/23/94	12.09	0:00	8.71	3.38
LF-04	6/21/94	12.09	0:00	8.71	3.38
LF-04	7/27/94	12.09	0:00	8.99	3.1
LF-04	10/20/94	11.9	15:25	8.72	3.18
LF-04	2/28/95	12.09	12:57	7.96	4.13
LF-04	4/20/95	12.09	9:30	8.43	3.66
LF-04	1/26/96	12.09	13:10	8.24	3.85
LF-04	10/7/96	12.09	15:32	7.79	4.3
LF-04	11/5/96	12.09	16:59	7.85	4.24
LF-04	12/4/96	12.09	15:13	7.85	4.24
LF-04	1/8/97	12.09	14:50	7.73	4.36

LF-04	2/5/97	12.09	14:31	7.74	4.35
LF-04	3/6/97	12.09	14:36	7.65	4.44
LF-04	4/4/97	12.09	15:05	7.68	4.41
LF-04	5/9/97	12.09	0:00	7.68	4.41
LF-04	6/5/97	12.09	0:00	8.07	4.02
LF-04	6/5/97	12.09	10:47	8.07	4.02
LF-04	7/8/97	12.09	0:00	8.44	3.65
LF-04	7/8/97	12.09	11:15	8.44	3.65
LF-04	8/5/97	12.09	16:16	8.55	3.54
LF-04	9/9/97	12.09	10:54	8.71	3.38
LF-04	10/7/97	12.09	14:43	8.57	3.52
LF-04	11/4/97	12.09	11:01	8.42	3.67
LF-04	12/10/97	12.09	12:48	8.2	3.89
LF-04	4/17/98	12.09	14:39	7.41	4.68
LF-05	8/16/89	39.16	0:00	12.17	26.99
LF-05	8/16/90	39.16	0:00	13.2	25.96
LF-05	11/20/90	39.16	0:00	13.46	25.7
LF-05	12/14/90	39.16	0:00	13.67	25.49
LF-05	1/14/91	39.16	0:00	13.33	25.83
LF-05	2/14/91	39.16	0:00	13.25	25.91
LF-05	3/20/91	39.16	0:00	14.25	24.91
LF-05	4/2/93	39.16	0:00	10.54	28.62
LF-05	6/4/93	39.16	0:00	11.46	27.7
LF-05	8/17/93	39.16	0:00	12.67	26.49
LF-05	9/20/93	39.16	0:00	13.17	25.99
LF-05	10/14/93	39.16	0:00	13.33	25.83
LF-05	11/29/93	39.16	0:00	13.42	25.74
LF-05	1/10/94	39.16	0:00	14.11	25.05
LF-05	2/22/94	39.16	0:00	13.12	26.04
LF-05	5/23/94	39.16	0:00	13.41	25.75
LF-05	6/21/94	39.16	0:00	13.72	25.44
LF-05	7/27/94	39.16	0:00	14.15	25.01
LF-05	10/20/94	39.14	16:14	14.04	25.1
LF-05	2/28/95	39.14	12:50	13.44	25.7
LF-05	4/20/95	39.16	9:50	13.03	26.13
LF-05	1/26/96	39.16	12:55	13.75	25.41
LF-05	10/7/96	39.16	13:55	12.85	26.31
LF-05	11/5/96	39.16	16:28	12.65	26.51
LF-05	12/4/96	39.16	13:53	12.58	26.58
LF-05	1/8/97	39.16	13:22	12.25	26.91
LF-05	2/5/97	39.16	13:24	12.28	26.88
LF-05	3/6/97	39.16	14:19	12.2	26.96
LF-05	4/4/97	39.16	14:09	12.19	26.97
LF-05	5/9/97	39.16	0:00	12.29	26.87
LF-05	6/5/97	39.16	0:00	12.8	26.36
LF-05	6/5/97	39.16	9:25	12.8	26.36
LF-05	7/8/97	39.16	0:00	13.43	25.73
LF-05	7/8/97	39.16	9:15	13.43	25.73
LF-05	8/5/97	39.16	14:52	13.64	25.52

LF-05	9/9/97	39.16	9:25	13.78	25.38
LF-05	10/7/97	39.16	13:22	13.82	25.34
LF-05	11/4/97	39.16	9:35	13.74	25.42
LF-05	12/10/97	39.16	12:32	13.42	25.74
LF-05	4/17/98	39.16	13:37	12.23	26.93
LF-06	8/16/89	14.02	0:00	10	4.02
LF-06	8/16/90	14.02	0:00	11.5	2.52
LF-06	11/20/90	14.02	0:00	10.58	3.44
LF-06	12/14/90	14.02	0:00	10.58	3.44
LF-06	1/14/91	14.02	0:00	10.17	3.85
LF-06	2/14/91	14.02	0:00	10	4.02
LF-06	3/20/91	14.02	0:00	10	4.02
LF-06	4/2/93	14.02	0:00	8.08	5.94
LF-06	6/4/93	14.02	0:00	10.21	3.81
LF-06	8/17/93	14.02	0:00	10.94	3.08
LF-06	9/20/93	14.02	0:00	11	3.02
LF-06	10/14/93	14.02	0:00	10.88	3.14
LF-06	11/29/93	14.02	0:00	10.5	3.52
LF-06	1/10/94	14.02	0:00	10.63	3.39
LF-06	2/22/94	14.02	0:00	10.6	3.42
LF-06	5/23/94	14.02	0:00	11.22	2.8
LF-06	6/21/94	14.02	0:00	11.5	2.52
LF-06	7/27/94	14.02	0:00	11.85	2.17
LF-06	10/20/94	13.88	15:06	11.14	2.74
LF-06	2/28/95	14.02	13:12	10.33	3.69
LF-06	4/20/95	14.02	9:50	11.04	2.98
LF-06	1/26/96	14.02	13:15	10.67	3.35
LF-06	10/7/96	14.02	15:22	10.32	3.7
LF-06	11/5/96	14.02	17:09	10.32	3.7
LF-06	12/4/96	14.02	15:05	10.53	3.49
LF-06	1/8/97	14.02	14:39	10.3	3.72
LF-06	2/5/97	14.02	14:17	10.38	3.64
LF-06	3/6/97	14.02	14:25	10.4	3.62
LF-06	4/4/97	14.02	14:55	10.35	3.67
LF-06	5/9/97	14.02	0:00	10.43	3.59
LF-06	6/5/97	14.02	0:00	10.79	3.23
LF-06	6/5/97	14.02	10:38	10.78	3.24
LF-06	7/8/97	14.02	0:00	11.36	2.66
LF-06	7/8/97	14.02	10:52	11.36	2.66
LF-06	8/5/97	14.02	16:05	11.44	2.58
LF-06	9/9/97	14.02	10:44	11.53	2.49
LF-06	10/7/97	14.02	14:26	11.21	2.81
LF-06	11/4/97	14.02	10:51	11.06	2.96
LF-06	12/10/97	14.02	12:37	6.76	7.26
LF-06	4/17/98	14.02	14:28	9.93	4.09
LF-06A	11/20/90	14.05	0:00	10.08	3.97
LF-06A	12/14/90	14.05	0:00	10.08	3.97
LF-06A	1/14/91	14.05	0:00	9.83	4.22
LF-06A	2/14/91	14.05	0:00	9.58	4.47

LF-06A	3/20/91	14.05	0:00	9.51	4.54
LF-06A	4/2/93	14.05	0:00	8.37	5.68
LF-06A	6/4/93	14.05	0:00	9.54	4.51
LF-06A	8/17/93	14.05	0:00	10.38	3.67
LF-06A	9/20/93	14.05	0:00	10.37	3.68
LF-06A	10/14/93	14.05	0:00	10.33	3.72
LF-06A	11/29/93	14.05	0:00	10	4.05
LF-06A	1/10/94	14.05	0:00	10.25	3.8
LF-06A	2/22/94	14.05	0:00	10.08	3.97
LF-06A	5/23/94	14.05	0:00	10.55	3.5
LF-06A	6/21/94	14.05	0:00	10.9	3.15
LF-06A	7/27/94	14.05	0:00	11.27	2.78
LF-06A	10/20/94	13.39	15:07	10.69	2.7
LF-06A	2/28/95	14.05	13:10	9.78	4.27
LF-06A	4/20/95	14.05	9:45	10.43	3.62
LF-06A	1/26/96	14.05	13:20	10.29	3.76
LF-06A	10/7/96	14.05	15:23	9.8	4.25
LF-06A	11/5/96	14.05	17:08	9.73	4.32
LF-06A	12/4/96	14.05	15:04	9.94	4.11
LF-06A	1/8/97	14.05	14:37	9.71	4.34
LF-06A	2/5/97	14.05	14:18	9.72	4.33
LF-06A	3/6/97	14.05	14:23	9.73	4.32
LF-06A	4/4/97	14.05	14:56	9.72	4.33
LF-06A	5/9/97	14.05	0:00	9.81	4.24
LF-06A	6/5/97	14.05	0:00	10.17	3.88
LF-06A	6/5/97	14.05	10:37	10.17	3.88
LF-06A	7/8/97	14.05	0:00	10.77	3.28
LF-06A	7/8/97	14.05	10:51	10.77	3.28
LF-06A	8/5/97	14.05	16:04	10.84	3.21
LF-06A	9/9/97	14.05	10:42	10.99	3.06
LF-06A	10/7/97	14.05	14:27	10.69	3.36
LF-06A	11/4/97	14.05	10:50	10.57	3.48
LF-06A	12/10/97	14.05	12:38	10.27	3.78
LF-06A	4/17/98	14.05	14:27	9.22	4.83
LF-07	8/16/89	36.33	0:00	6.96	29.37
LF-07	8/16/90	36.33	0:00	10.83	25.5
LF-07	11/20/90	36.33	0:00	11.17	25.16
LF-07	12/14/90	36.33	0:00	11.17	25.16
LF-07	1/14/91	36.33	0:00	10.75	25.58
LF-07	2/14/91	36.33	0:00	9.75	26.58
LF-07	3/20/91	36.33	0:00	9.92	26.41
LF-07	4/2/93	36.33	0:00	5.92	30.41
LF-07	6/4/93	36.33	0:00	9.38	26.95
LF-07	8/17/93	36.33	0:00	11.58	24.75
LF-07	9/20/93	36.33	0:00	11.75	24.58
LF-07	10/14/93	36.33	0:00	12.12	24.21
LF-07	11/29/93	36.33	0:00	11.96	24.37
LF-07	12/22/93	36.33	0:00	11.54	24.79
LF-07	1/10/94	36.33	0:00	12.02	24.31

LF-07	2/22/94	36.33	0:00	11.05	25.28
LF-07	5/23/94	36.33	0:00	11.93	24.4
LF-07	6/21/94	36.33	0:00	11.74	24.59
LF-07	7/27/94	36.33	0:00	14.49	21.84
LF-07	10/20/94	36.35	15:50	12.7	23.65
LF-07	2/28/95	36.33	13:33	11.05	25.28
LF-07	4/20/95	36.33	9:55	11.08	25.25
LF-07	1/26/96	36.33	13:45	12.37	23.96
LF-07	10/7/96	36.33	15:13	10.91	25.42
LF-07	11/5/96	36.33	17:26	10	26.33
LF-07	12/4/96	36.33	14:35	10.03	26.3
LF-07	1/8/97	36.33	14:22	9.3	27.03
LF-07	2/5/97	36.33	13:59	9.03	27.3
LF-07	3/6/97	36.33	15:05	8.65	27.68
LF-07	4/4/97	36.33	14:31	5.83	30.5
LF-07	5/9/97	36.33	0:00	9.01	27.32
LF-07	6/5/97	36.33	0:00	9.82	26.51
LF-07	6/5/97	36.33	9:37	9.82	26.51
LF-07	7/8/97	36.33	0:00	10.52	25.81
LF-07	7/8/97	36.33	9:43	10.52	25.81
LF-07	8/5/97	36.33	15:29	11.03	25.3
LF-07	9/9/97	36.33	9:58	11.69	24.64
LF-07	10/7/97	36.33	13:41	11.86	24.47
LF-07	11/4/97	36.33	10:08	11.77	24.56
LF-07	12/10/97	36.33	12:00	11.86	24.47
LF-07	4/17/98	36.33	13:53	9.43	26.9
LF-08	11/20/90	36.19	0:00	29.71	6.48
LF-08	12/14/90	36.19	0:00	29.46	6.73
LF-08	1/14/91	36.19	0:00	29.67	6.52
LF-08	2/14/91	36.19	0:00	29.33	6.86
LF-08	3/20/91	36.19	0:00	29.25	6.94
LF-08	4/2/93	36.19	0:00	26.83	9.36
LF-08	6/4/93	36.19	0:00	27.88	8.31
LF-08	8/17/93	36.19	0:00	29.25	6.94
LF-08	9/20/93	36.19	0:00	29.67	6.52
LF-08	10/14/93	36.19	0:00	29.83	6.36
LF-08	11/29/93	36.19	0:00	29.69	6.5
LF-08	12/22/93	36.19	0:00	29.54	6.65
LF-08	1/10/94	36.19	0:00	30.07	6.12
LF-08	2/22/94	36.19	0:00	29.5	6.69
LF-08	5/23/94	36.19	0:00	29.43	6.76
LF-08	6/21/94	36.19	0:00	29.44	6.75
LF-08	7/27/94	36.19	0:00	30.25	5.94
LF-08	10/20/94	36.12	15:55	29.81	6.31
LF-08	2/28/95	36.19	13:40	28.82	7.37
LF-08	4/20/95	36.19	10:30	29.03	7.16
LF-08	1/26/96	36.19	14:30	29.66	6.53
LF-08	10/7/96	36.19	14:00	28.55	7.64
LF-08	11/5/96	36.19	16:52	28.29	7.9

LF-08	12/4/96	36.19	14:10	28.5	7.69
LF-08	1/8/97	36.19	13:27	28.26	7.93
LF-08	2/5/97	36.19	13:31	28.07	8.12
LF-08	3/6/97	36.19	14:43	28.08	8.11
LF-08	4/4/97	36.19	14:15	28.02	8.17
LF-08	5/9/97	36.19	0:00	28.05	8.14
LF-08	6/5/97	36.19	0:00	28.57	7.62
LF-08	6/5/97	36.19	10:30	28.57	7.62
LF-08	7/8/97	36.19	0:00	29.1	7.09
LF-08	7/8/97	36.19	9:20	29.1	7.09
LF-08	8/5/97	36.19	15:03	29.33	6.86
LF-08	9/9/97	36.19	9:31	29.65	6.54
LF-08	10/7/97	36.19	13:26	29.62	6.57
LF-08	11/4/97	36.19	9:41	29.62	6.57
LF-08	12/10/97	36.19	11:36	29.37	6.82
LF-08	4/17/98	36.19	13:42	27.5	8.69
LFO-01	12/14/90	36.98	0:00	29.13	7.85
LFO-01	1/14/91	36.98	0:00	29.08	7.9
LFO-01	2/14/91	36.98	0:00	28.75	8.23
LFO-01	3/20/91	36.98	0:00	28.5	8.48
LFO-01	4/2/93	36.98	0:00	25.5	11.48
LFO-01	6/4/93	36.98	0:00	26.65	10.33
LFO-01	8/17/93	36.98	0:00	28.33	8.65
LFO-01	9/20/93	36.98	0:00	28.92	8.06
LFO-01	10/14/93	36.98	0:00	29.12	7.86
LFO-01	11/29/93	36.98	0:00	29.04	7.94
LFO-01	12/22/93	36.98	0:00	28.94	8.04
LFO-01	1/10/94	36.98	0:00	29.38	7.6
LFO-01	2/22/94	36.98	0:00	28.8	8.18
LFO-01	5/23/94	36.98	0:00	28.45	8.53
LFO-01	6/21/94	36.98	0:00	28.45	8.53
LFO-01	7/27/94	36.98	0:00	29.41	7.57
LFO-01	10/20/94	36.89	15:51	29.55	7.34
LFO-01	2/28/95	36.98	13:34	28.63	8.35
LFO-01	4/20/95	36.98	10:00	28.31	8.67
LFO-01	1/26/96	36.98	13:50	29.08	7.9
LFO-01	10/7/96	36.98	15:12	28.92	8.06
LFO-01	11/5/96	36.98	17:25	27.51	9.47
LFO-01	12/4/96	36.98	14:34	27.82	9.16
LFO-01	1/8/97	36.98	14:21	27.52	9.46
LFO-01	2/5/97	36.98	13:57	27.3	9.68
LFO-01	3/6/97	36.98	15:07	27.31	9.67
LFO-01	4/4/97	36.98	14:30	27.25	9.73
LFO-01	6/5/97	36.98	9:36	27.86	9.12
LFO-01	7/8/97	36.98	9:41	28.51	8.47
LFO-01	8/5/97	36.98	15:28	28.82	8.16
LFO-01	9/9/97	36.98	9:56	29.22	7.76
LFO-01	10/7/97	36.98	13:39	29.25	7.73
LFO-01	11/4/97	36.98	10:07	29.36	7.62

LFO-01	12/10/97	36.98	11:58	29.04	7.94
LFO-01	4/17/98	36.98	13:52	26.58	10.4
LFO-02	12/14/90	33.83	0:00 D		
LFO-02	1/14/91	33.83	0:00 D		
LFO-02	2/14/91	33.83	0:00	11.04	22.79
LFO-02	3/20/91	33.83	0:00	11.25	22.58
LFO-02	4/2/93	33.83	0:00	3.73	30.1
LFO-02	6/4/93	33.83	0:00	7.92	25.91
LFO-02	8/17/93	33.83	0:00 D		
LFO-02	9/20/93	33.83	0:00 D		
LFO-02	10/14/93	33.83	0:00 D		
LFO-02	11/29/93	33.83	0:00 D		
LFO-02	12/22/93	33.83	0:00 D		
LFO-02	1/10/94	33.83	0:00 D		
LFO-02	2/22/94	33.83	0:00	13.45	20.38
LFO-02	5/23/94	33.83	0:00	14.75	19.08
LFO-02	6/21/94	33.83	0:00 D		
LFO-02	7/27/94	33.83	0:00 D		
LFO-02	10/20/94	33.61	15:37 D		
LFO-02	2/28/95	33.83	13:23	12.23	21.6
LFO-02	4/20/95	33.83	10:10	14.69	19.14
LFO-02	1/26/96	33.83	14:00	13.92	19.91
LFO-02	10/7/96	33.83	15:00	14.3	19.53
LFO-02	12/4/96	33.83	14:42	12.77	21.06
LFO-02	1/8/97	33.83	13:59	11.52	22.31
LFO-02	2/5/97	33.83	13:53	11.08	22.75
LFO-02	3/6/97	33.83	15:23	11.28	22.55
LFO-02	4/4/97	33.83	14:38	11.92	21.91
LFO-02	6/5/97	33.83	9:47 D		
LFO-02	7/8/97	33.83	9:29 D		
LFO-02	8/5/97	33.83	15:59 D		
LFO-02	9/9/97	33.83	10:35 D		
LFO-02	10/7/97	33.83	14:14 D		
LFO-02	11/4/97	33.83	10:40 D		
LFO-02	12/10/97	33.83	12:31 D		
LFO-03	12/14/90	45.58	0:00	20.79	24.79
LFO-03	1/14/91	45.58	0:00	21.08	24.5
LFO-03	2/14/91	45.58	0:00	21.25	24.33
LFO-03	3/20/91	45.58	0:00	21.33	24.25
LFO-03	4/2/93	45.58	0:00 D		
LFO-03	8/17/93	45.58	0:00	19.83	25.75
LFO-03	9/20/93	45.58	0:00	20.44	25.14
LFO-03	10/14/93	45.58	0:00	20.75	24.83
LFO-03	11/29/93	45.58	0:00	21.27	24.31
LFO-03	12/22/93	45.58	0:00	21.27	24.31
LFO-03	1/10/94	45.58	0:00	22.25	23.33
LFO-03	2/22/94	45.58	0:00	22.37	23.21
LFO-03	5/23/94	45.58	0:00	21.75	23.83
LFO-03	6/21/94	45.58	0:00	21.34	24.24

LFO-03	7/27/94	45.58	0:00	21.71	23.87
LFO-03	10/20/94	45.5	15:33	22.5	23
LFO-03	2/28/95	45.58	13:19	22.84	22.74
LFO-03	4/20/95	45.58	10:05	21.48	24.1
LFO-03	1/26/96	45.58	13:25	20.62	24.96
LFO-03	10/7/96	45.58	14:57	21.38	24.2
LFO-03	12/4/96	45.58	14:39	20.56	25.02
LFO-03	1/8/97	45.58	14:03	20.72	24.86
LFO-03	2/5/97	45.58	13:48	20.39	25.19
LFO-03	3/6/97	45.58	15:28	20.15	25.43
LFO-03	4/4/97	45.58	14:35	20.14	25.44
LFO-03	6/5/97	45.58	9:43	20.66	24.92
LFO-03	7/8/97	45.58	10:42	20.93	24.65
LFO-03	8/5/97	45.58	15:55	21.23	24.35
LFO-03	9/9/97	45.58	10:32	21.61	23.97
LFO-03	10/7/97	45.58	14:13	21.87	23.71
LFO-03	11/4/97	45.58	10:36	22.06	23.52
LFO-03	12/10/97	45.58	12:27	22.26	23.32
LFO-03	4/17/98	45.58	14:21	18.91	26.67
LFO-04	12/14/90	36.95	0:00	15	21.95
LFO-04	1/14/91	36.95	0:00	15	21.95
LFO-04	2/14/91	36.95	0:00	14.71	22.24
LFO-04	3/20/91	36.95	0:00	14.67	22.28
LFO-04	4/2/93	36.95	0:00	12.12	24.83
LFO-04	6/4/93	36.95	0:00	13.6	23.35
LFO-04	8/17/93	36.95	0:00	14.33	22.62
LFO-04	9/20/93	36.95	0:00	14.67	22.28
LFO-04	10/14/93	36.95	0:00	14.88	22.07
LFO-04	11/29/93	36.95	0:00	14.88	22.07
LFO-04	12/22/93	36.95	0:00	9.79	27.16
LFO-04	1/10/94	36.95	0:00	15.25	21.7
LFO-04	2/22/94	36.95	0:00	14.75	22.2
LFO-04	5/23/94	36.95	0:00	14.85	22.1
LFO-04	6/21/94	36.95	0:00	15.14	21.81
LFO-04	7/27/94	36.95	0:00	14.42	22.53
LFO-04	10/20/94	36.85	15:56	15.75	21.1
LFO-04	2/28/95	36.95	13:38	15.12	21.83
LFO-04	4/20/95	36.95	10:25	14.96	21.99
LFO-04	1/26/96	36.95	14:25	16.27	20.68
LFO-04	11/5/96	36.95	16:51	14.87	22.08
LFO-04	12/4/96	36.95	14:11	14.97	21.98
LFO-04	1/8/97	36.95	13:30	14.74	22.21
LFO-04	2/5/97	36.95	13:29	14.63	22.32
LFO-04	3/6/97	36.95	14:41	14.51	22.44
LFO-04	4/4/97	36.95	14:16	14.43	22.52
LFO-04	6/5/97	36.95	10:28	14.68	22.27
LFO-04	7/8/97	36.95	9:19	15.09	21.86
LFO-04	8/5/97	36.95	15:01	15.27	21.68
LFO-04	9/9/97	36.95	9:29	15.47	21.48

LFO-04	10/7/97	36.95	13:24	15.48	21.47
LFO-04	11/4/97	36.95	9:39	15.41	21.54
LFO-04	12/10/97	36.95	11:35	5.41	31.54
LFO-04	4/17/98	36.95	13:41	14.28	22.67
LFO-05	12/14/90	34.1	0:00	16.5	17.6
LFO-05	1/14/91	34.1	0:00	14.42	19.68
LFO-05	2/14/91	34.1	0:00	13.83	20.27
LFO-05	3/20/91	34.1	0:00 D		
LFO-05	4/2/93	34.1	0:00	12.92	21.18
LFO-05	6/4/93	34.1	0:00	13.9	20.2
LFO-05	8/17/93	34.1	0:00	14.38	19.72
LFO-05	9/20/93	34.1	0:00 D		
LFO-05	10/14/93	34.1	0:00	14.88	19.22
LFO-05	11/29/93	34.1	0:00	13.88	20.22
LFO-05	12/22/93	34.1	0:00	13.6	20.5
LFO-05	1/10/94	34.1	0:00	14.01	20.09
LFO-05	2/22/94	34.1	0:00	14.05	20.05
LFO-05	5/23/94	34.1	0:00	14.8	19.3
LFO-05	6/21/94	34.1	0:00	14.72	19.38
LFO-05	7/27/94	34.1	0:00	15	19.1
LFO-05	10/20/94	33.99	16:00	14.12	19.87
LFO-05	2/28/95	34.1	13:42	13.72	20.38
LFO-05	4/20/95	34.1	10:45	14.62	19.48
LFO-05	1/26/96	34.1	14:15	14.3	19.8
LFO-05	10/7/96	34.1	14:07	14.35	19.75
LFO-05	11/5/96	34.1	16:32	14.29	19.81
LFO-05	12/4/96	34.1	14:27	14.58	19.52
LFO-05	1/8/97	34.1	13:36	14.26	19.84
LFO-05	2/5/97	34.1	13:34	14.47	19.63
LFO-05	3/6/97	34.1	14:50	14.31	19.79
LFO-05	4/4/97	34.1	14:18	14.29	19.81
LFO-05	6/5/97	34.1	10:17	14.3	19.8
LFO-05	7/8/97	34.1	9:23	14.97	19.13
LFO-05	8/5/97	34.1	15:06	15.06	19.04
LFO-05	9/9/97	34.1	9:33	15.22	18.88
LFO-05	10/7/97	34.1	13:29	14.89	19.21
LFO-05	11/4/97	34.1	9:45	14.32	19.78
LFO-05	12/10/97	34.1	11:40	14.81	19.29
LFO-05	4/17/98	34.1	13:44	14.93	19.17
LFO-06	1/14/90	34.27	0:00	23.75	10.52
LFO-06	12/14/90	34.27	0:00	23.75	10.52
LFO-06	3/20/91	34.27	0:00	20.33	13.94
LFO-06	4/2/93	34.27	0:00	15.92	18.35
LFO-06	6/4/93	34.27	0:00	17.67	16.6
LFO-06	8/17/93	34.27	0:00	18.75	15.52
LFO-06	9/20/93	34.27	0:00	19.08	15.19
LFO-06	10/14/93	34.27	0:00	19.29	14.98
LFO-06	11/29/93	34.27	0:00	19.46	14.81
LFO-06	12/22/93	34.27	0:00	19.44	14.83

LFO-06	1/10/94	34.27	0:00	19.81	14.46
LFO-06	2/22/94	34.27	0:00	18.83	15.44
LFO-06	5/23/94	34.27	0:00	19.12	15.15
LFO-06	6/21/94	34.27	0:00	19.5	14.77
LFO-06	7/27/94	34.27	0:00	19.93	14.34
LFO-06	10/20/94	34.09	16:03	19.55	14.54
LFO-06	2/28/95	34.27	13:50	18.48	15.79
LFO-06	4/20/95	34.27	10:50	18.68	15.59
LFO-06	1/26/96	34.27	14:20	18.14	16.13
LFO-06	10/7/96	34.27	14:15	18.08	16.19
LFO-06	11/5/96	34.27	16:45	18.39	15.88
LFO-06	12/4/96	34.27	14:22	19.14	15.13
LFO-06	1/8/97	34.27	13:46	19.27	15
LFO-06	2/5/97	34.27	13:38	19.3	14.97
LFO-06	3/6/97	34.27	14:55	19.44	14.83
LFO-06	4/4/97	34.27	14:21	19.23	15.04
LFO-06	6/5/97	34.27	10:24	19.38	14.89
LFO-06	7/8/97	34.27	9:28	20.07	14.2
LFO-06	8/5/97	34.27	15:09	20.39	13.88
LFO-06	9/9/97	34.27	9:36	20.58	13.69
LFO-06	10/7/97	34.27	13:32	20.48	13.79
LFO-06	11/4/97	34.27	9:49	20.49	13.78
LFO-06	12/10/97	34.27	11:42	20.38	13.89
LFO-06	4/17/98	34.27	13:46	19.98	14.29
LFO-07	12/14/90	24.47	0:00	19.21	5.26
LFO-07	1/14/91	24.47	0:00	19	5.47
LFO-07	2/14/91	24.47	0:00	18.92	5.55
LFO-07	3/20/91	24.47	0:00	18.88	5.59
LFO-07	4/2/93	24.47	0:00	17.71	6.76
LFO-07	6/4/93	24.47	0:00	18.42	6.05
LFO-07	8/17/93	24.47	0:00	18.96	5.51
LFO-07	9/20/93	24.47	0:00	19.17	5.3
LFO-07	10/14/93	24.47	0:00	19.29	5.18
LFO-07	11/29/93	24.47	0:00	19.04	5.43
LFO-07	12/22/93	24.47	0:00	19.83	4.64
LFO-07	1/10/94	24.47	0:00	19.38	5.09
LFO-07	2/22/94	24.47	0:00	19.2	5.27
LFO-07	5/23/94	24.47	0:00	19.3	5.17
LFO-07	6/21/94	24.47	0:00	19.58	4.89
LFO-07	7/27/94	24.47	0:00	19.87	4.6
LFO-07	10/20/94	24.35	16:07	19.69	4.66
LFO-07	2/28/95	24.47	13:45	19.15	5.32
LFO-07	4/20/95	24.47	10:55	19.3	5.17
LFO-07	1/26/96	24.47	14:10	11.47	13
LFO-07	10/7/96	24.47	14:25	19.08	5.39
LFO-07	11/5/96	24.47	16:39	18.97	5.5
LFO-07	12/4/96	24.47	14:17	19.02	5.45
LFO-07	1/8/97	24.47	13:42	18.88	5.59
LFO-07	2/5/97	24.47	13:42	18.87	5.6

LFO-07	3/6/97	24.47	15:00	18.83	5.64
LFO-07	4/4/97	24.47	14:25	18.8	5.67
LFO-07	6/5/97	24.47	10:21	19.04	5.43
LFO-07	7/8/97	24.47	9:31	19.32	5.15
LFO-07	8/5/97	24.47	15:14	19.39	5.08
LFO-07	9/9/97	24.47	9:41	19.58	4.89
LFO-07	10/7/97	24.47	13:35	14.47	10
LFO-07	11/4/97	24.47	9:51	19.35	5.12
LFO-07	12/10/97	24.47	11:45	19.47	5
LFO-08	5/9/97	36.63	0:00	7.33	29.3
LFO-08	6/5/97	36.63	0:00	9.18	27.45
LFO-08	6/5/97	36.63	9:46	9.18	27.45
LFO-08	7/8/97	36.63	0:00	10.43	26.2
LFO-08	7/8/97	36.63	9:46	10.43	26.2
LFO-08	8/5/97	36.63	15:31	10.8	25.83
LFO-08	9/9/97	36.63	9:59	11.53	25.1
LFO-08	10/7/97	36.63	13:43	11.6	25.03
LFO-08	11/4/97	36.63	10:11	11.35	25.28
LFO-08	12/10/97	36.63	12:02	11.05	25.58
LFO-08	4/17/98	36.63	14:00	7.62	29.01
LFO-09	5/9/97	33.67	0:00	3.93	29.74
LFO-09	6/5/97	33.67	0:00	4.57	29.1
LFO-09	6/5/97	33.67	9:53	4.57	29.1
LFO-09	7/8/97	33.67	0:00	5.82	27.85
LFO-09	7/8/97	33.67	9:51	5.82	27.85
LFO-09	8/5/97	33.67	15:33	6.1	27.57
LFO-09	9/9/97	33.67	10:02	7.14	26.53
LFO-09	10/7/97	33.67	13:45	4.07	29.6
LFO-09	11/4/97	33.67	10:13	6.46	27.21
LFO-09	12/10/97	33.67	12:04	6.06	27.61
LFO-09	4/17/98	33.67	14:02	3.35	30.32
LFO-10	5/9/97	38.88	0:00	5.65	33.23
LFO-10	6/5/97	38.88	0:00	7.1	31.78
LFO-10	6/5/97	38.88	10:04	7.1	31.78
LFO-10	7/8/97	38.88	0:00	8.58	30.3
LFO-10	7/8/97	38.88	9:58	8.58	30.3
LFO-10	8/5/97	38.88	15:38	8.81	30.07
LFO-10	9/9/97	38.88	10:08	8.76	30.12
LFO-10	10/7/97	38.88	13:50	8.32	30.56
LFO-10	11/4/97	38.88	10:20	8.44	30.44
LFO-10	12/10/97	38.88	12:10	7.53	31.35
LFO-10	4/17/98	38.88	14:07	4.02	34.86
LFO-11	5/9/97	39.52	0:00	6.74	32.78
LFO-11	6/5/97	39.52	0:00	8.31	31.21
LFO-11	6/5/97	39.52	10:08	8.31	31.21
LFO-11	7/8/97	39.52	0:00	10.3	29.22
LFO-11	7/8/97	39.52	10:10	10.3	29.22
LFO-11	8/5/97	39.52	15:43	10.98	28.54
LFO-11	9/9/97	39.52	10:15	11.41	28.11

LFO-11	10/7/97	39.52	13:54	11.47	28.05
LFO-11	11/4/97	39.52	10:23	11.57	27.95
LFO-11	12/10/97	39.52	12:14	11.08	28.44
LFO-11	4/17/98	39.52	14:11	4.07	35.45
LFO-12	5/9/97	39.44	0:00	7.79	31.65
LFO-12	6/5/97	39.44	0:00	9.41	30.03
LFO-12	6/5/97	39.44	9:54	9.41	30.03
LFO-12	7/8/97	39.44	0:00	10.8	28.64
LFO-12	7/8/97	39.44	10:15	10.8	28.64
LFO-12	8/5/97	39.44	15:50	11.45	27.99
LFO-12	9/9/97	39.44	10:25	12.03	27.41
LFO-12	10/7/97	39.44	14:00	12.26	27.18
LFO-12	11/4/97	39.44	10:31	12.54	26.9
LFO-12	12/10/97	39.44	12:18	12.47	26.97
LFO-12	4/17/98	39.44	14:16	5.83	33.61
LFO-13	5/9/97	38.96	0:00	8.24	30.72
LFO-13	6/5/97	38.96	0:00	9.51	29.45
LFO-13	6/5/97	38.96	9:30	9.51	29.45
LFO-13	7/8/97	38.96	0:00	10.93	28.03
LFO-13	7/8/97	38.96	10:21	10.93	28.03
LFO-13	8/5/97	38.96	15:21	11.78	27.18
LFO-13	9/9/97	38.96	9:50	12.47	26.49
LFO-13	10/7/97	38.96	14:03	12.64	26.32
LFO-13	11/4/97	38.96	9:59	12.82	26.14
LFO-13	12/10/97	38.96	11:51	12.51	26.45
LFO-13	4/17/98	38.96	13:49	6.59	32.37
LFO-14	5/9/97	39.89	0:00	10.57	29.32
LFO-14	6/5/97	39.89	0:00	11.41	28.48
LFO-14	6/5/97	39.89	9:33	11.41	28.48
LFO-14	7/8/97	39.89	0:00	12.53	27.36
LFO-14	7/8/97	39.89	10:35	12.53	27.36
LFO-14	8/5/97	39.89	15:25	13.18	26.71
LFO-14	9/9/97	39.89	9:53	13.77	26.12
LFO-14	10/7/97	39.89	14:09	13.98	25.91
LFO-14	11/4/97	39.89	10:05	14.2	25.69
LFO-14	12/10/97	39.89	11:55	14.32	25.57
LFO-14	4/17/98	39.89	13:54	9.21	30.68
LFO-15	5/9/97	41.61	0:00	15.25	26.36
LFO-15	6/5/97	41.61	0:00	15.57	26.04
LFO-15	6/5/97	41.61	9:50	15.57	26.04
LFO-15	7/8/97	41.61	0:00	16.06	25.55
LFO-15	7/8/97	41.61	10:26	16.06	25.55
LFO-15	8/5/97	41.61	16:25	16.48	25.13
LFO-15	9/9/97	41.61	10:30	16.97	24.64
LFO-15	10/7/97	41.61	14:21	17.22	24.39
LFO-15	11/4/97	41.61	10:34	17.45	24.16
LFO-15	4/17/98	41.61	14:18	13.43	28.18

(2) Measurements Based on Mean Sea Level

Attachment 10

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. OW-4
SHEET NO. 1 OF 1
PROJECT NO. 467.42
INSTALLATION
SURFACE ELEV. 34.3
BOREHOLE DIA. 10 IN.

PROJECT NAME WEYERHAEUSER
LOCATION PLYMOUTH, NC
CONTRACTOR LAW ENGINEERING
DRILLING METHOD HSA

SAMPLING NOTES						VISUAL CLASSIFICATION AND GENERAL OBSERVATIONS
INTERVAL		RECOVERY	MOISTURE			
NO.	TYPE	BLOWS			DEPTH	
					5	No soil samples collected. See boring MW-8 for lithology.
					10	
					15	
						BORING TERMINATED AT 16.5 FEET

GENERAL NOTES

DATE STARTED 22 APR 90
DATE COMPLETED 22 APR 90
RIG MOBILE B-56
CREW CHIEF TODD JOHNSON
LOGGED BTG CHECKED

WATER LEVEL OBSERVATIONS

WHILE DRILLING ▽
AT COMPLETION ▼
AFTER DRILLING
CAVE-IN: DATE/TIME DEPTH
WATER: DATE/TIME 5-2-90 DEPTH 10.8 FT. BGS.

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. MW-8
SHEET NO. 1 OF 3
PROJECT NAME WEYERHAEUSER
PROJECT NO. 467.42
LOCATION PLYMOUTH, NC
INSTALLATION
CONTRACTOR LAW ENGINEERING
SURFACE ELEV. 34.3
DRILLING METHOD MUD ROTARY
BOREHOLE DIA. 10 IN.

SAMPLING NOTES						VISUAL CLASSIFICATION AND GENERAL OBSERVATIONS
INTERVAL		RECOVERY		MOISTURE		
NO.	TYPE	BLOWS			DEPTH	
1	SS	6-6-7-10	50			SILTY SAND (SM) - fine grained; trace clay; brown. .4
2	UD		50			CLAY (CL) - silty; trace fine grained sand; orange, gray mottle.
3	SS	6-8-9-10	65		5	SILTY SAND (SM) - fine grained; trace clay in occasional thin partings (< .1 foot); mottled tan and orange. - no clay; 7.0-7.2 feet
4	SS	6-7-7-8	60			
5	SS	6-6-8-9	50		10	SILTY SAND (SM) - fine grained; interlaminated orange and gray, black (heavy minerals); trace clay.
6	SS	9-15-23-17	50		15	- no clay; 13.0-15.0 ft.
7	SS	3-3-3-5	90			SILTY CLAY (CL) - stiff; trace mica; mottled brown and blue green.

GENERAL NOTES

DATE STARTED 21 APR 90
DATE COMPLETED 23 APR 90
RIG MOBILE B-56
CREW CHIEF TODD JOHNSON
LOGGED BTG CHECKED

WATER LEVEL OBSERVATIONS

WHILE DRILLING ▽ N/A
AT COMPLETION ▼
AFTER DRILLING
CAVE-IN: DATE/TIME DEPTH
WATER: DATE/TIME 5-1-90 DEPTH 26.8 FT.BGS

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. MW-8
SHEET NO. 2 OF 3
PROJECT NO. 467.42
INSTALLATION
SURFACE ELEV. 34.3
BOREHOLE DIA. 10 IN.

PROJECT NAME WEYERHAEUSER
LOCATION PLYMOUTH, NC
CONTRACTOR LAW ENGINEERING
DRILLING METHOD MUD ROTARY

SAMPLING NOTES						VISUAL CLASSIFICATION AND GENERAL OBSERVATIONS
INTERVAL		RECOVERY		MOISTURE		
NO.	TYPE	BLOWS			DEPTH	
8	UD		100			CLAY (CH) - as determined from laboratory analysis.
9	SS	18-5-4-4	100		25	Change to 5 7/8 in. bit at 20.2 ft.
10	SS	3-3-5-7	100		30	SILT (ML) - some clay; as determined from laboratory analysis.
						CLAYEY SAND (SC) - fine grained; some zones more sandy.
11	SS	4-5-5-12	90		35	36.5
12	SS	23-31-32-44	75			SILTY SAND (SM) - fine grained; trace clay; gray, blue green. 36.8
					40	SILTY SAND (SM) - fine grained; trace clay; tan, gray, some black.
13	SS	11-15-	50			- some medium grained sand.

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. MW-8
SHEET NO. 3 OF 3
PROJECT NO. 467.42
INSTALLATION
SURFACE ELEV. 34.3
BOREHOLE DIA. 10 IN.

PROJECT NAME WEYERHAEUSER
LOCATION PLYMOUTH, NC
CONTRACTOR LAW ENGINEERING
DRILLING METHOD MUD ROTARY

SAMPLING NOTES						VISUAL CLASSIFICATION AND GENERAL OBSERVATIONS
INTERVAL		RECOVERY		MOISTURE		
NO.	TYPE	BLOWS			DEPTH	
		29-51				
					45	BORING TERMINATED AT 45.0 FEET
					50	
					55	
					60	
					65	

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. OW-7
SHEET NO. 1 OF 2
PROJECT NO. 467.42
INSTALLATION
SURFACE ELEV. 21.6
BOREHOLE DIA. 10 IN.

PROJECT NAME WEYERHAEUSER
LOCATION PLYMOUTH, NC
CONTRACTOR LAW ENGINEERING
DRILLING METHOD HSA

SAMPLING NOTES						VISUAL CLASSIFICATION AND GENERAL OBSERVATIONS
INTERVAL		RECOVERY		MOISTURE		
NO.	TYPE	BLOWS			DEPTH	
1	SS	2-2-3-3	75			SILTY SAND (SM) - fine grained; humic; light brown. .8
2	SS	4-4-3-5	75			CLAYEY SAND (SC) - fine grained; moderately stiff; orange.
						SILTY SAND (SM) - fine grained; orange-brown. 4.9
3	SS	5-4-4-7	75			
					5	CLAY (CL) - stiff; gray, brown, mottled. 5.5
4	SS	3-5-8-11	100			SILTY SAND (SM) - fine grained; orange-brown. 6.2
5	SS	4-13-14-15	60			CLAY (CL) - stiff; gray, brown, mottled. 8.0
					10	SAND (SP) - fine grained; white, brown and black laminations. 13.3
6	SS	4-8-11-10	75			SILTY SAND (SM) - fine grained; trace medium grained; laminated; tan, orange-brown.
					15	
						SILTY SAND (SM) - fine to medium grained; with white shell fragments; light gray to tan.
7	SS	5-7-7-8	50			

GENERAL NOTES

DATE STARTED 25 APR 90
DATE COMPLETED 25 APR 90
RIG MOBILE B-56
CREW CHIEF TODD JOHNSON
LOGGED BTG CHECKED

WATER LEVEL OBSERVATIONS

WHILE DRILLING ▽ 15.0 FT. BGS
AT COMPLETION ▼
AFTER DRILLING
CAVE-IN: DATE/TIME DEPTH
WATER: DATE/TIME 5-2-90 DEPTH 15.8 FT. BGS

LOG OF TEST BORING

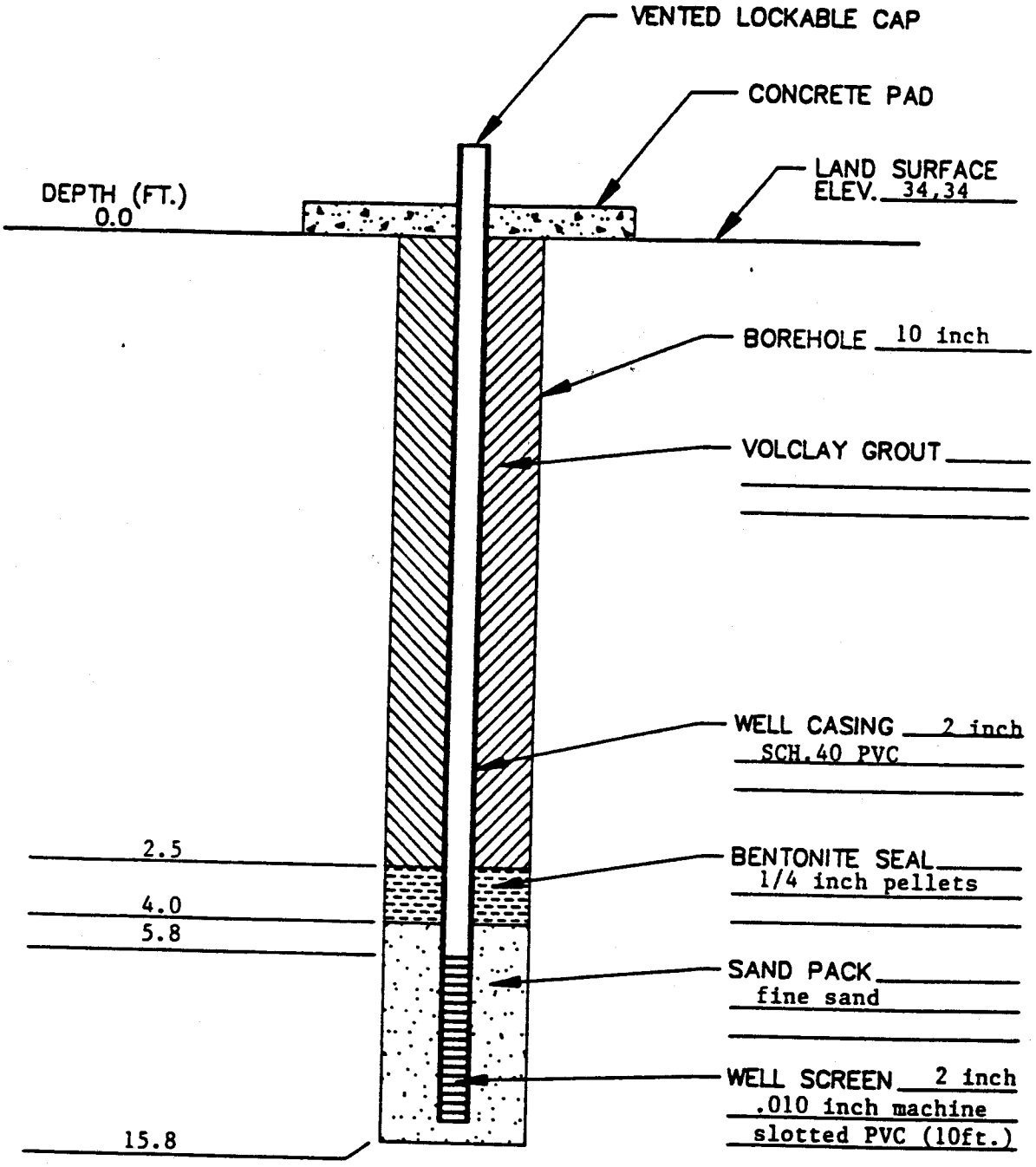
F-203 (R 01-87)

BORING NO. OW-7
SHEET NO. 2 OF 2
PROJECT NO. 467.42
INSTALLATION
SURFACE ELEV. 21.6
BOREHOLE DIA. 10 IN.

PROJECT NAME WEYERHAEUSER
LOCATION PLYMOUTH, NC
CONTRACTOR LAW ENGINEERING
DRILLING METHOD HSA

SAMPLING NOTES						VISUAL CLASSIFICATION AND GENERAL OBSERVATIONS
INTERVAL		RECOVERY		MOISTURE		
NO.	TYPE	BLOWS			DEPTH	
8	SS	2-2-5-6	100		25	- trace clay
						BORING TERMINATED AT 26.0 FEET
					30	
					35	
					40	

Attachment 11



OBSERVATION WELL CONSTRUCTION DIAGRAM

Not To Scale

PROJECT Weyerhaeuser

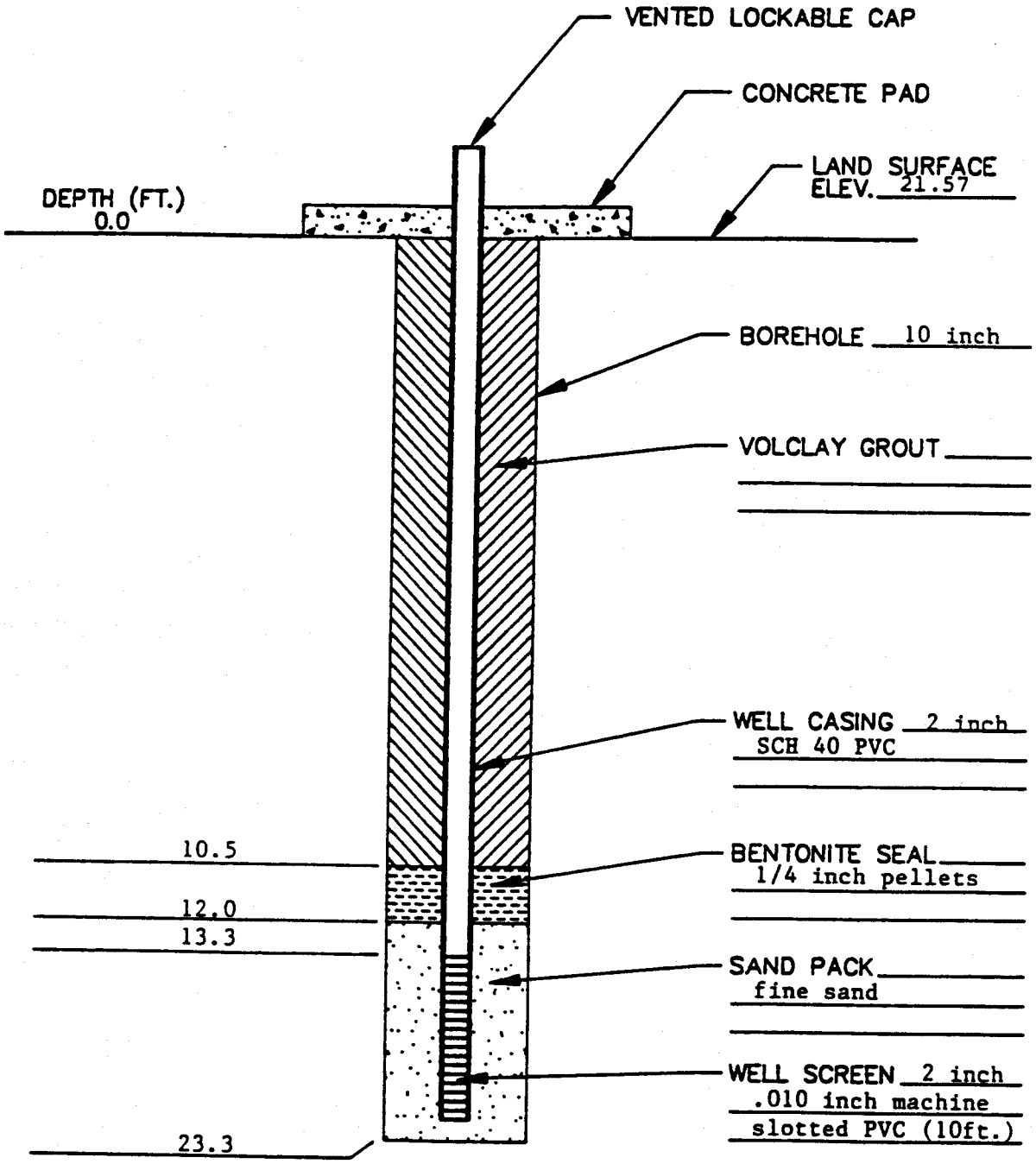
PROJECT NO. 467.42

WELL NO. OW-4 DATE INSTALLED 4/22/90

DRILLING CONTRACTOR Law Engineering

RMT GEOLOGIST B. Grothaus

RMT INC



OBSERVATION WELL CONSTRUCTION DIAGRAM

Not To Scale

PROJECT Weyerhaeuser

PROJECT NO. 467.42

WELL NO. OW-7 DATE INSTALLED 4/25/90

DRILLING CONTRACTOR Law Engineering

RMT GEOLOGIST B. Grothaus

RMT INC

Attachment 12

RMT, INC.

HYDROCON - 1.01
HYDRAULIC CONDUCTIVITY
Bouwer and Rice Method

Well: OW-4

PROJECT NAME: WeyCo
PROJECT NUMBER: 467.42
FIELD WORK DATE(S): 22 MAY 1990

USER NAME: CVC
DATE: 7 June 1990

Rw - BORING RADIUS (IN): 5.51
L - SCREEN LENGTH (FT): 10
H - SCREEN BASE TO WATER TABLE (FT): 5
START TIME (H,M,S): 0,0,0

Rc - WELL RADIUS (IN): 1
D - AQUIFER THICKNESS (FT): 5
STATIC WATER LEVEL READING (FT): 13.6

Rc was corrected for response in well screen filter material to 3.132 inches

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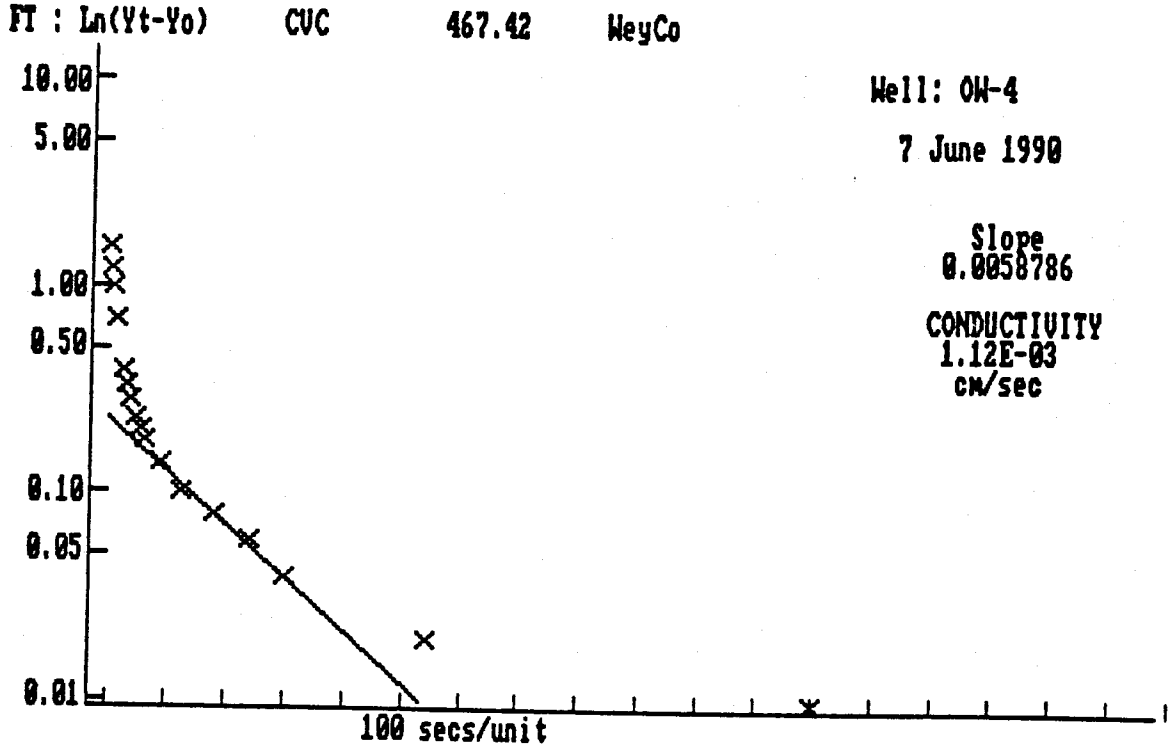
TIME (H,M,S)	DEPTH (FT)
0,0,0	15.17
0,0,2	14.81
0,0,6	14.57
0,0,12	14.29
0,0,25	13.98
0,0,30	13.93
0,0,36	13.88
0,0,46	13.83
0,0,56	13.8
0,1,1	13.78
0,1,31	13.74
0,2,6	13.7
0,3,1	13.68
0,4,1	13.66
0,5,1	13.64
0,9,1	13.62
0,20,1	13.6

(1/t) (ln(Yo/Yt))= 0.0058786

FULLY PENETRATING: C= 1.80

HYDRAULIC CONDUCTIVITY: 3.68E-05 ft/sec
1.12E-03 cm/sec


FT : Ln(Yt-Yo)
CVC
467.42
WeyCo
10.00
5.00
1.00
0.50
0.10
0.05
0.01
100 secs/unit
Well: OW-4
7 June 1990
Slope
0.0058786
CONDUCTIVITY
1.12E-03
cm/sec

RMT, INC.

HYDROCON - 1.01
HYDRAULIC CONDUCTIVITY
Bouwer and Rice Method

Well: OW-7

PROJECT NAME: WeyCo
PROJECT NUMBER: 467.42
FIELD WORK DATE(S): 22 May 1990

USER NAME: CVC
DATE: 1 June 1990

Rw - BORING RADIUS (IN): 8.06
L - SCREEN LENGTH (FT): 10
H - SCREEN BASE TO WATER TABLE (FT): 7.7
START TIME (H,M,S): 0,0,0

Rc - WELL RADIUS (IN): 1
D - AQUIFER THICKNESS (FT): 20
STATIC WATER LEVEL READING (FT): 18.94

Rc was corrected for response in well screen filter material to 4.493 inches

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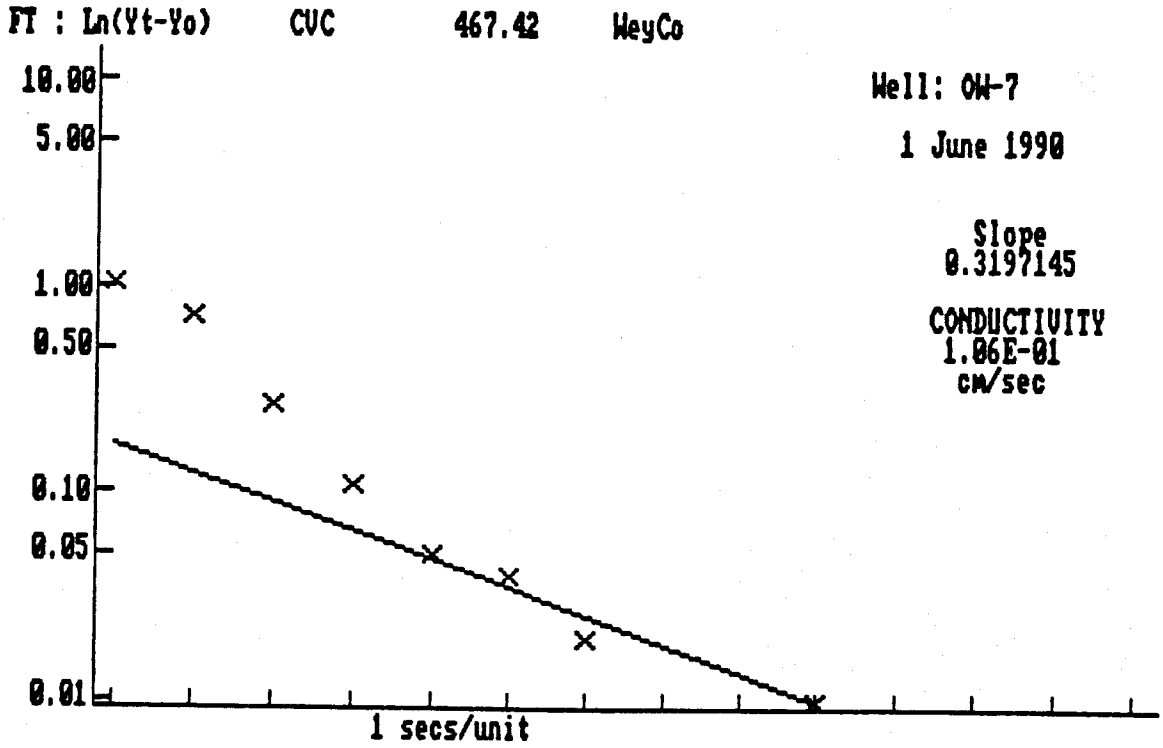
TIME (H,M,S)	DEPTH (FT)
0,0,0	19.95
0,0,1	19.65
0,0,2	19.21
0,0,3	19.05
0,0,4	18.99
0,0,5	18.98
0,0,6	18.96
0,0,9	18.95

(1/t) (ln(Yo/Yt))= 0.3197145

PARTIALLY PENETRATING: A= 2.00 B= 0.30

HYDRAULIC CONDUCTIVITY: 3.48E-03 ft/sec
1.06E-01 cm/sec


FT : Ln(Yt-Yo)
CVC
467.42
WeyCo
10.00
5.00
1.00
0.50
0.10
0.05
0.01
1 secs/unit
Well: OW-7
1 June 1990
Slope
0.3197145
CONDUCTIVITY
1.06E-01
cm/sec

Attachment 13

DESIGN SHEET

Project/Proposal Name	Prepared: By:	Date:	Checked: By:	Date:	Project/Proposal No.
Weyerhaeuser - Plymouth	JAF	1/14/99		1/14/99	5101.01

Mass Balance Calculations:

The liner design effectiveness of Landfill Number Three was evaluated using mass balance calculations to determine if the liner is protective of ground water quality.

Governing Equations:

$$C_{GW} = \frac{(Q_R)(C_P)+(Q_{GW})(C_a)}{Q_R + Q_{GW}}$$

$Q_R = (r)(A_1)$

$Q_{GW} = (K)(dh/dx)(A_2)$

Parameters:

K	1.1×10^{-2}	cm/sec	Geometric mean of OW-4 and OW-7
	0.0217	ft/min	
r	0.006	ft^3/acre/yr	HELP model output with open configuration
	1.38×10^{-7}	ft/yr	
A_1	21.1	acres	Area of Phase 1 foot-print
	9.19×10^5	ft^2	
A_2	500	ft^2	Cross sectional area perpendicular to groundwater flow assuming a 1 foot thick mixing zone with the 500 foot width of phase 1
dh/dx	0.013	ft/ft	Hydraulic gradient in the vicinity of phase 1 as mapped in 1993
Q_R		ft^3/min	Volumetric discharge through landfill liner
Q_{GW}		ft^3/min	Volumetric discharge of groundwater through the mixing zone

Calculations:

$$Q_R = 1.38 \times 10^{-7}\ ft/yr\ (9.19 \times 10^5\ ft^2)$$

$$Q_R = 0.126\ ft^3/yr\ ;\ 2.41 \times 10^{-7}\ ft^3/min$$

$$Q_{GW} = 0.0217\ ft/min\ (0.013\ ft/ft)\ (500\ ft^2)$$

$$Q_{GW} = 0.141\ ft^3/min$$

DESIGN SHEET

Project/Proposal Name	Prepared: By:	Date:	Checked: By:	Date:	Project/Proposal No.
Weyerhaeuser - Plymouth	JAF	01/14/99	[illegible]	1/14/99	5101.01

Calculations:

$$C_{GW} = \frac{Q_R(C_P) + Q_{GW}(C_a)}{Q_R + Q_{GW}}$$

$$C_{GW} = \frac{Q_R(C_P)}{Q_R + Q_{GW}}$$

Assuming upgradient groundwater is clean

$$C_P / C_{GW} = \frac{Q_R + Q_{GW}}{Q_R}$$

$$C_P / 2L = \frac{Q_R + Q_{GW}}{Q_R}$$

Assuming NCAC 2L standard is the maximum allowable concentration in groundwater

$$C_P / 2L = \frac{2.41 \times 10^{-7}\ ft^3/min + 0.141\ ft^3/min}{2.41 \times 10^{-7}\ ft^3/min}$$

$$C_P / 2L = 5.85 \times 10^5$$

The landfill leachate concentration can be 5 orders of magnitude greater than the 2L standard for any given constituent

Sample # 49119

Contained some of the highest constituent concentrations from TCLP data.
Manganese concentrations 15 ppm vs. the 2L of 0.05 ppm

$$C_{GW} = \frac{2.41 \times 10^{-7}\ ft^3/min\ (15\ ppm)}{2.41 \times 10^{-7}\ ft^3/min + 0.141\ ft^3/min}$$

$$C_{GW} = 2.56 \times 10^{-5}\ ppm$$

G:\data\hydro\5101\excel\massbal.xls