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Division of Waste Management
Solid Waste Section
Date **November 8, 2010** By **LY Frost**

November 3, 2010

Mr. Larry Frost
North Carolina Department of Environment and Natural Resources
Division of Waste Management - Solid Waste Section
Asheville Regional Office
2090 U.S. Highway 70
Swannanoa, NC 28778

Subject: Domtar Paper Company, LLC (Domtar), Plymouth, North Carolina
Landfill No. 3 Construction Plan Application - Phase 3 and Phase 4
Permit #94-01

Dear Mr. Frost:

Per your request, RMT North Carolina, Inc. (RMT) has prepared, and attached, a final Phase 3 and Phase 4 Construction Plan Application (Application) for the North Carolina Department of Environment and Natural Resources (NCDENR) review.

The original Application was dated June 2008, and was revised in August 2009 and again in August 2010. This final Application updates the June 2008 Application with the August 2009 and August 2010 revisions, and also incorporates the following:

- Domtar's November 17, 2009 Response to Hydrogeology Review
- RMT's August 13, 2010 Completeness Determination and Technical Review Response
- RMT's September 17, 2010 Completeness Determination and Technical Review Response (Attachment 4 - Post-Closure Care Opinion of Probable Cost)
- RMT's November 3, 2010 response to your September 22, 2010 e-mail to Travis Tarbet, RMT, regarding immediately covering asbestos waste, specifying a salvage operations storage area, and the logging of daily inspections and related actions

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Please contact me with any questions or comments regarding this Application.

Sincerely,

RMT North Carolina, Inc.

Todd W. Martin for

Michael B. Parker, P.E.
President and Project Manager

Attachments

cc: Bill Morris – Domtar Paper Company, LLC
Todd Martin – RMT, Inc.

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Phase 3 and Phase 4 Construction Plan Application

On-site Industrial Waste Landfill No. 3

Domtar Paper Company, LLC (Formerly Weyerhaeuser Company), Plymouth, North Carolina

June 2008, Revised August 2009, August 2010,
Revised November 2010

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Phase 3 and Phase 4 Construction Plan Application

On-site Industrial Waste Landfill No. 3

Domtar Paper Company, LLC (Formerly Weyerhaeuser Company), Plymouth, North Carolina

June 2008
Revised August 2009, August 2010, Revised November 2010

NORTH CAROLINA PROFESSIONAL SEAL 025240 ENGINEER MICHAEL B. PARKER 11/4/10

Michael B. Parker, P.E.
President and Project Manager

Todd W. Martin
Team Leader, Solid Waste

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Foreword

This construction plan application includes the following report in addition to accompanying engineering drawings. The following table is provided for convenience of the reviewer in correlating the sections of this submittal with exact references to the North Carolina Department of Environment and Natural Resources (NC DENR) Solid Waste Management Rules. References are cited as subsections of NC DENR 15A NCAC 13B.0504 (2), which lists the requirements for a construction plan application.

NC DENR REFERENCE	REPORT SECTION	SHEET NO.
2.a	2.2 Surface Hydrology	3 through 5
2.b	4 Engineering Design	8 through 9
2.c	4 Engineering Design	9 through 12
2.d	4.7 Erosion Control Plan	9
2.e		16 through 20
2.f		6, 7, and 15
2.g		13
2.h.i	2.1 Site Location (Appendix A)	
2.h.ii	1.4 General Information	
2.h.iii	7.4 Long-term Use	
2.h.iv	4.9 Capacity and Anticipated Life	
2.h.v	5 Operating Procedures	
2.h.vi	4.6 Earthwork Volumes and Borrow Materials	
2.h.vii	4.7 Erosion Control Plan	
2.h.viii	4.7 Erosion Control Plan	
2.h.ix	4.8 Sediment Control Plan	
2.h.x Rule .0503(2,a) Rule .0503(2,b) Rule .0503(2,c) Rule .0503(2,d,i) Rule .0503(2,d,ii) Rule .0503(2,e) Rule .0503(2,f) Rule .0503(2,g)	 5.6.3 Gas Monitoring 7.6 Public Safety 5.6.4 Stormwater Monitoring 4 Engineering Design 2.5 Design Considerations 7.6 Public Safety 4.4 Buffer Requirements 4.8 Sediment Control Plan	
2.h.xi	3 Waste Characterization Appendix B *Phase 2 – Hydrogeologic and Geotechnical Site Characterization for a Proposed Landfill* Appendix P *Construction Quality Assurance Plan* 7 Closure/Post-Closure	

Certification

The hydrogeology work for the Domtar Paper Company's On-site Industrial Waste Landfill, Plymouth North Carolina, was performed by an RMT, Inc. consulting hydrogeologist in support of RMT North Carolina, Inc.

NORTH CAROLINA LICENSED SEAL 249 GEOLOGIST DAN O. MADISON, JR.

Dan O. Madison, Jr., P.G.
Consulting Hydrogeologist
RMT, Inc.

Table of Contents

1. Introduction 1-1
   - 1.1 Background 1-1
   - 1.2 Purpose 1-1
   - 1.3 Document Overview 1-1
   - 1.4 General Information 1-3

2. Site Characterization 2-1
   - 2.1 Site Location 2-1
   - 2.2 Surface Hydrology 2-1
   - 2.3 Geology 2-2
   - 2.4 Hydrogeology 2-3
   - 2.5 Design Considerations 2-4

3. Waste Characterization 3-1
   - 3.1 Waste Types and Quantities 3-1
   - 3.2 Chemical Testing Results 3-2
   - 3.3 Physical Testing Results 3-3
   - 3.4 Design and Operating Considerations 3-4

4. Engineering Design 4-1
   - 4.1 Design Variances 4-1
   - 4.2 Liner System 4-1
     - 4.2.1 Liner Design 4-1
     - 4.2.2 Liner and Cap Stability 4-2
   - 4.3 Leachate Collection and Removal System 4-3
   - 4.4 Buffer Requirements 4-5
   - 4.5 Cover System 4-5
   - 4.6 Earthwork Volumes and Borrow Materials 4-6
   - 4.7 Erosion Control Plan 4-7
   - 4.8 Sediment Control Plan 4-7
   - 4.9 Capacity and Anticipated Life 4-8

5. Operating Procedures 5-1
5.1 Waste Route 5-1
5.2 Development of Phases 5-1
5.3 Waste Handling and Placement 5-1
5.4 Abnormal Conditions 5-2
5.4.1 Inclement Weather 5-2
5.4.2 Equipment Breakdown 5-2
5.5 Leachate and Stormwater Collection and Removal 5-3
5.6 Environmental Monitoring 5-4
5.6.1 Groundwater Monitoring Plan 5-4
5.6.2 Leachate Monitoring 5-5
5.6.3 Gas Monitoring 5-5
5.6.4 Stormwater Monitoring 5-5

6. Construction Quality Assurance Plan 6-1

7. Closure/Post-closure 7-1
7.1 Closure Method 7-1
7.2 Closure Schedule 7-1
7.3 Post-closure Care 7-2
7.4 Long-term Use 7-2
7.5 Abandonment of Leachate Collection and Environmental Monitoring Systems 7-3
7.6 Public Safety 7-3

8. References 8-1

List of Tables

Table 2-1 Site Coordinates 2-6
Table 2-2 Geologic Formations in Eastern North Carolina (Nelson, 1964) 2-7
Table 2-3 Water Elevation Summary – August 1989 through December 1999 2-8
Table 2-4 Water Elevation Summary – December 2009 through February 2009 2-16
Table 4-1 Phase Capacity [1] 4-12
Table 5-1 Groundwater Monitoring Parameters 5-6

List of Figures

Figure 4-1 Interface Direct Shear Test 4-9
Figure 4-2 Interface Direct Shear Tests....4-10
Figure 4-3 Interface Direct Shear Testing....4-11

List of Appendices

Appendix A Documentation of Design Issues
Appendix B Phase 2 – Hydrogeologic and Geotechnical Site Characterization for a Proposed Landfill
Appendix C Subgrade Settlement Calculations
Appendix D Waste Characterization and Analysis
Appendix E Slope Stability Analysis
Appendix F Groundwater Flow Model for Liner Design
Appendix G Water and Mass Balance Calculations
Appendix H Leachate Line Hydraulic Calculations and Drainage Layer Equivalency Report
Appendix I Pipe Strength Calculations
Appendix J Material Volume Calculations
Appendix K Borrow Investigation
Appendix L Stormwater/Erosion and Sedimentation Calculations
Appendix M Operations Plan
Appendix N Closure/Post-closure Plan
Appendix O Sampling and Analysis Procedures for Groundwater
Appendix P Construction Quality Assurance Plan Phase 3 and Phase 4 Construction – Landfill No. 3
Appendix Q EPG Pump Maintenance Information
Appendix R NPDES Permit

Acronyms

ASTM	American Society for Testing and Materials
BMP	best management practices
CD	consolidated drained
CQA	construction quality assurance
CSTRs	continuous stirred type reactors
CU	consolidated-undrained
cy	cubic yard
DEPOSITS	Modified Deposits Performance Of Sediments In Trap Structures
DOMTAR	Domtar Paper Company, LLC
EHMW	extra high molecular weight
ft^2	square feet
FTB	film-tear bond
GCL	geosynthetic clay liner
GRI	Geosynthetics Research Institute
HDPE	high density polyethylene
HELP	Hydrologic Evaluation of Landfill Performance
I.D.	inside diameter
LCRS	leachate collection and removal system
MQCP	Manufacturer's quality control plan
msl	mean sea level
MUSLE	Modified Universal Soil Loss Equation
NC DENR	North Carolina Department of Environment and Natural Resources
NCAC	North Carolina Administrative Code
NCE&SCP&DM	North Carolina Erosion and Sediment Control Planning and Design Manual
NDG	Nuclear density-moisture gauge
NPDES	National Pollutant Discharge Elimination System
pcf	pounds per cubic foot
psf	pounds per square foot
PVC	polyvinyl chloride

QA	quality assurance
QC	quality control
RMT	RMT North Carolina, Inc.
RPR	resident project representative
SDR	Standard Dimension Ratio
SLOSS	soil loss
TCLP	Toxicity Characteristic Leaching Procedure
TDS	total dissolved solids
VFPE	very flexible polyethylene
VOC	volatile organic compound
Weyerhaeuser	Weyerhaeuser Company

Section 1
Introduction

1.1 Background

The Domtar Paper Company, LLC (Domtar [formerly the Weyerhaeuser Company]) facility in Plymouth, North Carolina, consists of an integrated kraft process pulp and paper mill. Solid wastes generated by facility operations are disposed of in a state-permitted, on-site landfill (Landfill No. 3). In 1998, Weyerhaeuser retained RMT North Carolina, Inc. (RMT) to design a new landfill (Landfill No. 3) that would occupy about 96 acres of a 300-acre tract of land that had been approved for use as a landfill by North Carolina Department of Environment and Natural Resources (NC DENR). Landfill No. 3 is located to the east, southeast, and south of Landfill No. 2. On May 16, 2000, NC DENR issued a Permit-To-Construct, No. 94-01, for Phase 1A of Landfill No. 3. In December 2000, NC DENR granted approval to operate Phase 1A of Landfill No. 3. In December 2000, NC DENR granted approval to operate Phase 1B and 2 of Landfill No. 3. In December 2000, NC DENR granted approval to operate Phase 1B and 2 of Landfill No. 3. Based on a waste generation rate of 100,000 cubic yards per year, Phase 1B and Phase 2 are expected to be near capacity by 2010. Two paper machines (NC-1 and NC-5) have been permanently shut down at Plymouth. Also, a recycled fiber operation that supported NC-1 was permanently closed. A fine paper finishing operation that worked in conjunction with NC-5 was also permanently closed. The closure of these manufacturing units is the reason for the decrease in waste generation. This document and accompanying drawings are being submitted to obtain a Permit-To-Construct for Phase 3 and Phase 4 of Landfill No. 3.

1.2 Purpose

The purpose of this set of documents is to present NC DENR with the information necessary to approve the construction plans, construction quality assurance (CQA) plan, groundwater monitoring plan, and erosion control plan. Supporting technical information on the geotechnical and hydrogeological characteristics of the site and on the chemical and physical properties of waste materials is included in the appendices to this application.

1.3 Document Overview

This document consists of the following components:

- Construction plan application: addresses the requirements of North Carolina Administrative Code (NCAC) T15A:13B.0504.
- CQA plan (Appendix P): defines the testing and documentation procedures necessary to ensure that the facility is built as designed.
- Groundwater monitoring plan (Subsection 5.6.1): establishes the location of wells and sampling protocol and analytical parameters to monitor groundwater quality at the site.

- Drawings that illustrate the design of the new landfill facility. Five sets of bound drawings are provided separately with this application. The following drawings are provided as part of this submittal:

Drawing List

SHEET NO.	TITLE
1	TITLE SHEET
2	DATA POINT LOCATION MAP
3	HISTORICAL HIGH WATER TABLE CONFIGURATION (APRIL 2, 1993)*
4	NOT USED
5	GEOLOGIC CROSS SECTIONS – SHEET 1
6	GEOLOGIC CROSS SECTIONS – SHEET 2
7	OVERALL SITE PLAN
8	LINER GRADING PLAN
9	LEACHATE PIPING PLAN
10	FINAL GRADING PLAN – PHASE 3 AND 4
11	FINAL GRADING PLAN - OVERALL
12	PHASE PROGRESSION PLAN
13	BORROW AREA SITE PLAN
14	LANDFILL DETAILS – SHEET 1
15	LANDFILL DETAILS – SHEET 2
16	LEACHATE COLLECTION AND REMOVAL SYSTEM DETAILS
17	ENGINEERING CROSS SECTIONS
18	MISCELLANEOUS DETAILS
19	EROSION CONTROL DETAILS

Data that support the design of the landfill and groundwater monitoring plan are included in the appendices to this document.

1.4 General Information

Facility Name:	Domtar Paper Company Plymouth Mill Landfill No. 3
Site Owner and Operator:	Domtar Paper Company
Primary Contact:	Bill Morris, Environmental Engineer
Production Facility Location:	Martin County, North Carolina
Disposal Facility Location:	Washington County, North Carolina
Acreage:	7.54 acres for Phases 3 and 4; 96 acres total
Proposed Facility Capacity:	560,000 cubic yards (cy) for Phases 3 and 4
Anticipated Facility Life:	5 years for Phases 3 and 4; 99 years facility life based on current and estimated waste generation rate of 100,000 cy/yr
Waste Types:	Pulp and papermaking process wastes, including boiler ash, grits, liquor dregs, lime mud, wood wastes, paper waste, pulp rejects, general mill trash, demolition debris, dewatered wastewater solids, and related materials.
Leachate Treatment:	Hard piped to mill's wastewater treatment system along the proposed access road.

Section 2
Site Characterization

2.1 Site Location

The spatial limits of Landfill No. 3 are described in Table 2-1 as the coordinates and elevations of the inside corners of the perimeter berm. The points are listed sequentially in a counterclockwise manner starting with the northern-most west corner (just west of the north sediment basin No. 1). The points represent the limits of waste, stated as State Plane Coordinates. Phase 3 and Phase 4 are located within this footprint.

The landfill is located entirely on property owned by Domtar. The relationship of the property line to the landfill is shown on Sheet No. 7, and the legal description of the area permitted for landfill development is included as Appendix A.

2.2 Surface Hydrology

The contours shown on Sheet No. 2 are based on a April 13, 2007 aerial topographic survey,. While landfilling operations will have since altered some of the grades within the existing active landfill phases, the topographic conditions Phase 3 and Phase 4 areas are relatively unchanged.

The natural topography surrounding the overall landfill site exhibits relief of greater than 40 feet, ranging from approximately mean sea level (msl) on the flood plain of Welch Creek to greater than 42 feet msl in the center of Landfill No. 2, northwest of the site. In the vicinity of Landfill No. 3, a topographic ridge trends north-south.

Landfill No. 3 lies within the Welch Creek drainage basin. A portion of the surface water, which originates as precipitation runoff, drains directly to Welch Creek on the west. The remainder drains toward the northeast into Little Mill Creek, which flows into Welch Creek north of the landfill site within Domtar property. On the west side of the site, Welch Creek flows northerly until it discharges into the Roanoke River.

Landfill No. 3 footprint is not located within the 100-year flood plain; neither does it encroach upon jurisdictional wetlands. The delineation of the 100-year floodplain and the jurisdictional wetlands are shown on Sheet No. 2. A copy of the United States Army Corps of Engineers' Notification of Jurisdictional Determination is provided in Appendix A.

2.3 Geology

The landfill site is located within the Atlantic Coastal Plain physiographic province. The Coastal Plain consists of an eastward-thickening series of sediments, ranging in age from Cretaceous to Recent. This province is characterized as a broad, level, east-southeastward-sloping plain that was formerly an ocean floor (Nelson, 1964). During the Pleistocene Epoch (2 to 3 million years ago), the ocean encroached upon land inundating the area to the present 270-foot contour line (Mundorff, 1946). Ocean levels receded and advanced several times during the Pleistocene, Epoch each advancement was at a lower level than the previous one. As a result, a series of terraces was formed, representing coastal deposition areas of previous ocean levels. The landfill site is located near the scarp formed between the lowest and geologically most recent terrace, the Pamlico, and the Talbot Terrace. Throughout most of the area, Recent to Pleistocene age sediments form a layer 25 to 100 feet thick that overlie older deposits (Nelson, 1964).

The Coastal Plain sediments in the region range in thickness from about 1,000 feet in western Washington County to about 10,000 feet at Cape Hatteras. The sediments rest unconformably on ancient crystalline rocks similar or equivalent to those of the Piedmont. Lithologically, the sedimentary formations include beds of limestone, sand, unconsolidated shells, marl, clay, and unconsolidated sandstone. Thin beds of indurated sandstone and siltstone occur locally but comprise no major lithologic unit. The regional dip of the strata is to the east with gradients ranging from 5 to 15 feet per mile. Throughout most of the area, sediments of Pleistocene and Recent age form a layer 25 to 100 feet thick topping the older deposits. The geologic formations in eastern North Carolina consist of undifferentiated Recent to Pleistocene age formations, the Miocene age Yorktown Formation, the Eocene age Castle Hayne Limestone, the Paleocene age Beaufort Formation, and the Cretaceous age formations (Nelson, 1964). These specific formations are described in Table 2-2.

The local geology has been assessed based primarily on data collected from nine soil borings, 16 test pits, seven observation wells, and 10 monitoring wells during previous investigations (*Groundwater Quality Assessment for the Existing Landfill*, RMT, October 1989 and the *Phase 2 Hydrogeologic and Geotechnical Site Characterization for a Proposed Landfill*, RMT, December 1990 (the latter report is presented in Appendix B)). Well, boring, and test pit locations are shown on Sheet No. 3.

During these investigations, seven shallow monitoring wells (MW-1 through MW-7) were installed around the existing landfill, and three deep monitoring wells (MW-1A, MW-6A, and MW-8), one deep observation well (OW-1) and six shallow water table observation wells (OW-2 through OW-7) were installed around the Landfill No. 3 site. Monitoring wells MW-1A, MW-6A, and MW-8, and observation well OW-1 were installed to monitor the water level in a

partially confined aquifer underlying the water table aquifer, and to provide information regarding the distribution and characteristics of on-site clays. The shallow observation wells were installed to provide water table and hydraulic conductivity data regarding soil type and distribution in the shallow aquifer. Boring logs from these investigations were used to construct four geologic cross sections traversing the Landfill No. 3. Cross sections are presented on Sheet No. 6 and Sheet No. 7 and have been modified to reflect more recent topographic conditions based on the topographic map prepared in April 2007. The location of these wells and cross sections are shown on the Historical High Water Table Configuration (Sheet No. 3).

As shown on the geologic cross sections A-A′, B-B′, C-C′, and D-D′, the soils encountered during past investigations generally consisted of sands, silts, and clays. The dominant soil type logged in the shallow subsurface was silty sand, but many of the silty sand beds were interbedded with or interlaminated with clayey sands and clays. In most cases, the sand is fine-grained. Medium-grained and coarse-grained sand was occasionally found at depths greater than 10 feet.

2.4 Hydrogeology

Surficial sediments of Pleistocene to Recent age comprise the unconfined or water table aquifers of the area. The water table is usually within 2 to 7 feet of the land surface. Water from the shallow aquifer characteristically contains iron and is soft and corrosive. This aquifer is declining in importance as a source of domestic groundwater supplies in areas where artesian aquifers are available as sources of supply (Nelson, 1964).

The Miocene Age Yorktown aquifer contains all the confined water-bearing beds that lie above the Castle Hayne aquifer. The chemical quality of water from the Yorktown aquifer varies slightly with the lithology of the aquifer. Due to large amounts of calcareous material at all horizons in the aquifer, the water is commonly hard (Nelson, 1964).

The Eocene Age Castle Hayne Limestone is a productive aquifer in the region. Yields from individual wells are largely dependent on the thickness of the aquifer penetrated and borehole size. In Washington County, the chloride content of water from wells less than 300 feet in depth is within acceptable drinking water limits, but below this depth the water becomes increasingly brackish. In a North Carolina Department of Agriculture well in Washington County, the Castle Hayne was encountered at approximately 200 to 210 feet below the land surface (Nelson, 1964).

The formations of Cretaceous age in the area are not considered a potential source of water supply. Exploratory wells that have penetrated these formations indicate that they contain saline water throughout the area. The Beaufort Formation of Paleocene age may be a potential source of water supply; however, this potential has not been explored (Nelson, 1964).

Two aquifers, one shallow water table and one underlying the water table aquifer, were identified at the Landfill No. 3 site. As illustrated on the geologic cross sections, the shallow water table aquifer exists throughout the site. A clay layer, 15 to 18 feet thick, forms a lower confining unit for this aquifer throughout most of the site. The second aquifer is present below the clay layer. Where present, the clay unit acts as an upper confining unit or aquitard to the lower aquifer. The clay unit is present throughout most of the site but is discontinuous on the west side of the site along the flood plain to Welch Creek and on the far northeast side of the site. In these areas, the upper and lower aquifers are interconnected and groundwater occurs under water table conditions.

A map characterizing the water table, included as Sheet No. 3, was prepared using historic high groundwater levels measured on April 2, 1993. The water table contours have been adjusted to reflect isolated historical high levels measured in well MW-5 on May 16, 2003 and in wells MW-7 and MW-13 on December 1, 2005. The water table configuration shown on Sheet No. 3 represents the highest recorded levels measured since monitoring was initiated in 1989. It should be noted that an anomalously high water level was measured in MW-13 on May 16, 2003. This water level appears to be erroneous and was not used. Historic and current water level elevations are summarized on Table 2-3 and Table 2-4.

The shallow water table fluctuates with seasonal variations in precipitation and, as shown on the geologic cross sections, generally mimics the topography across the site. Groundwater in both aquifers flows from the south of the site toward Welch Creek on the west and Little Mill Creek on the north. Water levels in the water table aquifer range from approximately 2 feet below land surface in the vicinity of well OW-2 in the southwestern portion of the site, to approximately 16 feet below land surface in well MW-2 in the western portion of the site.

Two groups of private residences are located 1,900 to 2,400 feet south of Domtar's Landfill No. 2 and 500 feet from the proposed footprint of Landfill No. 3. Some of these homes rely on private wells for their domestic water supply. These wells are topographically upgradient of the landfill. Discussions with well owners and drillers in the area indicate that domestic water supply wells in the area are commonly 100 to 200 feet deep.

2.5 Design Considerations

The information generated by the hydrogeological and geotechnical investigations led to the identification of two main design considerations. The first is the location of the water table. As required in NCAC Title 15A Subchapter 13B, Section .0503, Subsection 2.d.i of the NCAC, the liner has been designed to maintain a 4-foot buffer zone between the bottom elevation of the solid waste and the seasonal high water table. This is demonstrated on the cross sections of the landfill shown on Sheet No. 17.

The second consideration was the amount of consolidation to be expected of the subgrade once the total height of the landfill has been achieved. A settlement analysis was performed in order to predict the settlement that would result from construction of the proposed waste facility. The analysis was based on two of the five consolidation curves, provided by Law Engineering and RMT; a southeast to northwest cross section of the proposed facility; and a generalized soil profile based on borings and wells SB-3, SB-6, SB-8, and MW-3.

For Phases 3 and 4 the maximum total settlement is estimated to be as much as 14.8 inches at the center of the landfill where waste loads are the highest (refer to Appendix C, Subgrade Settlement Calculations).

Interpretation of site geology, as described in Appendix B, *Phase 2 - Hydrogeological and Geotechnical Site Characterization for a Proposed Landfill,* indicates that the thick uniform deep clay aquitard laterally terminates abruptly as an erosional unconformity (resembling a scarp), rather than as a depositional pinchout. Based on our understanding of the site geology, the slope of the scarp is expected to range between 2 horizontal to 1 vertical and 4 horizontal to 1 vertical. Therefore, parameters selected for a worst-case subsurface geological model included an assumed conservative slope of 1.5 horizontal to 1 vertical for the clay scarp; a maximum thickness of 15 feet for this particular clay stratum; and a maximum differential settlement at 19 inches. Differential settlement occurring in this worst-case subsurface geology model could strain the liner by about 7 percent. Although this is probably much greater strain than the liner would actually experience, the liner design described in Section 4 could withstand this amount of strain and not rupture if subjected to the differential settlement modeled.

The leachate collection lines have been sloped to anticipate the long-term consolidation. The lines in Phases 1 through 10 have been designed with a camber with a change in grade occurring beneath the maximum height of the landfill (the location of the break line). Refer to Sheet No. 8 for the top of liner grades and the location of the break line. The lines in Phase 11 through Phase 18 compensate for the consolidation by having an initial slope of approximately 1 percent. In all cases, once the consolidation has occurred, the lines will result in a slope of no less than 0.5 percent.

Table 2-1
Site Coordinates

	NORTHING	EASTING
1	N 769689.71	E 2658387.39
2	N 769689.71	E 2658921.39
3	N 768891.14	E 2658921.39
4	N 768835.78	E 2658885.65
5	N 768510.68	E 2658822.08
6	N 768240.37	E 2658921.39
7	N 767185.78	E 2658921.39
8	N 767040.78	E 2658990.39
9	N 766823.76	E 2658990.39
10	N 766360.11	E 2658781.92
11	N 766105.12	E 2658039.18
12	N 766393.52	E 2657905.72
13	N 766198.87	E 2657258.53
14	N 767216.96	E 2656887.97
15	N 767531.20	E 2657171.61
16	N 767525.71	E 2657290.31
17	N 767594.78	E 2657392.91
18	N 767624.12	E 2657502.94
19	N 767648.04	E 2657627.08
20	N 767689.19	E 2657671.09
21	N 767842.98	E 2657705.57
22	N 767983.81	E 2657730.40
23	N 768126.81	E 2657747.66
24	N 768269.81	E 2657754.14
25	N 768414.00	E 2657935.37
26	N 768414.00	E 2658387.39

Table 2-2
Geologic Formations in Eastern North Carolina (Nelson, 1964)

SYSTEM	SERIES	FORMATION	DESCRIPTION	WATER SUPPLY
Quaternary	Recent Pleistocene	Undifferentiated	Chiefly interbedded sands and clays, with beds of shells occurring locally. Comprises a surficial layer over the entire area, ranging in thickness from 20 to 100 feet.	Present source of many domestic and farm supplies through dug and driven wells and capable of yielding small to moderate supplies throughout the area. Water is soft, relatively high in iron and locally corrosive.
Tertiary	Miocene	Yorktown Formation	Blue-gray marls, sands and shell beds interbedded with massive, dark gray, sandy clays. Extends over entire area, ranging in thickness from about 50 feet in the western part to about 300 feet in the eastern part.	Developed extensively as a source of domestic supply and is the principal aquifer in Hyde and Tyrrell Counties. Water is fairly hard but generally of good quality otherwise.
		Unnamed Formation	Brown phosphatic sand and silt with thin layers of olive-green sandy clay. Limited data on areal extent and thickness.	Has not been developed as a source of supply, but potentially a source of moderate quantities of good quality water in some areas.
	Eocene	Castle Hayne Limestone	White to light gray, porous, shell limestone, partially dolomitized at some places; white to gray calcareous sands and clays. Apparently extends throughout the area, ranging in thickness from about 120 feet to more than 400 feet.	Highly productive artesian aquifer, yielding several hundred gpm to individual wells. Principal aquifer in western Washington County. Water is hard with hydrogen sulfide common, and may be salty.
	Paleocene	Beaufort Formation	Glauconitic sands, clayey sands with beds of marl and shells occurring locally. Probably extends throughout the area, but data available limited.	Possible source of water supply in Washington County.
Cretaceous		Peedee Formation Black Creek Formation Tuscaloosa Formation	Clay, sand and sandy clay; some gravel; characteristically lenticular, often cross-bedded, drab, brown and reddish colors common.	The formations of Cretaceous age are not considered a source of potable water in the area.

Table 2-3
Water Elevation Summary - August 1989 through December 1999

STATION ID	TOP OF [2] CASING ELEVATION	DEPTH [1] TO WATER 08/16/89	WATER LEVEL[2] ELEVATION 08/16/89	DEPTH [1] TO WATER 01/14/90	WATER LEVEL[2] ELEVATION 01/14/90	DEPTH [1] TO WATER 08/16/90	WATER LEVEL[2] ELEVATION 08/16/90	DEPTH [1] TO WATER 11/20/90	WATER LEVEL[2] ELEVATION 11/20/90	DEPTH [1] TO WATER 12/14/90	WATER LEVEL[2] ELEVATION 12/14/90	DEPTH [1] TO WATER 01/14/91	WATER LEVEL[2] ELEVATION 01/14/91	DEPTH [1] TO WATER 02/14/91	WATER LEVEL[2] ELEVATION 02/14/91
LF-01	37.59	4	33.59	NM	NM	7.91	29.68	11.42	26.17	8.88	28.71	8.17	29.42	6.21	31.38
LF-01A	37.62	NM	NM	NM	NM	NM	NM	31.54	6.08	28.5	9.12	28.42	9.2	28	9.62
LF-02	27.68	20.33	7.35	NM	NM	21.79	5.89	21.58	6.1	21.71	5.97	21.5	6.18	21.21	6.47
LF-03	10.7	5.92	4.78	NM	NM	6.12	4.58	6.12	4.58	6.21	4.49	5.92	4.78	5.96	4.74
LF-04	12.09	7.79	4.3	NM	NM	8.75	3.34	8.13	3.96	8.17	3.92	7.75	4.34	7.5	4.59
LF-05	39.16	12.17	26.99	NM	NM	13.2	25.96	13.46	25.7	13.67	25.49	13.33	25.83	13.25	25.91
LF-06	14.02	10	4.02	NM	NM	11.5	2.52	10.58	3.44	10.58	3.44	10.17	3.85	10	4.02
LF-06A	14.05	NM	NM	NM	NM	NM	NM	10.08	3.97	10.08	3.97	9.83	4.22	9.58	4.47
LF-07	36.33	6.96	29.37	NM	NM	10.83	25.5	11.17	25.16	11.17	25.16	10.75	25.58	9.75	26.58
LF-08	36.19	NM	NM	NM	NM	NM	NM	29.71	6.48	29.46	6.73	29.67	6.52	29.33	6.86
LFO-01	36.98	NM	NM	NM	NM	NM	NM	NM	NM	29.13	7.85	29.08	7.9	28.75	8.23
LFO-02	33.83	NM	NM	NM	NM	NM	NM	NM	NM	Dry	Dry	Dry	Dry	11.04	22.79
LFO-03	45.58	NM	NM	NM	NM	NM	NM	NM	NM	20.79	24.79	21.08	24.5	21.25	24.33
LFO-04	36.95	NM	NM	NM	NM	NM	NM	NM	NM	15	21.95	15	21.95	14.71	22.24
LFO-05	34.1	NM	NM	NM	NM	NM	NM	NM	NM	16.5	17.6	14.42	19.68	13.83	20.27
LFO-06	34.27	NM	NM	23.75	10.52	NM	NM	NM	NM	23.75	10.52	NM	NM	NM	NM
LFO-07	24.47	NM	NM	NM	NM	NM	NM	NM	NM	19.21	5.26	19	5.47	18.92	5.55
LFO-08	36.63	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
LFO-09	33.67	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
LFO-10	38.88	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
LFO-11	39.52	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
LFO-12	39.44	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
LFO-13	38.96	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
LFO-14	39.89	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
LFO-15	41.61	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM

(1) Measured in feet below top of casing

(2) Relative to mean sea level

Table 2-3
Water Elevation Summary - August 1989 through December 1999

STATION ID	TOP OF [2] CASING ELEVATION	DEPTH [1] TO WATER 03/20/91	WATER LEVEL[2] ELEVATION 03/20/91	DEPTH [1] TO WATER 04/02/93	WATER LEVEL[2] ELEVATION 04/02/93	DEPTH [1] TO WATER 06/04/93	WATER LEVEL[2] ELEVATION 06/04/93	DEPTH [1] TO WATER 08/17/93	WATER LEVEL[2] ELEVATION 08/17/93	DEPTH [1] TO WATER 09/20/93	WATER LEVEL[2] ELEVATION 09/20/93	DEPTH [1] TO WATER 10/14/93	WATER LEVEL[2] ELEVATION 10/14/93	DEPTH [1] TO WATER 11/29/93	WATER LEVEL[2] ELEVATION 11/29/93
LF-01	37.59	5.42	32.17	2.92	34.67	6.21	31.38	8.29	29.3	8.88	28.71	9.25	28.34	9	28.59
LF-01A	37.62	27.67	9.95	23.79	13.83	25.54	12.08	27.54	10.08	28.25	9.37	28.5	9.12	28.45	9.17
LF-02	27.68	21.13	6.55	18.88	8.8	20.12	7.56	21.46	6.22	21.79	5.89	21.83	5.85	21.66	6.02
LF-03	10.7	5.83	4.87	5.78	4.92	5.79	4.91	6.29	4.41	6.33	4.37	6.38	4.32	6.17	4.53
LF-04	12.09	7.33	4.76	6.85	5.24	7.46	4.63	8.15	3.94	8.29	3.8	8.5	3.59	8.08	4.01
LF-05	39.16	14.25	24.91	10.54	28.62	11.46	27.7	12.67	26.49	13.17	25.99	13.33	25.83	13.42	25.74
LF-06	14.02	10	4.02	8.08	5.94	10.21	3.81	10.94	3.08	11	3.02	10.88	3.14	10.5	3.52
LF-06A	14.05	9.51	4.54	8.37	5.68	9.54	4.51	10.38	3.67	10.37	3.68	10.33	3.72	10	4.05
LF-07	36.33	9.92	26.41	5.92	30.41	9.38	26.95	11.58	24.75	11.75	24.58	12.12	24.21	11.96	24.37
LF-08	36.19	29.25	6.94	26.83	9.36	27.88	8.31	29.25	6.94	29.67	6.52	29.83	6.36	29.69	6.5
LFO-01	36.98	28.5	8.48	25.5	11.48	26.65	10.33	28.33	8.65	28.92	8.06	29.12	7.86	29.04	7.94
LFO-02	33.83	11.25	22.58	3.73	30.1	7.92	25.91	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
LFO-03	45.58	21.33	24.25	Dry	Dry	NM	NM	19.83	25.75	20.44	25.14	20.75	24.83	21.27	24.31
LFO-04	36.95	14.67	22.28	12.12	24.83	13.6	23.35	14.33	22.62	14.67	22.28	14.88	22.07	14.88	22.07
LFO-05	34.1	Dry	Dry	12.92	21.18	13.9	20.2	14.38	19.72	Dry	Dry	14.88	19.22	13.88	20.22
LFO-06	34.27	20.33	13.94	18.35	15.92	17.67	16.6	18.75	15.52	19.08	15.19	19.29	14.98	19.46	14.81
LFO-07	24.47	18.88	5.59	17.71	6.76	18.42	6.05	18.96	5.51	19.17	5.3	19.29	5.18	19.04	5.43
LFO-08	36.63	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
LFO-09	33.67	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
LFO-10	38.88	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
LFO-11	39.52	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
LFO-12	39.44	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
LFO-13	38.96	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
LFO-14	39.89	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
LFO-15	41.61	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM

(1) Measured in feet below top of casing

(2) Relative to mean sea level

Table 2-3
Water Elevation Summary - August 1989 through December 1999

STATION ID	TOP OF [2] CASING ELEVATION	DEPTH [1] TO WATER 12/22/93	WATER LEVEL[2] ELEVATION 12/22/93	DEPTH [1] TO WATER 01/10/94	WATER LEVEL[2] ELEVATION 01/10/94	DEPTH [1] TO WATER 02/22/94	WATER LEVEL[2] ELEVATION 02/22/94	DEPTH [1] TO WATER 05/23/94	WATER LEVEL[2] ELEVATION 05/23/94	DEPTH [1] TO WATER 06/21/94	WATER LEVEL[2] ELEVATION 06/21/94	DEPTH [1] TO WATER 07/27/94	WATER LEVEL[2] ELEVATION 07/27/94	DEPTH [1] TO WATER 10/20/94	WATER LEVEL[2] ELEVATION 10/20/94
LF-01	37.59	8.27	29.32	8.12	29.47	5.53	32.06	7.05	30.54	7.96	29.63	9	28.59	7.95	29.64
LF-01A	37.62	28.33	9.29	28.69	8.93	27.8	9.82	27.3	10.32	27.93	9.69	28.57	9.05	28.72	8.9
LF-02	27.68	NM	NM	22.04	5.64	21.35	6.33	21.62	6.06	22	5.68	22.49	5.19	22.39	5.29
LF-03	10.7	NM	NM	6.5	4.2	6.4	4.3	6.75	3.95	6.9	3.8	7.12	3.58	6.95	3.75
LF-04	12.09	NM	NM	8.38	3.71	8.05	4.04	8.71	3.38	8.71	3.38	8.99	3.1	8.72	3.37
LF-05	39.16	NM	NM	14.11	25.05	13.12	26.04	13.41	25.75	13.72	25.44	14.15	25.01	14.04	25.12
LF-06	14.02	NM	NM	10.63	3.39	10.6	3.42	11.22	2.8	11.5	2.52	11.85	2.17	11.14	2.88
LF-06A	14.05	NM	NM	10.25	3.8	10.08	3.97	10.55	3.5	10.9	3.15	11.27	2.78	10.69	3.36
LF-07	36.33	11.54	24.79	12.02	24.31	11.05	25.28	11.93	24.4	11.74	24.59	14.49	21.84	12.7	23.63
LF-08	36.19	29.54	6.65	30.07	6.12	29.5	6.69	29.43	6.76	29.44	6.75	30.25	5.94	29.81	6.38
LFO-01	36.98	28.94	8.04	29.38	7.6	28.8	8.18	28.45	8.53	28.45	8.53	29.41	7.57	29.55	7.43
LFO-02	33.83	Dry	Dry	Dry	Dry	13.45	20.38	14.75	19.08	Dry	Dry	Dry	Dry	Dry	Dry
LFO-03	45.58	21.27	24.31	22.25	23.33	22.37	23.21	21.75	23.83	21.34	24.24	21.71	23.87	22.5	23.08
LFO-04	36.95	9.79	27.16	15.25	21.7	14.75	22.2	14.85	22.1	15.14	21.81	14.42	22.53	15.75	21.2
LFO-05	34.1	13.6	20.5	14.01	20.09	14.05	20.05	14.8	19.3	14.72	19.38	15	19.1	14.12	19.98
LFO-06	34.27	19.44	14.83	19.81	14.46	18.83	15.44	19.12	15.15	19.5	14.77	19.93	14.34	19.55	14.72
LFO-07	24.47	19.83	4.64	19.38	5.09	19.2	5.27	19.3	5.17	19.58	4.89	19.87	4.6	19.69	4.78
LFO-08	36.63	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
LFO-09	33.67	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
LFO-10	38.88	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
LFO-11	39.52	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
LFO-12	39.44	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
LFO-13	38.96	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
LFO-14	39.89	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
LFO-15	41.61	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM

(1) Measured in feet below top of casing

(2) Relative to mean sea level

Table 2-3
Water Elevation Summary - August 1989 through December 1999

STATION ID	TOP OF [2] CASING ELEVATION	DEPTH [1] TO WATER 02/28/95	WATER LEVEL[2] ELEVATION 02/28/95	DEPTH [1] TO WATER 01/26/96	WATER LEVEL[2] ELEVATION 01/26/96	DEPTH [1] TO WATER 10/07/96	WATER LEVEL[2] ELEVATION 10/07/96	DEPTH [1] TO WATER 11/05/96	WATER LEVEL[2] ELEVATION 11/05/96	DEPTH [1] TO WATER 12/04/96	WATER LEVEL[2] ELEVATION 12/04/96	DEPTH [1] TO WATER 01/08/97	WATER LEVEL[2] ELEVATION 01/08/97	DEPTH [1] TO WATER 02/05/97	WATER LEVEL[2] ELEVATION 02/05/97
LF-01	37.59	4.92	32.67	7.05	30.54	5.9	31.69	4.65	32.94	5.96	31.63	4.25	33.34	4.38	33.21
LF-01A	37.62	27.26	10.36	28.1	9.52	26.55	11.07	26.06	11.56	26.47	11.15	26.13	11.49	25.9	11.72
LF-02	27.68	21.08	6.6	21.84	5.84	20.94	6.74	20.73	6.95	21	6.68	19.69	7.99	20.61	7.07
LF-03	10.7	6.32	4.38	NM	NM	6.2	4.5	6.12	4.58	6.22	4.48	6.04	4.66	6.02	4.68
LF-04	12.09	7.96	4.13	8.24	3.85	7.79	4.3	7.85	4.24	7.85	4.24	7.73	4.36	7.74	4.35
LF-05	39.16	13.44	25.72	13.75	25.41	12.85	26.31	12.65	26.51	12.58	26.58	12.25	26.91	12.28	26.88
LF-06	14.02	10.33	3.69	10.67	3.35	10.32	3.7	10.32	3.7	10.53	3.49	10.3	3.72	10.38	3.64
LF-06A	14.05	9.78	4.27	10.29	3.76	9.8	4.25	9.73	4.32	9.94	4.11	9.71	4.34	9.72	4.33
LF-07	36.33	11.05	25.28	12.37	23.96	10.91	25.42	10	26.33	10.03	26.3	9.3	27.03	9.03	27.3
LF-08	36.19	28.82	7.37	29.66	6.53	28.55	7.64	28.29	7.9	28.5	7.69	28.26	7.93	28.07	8.12
LFO-01	36.98	28.63	8.35	29.08	7.9	28.92	8.06	27.51	9.47	27.82	9.16	27.52	9.46	27.3	9.68
LFO-02	33.83	12.23	21.6	13.92	19.91	14.3	19.53	NM	NM	12.77	21.06	11.52	22.31	11.08	22.75
LFO-03	45.58	22.74	22.84	20.62	24.96	21.38	24.2	NM	NM	20.56	25.02	20.72	24.86	20.39	25.19
LFO-04	36.95	15.12	21.83	16.27	20.68	NM	NM	14.87	22.08	14.97	21.98	14.74	22.21	14.63	22.32
LFO-05	34.1	13.72	20.38	14.3	19.8	14.35	19.75	14.29	19.81	14.58	19.52	14.26	19.84	14.47	19.63
LFO-06	34.27	18.48	15.79	18.14	16.13	18.08	16.19	18.39	15.88	19.14	15.13	19.27	15	19.3	14.97
LFO-07	24.47	19.15	5.32	13	11.47	19.08	5.39	18.97	5.5	19.02	5.45	18.88	5.59	18.87	5.6
LFO-08	36.63	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
LFO-09	33.67	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
LFO-10	38.88	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
LFO-11	39.52	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
LFO-12	39.44	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
LFO-13	38.96	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
LFO-14	39.89	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
LFO-15	41.61	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM

(1) Measured in feet below top of casing

(2) Relative to mean sea level

Table 2-3
Water Elevation Summary - August 1989 through December 1999

STATION ID	TOP OF [2] CASING ELEVATION	DEPTH [1] TO WATER 03/06/97	WATER LEVEL[2] ELEVATION 03/06/97	DEPTH [1] TO WATER 04/04/97	WATER LEVEL[2] ELEVATION 04/04/97	DEPTH [1] TO WATER 05/09/97	WATER LEVEL[2] ELEVATION 05/09/97	DEPTH [1] TO WATER 06/05/97	WATER LEVEL[2] ELEVATION 06/05/97	DEPTH [1] TO WATER 07/08/97	WATER LEVEL[2] ELEVATION 07/08/97	DEPTH [1] TO WATER 08/05/97	WATER LEVEL[2] ELEVATION 08/05/97	DEPTH [1] TO WATER 09/09/97	WATER LEVEL[2] ELEVATION 09/09/97
LF-01	37.59	4.31	33.28	4.71	32.88	5.21	32.38	6.54	31.05	8.1	29.49	8.28	29.31	9.07	28.52
LF-01A	37.62	25.91	11.71	25.9	11.72	26.08	11.54	26.74	10.88	27.58	10.04	27.99	9.63	28.46	9.16
LF-02	27.68	20.57	7.11	20.51	7.17	20.59	7.09	21.13	6.55	21.73	5.95	21.98	5.7	22.22	5.46
LF-03	10.7	5.96	4.74	5.99	4.71	6.03	4.67	6.34	4.36	6.71	3.99	6.76	3.94	6.92	3.78
LF-04	12.09	7.65	4.44	7.68	4.41	7.68	4.41	8.07	4.02	8.44	3.65	8.55	3.54	8.71	3.38
LF-05	39.16	12.2	26.96	12.19	26.97	12.29	26.87	12.8	26.36	13.43	25.73	13.64	25.52	13.78	25.38
LF-06	14.02	10.4	3.62	10.35	3.67	10.43	3.59	10.78	3.24	11.36	2.66	11.44	2.58	11.53	2.49
LF-06A	14.05	9.73	4.32	9.72	4.33	9.81	4.24	10.17	3.88	10.77	3.28	10.84	3.21	10.99	3.06
LF-07	36.33	8.65	27.68	5.83	30.5	9.01	27.32	9.82	26.51	10.52	25.81	11.03	25.3	11.69	24.64
LF-08	36.19	28.08	8.11	28.02	8.17	28.05	8.14	28.57	7.62	29.1	7.09	29.33	6.86	29.65	6.54
LFO-01	36.98	27.31	9.67	27.25	9.73	NM	NM	27.86	9.12	28.51	8.47	28.82	8.16	29.22	7.76
LFO-02	33.83	11.28	22.55	11.92	21.91	NM	NM	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
LFO-03	45.58	20.15	25.43	20.14	25.44	NM	NM	20.66	24.92	20.93	24.65	21.23	24.35	21.61	23.97
LFO-04	36.95	14.51	22.44	14.43	22.52	NM	NM	14.68	22.27	15.09	21.86	15.27	21.68	15.47	21.48
LFO-05	34.1	14.31	19.79	14.29	19.81	NM	NM	14.3	19.8	14.97	19.13	15.06	19.04	15.22	18.88
LFO-06	34.27	19.44	14.83	19.23	15.04	NM	NM	19.38	14.89	20.07	14.2	20.39	13.88	20.58	13.69
LFO-07	24.47	18.83	5.64	18.8	5.67	NM	NM	19.04	5.43	19.32	5.15	19.39	5.08	19.58	4.89
LFO-08	36.63	NM	NM	NM	NM	7.33	29.3	9.18	27.45	10.43	26.2	10.8	25.83	11.53	25.1
LFO-09	33.67	NM	NM	NM	NM	3.93	29.74	4.57	29.1	5.82	27.85	6.1	27.57	7.14	26.53
LFO-10	38.88	NM	NM	NM	NM	5.65	33.23	7.1	31.78	8.58	30.3	8.81	30.07	8.76	30.12
LFO-11	39.52	NM	NM	NM	NM	6.74	32.78	8.31	31.21	10.3	29.22	10.98	28.54	11.41	28.11
LFO-12	39.44	NM	NM	NM	NM	7.79	31.65	9.41	30.03	10.8	28.64	11.45	27.99	12.03	27.41
LFO-13	38.96	NM	NM	NM	NM	8.24	30.72	9.51	29.45	10.93	28.03	11.78	27.18	12.47	26.49
LFO-14	39.89	NM	NM	NM	NM	10.57	29.32	11.41	28.48	12.53	27.36	13.18	26.71	13.77	26.12
LFO-15	41.61	NM	NM	NM	NM	15.25	26.36	15.57	26.04	16.06	25.55	16.48	25.13	16.97	24.64

(1) Measured in feet below top of casing

(2) Relative to mean sea level

Table 2-3
Water Elevation Summary - August 1989 through December 1999

STATION ID	TOP OF [2] CASING ELEVATION	DEPTH [1] TO WATER 10/07/97	WATER LEVEL[2] ELEVATION 10/07/97	DEPTH [1] TO WATER 11/04/97	WATER LEVEL[2] ELEVATION 11/04/97	DEPTH [1] TO WATER 12/10/98	WATER LEVEL[2] ELEVATION 12/10/98	DEPTH [1] TO WATER 04/17/98	WATER LEVEL[2] ELEVATION 04/17/98	DEPTH [1] TO WATER 09/11/98	WATER LEVEL[2] ELEVATION 09/11/98	DEPTH [1] TO WATER 10/06/98	WATER LEVEL[2] ELEVATION 10/06/98	DEPTH [1] TO WATER 11/10/98	WATER LEVEL[2] ELEVATION 11/10/98
LF-01	37.59	8.93	28.66	8.83	28.76	8.05	29.54	4.38	33.21	NM	NM	NM	NM	NM	NM
LF-01A	37.62	28.55	9.07	28.74	8.88	28.32	9.3	25.04	12.58	NM	NM	NM	NM	NM	NM
LF-02	27.68	22.08	5.6	22.08	5.6	21.8	5.88	19.89	7.79	NM	NM	NM	NM	NM	NM
LF-03	10.7	6.9	3.8	6.7	4	6.48	4.22	5.75	4.95	NM	NM	NM	NM	NM	NM
LF-04	12.09	8.57	3.52	8.42	3.67	8.2	3.89	7.41	4.68	NM	NM	NM	NM	NM	NM
LF-05	39.16	13.82	25.34	13.74	25.42	13.42	25.74	12.23	26.93	NM	NM	NM	NM	NM	NM
LF-06	14.02	11.21	2.81	11.06	2.96	7.26	6.76	9.93	4.09	NM	NM	NM	NM	NM	NM
LF-06A	14.05	10.69	3.36	10.57	3.48	10.27	3.78	9.22	4.83	NM	NM	NM	NM	NM	NM
LF-07	36.33	11.86	24.47	11.77	24.56	11.86	24.47	9.43	26.9	NM	NM	NM	NM	NM	NM
LF-08	36.19	29.62	6.57	29.62	6.57	29.37	6.82	27.5	8.69	NM	NM	NM	NM	NM	NM
LFO-01	36.98	29.25	7.73	29.36	7.62	29.04	7.94	26.58	10.4	28.55	8.43	28.95	8.03	29.18	7.8
LFO-02	33.83	Dry	Dry	Dry	Dry	Dry	Dry	NM	NM	NM	NM	NM	NM	NM	NM
LFO-03	45.58	21.87	23.71	22.06	23.52	22.26	23.32	18.91	26.67	21.4	24.18	20.47	25.11	20.98	24.6
LFO-04	36.95	15.48	21.47	15.41	21.54	5.41	31.54	14.28	22.67	14.59	22.36	14.88	22.07	14.95	22
LFO-05	34.1	14.89	19.21	14.32	19.78	14.81	19.29	14.93	19.17	14.93	19.17	16.04	18.06	16.57	17.53
LFO-06	34.27	20.48	13.79	20.49	13.78	20.38	13.89	19.98	14.29	23.2	11.07	21.27	13	21.58	12.69
LFO-07	24.47	14.47	10	19.35	5.12	19.47	5	NM	NM	NM	NM	11.57	12.9	NM	NM
LFO-08	36.63	11.6	25.03	11.35	25.28	11.05	25.58	7.62	29.01	11.42	25.21	NM	NM	NM	NM
LFO-09	33.67	4.07	29.6	6.46	27.21	6.06	27.61	3.35	30.32	7.25	26.42	7.99	25.68	NM	NM
LFO-10	38.88	8.32	30.56	8.44	30.44	7.53	31.35	4.02	34.86	8.02	30.86	9.17	29.71	NM	NM
LFO-11	39.52	11.47	28.05	11.57	27.95	11.08	28.44	4.07	35.45	11.3	28.22	11.56	27.96	NM	NM
LFO-12	39.44	12.26	27.18	12.54	26.9	12.47	26.97	5.83	33.61	11.9	27.54	12.32	27.12	NM	NM
LFO-13	38.96	12.64	26.32	12.82	26.14	12.51	26.45	6.59	32.37	12.43	26.53	12.83	26.13	NM	NM
LFO-14	39.89	13.98	25.91	14.2	25.69	14.32	25.57	9.21	30.68	13.31	26.58	13.66	26.23	NM	NM
LFO-15	41.61	17.22	24.39	17.45	24.16	NM	NM	13.43	28.18	15.63	25.98	16	25.61	NM	NM

(1) Measured in feet below top of casing

(2) Relative to mean sea level

Table 2-3
Water Elevation Summary - August 1989 through December 1999

STATION ID	TOP OF [2] CASING ELEVATION	DEPTH [1] TO WATER 01/14/99	WATER LEVEL[2] ELEVATION 01/14/99	DEPTH [1] TO WATER 02/03/99	WATER LEVEL[2] ELEVATION 02/03/99	DEPTH [1] TO WATER 02/26/99	WATER LEVEL[2] ELEVATION 02/26/99	DEPTH [1] TO WATER 03/29/99	WATER LEVEL[2] ELEVATION 03/29/99	DEPTH [1] TO WATER 04/26/99	WATER LEVEL[2] ELEVATION 04/26/99	DEPTH [1] TO WATER 05/18/99	WATER LEVEL[2] ELEVATION 05/18/99	DEPTH [1] TO WATER 06/21/99	WATER LEVEL[2] ELEVATION 06/21/99
LF-01	37.59	NM	NM	10.04	27.55	10.03	27.56	NM	NM	10.28	27.31	NM	NM	10.78	26.81
LF-01A	37.62	NM	NM	27.45	10.17	27.25	10.37	NM	NM	27.36	10.26	NM	NM	28.12	9.5
LF-02	27.68	NM	NM	21.02	6.66	21.06	6.62	NM	NM	21.32	6.36	NM	NM	21.88	5.8
LF-03	10.7	NM	NM	6.2	4.5	6.24	4.46	NM	NM	6.48	4.22	NM	NM	6.65	4.05
LF-04	12.09	NM	NM	7.89	4.2	7.98	4.11	NM	NM	8.23	3.86	NM	NM	8.54	3.55
LF-05	39.16	NM	NM	12.39	26.77	12.48	26.68	NM	NM	NM	NM	NM	NM	13.18	25.98
LF-06	14.02	NM	NM	10.3	3.72	10.45	3.57	NM	NM	10.77	3.25	NM	NM	11.1	2.92
LF-06A	14.05	NM	NM	9.73	4.32	9.87	4.18	NM	NM	10.14	3.91	NM	NM	10.53	3.52
LF-07	36.33	NM	NM	10.85	25.48	10.66	25.67	NM	NM	10.72	25.61	NM	NM	11.42	24.91
LF-08	36.19	NM	NM	28.82	7.37	28.76	7.43	NM	NM	NM	NM	NM	NM	29.43	6.76
LFO-01	36.98	28.75	8.23	NM	NM	28.28	8.7	28.26	8.72	28.35	8.63	28.55	8.43	28.96	8.02
LFO-02	33.83	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
LFO-03	45.58	21.31	24.27	NM	NM	20.87	24.71	21.06	24.52	21.11	24.47	21.23	24.35	21.55	24.03
LFO-04	36.95	14.68	22.27	NM	NM	14.35	22.6	14.35	22.6	NM	NM	14.6	22.35	14.92	22.03
LFO-05	34.1	14.39	19.71	NM	NM	14.62	19.48	14.02	20.08	NM	NM	15.91	18.19	16.09	18.01
LFO-06	34.27	19.91	14.36	NM	NM	19.97	14.3	20.13	14.14	NM	NM	21.14	13.13	21.48	12.79
LFO-07	24.47	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
LFO-08	36.63	11.58	25.05	NM	NM	10.97	25.66	10.74	25.89	10.98	25.65	11.13	25.5	11.98	24.65
LFO-09	33.67	7.68	25.99	NM	NM	7.37	26.3	7.09	26.58	7.77	25.9	7.6	26.07	8.32	25.35
LFO-10	38.88	7.51	31.37	NM	NM	6.43	32.45	6.76	32.12	7.58	31.3	7.99	30.89	9.14	29.74
LFO-11	39.52	11.54	27.98	NM	NM	10.01	29.51	9.69	29.83	10.07	29.45	10.58	28.94	11.4	28.12
LFO-12	39.44	NM	NM	NM	NM	12.28	27.16	12.22	27.22	12.25	27.19	12.43	27.01	13.03	26.41
LFO-13	38.96	13.08	25.88	NM	NM	12.41	26.55	12.41	26.55	12.54	26.42	12.85	26.11	13.26	25.7
LFO-14	39.89	14.09	25.8	NM	NM	13.45	26.44	13.4	26.49	13.4	26.49	13.63	26.26	14.18	25.71
LFO-15	41.61	17.02	24.59	NM	NM	16.52	25.09	16.63	24.98	16.78	24.83	16.88	24.73	17.22	24.39

(1) Measured in feet below top of casing

(2) Relative to mean sea level

Table 2-3
Water Elevation Summary - August 1989 through December 1999

STATION ID	TOP OF [2] CASING ELEVATION	DEPTH [1] TO WATER 07/03/99	WATER LEVEL[2] ELEVATION 07/03/99	DEPTH [1] TO WATER 08/30/99	WATER LEVEL[2] ELEVATION 08/30/99	DEPTH [1] TO WATER 10/21/99	WATER LEVEL[2] ELEVATION 10/21/99	DEPTH [1] TO WATER 12/21/99	WATER LEVEL[2] ELEVATION 12/21/99
LF-01	37.59	NM	NM	NM	NM	NM	NM	9.37	28.22
LF-01A	37.62	NM	NM	NM	NM	NM	NM	26.32	11.3
LF-02	27.68	NM	NM	NM	NM	NM	NM	20.64	7.04
LF-03	10.7	NM	NM	NM	NM	NM	NM	6.02	4.68
LF-04	12.09	NM	NM	NM	NM	NM	NM	7.88	4.21
LF-05	39.16	NM	NM	NM	NM	NM	NM	11.94	27.22
LF-06	14.02	NM	NM	NM	NM	NM	NM	10.32	3.7
LF-06A	14.05	NM	NM	NM	NM	NM	NM	9.67	4.38
LF-07	36.33	NM	NM	NM	NM	NM	NM	8.22	28.11
LF-08	36.19	NM	NM	NM	NM	NM	NM	28.22	7.97
LFO-01	36.98	29.5	7.48	29.6	7.38	26.33	10.65	27.53	9.45
LFO-02	33.83	NM	NM	NM	NM	NM	NM	NM	NM
LFO-03	45.58	21.81	23.77	22.07	23.51	17.88	27.7	17.83	27.75
LFO-04	36.95	15.17	21.78	15.27	21.68	13.1	23.85	14.04	22.91
LFO-05	34.1	16.73	17.37	16.7	17.4	13.16	20.94	15.06	19.04
LFO-06	34.27	21.78	12.49	21.87	12.4	18.05	16.22	21.05	13.22
LFO-07	24.47	NM	NM	NM	NM	NM	NM	NM	NM
LFO-08	36.63	12.61	24.02	12.81	23.82	4.4	32.23	7.38	29.25
LFO-09	33.67	8.76	24.91	8.85	24.82	2.8	30.87	5.37	28.3
LFO-10	38.88	9.99	28.89	9.25	29.63	2.11	36.77	6.24	32.64
LFO-11	39.52	11.09	28.43	12.35	27.17	2.18	37.34	5.72	33.8
LFO-12	39.44	14.11	25.33	13.68	25.76	3.01	36.43	7.34	32.1
LFO-13	38.96	14.34	24.62	14.18	24.78	3.22	35.74	8.02	30.94
LFO-14	39.89	14.63	25.26	14.9	24.99	7.58	32.31	9.47	30.42
LFO-15	41.61	17.52	24.09	17.76	23.85	11.39	30.22	12.54	29.07

(1) Measured in feet below top of casing

(2) Relative to mean sea level

Table 2-4
Water Elevation Summary - December 1999 through February 2009

WELL NAME	12/21/99	02/24/00	05/26/00	08/15/00	11/16/00	02/27/01	06/05/01	09/12/01	12/27/01	03/26/02	06/30/02	10/30/02	05/16/03	12/30/03	12/30/04
LF-01	28.22	28.82	28.31	27.66	28.26	28.15	27.55	27.8	27.13	28.44	27.53	27.43	28.73	30.18	29.21
LF-01A	11.3	11.67	11.12	10.92	10.92	10.2	9.58	9.39	8.34	9.53	9.14	8.52	12.5	13.36	10.91
LF-02	7.04	7.31	6.97	6.99	6.75	6.43	5.99	5.82	5.23	6.09	5.59	5.18	8.49	8.38	6.76
LF-03	4.68	4.8	4.56	4.62	4.53	4.49	4.07	3.94	3.77	4.43	3.72	3.79	4.87	5.19	4.66
LF-04	4.21	4.42	4.07	4.28	4.05	3.99	3.57	3.51	3.11	3.94	3.86	3.41	4.69	5.04	4.36
LF-05	27.22	27.17	26.91	22.02	26.89	NA	NA	NA	25.2	25.13	25.31	24.57	28.71	26.1	25.1
LF-06	3.7	3.88	3.67	4.06	3.47	3.51	3.17	3.02	2.88	-0.24	2.79	3.25	4	4.54	3.79
LF-06A	4.38	4.56	4.28	4.55	4.12	4.11	3.69	3.46	3.33	3.95	2.25	2.94	4.58	5.17	4.28
LF-07	28.11	29.27	28.91	29.26	27.63	27.5	26.62	26.43	25.37	27.12	25.96	25.65	29.06	29.57	27.7
LF-08	7.97	8.25	7.85	7.93	7.74	7.37	6.86	6.69	4.79	6.86	6.39	6.13	8.49	9.13	7.75
LF-09	NA	NA	NA	NA	NA	NA	NA	NA	7.29	NA	NA	NA	9.91	10.21	9.05
LF-10	NA	NA	NA	NA	NA	NA	NA	NA	4.04	NA	NA	NA	4.92	5.26	4.91
LF-11	NA	NA	NA	NA	NA	NA	NA	NA	4.39	NA	NA	NA	5.25	5.59	5.24
LF-12	NA	NA	NA	NA	NA	NA	NA	NA	5.87	NA	NA	NA	7.14	7.58	7.27
LF-13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	24.58	19.28	17.62
LFO-04	22.91	23.2	22.79	22.86	22.36	22.02	21.75	21.64	21.14	21.19	20.91	20.9	22.19	22.12	21.45
LFO-14	25.05	27.28	26.82	27.17	24.79	23.67	22.97	22.88	21.33	22.38	22.57	21.41	26.92	28.32	23.6

WELL NAME	03/31/05	06/28/05	09/22/05	12/1/2005	03/23/06	06/06/06	08/22/06	11/27/06	02/27/07	05/30/07	08/14/07	08/07/08	11/24/08	02/23/09
LF-01	30.11	31.39	28.59	29.09	28.72	28.79	28.79	30.19	29.35	28.28	27.17	25.99	25.91	26.12
LF-01A	11.84	10.71	11.21	11.52	11.22	10.98	10.98	12.25	11.33	10.82	9.2	8.2	7.87	8.11
LF-02	5.68	6.57	6.71	7.08	6.88	6.84	6.84	7.86	7	6.58	5.48	5.03	4.68	5
LF-03	4.89	4.38	4.49	4.75	4.65	4.65	4.65	5.05	4.75	4.29	3.8	3.36	3.57	3.7
LF-04	4.74	4.09	4.29	4.51	4.29	4.28	4.28	5.06	4.46	4.04	3.29	3.02	3.22	3.31
LF-05	25.06	24.9	24.95	24.85	24.56	24.64	24.64	24.31	24.3	24.16	24.06	23.69	23.29	23.31
LF-06	4.36	3.22	3.46	3.82	3.68	3.72	3.72	4.77	3.41	3.42	2.6	2.12	2.67	2.87
LF-06A	4.83	3.75	3.94	7.56	4.23	4.18	4.18	5.23	4.48	3.8	3.05	2.58	3	3.25
LF-07	28.94	26.91	26.88	30.72	27.52	27.67	27.67	27.66	28.06	26.68	25.58	24.23	23.83	23.72
LF-08	8.29	7.65	7.79	8.04	7.92	7.4	7.4	8.54	7.54	8.11	6.49	5.27	6.13	5.74
LF-09	9.62	9.23	9.3	9.53	9.33	9.32	9.32	9.53	9.15	9.07	8.38	7.87	7.06	7.50
LF-10	5.13	4.57	4.81	4.78	4.85	4.88	4.88	5.31	5.13	4.56	4.06	3.66	3.79	4.08
LF-11	5.47	4.89	5	5.23	4.83	5.21	5.21	5.64	5.27	4.74	4.34	3.54	4.24	4.29
LF-12	7.57	6.52	6.69	7.28	7.12	6.92	6.92	7.57	7.16	6.42	5.72	4.62	5.12	5.94
LF-13	18.99	18.88	17.73	17.88	17.86	17.78	17.78	17.78	17.75	17.18	16.33	15.86	15.23	13.42
LFO-04	21.61	21.3	22.44	21.22	21.21	21.15	21.15	21.25	21.05	20.95	20.41	19.46	19.35	19.37
LFO-14	26.61	24.12	23.37	23.97	24.17	23.81	23.81	24.85	24.67	23.37	21.87	NA	NA	NA

Water level elevations are in feet MSL.

NA - Data not available

Section 3
Waste Characterization

3.1 Waste Types and Quantities

Nonhazardous solid wastes are produced by the wood products, pulp and paper-making operations processes. Other than boiler ash, most of these wastes are unique to the industry. The processes and resulting wastes are described in more detail in Section 4 of *Waste Characterization and Analysis Report*, which is included in Appendix D. Waste types include the following materials:

- **Ash**: generated by the combustion of bark, wood wastes, dewatered wastewater treatment solids, paper fiber, and plastic derived from the mill-recycled fiber facility, and coal, and other similar fuels, including fly ash from electrostatic precipitators and bottom ash off boiler grates.
- **Paper wastes**: finished paper products rendered unusable during the production process, including broke and butt ends. Most paper waste is repulped in the process, but unusable materials are disposed of from operations and offices.
- **Liquor dregs**: solids accumulated in a clarifier used to purify a solution of pulping chemicals, primarily sodium carbonate, that are generated in the recovery boiler.
- **Grits**: insoluble solids that form during the slaking process that involves the reaction of clarified liquor with lime to remove carbonate from the solution.
- **Lime mud**: fine-grained calcium carbonate recovered from the slaker in a clarifier. Lime mud from this clarifier is sent to a lime kiln for conversion to lime. Waste lime mud results when the kiln is unavailable and from clean-up and routine maintenance activities.
- **Wood waste**: bark and other waste wood materials that cannot be burned in the boilers or used in the production process due to contamination with dirt, gravel, and other materials.
- **Miscellaneous trash, demolition debris, and other trash**: inert, nonhazardous materials and minor quantities of putrescible waste collected as office waste and general refuse from the mill site.
- **Dewatered wastewater solids:** dewatered solids dredged from wastewater treatment impoundments.

Waste material to be disposed of in Phase 3 and Phase 4 will be similar to the waste that is currently being disposed of in Phase 1 and Phase 2 of Landfill No. 3.

Landfill No, 3 has historically been received dewatered sludge at a rate of approximately 65,000 cubic yards (cy) per year. After December 31, 2002, mill waste has also been received. Based on measurements of landfill volumes in Landfill No. 2 since 1996, maximum in-place disposal rates are estimated to be approximately 110,000 cy per year. Therefore, the combined waste volume for disposal for Phase 3 and Phase 4 is estimated to be as high as 175,000 cy per year. During the year 2014, the waste volume is expected to be about 153,000 cy per year. After that period (2015 onward), the disposal rate is estimated to be about 100,000 cy per year.

3.2 Chemical Testing Results

The results of a waste identification, sampling, and chemical analysis program, described in Sections 5 and 6 of *Waste Characterization and Analysis Report* (included in Appendix D), are summarized in the following paragraphs. Each of the wastes identified and tested were found to be nonhazardous by the Toxicity Characteristic Leaching Procedure (TCLP). Waste materials were also subjected to an American Society for Testing and Materials (ASTM) water leach, believed to more accurately represent actual landfill conditions, and were analyzed for metals and selected volatile organic compounds (VOCs). Overall, the test results indicate that metals and inorganic parameters such as alkalinity and total dissolved solids (TDS) would provide the most reliable indication of a release from the facility.

Results of the TCLP tests conducted in 1989 indicate that minor amounts of metals and associated inorganic species leach from the waste materials. Barium, cadmium, arsenic, chromium, and selenium were detected at concentrations ranging from 0.014 to 1.5 mg/L in the extract solutions. Some ash analyses have been performed and the information is enclosed in Appendix D. However, with the exception of generation rates, nothing has changed in the combustion process that generates waste ash. Three VOCs were detected in the entire suite of samples subjected to the TCLP. Methylene chloride was detected at 7 mg/L in dewatered primary wastewater solids that are currently being burned in the mill boilers. Carbon disulfide was detected at 12 mg/L in the lime waste composite (grits, dregs, and lime mud). The composite sample of paper and wood waste contained 11 mg/L of 2-butanone.

Barium, arsenic, and chromium were also detected in the water leach samples, though at lower concentrations than in the TCLP leachates. No VOCs were detected above the method detection limit in water leach samples.

Barium and cadmium were detected in the dewatered wastewater solids samples, also at lower concentrations than in the TCLP leachates. No other constituent was detected in the samples, except for the cresols, which were only detected at the quantitation limit.

3.3 Physical Testing Results

The objective of the physical testing was to derive test parameters to evaluate the ability of the wastes to be stacked in a stable manner. Since ash and dewatered 30-year-old wastewater solids dredged from wastewater treatment ponds will be major components of the waste disposed of in the facility, physical testing of these materials was conducted. A suite of tests were performed to determine the moisture content, specific gravity, unit weight, and shear strength properties of the ash and dewatered wastewater solids. Consolidation of the ash was also evaluated. These test results are summarized in the following paragraphs and are included in Appendix D. Parameters derived from these test results were used to run slope stability models of Landfill No. 3.

The specific gravity of the ash was 2.13. The average initial moisture content and dry density of the ash were approximately 40 percent and 34 pounds per cubic foot (pcf), respectively. Based on RMT's previous experience, a total unit weight value of 70 pcf is a common value for pulp and paper mill ash. Therefore, RMT selected to use the conservative value of 70 pcf instead of 51 pcf in this slope stability analysis. Direct shear tests on ash yielded a friction angle of 35 degrees and cohesion of 252 pounds per square foot (psf) for a consolidated-undrained (CU) condition. Triaxial shear strength testing under a condition produced a friction angle of 22 degrees with cohesion of 470 psf. Therefore, we used an average friction angle of 28 degrees with a conservative cohesion value of 0 psf for the CU condition slope stability analysis of ash. The same CU triaxial shear strength test with pore pressure measurements resulted in a friction angle of 41 degrees with cohesion of 0 psf. These parameters along with a typical (conservative) total unit weight for ash of 70 pcf were used in the slope stability analysis for the consolidated drained (CD) condition.

The dewatered wastewater solids testing in 1998 by Kiber Environmental Services, Inc. are more representative of the dewatered wastewater solids proposed for disposal in this landfill than those tested in 1990 and presented in RMT's 1990 report. The specific gravity of the wastewater solids tested in 1998 ranged from 1.95 to 2.34. The moisture content of the dredged wastewater solids after it was dewatered using plate and frame presses ranged from 117.8 to 169.8 percent. The dry unit weight of the dredged dewatered wastewater solids ranged from 27.1 to 31.8 pcf when compacted to a single-point reduced standard Proctor dry density. At low confining pressures (less than 7 psi), the CU triaxial shear strength cohesion ranged from 612 to 1,151 psf with friction angles that range from 19.1 to 21.5 degrees. The CD triaxial shear strength cohesion ranged from 158 to 310 psf with friction angles that ranged from 36.1 to 41.5 degrees. Since the current dewatering system consists of the Netzsch plate and frame press; shear strength parameters from the sample dewatered with Netzsch trail run No. 6 were used in the slope stability analysis. A CU cohesion of 667 psf, a CU friction angle of 21 degrees, a CD cohesion of 167 psf, a CD friction angle of 41 degrees, and average total unit weight of 70 pcf

were used in the slope stability analyses for the dewatered wastewater solids. See Appendix E for additional information.

The strength parameters of the various dewatered wastewater solids and ash mixtures tested were comparable to the strength parameters for ash. The CU cohesion of the 60/40 dewatered wastewater solids/ash mixture ranged from 508 to 2,261 psf and the CU friction angles ranged from 23.6 to 35.7 degrees. Since the dewatered wastewater solids/ash combination shear strength parameters exceeded the dewatered wastewater solids only shear strength parameters, the slope stability analysis was conducted for both dewatered wastewater solids only and ash only.

These data and subsequent stability modeling (refer to Appendix E, Slope Stability Analysis) indicate that the waste mass will be stable at 3 horizontal to 1 vertical slopes. RMT performed only CU (total) and CD (effective) analysis because the wastewater solids will be dewatered prior to placement in the landfill. Consolidation testing indicates that the waste will be compressible, and only a minor amount of that moisture will be released as a result of compaction

3.4 Design and Operating Considerations

The chemical and physical test results have the following implications for the design and operation of the landfill:

- **Groundwater protection**: Metals and other inorganic complexes could potentially leach from the waste materials. In addition, consolidation of the wastes will tend to release liquids. Adequate lining and leachate collection systems are necessary. Groundwater around the facility should be monitored for these parameters listed in Subsection 5.6.1 and Table 5-1.
- **Leachate collection**: Ash and dewatered wastewater solids particles are predominantly silt sized. Leachate collection piping should be protected with adequate drainage system design features to avoid clogging.
- **Stability**: The waste materials should be stable when placed at 3:1 slopes. Wastes other than ash or adequately dewatered, compacted wastewater solids should be incorporated into the ash during operations (refer to Appendix E, Slope Stability Analysis).
- **Waste cover**: Ash and dewatered secondary waste treatment solids are soil-like materials suitable for use as a cover material.
- **Dust control**: Ash is susceptible to creating a dust hazard due to its fine-grain size and low initial moisture content. Dust control measures, such as water spreading, should be provided.

Section 4
Engineering Design

4.1 Design Variances

Domtar has requested the following design variances from NC DENR:

- **Liner configuration:** In lieu of the stipulated liner design, Domtar has proposed a composite liner system consisting of one layer of 60-mil geomembrane and one layer of geosynthetic clay liner (GCL) overlying 1 foot of compacted prepared subgrade that has a permeability of 4.2×10^{-4} cm/sec or less.
- **Final grade slopes:** Domtar proposes final landfill grades constructed at 3 (horizontal): 1 (vertical), with 15-foot wide intermediate drainage terraces for every 20-foot rise in elevation. Slope stability calculations, together with observations of existing Landfill No. 2 that was similarly constructed, indicate that such construction will be stable.
- **Liner base grade separation to groundwater:** Liner base grades for the entire landfill are based upon historic high groundwater levels. Base grades provide a minimum of 4 feet separation from the bottom of liner to the groundwater table, except at the leachate collection sumps. In the sump area, a 2-foot thick layer of clay will be provided in addition to the composite liner. The clay will have a maximum hydraulic conductivity of 1×10^{-7} cm/sec.

NC DENR has previously granted these design variances for Landfill No. 3, Phase 1A through Phase 2.

4.2 Liner System

4.2.1 Liner Design

Section .1600 of the Solid Waste Management Rules contains the requirements for design and construction of municipal solid waste landfill facilities. Rule .1624(b)(1)(A) allows for alternate liner systems, provided the owner can demonstrate compliance with the design and construction requirements of this section through appropriate site-specific modeling.

Domtar proposes the same composite liner system that has been used in Phases 1 and 2. That system includes the following elements from top to bottom (a graphic view of the proposed liner is shown on Sheet No. 14):

- 32 oz. Geocushion™ or Tenax Tendrain™ geocomposite (geonet with 12-ounce non-woven geotextile)

- 60-mil high-density polyethylene (HDPE) textured geomembrane
- GCL
- 1-foot compacted prepared subgrade with permeability of 4.2×10^{-4} cm/sec or less

Mass balance calculations were completed to demonstrate that based on the existing site conditions, site geology, waste characteristics, and liner performance, the proposed composite liner configuration will be protective of the 15A NCAC 2L Groundwater Standards. The results of the mass balance calculations are presented in a technical memorandum titled *Mass Balance Calculations for Liner Design of Landfill No. 3*, included in Appendix G. The calculations have been revised to reflect NC DENR comments received in a letter dated April 29, 1999 (also included in Appendix G). The calculations show that the proposed composite liner configuration will be protective of the groundwater.

4.2.2 Liner and Cap Stability

Liner and cap stability and anchor trench design were evaluated using interface friction values for the geosynthetic components that are based on RMT's experience. These values are considered to be conservative and generally consistent. Interface friction values for the GCL/soil interface and the GCL/60-mil textured geomembrane interface, and geocomposite were based upon direct shear testing performed by Geosyntec Laboratories in Atlanta, Georgia. These are included as Figures 4-1, 4-2, and 4-3. The GCL/soil interface friction test was conducted using a lean sandy clay soil (LL = 42, PI = 17, P200 = 63). The interface friction angles shown below were used in the geotechnical analysis.

INTERFACE COMPONENT	INTERFACE FRICTION (degrees)
Stone drainage layer/Geocushion™	23
Geocushion™/textured geomembrane	36
Textured geomembrane/GCL	26
Drainage composite/textured geomembrane	36
GCL/sandy clay soil subgrade	25
Sandy soil general fill/drainage composite	34
GCL/select ash	33

Liner stability and anchor trench calculations are provided in Appendix E.

4.3 Leachate Collection and Removal System

The leachate collection and removal system (LCRS) will be comprised of the following components:

- A drainage layer
- Perforated leachate collection lines
- Dual submersible pumps in each leachate collection sump
- A header pipe and force main

The drainage layer will consist of either an 18-inch thick graded granular filter layer or a geocomposite drainage net placed beneath a 14-inch thick graded granular filter layer. Laboratory testing has demonstrated that the latter drainage layer out performs the granular material only drainage layer. A copy of this laboratory drainage layer equivalency report is included in Appendix H. The drainage geocomposite would replace the Geocushion™ located between the HDPE liner and the aggregate. A graphic view of the proposed and alternate liner/leachate collection layers are shown on Sheet 16. The 18-inch thick graded granular filter layer would be composed of a 6-inch thick clean sand layer be placed over a 12-inch thick gravel drainage layer. The 14-inch thick graded granular filter layer would be composed of a 6-inch thick clean sand layer placed over an 8-inch thick gravel drainage layer.

The sand layer will contain less than 5 percent passing No. 200 sieve. The sand will serve to filter out fines within the waste to minimize clogging. The gravel in the lower portion of the drainage layer will be sized to provide a lateral hydraulic conductivity of at least 0.3 cm/sec. The gravel will also serve to provide bedding for the leachate collection piping and protection of the liner. The composite liner system will also be protected from damage during operations by the overlying 32-ounce Geocushion™ or geocomposite drainage layer.

The leachate collection lines will consist of 6-inch diameter perforated pipes. These pipes will be constructed of HDPE for its chemical resistivity and flexibility, and will be placed at a minimum slope of 0.5 percent. The collection pipes will have a maximum spacing of 200 feet to limit leachate head on the liner to less than 12 inches. The leachate line hydraulic calculations are provided in Appendix H. To provide protection from pipe crushing under the anticipated waste loads, the collection piping will have a maximum Standard Dimension Ratio (SDR) of 17. These calculations are presented as Appendix I, Pipe Strength Calculations. Each end of the leachate collection lines will be fitted with cleanouts to provide access for inspection or periodic cleaning.

Leachate collected by the perforated piping will flow by gravity to one or more collection sumps located in the low area of each landfill phase. Phase 3 and Phase 4 of the landfill are designed with a total of two collection sumps. Submersible pumps will pump the leachate out of the landfill. A level switch in the sump will automatically activate the dual submersible pump system, which will lift leachate into a header pipe and force main. The pumps will be installed in 18-inch diameter inclined riser pipes that are placed on the inside slope face of the lined perimeter berm. Each wheeled, submersible leachate collection pump will be attached to a cable to allow retrieval and maintenance of the pump. See Sheet No. 16 for leachate collection system details. Maintenance of the submersible pumps will be conducted in accordance with the manufacturer's recommendations.

Leachate will be pumped from the landfill through a 6-inch dual-walled leachate force main and discharged into a wet well located at the wastewater solids dewatering building on the north side of the landfill. This leachate, mixed with filtrate from the wastewater solids press building, will be recirculated onto the landfill as needed to control dust. A pump will also discharge the leachate and any filtrate from the wastewater solids dewatering activities to the mill's permitted wastewater treatment system.

Water balance modeling, including the Hydrologic Evaluation of Landfill Performance (HELP) model, was used for various landfill operational scenarios to determine leachate flow into the collection layers. The peak daily flow rate collected in the primary leachate collection layer was used to size the pumps and the force main. Tables summarizing the average and peak leachate generation rates of various phases of landfill construction are included in Appendix G.

Stormwater runon and runoff will be controlled by means of the landfill's perimeter berms and temporary stormwater control berms. The exterior berms are designed to contain, if necessary, all water falling within the landfill during a 24-hour, 25-year storm. The interior stormwater control berms (shown on Sheet No. 19) will allow segregation of stormwater and leachate so that not all precipitation falling on the landfill will have to be treated as leachate. The temporary berms will be placed to provide adequate waste disposal area, while maximizing the area where precipitation may be diverted as stormwater. The leachate pumps are sized so that even if all precipitation in the cell is treated as leachate, it may be discharged within a period of 7 days.

4.4 Buffer Requirements

As indicated in Title 15A, Subchapter 13B, Section .0503, (2)(d)(iv), this landfill must comply with the groundwater standards established under 15A NCAC 2L at the compliance boundary. The regulations also stipulate that the compliance boundary for water quality standards be set at no more than 250 feet from the waste within 50 feet of the property boundary (Title 15A, Subchapter 13B, Section .1631 (2)(A)). Based on this guidance, the waste boundary for Landfill No. 3 will be set at a total of 300 feet (where feasible) from the property boundary in order to comply with both criteria. The landfill's east boundary of Phase 3 and Phase 4 will be set a minimum of 200 feet from the property boundary in order to comply with NC DENR policy (refer to Communication Record dated January 5, 2000, included in Appendix A). The buffer zone is indicated on Sheet No. 7. The edge of waste is also located more than 500 feet from any known residence or well and more than 50 feet from any rivers or streams.

4.5 Cover System

Due to the characteristics of the wastes to be placed in the landfill, problems typical of municipal landfills, such as vectors, blowing litter, and odor generation, should not exist at the Domtar site. The waste is predominantly ash and wastewater solids. The ash is inert, and therefore poses no odor problems and is not attractive to vectors and other animals. The wastewater solids pose no odor problems; in addition, the wastewater solids are not attractive to vectors and other animals. Litter susceptible to being blown away will be covered during daily operation. Based on these points and the fact that the ash is soil-like in nature, daily cover other than ash or dewatered wastewater solids will not be utilized.

The final cover system will be constructed after the waste has reached final grades. Domtar proposes a final cover system that includes the following element from bottom to top:

- 12-inch select ash foundation layer
- GCL
- 40-mil very flexible polyethylene (VFPE) textured geomembrane liner

- Geocomposite drainage layer
- 12 inches general fill (vegetation support layer)
- 6 inches top soil

Suitable vegetation will be placed on the top layer to protect the final cover system against erosion and to enhance evapotranspiration. In order to promote surface runoff, the final cover will be sloped a minimum of 3 to 5 percent at the top and a maximum of 33 percent at the sideslopes.

A portion of the precipitation falling on the closed landfill will be lost to runoff and evapotranspiration. In Appendix G, Water and Mass Balance Calculations, it is demonstrated that this amount could be as much as 15 percent. The remainder will be intercepted by the geocomposite drainage layer and diverted to the grassed swales along the terraces. The swales will flow to articulated block drainage channels that run down the exterior face of the landfill. The flow in the drainage layer is facilitated by the low hydraulic conductivity of the underlying layer of VFPE geomembrane. Should any precipitation infiltrate beyond the VFPE geomembrane, through a poor seam or hole in the geomembrane, the GCL will act as an efficient backstop. When the GCL is hydrated, the bentonite in the mat will swell and plug the leak in the VFPE geomembrane. The purpose for the select ash leveling course is to ensure that there will be no large, hard, angular particles beneath the GCL that would tend to puncture the GCL or otherwise render it ineffective.

The components of the final cover system will act together to promote runoff and evapotranspiration and to reduce infiltration of stormwater into the waste. The final grades of the cover system are shown on Sheet No. 12. Cap detail is shown on Sheet No. 17.

4.6 Earthwork Volumes and Borrow Materials

Most of Landfill No. 3 will be constructed on fill materials above existing grades for compliance with NC DENR requirements for waste separation to groundwater and to allow for the estimated long-term subgrade settlement.

The calculated fill volumes needed for each phase are shown in Appendix J, Material Volume Calculations. Much of this fill volume is available on Domtar's property.

Weyerhaeuser (now Domtar) initiated a borrow investigation of their newly acquired properties. The purpose of this investigation was to identify sources and reserves for material suitable for general fill and select clay, for constructing Landfill No. 3, and capping Landfill No. 2 and the asbestos monofill.

Results of the borrow area investigation confirming sources and volumes of fill material suitable for general fill and select clay are included as Appendix K. RMT estimated that the upper 11 feet of both proposed borrow sites (former Snell and former Beasly properties) contain up to 250,000 cy of general fill soil and up to 515,000 cy of clayey soil.

4.7 Erosion Control Plan

In order to preserve the integrity of the final cover, a suitable stand of grass will be planted over the majority of the landfill. In addition, a terrace system has been designed to reduce the length of the drainage path of the overland runoff. When the design is implemented, terraces will be placed every 20 vertical feet on the 3 (horizontal): 1 (vertical) sideslopes. The terraces will collect sheet flow into shallow concentrated flow and will route the runoff to lined channels (refer to Sheet No. 11 and Sheet No. 18). The slope of the terraces will be a minimum of 0.5 percent. Erosion calculations were performed on these terraces using Sedimot II to predict the total sediment yield based on a 25-year, 24-hour storm event. The results showed that a total of 2,776 tons would be eroded from the north terraces, 1,959 tons would be eroded from the east terraces, and 1,963 tons would be removed from the west terraces (refer to Appendix L, Stormwater/Erosion and Sedimentation Calculations).

In addition to these permanent measures, temporary measures will be undertaken during construction to reduce erosion. These measures include silt fences at the perimeter, hay bales in the terraces before the cap is placed, and sediment traps at borrow areas.

These measures, both permanent and temporary, have been placed to reduce the amount of erosion on the landfill. In order to reduce the erosive effects of the increased runoff from the landfill, detention basins have been designed to attenuate the runoff from the finished landfill to the peak runoff rate of the existing terrain. The calculations for the design of these basins are included in Appendix L, Stormwater/Erosion and Sedimentation Calculations.

Finally, the area will be fertilized, seeded, and mulched in accordance with North Carolina Department of Transportation specifications. Completed areas will be revegetated in a timely manner so as to minimize erosion of the finished surface.

4.8 Sediment Control Plan

In order to control the amount of sediment being discharged to the surroundings in the runoff from the landfill, the detention basins described in Subsection 4.7 were also designed to reduce the amount of sediment in the discharge. The efficiency of these basins was evaluated using Sedimot II. As designed, the basins alone will remove at least 60 percent of the sediment in the influent stream. These calculations are included in Appendix L, Stormwater/Erosion and

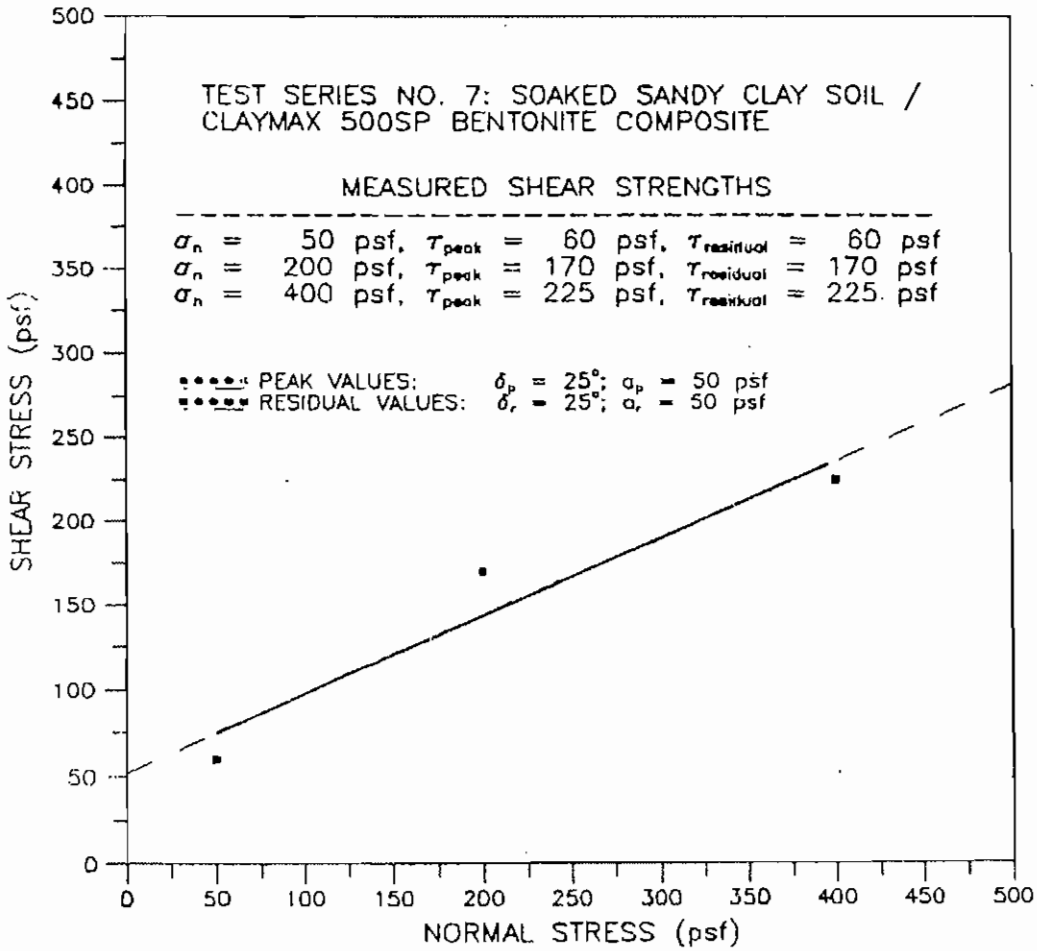
Sedimentation Calculations. Grass-lined swales along the terraces will also serve as a best management practice (BMP) to remove additional sediment.

4.9 Capacity and Anticipated Life

Landfill No. 3 will be developed and closed in 18 phases as shown on Sheet No. 13. The final closure contours are shown on Sheet No. 12. The completed facility will provide a net waste storage capacity for a site life of approximately 99 years based on current and anticipated waste generation rates (see Subsection 3.1, Waste Types and Quantities, of this document). Based on current waste generation rates, Phase 3 and Phase 4 are estimated to have a life of 5 years. Refer to Table 4-1 for a summary of the estimated life for each phase.

FIGURE 4-1

JAMES CLEM CORPORATION
INTERFACE DIRECT SHEAR TESTING



NOTE: The reported value of adhesion may not be the true adhesion of the interface, and caution should be exercised in using this adhesion value for applications involving normal stresses outside the range of stresses covered by the test.

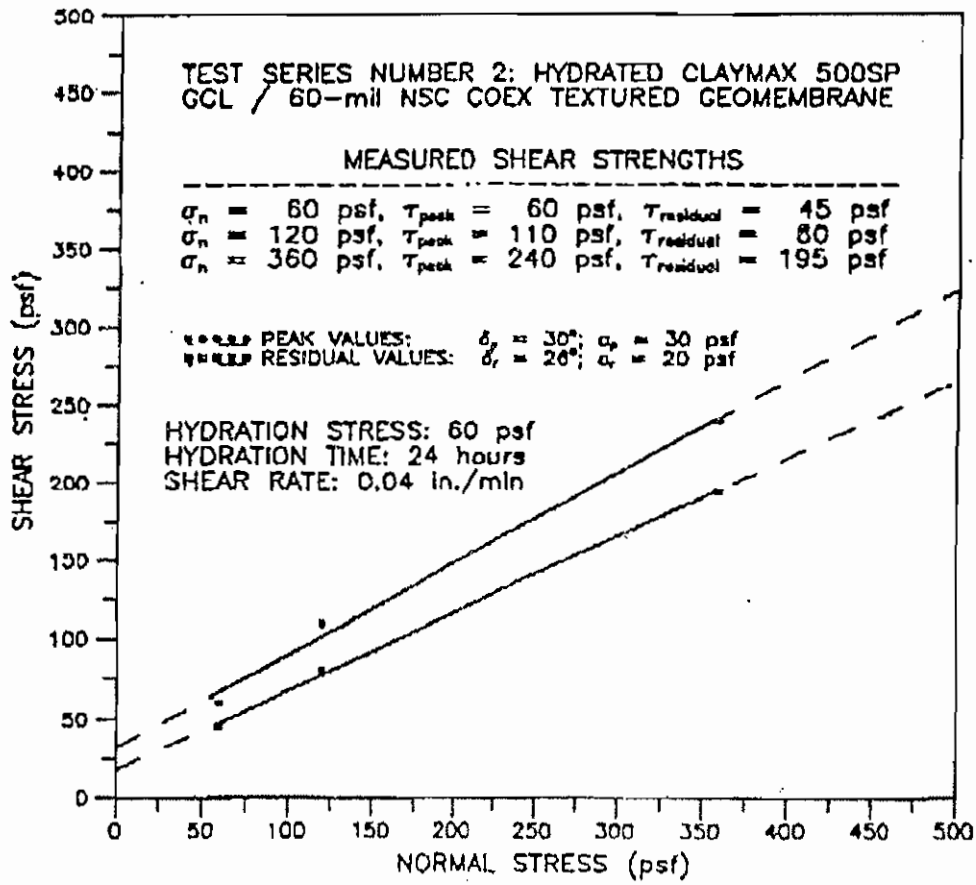
DATE TESTED: NOVEMBER 1992

GEOSYNTEC CONSULTANTS
GEOMECHANICS AND ENVIRONMENTAL LABORATORY

FIGURE NO.	B-13
PROJECT NO.	GL3360
DOCUMENT NO.	GEL92211
PAGE NO.	

FIGURE 4-2

RMT, INC.
INTERFACE DIRECT SHEAR TESTING



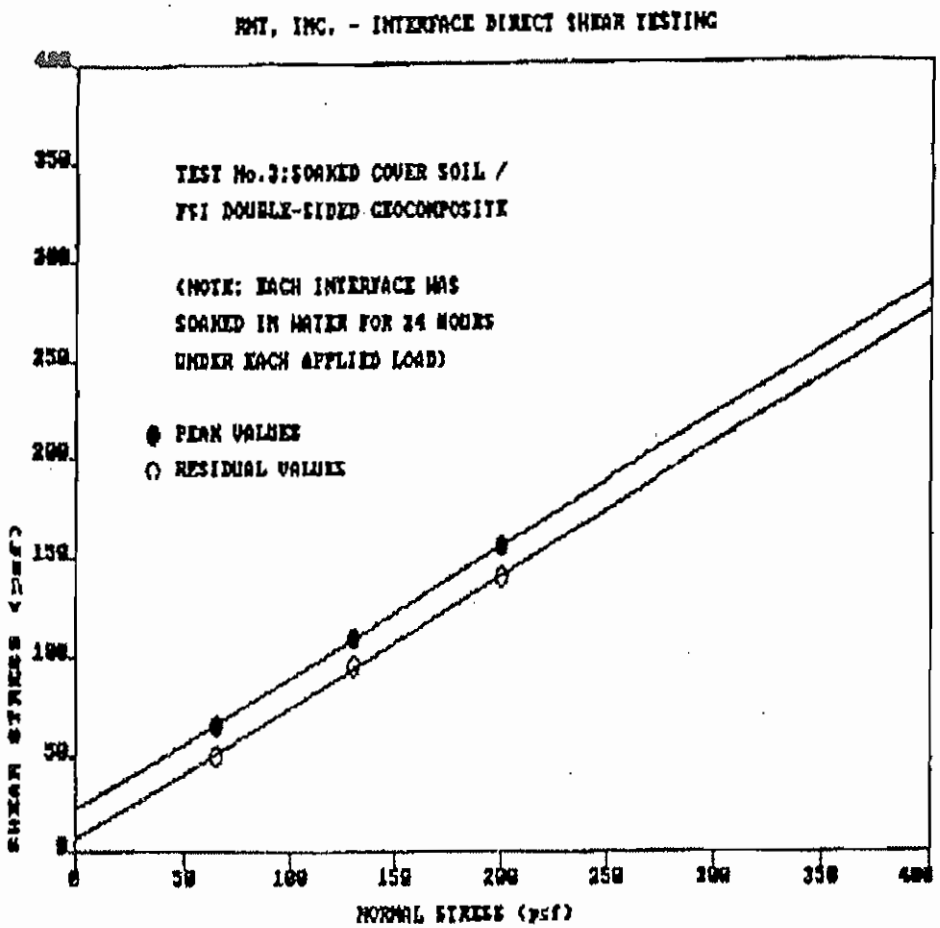
NOTE: The reported value of adhesion may not be the true adhesion of the interface, and caution should be exercised in using this adhesion value for applications involving normal stresses outside the range of stresses covered by the test.

DATE TESTED: 7 JULY 1993

GEOSYNTEC CONSULTANTS
GEOMECHANICS AND ENVIRONMENTAL LABORATORY

FIGURE NO.	A-4
PROJECT NO.	GL3410
DOCUMENT NO.	
PAGE NO.	

FIGURE 4-3



THE REGRESSION POLYNOMIAL OF LINE 6 - PEAK VALUES

(2.226E+01) + (6.664E-01)*X $a = 20$ PSF $\delta = 34°$
THE VARIANCE - 6.170E-01

THE REGRESSION POLYNOMIAL OF LINE 7 - RESIDUAL VALUES

(7.262E+00) + (6.664E-01)*X $a = 5$ PSF $\delta = 34°$
THE VARIANCE - 6.170E-01

Table 4-1
Phase Capacity [1]

PHASE	CAPACITY (cy)	ANTICIPATED LIFE [2] (years)
1A, 1B	548,103	4.4
2	682,960	3.9
3	597,000	3.4
4	864,000	7.1
5	782,000	7.8
6	810,000	8.1
7	757,000	7.6
8	773,000	7.7
9	618,000	6.2
10	499,000	5.0
11	589,000	5.9
12	368,000	3.7
13	432,000	4.3
14	458,000	4.6
15	514,000	5.1
16	562,000	5.6
17	367,000	3.7
18	528,000	5.3
Total		**99**

(1) Waste material only - excludes cap material and leachate collection layer
(2) Anticipated life of each phase was estimated by using 65,000 cy for the first two years, 175,000 cy for the next 11 years, 153,000 cy for the following year, then 100,000 cy thereafter.

Section 5
Operating Procedures

5.1 Waste Route

Waste transport vehicles will enter the facility through a new paved access road. This road is located west of the facility. Trucks will unload at the active end of the phase and exit along a temporary gravel access road on the outside of the delineation berm for the active phase. This temporary access road will allow for one-way traffic to enter on one side of the phase, unload, and exit on the opposite side of the phase. Temporary access roads will be constructed, modified, and maintained as necessary for each phase of development. A permanent haul road was constructed prior to construction of Phase 1A as shown on Sheet No. 7.

5.2 Development of Phases

Landfill No. 3 will consist of 18 phases. Phases 1 and 2 have already been constructed and are in active operation. The first nine phases will progress in a southerly direction. The final eight phases will be located to the west of the initial 10 phases. The phasing progression has been designed to allow subsequent phases to tie into the existing leachate removal system in the liner and the terrace system in the cap. Each phase subsequent to the first phase will be constructed before the preceding phase reaches capacity. Capacity development in advance of disposal need will ensure continuous waste disposal operations and aid in minimizing access conflicts between disposal operations and phase construction. The phasing progression is shown on Sheet No. 12.

5.3 Waste Handling and Placement

During initial placement of waste in a phase, special care will be taken to protect the leachate collection and removal system and the underlying liner system. The initial step for the development of a phase after the liner and leachate collection and removal systems are in place will be to ensure a minimum of 1 foot of select waste covers the lined area. This layer of select waste will be placed immediately after placement of the sand layer and just prior to placement of the waste. This select waste will consist of ash void of cinders and other large particles that could adversely impact the liner. The select waste will be unloaded from the perimeter berm into the phase to be developed. A bulldozer will then place the waste appropriately. Trucks will not be permitted on the lined area until the protection layer is in place.

After placement of the protection layer, wastes will be placed in lifts that average between 2 and 3 feet in thickness. The waste will be compacted by the successive passes of the bulldozer and the truck traffic from the hauling and dumping of the waste. As the waste grades increase with each successive lift, slopes no steeper than 3 horizontal to 1 vertical will be maintained. Maintaining the waste slopes facilitates and encourages surface drainage within the active phase. This will also ease the construction effort when the final cover is applied by minimizing the amount of regrading required. The waste mound will be built up while its leading face will advance towards the subsequent phase. This method of waste placement has been termed the "moving face" concept. Waste placement will continue to advance upward until the surface grades intersect the final waste grades.

Final grades will be achieved first in the earliest part of the phase. Prior to the placement of the final cover, a 12-inch intermediate select ash layer will be placed. Placement of the temporary covers and final cap system will occur as required to minimize leachate generation in a completed or partially completed phase.

Each subsequent phase will be constructed before the active phase reaches capacity. Construction in the subsequent phase will consist of the liner system, the leachate collection and removal system, the protection layer (select waste), and diversion berms to control stormwater runon and runoff. This will provide continuous operating capacity and compensate for construction delays due to uncontrollable circumstances such as inclement weather.

If waste characteristics change, then the operation assumptions need to be reviewed. Waste characteristics will be reviewed when the permits are reviewed, approximately every 5 years.

5.4 Abnormal Conditions

5.4.1 Inclement Weather

The operation of the landfill will continue through most weather conditions with no change in procedure. During extreme weather conditions, which require operations to cease temporarily, wastes will be stored at their source. Access to the site is by haul roads with all-weather surfaces that have the capacity to accept the traffic demands imposed by the haul trucks.

5.4.2 Equipment Breakdown

The landfill will cease operations if equipment that is essential for proper and safe operation breaks down. Operations will not continue until the equipment has been repaired or replaced and proper and safe operations can be ensured.

In the event that a haul truck breakdown occurs on the way to the landfill, the truck will be repaired or the load will be transferred to another haul truck and transported to the facility.

5.5 Leachate and Stormwater Collection and Removal

The leachate collection system for Phases 1 through 18 has been designed to flow by gravity to a series of sumps. Leachate will then be pumped to a wet well located at the wastewater solids press building. From there it will be pumped to the wastewater treatment system. In order to design the leachate collection system, the HELP model was used to determine the peak leachate generation rate. The model was based on the situation where the subsequent phase has been constructed and only a 2-foot thick (protection) layer of waste has been placed.

As discussed in Subsection 4.3, leachate will be collected in a series of sumps equipped with both primary and secondary submersible pumps. It is anticipated that during normal landfill operations, the pumps will cycle to minimize pump burnout. In the event of an extraordinary rainfall event, primary and secondary pumps will be active thereby minimizing the amount and holding time of leachate within the landfill.

The following stormwater and leachate management practices will be maintained at the landfill:

- Diversion of non-contact stormwater away from the leachate system and removal of surface water discharge outside the landfill boundary. This can be accomplished via temporary internal diversion berms within the landfill and the use of portable pumps, if necessary. Internal berms are most important in the initial time period after the landfill is opened because extreme leachate generation rates are more likely. Although the landfill system with internal stormwater diversion berms will allow for temporary storage/handling of the leachate generated from a 25-year, 24-hour storm event, it is crucial to separate and discharge non-contact stormwater before it is considered leachate. The pumps are sized to take up to 7 days to discharge leachate generated from the 25-year, 24-hour storm event.
- Limitation of the active filling area of the landfill to a small area to minimize the volume of leachate generated. This area is typically 5 acres or less depending on specific site conditions.
- Maintenance of a filling sequence that reaches final waste grades as soon as possible so that final cover soils can be placed to further divert surface water.
- Proper maintenance, operation, and monitoring of the leachate pumps, pump controls, discharge piping, leachate collection piping, and clean-outs.

A detailed operations plan is included as Appendix M.

5.6 Environmental Monitoring

NC DENR regulations stipulate that four media (*i.e.*, groundwater, leachate, gas, and stormwater) be monitored around landfill sites. The proposed monitoring plans for the site are presented in the following paragraphs.

5.6.1 Groundwater Monitoring Plan

Domtar has implemented a groundwater monitoring plan for Landfill No. 3 as required under NCAC Title 15A, Subchapter 13B, Section .0600 and in accordance with Title 15A, Subchapter 2C, Section .0100. The groundwater monitoring program was designed to provide information on groundwater quality immediately upgradient and downgradient of Landfill No. 3. These monitoring wells are located adjacent to the landfill and will detect changes in groundwater quality should a release occur. Baseline groundwater quality monitoring was performed prior to site operations to characterize existing groundwater quality. Additional baseline groundwater quality data was provided by a past investigation of Landfill No. 2 located immediately west and northwest (downgradient) of Landfill No. 3 (*Groundwater Quality Assessment for the Existing Landfill*, RMT, October 1989).

The groundwater monitoring plan consists of 13 existing monitoring wells: two wells (MW-1 and MW-1A) upgradient from the landfill, six wells (MW-2, MW-3, MW-4, MW-5, MW-6, and MW-6A) around the perimeter of Landfill No. 2, four wells (MW-9, MW-10, MW-11, and MW-12) around the perimeter of Landfill No. 3, Phase 1A, and one well (MW-13) located east of Phase 2. These monitoring well locations are shown on Sheet No. 3. The existing monitoring well nest MW-1/ MW-1A is located upgradient of all landfill activity. Well MW-1 is screened in the water table aquifer and well MW-1A is screened in the lower confined aquifer. These wells are presently used to provide background water quality data and to assess the water table configuration.

Monitoring wells MW-2 through MW-6 and MW-6A monitor groundwater quality related to Landfill No. 2 and wells MW-9 through MW-13 monitor groundwater quality related to Landfill No. 3. These wells will continue to be monitored on a semiannual basis for the parameters summarized on Table 5-1. Groundwater sampling and analysis procedures are outlined in Appendix O, Sampling and Analysis Procedures for Groundwater.

Water levels in the wells will be measured quarterly (February, May, August, and November). Data obtained from shallow wells will be used to monitor water table variations.

5.6.2 Leachate Monitoring

Leachate monitoring will not be necessary during the operating period. Leachate generated will be pumped from a sump to a wet well and then on to the wastewater treatment system. During the post-closure period, after the volume of leachate generated begins to decline, testing may be performed to determine if continued treatment is necessary. Testing guidelines shall be those established for testing the groundwater as discussed in Appendix O, Sampling and Analysis Procedures for Groundwater.

5.6.3 Gas Monitoring

Due to the predominantly inorganic nature of the wastes, it is anticipated that Landfill No. 3 will not generate appreciable amounts of gas. Therefore, a variance from gas monitoring is requested. As an added precaution, however, a passive gas collection and removal system has been included in the cap system design. The layout for this system is shown on Sheet No. 12 and details are shown on Sheet No. 18. This will be re-evaluated if the waste types or quantities vary in the future and gas generation becomes a necessary concern.

5.6.4 Stormwater Monitoring

All surface runoff from Landfill No. 3 will be directed to one of the four permanent sedimentation ponds. Stormwater discharge from these ponds will be controlled with a normally open outlet valve in the spillway outlet pipe. Discharge is either to Welch Creek or Little Mill Creek. Each pond is sized to retain the runoff from the 10-year frequency, 24-hour storm at the elevation of the principal spillway. The principal spillway has the capacity to carry a 25-year frequency, 24-hour storm event without overflowing into the emergency spillway. Water quality will be observed and recorded after each rainfall event in accordance with the mill's current National Pollutant Discharge Elimination System (NPDES) permit (General Permit No. NCG 12000, Certificate of Coverage No. NCG120012) and then released through the outlet valve.

Table 5-1
Groundwater Monitoring Parameters

PARAMETERS
Biochemical Oxygen Demand (BOD)
Chemical Oxygen Demand (COD)
Nitrate Nitrogen
Total Organic Carbon (TOC)
Chloride
Fluoride
Total Dissolved Residue
Arsenic
Barium
Cadmium
Copper
Chromium
Iron
Lead
Manganese
Mercury
Selenium
Silver
Zinc
Total Organic Halides (TOH)
Sulfate

Section 6
Construction Quality Assurance Plan

The purpose of the CQA plan is to provide procedures that will ensure that the landfill liner and final cover are constructed and documented consistent with the performance requirements discussed in Section 4, Engineering Design, of this document. The plan will also ensure that the landfill liner and cover are constructed, tested, and documented in adherence to their design and regulatory requirements. The CQA plan is included as Appendix P, CQA Plan.

Section 7
Closure/Post-closure

7.1 Closure Method

Waste will continue to be placed as discussed in Section 5, Operating Procedures, until final grades are reached. Once the surface is at the appropriate elevation, a 12-inch intermediate layer of select waste will then be placed, compacted, and graded. This layer will serve as a smooth support layer for the GCL, which is to be placed over the select waste. The GCL will be covered with a textured 40-mil VFPE geomembrane. Together, the GCL and VFPE form the barrier layer of the cover system. A geocomposite drainage layer will be placed over the textured geomembrane. The textured geomembrane will provide greater friction at the interface with the geotextile component of the geocomposite than a smooth geomembrane would. This enhanced interface friction provides additional stability to the cover system on the 3 (horizontal): 1 (vertical) sideslopes.

The final component of the cover system is the 18-inch thick vegetative layer. This layer will consist of 6 inches of topsoil and 12 inches of general fill soil capable of supporting vegetative growth. In addition, the sedimentation basins will be cleaned of sediment build-up within the basin as necessary, and this sediment, which will consist of the material eroded from the cover, will be blended into the vegetative layer.

Sheet No. 11 shows the final grades for the landfill. The sideslopes are designed to be no steeper than 3 (horizontal): 1 (vertical). The top of the final cover is sloped at 5 percent minimum with the exception of a small area at 3 percent. Detailed information regarding the landfill closure is provided in Appendix N.

7.2 Closure Schedule

To minimize leachate generation, the landfill will be progressively closed in phases as the waste reaches final grades (see Sheet No. 12). At the waste generation rate of 175,000 cy per year, Phases 3 and 4 are estimated to have a combined life expectancy of about 5 years. Domtar will begin final closure activities within 30 days of the final receipt of wastes. Final closure is not anticipated to require more than 180 days from the beginning of closure.

7.3 Post-closure Care

Domtar will regularly perform the following maintenance activities for the duration of the period of post-closure care:

- **Final Cover**: The finished cap and perimeter berm will periodically receive a walking inspection to check for and document evidence of settling, subsidence, erosion, and other potential failures of the final cover. These inspections will also encompass the perimeter berm, ditches, channels, and sedimentation basins to ensure that stormwater runon and runoff is being properly routed. These inspections, along with any repairs that were required, will be documented and kept in Domtar files.

  In addition, the landfill will be mowed, fertilized, and reseeded as needed. This will help to protect the final cover against erosion and decrease the potential for leachate generation. Any vegetation that poses a danger to the integrity of the final cover, such as trees and woody vegetation, will be discouraged and removed.

- **Pumps**: Proper maintenance of this equipment is critical to the operation of the leachate collection and transfer system. Manufacturer's recommendations for routine inspection and cleaning intervals will be followed for pumps and pump controls. In addition, all valves and flow measurement devices will be inspected and cleaned as necessary on a regular basis. An EPG WSDPT 12-8 Sure Pump Wheeled Sump Drainer manual is included as Appendix Q.

- **Piping**: The design allows for cleaning of leachate collection piping as needed. A jetting hose will be fed through cleanout openings into the leachate collection lines to scour the interior of the pipe. The jetting action will sweep sediment to the low end of the line for removal. It is anticipated that the amount of sediment removed will be minimal due to the nature of the wastes and the graded granular filter in the liner system.

- **Monitoring**: Groundwater will continue to be monitored as described in Subsection 5.6.1 for the required duration of the post-closure period.

- **Leachate Treatment**: Leachate collected in the leachate transfer station will continue to be treated in the mill wastewater treatment system for the required duration of the post-closure period unless testing establishes that leachate treatment is no longer necessary.

Detailed information regarding the landfill post-closure requirements is provided in Appendix N.

7.4 Long-term Use

Once the landfill has been closed, it will not be used for any purpose or activity that would be detrimental to the integrity of the final cover, stormwater management system, or leachate collection and removal system.

7.5 Abandonment of Leachate Collection and Environmental Monitoring Systems

The leachate collection and removal system will be abandoned when it can be shown that the leachate is no longer generated or that the leachate no longer poses a threat to human health or the environment. Abandonment of this system will consist of plugging the upstream and downstream inverts of the lines in the system, using the cleanouts and manholes for access, and removing the pumps, valves, controls, and flow measuring devices.

Abandonment of groundwater monitoring wells and piezometers will be performed in accordance with NCAC Title 15A, Subchapter 2C.

The primary method of abandonment will be removal of all well casing and screen materials. Plugging shall be accomplished by filling the entire resulting borehole with bentonite or a cement/bentonite grout from the bottom to the ground surface using a rigid tremie.

If abandonment of a well by removal is likely to be detrimental to the environment, or if attempts to abandon a well are unsuccessful, a secondary abandonment method may be used. Where all or part of a well's casing and other components cannot be removed and abandoned in accordance with the primary method, the well will be plugged by installing a cement/bentonite grout inside the well casing. The well casing and screen will be filled with a cement/bentonite grout from the bottom to the ground surface. The grout will be introduced from the bottom of the well via a rigid tremie pipe. The concrete pad will be removed and the well casing will be cut off just below the land surface.

Abandonment of these systems will be documented, including the procedure used and the date performed. This documentation will be incorporated into a report and submitted to the Solid Waste Section of the NC DENR.

7.6 Public Safety

Landfill No. 3 is located within the confines of Domtar property. This property has a perimeter fence with controlled access for authorized entry only. Therefore, public access is limited.

The wastes placed in this landfill are anticipated to have negligible potential for generating gas due to the inert nature of the waste. In addition, open burning of waste will not be allowed. Therefore, it is expected that this facility will pose no threat to the public or the environment from the generation of gas either through fires or explosions.

Section 8
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Appendix A
Documentation of Design Issues

Attachment A1	**Legal Description and Notification of Jurisdictional Wetlands Determination**
Attachment A2	**Communication Record dated January 5, 2000 (regarding setback from property line)**

Attachment A1
Legal Description and Notification of Jurisdictional Wetlands Determination

N. C. DEPARTMENT OF HUMAN RESOURCES
DIVISION OF HEALTH SERVICES
SOLID WASTE & VECTOR CONTROL BRANCH
P. O. BOX 2091
RALEIGH, NORTH CAROLINA 27602

Wake County
Raleigh, NC

ORDER OF APPROVAL
for
Weyerhaeuser Landfill
Plymouth, North Carolina
SR 1341

I. Order of Approval Issued to W. F. Ruffin
on June 16, 19 78.

II. Required information for evaluating proposed site and operational plans for a sanit landfill on the below described property has been submitted for review in complian with the "Solid Waste Management Rules". Those plans are hereby approved for oper with a complete set of the approved plans being returned to the applicant.

III. Description of Property:

Beginning at a corner on the East bank of Welch Creek and being the northwest corner of Howard Walker Tract, said corner being identified on map hereto attached by the Figure 1, running thence from said beginning along said Walker's line South 84 degrees 45 minutes East for 36.31 chains to a corner; thence with said Walker's line North 59 degrees 45 minutes East for 10.72 chains to a corner in Reedy Branch; thence down Reedy Branch for 19.95 chains to Little Mill Creek; thence down Little Mill Creek to the Atlantic Coast Line Railroad right-of-way; thence with the southern right-of-way of said railroad South 83 degrees West for 20.18 chains to Welch Creek; thence up Welch Creek to the beginning, containing 114 acres.

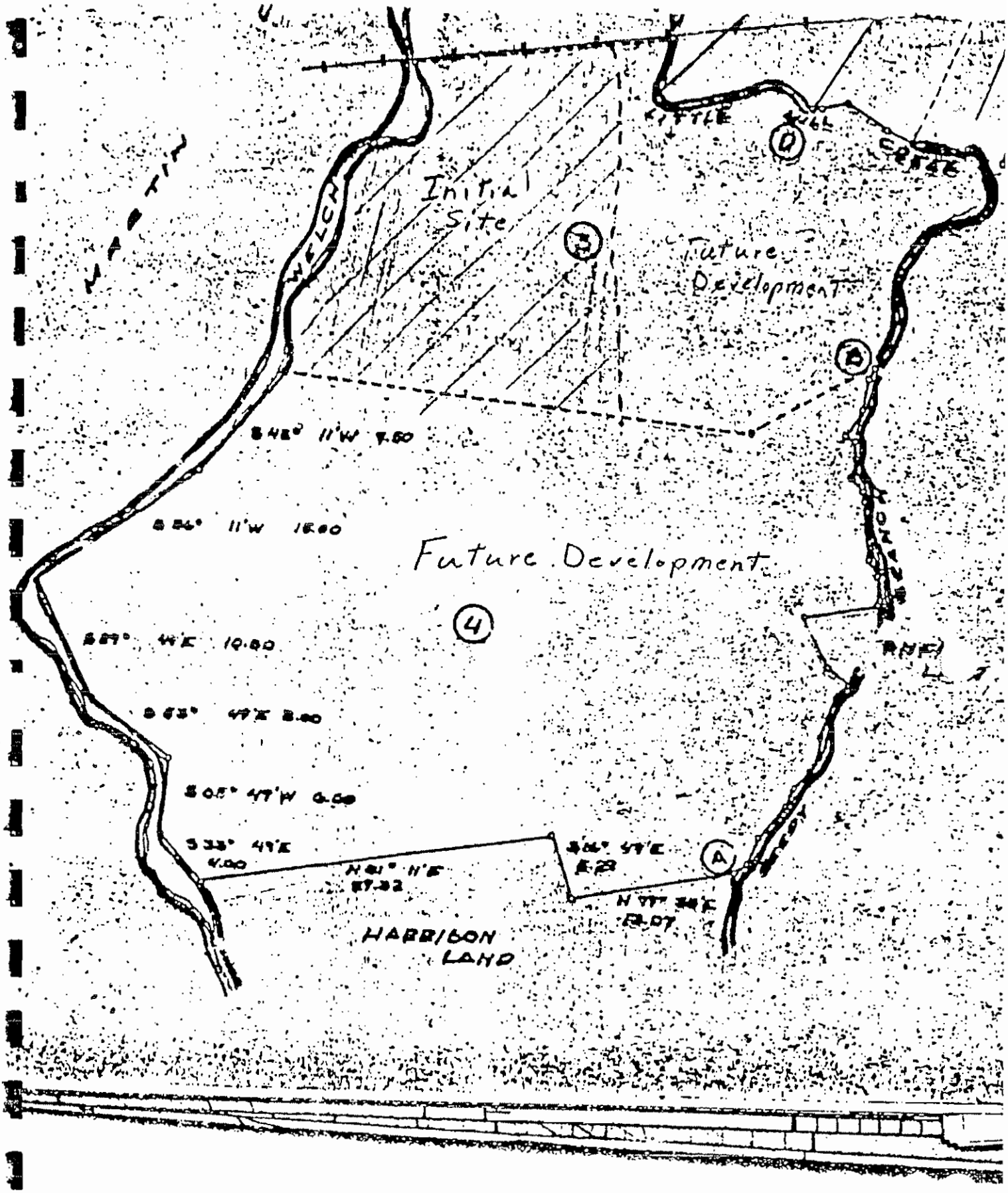
IV. Effective Date: This approval is not effective until the applicant has recorded thi document with the Register of Deeds in the county where the sanitary landfill is located. (G.S. 130A-66.21)

This is to certify that this is an exact and true copy of the above order of approval.

Jacob Koomen, M.D., M.P.H.
Director
Division of Health Services

Jerry C. Perkins, Head
Solid Waste & Vector Control Branch
Sanitary Engineering Section

DHS Form 2510 (8/76)
Solid Waste & Vec



Initial Site
Future Development
Future Development
WELCH
LITTLE
CREEK
HARRISON LAND

U.S. ARMY CORPS OF ENGINEERS
Wilmington District

Action ID: 199910838 County: Washington

Notification of Jurisdictional Determination

Property owner/Authorized Agent Weyerhaeuser Co. c/o Adam C. Brown

Address 100 Verdae Blvd.

Greenville, SC 29607-3825

Telephone Number

Size and Location of Property(waterbody, Highway name/number, town, etc.)
Tract located immediatly S. of existing landfill, adjacent Welch Creek, Plymouth, NC

Indicate Which of the following apply:

- There are wetlands on the above described property which we strongly suggest should be delineated and surveyed. The surveyed wetland lines must be verified by our staff before the Corps will make a final jurisdictional determination on your property.
- Because of the size of your property and our present workload, our identification and delineation of your wetlands cannot be accomplished in a timely manner. You may wish to employ a consultant to obtain a more timely delineation of the wetlands. Once your consultant has flagged a wetland line on the property, Corps staff will review it, and, if it is accurate, we strongly recommend that you have the line surveyed for final approval by the Corps. The Corps will not make a final jurisdictional determination on your property without an approved survey. and surveyed as per plat signed by WTW 3/2/99
- The wetlands on your lot have been delineated, and the limits of Corps jurisdiction have been explained to you. Unless there is a change in the law or our published regulations, this determination may be relied upon for a period not to exceed ~~three~~ five years from the date of this notification.
- There are no wetlands present on the above described property which are subject to the permit requirements of Section 404 of the Clean Water Act (33 USC 1344). Unless there is a change in the law or our published regulations, this determination may be relied upon for a period not to exceed three years from the date of this notification.
- The project is located in one of the 20 Coastal Counties. You should contact the nearest State Office of Coastal Management to determine their requirements.

Placement of dredged or fill material in wetlands on this property without a Department of the Army permit is in most cases a violation of Section 301 of the Clean Water Act (33 USC 1311). A permit is not required for work on the property restricted entirely to existing high ground. If you have any questions regarding the Corps of Engineers regulatory program, please contact Tom Walker at (252) 975-1616 x24.

Property owner/Authorized Agent Signature

Project Manager Signature William T Walker

Date 3/2/99 Expiration Date 3/2/2004

SURVEY PLAT OR FIELD SKETCH OF DESCRIBED PROPERTY AND THE WETLAND DELINEATION FORM MUST BE ATTACHED TO THE YELLOW (FILE) COPY OF THIS FORM.

CESAW Form 566
1 OCT 92

Attachment A2
Communication Record dated January 5, 2000
(regarding setback from property line)

Communication Record

RMT, Inc., North Carolina ("RMT")
100 Verdae Boulevard (29607-3825)
PO Box 16778 (29606-6778)
Greenville, South Carolina
Tel. (864) 281-0030 • Fax (864) 281-0288

Participant	Company Name	Telephone No.
Cheryl Marks	NC DENR	919-733-0692 x346
Kent Nilsson	RMT, Inc., North Carolina	
Dan Madison	RMT	
Jon Freitag	RMT	

Prepared By: Kent Nilsson **Title** Project Manager

Signature:

Project Name: Weyerhaeuser Landfill No. 3

Project No.: 00-05101.08 **Meeting At:**

Date: 1/5/00 **Time:** 1:30 p.m. **Telephone Conversation:** Yes

Subject/Purpose: NC DENR review of Permit Application

Weyerhaeuser File No. 4.6

Discussion/Decision (Summary):

Telephone call was placed to Cheryl Marks in follow-up to a call received from her on Thursday, December 30. During the December 30th call, Ms. Marks indicated that she was reviewing our Permit to Construct, and had some issues related to the setback from property line and our mass balance calculations or model.

She had noted that the separation from edge of waste to property line was as narrow as about 50 feet along east side of the landfill. The southerly area of Phase I appeared to have a buffer of a little over 100 feet. Ms. Marks indicated that a 200-foot setback was required. I reminded her that Weyerhaeuser had previously received approval from NC DENR for the 50 setback on the east side of the landfill where the Bell heirs property juts into the landfill site. Marks said that the project had changed hands a number of times over the years, and that she had no record of such approval.

Ms. Marks also stated that although our mass balance model was acceptable for demonstrating the protection of a double composite liner system previously proposed, it was not acceptable for modeling the effectiveness of the membrane/GCL system now proposed. NC DENR will instead require numerical flow and dispersion modeling.

In RMT's January 5 call to NC DENR, Ms. Marks was further queried regarding the regulation citation for the 200-foot setback for edge of waste from property line. We could only find reference to a 50-foot setback. She replied that the 200-foot setback was department policy, not regulation. She further explained that industrial landfills were governed under Section .1600 (Requirements for Municipal Solid Waste Landfill Facilities), not .0500 (Disposal Sites). *(Note in Section .0503 Siting and Design Requirements for Disposal Sites, that industrial solid waste landfills are specifically identified.)*

John Freitag asked Ms. Marks if she had reviewed the groundwater model submitted in the permit application, and if that could be used as a basis for the advection and dispersion modeling that NC DENR will require. Jon reminded her that it was the model for the influence of the south drainage feature restoration, found in Appendix F of the permit application document. Ms. Marks said she thought that the model only applied to the drainage feature and she had not reviewed the model. She also indicated that the modeling would need to address justification for the location and spacing of the proposed monitoring wells. The HELP model may not be acceptable basis for the source loading of numerical advection/dispersion model. No clarification or reasoning was offered.

Nilsson emphasized that it was Weyerhaeuser's intent to go to construction this Spring, and concern was expressed regarding the impact of potential changes to the issue of the permit. When asked when she thought her review would be complete, Ms. Marks replied that she could not give a date. She said she had a MSW landfill permit to review that has a higher priority.

Follow-up Assignments:

Ms. Marks agreed to do the following:

- Review the groundwater flow model in Appendix F to determine if it is suitable for use as a basis for the requested advection and dispersion modeling.
- Discuss with Jim Coffey her review priorities.
- Submit a letter to RMT stating that the 200-foot setback is a Solid Waste Department policy.

cc: Wynne Shaw, Weyerhaeuser
Bill Morris, Weyerhaeuser
Mac Jones, Weyerhaeuser
Joe Kloeker, Weyerhaeuser
Kathy Huibregtse, RMT
Ed Timmons, RMT
RMT File – 00-05101.08

Appendix B
Phase 2 – Hydrogeologic and Geotechnical Site Characterization for a Proposed Landfill

RMT INC.

100 Verdae Boulevard
P.O. Box 16778
Greenville, SC 29606
Phone: (803) 281-0030
FAX: (803) 281-0288

PHASE 2

HYDROGEOLOGIC AND GEOTECHNICAL SITE CHARACTERIZATION FOR A PROPOSED LANDFILL

Weyerhauser Paper Company
Plymouth, N.C.

Issued: July 1990
Revised: December 1990

Brian T. Grothaus
Project Hydrogeologist

William F. Goforth, P.G.
Senior Hydrogeologist

James G. Kahle, P.E.
Geotechnical Engineer

Mark S. Taylor, P.G
Project Manager

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TABLE OF CONTENTS

Section Page

EXECUTIVE SUMMARY

1. INTRODUCTION . . . 1
   1.1 Background . . . 1
   1.2 Objectives of Investigation . . . 1
   1.3 Scope . . . 3
   1.4 Qualifiction . . . 3

2. FINDINGS AND CONCLUSIONS . . . 5

3. RECOMMENDATIONS . . . 7

4. FIELD INVESTIGATION . . . 8
   4.1 Subsurface Investigation . . . 8
      4.1.1 Soil Sampling and Analysis . . . 8
      4.1.2 Borings . . . 9
      4.1.3 Test Pit Excavations . . . 10
   4.2 Monitoring Well Installation . . . 10
   4.3 Hydraulic Conductivity Testing . . . 11

5. SITE GEOLOGY . . . 13
   5.1 Soils . . . 13
   5.2 Sedimentary Units . . . 13
   5.3 Stratigraphic Relationships . . . 14

6. HYDROGEOLOGY . . . 15
   6.1 Aquifer Identification . . . 15
   6.2 Water Table . . . 15
   6.3 Ground Water Flow . . . 18

7. ENGINEERING PROPERTIES OF SOILS . . . 22
   7.1 Compressibility . . . 22
   7.2 Permeability . . . 24
   7.3 Clay Borrow Results . . . 24
   7.4 Shear Strength . . . 28

8. IMPLICATIONS FOR LANDFILL DESIGN . . . 29
   8.1 Subgrade Support . . . 29
   8.2 Landfill Design Options . . . 30
      8.2.1 At-grade Design Option . . . 30
      8.2.2 Deep Excavation Design Option . . . 30
   8.3 Liner . . . 31
   8.4 Excavation and Grading . . . 33

TABLE OF CONTENTS, cont.

List of Tables

Table 1 Summary of Well Construction Data 12
Table 2 Summary of *In-Situ* Hydraulic Conductivity Test Results 16
Table 3 Summary of Water Level Elevations 17
Table 4 Ground Water Flow Rates 19
Table 5 Summary of Vertical Ground Water Gradients 20
Table 6 Summary of Consolidation Testing 23
Table 7 Soil Summary 25
Table 8 Summary of Index Test Results 26
Table 9 Hydraulic Conductivity Test Results 27

List of Figures

Figure 1 Site Location Map 2

Appendices

Appendix A Boring Logs
Appendix B Test Pit Logs
Appendix C Well Construction Diagrams
Appendix D Geotechnical Analytical Results
Appendix E *In-Situ* Hydraulic Conductivity Test Results
Appendix F Ground Water Flow Calculations
Appendix G Settlement Computations

List of Plates

Plate 1 Data Point Location Map
Plate 2 Hydrogeologic Cross-Sections A-A' and B-B'
Plate 3 Hydrogeologic Cross-Sections C-C' and D-D'
Plate 4 Water Table Configuration
Plate 5 Potentiometric Surface

EXECUTIVE SUMMARY

Background data have been collected to design a new landfill that will replace the existing facility in three to five years. Samples of subsurface soils from the site proposed for the new landfill were collected and tested. Physical property testing indicated that on-site, clayey soils could be used as cap and liner construction material. Two aquifers were identified and characterized on the site. An issue to be resolved during the conceptual design of the landfill will be whether to construct the facility above the water table, or to dewater the shallow aquifer and construct the landfill in a deep excavation.

Hydrogeology

The site is underlain by unconsolidated silts, sands, and clays. A clay layer at an approximate 20 foot depth separates the surface aquifer from a deeper, confined aquifer over a portion of the site. Ground water in both aquifers flows from the south of the site toward Welch Creek on the west and Little Mill Creek on the north. Ground water percolates slowly downward into the lower aquifer on the eastern side of the site, but appears to move upward toward the surface along the creek to the west.

Soil Properties

An acceptable amount of settlement caused by consolidation of underlying soils due to loading by the new landfill is expected. Shallow soils, primarily interbedded silts, and sands, containing clay appear to be suitable for use as liner or final cap material. There are indications of sufficient clayey soils on-site to justify preparation of an estimate of quantities available for use in landfill construction.

Implications for Landfill Design

The data obtained from this investigation suggest that the following options for the design of the landfill should be evaluated.

1) Limiting the landfill subgrade to the shallow subsurface above the water table;
2) Dewatering the shallow aquifer above the major clay unit and constructing the bottom of the landfill near the top of the deep clay layer;
3) Using on-site clay for construction materials.

The first alternative would offer significantly less airspace for long-term waste disposal.

The second alternative would offer more airspace, but would require a variance from North Carolina Regulatory Standards which require a four foot separation between waste and the water table.

Section 1

INTRODUCTION

1.1 Background

The Weyerhaeuser Company Plymouth Mill maintains a State-permitted landfill for the disposal of boiler ash and process wastes. The landfill is located on Weyerhaeuser-owned property adjacent to the mill in Plymouth, North Carolina, as shown on Figure 1. A five-year permit to complete a vertical expansion for the existing landfill was recently obtained.

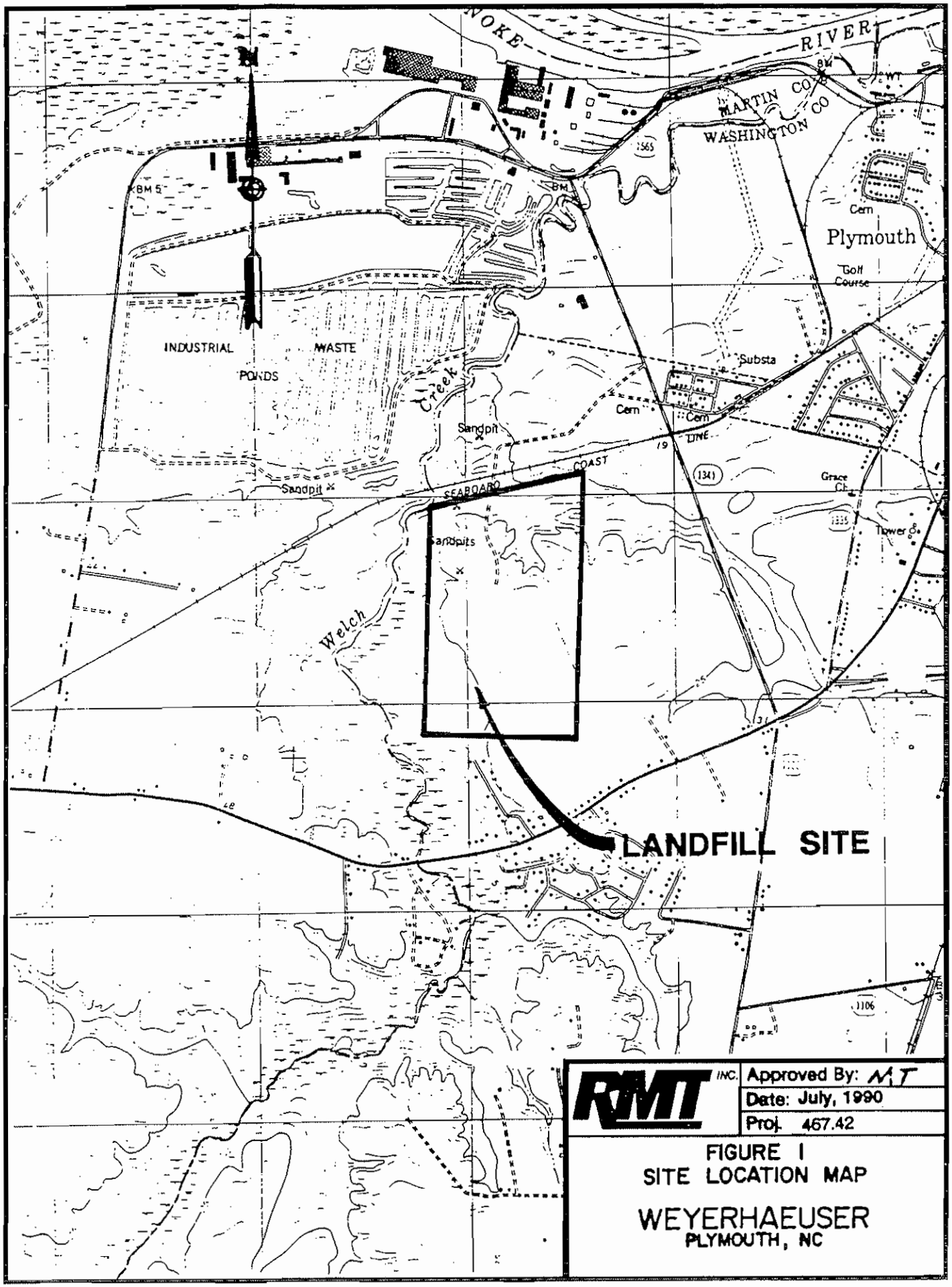
Weyerhaeuser is currently developing plans for a new landfill that will be located adjacent to the existing facility, as shown on Plate 1. The first step in the permitting process, approval of the site for use as a landfill, was granted by the North Carolina Department of Environment and Natural Resources (NCDENR) as part of Solid Waste Management, Permit No. 94-01. Weyerhaeuser is in the process of preparing the second part of a North Carolina landfill permit which is the construction plan application.

RMT, Inc., has been retained by Weyerhaeuser to investigate subsurface conditions on the site to provide baseline data for use in the development of the construction plan application. A Preliminary Site Characterization was conducted during the summer of 1989. In April 1990, Phase 2 of the Site Characterization was conducted to provide the subsurface data needed to design the new landfill.

1.2 Objectives of Investigation

The objectives of the field investigation were as follows:

- Characterize the geologic and hydrologic conditions of the proposed landfill site to provide engineering design criteria and to meet the requirements of NCAC 10G.0504(1)(c), and
- Determine the following on-site soils characteristics:
  - Permeability,
  - Settlement,
  - Construction/compaction properties, and
  - Borrow potential for liner and cover material.



RMT INC.

Approved By: MT

Date: July, 1990

Proj. 467.42

FIGURE I
SITE LOCATION MAP

WEYERHAEUSER
PLYMOUTH, NC

TELEDYNE POST N32083

1.3 Scope

This report presents the data collected during Phase 2 of the Site Characterization, and discusses the implications of that data for designing the new landfill. It contains hydrogeologic and geotechnical information needed to prepare a construction plan application. It is not intended to be used as a substitute for the site plan application required by NCAC 10G.0504(1)(b).

This study of hydrogeological and geotechnical characteristics includes:

- Testing of selected soil samples, including standard penetration, grain size distribution, soil classification, moisture content, dry density, Atterberg limits, *in situ* and remolded permeability, and compaction;
- Field observation of geologic features;
- Tabulation of water table elevations; and
- Settlement analysis.

Recommendations for engineering design criteria and construction of the new landfill were developed from an analysis of the data obtained during the study. These recommendations cover the following design issues:

- Depth of the landfill excavation,
- Separation between the base of the landfill and the water table,
- Excavation and fill slopes,
- Liner selection,
- Potential use of on-site soils for liner and cap construction,
- Identification of alternate construction materials,
- Construction constraints, and
- Construction requirements, including quality control procedures.

1.4 Qualification

The RMT evaluation of hydrogeologic and geotechnical conditions was based on knowledge of the site derived from data obtained during this investigation. The general subsurface conditions utilized in our evaluation have been based on interpolation of subsurface data between the borings, wells, and test pits. In evaluating the subsurface data, we have examined previous correlations between

penetration resistances and foundation bearing pressures conserved in soil conditions similar to the Plymouth site. If the project information is incorrect or if the structure location (horizontal or vertical) dimensions are changed, please contact RMT so that the recommendations in Section 3 can be reviewed. The discovery of any site or subsurface conditions during construction which deviate from the data generated during this investigation should be reported to RMT for evaluation. The assessment of site environmental conditions or the presence of pollutants in the soil, rock and ground water of the site was beyond the scope of this investigation.

Section 2
FINDINGS AND CONCLUSIONS

Based on the following findings, RMT concludes that this site is suitable for construction of a landfill. In support of this conclusion, the investigation results indicated the following:

1. The soils encountered in borings and test pit excavations consisted of sands, silts, and clays. The dominant soil type logged in the shallow subsurface was silty sand, but many of the silty sand beds were interbedded with or interlaminated with clayey sands and clays. In most cases, the sand is fine-grained. Medium and coarse-grained sand was occasionally found at depths greater than 10 feet.

2. In spite of the overall heterogeneous character of the sediments on the site, the following generalizations apply:
   - The upper stratigraphic intervals in the northeastern part of the pine plantation area tend to contain more clay than the same interval in other areas of the site;
   - The upper ten feet of soil in TP-15, TP-6, TP-3, and OW-3 contain virtually no clay; and
   - A blue-green clay unit that was encountered at a depth of approximately 20 feet, was observed throughout most of the east-central part of the site, in the vicinity of the pine plantation. This unit was penetrated by three borings at thicknesses ranging from 15.5 to 18 feet.

3. Two acquifers were identified on-site. A shallow water table acquifer exists throughout the site, and, in the east-central part of the site, a confined acquifer, separated from the water table aquifer by the blue-green clay aquitard. The landfill could be placed in a deep excavation while maintaining the four foot minimum separation between the base of the landfill and the water table required by North Carolina regulations. This would be accomplished by dewatering the shallow aquifer.

4. The shallow water table generally mimics topography across the site. Although no record of water table fluctuations exists for this site, the water table would be expected

to fluctuate with seasonal variations in precipitation. The design of the landfill should anticipate these fluctuations.

5. Downward ground water gradients exist in the area underlain by the deep clay unit. This suggests that leachate migrating from the proposed landfill will tend to infiltrate downward through the deep clay unit. Leaching data (Waste Characterization and Analysis, RMT, July 1990) indicate that the wastes could potentially release certain metals to the environment. Adequate environmental barriers will be needed to control such releases and monitoring systems will be required to determine if any have occurred.

6. Penetration tests and laboratory strength testing indicate that the underlying soils on the site will provide adequate subgrade support for a landfill with acceptable settlement characteristics.

7. Some on-site soils could be used for liner and cap material. Tests on selectively collected composite samples showed that recompacted soils classified as CL, ML, and SC achieved maximum permeabilities ranging between 1.9×10^{-8} and 5×10^{-8} cm/sec. These permeabilities exceed the desired maximum liner permeability of 1×10^{-7} cm/sec. Although an estimate of available quantities was not attempted, the data indicate that at least a portion of the required liner or cap material might be available on-site.

Section 3
RECOMMENDATIONS

Based on the findings and conclusions of this investigation, RMT makes the following recommendations:

1. Proceed with designing the landfill.

2. Consider the following elements:
   - The two design options, deep or shallow excavation, should be evaluated based on ground water configuration;
   - Ground water control measures should be included in either design option;
   - A detailed dewatering analysis should be prepared prior to deep excavation design;
   - Shear strength data from the Preliminary Site Characterization for a Proposed Landfill, RMT, October 1989, should be used;
   - Stability of embankments should be checked during construction.

3. Estimate the available quantities of soils suitable for use as liner or cap material.

4. Identify an off-site source of clay soil.

5. Collect ongoing water level and precipitation measurements to evaluate seasonal water table fluctuations.

Section 4
FIELD INVESTIGATION

4.1 Subsurface Investigation

To supplement information collected during the preliminary site investigation, three monitoring wells and seven observation wells were installed, five soil borings were drilled, and sixteen test pits were excavated on-site. Resulting soil and water level data have been used to provide a more detailed interpretation of on-site soil stratigraphy and ground water flow conditions. Lithologic logs from wells, borings and test pits are included in Appendices A and B. Well construction diagrams are included in Appendix C.

4.1.1 Soil Sampling and Analysis

Sampling activities were conducted to assess the type, distribution, and geotechnical characteristics of soils at the site. Data was compiled and analyzed to assess the suitability of on-site soils for use as landfill liner or cover material. The information was collected to define the areas of the site that would provide a natural separation between shallow and deep aquifers.

Soil samples were collected on a continuous basis from the soil borings with a split barrel sampler. Undisturbed samples were collected from selected intervals using thin-walled tube samplers (*i.e.*, Shelby tube). Continuous split barrel soil samples were also collected from each of the well boreholes to ten feet below ground surface and then at five foot intervals to total boring depth.

The laboratory coefficient of permeability was measured for undisturbed soil samples. These samples were collected from shallow and intermediate depths relative to the projected landfill excavation base, and from the upper part of the deep clay unit.

Scoop samples were collected from each different soil unit within a test pit, unless the equivalent unit had been previously sampled. In addition to scoop samples, bulk samples were collected wherever predominantly clay units were encountered in the test pits. Bulk samples were tested for grain size (ASTM D422) and Atterberg limits (ASTM D4318). Moisture-density tests (ASTM D155) were also performed on cohesive soil samples. Split

barrel, scoop, and bulk samples, were visually classified in the field by an RMT hydrogeologist in accordance with the Unified Soil Classification System. Selected soil samples were subsequently analyzed in the laboratory (Appendix D). The results were checked against visual classifications and changes were made when necessary.

Selected split barrel and scoop samples from boreholes and test pits were analyzed for geotechnical properties. The analytical results are tabulated and included in Appendix D along with supporting documentation.

4.1.2 Borings

Five soil borings (SB-5 through SB-9) were drilled to 20 feet. The locations of the soil borings are shown on Plate 1. The soil borings were located to collect information regarding the distribution, type, and geotechnical characteristics of shallow subsurface soils. Borings were drilled with hollow stem augers (approximately six inch O.D., three inch I.D.). Upon completion, each boring was grouted from total depth to land surface with a Portland cement/bentonite grout slurry.

Well borings were drilled by two methods: hollow stem auger and mud rotary. Shallow observation wells (OW-2 through OW-7) were drilled to depths ranging from 13.2 to 23.3 feet. Small diameter augers (6 inch) were employed during soil sampling to minimize potential problems with flowing sands, a common phenomenon in the Coastal Plain physiographic province. After reaching total depth, each boring was overdrilled using ten inch O.D. hollow stem augers for well construction.

The four deep wells, MW-1A, MW-6A, MW-8, and OW-1 were drilled using the mud rotary method. These wells were drilled to determine the thickness and occurrence of the deep clay unit encountered in monitoring wells MW-1, MW-5, and MW-7, and soil borings SB-2, SB-3, and SB-4 during the Preliminary Site Characterization Phase. The drilling was begun using a 5 and 7/8 inch tricone bit. After encountering the top of the deep clay unit in MW-1, MW-8, and OW-1, the borehole was overdrilled with a ten inch tricone bit. Then six inch diameter schedule 40 PVC casing was installed, and the annulus was grouted to ground surface using a tremie line. The borehole was advanced through the clay unit using a 5 and 7/8 inch tricone

bit. The entire borehole for MW-6A was drilled using a 5 and 7/8 inch tricone bit since the deep clay unit was not encountered.

4.1.3 Test Pit Excavations

Sixteen test pits were excavated on-site to supplement geotechnical information from the borings and permit collection of clay samples for geotechnical analysis. The pits ranged in depth from five to ten feet. The test pits provided larger scale observation of soil stratigraphic and textural relationships than could be obtained from soil borings. Water table observations were also documented from some of the test pits.

4.2 Monitoring Well Installation

Three monitoring wells (MW-1A, MW-6A, and MW-8) were installed on-site. Monitoring wells MW-1A, MW-6, MW-8, and observation well OW-1 were installed to monitor the water level of the deep confined aquifer, and provide information regarding the distribution and characteristics of on-site clays. The locations of the four wells are shown on Plate 1. Wells MW-1A, MW-6A, and OW-1 were installed as deep companion wells to the existing MW-1, MW-6, and MW-7 wells, respectively. Monitoring well MW-8 was installed as a deep companion well to observation well OW-4. Monitoring wells MW-1A and MW-8, and observation well OW-1 were drilled to a sufficient depth to set five foot screens in the aquifer beneath the blue green clay unit. The deep clay unit was not encountered while drilling MW-6A. Therefore, this well was installed to a depth of 50 feet.

Once the deep boreholes were advanced to the desired depth, two inch diameter schedule 40 PVC casing and screen with threaded, flush joints were installed through the surface casing. The screens were five feet in length and machine slotted with .010 inch openings. After the screen and casing had been placed at the desired depth, the annular space above the sand pack was sealed with bentonite pellets. The remaining annular space was grouted to the land surface. A Portland cement slurry containing approximately five to eight percent powdered bentonite was used for the monitoring wells. A Volcay® gel was used for the observation well. Lockable steel protective covers were placed over the monitoring wells and secured in the grout column. No cover was placed over OW-1 to permit well removal at a later date. A concrete pad was framed and poured around each monitoring well. The wells were developed by pumping with a positive displacement PVC pump.

Prior to drilling each borehole, the drill rig and downhole tools were decontaminated by steam cleaning. Well casing, screen, and all development equipment were also decontaminated by steam cleaning before use.

In addition to the deep wells, six shallow water table observation wells, OW-2 through OW-7, were installed on-site for the purpose of providing water table data and data regarding soil type and distribution. The locations of OW-2 through OW-7 are shown on Plate 1. The observation wells differ from the monitoring wells by the absence of a steel protective cover and the use of Volclay® grout in lieu of a Portland cement grout. The observation wells were constructed in this manner to facilitate removal at a later date. The wells were constructed through the hollow stem augers as they were withdrawn from the boreholes. The procedures and materials used were similar to deep observation well, OW-1; however, no surface casing was installed and 10 foot screens were used to bracket the observed water table. Table 1 summarizes the details of the well construction.

4.3 Hydraulic Conductivity Testing

In-situ hydraulic conductivity tests were performed on the ten ground water monitoring and observation wells by inducing water displacement with a ten foot long, solid PVC slug. After introducing the slug, the water level was allowed to equilibrate. The slug was then removed causing the water level to drop beneath the elevation of the static water table. The recovery was monitored closely with pressure transducers and an Enviro-Labs Model EL-200 data logger. Hydraulic conductivities were calculated using the Bouwer and Rice (1976) method for those wells in the unconfined aquifer, and the Naval Facilities Engineering Command (1971) method for those in the confined aquifer. The calculations and graphs are included as Appendix E.

TABLE 1
SUMMARY OF WELL CONSTRUCTION DATA

WEYERHAEUSER
PLYMOUTH, NORTH CAROLINA

	WELL NUMBER									
	MW-1A	MW-6A	MW-8	OW-1	OW-2	OW-3	OW-4	OW-5	OW-6	OW-7
Date Installed	4-18-90	4-19-90	4-23-90	4-20-90	4-25-90	4-18-90	4-22-90	4-24-90	4-24-90	4-25-90
Well Diameter (inches)	2	2	2	2	2	2	2	2	2	2
Well Material	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC
Screen Slot Size (inches)	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Ground Elevation[1]	34.97	11.52	34.30	34.52	32.05	42.63	34.34	30.90	31.32	21.57
Top of Casing Elevation[1]	37.58	13.39	36.12	36.89	33.61	45.50	36.85	33.99	34.09	24.35
Top of Bentonite Seal (feet below ground surface)	32.9	37.0	29.0	29.5	0.8	7.0	2.5	7.0	11.0	10.5
Gravel Pack Zone (feet below ground surface)	36.9-44.0	42.0-50.0	34.0-43.0	36.1-44.7	3.0-13.2	9.0-21.0	4.0-15.8	8.5-19.9	13.1-25.0	12.0-23.3
Screen Zone (feet below ground surface)	39.0-44.0	45.0-50.0	38.0-43.0	39.7-44.7	3.2-13.2	11.0-21.0	5.8-15.8	9.9-19.9	15.0-25.0	13.3-23.3
Total Boring Depth (feet below ground surface)	46.0	52.0	45.0	47.0	22.0	23.0	18.5	22.0	27.0	26.0

[1] Elevations are feet above Mean Sea Level (MSL).

wp\467421bl.1/odf90

Section 5

SITE GEOLOGY

5.1 Soils

The soils encountered in borings and test pit excavations consisted of sands, silts, and clays. The dominant soil type logged was silty sand, but many of the silty sand beds were interbedded and interlaminated with clayey sands and clays. In most cases, the sand was fine-grained. Medium and coarse-grained sands were occasionally found at depths greater than 10 feet. The sands varied in color; orange brown, brown, dark gray, and purple gray sands were common.

Tan and orange brown silty sands were the most common and were often difficult to distinguish from clayey sands and interbedded clays. There were some silty sand beds which are mottled with clay. In these beds, the silty sand was often orange brown and the intermingled clays were light gray.

Many of the clays were orange brown, though light and dark gray units were also encountered. A blue-green clay unit was distinct in that it was generally thick, largely homogenous, and moderately stiff. Laboratory analyses show that this clay unit contained a large amount of silt.

A second distinctive unit, only penetrated in the lower eleven feet of MW-6A (41 to 52 feet), consisted of approximately five feet of gray clayey silt overlying six feet of gray silty sand. The silty sand section contained abundant broken and whole fossil specimens of gastropods, pelecypods, and corals.

5.2 Sedimentary Units

In many instances, the upper six inches to one foot of soil is a brown or black humic silty sand (topsoil). The underlying one to two feet is frequently a fine-grained silty sand to poorly graded sand (SP). The next fifteen feet of soil generally consists of silty sand containing variable amounts of clay, interbedded with clays and clayey sands of variable thickness. The different soil types are not homogeneous units of common thickness and spatial distribution. This limits the reliability of the stratigraphic interpretations depicted on the cross-sections (Plates 2 and 3), with regard to providing an accurate assessment of depth to, and volume of, clay soils in areas between points of control. Often the upper part of this approximately fifteen foot thick, stratigraphic interval is a clay or clayey layer. Measured thicknesses ranged from less than one foot to approximately five feet before grading into a predominantly silty sand.

In spite of the overall heterogeneous character of the sediment described above, some generalizations can be drawn from the observations made during this investigation. First, the upper stratigraphic interval tends to contain more clay in the northeastern part of the pine plantation (*e.g.*, TP-2, SB-5, TP-1). Second, the upper ten feet of soil in TP-15, TP-6, TP-3, and OW-3 was largely devoid of clay. Finally, the deep blue-green clay unit, penetrated over a thickness as great as twenty feet, has been observed throughout most of the east-central part of the site in the vicinity of the plantation. This clay unit extends northeastward toward Little Mill Creek. The unit was not encountered near the northeastern and western site boundaries, in wells OW-7 and MW-6A, but was encountered in the following wells and soil borings: MW-1, MW-1A, MW-7, SB-2, SB-3, SB-4, MW-8, OW-1, SB-5, OW-5, and OW-6.

5.3 Stratigraphic Relationships

Several lines of evidence suggest a predominantly marine/nearshore depositional environment for the sediments penetrated on-site. The gray silty sand interval in the base of MW-6A, which contains corals and other marine fossils, indicates a marine environment. Scattered occurrences of sand-sized shell fragments in sandy units also suggest this interpretation for at least a part of the shallower section. The thickness and largely uniform texture and color of the deep clay unit combined with these other characteristics are consistent with a marine/nearshore interpretation.

Two possible explanations for the distribution of the deep clay aquitard are that it terminates laterally as a depositional pinch-out, or that it is an erosional unconformity. The apparent abrupt termination of such a thick, uniform unit is best explained by the latter. Both the western and northeastern sides of the site are bounded by creeks; Welch Creek to the west and Little Mill Creek to the northeast. The cutbanks of the creeks could have scoured out the clay unit and left in its place reworked sands, silts, and clays. There is evidence for this in OW-5 and OW-6. These lateral stratigraphic relationships are illustrated on Plates 2 and 3.

The occurrence of this blue-green clay near the base of OW-5, which is interbedded with orange, brown, and gray clays with some sand, suggests reworking of the unit as depicted in cross-section A-A'. Similarly, the blue-green and brown mottled clay in the base of OW-6 also appears to be reworked. Its nonuniform color and elevation relative to MW-8 to the south, support this interpretation.

Section 6
HYDROGEOLOGY

6.1 Aquifer Identification

A water table aquifer and a confined aquifer were identified during the course of the field investigation. The two aquifers are separated by a deep clay aquitard which was encountered in the east-central part of the site. Ground water below the deep clay unit is confined, as evidenced by water levels in the deep wells that rise above the base of the confining unit. Hydraulic conductivity values calculated from the shallow unconfined aquifer range from 1.1×10^{-1} cm/sec to 4.3×10^{-6} cm/sec. Hydraulic conductivities from the deep wells range from 3.5×10^{-2} cm/sec to 7.2×10^{-6} cm/sec. The highest value was calculated from OW-7 conductivity data. The hydraulic conductivity values from the deep confined aquifer range from 3.5×10^{-2} cm/sec to 4.0×10^{-3} cm/sec. The ranges from both aquifers are consistent with the generalization that the sediments beneath the deep clay are more sandy than the sediment above. Hydraulic conductivity values for all wells are summarized in Table 2.

6.2 Water Table

Ground water levels were measured on May 24, 1990 and June 14, 1990. Results are presented in Table 3. Maps characterizing the water table and potentiometric surface, included as Plates 4 and 5, were prepared using the June 1990 water levels. The potentiometric surface is based on data points from the deep wells in the four nested well pairs, and can be illustrated as a simple westward dipping plane. By contrast, the water table configuration suggests that there are essentially three areas with three different flow characteristics: western, northeastern, and central divide.

The central ground water divide area lies largely in the vicinity of the active plantation. It is characterized by the lowest average gradient of the three areas at 4.3×10^{-3} ft/ft. This low gradient area appears to represent a transition in flow direction between the northeastern and western areas. The division in flow is marked by an axis approximated by a northwest-southeast line connecting MW-1 and MW-5. The gradient increases on either side of the axis in the transition with the northeastern and western areas. The MW-7/OW-5 well pair that lies east of the axis in the transition between the central divide and northeastern areas also displays a lower gradient characteristic of the rest of the central divide area, 7.1×10^{-3} ft/ft.

TABLE 2

SUMMARY OF IN-SITU HYDRAULIC CONDUCTIVITY TEST RESULTS

WEYERHAEUSER
PLYMOUTH, NC

MAY 22-23, 1990

WELL DESIGNATION	HYDRAULIC CONDUCTIVITY (cm/sec)
OW-1	3.5×10^{-2}
OW-2	3.0×10^{-4}
OW-3	3.8×10^{-3}
OW-4	1.1×10^{-3}
OW-5	6.9×10^{-6}
OW-6	4.3×10^{-6}
OW-7	1.1×10^{-1}
MW-1A	4.0×10^{-3}
MW-6A	7.2×10^{-5}
MW-8	6.0×10^{-3}
MW-1[1]	2.1×10^{-3}
MW-2[1]	2.5×10^{-2}
MW-3[1]	2.5×10^{-3}
MW-4[1]	3.3×10^{-3}
MW-5[1]	1.5×10^{-3}
MW-6[1]	1.4×10^{-3}
MW-7[1]	3.3×10^{-4}

[1] Measured during Preliminary Site Characterization Phase.

TABLE 3

SUMMARY OF WATER LEVEL ELEVATIONS [1]
WEYERHAEUSER - PLYMOUTH

WELL ID	WATER LEVEL ELAVATION MAY 24, 1990	WATER LEVEL ELEVATION JUNE 14, 1990
MW-1	32.87	31.92
MW-1A[2]	7.68	11.80
MW-2	NM	6.85
MW-3	NM	4.25
MW-4	NM	3.84
MW-5	NM	26.73
MW-6	3.54	3.25
MW-6A	4.08	3.36
MW-7	NM	27.35
MW-8[2]	8.21	7.72
OW-1[2]	9.78	9.71
OW-2	26.56	25.55
OW-3	27.59	27.50
OW-4	22.88	23.04
OW-5	19.82	19.61
OW-6	7.22	7.71
OW-7	5.41	5.28

[1] - All elevations are feet above Mean Sea Level.
[2] - Screened in lower aquifer

The northeastern area, by contrast, displays the highest gradient of the three areas, averaging approximately 2.6 x 10^{-2} ft/ft. The topography of this area is characterized by relatively high and complex relief. The water table configuration appears to be strongly influenced by a topographic low that trends from north to south. The low is bounded to the north by Little Mill Creek and terminates to the south between OW-4 and OW-6.

The approximate eastern boundary of the western area is marked by the location of wells OW-2, OW-3, and MW-5. The horizontal gradient in this area averages approximately 2 x 10^{-2} ft/ft. The direction of ground water flow within the western area is generally to the west toward Welch Creek. Flow in the northeastern area is generally convergent on Little Mill Creek. Flow within the central area is divided, indicating movement in the general directions east and west.

6.3 Ground Water Flow

Calculated ground water flow rates are summarized in Table 4. These are based on the horizontal hydraulic gradients between twelve well pairs and their associated horizontal hydraulic conductivities. The flow rates for those well pairs screened in the shallow aquifer range from .003 ft/day to 2.19 ft/day based on the June 14, 1990 water level data. The highest flow rate, 2.19 ft/day, corresponds to the well pair OW-5/OW-7 that has the highest hydraulic conductivity and one of the highest gradients.

Flow rates within the western area, based on four well pairs, range from .05 ft/day to .90 ft/day. Rates within the eastern area, based on three well pairs, range from .05 ft/day to 2.19 ft/day. Rates from two of the well pairs, .05 and .07 ft/day, involve well OW-6. The hydraulic conductivity value calculated for well OW-6 is suspect since there was insufficient water in the well to conduct a reliable test. The 2.19 ft/day value was calculated from the OW-5/OW-7 well pair as discussed above. The range of flow rates and average hydraulic gradient are lower in the western area than the eastern area. The central area flow rates, based on two well pairs, were .02 and .03 ft/day. The flow rate from the MW-7/OW-5 well pair, which lies on the eastern edge of the transition between the central divide and northeastern areas, is .003 ft/day which was the lowest flow rate calculated. This suggests a low effective hydraulic conductivity between these wells.

Vertical ground water gradients were calculated for the four well pairs as presented in Table 5. Calculations are included as Appendix F. One well pair, MW-6/MW-6A, has an upward gradient. The remaining well pairs have downward ground water gradients. The lateral extent of the deep clay unit

TABLE 4

GROUND WATER FLOW RATES

WEYERHAEUSER
PLYMOUTH, NC

Well Pair	Horizontal Gradient	Average Hydraulic Conductivity	Ground Water Velocity[1]
MW-1A/MW-6A[2]	$3.5X10^{-3}$ ft/ft	$2.04X10^{-3}$ cm/sec	.02 ft/day (7.4 ft/yr)
MW-1/MW-6	$1.2X10^{-2}$ ft/ft	$1.75X10^{-3}$ cm/sec	.06 ft/day (21.7 ft/yr)
[3]MW-1/OW-2	$4.9X10^{-3}$ ft/ft	$1.20X10^{-3}$ cm/sec	.02 ft/day (6.1 ft/yr)
[3]MW-1/OW-3	$3.0X10^{-3}$ ft/ft	$2.95X10^{-3}$ cm/sec	.03 ft/day (9.2 ft/yr)
[4]OW-2/MW-6	$2.0X10^{-2}$ ft/ft	$8.50X10^{-4}$ cm/sec	.05 ft/day (17.6 ft/yr)
[4]MW-2/OW-3	$2.2X10^{-2}$ ft/ft	$1.44X10^{-2}$ cm/sec	.90 ft/day (327.8 ft/yr)
[4]MW-3/MW-5	$1.9X10^{-2}$ ft/ft	$2.00X10^{-3}$ cm/sec	.11 ft/day (39.3 ft/yr)
[4]MW-4/MW-5	$1.8X10^{-2}$ ft/ft	$2.40X10^{-3}$ cm/sec	.12 ft/day (44.7 ft/yr)
[5]MW-5/OW-6	$3.1X10^{-2}$ ft/ft	$7.52X10^{-4}$ cm/sec	.07 ft/day (24.1 ft/yr)
[5]OW-4/OW-6	$3.3X10^{-2}$ ft/ft	$5.52X10^{-4}$ cm/sec	.05 ft/day(18.8 ft/yr)
[5]OW-5/OW-7	$1.4x10^{-2}$ ft/ft	$5.50x10^{-2}$ cm/sec	2.19 ft/day (796.7 ft/yr)
MW-7/OW-5	$7.1X10^{-3}$ ft/ft	$1.68X10^{-4}$ cm/sec	.003 ft/day (1.2 ft/yr)

[1] Darcy Velocity
[2] Deep Wells
[3] Central divided area
[4] Western area
[5] Northeastern area

TABLE 5

SUMMARY OF VERTICAL GROUND WATER GRADIENTS

WEYERHAEUSER
PLYMOUTH, NC

MONITORING WELL PAIR	GRADIENT [1]
MW - 1 / MW - 1A	- 0.774
OW - 4 / MW - 8	- 0.613
MW - 7 / OW - 1	- 0.678
MW - 6 / MW - 6A	+ 0.003

[1] + Denotes upward flow gradient.
- Denotes downward flow gradient.

appears to dictate the area where a negative ground water gradient is likely to exist. This suggests that any leachate escaping from the proposed landfill will tend to infiltrate downward towards the deep clay unit.

Section 7
ENGINEERING PROPERTIES OF SOILS

7.1 Compressibility

To estimate the settlement characteristics of the soil beneath the proposed landfill, the compressibility of the clay layer (encountered at about 20 feet deep over most of the site) was measured by performing consolidation tests on two undisturbed samples. The samples were of silty clay (ML) from a 22 to 24 foot depth in MW-1A, and clayey plastic silt (MH) from 20 to 22 foot depth in OW-1.

The compression index (C_c) and the recompression index (C_r) determined from consolidation testing are used to estimate the field settlement due to consolidation. These indices are directly proportional to settlement. As the index values increase, settlement calculations indicate a greater settlement potential. The C_c values for OW-1 and MW-1A were calculated to be 0.48 and 0.49, respectively. The C_r values for the OW-1 and MW-1A samples were calculated to be 0.15 and 0.14, respectively.

The coefficient of consolidation (C_v) was calculated for each consolidation test. A C_v value was calculated by Casagrande and Fadum's logarithm-of-time method for each load during each test. The 1 ton per square foot load C_v values for the OW-1 and MW-1A samples were calculated to be 0.1 and 9.2 square feet per day, respectively. The results of the consolidation tests are summarized in Table 6, and settlement computations are presented in Appendix G.

In summary, the consolidation testing at OW-1 and MW-1A indicate that the soil is an over-consolidated clay (*i.e.*, it has a pre-consolidation pressure greater than the existing overburden pressure). This also suggests that the recompression index (C_r) be used to calculate settlement once the height and contact pressure from the landfill is known.

A second component of settlement caused by the weight of the landfill, would be from the compression of the near surface soils (from the ground surface to the clay layer at 20 feet). These soils are predominately sands and silts with some clayey layers in the upper 10 feet. The standard penetration tests indicated generally loose to medium compact conditions. Experience indicates that these soils will behave similar to over-consolidated clay. Settlement would occur quickly, i.e., as the load was applied. An estimate of the compression index for the sands and silty sands would be C_c = 0.05 to 0.06 for loose, and C_c = 0.02 to 0.03 for dense. The medium compact soils would fall

TABLE 6

WEYERHAEUSER CO.
PLYMOUTH, NORTH CAROLINA

Summary of Consolidation Testing

Sample	Sample Depth (feet)	Consolidation Moisture (%)	P-200 (%)	Plasticity Index (%)	Classification	C_c	C'	CR	CV (@ 1 ton per ft^2
MW-1A	22-24	44.5	88.8	14	ML	0.48	0.15	0.21	0.1
OW-1	20-22	46	88.7	20	MH	0.49	0.14	0.23	9.2

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between these values. In other words, the sands and silty sands are probably about 1/3 less compressible than the clay layer at 20 feet, which itself is not very compressible.

7.2 Permeability

Undisturbed soil samples were taken at MW-1A , MW-8, OW-1, OW-2, OW-3, and SB-9 in order to classify site soils and measure the laboratory coefficient of permeability. Permeability test results on undisturbed soils are presented in Table 7. The results indicated that the more clayey and silty soils are relatively impermeable. ($K = 9.6 \times 10^{-7}$ to 1.7×10^{-6} cm/sec). The more sandy materials that classify as SM are more permeable ($K = 2.3 \times 10^{-4}$ to 1.3×10^{-5} cm/sec).

7.3 Clay Borrow Results

The clay borrow investigation consisted of collecting 9, five-gallon soil samples from 16 test pits spread across the proposed landfill site. Soil samples were taken at depths ranging from 0.5 to 8.5 feet. Grain size analysis and Atterberg Limits were performed on each of the 14 soil samples collected from the test pits. The results of test pit sampling are summarized in Table 8.

Soil samples from the test pits were composited based on the soil classification. Modified Proctor curves were then prepared on the composited samples to determine the optimum moisture and density of each soil group. Permeability tests were also performed on each of the recompacted composite samples. The moisture contents of the composite permeability samples were varied from 0 to 5 percent above the optimum moisture content in order to determine the effect on the permeability of the samples. The results of this analysis are presented in Table 9.

Recompacted soils classified as CL and SC achieved maximum permeabilities ranging between 1.9×10^{-8} and 5×10^{-8} cm/sec. This permeability exceeds the desired liner permeability requirements of 1×10^{-7} cm/sec. Based on the results of the permeability tests, the CL and SC soils compacted to a density of approximately 90 percent Modified Proctor or greater, and placed at a moisture content greater than the optimum moisture content, should achieve a desirable permeability for a liner or barrier layer.

TABLE 7

WEYERHAEUSER CO.
PLYMOUTH, NORTH CAROLINA

Soil Summary

Sample Location	Depth (feet)	Permeability Moisture (%)	P-200 (%)	Placity Index (%)	Classification	Permeability (cm/s)
MW-1A	22-24	36.7	88.8	14	ML	1.7×10^{-6}
MW-8	2-4	24.9	65.6	20	CL	2.4×10^{-6}
MW-8	20-22	35.4	89.7	24	CH	4.7×10^{-6}
OW-1	4-6 8-10 20-22	25.7 31.1 38.5	61.4 33.1 88.7	17 NP 20	CL SM MH	9.6×10^{-7} 1.3×10^{-5} 2.5×10^{-6}
OW-2	13-15	33.3	60.0	16	CL	1.1×10^{-7}
OW-3	9-11	24.9	62.5	19	CL	1.7×10^{-7}
OW-3	15-16.5	16.1	15.1	NP	SM	2.3×10^{-4}
SB-9	18-20	19.6	33.6	NP	SC-SM	4.4×10^{-6}

NP - Non Plastic

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TABLE 8

WEYERHAEUSER CO.
PLYMOUTH, NORTH CAROLINA

Summary of Index Test Results

Sample Number	Sample Depth		Water content Percent	P-200 (Percent)	Atterberg Limits			Classification
	Top (ft)	Bottom (ft)			Liquid Limit	Plastic Limit	Plastic Index	
TP 1-3	1.1	2.6	25.6	77.9	55.0	25.0	30	CH
TP 2-5	6	6.5	19.7	24.2	--*	--	--	SC-SM
TP 4-2	4.5	5.2	19.9	44.5	35.0	18.0	17.0	SC
TP 6-1	8	9	14.0	15.5	--	--	--	SM
TP 7-1	6	6.5	26.4	55.3	40	19	21	CL
TP 8-1	5	6	23.8	63.9	43	21	22	CL
TP 8-3	8	8.5	8.1	7.0	--	--	--	SP-SM
TP 9-2	2.7	3	18.7	38.9	27.0	16.0	11.0	SC
TP 9-3	4	5	20.3	39.4	26.0	18.0	8.0	SC
TP 10-2	3	5	19.3	37.4	28.0	16.0	12.0	SC
TP 11-1	1.8	4	17.5	42.8	29.0	16.0	13.0	SC
TP 11-2	5.5	7	15.8	10.8	--	--	--	SP-SM
TP 14-3	6.5	7	27.1	56.9	35.0	17.0	18.0	CL
TP 16-1	0.4	1.8	25.2	66.0	48.0	22.0	26.0	CL

* - Nonplastic

wp\4\46742.tbl\cdf90

TABLE 9

WEYERHAEUSER CO.
PLYMOUTH, NORTH CAROLINA

Hydraulic Conductivity
Test Results

Sample	Composite Source	Maximum Modified Dry Density (PCF)	Optimum Moisture Content (%)	Percent Compaction (%)	Percent Above Optimum Moisture (%)	Hydraulic Conductivity (cm/s)
TP1-3	TP1-3	112.7	17.2	89.4	-0.5	1.1×10^{-7}
				90.2	+3.9	1.1×10^{-8}
Composite 1	TP9-3, 10-2, and 11-1	122.8	11.1	89.6	-0.2	3.5×10^{-8}
				89.2	+2.9	1.1×10^{-5}
				89.3	+5.8	2.8×10^{-8}
Composite 2	TP4-2, 14-3	119.4	13.2	88.6	+1.0	5.6×10^{-6}
				89.7	+4.6	1.9×10^{-8}
Composite 3	TP7-1, 8-1	117.3	13.5	89.3	+0.1	2.3×10^{-7}
				88.9	+5.3	5.0×10^{-6}

7.4 Shear Strength

The shear strength of the subgrade soils will be a factor in evaluating the embankment stability of the landfill. Shear strength testing was not performed as part of this investigation since the borings indicated soil conditions that are similar to those investigated for the adjacent landfill vertical expansion (RMT report dated September 28, 1989). Based on the shear strength testing performed as part of that investigation, RMT recommends the following estimates for drained, shear strength:

- Sands, silty sands (SP, SM), loose to medium compact, $\emptyset = 30°$, $C = 0$.
- Clayey sands, clayey silts, silty clay (SC, ML, CL), $\emptyset = 25°$, $C = 200$ psf.

Section 8
IMPLICATIONS FOR LANDFILL DESIGN

As discussed in Section 7, the near surface sands, silts and interbedded clay layers, and the underlying clay layer encountered at 20 feet, are not excessively compressible, and have good shear strength or subgrade support properties. These results indicate that the site has favorable soil conditions for the construction and support of the proposed landfill.

A major consideration for the design and operation of a landfill is the shallow ground water characteristics indicated in the wells and test pits. The depth to ground water from the ground surface varied from four to eighteen feet below the ground surface, and generally conformed to the surface topography. Thus, the presence of shallow ground water will complicate the construction of a landfill where the design calls for excavations greater than four feet (depending on the location on the site). The following presentation and discussion outlines the opportunities and implications of both a shallow design and a deeper landfill excavation design.

8.1 Subgrade Support

The soil borings indicate that the upper fifteen feet of surface sand, silt, and clay layers generally had N-values of six to ten blows or more. This indicates a loose to medium compact soil. The landfill bottom is anticipated to be situated in these soils. Based on RMT experience, these soils will generally provide adequate subgrade support for berms and embankments associated with the landfill, as well as support for construction equipment used during landfill excavation. Based on the strength parameters presented in Section 7, RMT recommends that an embankment stability analysis be performed once the landfill geometry (height, slopes, grades)is developed.

A second issue related to subgrade support is settlement. Excessive differential settlement is undesirable because it would result in warping and damage to any leachate collection system. Settlement of the landfill is composed of 1) the compression of the underlying soils due to the weight of the fill, and 2) the compression of the fill itself caused by its own weight. The test borings and wells did not indicate the presence of any soft compressible, thick clays that would cause excessive settlement. The thick, clay layer encountered at approximately 20 feet, was tested and found to be over-consolidated and relatively incompressible. Loose to medium compact sands and silts are generally not that compressible. Therefore, the data indicate that settlement caused by the weight of

a landfill would be tolerable (within the range of normal landfill design). Once the height and geometry of the landfill is determined, maximum, minimum, and differential settlements should be calculated (based on data presented in Section 7) to aid in the design of a leachate collection system.

Some very loose or soft near-surface soil layers were encountered. In general, these soil conditions did not predominate. RMT does not anticipate that these soil conditions will adversely affect the bearing capacity or settlement of the underlying sub-soils for support of the landfill. However, if soft or very loose soil conditions were encountered at construction levels, they would likely not support construction equipment and would need to be undercut and replaced locally.

8.2 Landfill Design Options

As discussed in Section 6, two aquifers were identified on the site. Shallow ground water was encountered at depths of four to eighteen feet below the ground surface. A second, deeper, aquifer was encountered at elevations of fifteen to ten feet MSL.

8.2.1 At-grade Design Option

In a shallow design, the bottom elevation of the landfill would be established several feet above the seasonal high water table. If the shallow option is selected, the civil design should anticipate the need for local dewatering at the bottom of the excavation. This could be accomplished by trenches, french drains, or pumping from sumps in the excavation where shallow ground water is encountered.

The landfill design should also include ground water control systems to accommodate fluctuations in the water table. These systems should not be designed to keep water out, but to control ground water flow by drainage methods. Such methods could include perimeter, open drainage ditches, and interior drainage trenches with pipes and grated, protective filters.

8.2.2 Deep Excavation Design Option

A ground water dewatering and control system would be needed to place the landfill in a deeper excavation. One way to accomplish this dewatering system would be to intercept the shallow ground water table on the upgradient side of the site by using either well points or a deep perimeter trench.

Well points, although relatively easy to install, would probably not be workable in the silty and clay layers that were encountered in the borings on this site. Well points work the best in clean sands, but tend to choke off in the "dirtier" sands containing silt and clay.

If a deep perimeter trench is selected, the engineering design should call for construction in such a manner that the trench would always drain by gravity to the creek. The trench could possibly be designed so that it would serve as the perimeter edge of the initial cells. Once the trench was constructed, permanent dewatering could be installed prior to the installation of any liner materials.

If the deeper excavation is selected, RMT recommends that a detailed dewatering analysis be prepared. The analysis should include a flow model that would predict dewatering flow rates under steady state conditions. The sequencing of the dewatering and excavation will be critical. The plan should address:

1. A construction phasing and methods to accomplish the dewatering scheme .
2. A permanent dewatering design.
3. The additional costs of dewatering.

8.3 Liner

Atterberg testing and permeability testing indicate that the shallow soils contain strata with sufficient amounts of finer material (silts and clays) to be considered for usage as relatively impermeable natural soil liners and cap material. The hydraulic conductivity test results show that permeabilities of 5.0×10^{-8} centimeters per second were achieved with the CL and ML soils, when compacted to 88 percent to 90 percent of Modified Proctor and at a moisture content 4 - 5 percent above the optimum.

A problem with use of on-site clay and silty soils is that the thickness and continuity of the clay layers is not uniform across the site. A few sample locations, such as test pit #6, did not exhibit any clay or silt layers. Also, the clay layers are interspersed with more sandy layers that would be less suitable for liner or cap material. It may prove to be difficult to sort these clays in the field. However, from a cost point of view, it would be desirable for Weyerhaeuser to use these clay soils where practical. Therefore, it is suggested that a strategy for usage of the relatively impermeable, natural on-site soils be as follows:

1. General excavation of the site should be carefully monitored (under the direction of a geotechnical engineer) by a full-time soils technician experienced with the USCS classification system. The technician would classify the soil as it was excavated and segregate the clay and silty soils from the sandy soils.

2. Construction of liner with on-site soils should be monitored carefully and performance tested to confirm that the desired permeability is achieved.

3. An alternate source of low permeability clay of sufficient quantity should be identified.

4. If the installation with on-site ML/CL soils does not achieve the desired permeability, or if quantities are insufficient, then the alternate source would be utilized.

This approach would utilize on-site materials to their best advantage, but would provide an alternative if on-site soils proved to be inadequate.

The monitoring of liner material is a critical aspect. Placement and compaction need to be carefully observed and conformance tests should be performed. RMT recommends that a test series include field Atterberg Limits and compaction. Test frequency should be one test per 20,000 feet^2 per lift. Permeability tests and grain size tests should be performed on samples from the in-place liner at least every 100,000 feet^2 per lift or when materials change substantially. Compaction requirements for the liner should be established at 95 percent Standard Proctor and at least 4 percent greater than optimum moisture content.

Since the quantities of on-site material suitable for liner construction are not assured, RMT recommends that an alternate borrow material be identified and confirmed for quantity and performance (compaction, Atterberg Limits, grain size, and permeability).

An alternate liner material may include the addition of bentonite clay to the on-site silty sand (SM) soils. This is accomplished by blending the bentonite with the natural soils by either spreading and discing, or by a pug mill operation. Generally, three to five percent by dry weight bentonite added to a soil will achieve acceptable permeabilities for most soil liners.

8.4 Excavation and Grading

RMT recommends that the top soil generally present on the site be excavated and stock-piled for future use as vegetative cover.

The natural sandy, silty, and clay soils encountered throughout the upper fifteen feet will be useful for embankment construction. RMT recommends that earthwork design be based on embankment slopes of 3:1. RMT further recommends that natural soils be compacted at 95 percent of Standard Proctor at plus or minus 3 percent of optimum for use as structural compacted fill and embankments. Compacted backfill should be placed in loose lifts not exceeding nine inches, and then compacted with multiple passes of a sheepsfoot roller. RMT recommends that compaction or density tests be performed every 10,000 square feet per lift to ensure that proper compaction is achieved.

Natural site soils removed from below the ground water level may be somewhat wetter than optimum moister content for compaction. They likely will need to be dried prior to usage as compacted fill. Natural sandy soils will probably dry upon gravity drainage in stock piles. However, finer-grained soils will likely require dewatering by mechanical aeration, such as discing and air drying.

Materials that were encountered in the backhoe test pits and soil borings are amenable to conventional excavation methods such as scrapers, dozers, backhoes, and drag lines.

Soils will tend to pump under heavy equipment when excavation grade gets to within two feet or less of the ground water table. Traffic will tend to increase this problem. Typically, drainage trenches are installed to lower the ground water level in the area of construction. In areas of relatively loose soil conditions, soil may need to be undercut and replaced with compacted backfill in order to operate heavy construction equipment.

Excavation slopes should be maintained at approximately 3:1 horizontal to vertical. Excavation slopes of 3:1 that lie below the ground water level prior to dewatering may not be stable, and some sloughing may occur. Slopes that are above the ground water table, either naturally or after dewatering, will probably be stable a slopes steeper than 3:1. Once a grading plan is developed, RMT recommends that a stability analysis be performed for those excavated slopes planned for steeper than 3:1, or deeper than twenty feet.

APPENDIX A

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LOG OF TEST BORING REFERENCE SHEET

SAMPLE TYPES

SS	Split Spoon
UD	Undisturbed
AU	Auger
BULK	Bulk
RC	Rock Cuttings

PENETRATION RESISTANCE

SANDS	
0 - 4	Very Loose
5 - 10	Loose
11 - 20	Firm
21 - 30	Very Firm
31 - 50	Dense
Over 50	Very Dense

SILTS & CLAYS	
0 - 2	Very Soft
3 - 4	Soft
5 - 8	Firm
9 - 15	Stiff
16 - 30	Very Stiff
Over 30	Hard

VISUAL CLASSIFICATION OF SOILS

- GRAVEL, WELL GRADED; POORLY SORTED (GW)
- GRAVEL, POORLY GRADED; WELL SORTED (GP)
- SILTY GRAVELS (GM)
- CLAYEY GRAVEL (GC)
- SAND, WELL GRADED; POORLY SORTED (SW)
- SAND, POORLY GRADED; WELL SORTED (SP)
- SILTY SAND (SM)
- CLAYEY SAND (SC)
- INORGANIC SILTS WITH SLIGHT PLASTICITY (ML)
- CLAYS--INORGANIC; LOW TO MEDIUM PLASTICITY (CL)
- CLAY, HIGH PLASTICITY (CH)
- INORGANIC SILTS WITH ELASTICITY (MH)
- PEAT--ORGANIC SOILS (PT)
- SLUDGE (FILL)
- WASTE AND/OR TRASH (AF)
- NO DESCRIPTION

STANDARD PENETRATION TEST

4-7-6	blows of hammer required to drive sample tube, 6" intervals
WOH	weight of hammer

WATER LEVEL OBSERVATIONS

WHILE DRILLING ▽

AT COMPLETION ▼

VISUAL CLASSIFICATION OF ROCK TYPES

- SHALE (SHALE)
- LIMESTONE (LIME)
- DOLOMITE (DOLO)
- GNEISS (GNEISS)
- SCHIST (SCH)

RMT INC.

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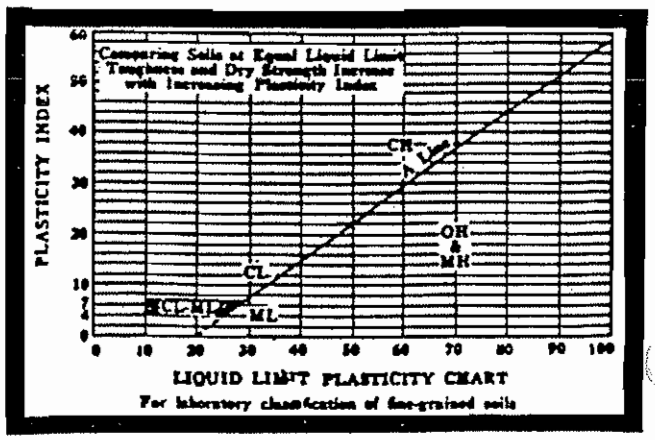
UNIFIED SOIL CLASSIFICATION SYSTEM

Major Divisions			Group Symbols	Typical Names	Field Identification Procedures (Excluding particles larger than 3 inches and basing fractions on estimated weights)			Information Required for Describing Soils
1	2		3	4	5			6
Coarse-grained Soils: More than half of material is larger than No. 200 sieve size. The No. 200 sieve size is about the smallest particle visible to the naked eye.	Gravels: More than half of coarse fraction is larger than No. 4 sieve size. (For visual classification, the ¼-in. size may be used as equivalent to the No. 4 sieve size)	Clean Gravels (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines.	Wide range in grain sizes and substantial amounts of all intermediate particle sizes.			For undisturbed soils add information on stratification, degree of compactness, cementation, moisture conditions and drainage characteristics.
			GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines.	Predominantly one size or a range of sizes with some intermediate sizes missing.			
		Gravels with Fines (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures.	Nonplastic fines or fines with low plasticity. (for identification procedures see ML below)			Give typical name; indicate approximate percentages of sand and gravel, max. size; angularity, surface condition, and hardness of the coarse grains; local or geologic name and other pertinent descriptive information; and symbol in parentheses.
			GC	Clayey gravels, gravel-sand-clay mixtures.	Plastic fines (for identification procedures see CL below).			
	Sands: More than half of coarse fraction is smaller than No. 4 sieve size. (For visual classification, the ¼-in. size may be used as equivalent to the No. 4 sieve size)	Clean Sands (Little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines.	Wide range in grain sizes and substantial amounts of all intermediate particle sizes.			
			SP	Poorly-graded sands, gravelly sands, little or no fines.	Predominantly one size or a range of sizes with some intermediate sizes missing.			
		Sands with Fines (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures.	Nonplastic fines or fines with low plasticity. (for identification procedures see ML below)			Example: Silty sand, gravelly; about 20% hard, angular gravel particles ½-in. maximum size; rounded and subangular sand grains coarse to fine; about 15% nonplastic fines with low dry strength; well compacted and moist in place; alluvial sand; (SM).
			SC	Clayey sands, sand-clay mixtures.	Plastic fines (for identification procedures see CL below).			
Fine-grained Soils: More than half of material is smaller than No. 200 sieve size. The No. 200 sieve size is about the smallest particle visible to the naked eye.	Silts and Clays: Liquid limit less than 50				Identification Procedures on Fraction Smaller than No. 40 Sieve Size			
					Dry Strength (Crushing characteristics)	Dilatancy (Reaction to shaking)	Toughness (Consistency near PL)	
			ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.	None to slight	Quick to slow	None	Give typical name, indicate degree and character of plasticity, amount and maximum size of coarse grains, color in wet condition, odor if any, local or geologic name, and other pertinent descriptive information; and symbol in parentheses.
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.	Medium to high	None to very slow	Medium	
			OL	Organic silts and organic silty clays of low plasticity.	Slight to medium	Slow	Slight	For undisturbed soils add information on structure, stratification, consistency in undisturbed and remolded states, moisture and drainage conditions.
	Silts and Clays: Liquid limit greater than 50		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.	Slight to medium	Slow to none	Slight to medium	
			CH	Inorganic clays of high plasticity, fat clays.	High to very high	None	High	
			OH	Organic clays of medium to high plasticity, organic silts.	Medium to high	None to very slow	Slight to medium	Example: Clayey silt, brown, slightly plastic, small percentage of fine sand, numerous vertical root holes, firm and dry in place, loess, (ML).
Highly Organic Soils			Pt	Peat and other highly organic soils.	Readily identified by color, odor, spongy feel and frequently by fibrous texture.			

Component	Size Range
Cobbles	Above 3 in.
Gravel	3 in. to No. 4 sieve
Coarse gravel	3 in. to ¾ in.
Fine gravel	¾ in. to No. 4 sieve
Sand	No. 4 to No. 200
Coarse	No. 4 to No. 10
Medium	No. 10 to No. 40
Fine	No. 40 to No. 200
Fines (silt or clay)	Below No. 200 sieve



LIQUID LIMIT PLASTICITY CHART
For laboratory classification of fine-grained soils

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LOG OF TEST BORING REFERENCE SHEET

SAMPLE TYPES

SS	Split Spoon
UD	Undisturbed
AU	Auger
BULK	Bulk
RC	Rock Cuttings

PENETRATION RESISTANCE

SANDS

0 - 4	Very Loose
5 - 10	Loose
11 - 20	Firm
21 - 30	Very Firm
31 - 50	Dense
Over 50	Very Dense

SILTS & CLAYS

0 - 2	Very Soft
3 - 4	Soft
5 - 8	Firm
9 - 15	Stiff
16 - 30	Very Stiff
Over 30	Hard

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Major Divisions			Group Symbols	Typical Names	Field Identification Procedures (Excluding particles larger than 3 inches and basing fractions on estimated weights)			Information Required for Describing Soils
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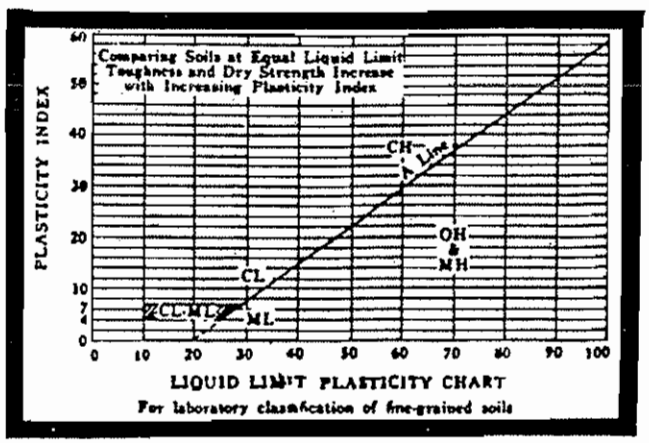
			GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines.	Predominantly one size or a range of sizes with some intermediate sizes missing.			
		Gravels with Fines (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures.	Nonplastic fines or fines with low plasticity. (for identification procedures see ML below)			Give typical name; indicate approximate percentages of sand and gravel, max. size; angularity, surface condition, and hardness of the coarse grains; local or geologic name and other pertinent descriptive information; and symbol in parentheses.
			GC	Clayey gravels, gravel-sand-clay mixtures.	Plastic fines (for identification procedures see CL below).			
	Sands. More than half of coarse fraction is smaller than No. 4 sieve size.	Clean Sands (Little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines.	Wide range in grain sizes and substantial amounts of all intermediate particle sizes.			
			SP	Poorly-graded sands, gravelly sands, little or no fines.	Predominantly one size or a range of sizes with some intermediate sizes missing.			Example: Silty sand, gravelly; about 20% hard, angular gravel particles ½-in. maximum size; rounded and subangular sand grains coarse to fine; about 15% nonplastic fines with low dry strength; well compacted and moist in place; alluvial sand; (SM).
		Sands with Fines (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures.	Nonplastic fines or fines with low plasticity. (for identification procedures see ML below)			
			SC	Clayey sands, sand-clay mixtures.	Plastic fines (for identification procedures see CL below).			
Fine-grained Soils. More than half of material is smaller than No. 200 sieve size.	Silts and Clays. Liquid limit less than 50				Identification Procedures on Fraction Smaller than No. 40 Sieve Size			
					Dry Strength (Crushing characteristics)	Dilatancy (Reaction to shaking)	Toughness (Consistency near PL)	
			ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.	None to slight	Quick to slow	None	Give typical name, indicate degree and character of plasticity, amount and maximum size of coarse grains, color in wet condition, odor if any, local or geologic name, and other pertinent descriptive information; and symbol in parentheses.
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.	Medium to high	None to very slow	Medium	
			OL	Organic silts and organic silty clays of low plasticity.	Slight to medium	Slow	Slight	
	Silts and Clays. Liquid limit greater than 50		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.	Slight to medium	Slow to none	Slight to medium	For undisturbed soils add information on structure, stratification, consistency in undisturbed and remolded states, moisture and drainage conditions.
			CH	Inorganic clays of high plasticity, fat clays.	High to very high	None	High	
			OH	Organic clays of medium to high plasticity, organic silts.	Medium to high	None to very slow	Slight to medium	Example: Clayey silt, brown, slightly plastic, small percentage of fine sand, numerous vertical root holes, firm and dry in place, loess, (ML).
Highly Organic Soils			Pt	Peat and other highly organic soils.	Readily identified by color, odor, spongy feel and frequently by fibrous texture.			

Component	Size Range
Cobbles	Above 3 in.
Gravel	3 in. to No. 4 sieve
Coarse gravel	3 in. to ¾ in.
Fine gravel	¾ in. to No. 4 sieve
Sand	No. 4 to No. 200
Coarse	No. 4 to No. 10
Medium	No. 10 to No. 40
Fine	No. 40 to No. 200
Fines (silt or clay)	Below No. 200 sieve



LIQUID LIMIT PLASTICITY CHART

For laboratory classification of fine-grained soils

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. SB-5
SHEET NO. 1 OF 1
PROJECT NO. 467.42
INSTALLATION
SURFACE ELEV. 30.5
BOREHOLE DIA. 6 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	3-3-4-4	50			CLAY (CL) - stiff; trace sand (fine grained); tan, orange; interbedded with SILTY SAND (SM); clayey; tan, orange.
2	SS	4-4-6-5	50			SILTY SAND (SM) - fine grained; trace clay; tan. 4.0
3	SS	5-4-4-4	65		5	SILT (ML) - as determined from laboratory analysis.
4	SS	1-1-2-3	85			SILTY SAND (SM) - fine grained; some clay laminae (gray); tan, orange.
5	SS	3-5-4-3	100			- no clay. 10.0
6	SS	2-1-2-3	60		10	SILTY SAND (SM) - fine grained; trace clay; gray.
7	SS	1-1-1-1	90			
8	SS	WOH 3-3	100		15	15.0
9	SS	3-4-4-5	100			SILTY CLAY (CL) - stiff; micaceous; blue gray.
10	SS	2-3-4-5	90			
						BORING TERMINATED AT 20.0 FEET

GENERAL NOTES

DATE STARTED 26 APR 90
DATE COMPLETED 26 APR 90
RIG MOBILE B-56
CREW CHIEF TODD JOHNSON
LOGGED BTG CHECKED

WATER LEVEL OBSERVATIONS

WHILE DRILLING ▽ 8.0 FT. BGS
AT COMPLETION ▼
AFTER DRILLING
CAVE-IN: DATE/TIME DEPTH
WATER: DATE/TIME 4-26-90/1230 DEPTH 4.5 FT. BGS

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. SB-6
SHEET NO. 1 OF 1
PROJECT NO. 467.42
INSTALLATION
SURFACE ELEV. 37.2
BOREHOLE DIA. 6 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	1-2-2-4	85			SILTY SAND (SM) - fine grained; humic dark gray. .7
2	SS	3-4-5-6	75			SILTY SAND (SM) - fine grained; light gray. SILTY SAND (SM) - fine grained; clayey; orange; light gray mottling.
3	SS	3-4-4-4	70		▽ 5	CLAYEY SAND (SC) - fine grained; firm; color as above. 5.0
4	SS	5-3-2-5	0			SILTY SAND (SM) - fine grained; gray.
5	SS	1-4-3-2	10			
6	SS	2-2-9-14	75		10	SILTY SAND (SM) - fine grained; clayey; light gray and orange mottled. 11.0
7	SS	5-10-10-8	70			SILTY SAND (SM) - fine to medium grained; some shell fragments; orange, gray.
8	SS	3-4-3-2	75		15	- trace clay; 15.0-15.5 ft.
9	SS	1-2-2-3	85			SILTY SAND (SM) - fine grained; clayey in some zones; dark gray, brown at base.
10	SS	7-14-15-12	75			SILTY SAND (SM) - fine to medium grained; trace clay; gray, tan.
						BORING TERMINATED AT 20.0 FEET

GENERAL NOTES

DATE STARTED 26 APR 90
DATE COMPLETED 29 APR 90
RIG MOBILE B-56
CREW CHIEF TODD JOHNSON
LOGGED BTG CHECKED

WATER LEVEL OBSERVATIONS

WHILE DRILLING ▽ 5.0 FT. BGS
AT COMPLETION ▼
AFTER DRILLING
CAVE-IN: DATE/TIME DEPTH
WATER: DATE/TIME DEPTH

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. SB-7
SHEET NO. 1 OF 2
PROJECT NO. 467.42
INSTALLATION
SURFACE ELEV. 38.4
BOREHOLE DIA. 6 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	2-3-3-3	75			SILTY SAND (SM) - fine grained; brown, tan. - some clay; 1.1 - 1.45 ft.
2	SS	3-4-4-6	85			CLAY (CL) - sandy (very fine grained); tan. 2.5
3	SS	5-3-3-4	95		5	CLAYEY SAND (SC) - fine grained; mottled gray and tan. 4.0
4	SS	3-1-2-4	85			SILTY SAND (SM) - fine grained; trace clay; tan and gray mottled. - clayey; gray; 5.3-6.0 ft. - CLAY (CL); 7.2-7.5 ft.
5	SS	3-3-3-1	75			- wet; 8.0 ft.
6	SS	5-8-16-19	100		10	11.1
7	SS	2-3-7-10	85			SILTY SAND (SM) - fine grained; trace shell fragments; tan and gray mottled.
8	SS	3-2-1-1	100		15	- no shell fragments; tan; 15.5-15.9 ft. 15.9
9	SS	WOH 2-2	100			CLAYEY SAND (SC) - fine grained; gray; some clay. 16.5
10	SS	1-2-2-2	100			CLAY (CH) - dark gray; with SAND (SP)/SILTY SAND (SM); fine to medium grained 17.2-18.0 ft. 18.8
						CLAYEY SAND (SC) - fine to medium grained; dark

GENERAL NOTES

DATE STARTED 17 APR 90
DATE COMPLETED 17 APR 90
RIG MOBILE B-56
CREW CHIEF TODD JOHNSON
LOGGED BTG CHECKED

WATER LEVEL OBSERVATIONS

WHILE DRILLING ▽ 8.0 FT. BGS
AT COMPLETION ▼ 5.0 FT. BGS
AFTER DRILLING
CAVE-IN: DATE/TIME DEPTH
WATER: DATE/TIME 4-26-90/1305 DEPTH 4.5 FT. BGS

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. SB-7
SHEET NO. 2 OF 2
PROJECT NAME WEYERHAEUSER
PROJECT NO. 467.42
LOCATION PLYMOUTH, NC
INSTALLATION
CONTRACTOR LAW ENGINEERING
SURFACE ELEV. 38.4
DRILLING METHOD HSA
BOREHOLE DIA. 6 IN.

SAMPLING NOTES						VISUAL CLASSIFICATION AND GENERAL OBSERVATIONS
INTERVAL		RECOVERY		MOISTURE		
NO.	TYPE	BLOWS			DEPTH	
						gray; some organics 19.5-20.0 ft.
						BORING TERMINATED AT 20.0 FEET
					25	
					30	
					35	
					40	

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. SB-8
SHEET NO. 1 OF 2

PROJECT NAME WEYERHAEUSER
PROJECT NO. 467.42
LOCATION PLYMOUTH, NC
INSTALLATION
CONTRACTOR LAW ENGINEERING
SURFACE ELEV. 39.9
DRILLING METHOD HSA
BOREHOLE DIA. 6 IN.

SAMPLING NOTES						VISUAL CLASSIFICATION AND GENERAL OBSERVATIONS
INTERVAL		RECOVERY	MOISTURE			
NO.	TYPE	BLOWS			DEPTH	
1	SS	4-3-3-3	85			SILTY SAND (SM) - fine grained; gray; humic 0-.3 ft.
2	SS	3-4-3-4	85			
3	SS	5-6-4-4	85		5	SILTY SAND (SM) - fine grained; some clay; mottled white, tan, gray; with interbedded CLAYEY SAND (SC); fine grained; gray.
4	SS	4-5-7-7	95			
5	SS	3-4-5-6	90			
6	SS	3-2-2-2	100	▽	10	SILTY SAND (SM) - fine grained; gray.
7	SS	3-3-5-6	75			- fine to medium grained; with some CLAYEY SAND (SC); mottled tan and light gray; 12.8-16.0 ft.
8	SS	5-6-11-9	100		15	16.0
9	SS	11-3-2-3	100			SILTY SAND (SM) - fine to medium grained; trace clay; dark gray, tan. 18.0
10	SS	WOH-1-2-2	100			SAND (SP) - fine to coarse grained; tan. 18.5 SAND (SM) - fine grained; some clay; dark gray; with SILTY CLAY (CL); stiff; trace sand (fine grained); gray; 19.75-20.2 ft.

GENERAL NOTES

DATE STARTED 17 APR 90
DATE COMPLETED 17 APR 90
RIG MOBILE B-56
CREW CHIEF TODD JOHNSON
LOGGED BTG CHECKED

WATER LEVEL OBSERVATIONS

WHILE DRILLING ▽ 10.5 FT. BGS
AT COMPLETION ▼
AFTER DRILLING
CAVE-IN: DATE/TIME DEPTH
WATER: DATE/TIME 4-26-90/1235 DEPTH 12.0 FT. BGS

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. SB-8
SHEET NO. 2 OF 2
PROJECT NAME WEYERHAEUSER
PROJECT NO. 467.42
LOCATION PLYMOUTH, NC
INSTALLATION
CONTRACTOR LAW ENGINEERING
SURFACE ELEV. 39.9
DRILLING METHOD HSA
BOREHOLE DIA. 6 IN.

SAMPLING NOTES						VISUAL CLASSIFICATION AND GENERAL OBSERVATIONS
INTERVAL		RECOVERY		MOISTURE		
NO.	TYPE	BLOWS			DEPTH	
						BORING TERMINATED AT 20.2 FEET
					25	
					30	
					35	
					40	

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. SB-9
SHEET NO. 1 OF 1

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

PROJECT NO. 467.42
INSTALLATION
SURFACE ELEV. 37.7
BOREHOLE DIA. 6 IN.

SAMPLING NOTES						VISUAL CLASSIFICATION AND GENERAL OBSERVATIONS
INTERVAL		RECOVERY		MOISTURE		
NO.	TYPE	BLOWS			DEPTH	
1	SS	1-2-2-3	60			SILTY SAND (SM) - fine grained; light brown; some humus.
2	SS	4-4-5-5	65			SILTY SAND (SM) - fine grained; clayey; orange.
3	SS	4-4-6-5	60		5	CLAYEY SAND (SC) - fine grained; tan; orange and gray mottling; CLAY (CL); 4.0-4.5 ft.; and 6.0-6.7 ft.; color as above.
4	SS	4-9-13-10	85			6.7 SILTY SAND (SM) - fine grained; tan; tan and gray mottled.
5	SS	5-5-5-4	65			
6	SS	4-4-4-5	65		10	
7	SS	3-5-4-5	90			
8	SS	2-1-1-WOH	100		15	- increased clay 15.0
9	SS	WOH-2-2	100			SILTY CLAY (CL) - soft; wet; dark gray; trace sand (fine grained); 15.9-16.0 ft. 17.2
10	UD		100			SILTY CLAY (CL) - trace fine grained sand; orange; gray; micaceous; gray; blue green at 18.0 ft.
						SILTY SAND (SM) - fine grained; purple gray. BORING TERMINATED AT 20.0 FEET

GENERAL NOTES

DATE STARTED 26 APR 90
DATE COMPLETED 26 APR 90
RIG MOBILE B-56
CREW CHIEF TODD JOHNSON
LOGGED BTG CHECKED

WATER LEVEL OBSERVATIONS

WHILE DRILLING ▽ 12.0 FT. BGS
AT COMPLETION ▼
AFTER DRILLING
CAVE-IN: DATE/TIME DEPTH
WATER: DATE/TIME 4-26-90/1235 DEPTH 13.0 FT. BGS

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. OW-1
SHEET NO. 1 OF 3
PROJECT NO. 467.42
INSTALLATION
SURFACE ELEV. 34.5
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	
1	SS	4-6-6-6	50			SILT (ML) - some very fine sand; brown. .5
						CLAY (CL) - trace fine grained sand; stiff; tan.
2	UD		0			CLAY (CL) - sandy (fine grained); silty; tan, gray, orange.
						- Increasing sand.
3	UD		100		5	6.0
4	SS	2-2-3-4	75			SILTY SAND (SM) - fine grained; trace clay; interlaminated gray and orange.
5	UD		65			- interlaminated with silty clay; micaceous; gray.
					10	- gray
6	SS	4-3-10-18	75			- more clayey
					15	- fine to medium grained; gray
7	SS	9-4-2-2	50			17.8
						SILTY SAND (SM) - as above, interbedded with CLAY (CL); silty; stiff; slightly micaceous; blue green and tan.
8	SS	3-4	100			SILTY CLAY (CL) - stiff; slightly micaceous; blue

GENERAL NOTES

DATE STARTED 20 APR 90
DATE COMPLETED 21 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 5-4-90/1120 DEPTH 23.85 FT. BGS

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. OW-1
SHEET NO. 2 OF 3

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

PROJECT NO. 467.42
INSTALLATION
SURFACE ELEV. 34.5
BOREHOLE DIA. 10 IN.

SAMPLING NOTES						VISUAL CLASSIFICATION AND GENERAL OBSERVATIONS
INTERVAL		RECOVERY	MOISTURE			
NO.	TYPE	BLOWS			DEPTH	
9	UD		100			green, tan.
						SILT (MH) - as determined from laboratory analysis.
					25	
10	SS	33-5-6-6	85			Change to 5 7/8 in. bit at 21.5 ft.
11	SS	3-3-4-6	100			
					30	
12	SS	4-4-4-5	100			
13	SS	3-4-4-6	100			SILTY CLAY (CL) - as above; with trace fine grained sand.
					35	
						SILTY SAND (SM) - fine grained; gray. 37.3
14	SS	23-43-47-54	50			SILTY SAND (SM) - fine to medium grained; trace coarse grained sand; laminated; tan; trace shell fragments.
					40	

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. OW-1
SHEET NO. 3 OF 3
PROJECT NO. 467.42
INSTALLATION
SURFACE ELEV. 34.5
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	
15	SS	28-32-41-52	65		45	
						BORING TERMINATED AT 47.0 FEET
					50	
					55	
					60	
					65	

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. OW-2
SHEET NO. 1 OF 2

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

PROJECT NO. 467.42
INSTALLATION
SURFACE ELEV. 32.1
BOREHOLE DIA. 10 IN.

SAMPLING NOTES						VISUAL CLASSIFICATION AND GENERAL OBSERVATIONS
INTERVAL		RECOVERY		MOISTURE		
NO.	TYPE	BLOWS			DEPTH	
1	SS	2-1-1-1	75			SILTY SAND (SM) - fine grained; gray, black; humic. .5
2	SS	3-2-2-4	90			SILTY SAND (SM) - fine grained; tan. SILTY SAND (SM) - fine grained; clayey; mottled tan and gray. 4.0
3	SS	1-4-3-2	100		5	SILTY SAND (SM) - as above; trace clay.
4	SS	2-2-1-1	100			7.5
5	SS	WOH-1	90		10	CLAY (CL) - trace sand (fine grained); soft; dark gray; interbedded with CLAYEY SAND (SC); dark gray; fine grained.
6	UD		100			15.0
7	SS	12-8-4-4	50		15	SILTY SAND (SM) - fine grained; gray and tan. CLAYEY SAND (SC) - fine grained; slightly micaceous; light gray; interlaminated with SILTY SAND (SM); fine grained; orange-brown, tan.

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 ▽ 3.3 FT.
AT COMPLETION ▼
AFTER DRILLING
CAVE-IN: DATE/TIME DEPTH
WATER: DATE/TIME 5-3-90 DEPTH 5.95 FT. BGS

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. OW-2
SHEET NO. 2 OF 2
PROJECT NO. 467.42
INSTALLATION
SURFACE ELEV. 32.1
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	4-2-4-5	100			
						BORING TERMINATED AT 22.0 FEET
					25	
					30	
					35	
					40	

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. OW-3
SHEET NO. 1 OF 2

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

PROJECT NO. 467.42
INSTALLATION
SURFACE ELEV. 42.6
BOREHOLE DIA. 10 IN.

SAMPLING NOTES						VISUAL CLASSIFICATION AND GENERAL OBSERVATIONS
INTERVAL NO.	TYPE	BLOWS	RECOVERY	MOISTURE	DEPTH	
1	SS	2-1-2-1	50			SILTY SAND (SM) - fine grained; tan.
2	SS	3-2-2-2	75			CLAYEY SAND (SC) - fine grained; tan. 3.0
3	SS	3-3-5-7	90		5	SILTY SAND (SM) - fine grained; some roots; trace black organics; some gray mottle.
4	SS	6-7-6-7	85			8.0
5	SS	3-4	100			CLAYEY SAND (SC) - fine grained; tan, gray; interbedded with SILTY SAND (SM); fine grained; tan.
6	UD		100		10	9.0 SILTY CLAY (CL) - as determined from laboratory analysis.
7	SS	3-5-5-4	80			CLAYEY SAND (SC) - fine grained; tan; gray; interbedded with SILTY SAND (SM); fine grained; tan.
8	UD		75		15	

GENERAL NOTES

DATE STARTED 18 APR 90
DATE COMPLETED 19 APR 90
RIG MOBILE B-56
CREW CHIEF TODD JOHNSON
LOGGED BTG CHECKED

WATER LEVEL OBSERVATIONS

WHILE DRILLING 13.0 FT. BGS
AT COMPLETION 13.5 FT. BGS
AFTER DRILLING
CAVE-IN: DATE/TIME DEPTH
WATER: DATE/TIME 5-4-90 DEPTH 14.65 FT. BGS

LOG OF TEST BORING

F-203 (R 01-87)

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

BORING NO.: OW-3
SHEET NO. 2 OF 2
PROJECT NO.: 467.42
INSTALLATION:
SURFACE ELEV.: 42.6
BOREHOLE DIA.: 10 IN.

SAMPLING NOTES						VISUAL CLASSIFICATION AND GENERAL OBSERVATIONS
INTERVAL		RECOVERY	MOISTURE			
NO.	TYPE	BLOWS			DEPTH	
						- fine to medium grained;21.0 to 21.2 ft. 21.2
9	SS	1-1-3-4	100			CLAY (CH) - moderately stiff; light gray; some clayey sand; fine grained; gray. 22.5
						SILTY SAND (SM) - fine to medium grained; tan; interlaminated with CLAYEY SAND (SC); fine grained; gray.
					25	
					30	
					35	
					40	

BORING TERMINATED AT 23.0 FEET

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. OW-5
SHEET NO. 1 OF 2
PROJECT NAME WEYERHAEUSER
PROJECT NO. 467.42
LOCATION PLYMOUTH, NC
INSTALLATION
CONTRACTOR LAW ENGINEERING
SURFACE ELEV. 30.9
DRILLING METHOD HSA
BOREHOLE DIA. 10 IN.

SAMPLING NOTES						VISUAL CLASSIFICATION AND GENERAL OBSERVATIONS
INTERVAL		RECOVERY		MOISTURE		
NO.	TYPE	BLOWS			DEPTH	
1	SS	3-3-4-5	50			CLAY (CL) - trace sand (fine grained); brown, orange, green-gray.
2	SS	5-6-8-9	70			SILTY SAND (SM) - fine grained; interlaminated with clay, as above; gray-tan. 4.3
3	SS	5-6-6-6	90		5	SILTY SAND (SM) - fine grained; mottled tan and orange.
4	SS	4-5-5-5	100			
5	SS	4-2-1-2	100		▽	- as above with gray clay; 9.0-9.8 ft. 9.8
					10	SILTY CLAY (CL) - gray-purple; some fine grained sand; trace of CLAYEY SAND (SC).
6	SS	2-2-3-5	75		15	18.4
7	SS	3-3-6-6	100			SILTY CLAY (CL) - trace of sand (fine grained); micaceous; blue-green.

GENERAL NOTES

DATE STARTED 24 APR 90
DATE COMPLETED 24 APR 90
RIG MOBILE B-56
CREW CHIEF TODD JOHNSON
LOGGED BTG CHECKED

WATER LEVEL OBSERVATIONS

WHILE DRILLING ▽ 9.0 FT.
AT COMPLETION ▼
AFTER DRILLING
CAVE-IN: DATE/TIME DEPTH
WATER: DATE/TIME 4-25-90/0715 DEPTH 10.4 FT. BGS

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. OW-5
SHEET NO. 2 OF 2
PROJECT NAME WEYERHAEUSER
PROJECT NO. 467.42
LOCATION PLYMOUTH, NC
INSTALLATION
CONTRACTOR LAW ENGINEERING
SURFACE ELEV. 30.9
DRILLING METHOD HSA
BOREHOLE DIA. 10 IN.

SAMPLING NOTES						VISUAL CLASSIFICATION AND GENERAL OBSERVATIONS
INTERVAL		RECOVERY		MOISTURE		
NO.	TYPE	BLOWS			DEPTH	
8	SS	6-10-8-7	90			20.8
						SILTY CLAY (CL) - sandy (fine to medium grained); gray, light brown, orange; laminated; some mottled. 21.8
						BORING TERMINATED AT 22.0 FEET
					25	
					30	
					35	
					40	

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. OW-6
SHEET NO. 1 OF 2
PROJECT NAME WEYERHAEUSER
PROJECT NO. 467.42
LOCATION PLYMOUTH, NC
INSTALLATION
CONTRACTOR LAW ENGINEERING
SURFACE ELEV. 31.3
DRILLING METHOD HSA
BOREHOLE DIA. 10 IN.

SAMPLING NOTES						VISUAL CLASSIFICATION AND GENERAL OBSERVATIONS
INTERVAL		RECOVERY		MOISTURE		
NO.	TYPE	BLOWS			DEPTH	
1	SS	3-3-5-5	50			SILTY SAND (SM) - fine grained; clayey; tan. .2
						CLAY (CL) - silty; trace of fine grained sand; tan.
2	SS	4-3-3-3	65			SILTY SAND (SM) - fine grained; clayey; mottled tan and gray. 3.0
3	SS	3-3-5-4	90			SILTY SAND (SM) - fine grained; trace clay; tan and gray mottled.
					5	
4	SS	4-5-4-4	75			- clay in thin laminations; 6.0-7.0 ft.
						- gray with black laminae interbedded with tan-orange; 7.0-7.5 ft.
5	SS	3-2-3-4	100			SILTY SAND (SM) - fine grained; tan and gray mottled; interbedded with CLAY (CL); silty; sandy (fine grained).
					10	
						SILTY CLAY (CL) - trace fine grained sand; gray. 13.8
6	SS	3-5-8-6	100			SILTY SAND (SM) - fine grained; clayey; gray. 14.5
					15	
						SILTY SAND (SM) - fine grained; gray. 17.7
7	SS	4-5-7-7	100			SILTY CLAY (CL) - trace mica; brittle; light brown.
					▼	

GENERAL NOTES

DATE STARTED 23 APR 90
DATE COMPLETED 24 APR 90
RIG MOBILE B-56
CREW CHIEF TODD JOHNSON
LOGGED BTG CHECKED

WATER LEVEL OBSERVATIONS

WHILE DRILLING ▽
AT COMPLETION ▼ 18.8 FT. BGS
AFTER DRILLING
CAVE-IN: DATE/TIME DEPTH
WATER: DATE/TIME 5-3-90/0940 DEPTH DRY

LOG OF TEST BORING

F-203 (R 01-87)

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

BORING NO.: OW-6
SHEET NO. 2 OF 2
PROJECT NO.: 467.42
INSTALLATION:
SURFACE ELEV.: 31.3
BOREHOLE DIA.: 10 IN.

SAMPLING NOTES						VISUAL CLASSIFICATION AND GENERAL OBSERVATIONS
INTERVAL		RECOVERY		MOISTURE		
NO.	TYPE	BLOWS			DEPTH	
8	SS	4-5-7-8	100			
						SILTY CLAY (CL) - stiff; micaceous; blue green and brown mottled.
9	SS	5-4-5-7	100		25	
						BORING TERMINATED AT 27.0 FEET
					30	
					35	
					40	

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. OW-7
SHEET NO. 1 OF 2
PROJECT NAME WEYERHAEUSER
PROJECT NO. 467.42
LOCATION PLYMOUTH, NC
INSTALLATION
CONTRACTOR LAW ENGINEERING
SURFACE ELEV. 21.6
DRILLING METHOD HSA
BOREHOLE DIA. 10 IN.

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		15	SILTY SAND (SM) - fine grained; trace medium grained; laminated; tan, orange-brown.
						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	

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. MW-1A
SHEET NO. 1 OF 3
PROJECT NAME WEYERHAEUSER
PROJECT NO. 467.42
LOCATION PLYMOUTH, NC
INSTALLATION
CONTRACTOR LAW ENGINEERING
SURFACE ELEV. 35.0
DRILLING METHOD MUD ROTARY
BOREHOLE DIA. 10 IN.

SAMPLING NOTES						VISUAL CLASSIFICATION AND GENERAL OBSERVATIONS
INTERVAL		RECOVERY	MOISTURE			
NO.	TYPE	BLOWS			DEPTH	
1	SS	4-3-3-4	100			SILTY SAND (SM) - fine grained; gray. 1.0
2	SS	3-2-3-3	75			CLAYEY SAND (SC) - fine grained; tan, gray. 2.8
3	SS	2-2-1-2	75		5	SILTY SAND (SM) - fine grained sand; trace clay; orange, tan. - scattered clay zones; 4.0-5.5 ft.
4	SS	2-1-1-WOH	100			7.4
5	SS	5-2-7-10	100			SILTY SAND (SM) - fine grained; clayey; gray. 9.0
6	UD		0		10	SILTY SAND (SM) - fine to medium grained; gray; clayey zone 9.5 to 9.8 ft; some wood fragments.
7	SS	3-8-10-14	75		15	SILTY SAND (SM) - fine grained; gray. 18.5
						CLAY (CH) - stiff; gray-brown. 19.0
						SILTY SAND (SM) - fine to medium grained; gray; coarsening downward.

GENERAL NOTES

DATE STARTED 17 APR 90
DATE COMPLETED 18 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 5-3-90/1020 DEPTH 23.0 FT. BGS

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. MW-1A
SHEET NO. 2 OF 3
PROJECT NO. 467.42
INSTALLATION
SURFACE ELEV. 35.0
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	SS	11-12-5-5	100			SILTY CLAY (CL) - very stiff; light blue green.
9	UD		100			CLAYEY SILT (ML) - as determined from laboratory analysis. Change to 5 7/8 in. bit at 23.0 ft. SILTY CLAY (CL) - very stiff; light blue green.
					25	- trace medium grained sand
10	SS	4-4-5-6	100			CLAYEY SILT (ML) - as determined from laboratory analysis.
					30	SILTY CLAY (CL) - trace sand (medium grained); very stiff; light blue green.
11	SS	3-4-5-6	20			
					35	
						SAND (SP-SM) - fine to medium grained; some coarse sand; gray.
12	SS	20-41-50/5	50			
					40	
						SILTY SAND (SM) - fine to medium grained, some coarse; with quartz pebbles; gray.

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. MW-1A
SHEET NO. 3 OF 3
PROJECT NO. 467.42
INSTALLATION
SURFACE ELEV. 35.0
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	
						44.5
13	SS	28-32-39-33	100		45	SILTY SAND (SM) - fine to medium grained; trace coarse sand; laminated; trace shell fragments; tan, some dark brown.
						BORING TERMINATED AT 46.0 FEET
					50	
					55	
					60	
					65	

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. MW-6A
SHEET NO. 1 OF 3
PROJECT NO. 467.42
INSTALLATION
SURFACE ELEV. 11.5
BOREHOLE DIA. 6 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	
1	SS	2-2-1-2	65			SILTY SAND (SM) - very fine grained; light brown, some tan mottle.
2	SS	3-2-2-3	50			SILTY SAND (SM) - very fine grained; clayey; tan. 2.5
						SILTY SAND (SM) - as above; no clay. 4.5
3	SS	3-5-5-4	50		5	SILTY SAND (SM) - fine grained; humic; tan, dark brown. 6.7
4	SS	2-3-5-7	40			SILTY SAND (SM) - fine grained; light gray.
5	SS	6-9-10-4	50			CLAYEY SAND (SC) - fine to medium grained; trace coarse sand; tan-gray. 8.5
					10	SILTY SAND (SM) - fine to medium grained; mottled black, brown, tan, gray.
6	SS	4-4-3-5	75		15	SILTY SAND (SM) - fine to medium grained; trace coarse grained sand; tan; and alternating (< .1 foot) SILT (ML) laminae; clayey; micaceous; gray.
7	SS	6-8-8-9	75			SILTY SAND (SM) - fine grained; tan; some black heavy mineral laminae.

GENERAL NOTES

DATE STARTED 19 APR 90
DATE COMPLETED 19 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 5-3-90 DEPTH 7.2 FT. BGS

LOG OF TEST BORING

F-203 (R 01-87)

PROJECT NAME	WEYERHAEUSER	BORING NO.	MW-6A
LOCATION	PLYMOUTH, NC	SHEET NO.	2 OF 3
CONTRACTOR	LAW ENGINEERING	PROJECT NO.	457.42
DRILLING METHOD	MUD ROTARY	INSTALLATION	
		SURFACE ELEV.	11.5
		BOREHOLE DIA.	6 IN.

SAMPLING NOTES						VISUAL CLASSIFICATION AND GENERAL OBSERVATIONS
INTERVAL NO.	TYPE	BLOWS	RECOVERY	MOISTURE	DEPTH	
8	SS	8-9-8-9	65			24.0
					25	CLAYEY SAND (SC) - fine grained; micaceous; silty; light gray, brown.
9	SS	8-8-16-50/4"	82			SILTY SAND (SM) - fine to coarse grained; tan, gray; with black laminations; interbedded (approx. 0.5 foot) with CLAY (CL); sandy (fine to medium grained); micaceous; gray green, brown mottle.
10	SS	88/6"	100		30	SILTY SAND (SM) - fine to medium grained; brown to dark brown; some CLAYEY SAND (SC). -laminated; 33.0-35.0 ft.
11	SS	11-15-22-27	50		35	
12	SS	17-25-30-24	50		40	- trace clay, mica.
						SILT (ML) - clayey; some very fine grained sand; gray (Yorktown Fm.?)
13	SS	5-7-8-9	100			

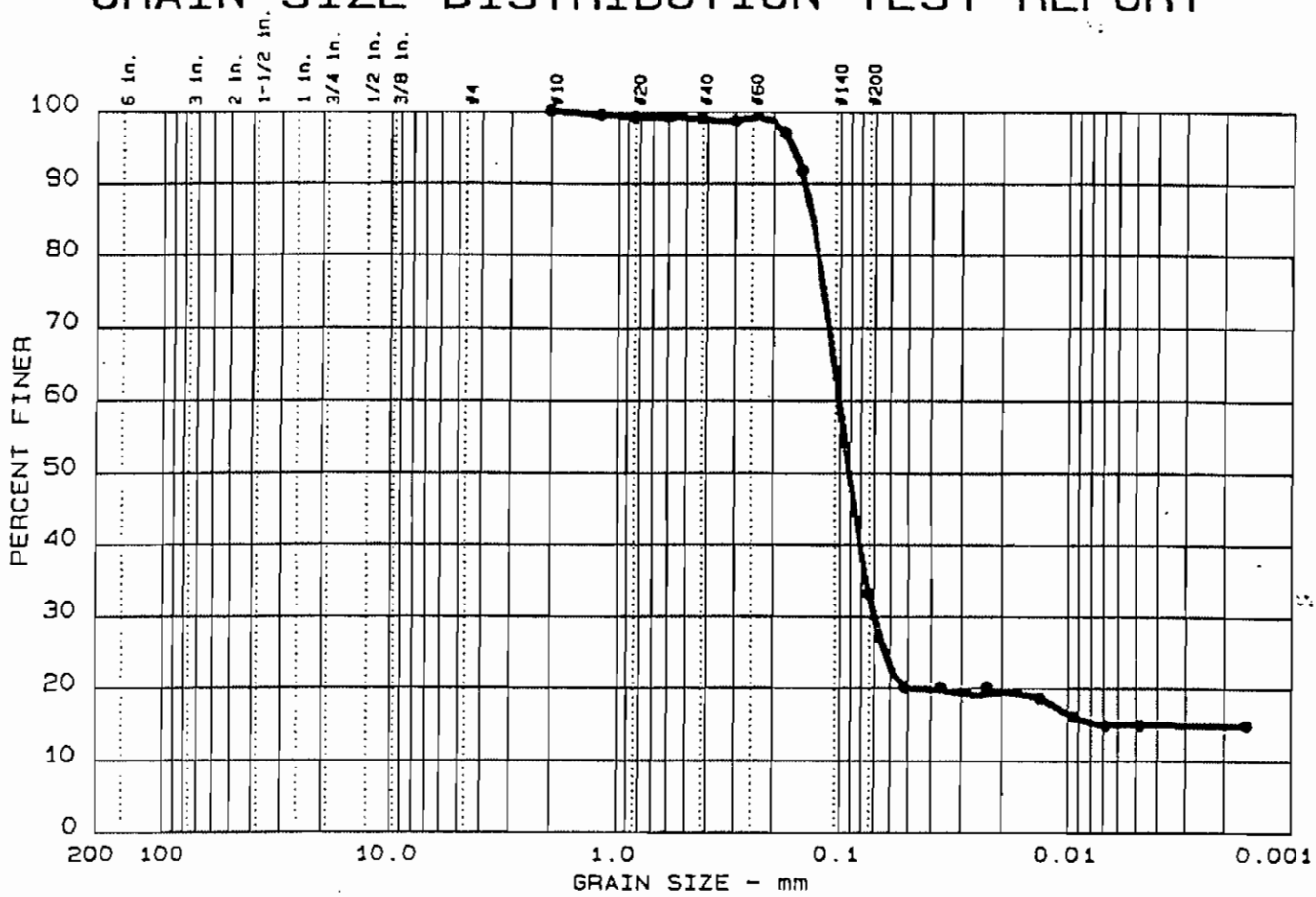
LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. MW-6A
SHEET NO. 3 OF 3
PROJECT NAME WEYERHAEUSER
PROJECT NO. 467.42
LOCATION PLYMOUTH, NC
INSTALLATION
CONTRACTOR LAW ENGINEERING
SURFACE ELEV. 11.5
DRILLING METHOD MUD ROTARY
BOREHOLE DIA. 6 IN.

SAMPLING NOTES						VISUAL CLASSIFICATION AND GENERAL OBSERVATIONS
INTERVAL		RECOVERY		MOISTURE		
NO.	TYPE	BLOWS			DEPTH	
					45	
						SILTY SAND (SM) - fine grained sand; fine to very coarse shell hash (gastropods, pelecypods, corals); gray.
14	SS	15-21-19-19	90			
15	SS	16-13-32-50	100		50	
						BORING TERMINATED AT 52.0 FEET
					55	
					60	
					65	

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	13	0.0	0.0	66.9	18.2	14.9

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.13	0.10	0.09	0.070	0.0070			

MATERIAL DESCRIPTION	USCS	AASHTO
●		

Project No.: 467.42
Project: WEYERHAEUSER
● Location: OW-1 8-10'

Date: 6-1-90

Remarks:

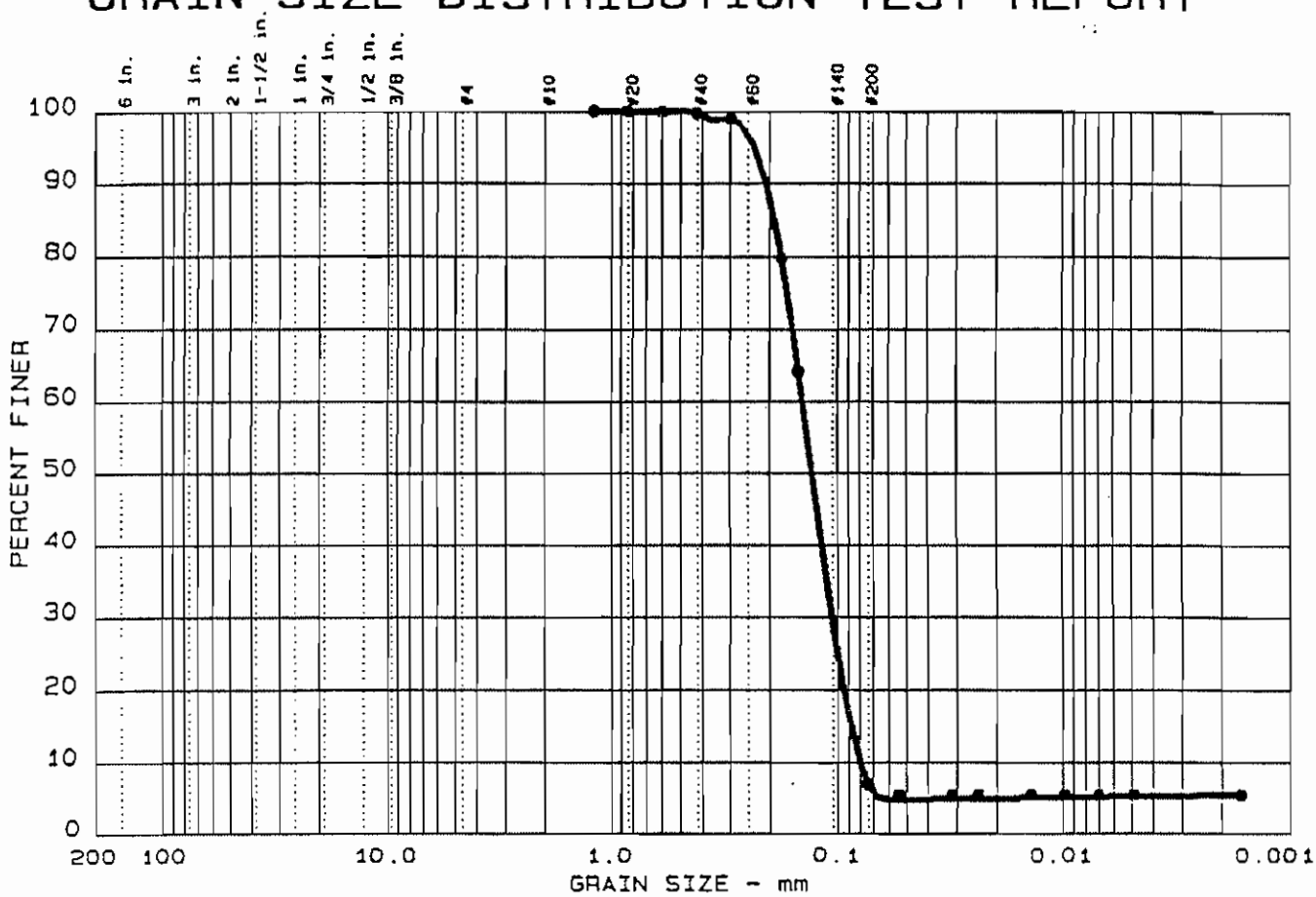
GRAIN SIZE DISTRIBUTION TEST REPORT

RMT, INC.

Figure No. _____

✓ JAB 6-28-90

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	14	0.0	0.0	93.0	1.5	5.5

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.19	0.14	0.13	0.105	0.0872	0.0795	0.98	1.8

MATERIAL DESCRIPTION	USCS	AASHTO
●		

Project No.: 467.42
Project: WEYERHAEUSER
● Location: TP8-3 8.0-8.5'

Date: 5-22-90

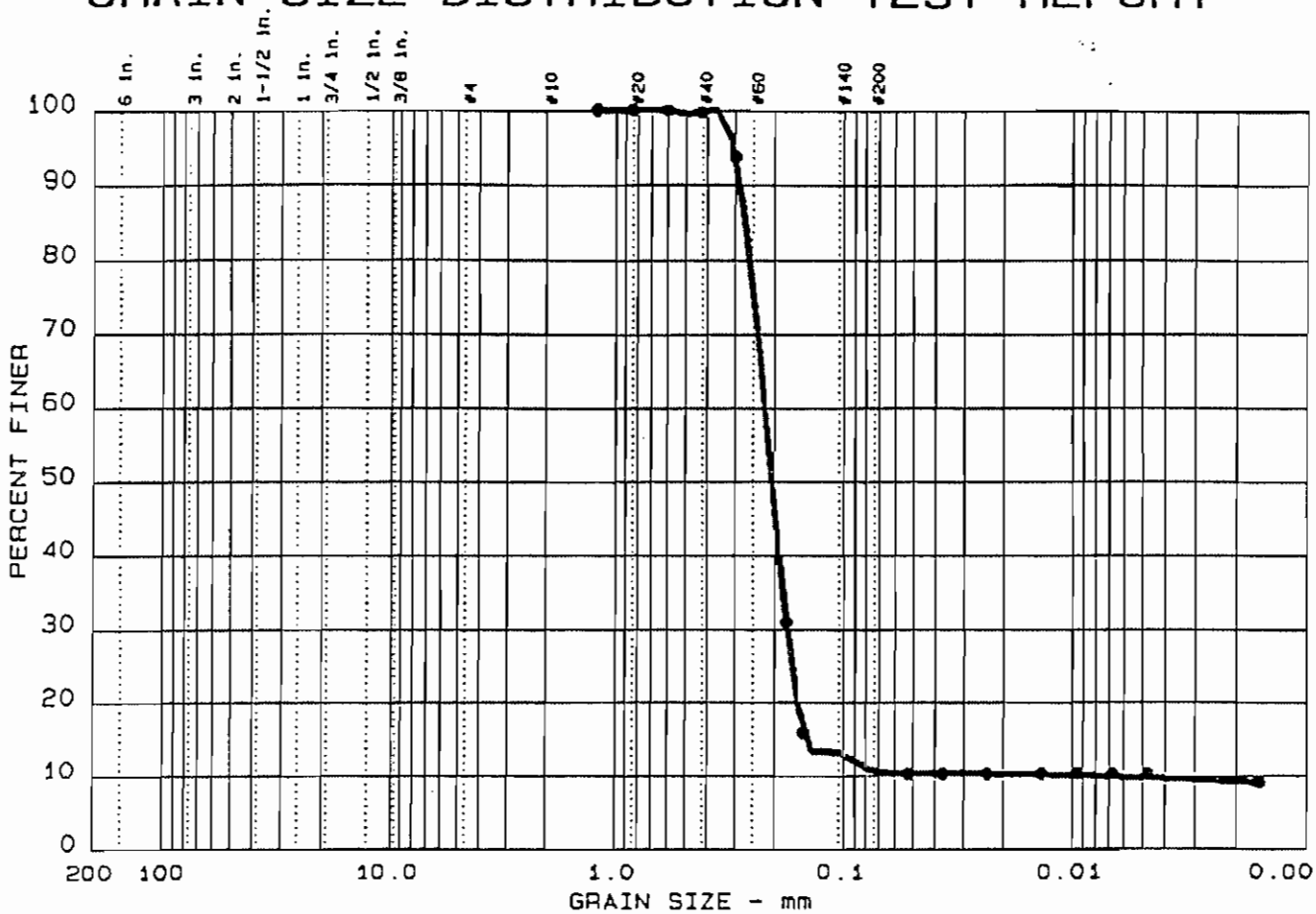
Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT

RMT, INC.

Figure No. _____

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	13	0.0	0.0	89.2	1.0	9.8

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.27	0.22	0.20	0.176	0.1459	0.0082	17.08	26.8

MATERIAL DESCRIPTION	USCS	AASHTO
●		

Project No.: 467.42
Project: WEYERHAEUSER
◆ Location: TP11-2 5.5-7.0'

Date: 5-22-90

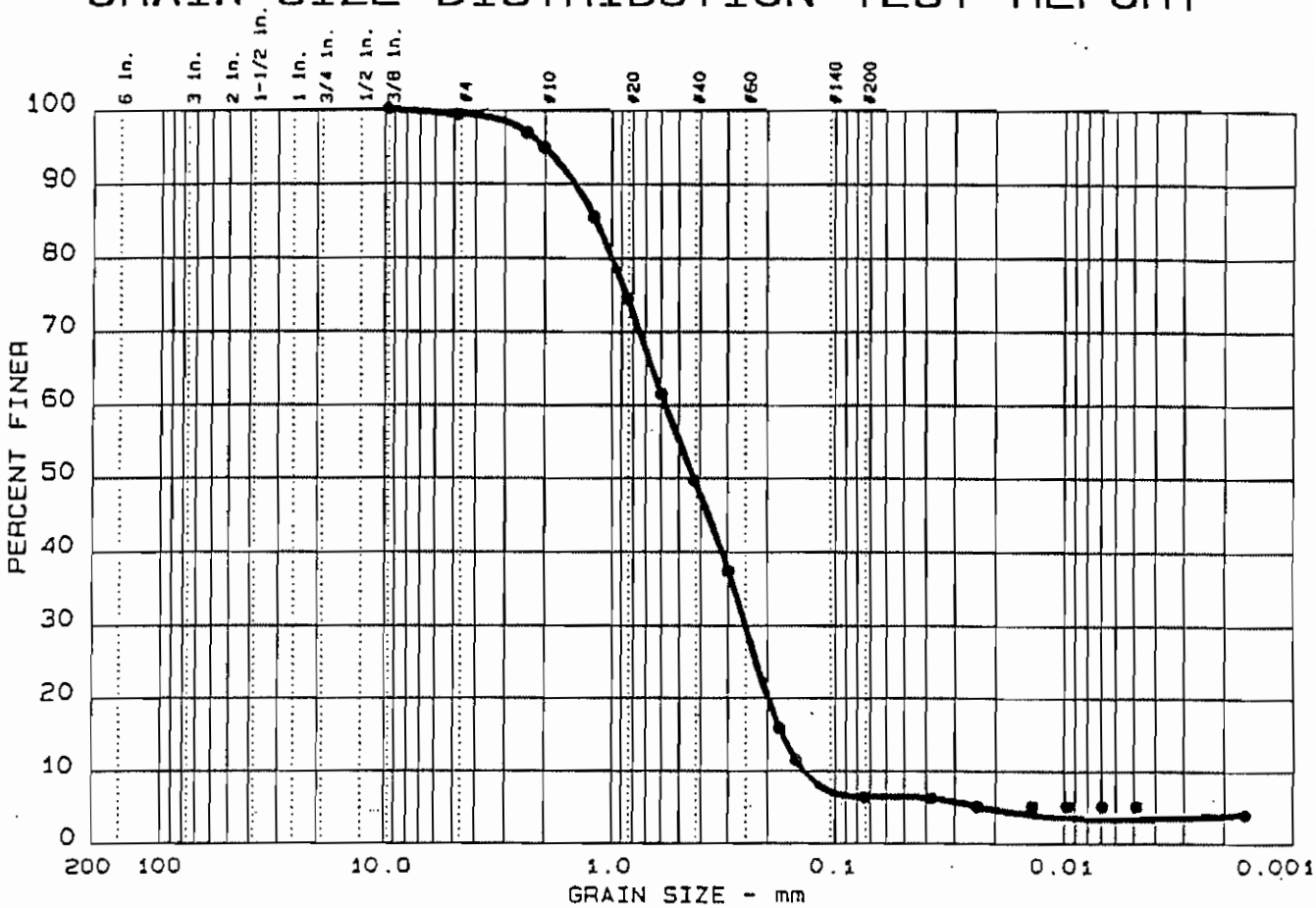
Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT

RMT, INC.

Figure No. _____

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	11	0.0	0.7	92.9	3.0	3.4

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			1.16	0.57	0.42	0.250	0.1710	0.1358	0.81	4.2

MATERIAL DESCRIPTION	USCS	AASHTO
●		

Project No.: 467.42
Project: WEYERHAEUSER
● Location: MW-1A S-10

Date: 5-22-90

Remarks:

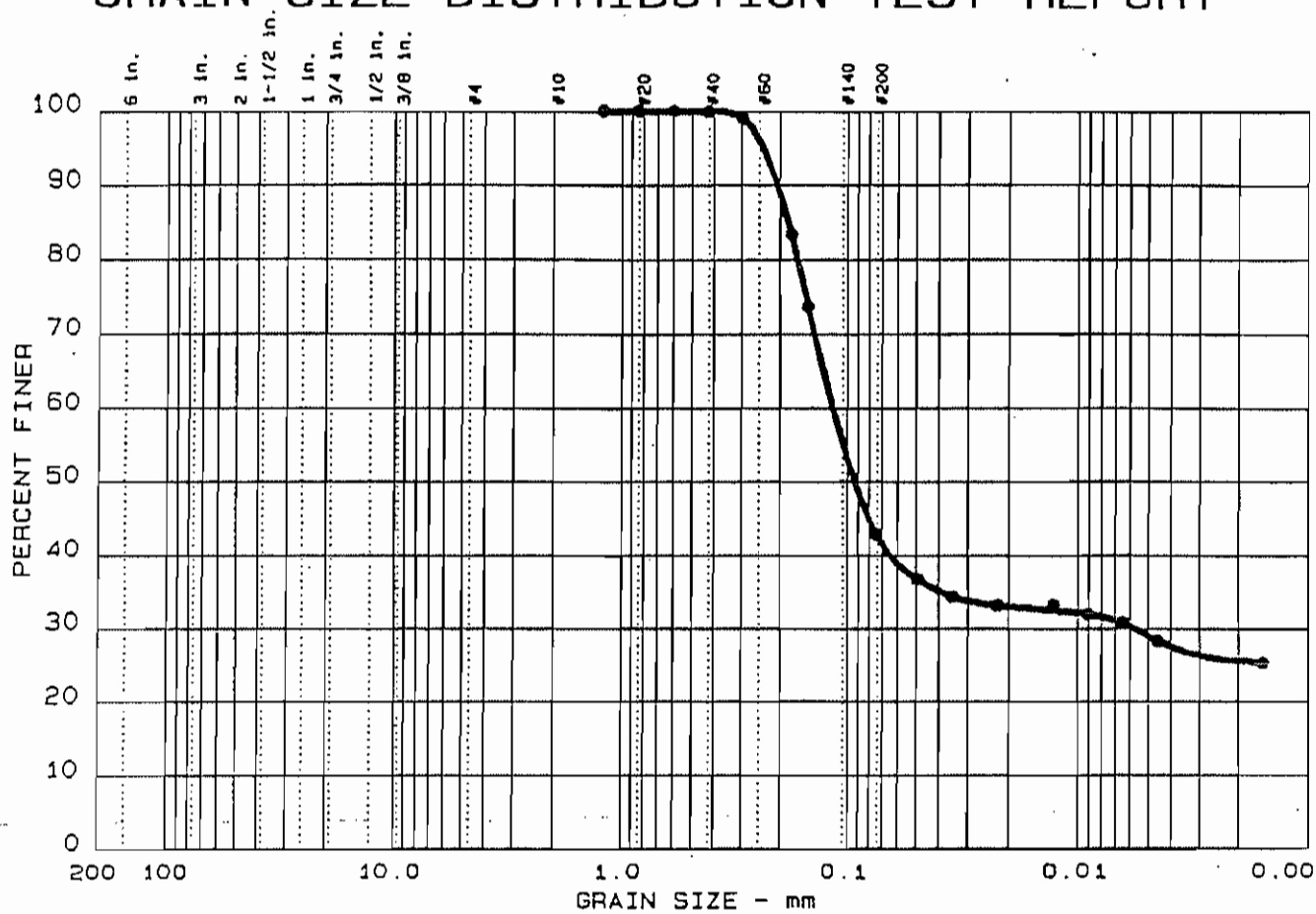
GRAIN SIZE DISTRIBUTION TEST REPORT

RMT, INC.

Figure No. _____

✓ JM 6-12-90

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	10	0.0	0.0	57.2	13.9	28.9

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	29	13	0.18	0.12	0.09	0.006				

MATERIAL DESCRIPTION	USCS	AASHTO
●	CL	

Project No.: 467.42
Project: WEYERHAEUSER
● Location: TP11-1 1.8-4.0'

Date: 6-8-90

Remarks:

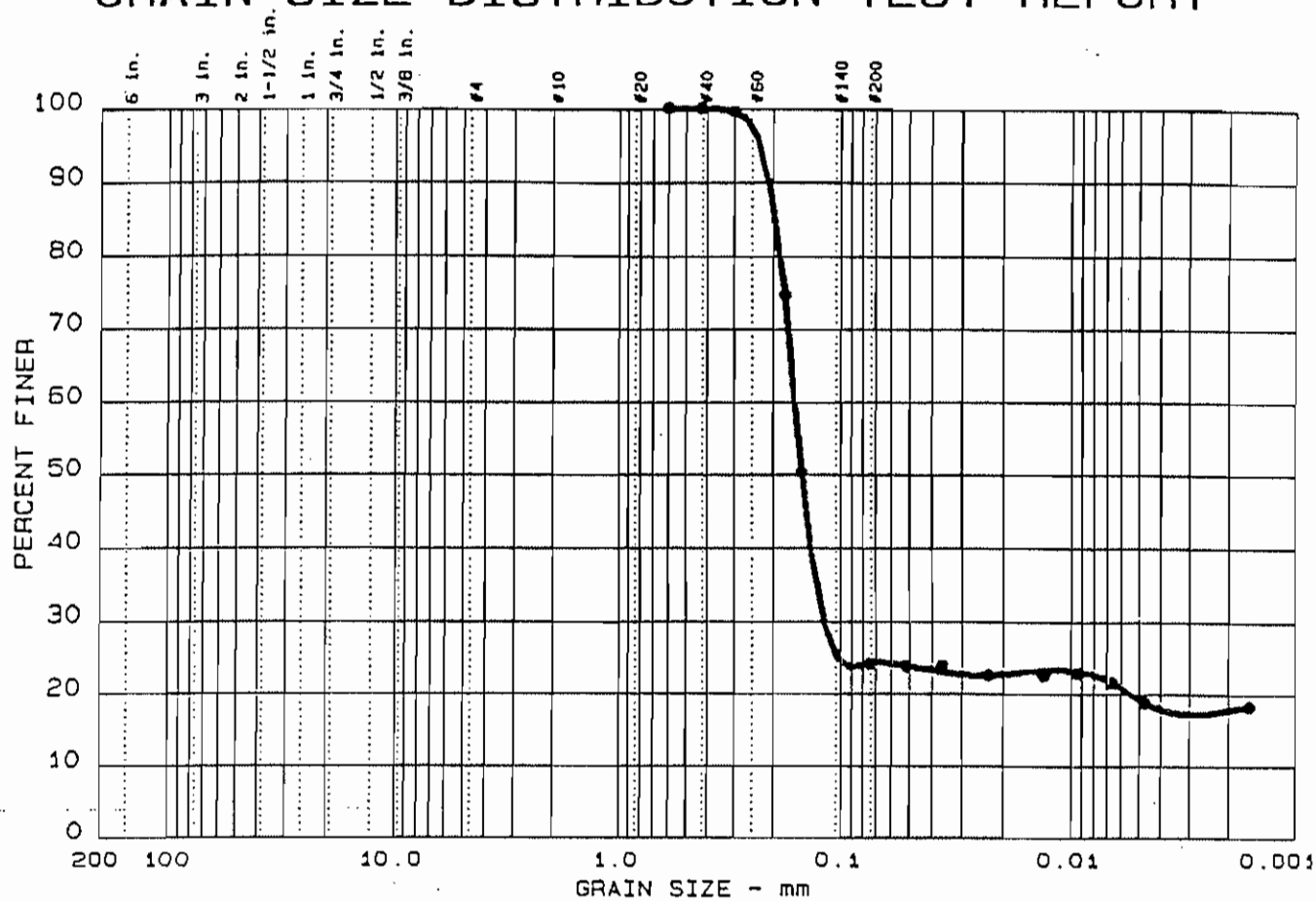
GRAIN SIZE DISTRIBUTION TEST REPORT

RMT. INC.

Figure No. _____

✓ 6-20-90

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	3	0.0	0.0	75.8	4.8	19.4

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.19	0.16	0.15	0.118				

MATERIAL DESCRIPTION	USCS	AASHTO
●		

Project No.: 467.42
Project: WEYERHAEUSER
◆ Location: TP2-5 6.0-6.5'

Date: 6-8-90

Remarks:

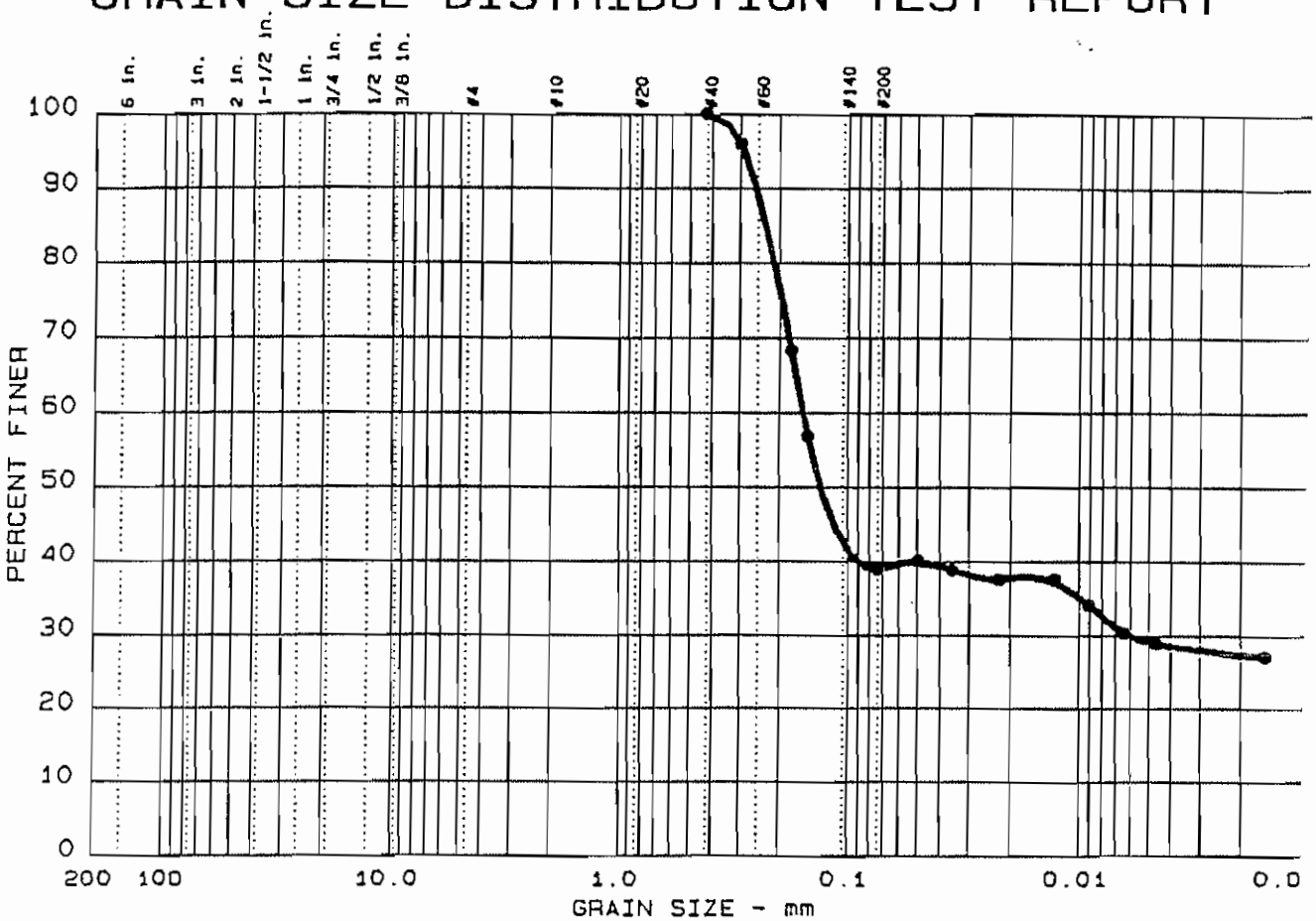
GRAIN SIZE DISTRIBUTION TEST REPORT

RMT, INC.

Figure No. _____

✓ JM 6-20-90

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	5	0.0	0.0	61.1	9.8	29.1

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.23	0.16	0.13	0.006				

MATERIAL DESCRIPTION	USCS	AASHTO
●		

Project No.: 467.42
Project: WEYERHAEUSER
● Location: TP9-2 2.7-3.0'

Date: 6-8-90

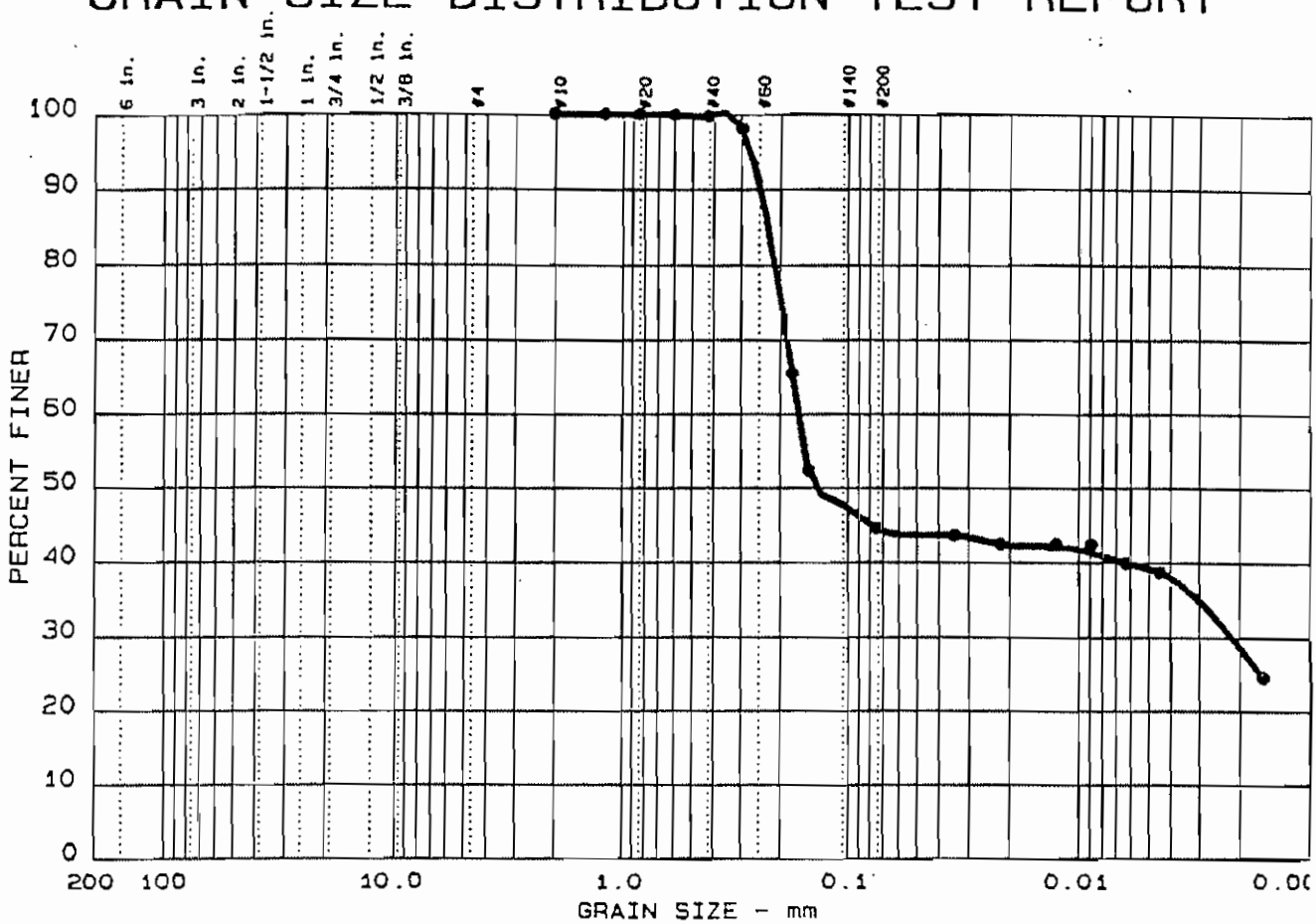
Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT

RMT. INC.

Figure No. _____

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	11	0.0	0.0	55.5	5.4	39.1

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	35	17	0.23	0.17	0.14	0.002				

	MATERIAL DESCRIPTION	USCS	AASHTO
●		CL	

Project No.: 467.42
Project: WEYERHAEUSER
● Location: TP4-2 4.5-5.2

Date: 6-8-90

Remarks:

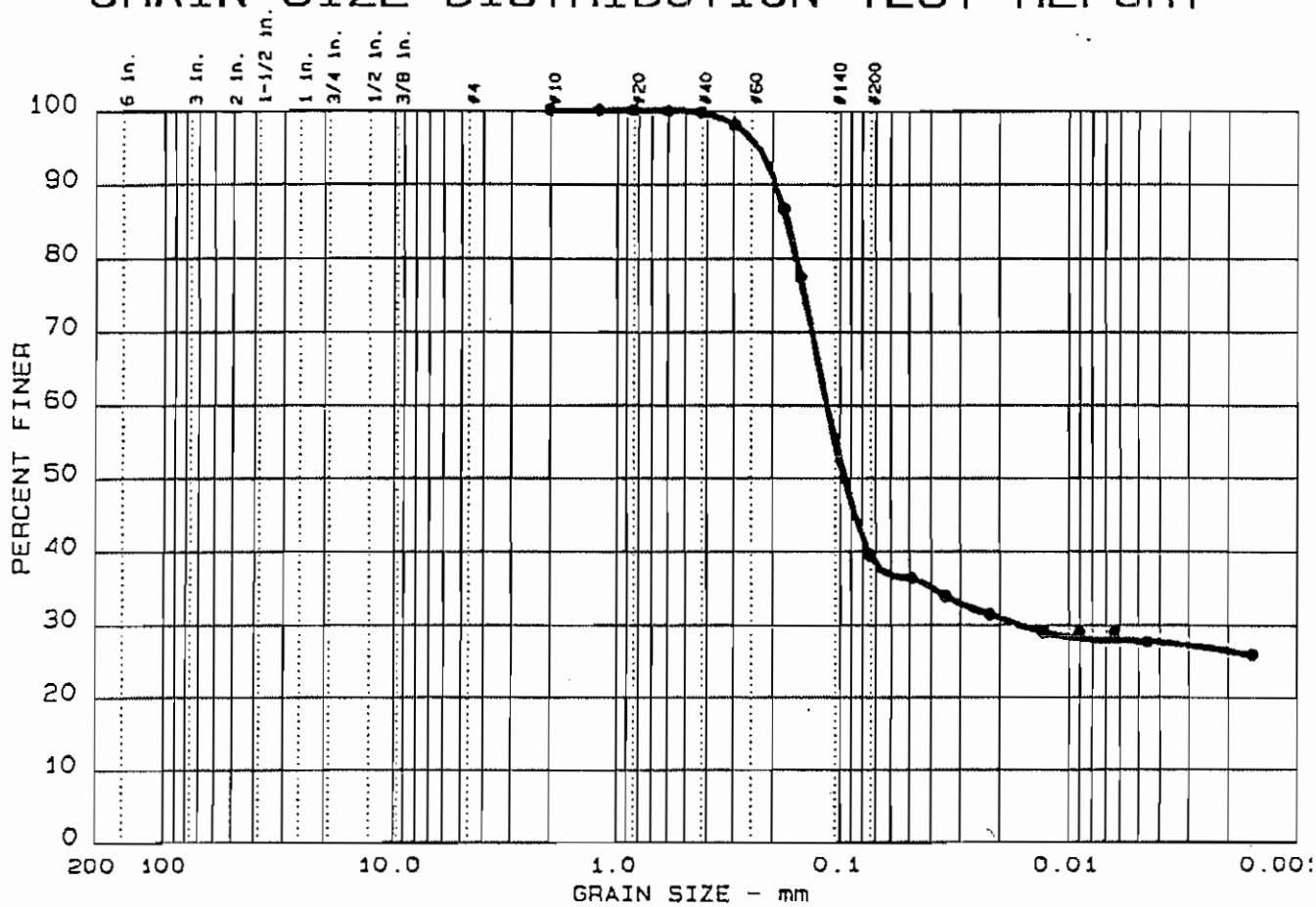
GRAIN SIZE DISTRIBUTION TEST REPORT

RMT, INC.

Figure No. _____

✓ JPM 6-12-90

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	9	0.0	0.0	60.6	11.7	27.7

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	26	8	0.17	0.11	0.10	0.017				

MATERIAL DESCRIPTION	USCS	AASHTO
●	CL	

Project No.: 467.42
Project: WEYERHAEUSER
● Location: TP9-3 4.0-5.0'

Date: 6-8-90

Remarks:

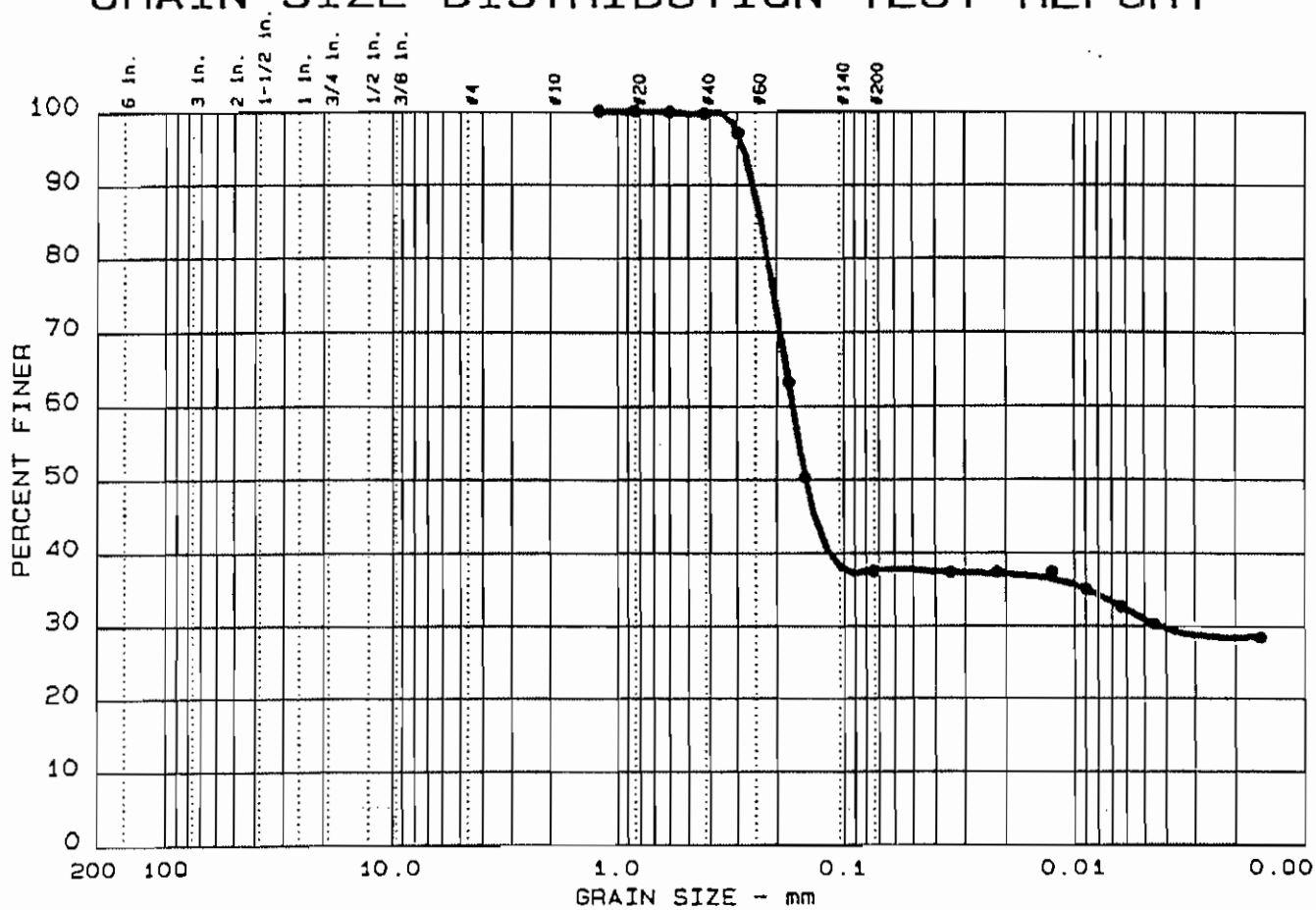
GRAIN SIZE DISTRIBUTION TEST REPORT

RMT. INC.

Figure No. _____

✓ JM 6-12-90

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75 mm	% GRAVEL	% SAND	% SILT	% CLAY
●	1	0.0	0.0	62.6	6.6	30.8

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	28	12	0.23	0.17	0.15	0.004				

MATERIAL DESCRIPTION	USCS	AASHTO
●	CL	

Project No.: 467.42
Project: WEYERHAEUSER
● Location: TP10-2 3.0-5.0'

Date: 6-11-90

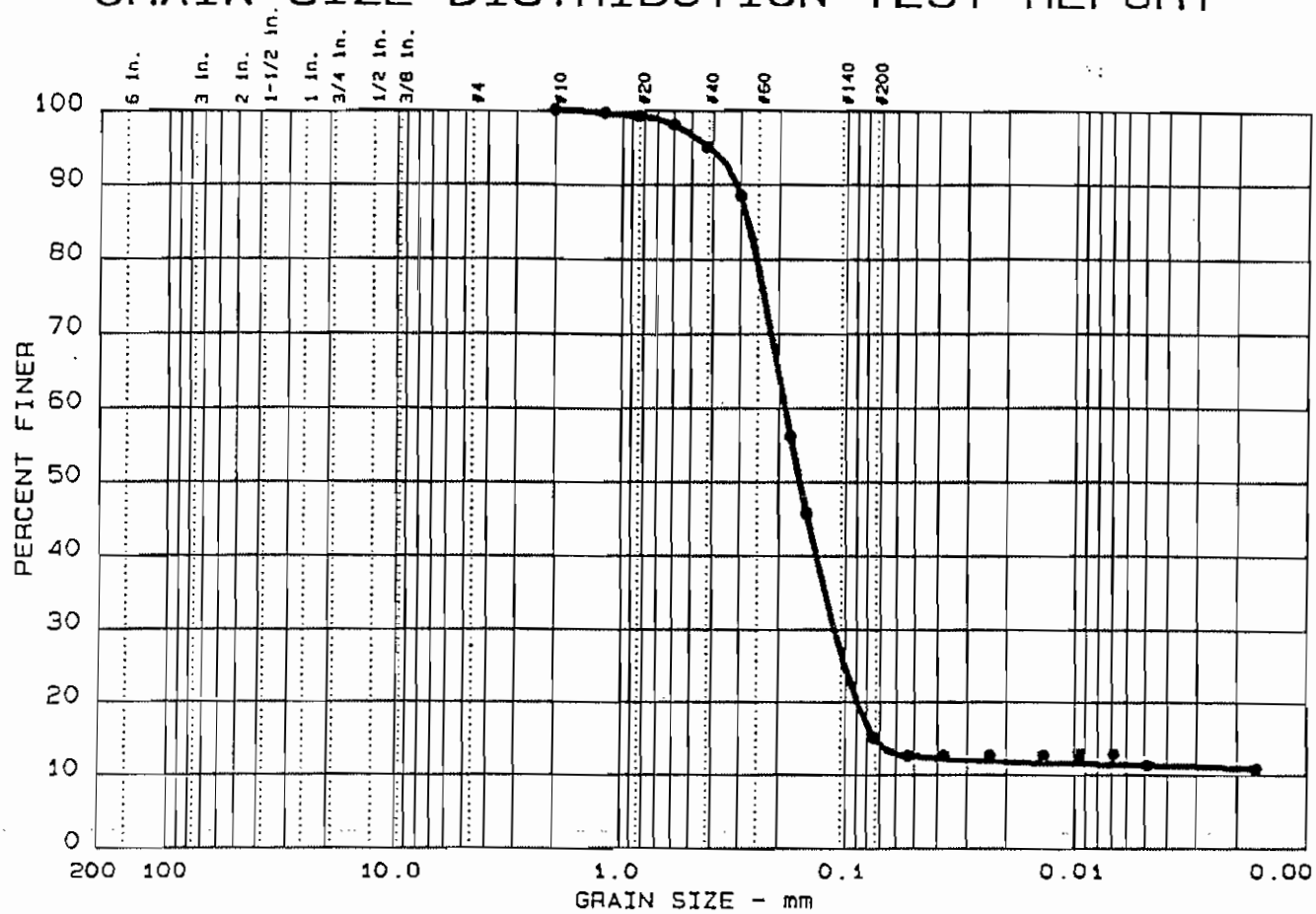
Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT

RMT. INC.

Figure No. _____

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	20	0.0	0.0	84.9	3.7	11.4

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.27	0.19	0.16	0.112	0.0729			

	MATERIAL DESCRIPTION	USCS	AASHTO
●			

Project No.: 467.42
Project: WEYERHAEUSER
● Location: OW-3 15-16.5'

Date: 6-6-90

Remarks:

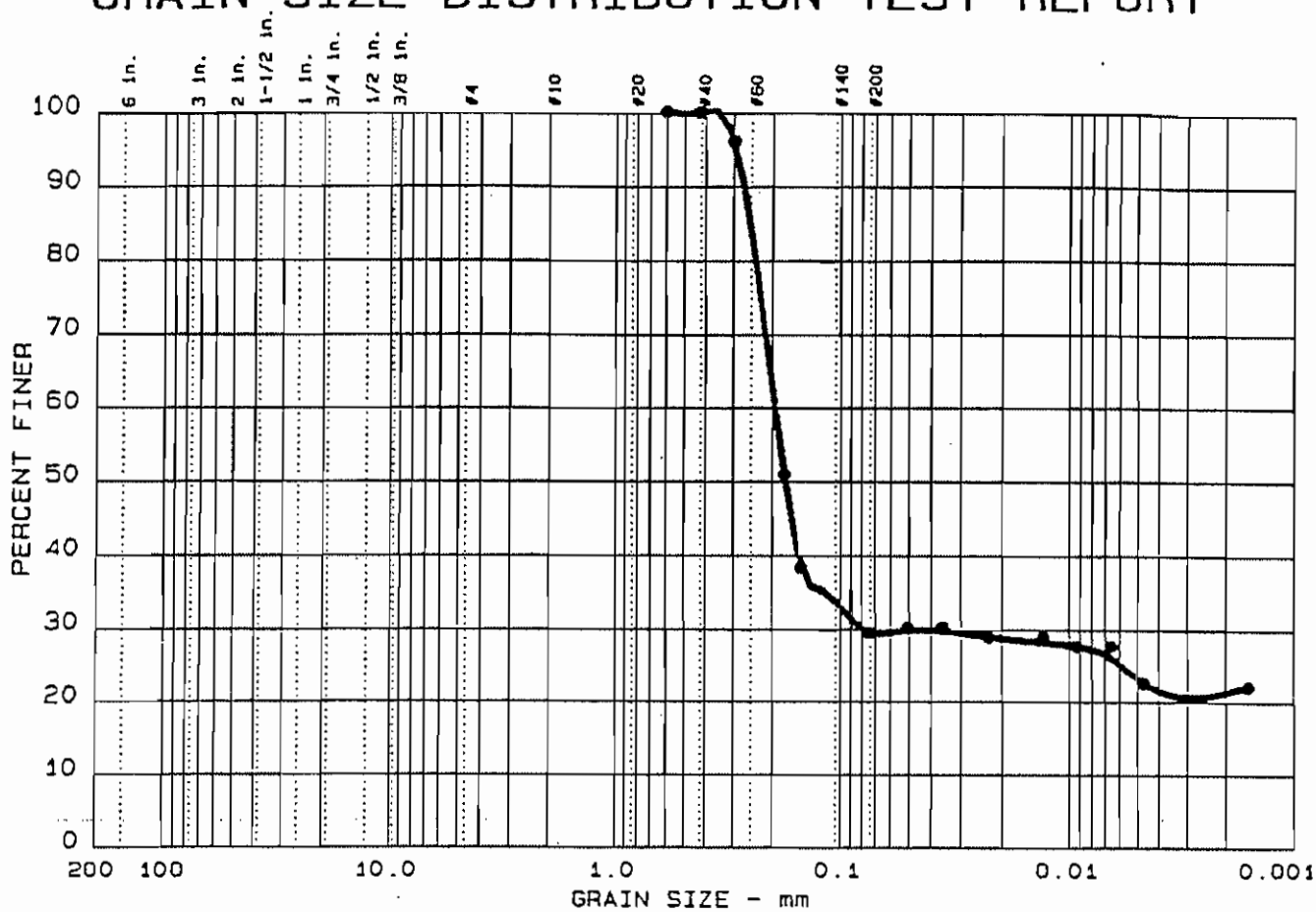
GRAIN SIZE DISTRIBUTION TEST REPORT

RMT, INC.

Figure No. _____

✓ 6-20-90

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	4	0.0	0.0	70.6	6.1	23.3

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.25	0.19	0.18	0.079				

MATERIAL DESCRIPTION	USCS	AASHTO
●		

Project No.: 467.42
Project: WEYERHAEUSER
● Location: OW-3 S5

Date: 6-8-90

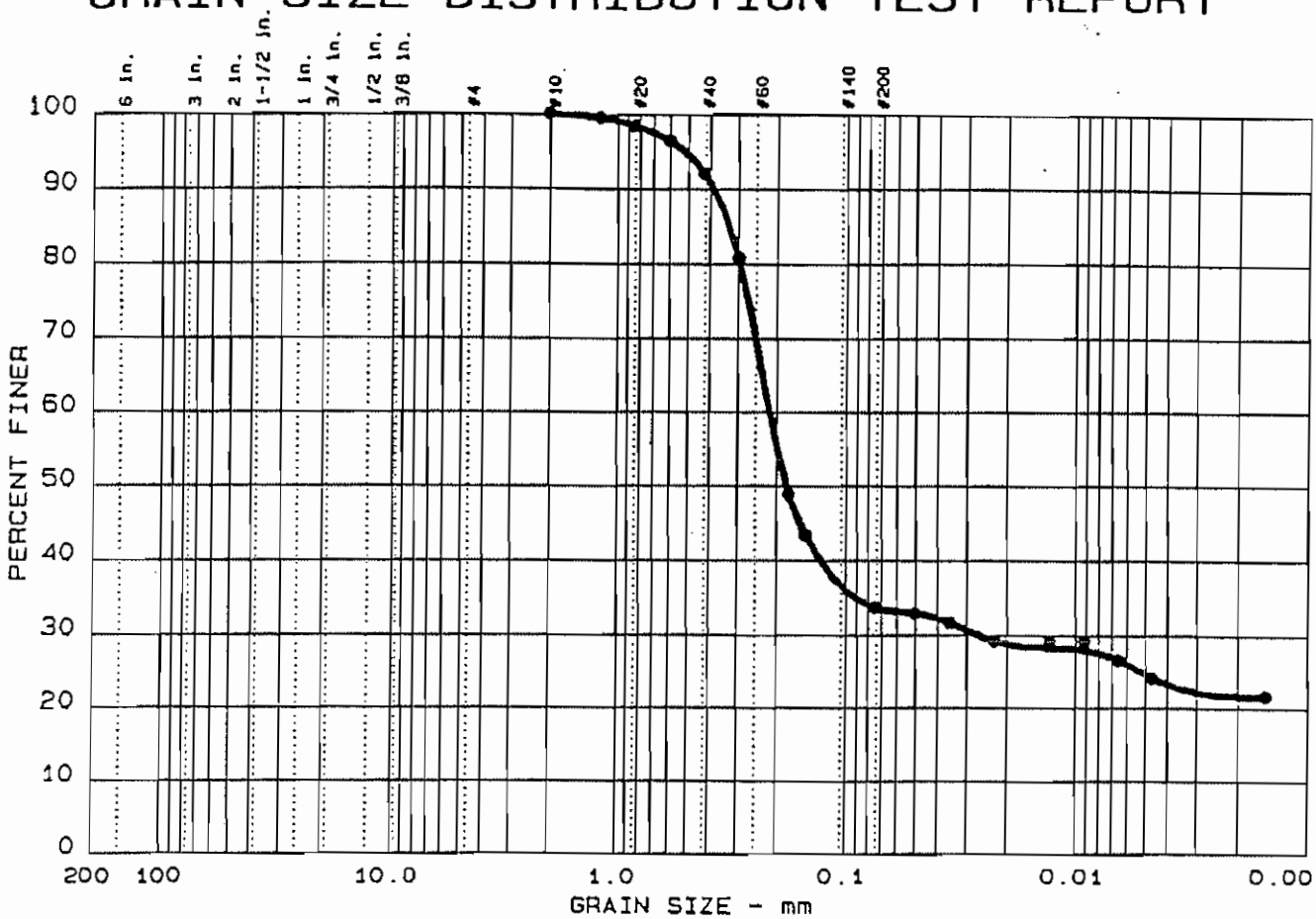
Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT

RMT, INC.

Figure No. _____

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	1	0.0	0.0	66.4	8.9	24.7

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.33	0.22	0.18	0.026				

MATERIAL DESCRIPTION	USCS	AASHTO
●		

Project No.: 467.42
Project: WEYERHAEUSER
● Location: SB-9 18-20'

Date: 5-29-90

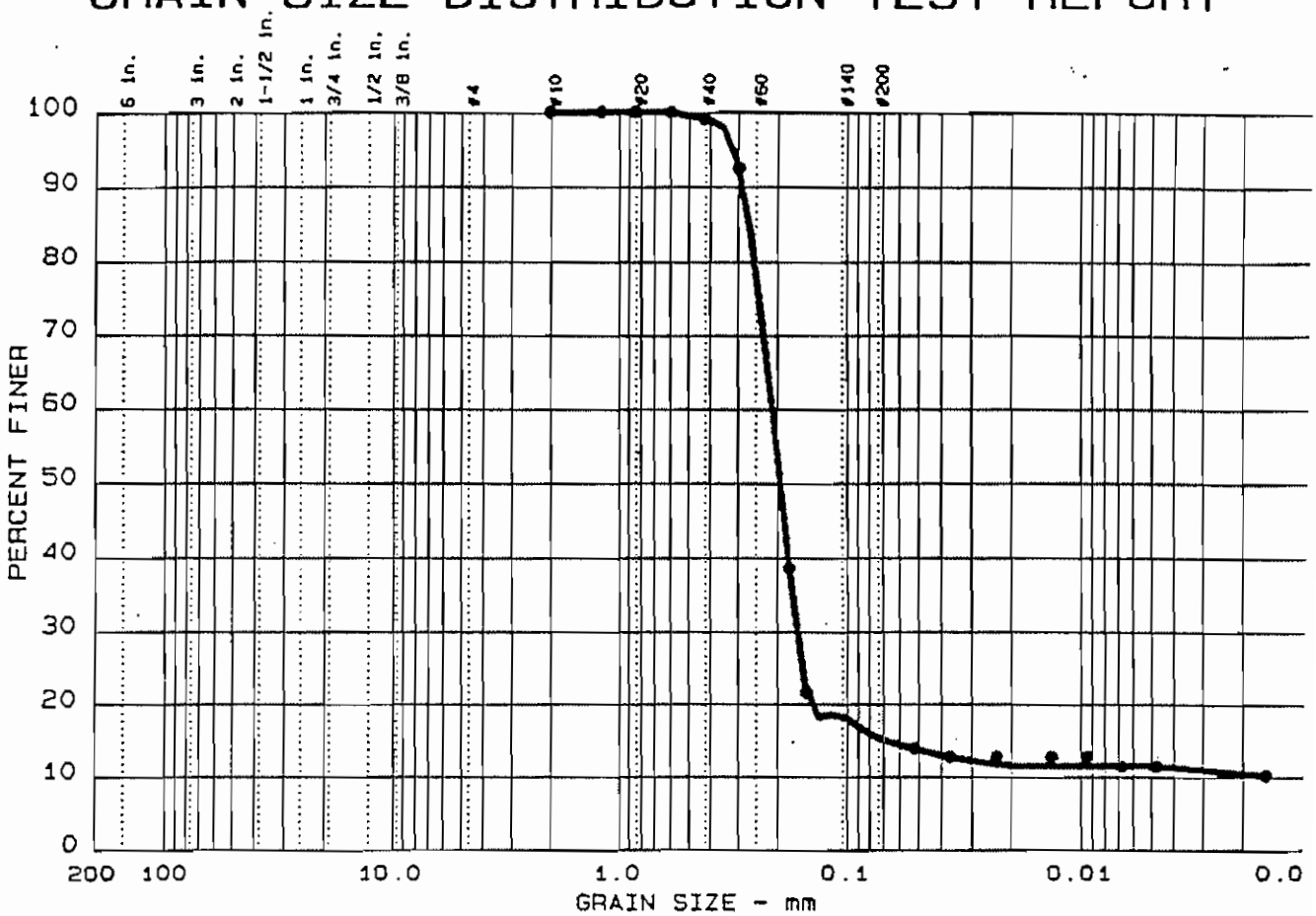
Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT

RMT. INC.

Figure No. _____

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	16	0.0	0.0	84.5	4.1	11.4

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.27	0.21	0.19	0.164	0.0669			

	MATERIAL DESCRIPTION	USCS	AASHTO
●			

Project No.: 467.42
Project: WEYERHAEUSER
● Location: TP6-1 8-9.0'

Date: 5-22-90

Remarks:

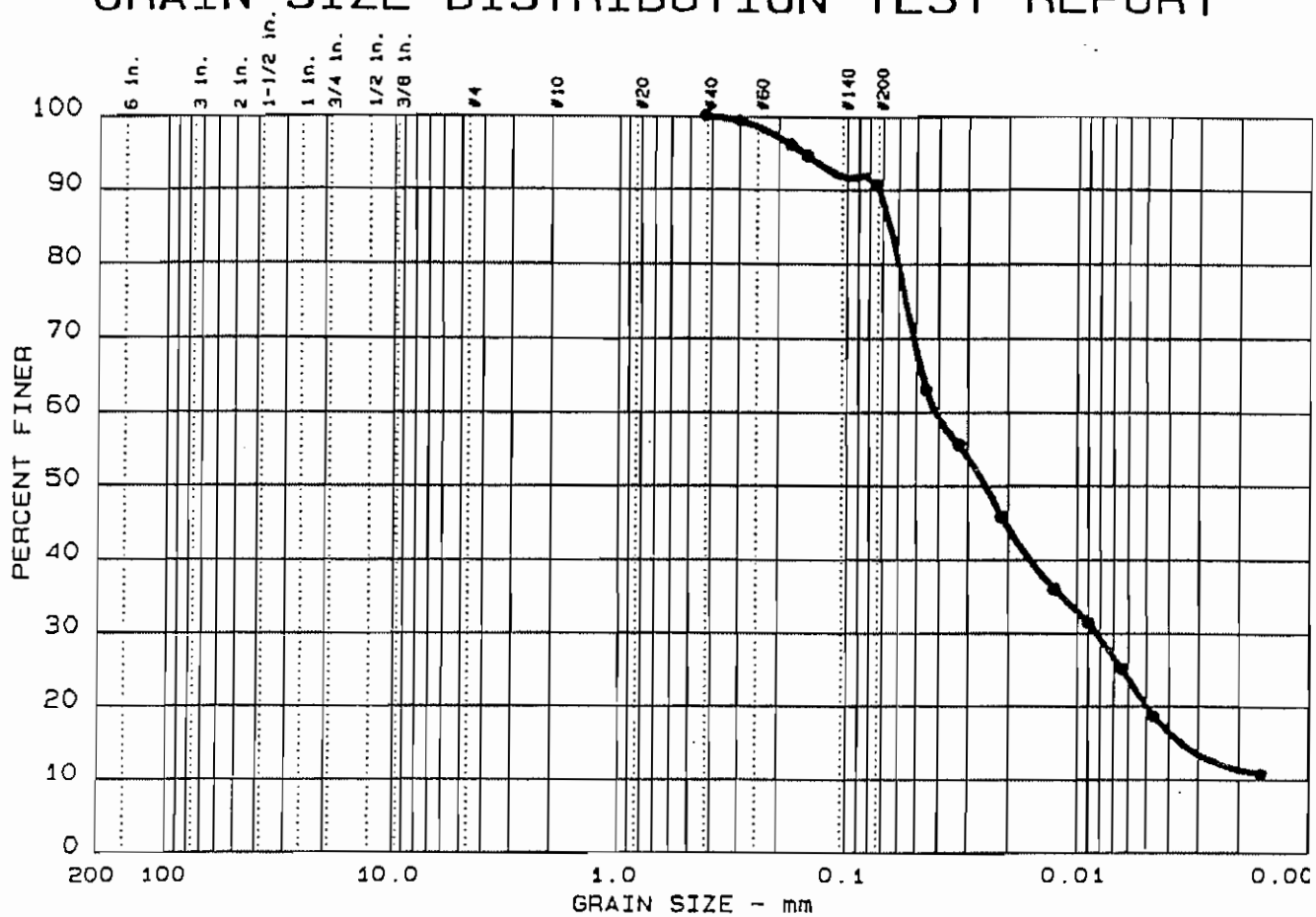
GRAIN SIZE DISTRIBUTION TEST REPORT

RMT, INC.

Figure No. _____

✓ Jill 6-20-9.

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	1	0.0	0.0	9.3	70.6	20.1

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●					0.03	0.008	0.0035			

	MATERIAL DESCRIPTION	USCS	AASHTO
●			

Project No.: 467.42
Project: WEYERHAEUSER
● Location: MW-8 S8

Date: 6-8-90

Remarks:

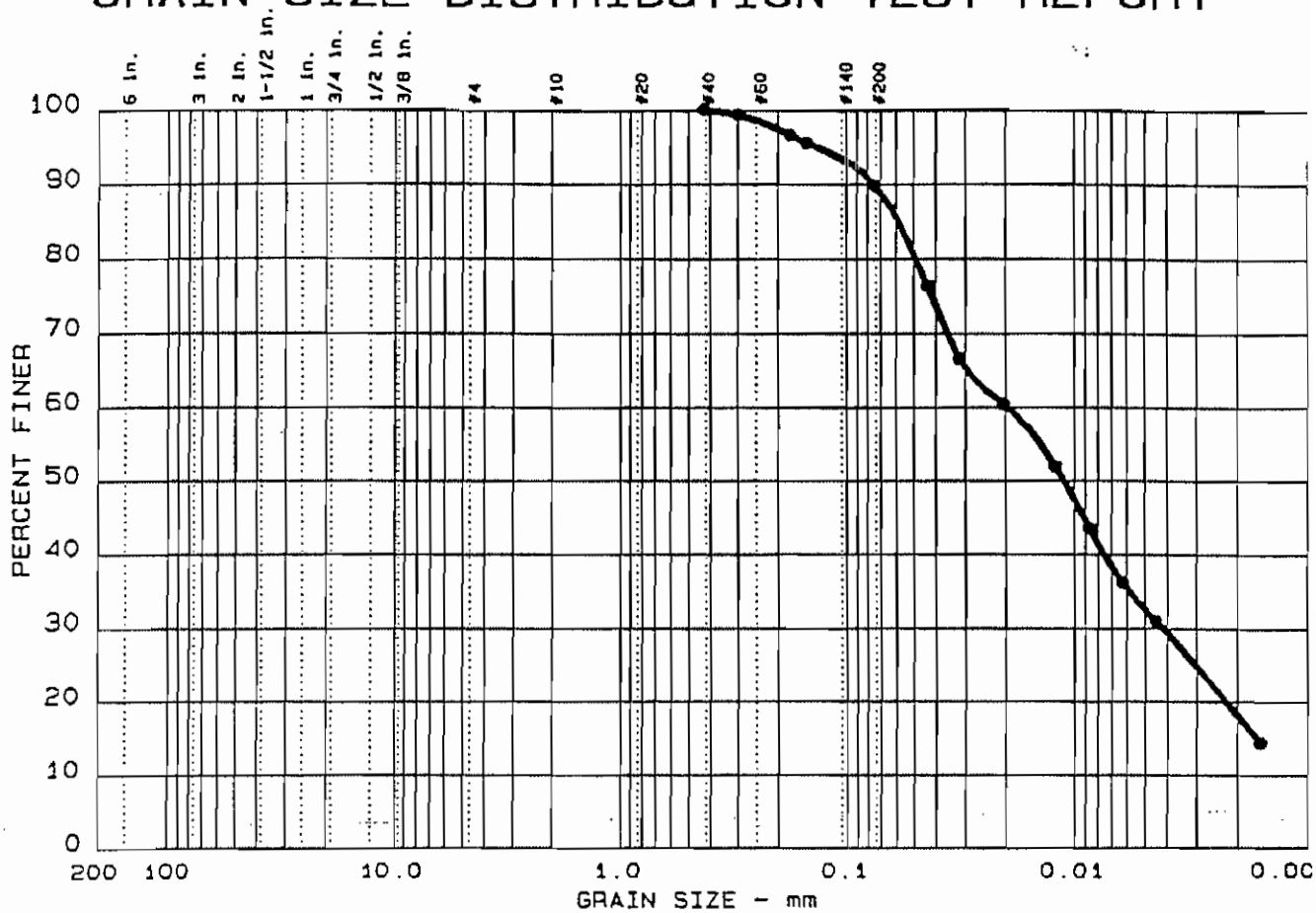
GRAIN SIZE DISTRIBUTION TEST REPORT

RMT. INC.

Figure No. _____

✓ JM 6-20-90

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	2	0.0	0.0	10.1	57.3	32.6

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●					0.01	0.004	0.0016			

MATERIAL DESCRIPTION	USCS	AASHTD
●		

Project No.: 467.42
Project: WEYERHAEUSER
● Location: MW-1A S8

Date: 6-8-90

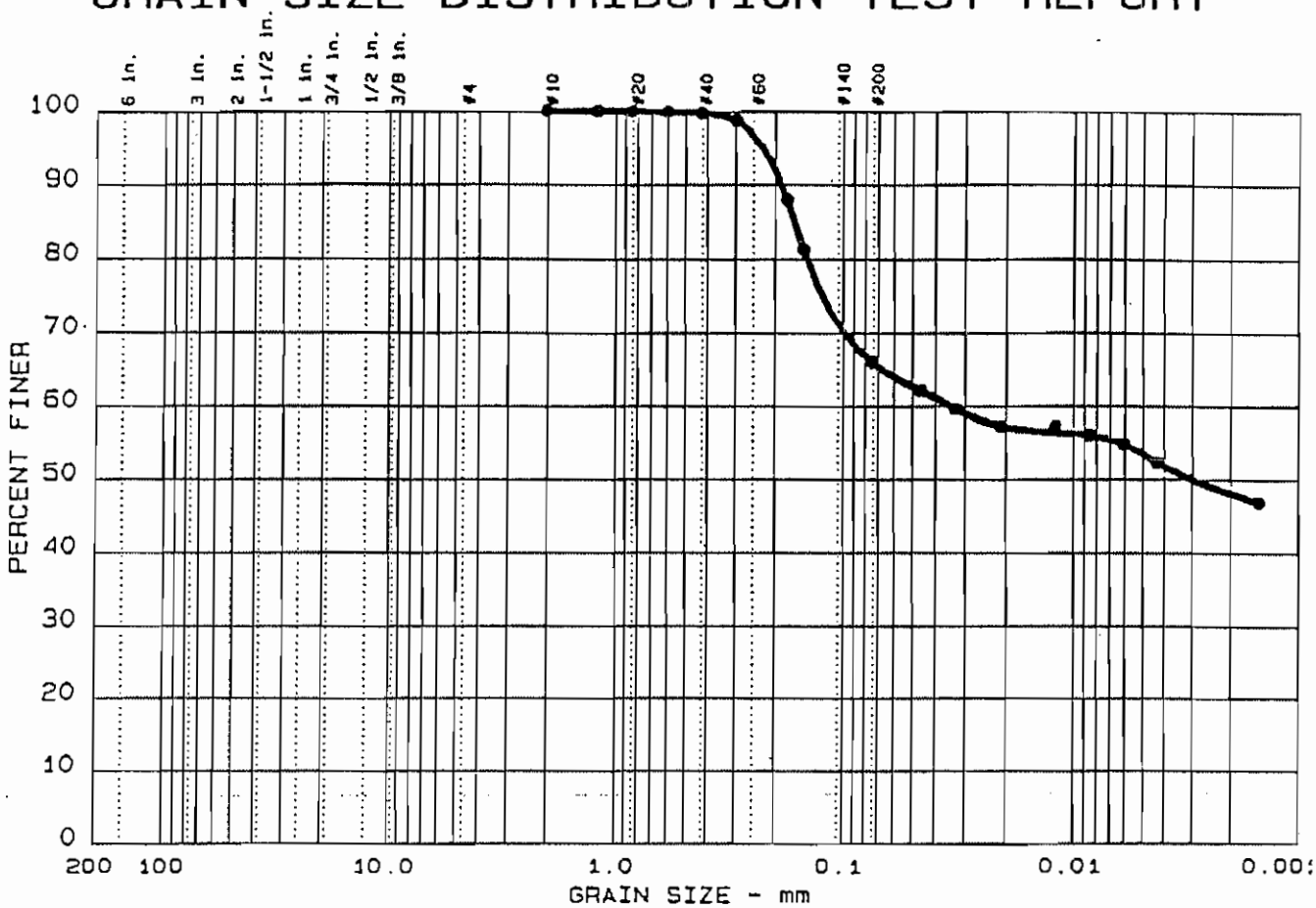
Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT -

RMT, INC.

Figure No. _____

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	16	0.0	0.0	34.0	12.5	53.5

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	48	26	0.16		0.00					

MATERIAL DESCRIPTION	USCS	AASHTO
●	CL	

Project No.: 467.42
Project: WEYERHAEUSER
● Location: TP16-1 .4-1.8'

Date: 6-8-90

Remarks:

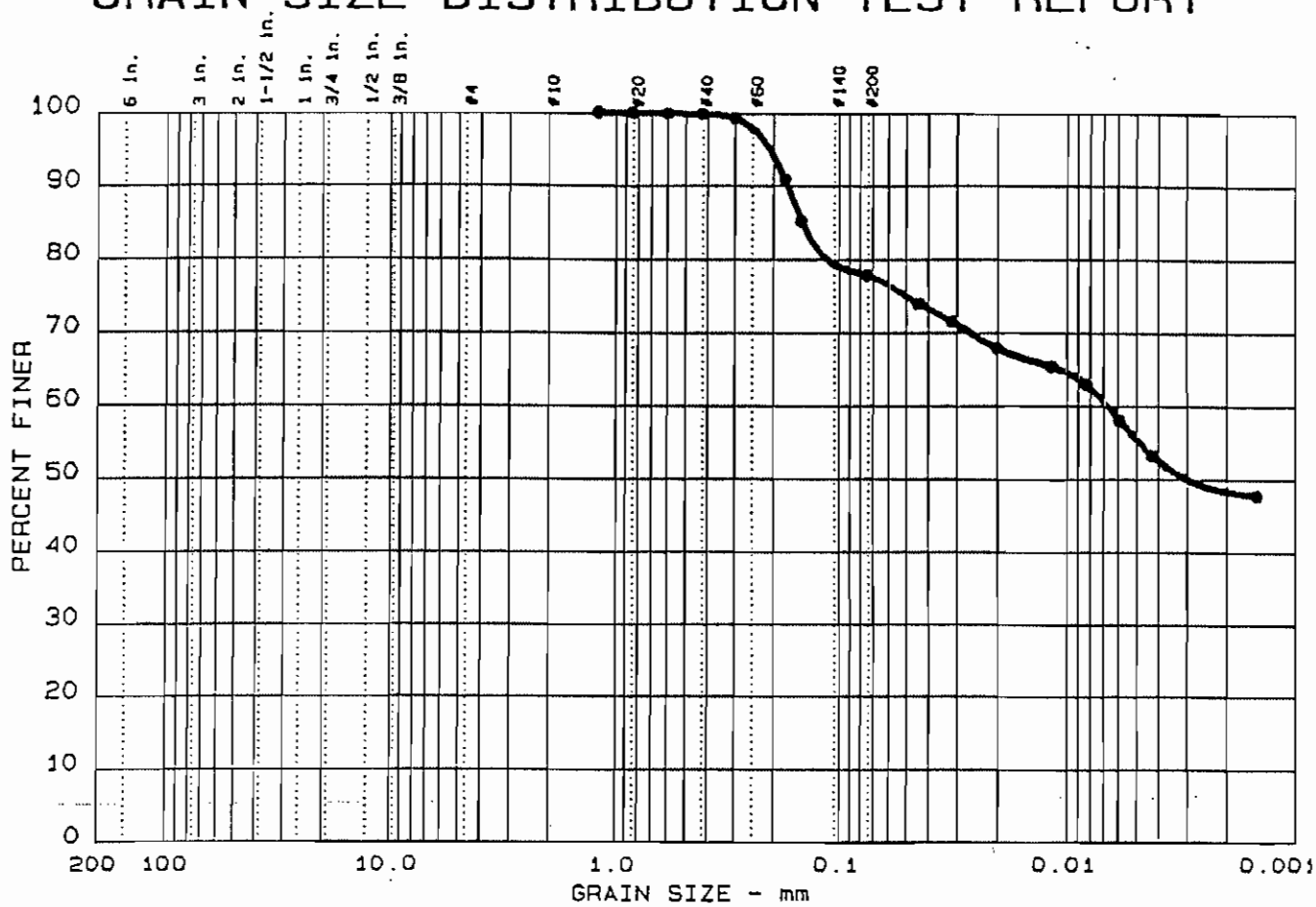
GRAIN SIZE DISTRIBUTION TEST REPORT

RMT, INC.

Figure No. _____

JCA 6-12-90

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	15	0.0	0.0	22.1	22.5	55.4

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	55	30	0.15		0.00					

MATERIAL DESCRIPTION	USCS	AASHTO
●	CH	

Project No.: 467.42
Project: WEYERHAEUSER
● Location: TP1-3 1.1-2.6'

Date: 6-8-90

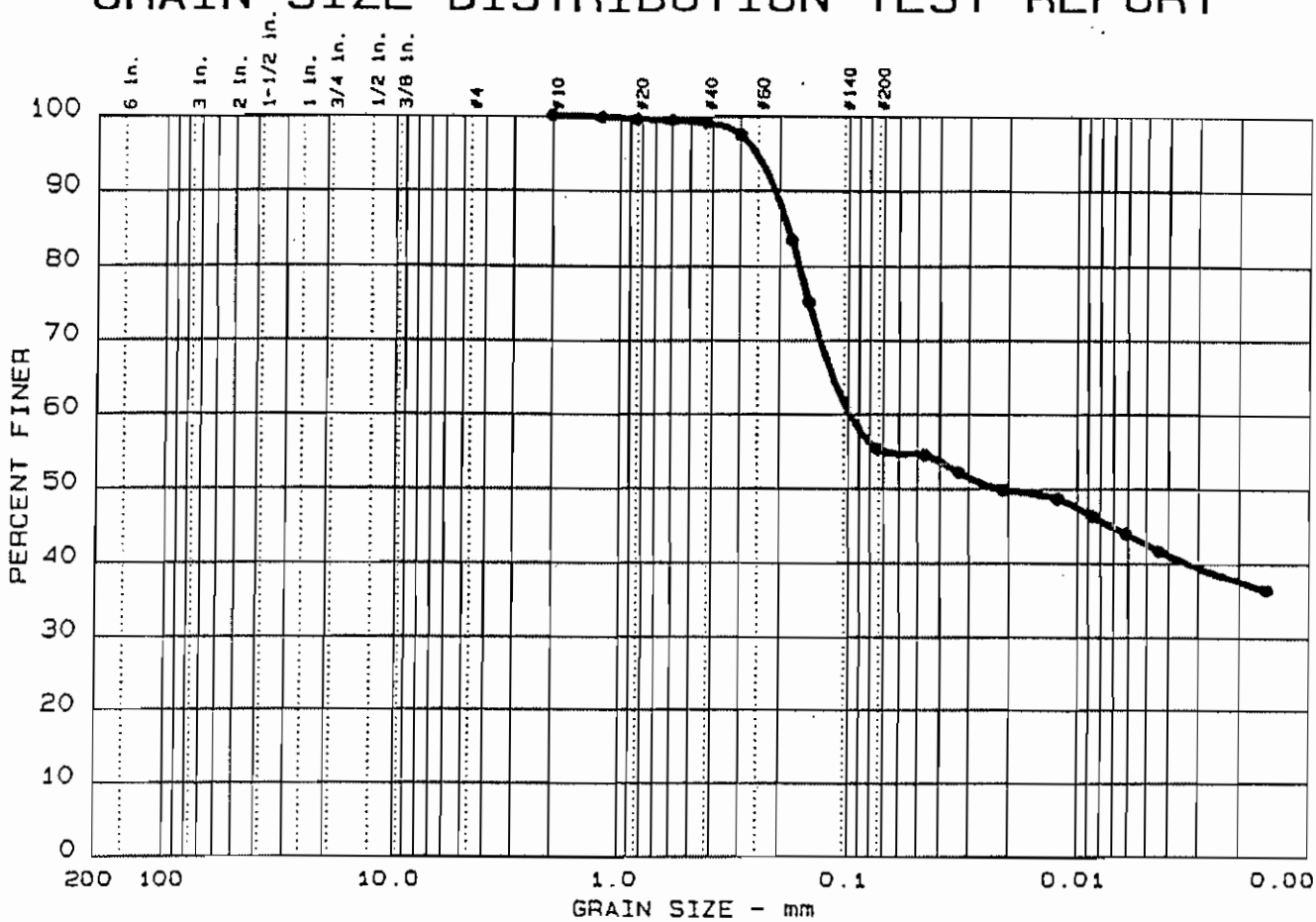
Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT

RMT. INC.

Figure No. _____

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	13	0.0	0.0	44.7	12.8	42.5

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	40	21	0.18	0.10	0.02					

MATERIAL DESCRIPTION	USCS	AASHTO
●	CL	

Project No.: 467.42
Project: WEYERHAEUSER
● Location: TP7-1 6.0-6.5'

Date: 6-8-90

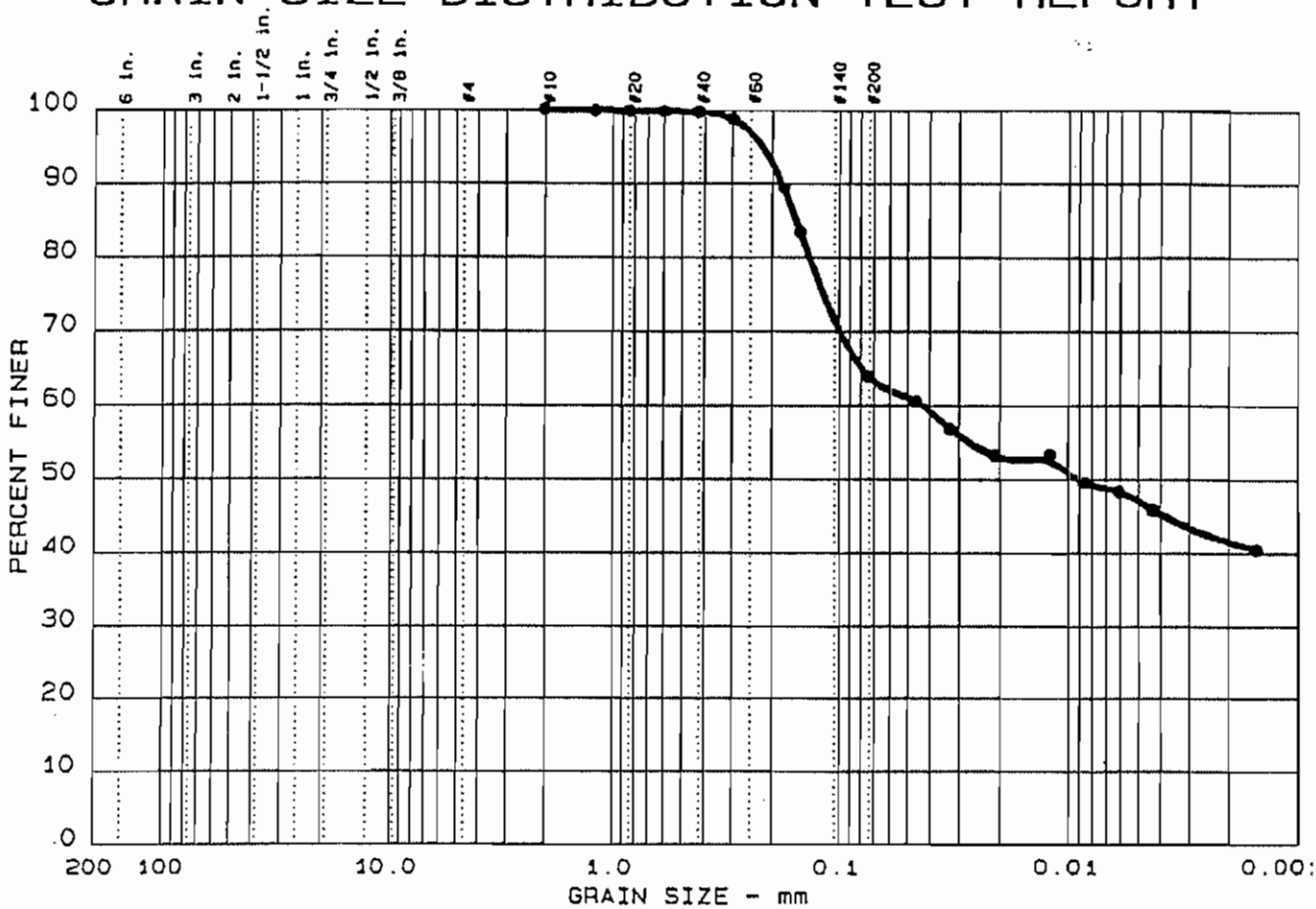
Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT

RMT. INC.

Figure No. _____

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	14	0.0	0.0	36.1	16.9	47.0

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	43	22	0.15		0.01					

MATERIAL DESCRIPTION	USCS	AASHTO
●	CL	

Project No.: 467.42
Project: WEYERHAEUSER
● Location: TP8-1 5.0-6.0'

Date: 6-8-90

Remarks:

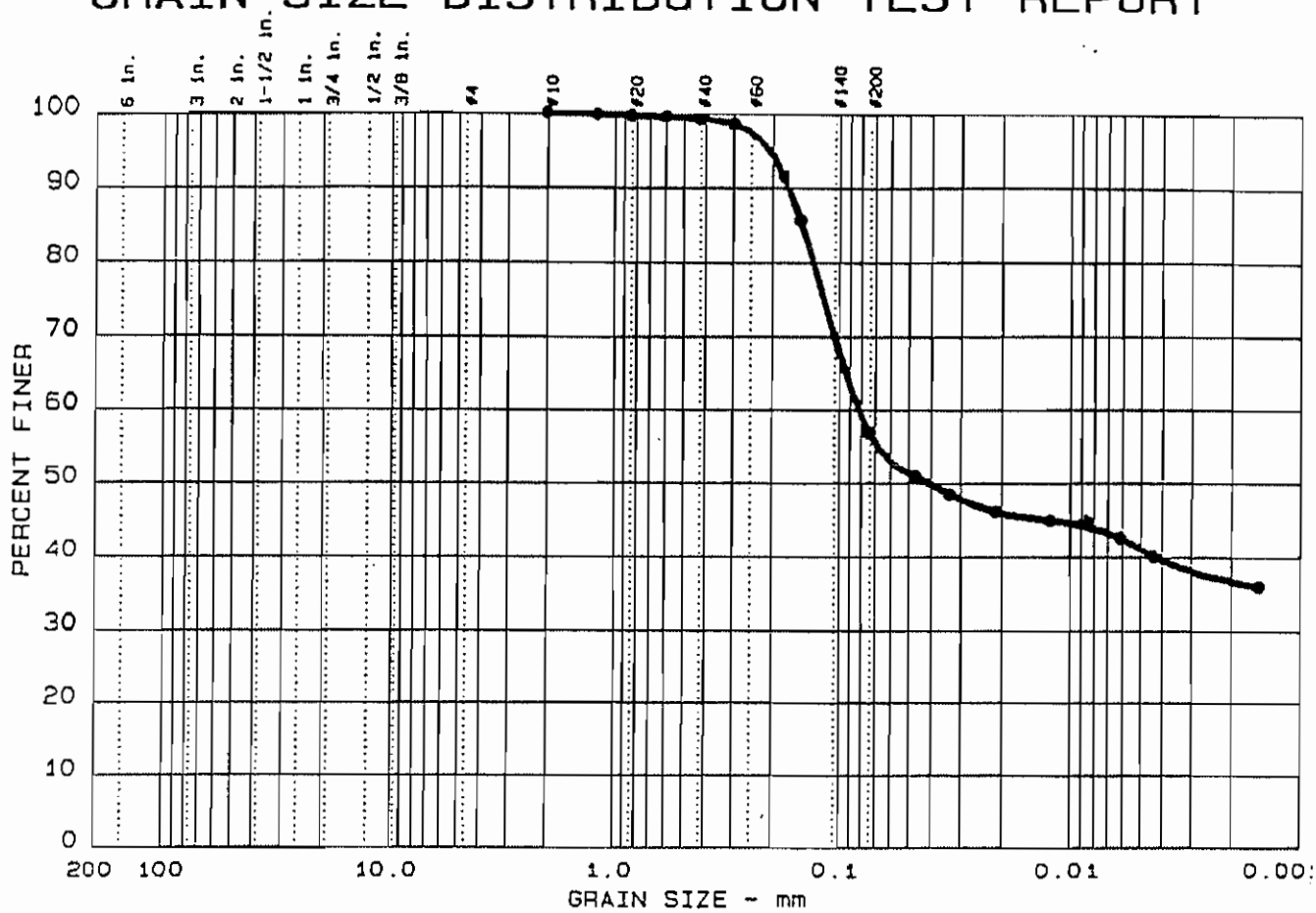
GRAIN SIZE DISTRIBUTION TEST REPORT

RMT. INC.

Figure No. _____

✓ JP 6-12-90

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	12	0.0	0.0	43.1	15.8	41.1

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	35	18	0.15	0.08	0.04					

MATERIAL DESCRIPTION	USCS	AASHTO
●	CL	

Project No.: 467.42
Project: WEYERHAEUSER
● Location: TP14-3 6.5-7.0'

Date: 6-8-90

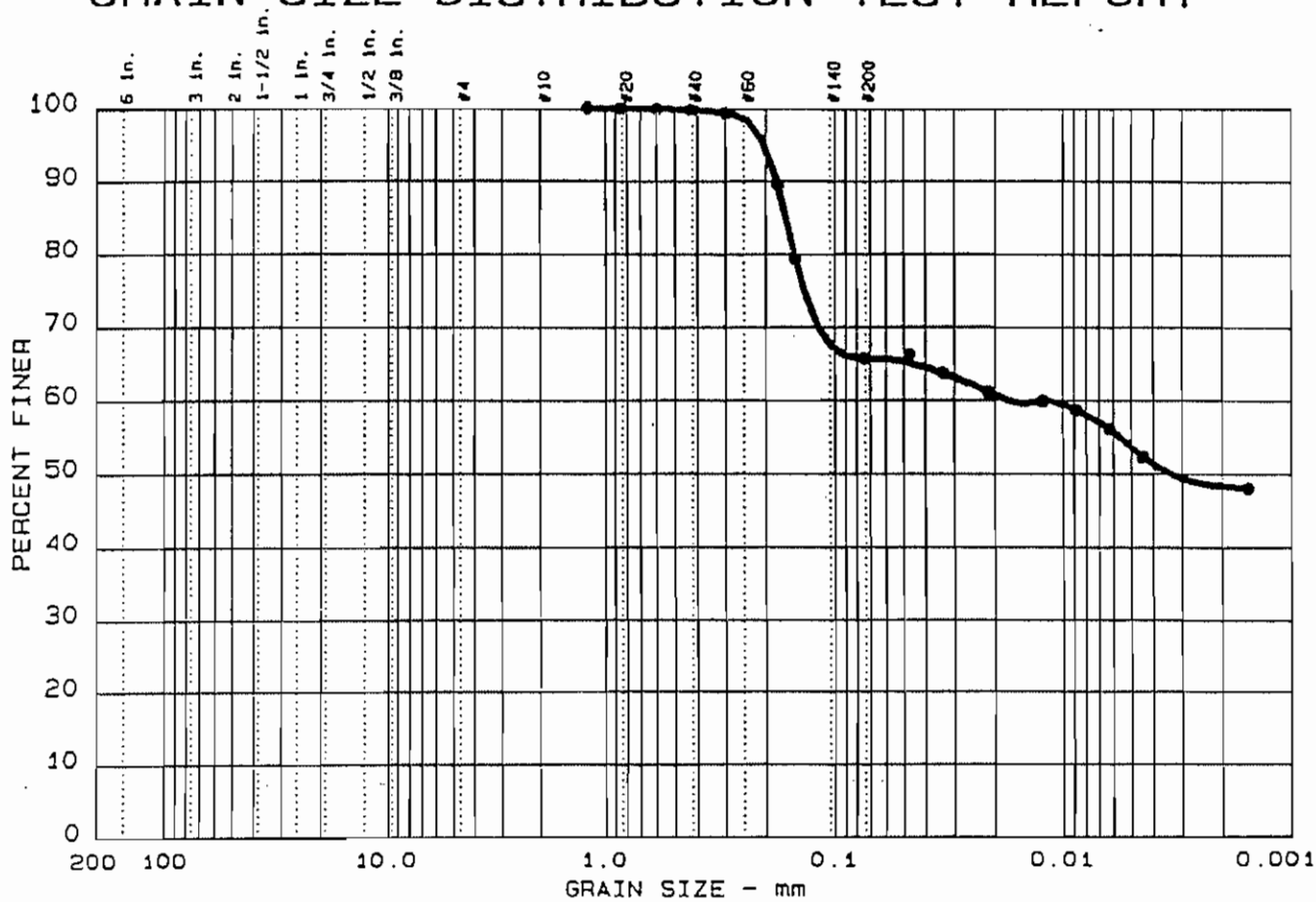
Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT

RMT, INC.

Figure No. _____

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	7	0.0	0.0	34.4	12.0	53.6

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.16		0.00					

MATERIAL DESCRIPTION	USCS	AASHTO
●		

Project No.: 467.42
Project: WEYERHAEUSER
● Location: MW-8 2-4.0'

Date: 6-8-90

Remarks:

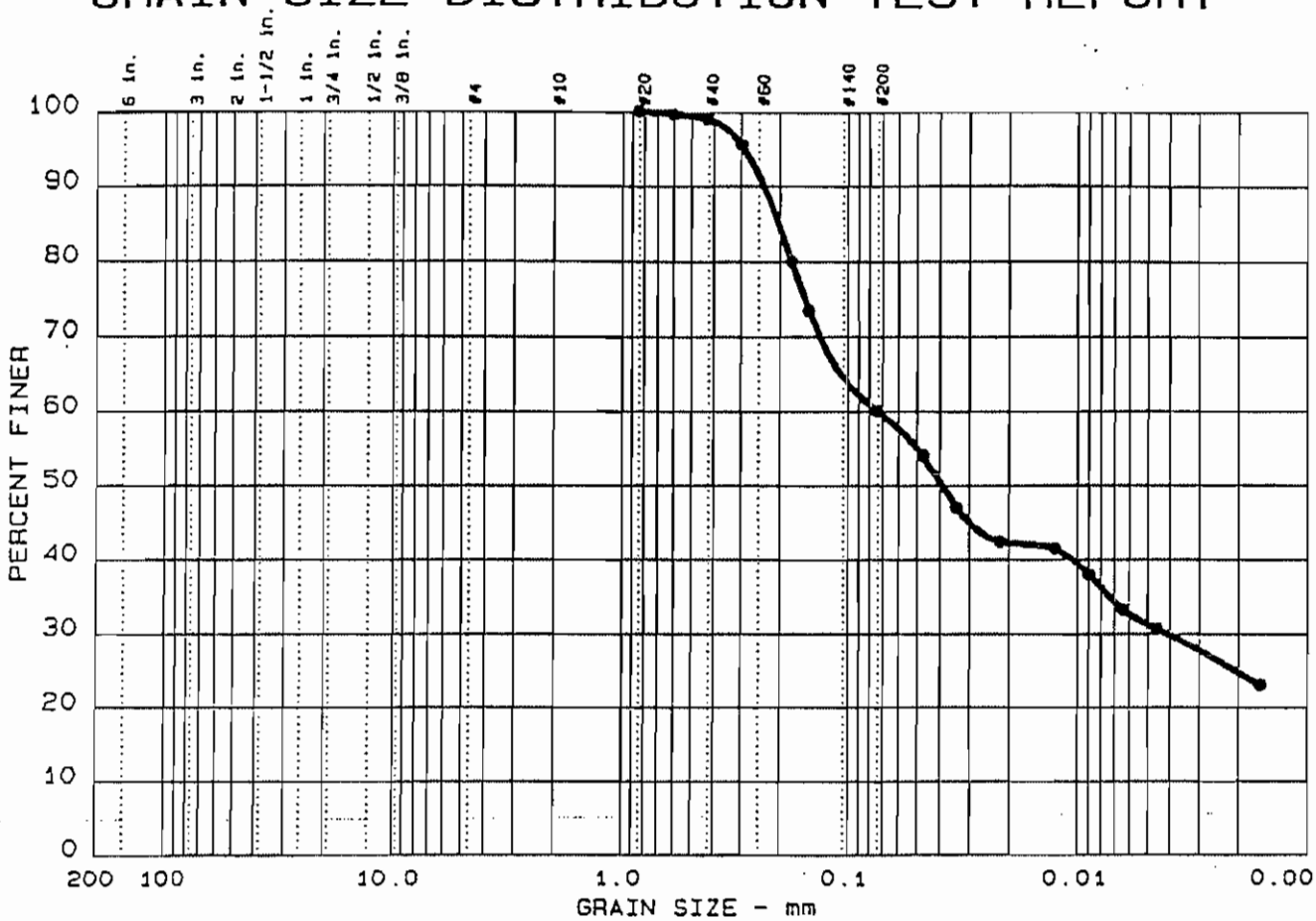
GRAIN SIZE DISTRIBUTION TEST REPORT

RMT. INC.

Figure No. _____

6-6-90 6-20-90

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	17	0.0	0.0	40.0	28.8	31.2

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.20		0.04	0.004				

MATERIAL DESCRIPTION	USCS	AASHTO
●		

Project No.: 467.42
Project: WEYERHAEUSER
● Location: OW-2 13-15'

Date: 6-6-90

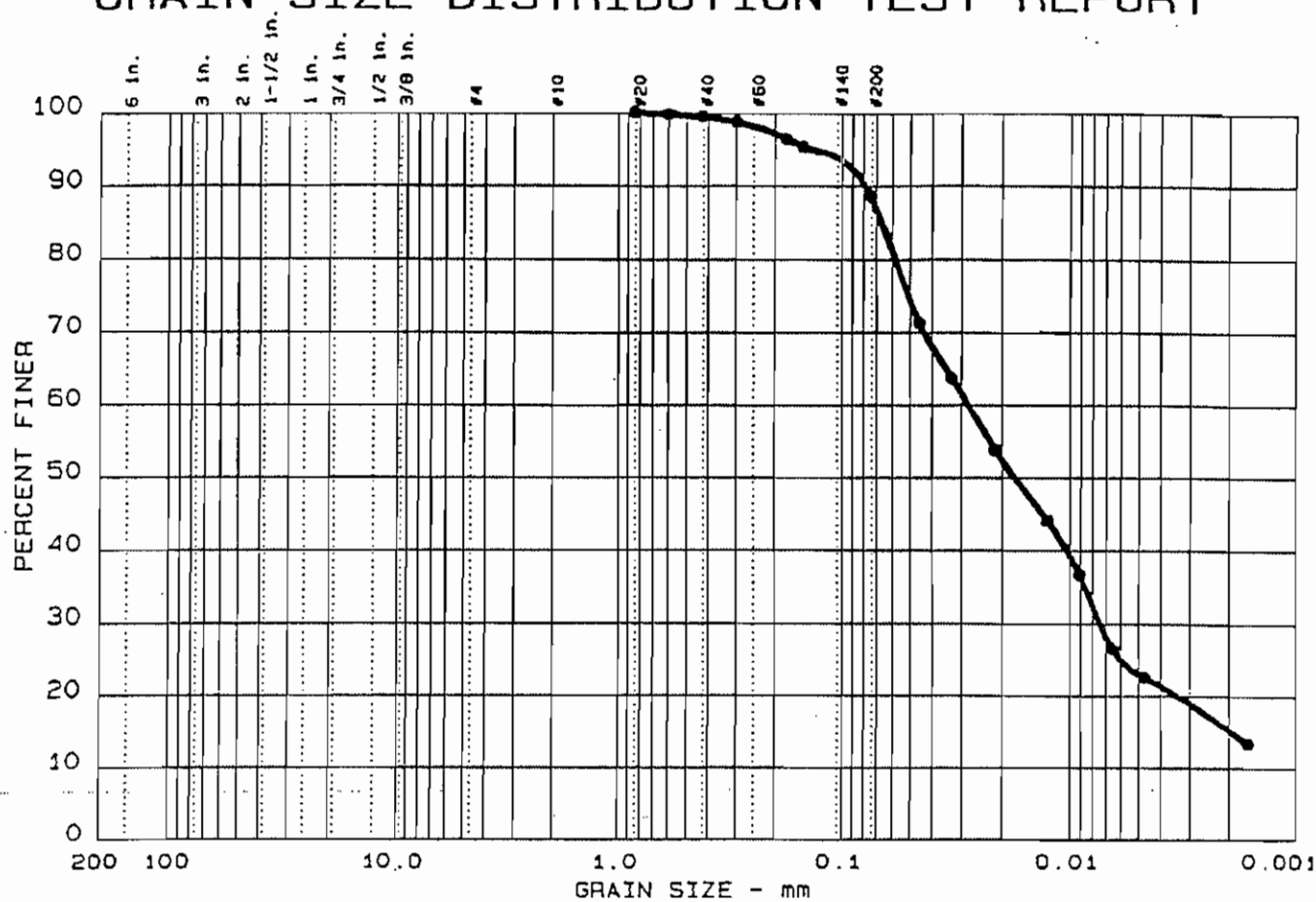
GRAIN SIZE DISTRIBUTION TEST REPORT
RMT. INC.

Remarks:

Figure No. _____

6-6-90 6-20-90

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	18	0.0	0.0	11.3	65.6	23.1

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●					0.02	0.007	0.0019			

MATERIAL DESCRIPTION	USCS	AASHTO
●		

Project No.: 467.42
Project: WEYERHAEUSER
◆ Location: OW-1 20-22'

Date: 6-6-90

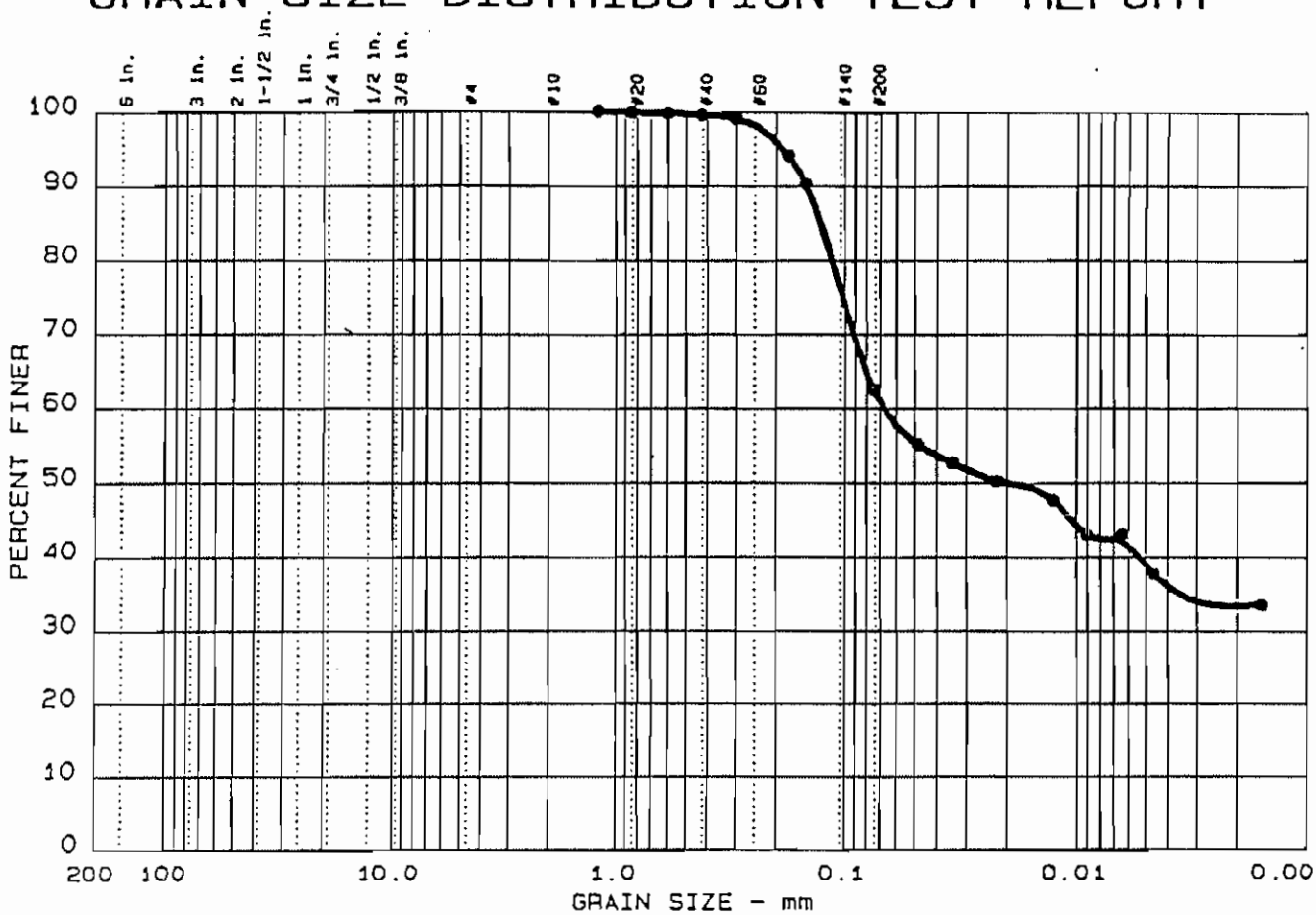
Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT

RMT. INC.

Figure No. _____

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75 mm	% GRAVEL	% SAND	% SILT	% CLAY
●	19	0.0	0.0	37.5	23.5	39.0

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.13		0.02					

MATERIAL DESCRIPTION	USCS	AASHTO
●		

Project No.: 467.42
Project: WEYERHAEUSER
● Location: OW-3 9-11.0'

Date: 6-6-90

Remarks:

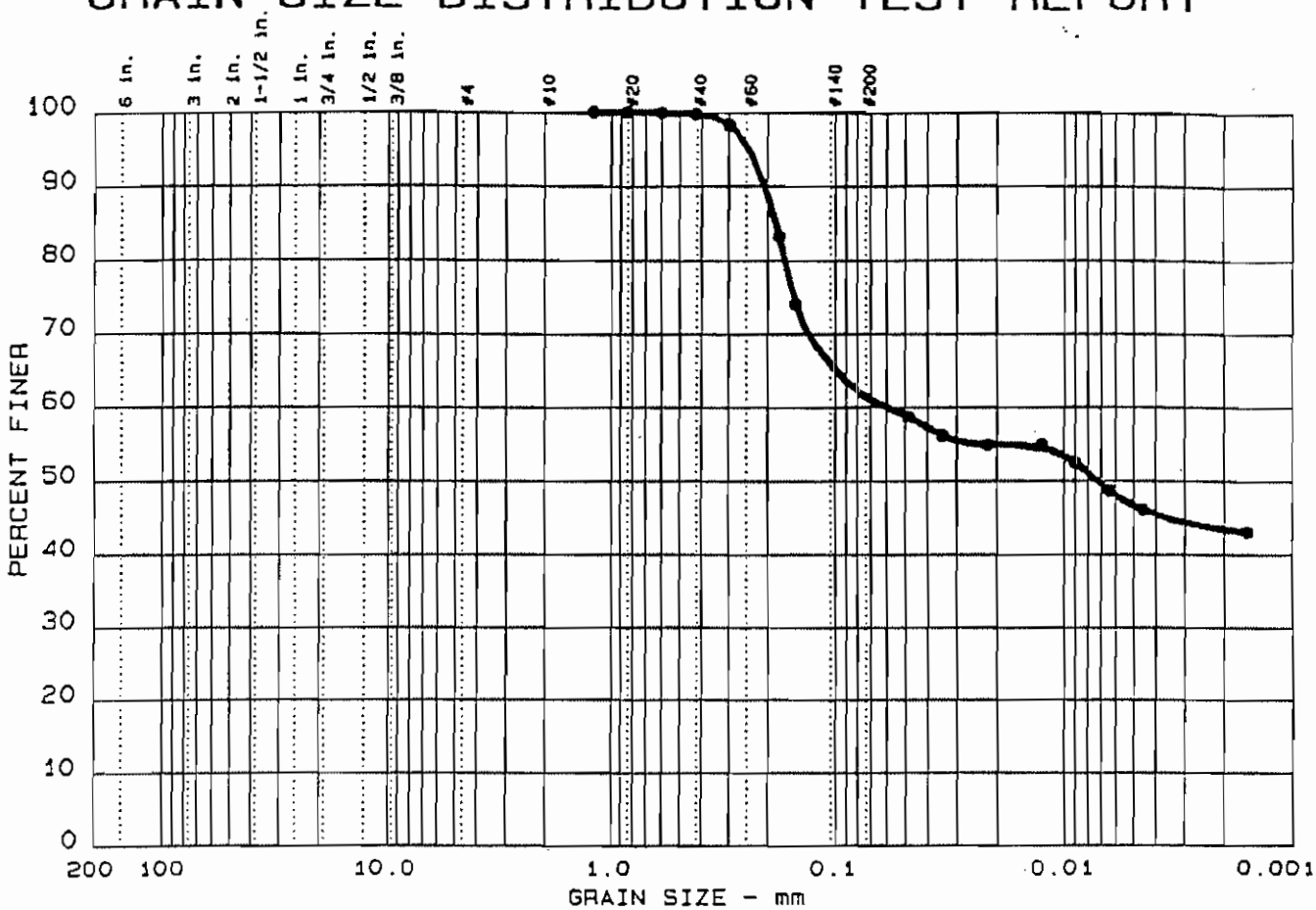
GRAIN SIZE DISTRIBUTION TEST REPORT

RMT, INC.

Figure No. _____

✓ 6-20-9.

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	6	0.0	0.0	38.6	14.8	46.6

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.18		0.01					

MATERIAL DESCRIPTION	USCS	AASHTO
●		

Project No.: 467.42
Project: WEYERHAEUSER
● Location: OW-1 4-6.0'

Date: 6-8-90

Remarks:

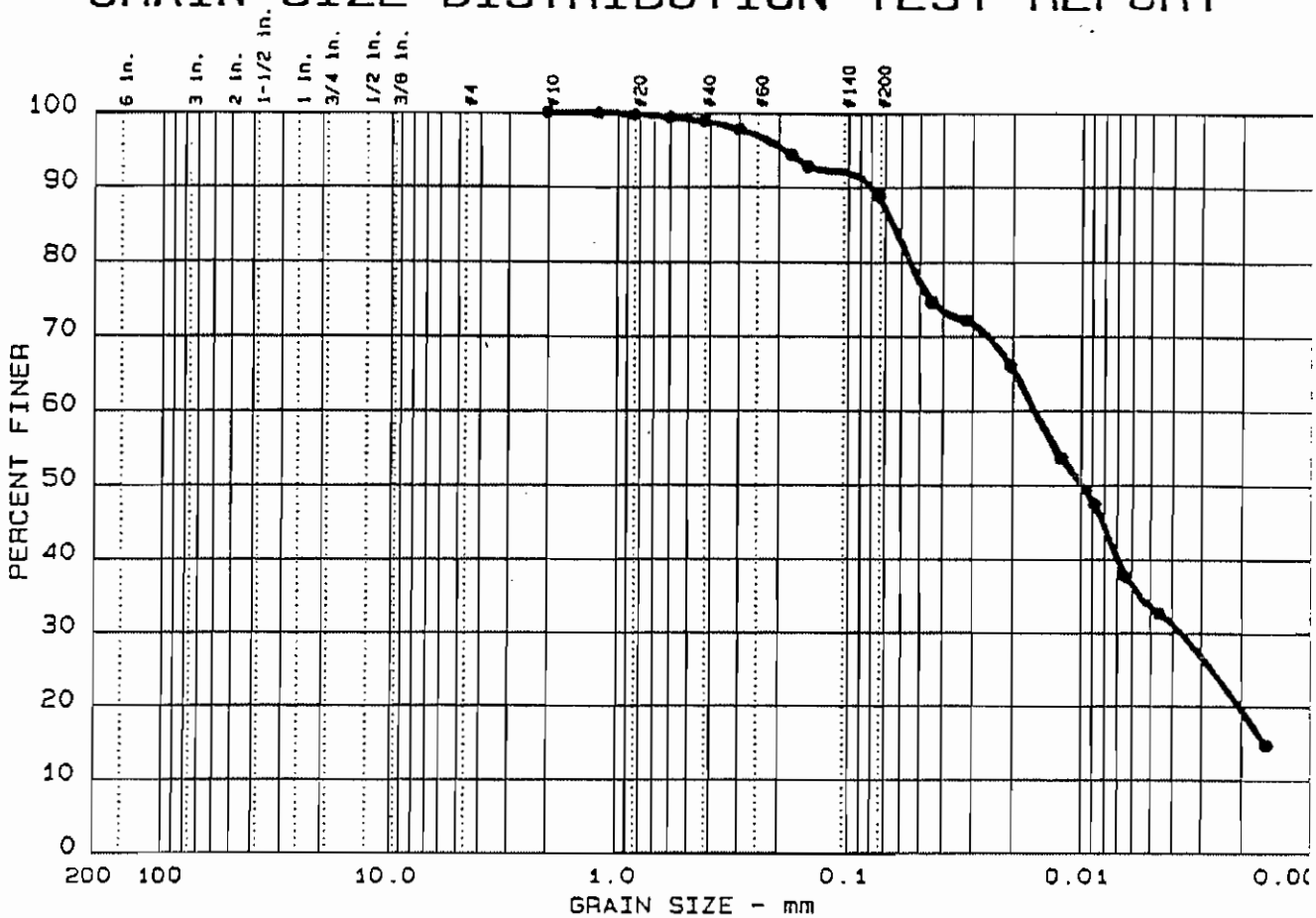
GRAIN SIZE DISTRIBUTION TEST REPORT

RMT, INC.

Figure No. _____

✓ JAI 6-27-9

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	10	0.0	0.0	11.2	55.2	33.6

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●					0.01	0.004	0.0016			

MATERIAL DESCRIPTION	USCS	AASHTO
●		

Project No.: 467.42
Project: WEYERHAEUSER
● Location: MW-1A 22-24.0'

Date: 6-1-90

Remarks:

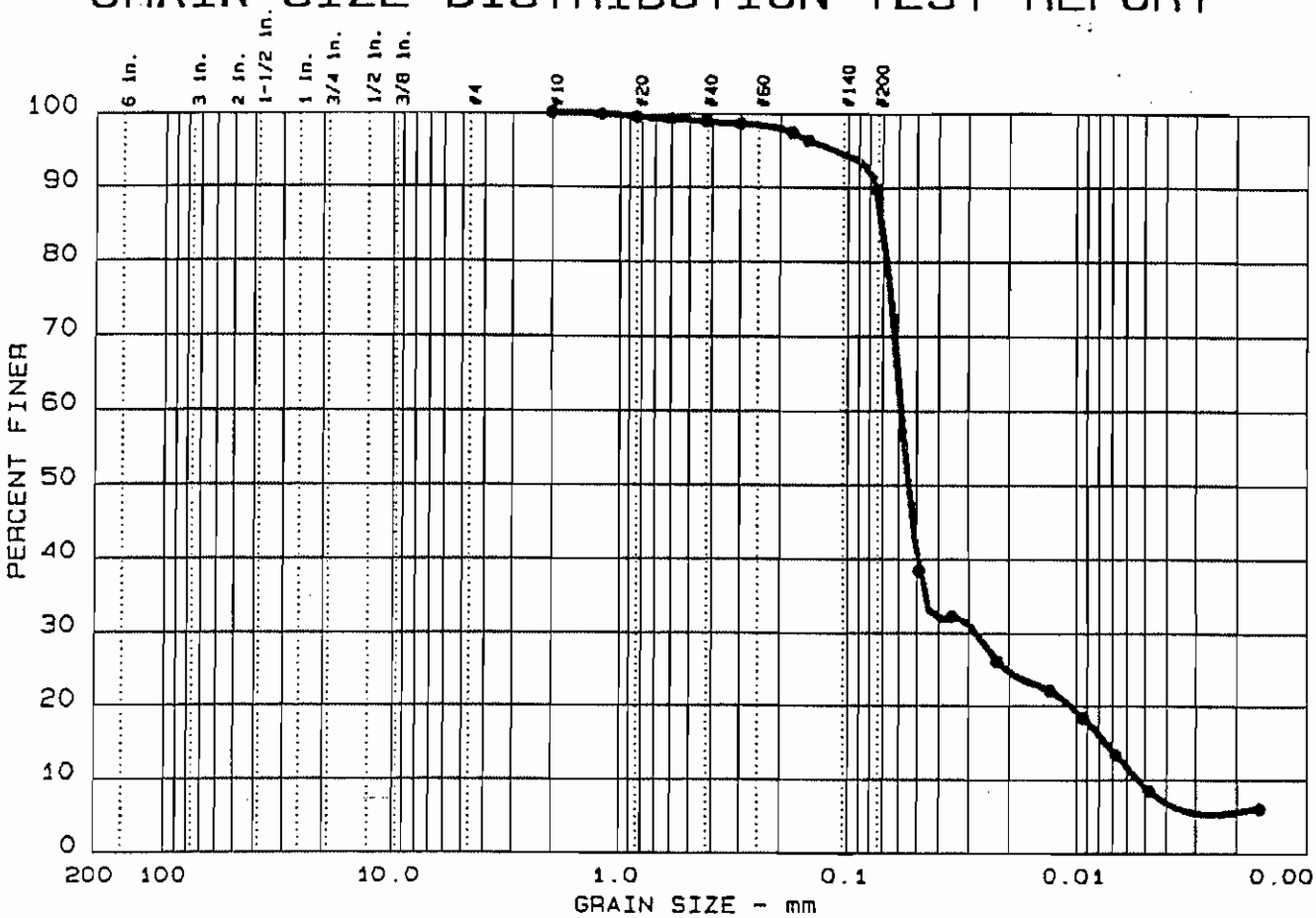
GRAIN SIZE DISTRIBUTION TEST REPORT

RMT. INC.

Figure No. _____

✓ pp 6-27-90

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	12	0.0	0.0	10.3	80.6	9.1

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●					0.05	0.028	0.0073	0.0053	2.47	10.9

MATERIAL DESCRIPTION	USCS	AASHTO
●		

Project No.: 467.42
Project: WEYERHAEUSER
● Location: MW-8 20-22.0'

Date: 6-1-90

Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT

RMT, INC.

Figure No. _____

RMT Soils Laboratory - Atterberg Limit De

PROJECT: Weyerhaeuser

			By	Date
	Tech: GTF	06/01/90	QC GMP	6/4/90
JOB #: 467.42	Input: GTF	06/01/90	QA JPL	6/4/90

JOB #: 467.42

BORING: TP-11-2 DEPTH: 5.5-7.0'

	Natural Moisture	LIQUID LIMIT		OVEN LL	PLASTIC LIMIT
TARE		115.28	115.33		115.09
BLOWS		25	24		
WET WT		131.67	133.07		134.38
DRY WT		126.22	127.17		129.65
% WATER		49.8	49.6		32.5

BORING	TP-11-2
DEPTH	5.5-7.0'
% WATER	
LL	50
PL	32
PI	18
CLASS	MH

JOB #: 467.42

BORING: MW-1A DEPTH: 22-24'

	Natural Moisture	LIQUID LIMIT		OVEN LL	PLASTIC LIMIT
TARE		115.21	114.69		115.29
BLOWS		28	28		
WET WT		137.89	139.61		142.24
DRY WT		130.84	131.75		135.69
% WATER		45.7	46.7		32.1

BORING	MW-1A
DEPTH	22-24'
% WATER	
LL	46
PL	32
PI	14
CLASS	ML

JOB #: 467.42

BORING: SB-9 DEPTH: 18-20.0'

	Natural Moisture	LIQUID LIMIT		OVEN LL	PLASTIC LIMIT
TARE					
BLOWS					
WET WT		NON-PLASTIC MATERIAL			
DRY WT					
% WATER					

BORING	SB-9
DEPTH	18-20.0'
% WATER	
LL	
PL	0
PI	
CLASS	NP

RMT Soils Laboratory - Atterberg Limit Determination

PROJECT: Weyerhaeuser

			By	Date
	Tech: GTF	05/31/90	QC GAP	6/4/90
JOB #: 467.42	Input: GTF	05/31/90	QA JCP	6/4/90

JOB #: 467.42

BORING: OW-1 DEPTH: 8-10.0'

	Natural Moisture	LIQUID LIMIT		OVEN LL	PLASTIC LIMIT
TARE					
BLOWS					
WET WT	NON-PLASTIC MATERIAL				
DRY WT					
% WATER					

BORING	OW-1
DEPTH	8-10.0'
% WATER	
LL	
PL	0
PI	
CLASS	NP

JOB #: 467.42

BORING: MW-8 DEPTH: 20-22.0'

	Natural Moisture	LIQUID LIMIT		OVEN LL	PLASTIC LIMIT
TARE		115.88	115.43		114.87
BLOWS		26	26		
WET WT		139.72	141.45		137.27
DRY WT		131.76	132.71		132.56
% WATER		50.4	50.8		26.6

BORING	MW-8
DEPTH	20-22.0'
% WATER	
LL	51
PL	27
PI	24
CLASS	CH

JOB #: 467.42

BORING: OW-3 DEPTH: S-5

	Natural Moisture	LIQUID LIMIT		OVEN LL	PLASTIC LIMIT
TARE		115.06	115.39		115.21
BLOWS		26	28		
WET WT		144.26	142.02		129.26
DRY WT		139.10	137.38		127.34
% WATER		21.6	21.4		15.8

BORING	OW-3
DEPTH	S-5
% WATER	
LL	21
PL	16
PI	5
CLASS	CL-ML

RMT Soils Laboratory - Atterberg Limit Determination

PROJECT: Weyerhaeuser

JOB #: 467.42

			By	Date
Tech: GTF	05/31/90	QC	GMP	6/4/90
Input: GTF	05/31/90	QA	DA	6/4/90

JOB #: 467.42

BORING: TP-2-5 DEPTH: 6.0-6.5'

	BORING	TP-2-5
	DEPTH	6.0-6.5'
	% WATER	
	LL	
	PL	0
	PI	
	CLASS	NP

	Natural Moisture	LIQUID LIMIT		OVEN LL	PLASTIC LIMIT
TARE					
BLOWS					
WET WT		NON-PLASTIC MATERIAL			
DRY WT					
% WATER					

JOB #: 467.42

BORING: TP-9-2 DEPTH: 2.7-3.0'

	BORING	TP-9-2
	DEPTH	2.7-3.0'
	% WATER	
	LL	27
	PL	16
	PI	11
	CLASS	CL

	Natural Moisture	LIQUID LIMIT		OVEN LL	PLASTIC LIMIT
TARE		114.90	115.41		115.20
BLOWS		20	22		
WET WT		139.11	137.68		137.82
DRY WT		133.85	132.90		134.62
% WATER		27.0	26.9		16.5

JOB #: 467.42

BORING: MW-1A DEPTH: S8

	BORING	MW-1A
	DEPTH	S8
	% WATER	
	LL	48
	PL	28
	PI	20
	CLASS	ML

	Natural Moisture	LIQUID LIMIT		OVEN LL	PLASTIC LIMIT
TARE		115.35	115.29		115.06
BLOWS		26	28		
WET WT		135.44	134.75		136.91
DRY WT		128.93	128.46		132.10
% WATER		48.2	48.4		28.2

RMT Soils Laboratory - Atterberg Limit Determination

PROJECT: WEYERHAEUSER

JOB #: 467.42

			By	Date
Tech: GTF	06/06/90	QC	GAP	6/18/90
Input: GTF	06/06/90	QA	JM	6/20/90

PROJECT: WEYERHAEUSER JOB #: 467.42

BORING: OW-3 DEPTH: 15-16.5'

	BORING	OW-3
	DEPTH	15-16.5'
	% WATER	
	LL	
	PL	0
	PI	
	CLASS	NP

	Natural Moisture	LIQUID LIMIT		OVEN LL	PLASTIC LIMIT
TARE					
BLOWS					
WET WT	NON-PLASTIC MATERIAL				
DRY WT					
% WATER					

PROJECT: WEYERHAEUSER JOB #: 467.42

BORING: OW-3 DEPTH: 9-11'

	BORING	OW-3
	DEPTH	9-11'
	% WATER	
	LL	37
	PL	18
	PI	19
	CLASS	CL

	Natural Moisture	LIQUID LIMIT		OVEN LL	PLASTIC LIMIT
TARE		116.19	115.22		115.14
BLOWS		25	24		
WET WT		142.00	139.34		137.07
DRY WT		135.00	132.83		133.68
% WATER		37.2	36.8		18.3

PROJECT: WEYERHAEUSER JOB #: 467.42

BORING: OW-1 DEPTH: 20-22'

	BORING	OW-1
	DEPTH	20-22'
	% WATER	
	LL	53
	PL	33
	PI	20
	CLASS	MH

	Natural Moisture	LIQUID LIMIT		OVEN LL	PLASTIC LIMIT
TARE		115.17	115.00		115.29
BLOWS		21	22		
WET WT		136.80	140.81		137.45
DRY WT		129.23	131.80		131.90
% WATER		52.7	52.8		33.4

RMT Soils Laboratory - Atterberg Limit Determination

PROJECT: WEYERHAEUSER

			By	Date
	Tech: GTF	05/22/90	QC	
JOB #: 467.42	Input: GTF	06/12/90	QA	

PROJECT: WEYERHAEUSER JOB #: 467.42

BORING: MW-8 DEPTH: S8

Natural Moisture	LIQUID LIMIT	OVEN LL	PLASTIC LIMIT
TARE			
BLOWS			
WET WT	NON-PLASTIC MATERIAL		
DRY WT			
% WATER			

BORING	MW-8
DEPTH	S8
% WATER	
LL	
PL	0
PI	
CLASS	NP

PROJECT: WEYERHAEUSER JOB #: 467.42

BORING: MW-1A DEPTH: S10

Natural Moisture	LIQUID LIMIT	OVEN LL	PLASTIC LIMIT
TARE			
BLOWS			
WET WT	NON-PLASTIC MATERIAL		
DRY WT			
% WATER			

BORING	MW-1A
DEPTH	S10
% WATER	
LL	
PL	0
PI	
CLASS	NP

RMT Soils Laboratory - Atterberg Limit Determination

PROJECT: WEYERHAEUSER

JOB #: 467.42

			By	Date
Tech:	GTF	06/06/90	QC	6/18/90
Input:	GTF	06/06/90	QA	6/20/90

PROJECT: WEYERHAEUSER JOB #: 467.42

BORING: OW-2 DEPTH: 13-15'

	Natural Moisture	LIQUID LIMIT		OVEN LL	PLASTIC LIMIT
TARE		115.13	115.10		115.13
BLOWS		23	23		
WET WT		138.09	139.67		135.37
DRY WT		132.31	133.54		132.40
% WATER		33.3	32.9		17.2

BORING	OW-2
DEPTH	13-15'
% WATER	
LL	33
PL	17
PI	16
CLASS	CL

PROJECT: WEYERHAEUSER JOB #: 467.42

BORING: OW-1 DEPTH: 4-6.0'

	Natural Moisture	LIQUID LIMIT		OVEN LL	PLASTIC LIMIT
TARE		115.34	115.28		115.43
BLOWS		26	23		
WET WT		138.22	139.39		138.38
DRY WT		132.24	133.06		134.90
% WATER		35.6	35.2		17.9

BORING	OW-1
DEPTH	4-6.0'
% WATER	
LL	35
PL	18
PI	17
CLASS	CL

PROJECT: WEYERHAEUSER JOB #: 467.42

BORING: MW-8 DEPTH: 2-4.0'

	Natural Moisture	LIQUID LIMIT		OVEN LL	PLASTIC LIMIT
TARE		115.41	115.88		115.35
BLOWS		24	23		
WET WT		136.87	144.38		144.95
DRY WT		130.85	136.33		140.18
% WATER		38.8	39.0		19.2

BORING	MW-8
DEPTH	2-4.0'
% WATER	
LL	39
PL	19
PI	20
CLASS	CL

RMT Soils Laboratory - Atterberg Limit Determination

PROJECT: WEYERHAEUSER

			By	Date
	Tech: GTF	06/08/90	QC JPM	6-12-90
JOB #: 467.42	Input: GTF	06/28/90	QA JB	6-12-90

PROJECT: WEYERHAEUSER JOB #: 467.42

BORING: TP11-1 DEPTH: 1.8-4.0'

	Natural Moisture	LIQUID LIMIT		OVEN LL	PLASTIC LIMIT
TARE		116.04	115.49		115.08
BLOWS		22	21		
WET WT		141.72	139.70		137.07
DRY WT		135.89	134.21		134.05
% WATER		28.9	28.7		15.9

BORING	TP11-1
DEPTH	1.8-4.0'
% WATER	
LL	29
PL	16
PI	13
CLASS	CL

PROJECT: WEYERHAEUSER JOB #: 467.42

BORING: TP9-3 DEPTH: 4.0-5.0'

	Natural Moisture	LIQUID LIMIT		OVEN LL	PLASTIC LIMIT
TARE		114.76	115.87		115.45
BLOWS		20	22		
WET WT		144.03	146.80		138.72
DRY WT		137.80	140.35		135.18
% WATER		26.3	25.9		17.9

BORING	TP9-3
DEPTH	4.0-5.0'
% WATER	
LL	26
PL	18
PI	8
CLASS	CL

PROJECT: WEYERHAEUSER JOB #: 467.42

BORING: TP10-2 DEPTH: 3.0-5.0'

	Natural Moisture	LIQUID LIMIT		OVEN LL	PLASTIC LIMIT
TARE		115.29	115.05		115.24
BLOWS		25	25		
WET WT		145.48	144.20		138.53
DRY WT		138.79	137.80		135.25
% WATER		28.5	28.1		16.4

BORING	TP10-2
DEPTH	3.0-5.0'
% WATER	
LL	28
PL	16
PI	12
CLASS	CL

RMT Soils Laboratory - Atterberg Limit Determination

PROJECT: WEYERHAEUSER

JOB #: 467.42

			By	Date
Tech:	GTF	06/08/90	QC JPL	6-12-90
Input:	GTF	06/28/90	QA JPL	6-12-90

PROJECT: WEYERHAEUSER JOB #: 467.42

BORING: TP7-1 DEPTH: 6.0-6.5'

	Natural Moisture	LIQUID LIMIT		OVEN LL	PLASTIC LIMIT
TARE		115.27	114.69		115.28
BLOWS		22	23		
WET WT		141.93	143.17		142.98
DRY WT		134.24	134.87		138.58
% WATER		39.9	40.7		18.9

BORING	TP7-1
DEPTH	6.0-6.5'
% WATER	
LL	40
PL	19
PI	21
CLASS	CL

PROJECT: WEYERHAEUSER JOB #: 467.42

BORING: TP14-3 DEPTH: 6.5-7.0'

	Natural Moisture	LIQUID LIMIT		OVEN LL	PLASTIC LIMIT
TARE		115.32	115.08		115.49
BLOWS		27	25		
WET WT		142.78	139.35		136.79
DRY WT		135.65	133.06		133.67
% WATER		35.4	35.0		17.2

BORING	TP14-3
DEPTH	6.5-7.0'
% WATER	
LL	35
PL	17
PI	18
CLASS	CL

PROJECT: WEYERHAEUSER JOB #: 467.42

BORING: TP4-2 DEPTH: 4.5-5.2'

	Natural Moisture	LIQUID LIMIT		OVEN LL	PLASTIC LIMIT
TARE		115.25	115.39		115.81
BLOWS		21	25		
WET WT		142.42	145.07		136.71
DRY WT		135.25	137.30		133.53
% WATER		35.1	35.5		17.9

BORING	TP4-2
DEPTH	4.5-5.2'
% WATER	
LL	35
PL	18
PI	17
CLASS	CL

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. MW-8
SHEET NO. 1 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	
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 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	
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 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	
		29-51				
					45	BORING TERMINATED AT 45.0 FEET
					50	
					55	
					60	
					65	

APPENDIX B

LOG OF TEST PIT OR EXCAVATION

PIT NUMBER TP-1

PROJECT NAME Weyerhaeuser

PROJECT NUMBER 467.42

LOCATION Plymouth, N.C.

DATE 5-2-90

CONTRACTOR Hopkins

METHOD Backhoe

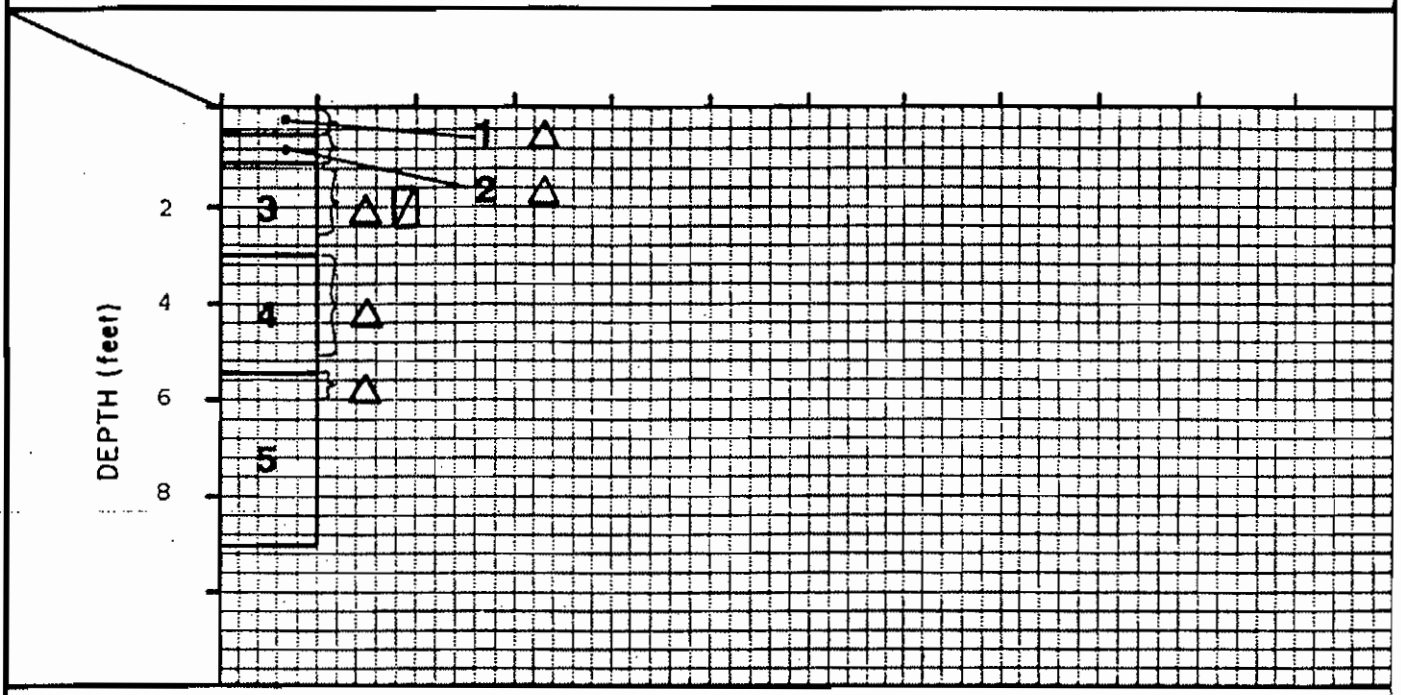
WIDTH 2-3 ft.

LOGGED BY BTG

CHECKED BY

PAGE 1 OF 1

GRAPHIC REPRESENTATION OF EXCAVATION



ORIENTATION

DESCRIPTION OF UNITS

1) SILTY SAND (SM); fine grained; trace clay; tan; (some topsoil, black).
2) CLAYEY SAND (SC); fine grained; orange-brown.
3) CLAY (CH); orange-brown mottled with gray.
4) SILTY SAND (SM); fine grained; some thin clay laminae in upper foot; orange-gray.
5) SILTY SAND/CLAYEY SAND (SM-SC); fine grained; mottled orange and light gray.

LEGEND:

△ Jar Sample ▨ Bulk Sample

LOG OF TEST PIT OR EXCAVATION

PIT NUMBER TP-2

PROJECT NAME Weyerhaeuser

PROJECT NUMBER 467.42

LOCATION Plymouth, N.C.

DATE 5-1-90

CONTRACTOR Hopkins

METHOD Backhoe

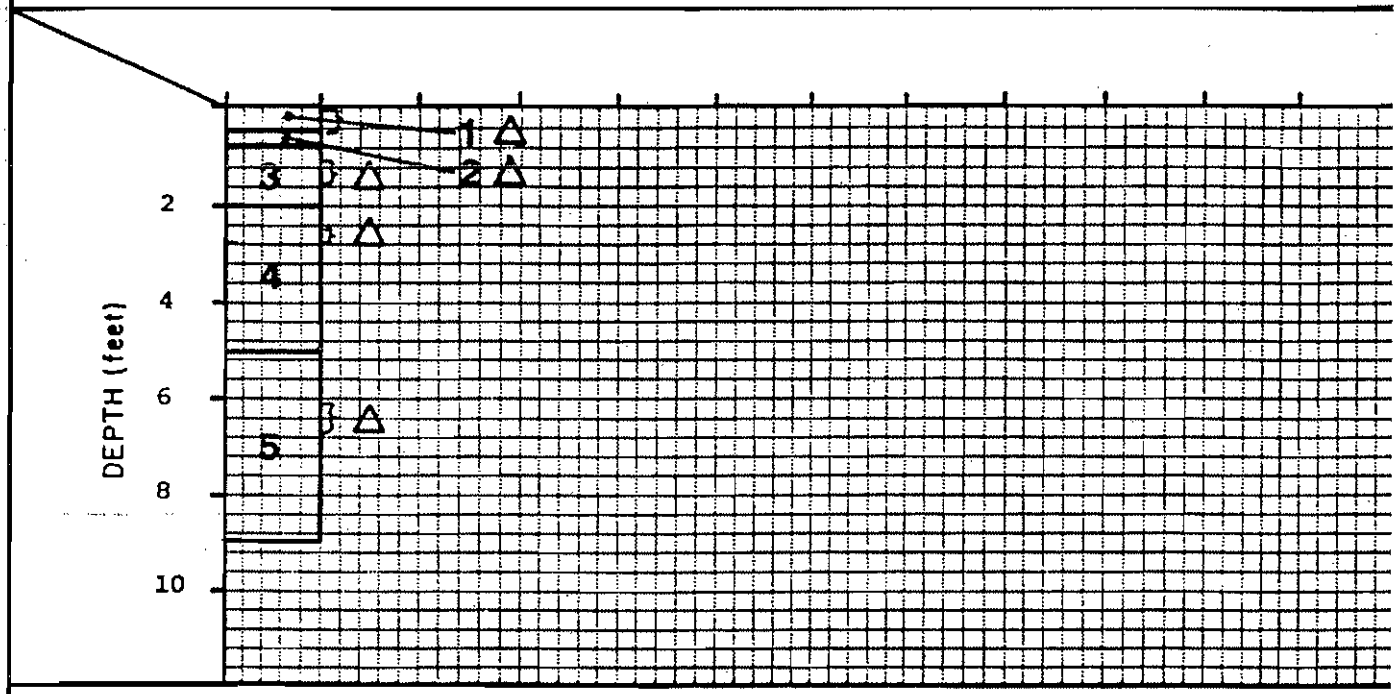
WIDTH 2-3 ft.

LOGGED BY BTG

CHECKED BY

PAGE 1 OF 1

GRAPHIC REPRESENTATION OF EXCAVATION



ORIENTATION

DESCRIPTION OF UNITS

1) SILTY SAND/SANDY SILT (SM-ML) ; gray; (topsoil).
2) SILTY SAND (SM); fine grained; light brown, tan.
3) SILTY SAND/CLAYEY SAND (SM-SC); fine grained.
4) CLAY (CL); sandy (fine grained); orange-brown, some gray.
5) CLAYEY SAND (SC); very fine grained; gray brown.

LEGEND:

△ Jar Sample

LOG OF TEST PIT OR EXCAVATION

PIT NUMBER TP-3

PROJECT NAME Weyerhaeuser

PROJECT NUMBER 467.42

LOCATION Plymouth, NC

DATE 5-1-90

CONTRACTOR Hopkins

METHOD Backhoe

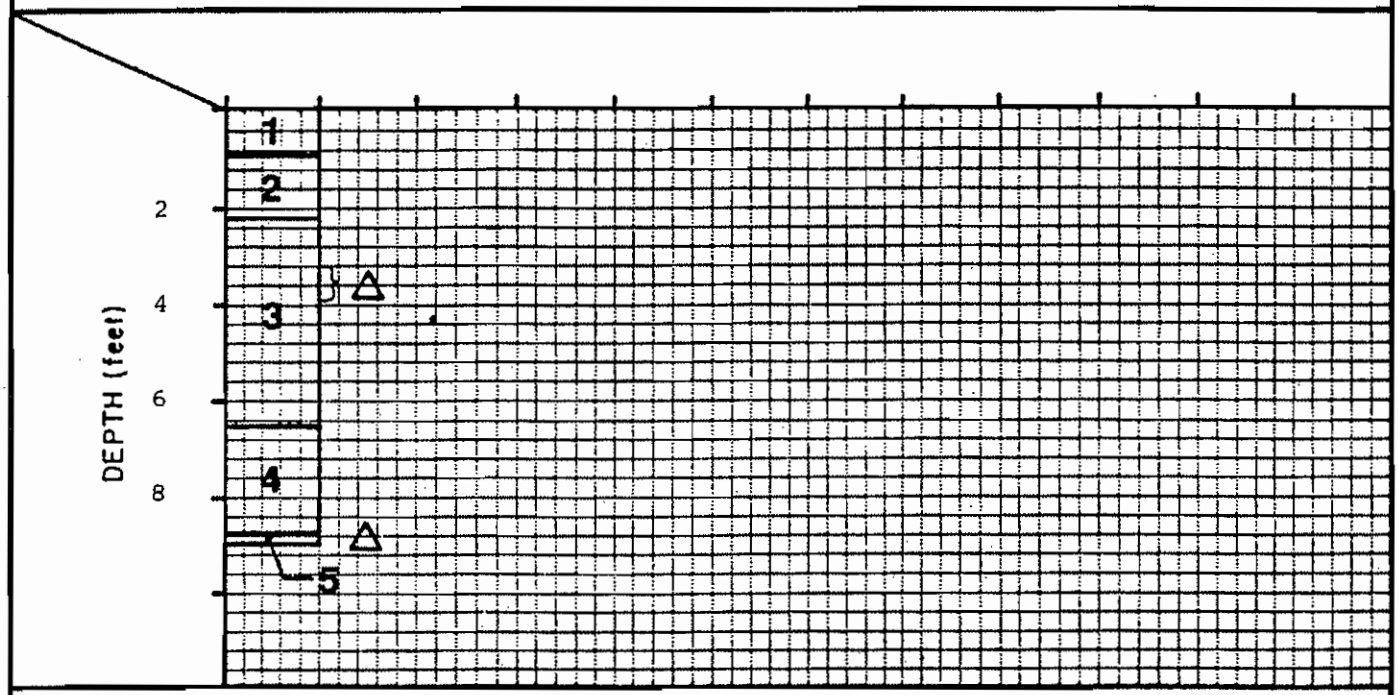
WIDTH 2-3 ft.

LOGGED BY BTG

CHECKED BY

PAGE 1 OF 1

GRAPHIC REPRESENTATION OF EXCAVATION



ORIENTATION

DESCRIPTION OF UNITS

1) SILTY SAND (SM); fine grained; gray, (topsoil).
2) SAND/SILTY SAND (SP-SM); fine grained; tan.
3) SILTY SAND (SM); fine grained; trace clay below 3.2 feet; orange, gray.
4) SAND/SILTY SAND (SP-SM); fine grained; orange, white, tan.
5) CLAY (CL); fine grained sand, mottled gray and orange.

LEGEND:

△ Jar Sample

LOG OF TEST PIT OR EXCAVATION

PIT NUMBER TP-4

PROJECT NAME Weyerhaeuser

PROJECT NUMBER 467.42

LOCATION Plymouth, NC

DATE 5-2-90

CONTRACTOR Hopkins

METHOD Backhoe

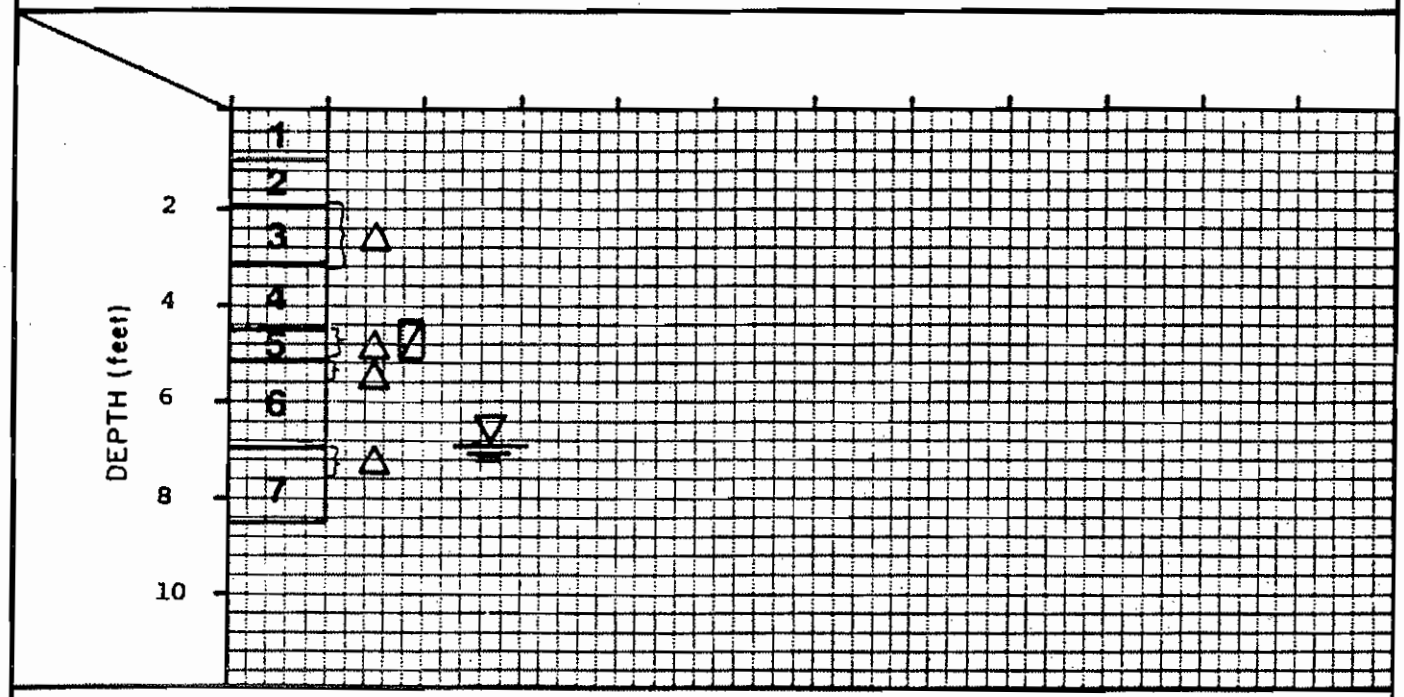
WIDTH 2-3 ft.

LOGGED BY BTG

CHECKED BY

PAGE 1 OF 1

GRAPHIC REPRESENTATION OF EXCAVATION



ORIENTATION

DESCRIPTION OF UNITS

1) SILTY SAND (SM); fine grained; gray; (topsoil).
2) SAND/SILTY SAND (SP-SM); fine grained; tan.
3) SILTY SAND/CLAYEY SAND (SM-SC); fine grained; orange-brown.
4) SILTY SAND (SM); fine grained; orange.
5) CLAYEY SAND(SC)/SILTY SAND (SC-SM); fine grained; interlaminated gray and orange-brown.
6) SILTY SAND (SM); fine grained; trace clay; orange, tan.
7) SAND/SILTY SAND (SP-SM); fine grained; clayey (7.5 to 8.0 feet); light gray.

LEGEND:

△ Jar Sample

▨ Bulk Sample

▽ Water Level While Excavating

LOG OF TEST PIT OR EXCAVATION

PIT NUMBER TP-5

PROJECT NAME Weyerhaeuser

PROJECT NUMBER 467.42

LOCATION Plymouth, N.C.

DATE 5-2-90

CONTRACTOR Hopkins

METHOD Backhoe

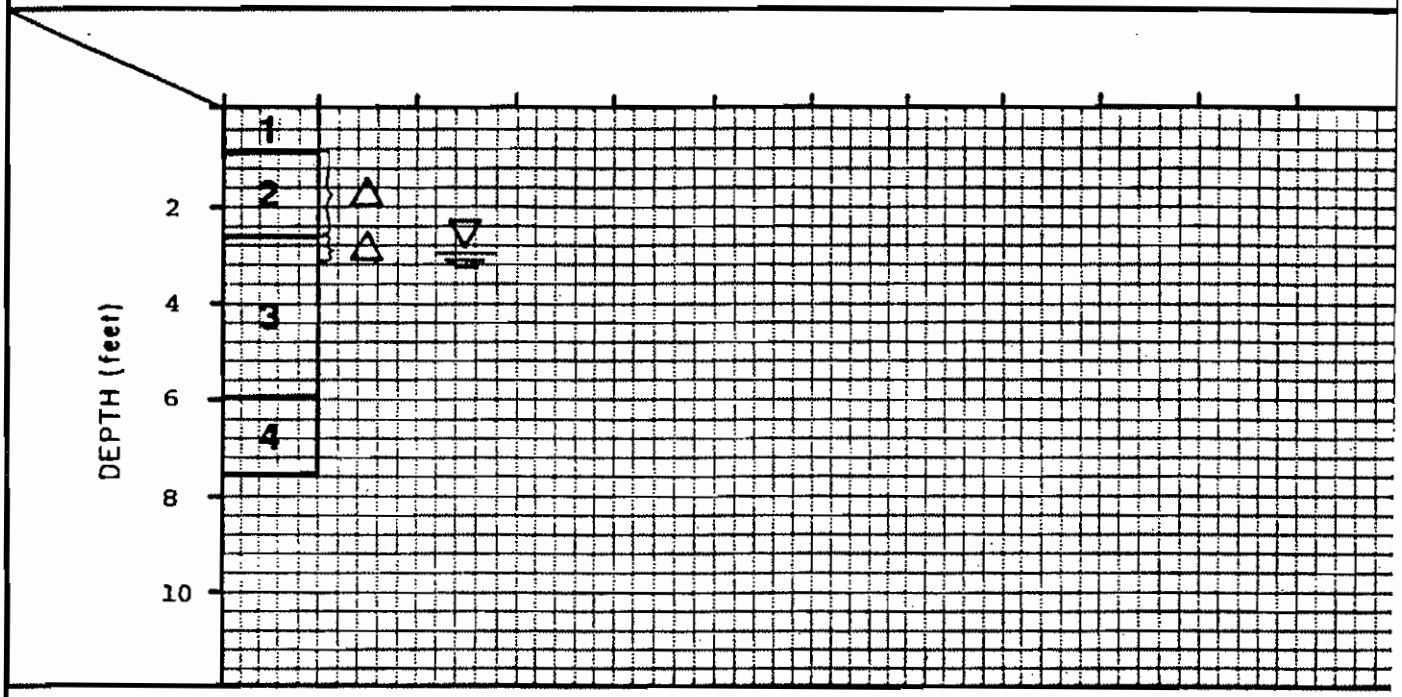
WIDTH 2-3 ft.

LOGGED BY BTG

CHECKED BY

PAGE 1 OF 1

GRAPHIC REPRESENTATION OF EXCAVATION



ORIENTATION

DESCRIPTION OF UNITS

1) SILTY SAND (SM); fine grained; brown; (topsoil).
2) SILTY SAND (SM); fine grained; brown-light gray.
3) SILTY SAND/CLAYEY SAND (SM-SC); fine grained; mottled light gray, orange.
4) SILTY SAND (SM); as above; trace clay.

LEGEND:

△ Jar Sample

▽ Water Level While Excavating

LOG OF TEST PIT OR EXCAVATION

PIT NUMBER TP-6

PROJECT NAME Weyerhaeuser

PROJECT NUMBER 467.42

LOCATION Plymouth, N.C.

DATE 5-1-90

CONTRACTOR Hopkins

METHOD Backhoe

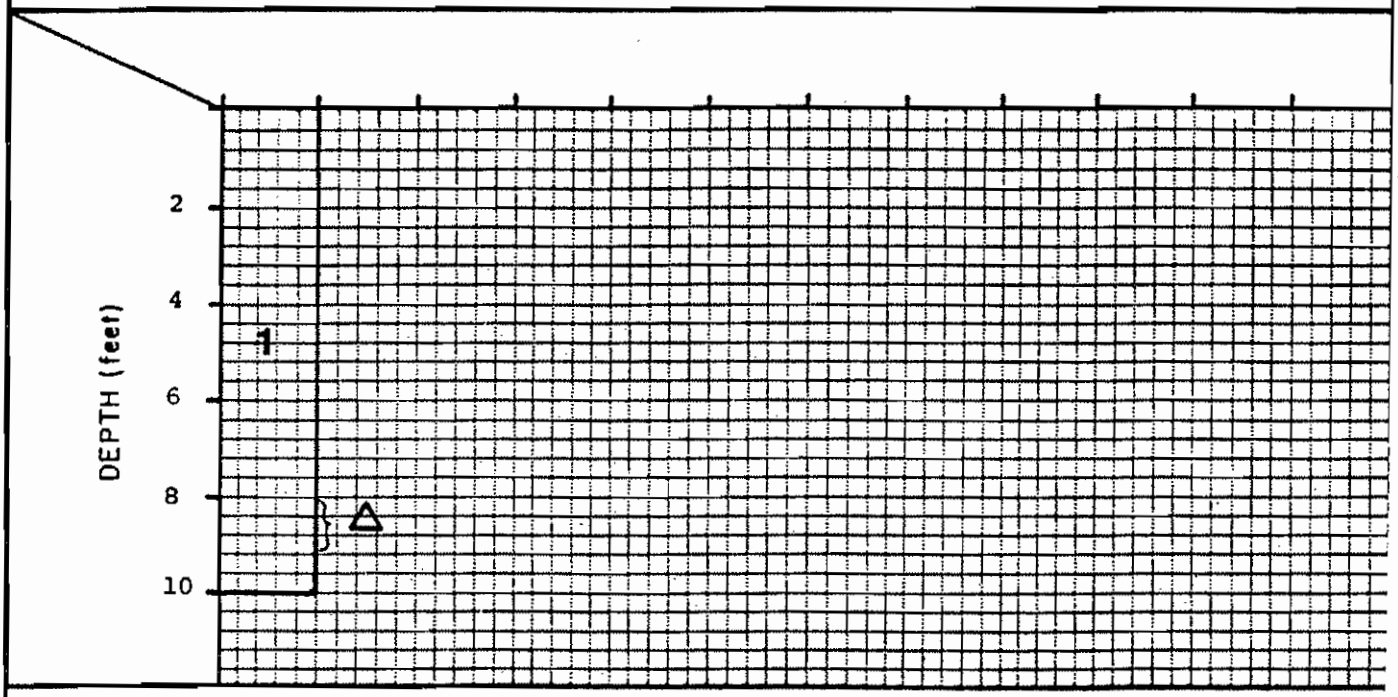
WIDTH 2-3 ft.

LOGGED BY BTG

CHECKED BY

PAGE 1 OF 1

GRAPHIC REPRESENTATION OF EXCAVATION



ORIENTATION

DESCRIPTION OF UNITS

1) SAND/SILTY SAND (SP-SM); fine grained; tan, orange-brown, white.

LEGEND:

△ Jar Sample

LOG OF TEST PIT OR EXCAVATION

PIT NUMBER TP-7

PROJECT NAME Weyerhaeuser

PROJECT NUMBER 467.42

LOCATION Plymouth, N.C.

DATE 5-1-90

CONTRACTOR Law Engineering

METHOD Backhoe

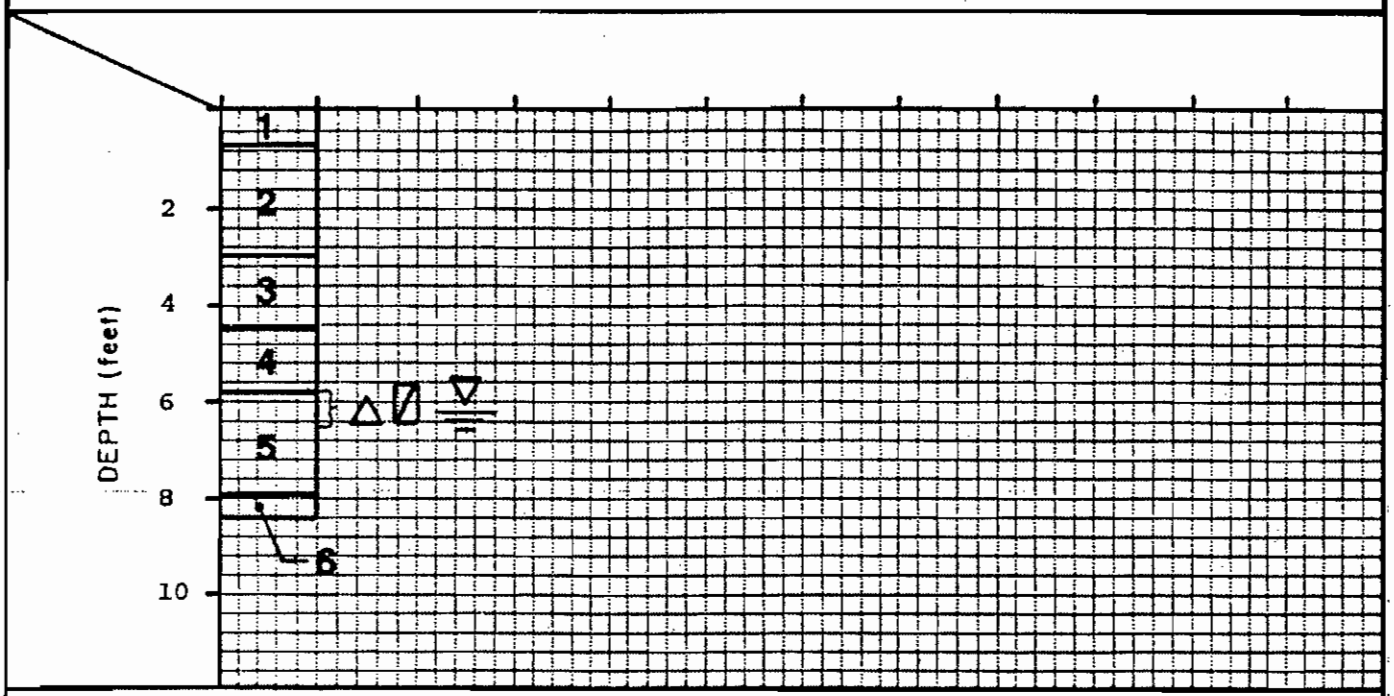
WIDTH 2-3 ft.

LOGGED BY BTG

CHECKED BY

PAGE 1 OF 1

GRAPHIC REPRESENTATION OF EXCAVATION



ORIENTATION

DESCRIPTION OF UNITS

1) SILTY SAND (SM); fine grained; dark gray (topsoil).

2) SAND/SILTY SAND (SP-SM); fine grained; light brown, tan.

3) SILTY SAND (SM); fine grained; orange-brown.

4) SILTY SAND (SM); as above with trace clay.

5) CLAY/CLAYEY SAND (CL-SC); fine grained; mottled orange and gray.

6) SILTY SAND (SM); fine grained; orange.

LEGEND:

△ Jar Sample

▨ Bulk Sample

▽ Water Level While Excavating

LOG OF TEST PIT OR EXCAVATION

PIT NUMBER TP-8

PROJECT NAME Weyerhaeuser

PROJECT NUMBER 467.42

LOCATION Plymouth, N.C.

DATE 5-1-90

CONTRACTOR Hopkins

METHOD Backhoe

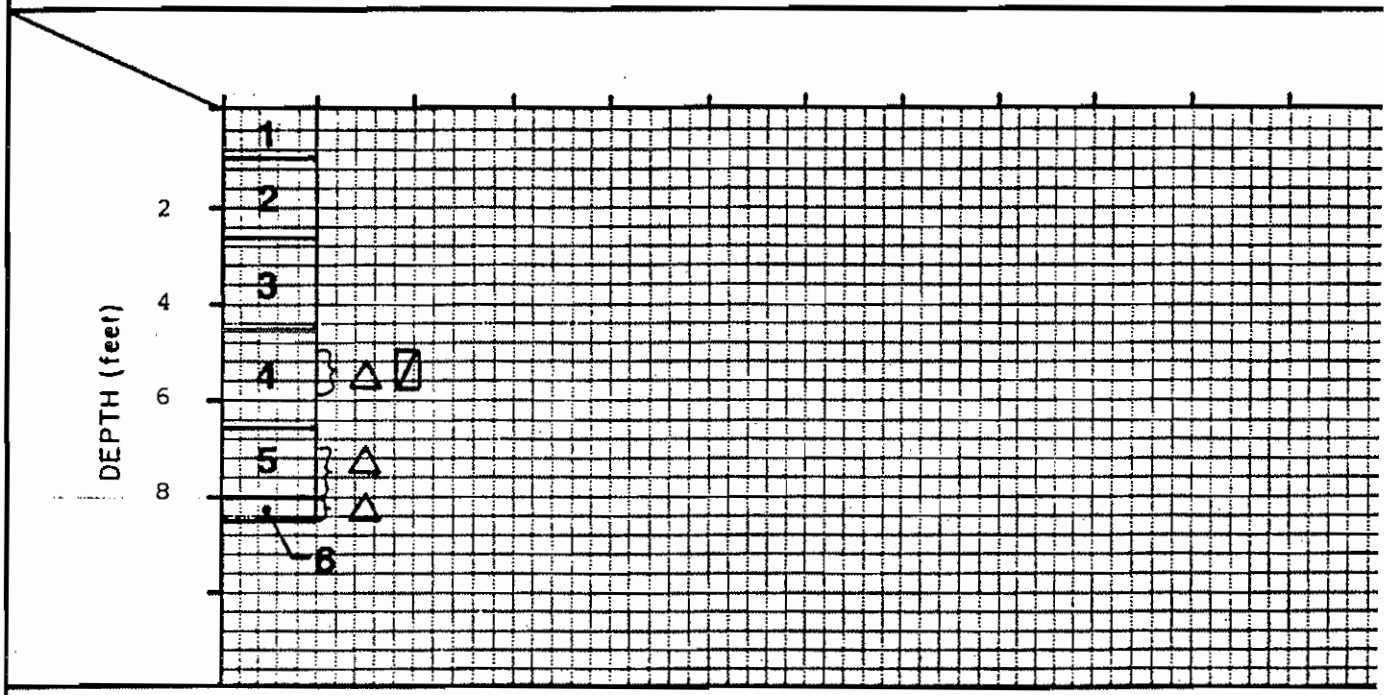
WIDTH 2-3 ft.

LOGGED BY BTG

CHECKED BY

PAGE 1 OF 1

GRAPHIC REPRESENTATION OF EXCAVATION



ORIENTATION

DESCRIPTION OF UNITS

1) SILTY SAND (SM); fine grained; dark gray; (topsoil)
2) SAND/SILTY SAND (SP-SM); fine grained; tan
3) SILTY SAND/CLAYEY SAND (SM-SC); fine grained; orange.
4) CLAY (CL); trace sand (fine grained); gray and orange-brown mottled.
5) SILTY SAND (SM); fine grained; trace clay; orange.
6) SAND (SP); fine grained; white.

LEGEND:

△ Jar Sample ▨ Bulk Sample

LOG OF TEST PIT OR EXCAVATION

PIT NUMBER TP-9

PROJECT NAME Weyerhaeuser

PROJECT NUMBER 467.42

LOCATION Plymouth, N.C.

DATE 5-1-90

CONTRACTOR Hopkins

METHOD Backhoe

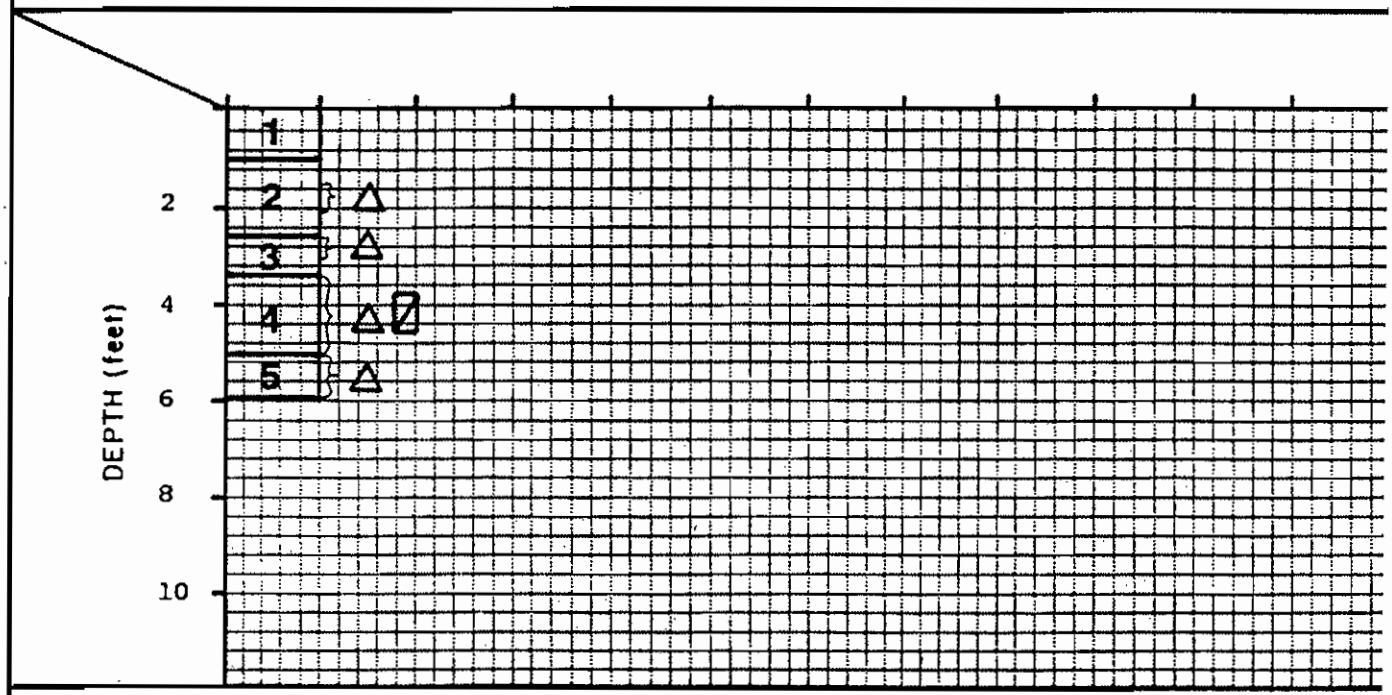
WIDTH 2-3 ft.

LOGGED BY BTG

CHECKED BY

PAGE 1 OF 1

GRAPHIC REPRESENTATION OF EXCAVATION



ORIENTATION

DESCRIPTION OF UNITS

1) SILTY SAND (SM); fine grained; brown, black.
2) SAND/SILTY SAND (SP-SM); fine grained; light brown, gray.
3) CLAYEY SAND (SC); fine grained; orange-brown.
4) CLAYEY SAND (SC); fine grained; gray, orange-brown.
5) SILTY SAND (SM); fine grained; saturated; tan and gray mottled.

LEGEND:

△ Jar Sample ▨ Bulk Sample

LOG OF TEST PIT OR EXCAVATION

PIT NUMBER TP-10

PROJECT NAME Weyerhaeuser

PROJECT NUMBER 467.42

LOCATION Plymouth, N.C.

DATE 5-1-90

CONTRACTOR Hopkins

METHOD Backhoe

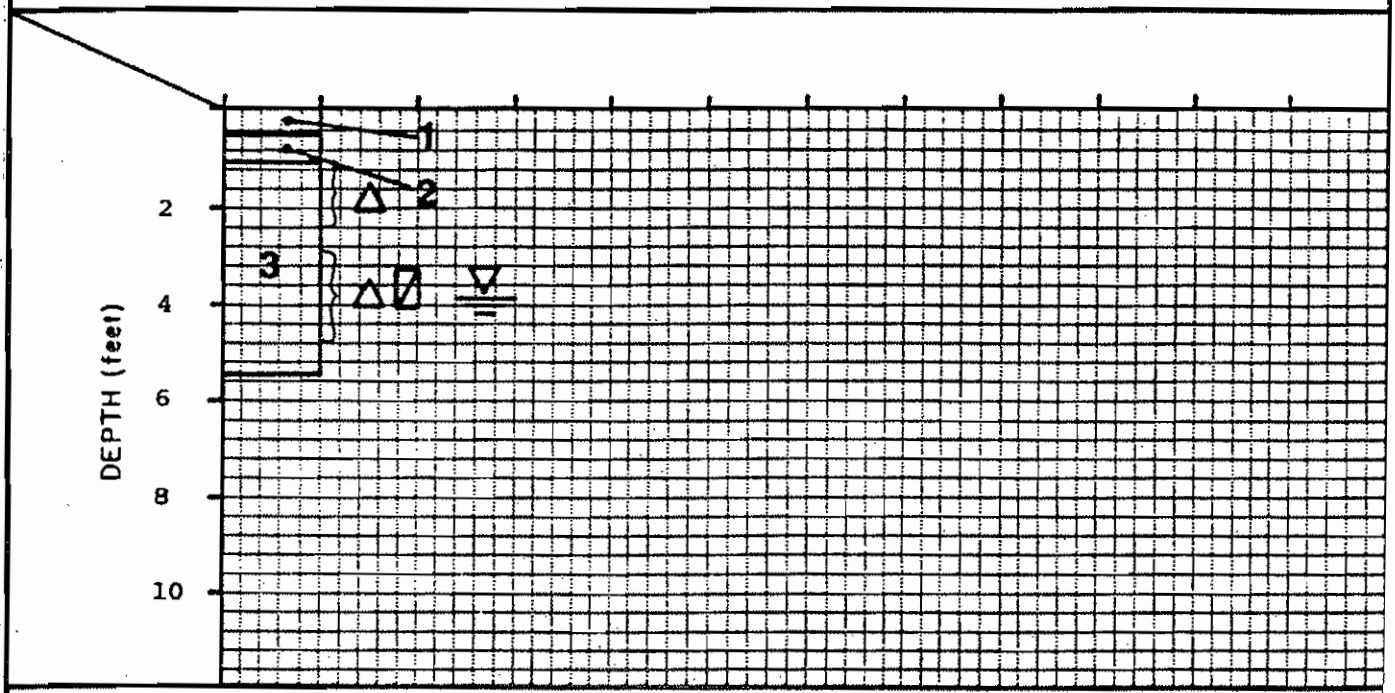
WIDTH 2-3 ft.

LOGGED BY BTG

CHECKED BY

PAGE 1 OF 1

GRAPHIC REPRESENTATION OF EXCAVATION



ORIENTATION

DESCRIPTION OF UNITS

1) SILTY SAND (SM); brown, black; roots; (topsoil)
2) SAND/SILTY SAND (SP-SM); fine grained; light brown
3) CLAYEY SAND (SC); fine grained; silty; orange-brown, and gray mottled - more silty, less clayey, below 4.0 feet.

LEGEND:

△ Jar Sample

Bulk Sample

Water Level While Excavating

LOG OF TEST PIT OR EXCAVATION

PIT NUMBER TP-11

PROJECT NAME Weyerhaeuser

PROJECT NUMBER 467.42

LOCATION Plymouth, N.C.

DATE 5-1-90

CONTRACTOR Hopkins

METHOD Backhoe

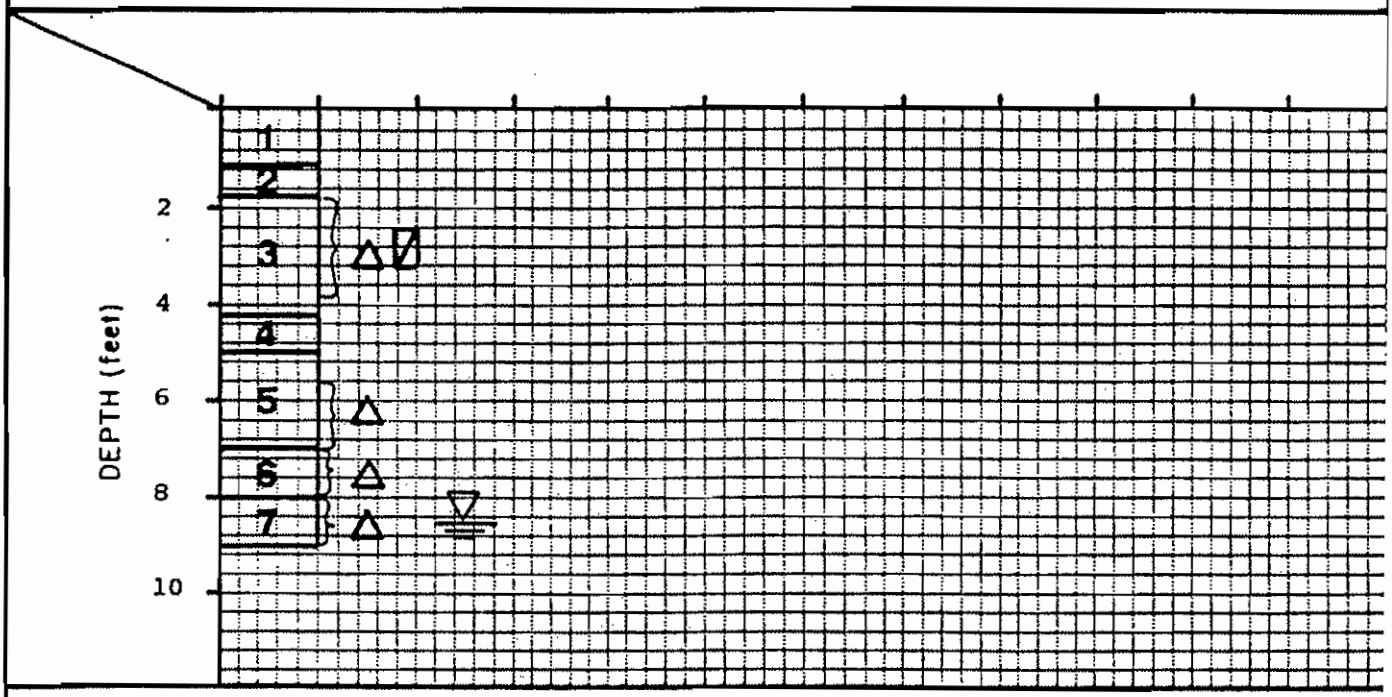
WIDTH 2-3 ft.

LOGGED BY BTG

CHECKED BY

PAGE 1 OF 1

GRAPHIC REPRESENTATION OF EXCAVATION



ORIENTATION

DESCRIPTION OF UNITS

1) SILTY SAND (SM); fine grained; gray; (topsoil).
2) SAND/SILTY SAND (SP-SM); fine grained; tan.
3) CLAYEY SAND (SC); fine grained; mottled orange-brown and gray.
4) SILTY SAND (SM); fine grained; trace clay; mottled as above (more gray).
5) SAND/SILTY SAND (SP-SM); fine grained; orange.
6) SILT (ML-MH); trace sand (fine grained); trace clay; orange-gray mottle.
7) SAND/SILTY SAND (SP-SM); fine grained; mottled as above.

LEGEND:

△ Jar Sample

▨ Bulk Sample

▽ Water Level While Excavating

LOG OF TEST PIT OR EXCAVATION

PIT NUMBER TP-12

PROJECT NAME Weyerhaeuser

PROJECT NUMBER 467.42

LOCATION Plymouth, N.C.

DATE 5-2-90

CONTRACTOR Hopkins

METHOD Backhoe

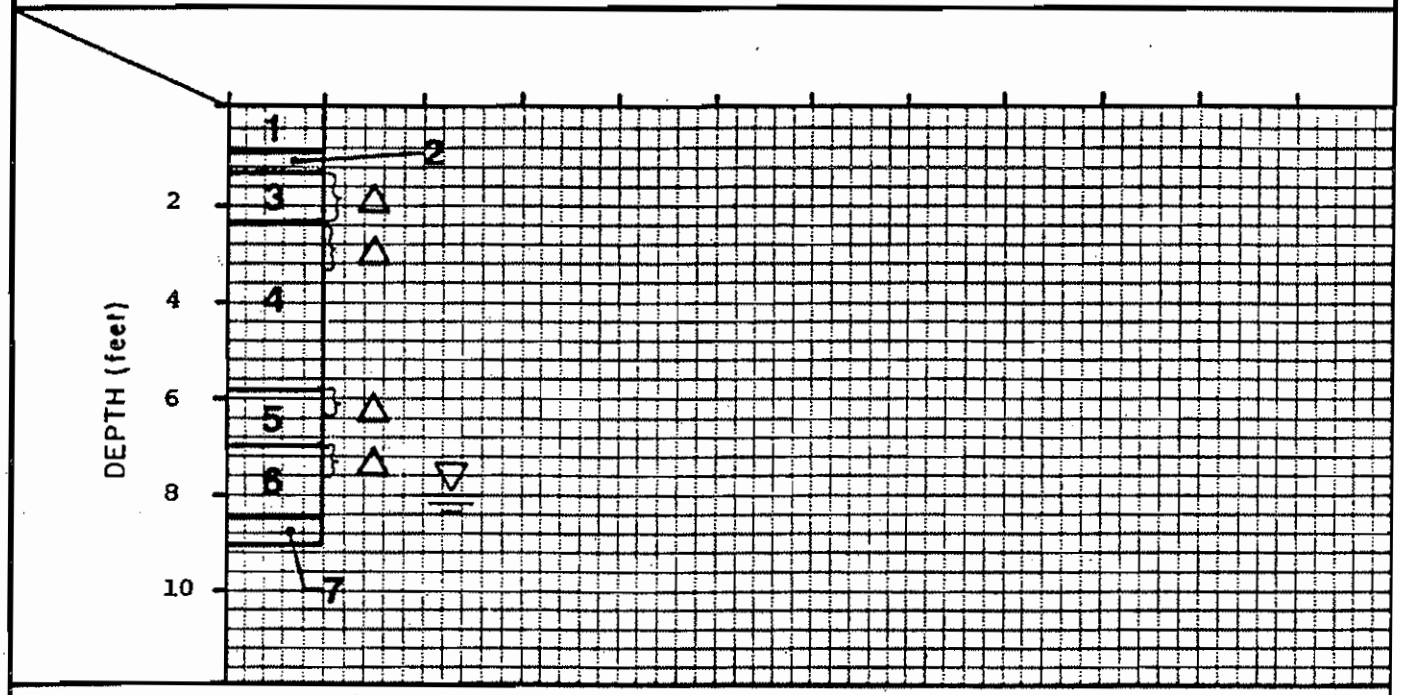
WIDTH 2-3 ft.

LOGGED BY BTG

CHECKED BY

PAGE 1 OF 1

GRAPHIC REPRESENTATION OF EXCAVATION



ORIENTATION

DESCRIPTION OF UNITS

1) SILTY SAND (SM); fine grained; gray; (topsoil).
2) SAND/SILTY SAND (SP-SM); fine grained; tan.
3) CLAYEY SAND (SC); fine grained; orange-brown.
4) SILTY SAND (SM); fine grained; orange-brown.
5) SILTY SAND (SM); as above; interlaminated with sandy clay (fine grained); gray.
6) SILTY SAND (SM); fine grained; tan, orange-brown.
7) SILTY SAND (SM); fine grained; tan, grey mottled.

LEGEND:

△ Jar Sample

LOG OF TEST PIT OR EXCAVATION

PIT NUMBER TP-13

PROJECT NAME Weyerhaeuser

PROJECT NUMBER 467.42

LOCATION Plymouth, N.C.

DATE 5-2-90

CONTRACTOR Hopkins

METHOD Backhoe

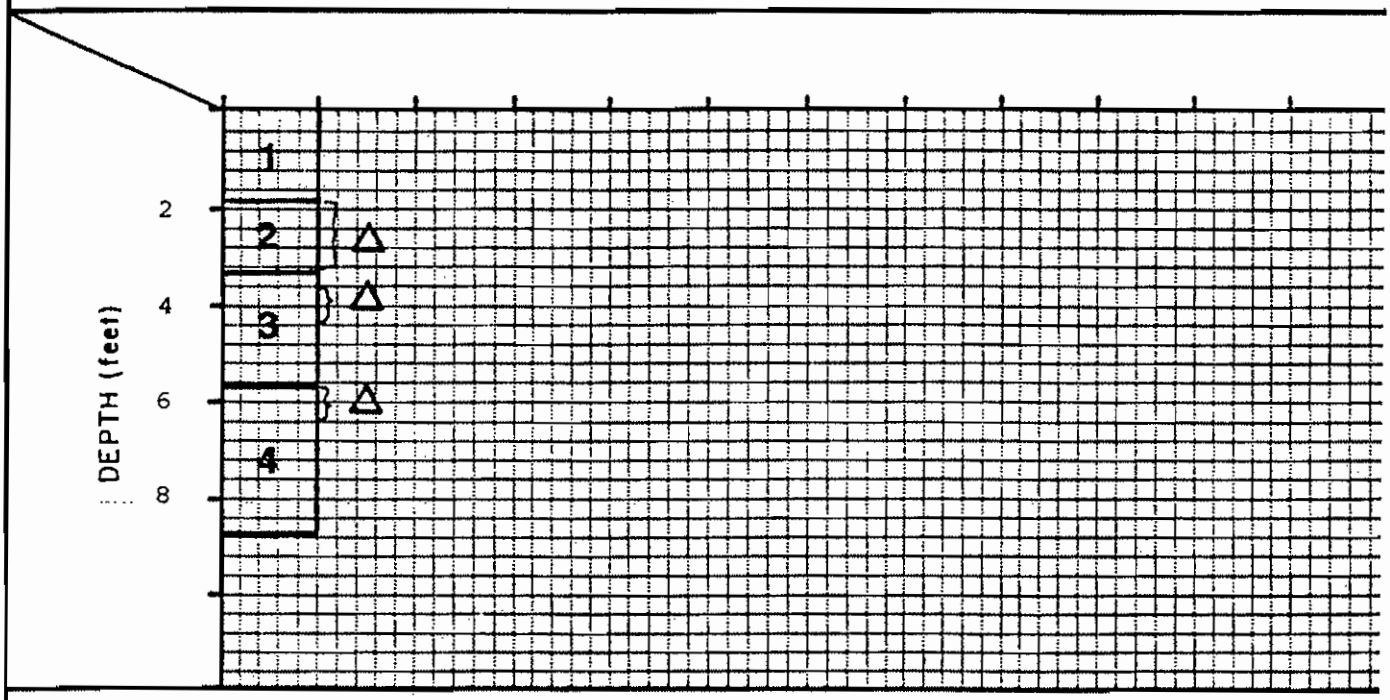
WIDTH 2-3 ft.

LOGGED BY BTG

CHECKED BY

PAGE 1 OF 1

GRAPHIC REPRESENTATION OF EXCAVATION



ORIENTATION

DESCRIPTION OF UNITS

1) SILTY SAND (SM); fine grained; tan, gray; mixed with topsoil, roots in upper foot.
2) CLAYEY SAND (SC); very fine grained; orange.
3) SILTY SAND (SM); very fine grained; orange.
4) SILTY SAND (SM); fine grained; mottled gray, orange, red (5.7-7.0 ft.)

LEGEND:

△ Jar Sample

LOG OF TEST PIT OR EXCAVATION

PIT NUMBER TP-14

PROJECT NAME Weyerhaeuser

PROJECT NUMBER 467.42

LOCATION Plymouth, N.C

DATE 5-2-90

CONTRACTOR Hopkins

METHOD Backhoe

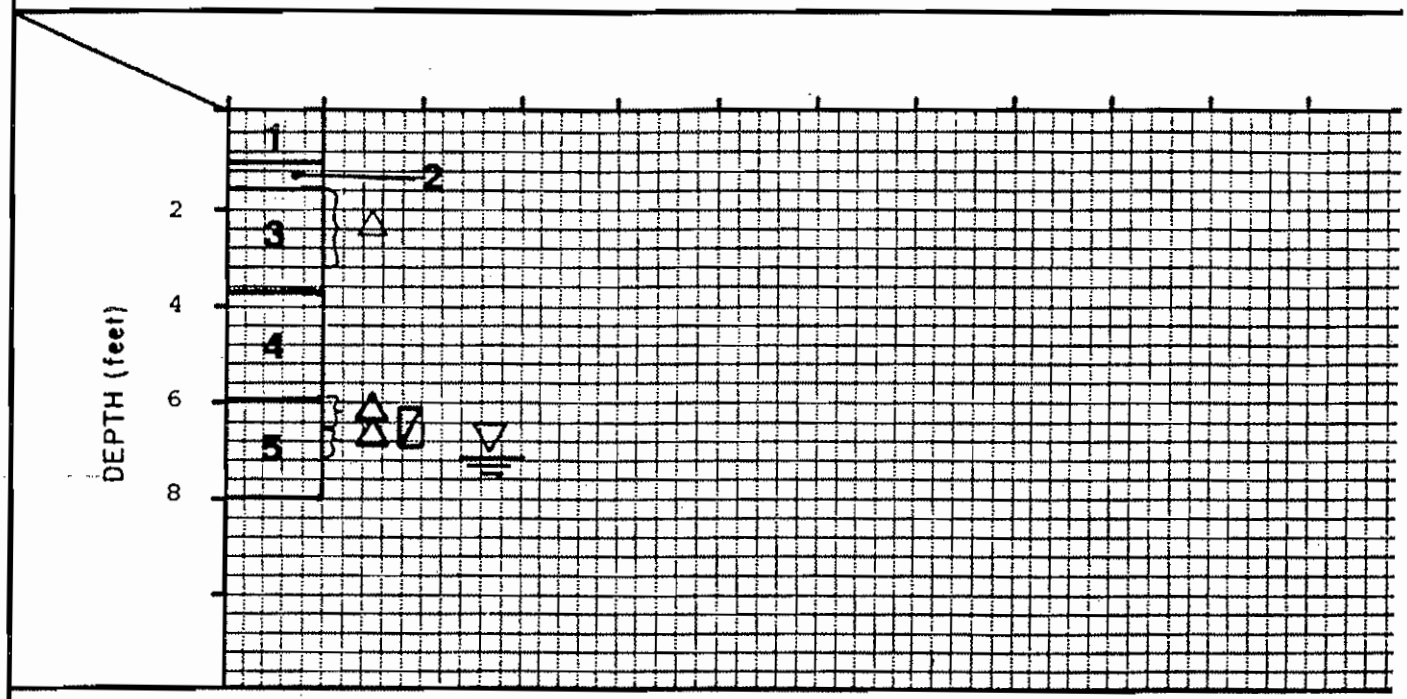
WIDTH 2-3 ft.

LOGGED BY BTC

CHECKED BY

PAGE 1 OF 1

GRAPHIC REPRESENTATION OF EXCAVATION



ORIENTATION

DESCRIPTION OF UNITS

1) SILTY SAND (SM); fine grained; top soil; gray.
2) SAND (SP)/SILTY SAND (SM); fine grained; tan.
3) CLAYEY SAND (SC); fine grained; orange-brown.
4) SILTY SAND (SM); fine grained; orange-brown; trace clay.
5) CLAY (CL); some fine grained; silty and clayey sand, mottled orange-brown, and gray.

LEGEND:

△ Jar Sample

▨ Bulk Sample

▽ Water Level While Excavating

LOG OF TEST PIT OR EXCAVATION

PIT NUMBER TP-15

PROJECT NAME Weyerhaeuser

PROJECT NUMBER 467.42

LOCATION Plymouth, N.C.

DATE 5-2-90

CONTRACTOR Hopkins

METHOD Backhoe

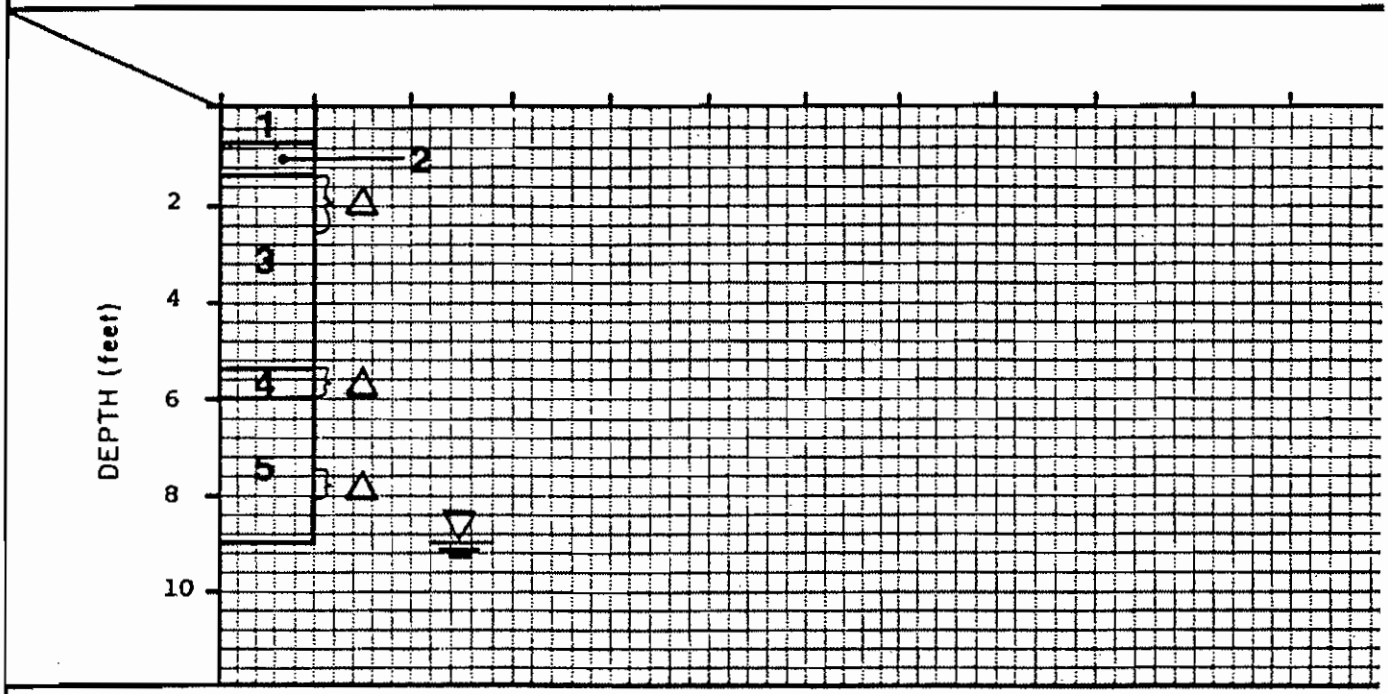
WIDTH 2-3 ft.

LOGGED BY BTG

CHECKED BY

PAGE 1 OF 1

GRAPHIC REPRESENTATION OF EXCAVATION



ORIENTATION

DESCRIPTION OF UNITS

1) SILTY SAND (SM); fine grained; brown; (topsoil).
2) SILTY SAND (SM); fine grained, tan.
3) SILTY SAND (SM); fine grained; some clay near top; orange.
4) CLAYEY SAND (SC); fine grained; light brown, gray, orange mottled.
5) SAND/SILTY SAND (SP-SM); fine grained; orange, grading to gray.

LEGEND:

△ Jar Sample

▽ Water Level While Excavating

LOG OF TEST PIT OR EXCAVATION

PIT NUMBER TP-16

PROJECT NAME Weyerhaeuser

PROJECT NUMBER 467.42

LOCATION Plymouth, N.C.

DATE 5-2-90

CONTRACTOR Hopkins

METHOD Backhoe

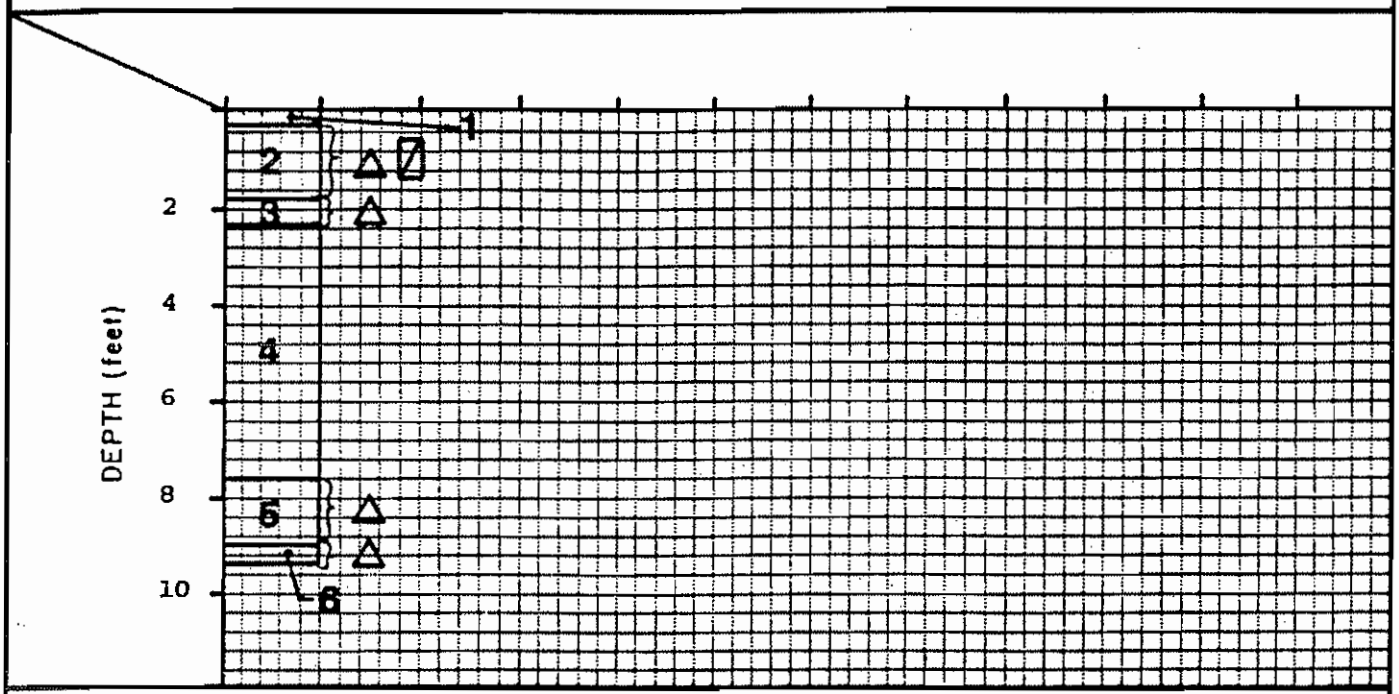
WIDTH 2-3 ft.

LOGGED BY BTG

CHECKED BY

PAGE 1 OF 1

GRAPHIC REPRESENTATION OF EXCAVATION



ORIENTATION

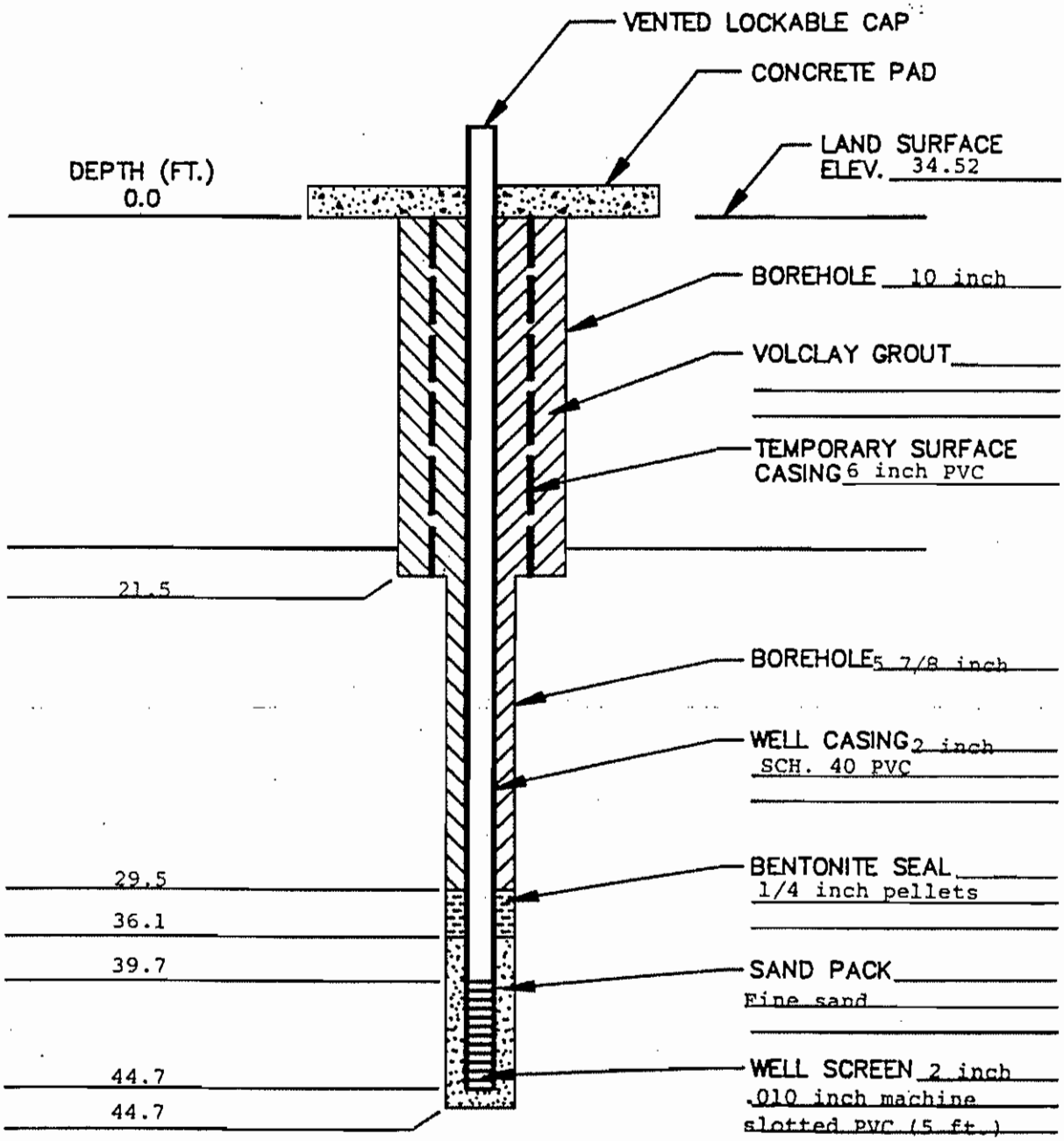
DESCRIPTION OF UNITS

1) SILTY SAND (SM); fine grained; gray; (topsoil).
2) CLAY (CL); trace fine grained sand; stiff; orange.
3) CLAYEY SAND/SILTY SAND (SC-SM); fine grained; orange.
4) SILTY SAND (SM); fine grained; orange and gray mattle.
5) SILTY SAND (SM); fine grained; clayey; mostly light gray, mottled with orange.
6) CLAY (CL); gray with orange mottle.

LEGEND:

△ Jar Sample ☑ Bulk Sample

APPENDIX C



OBSERVATION WELL CONSTRUCTION DIAGRAM

Not To Scale

PROJECT Weyerhaeuser

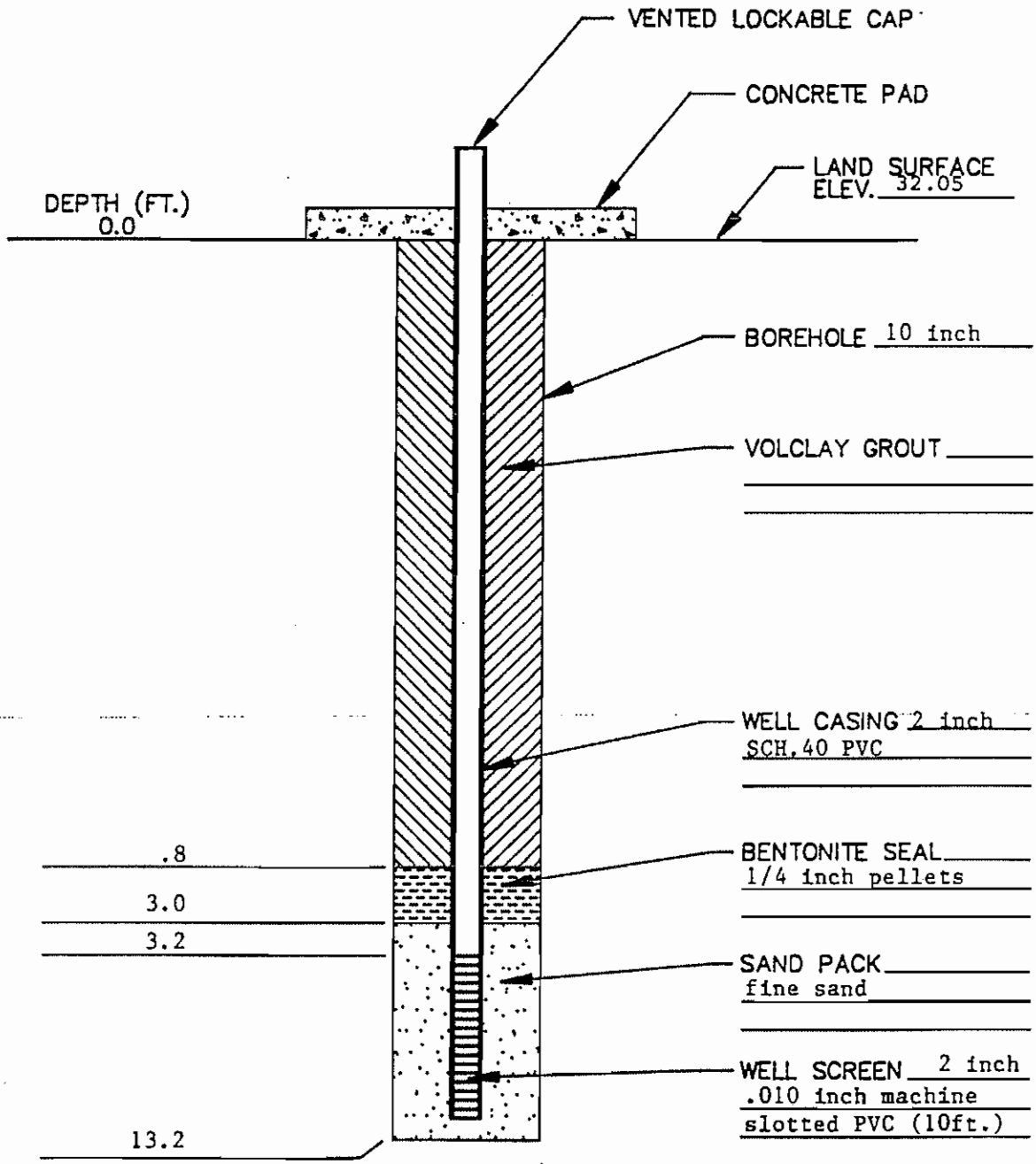
PROJECT NO. 467.42

WELL NO. OW-1 DATE INSTALLED 4-20-90

DRILLING CONTRACTOR Law Engineering

RMT GEOLOGIST B. Grothaus

RMT INC.



OBSERVATION WELL CONSTRUCTION DIAGRAM

Not To Scale

PROJECT Weyerhaeuser

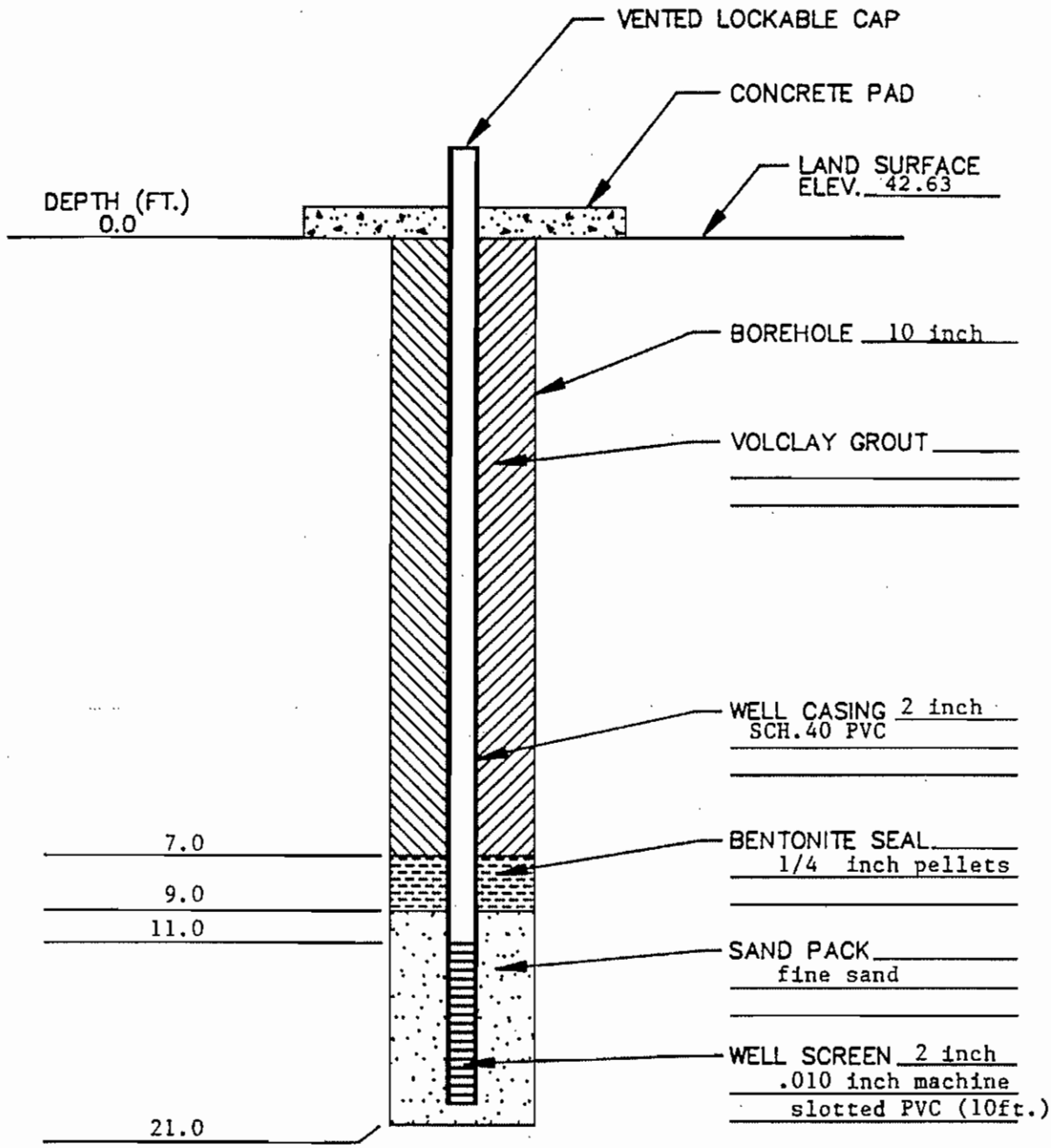
PROJECT NO. 467.42

WELL NO. OW-2 DATE INSTALLED 4/25/90

DRILLING CONTRACTOR Law Engineering

RMT GEOLOGIST B. Grothaus

RMT INC.



OBSERVATION WELL CONSTRUCTION DIAGRAM

Not To Scale

PROJECT Weyerhaeuser

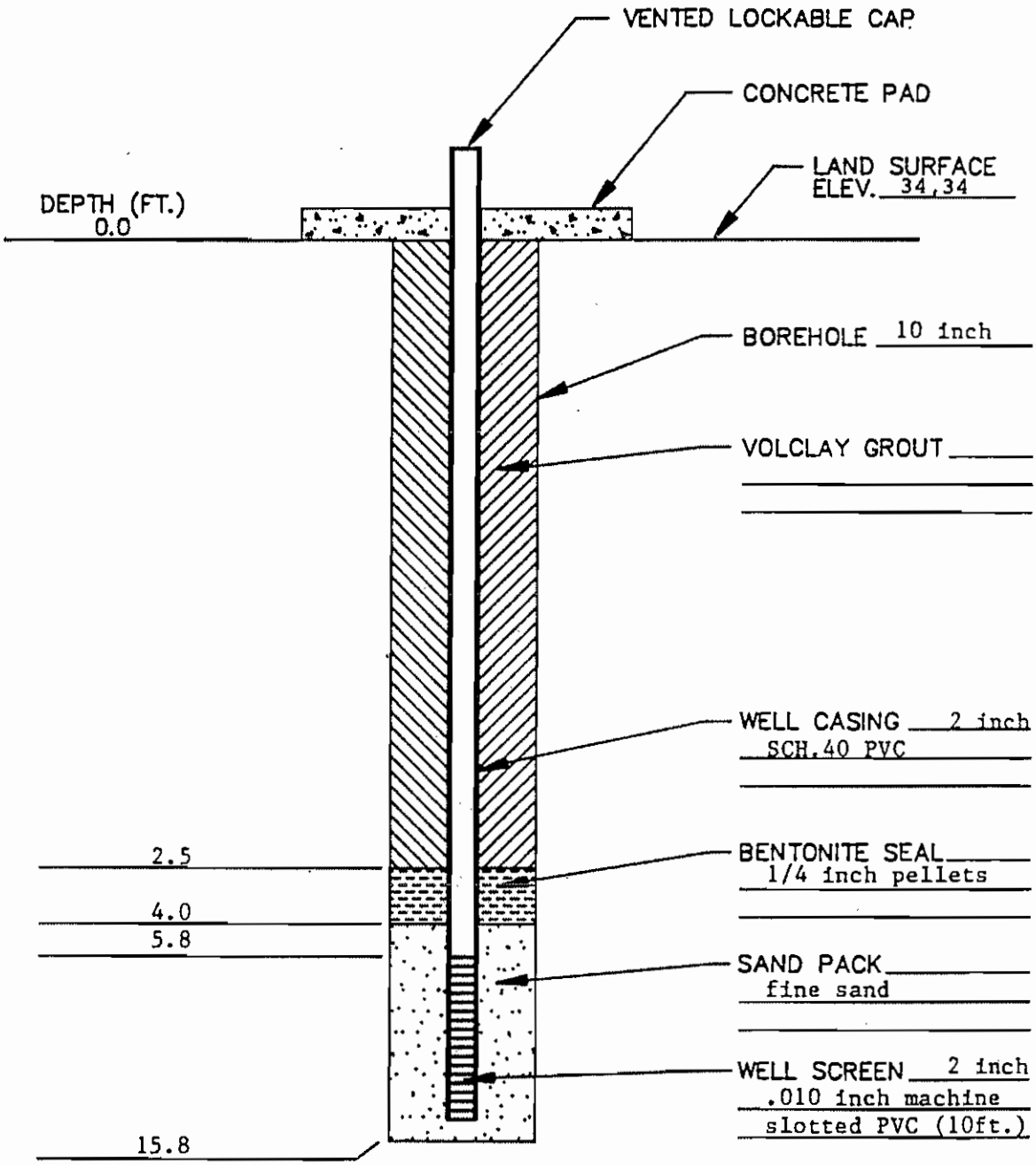
PROJECT NO. 467.42

WELL NO. OW-3 DATE INSTALLED 4/18/90

DRILLING CONTRACTOR Law Engineering

RMT GEOLOGIST B. Grothaus

RMT INC.



OBSERVATION WELL CONSTRUCTION DIAGRAM

Not To Scale

PROJECT Weyerhaeuser

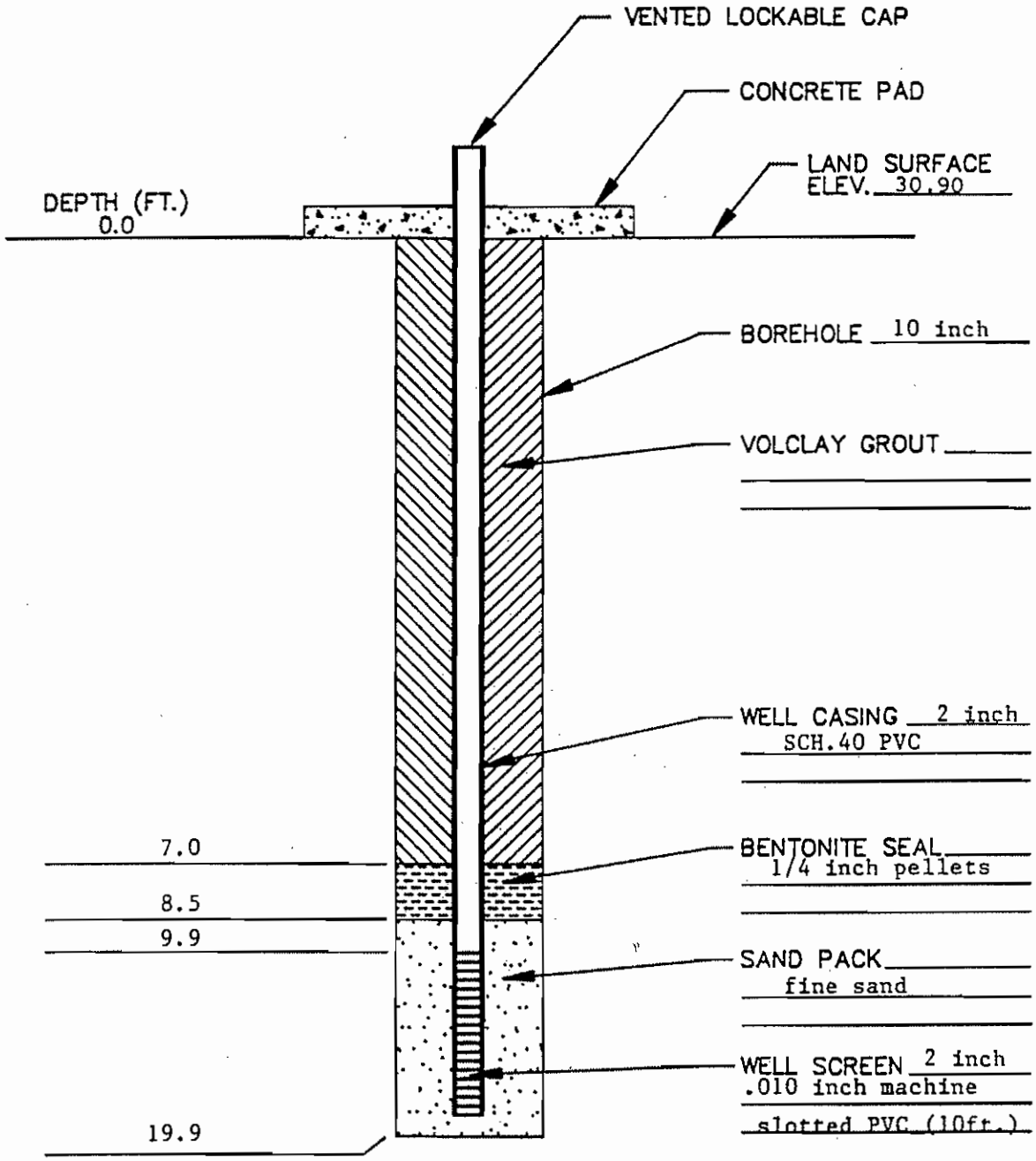
PROJECT NO. 467.42

WELL NO. OW-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

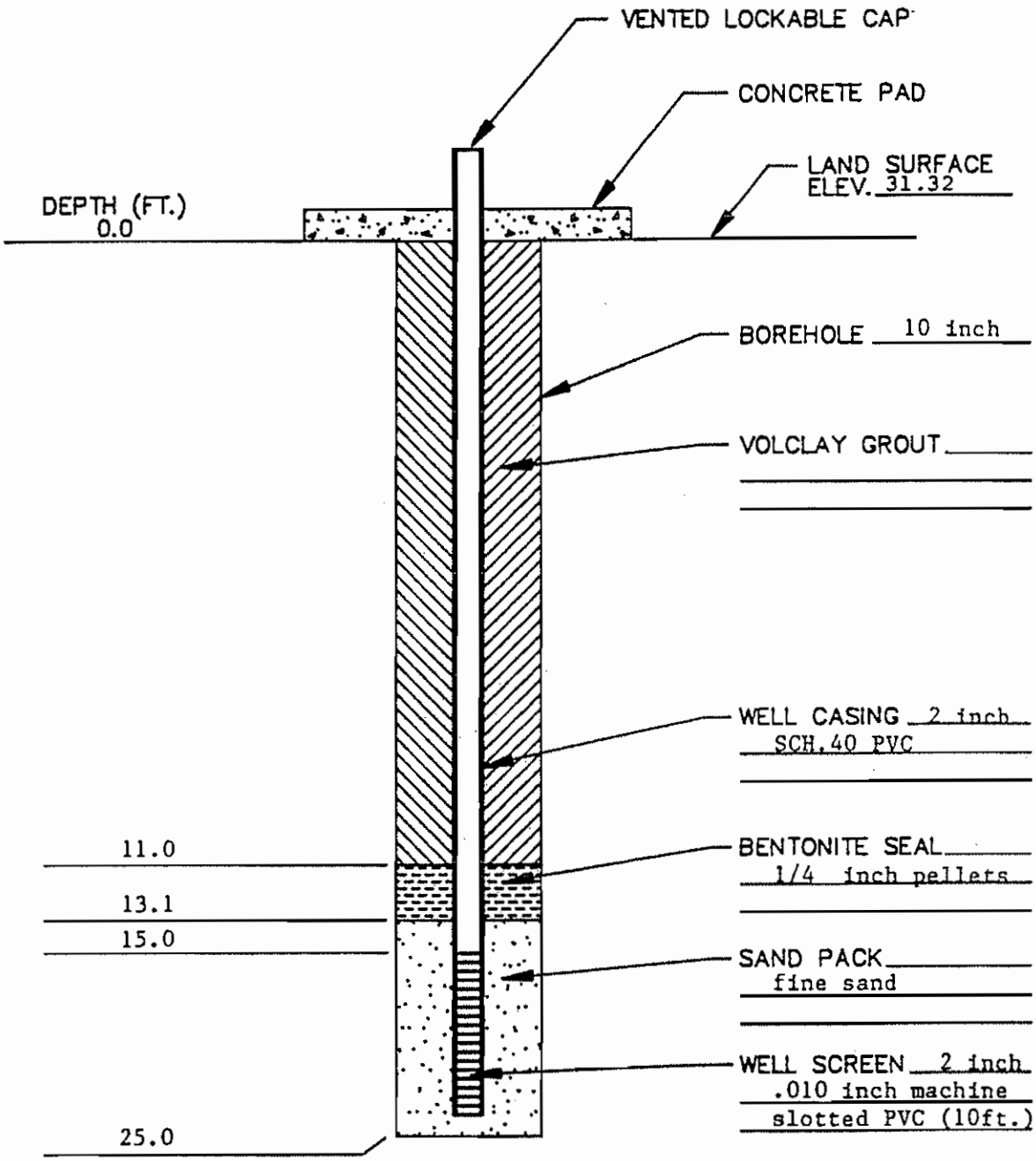
PROJECT NO. 467.42

WELL NO. OW-5 DATE INSTALLED 4/24/90

DRILLING CONTRACTOR Law Engineering

RMT GEOLOGIST B. Grothaus

RMT INC.



OBSERVATION WELL CONSTRUCTION DIAGRAM

Not To Scale

PROJECT Weyerhaeuser

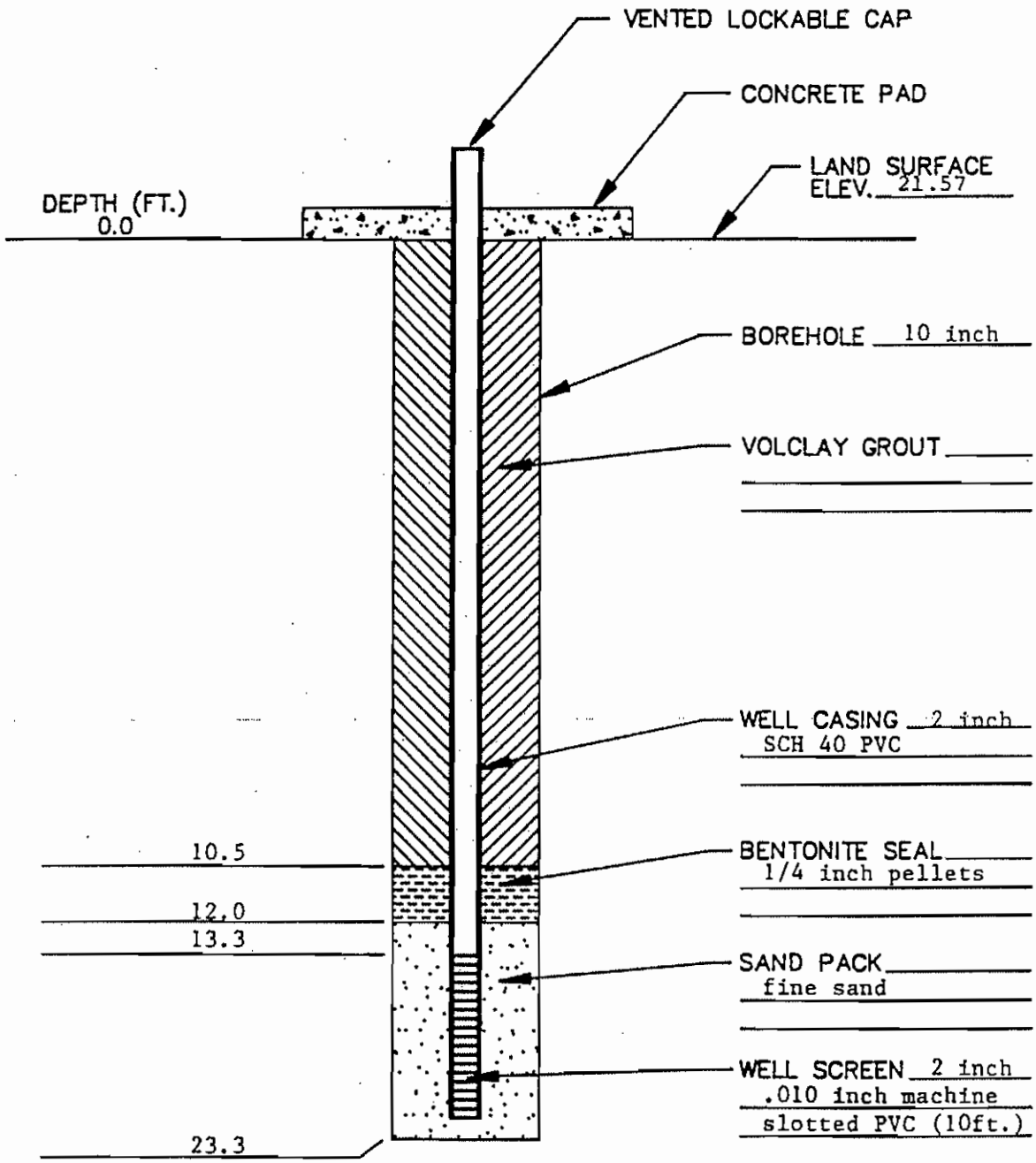
PROJECT NO. 467.42

WELL NO. OW-6 DATE INSTALLED 4/24/90

DRILLING CONTRACTOR Law Engineering

RMT GEOLOGIST B. Grothaus

RMT INC.



OBSERVATION WELL CONSTRUCTION DIAGRAM

Not To Scale

PROJECT Weyerhaeuser

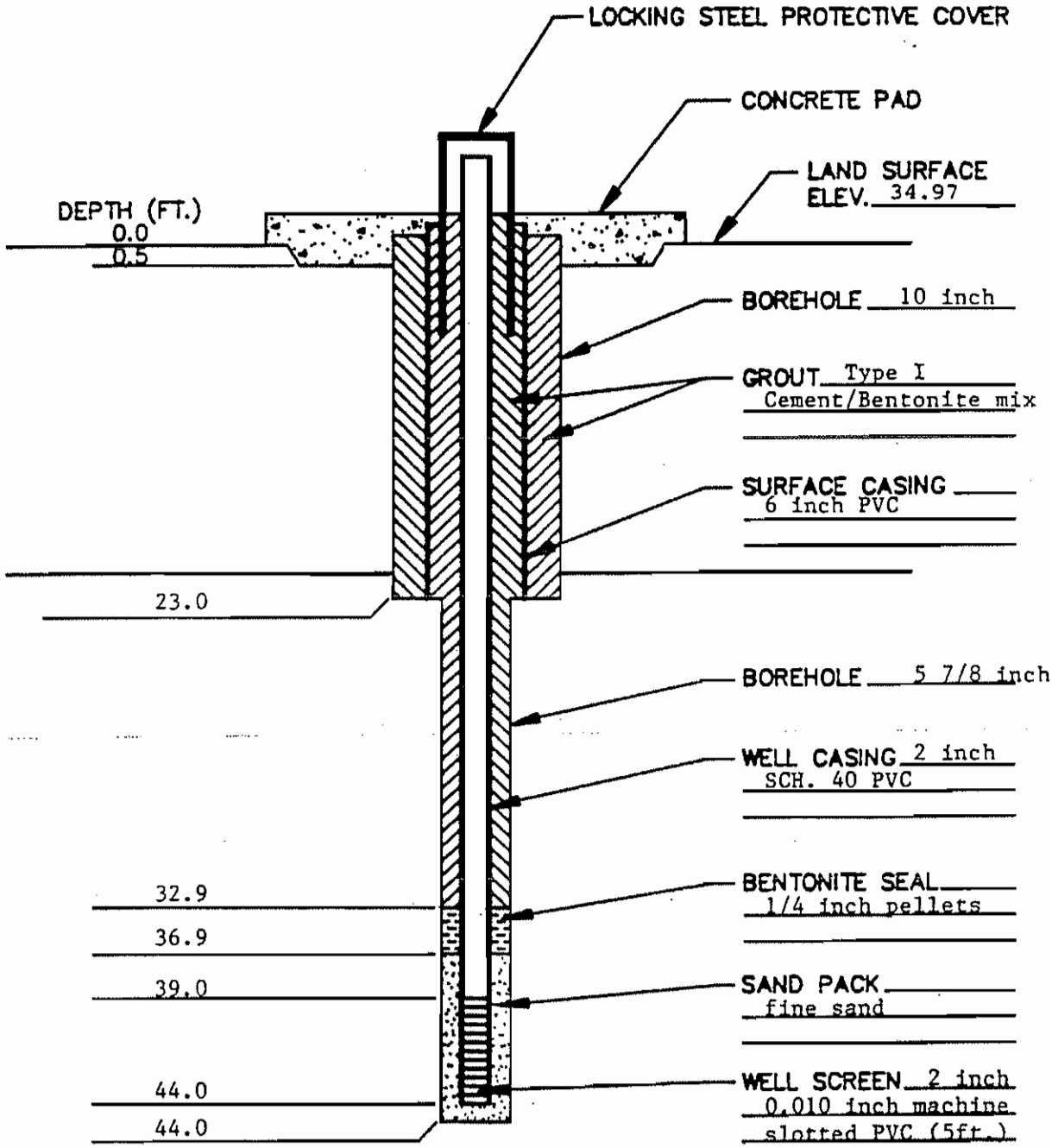
PROJECT NO. 467.42

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

DRILLING CONTRACTOR Law Engineering

RMT GEOLOGIST B. Grothaus

RMT INC.



MONITORING WELL CONSTRUCTION DIAGRAM

Not To Scale

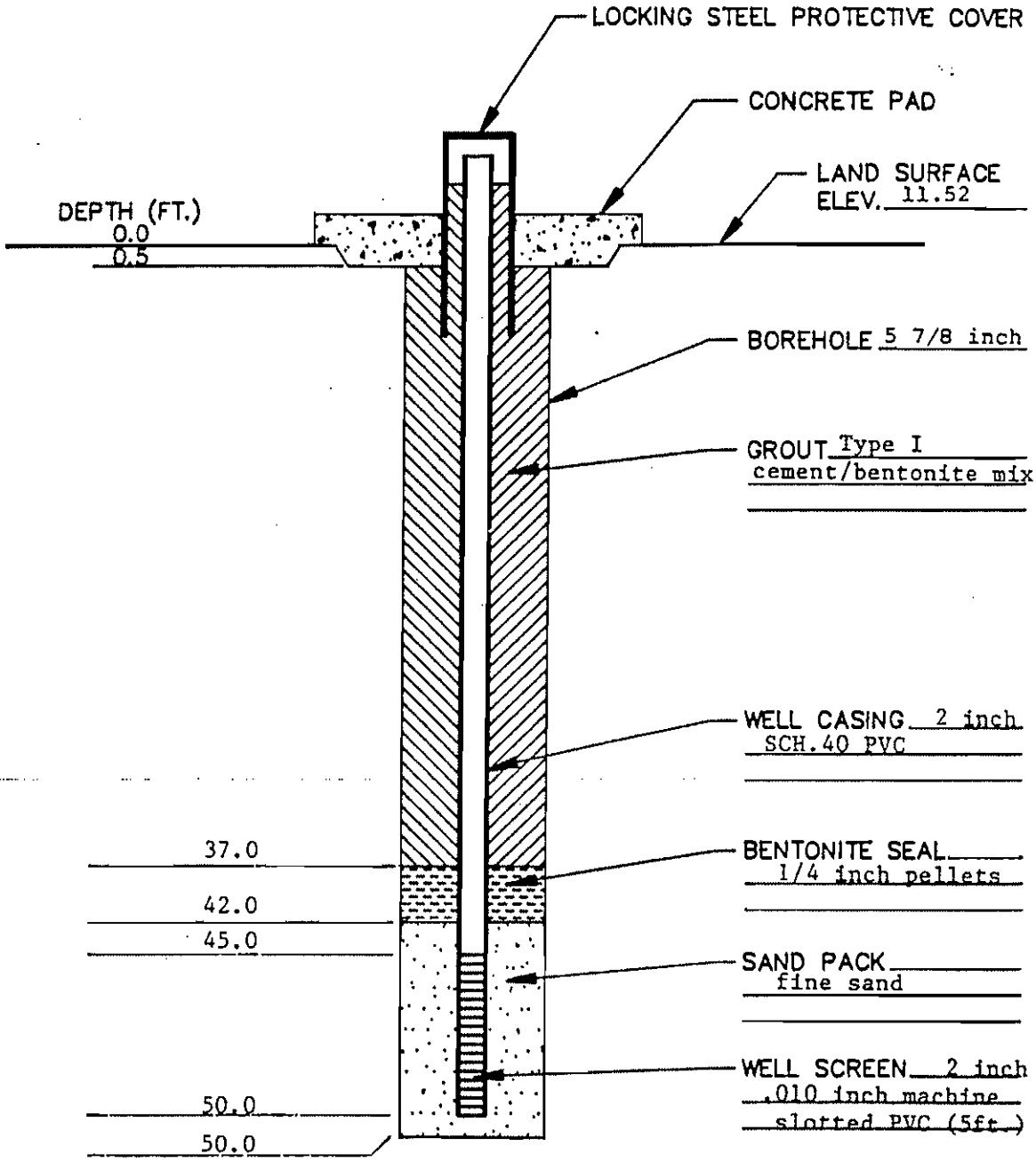
PROJECT Weyerhaeuser

PROJECT NO. 467.42

WELL NO. MW-1A DATE INSTALLED 4/18/90

DRILLING CONTRACTOR Law Engineering

RMT GEOLOGIST B. Grothaus



WELL CONSTRUCTION DIAGRAM

Not To Scale

PROJECT Weyerhaeuser

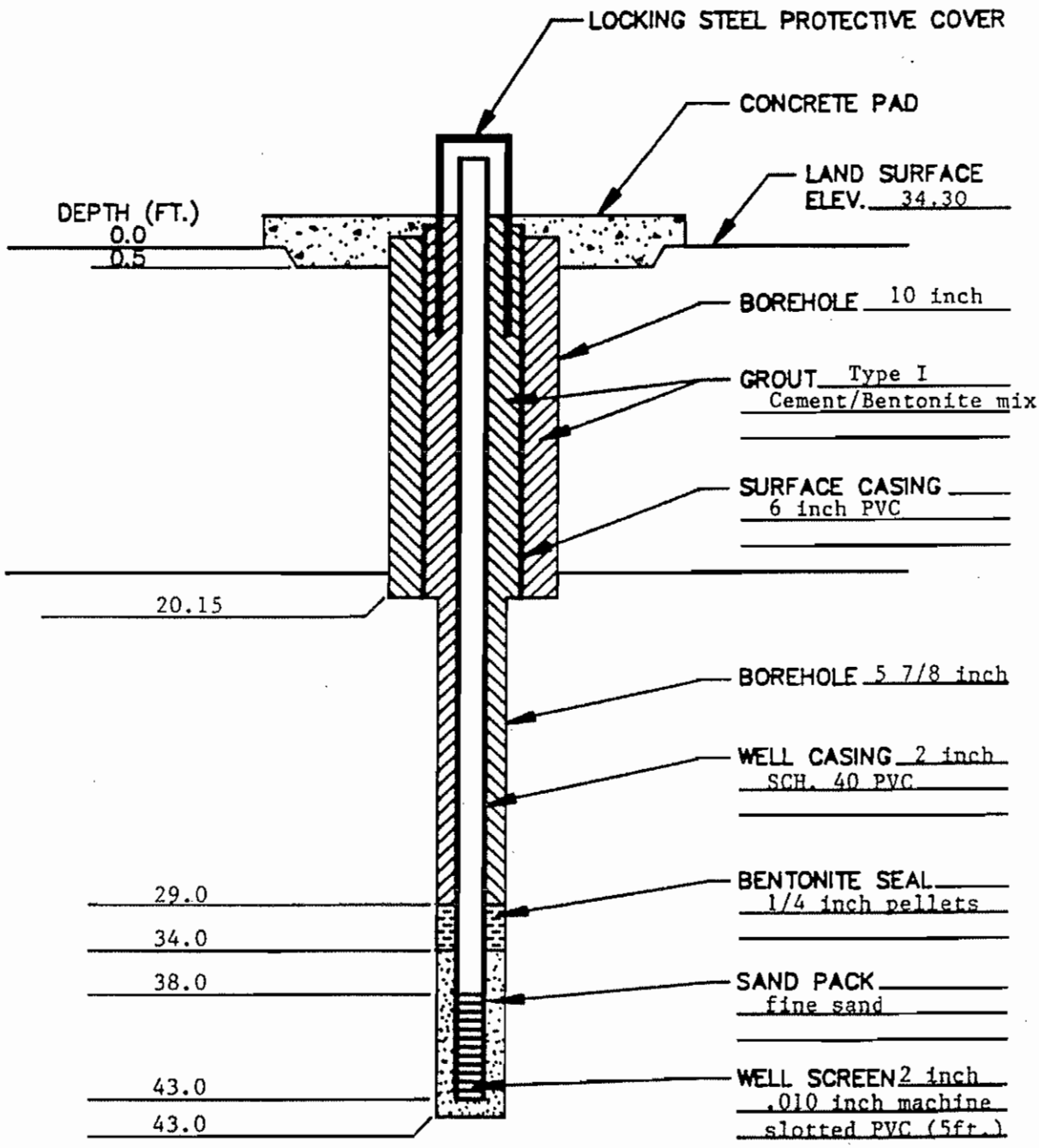
PROJECT NO. 467.42

WELL NO. MW-6A DATE INSTALLED 4/19/90

DRILLING CONTRACTOR Law Engineering

RMT GEOLOGIST B. Grothaus

RMT



MONITORING WELL CONSTRUCTION DIAGRAM

Not To Scale

PROJECT Weyerhaeuser

PROJECT NO. 467.42

WELL NO. MW-8 DATE INSTALLED 4/23/90

DRILLING CONTRACTOR Law Engineering

RMT GEOLOGIST B. Grothaus

APPENDIX D

TABULATION OF SOIL TEST DATA ON SAMPLES FROM WELLS AND BORINGS

SAMPLE	DEPTH (ft)		INDICES			GRAIN SIZE (%)				ATTERBERG LIMITS				MOD.PROCTOR		PERMEABILITY			CONSOLIDATION		
LOCATION	TOP	BOT	% M	DD	Gs	GRVL	SAND	SILT	CLAY	LL	PL	PI	CLASS	MDD	OMC	% M	DD	k	% M	DD	Cc
MW-1A	22	24	----	----	2.64	0.0	11.2	55.2	33.6	46.0	32.0	14.0	ML	----	----	36.7	84.1	1.7E-08	44.5	78.1	0.49
MW-1A	38	30	34.0	86.0	2.71	0.0	10.1	57.3	32.6	48.0	28.0	20.0	ML	----	----	----	----	----	----	----	----
MW-1A	38	39.5	14.3	----	2.63	0.7	92.9	3.0	3.4	NON-PLASTIC			SP-SM	----	----	----	----	----	----	----	----
MW-8	20	22	36.7	----	2.67	0.0	10.3	80.6	9.1	51.0	27.0	24.0	CH	----	----	35.4	84.4	4.7E-08	----	----	----
MW-8	29	31	39.9	79.6	2.67	0.0	9.3	70.6	20.1	NON-PLASTIC			ML	----	----	----	----	----	----	----	----
MW-8	2	4	----	----	2.59	0.0	34.4	12.0	53.6	39.0	19.0	20.0	CL	----	----	24.9	95.7	2.4E-08	----	----	----
OW-1	4	6	----	----	2.59	0.0	38.6	14.8	46.6	35.0	18.0	17.0	CL	----	----	25.7	93.8	9.6E-07	----	----	----
OW-1	8	10	----	----	2.65	0.0	66.9	18.2	14.9	NON-PLASTIC			SM	----	----	31.1	88.8	1.3E-05	----	----	----
OW-1	20	22	29.6	----	2.62	0.0	11.3	65.6	23.1	53.0	33.0	20.0	MH	----	----	38.5	79.9	2.5E-08	46	75.9	0.48
OW-2	13	15	----	----	2.67	0.0	40.0	28.8	31.2	33.0	17.0	16.0	CL	----	----	33.3	85.9	1.1E-07	----	----	----
OW-3	8	9	16.2	----	2.65	0.0	70.6	6.1	23.3	21.0	16.0	5.0	SC-SM	----	----	----	----	----	----	----	----
OW-3	9	11	----	----	2.61	0.0	37.5	23.5	39.0	37.0	18.0	19.0	CL	----	----	24.9	96.3	1.7E-07	----	----	----
OW-3	15	16.5	----	----	2.64	0.0	84.9	3.7	11.4	NON-PLASTIC			SC	----	----	16.1	106.6	2.3E-04	----	----	----
SB-5	4	6	----	----	2.45	----	----	----	----	28.0	24.0	4.0	ML	----	----	----	----	----	----	----	----

KEY: %M - percent moisture
DD - dry density
Gs - specific gravity
GRVL - gravel

LL - liquid limit
PL - plastic limit
PI - plasticity index
CLASS - USCS classification

MDD - maximum dry density
OMC - optimum moisture content
k - hydraulic conductivity
Cc - compression index

TABULATION OF SOIL TEST DATA ON SAMPLES FROM TEST PITS

SAMPLE LOCATION	DEPTH (ft)		INDICES			GRAIN SIZE (%)				ATTERBERG LIMITS				MOD.PROCTOR		PERMEABILITY			CONSOLIDATION		
	TOP	BOT	% M	DD	Gs	GRVL	SAND	SILT	CLAY	LL	PL	PI	CLASS	MDD	OMC	% M	DD	k	% M	DD	Cc
TP1-3	1.1	2.6	25.6	----	----	0.0	22.1	22.5	55.4	55.0	25.0	30.0	CH	112.7	17.2	----	----	----	----	----	----
	1.1	2.6	----	----	2.63	----	----	----	----	51.0	43.0	8.0	MH/ML	----	----	----	----	----	----	----	----
TP1-5	5.5	8	----	----	2.46	----	----	----	----	NON-PLASTIC			SM	----	----	----	----	----	----	----	----
TP3-1	3.2	3.8	----	----	2.60	----	----	----	----	NON-PLASTIC			SM	----	----	----	----	----	----	----	----
TP2-5	6	6.5	19.7	----	2.62	0.0	75.8	4.8	19.4	NON-PLASTIC			SC	----	----	----	----	----	----	----	----
TP4-2	4.5	5.2	19.9	----	----	0.0	55.5	5.4	39.1	35.0	18.0	17.0	SC	----	----	----	----	----	----	----	----
	4.5	5.2	----	----	----	----	----	----	----	40.0	56.0	NP	SM	----	----	----	----	----	----	----	----
TP6-1	8	9	14.0	----	2.69	0.0	84.5	4.1	11.4	NON-PLASTIC			SM	----	----	----	----	----	----	----	----
TP7-1	6	6.5	26.4	----	----	0.0	44.7	12.8	42.5	40.0	19.0	21.0	CL	----	----	----	----	----	----	----	----
	6	6.5	----	----	----	----	----	----	----	40.0	19.0	21.0	ML	----	----	----	----	----	----	----	----
TP8-1	5	6	23.8	----	----	0.0	36.1	16.9	47.0	43.0	21.0	22.0	CL	----	----	----	----	----	----	----	----
	5	6	----	----	----	----	----	----	----	45.0	54.0	NP	ML	----	----	----	----	----	----	----	----
TP8-3	8	8.5	8.1	----	2.61	0.0	93.0	1.5	5.5	NON-PLASTIC			SP-SM	----	----	----	----	----	----	----	----
TP9-2	2.7	3	18.7	----	2.65	0.0	61.1	9.8	29.1	27.0	16.0	11.0	SC	----	----	----	----	----	----	----	----
TP9-3	4	5	20.3	----	----	0.0	60.6	11.7	27.7	26.0	18.0	8.0	SC	----	----	----	----	----	----	----	----
	3.5	5	----	----	----	----	----	----	----	26.0	15.0	11.0	SC	----	----	----	----	----	----	----	----
TP10-2	3	5	19.3	----	----	0.0	62.6	6.6	30.8	28.0	16.0	12.0	SC	----	----	----	----	----	----	----	----
	3	5	----	----	----	----	----	----	----	25.0	12.0	13.0	SC	----	----	----	----	----	----	----	----
TP11-1	1.8	4	17.5	----	----	0.0	57.2	13.9	28.9	29.0	16.0	13.0	SC	----	----	----	----	----	----	----	----
	1.8	4	----	----	----	----	----	----	----	30.0	10.0	20.0	SC	----	----	----	----	----	----	----	----
TP11-2	5.5	7	15.8	----	2.69	0.0	89.2	1.0	9.8	NON-PLASTIC			SP-SM	----	----	----	----	----	----	----	----
TP14-3	6.5	7	27.1	----	----	0.0	43.1	15.8	41.1	35.0	17.0	18.0	CL	----	----	----	----	----	----	----	----
	6.5	7	----	----	----	----	----	----	----	29.0	15.0	14.0	CL	----	----	----	----	----	----	----	----
TP16-1	0.4	1.8	25.2	----	----	0.0	34.0	12.5	53.5	48.0	22.0	26.0	CL	----	----	----	----	----	----	----	----
	0.4	1.8	----	----	----	----	----	----	----	49.0	18.0	31.0	CL	----	----	----	----	----	----	----	----

TABULATION OF SOIL TEST DATA ON BULK AND COMPOSITE SAMPLES

SAMPLE	DEPTH (ft)		INDICES			GRAIN SIZE (%)				ATTERBERG LIMITS				MOD.PROCTOR		PERMEABILITY			CONSOLIDATION		
LOCATION	TOP	BOT	% M	DD	Gs	GRVL	SAND	SILT	CLAY	LL	PL	PI	CLASS	MDD	OMC	% M	DD	k	% M	DD	Cc
TP1-3	1.1	2.6	----	----	----	----	----	----	----	----	----	----	----	----	----	16.7	100.7	1.1E-07	----	----	----
	1.1	2.6	----	----	----	----	----	----	----	----	----	----	----	----	----	21.1	101.7	1.1E-08	----	----	----
COMPOSITE #	----	----	----	----	----	----	----	----	----	----	----	----	----	122.8	11.1	10.9	110.0	3.5E-06	----	----	----
	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	14.0	109.5	1.1E-05	----	----	----
	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	16.9	109.7	2.8E-08	----	----	----
COMPOSITE #	----	----	----	----	----	----	----	----	----	----	----	----	----	119.4	13.2	14.2	105.8	5.6E-06	----	----	----
	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	17.8	107.1	1.9E-08	----	----	----
COMPOSITE #	----	----	----	----	----	----	----	----	----	----	----	----	----	117.3	13.5	13.6	104.7	2.3E-07	----	----	----
	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	18.8	104.3	5.0E-08	----	----	----

SAMPLE	DEPTH (ft)		INDICES			GRAIN SIZE (%)				ATTERBERG LIMITS				MOD.PROCTOR		PERMEABILITY			CONSOLIDATION		
LOCATION	TOP	BOT	% M	DD	Gs	GRVL	SAND	SILT	CLAY	LL	PL	PI	CLASS	MDD	OMC	% M	DD	k	% M	DD	Cc
MW-1A	22	24	----	----	2.64	0.0	11.2	55.2	33.6	46.0	32.0	14.0	ML	----	----	36.7	84.1	1.7E-08	44.5	78.1	0.49
MW-1A	38	30	34.0	86.0	2.71	0.0	10.1	57.3	32.6	48.0	28.0	20.0	ML	----	----	----	----	----	----	----	----
MW-1A	38	39.5	14.3	----	2.63	0.7	92.9	3.0	3.4	NON-PLASTIC			SP-SM	----	----	----	----	----	----	----	----
MW-8	20	22	36.7	----	2.67	0.0	10.3	80.6	9.1	51.0	27.0	24.0	CH	----	----	35.4	84.4	4.7E-08	----	----	----
MW-8	29	31	39.9	79.6	2.67	0.0	9.3	70.6	20.1	NON-PLASTIC			ML	----	----	----	----	----	----	----	----
MW-8	2	4	----	----	2.59	0.0	34.4	12.0	53.6	39.0	19.0	20.0	CL	----	----	24.9	95.7	2.4E-08	----	----	----
OW-1	4	6	----	----	2.59	0.0	38.6	14.8	46.6	35.0	18.0	17.0	CL	----	----	25.7	93.8	9.6E-07	----	----	----
OW-1	6	10	----	----	2.65	0.0	66.9	18.2	14.9	NON-PLASTIC			SM	----	----	31.1	88.8	1.3E-05	----	----	----
OW-1	20	22	29.6	----	2.62	0.0	11.3	65.6	23.1	53.0	33.0	20.0	MH	----	----	38.5	79.9	2.5E-08	46	75.9	0.48
OW-2	13	15	----	----	2.67	0.0	40.0	28.8	31.2	33.0	17.0	16.0	CL	----	----	33.3	85.9	1.1E-07	----	----	----
OW-3	8	9	16.2	----	2.65	0.0	70.6	6.1	23.3	21.0	16.0	5.0	SC-SM	----	----	----	----	----	----	----	----
OW-3	9	11	----	----	2.61	0.0	37.5	23.5	39.0	37.0	18.0	19.0	CL	----	----	24.9	96.3	1.7E-07	----	----	----
OW-3	15	16.5	----	----	2.64	0.0	84.9	3.7	11.4	NON-PLASTIC			SC	----	----	16.1	106.6	2.3E-04	----	----	----
SB-5	4	6	----	----	2.45	----	----	----	----	28.0	24.0	4.0	ML	----	----	----	----	----	----	----	----

Tabulation ~~Summary~~ of Soil Testing Results

Wells & Borings

Test Pits

Bulk Samples

SAMPLE LOCATION	DEPTH (ft)		INDICES			GRAIN SIZE (%)				ATTERBERG LIMITS				MOD.PROCTOR		PERMEABILITY			CONSOLIDATION		
	TOP	BOT	% M	DD	Gs	GRVL	SAND	SILT	CLAY	LL	PL	PI	CLASS	MDD	OMC	% M	DD	k	% M	DD	Cc
TP1-3	1.1	2.6	25.6	----	----	0.0	22.1	22.5	55.4	55.0	25.0	30.0	CH	112.7	17.2	----	----	----	----	----	----
	1.1	2.6	----	----	2.63	----	----	----	----	51.0	43.0	8.0	MH/ML	----	----	----	----	----	----	----	----
TP1-5	5.5	6	----	----	2.46	----	----	----	----	NON-PLASTIC			SM	----	----	----	----	----	----	----	----
TP3-1	3.2	3.8	----	----	2.60	----	----	----	----	NON-PLASTIC			SM	----	----	----	----	----	----	----	----
TP2-5	6	6.5	19.7	----	2.62	0.0	75.8	4.8	19.4	NON-PLASTIC			SC	----	----	----	----	----	----	----	----
TP4-2	4.5	5.2	19.9	----	----	0.0	55.5	5.4	39.1	35.0	18.0	17.0	SC	----	----	----	----	----	----	----	----
	4.5	5.2	----	----	----	----	----	----	----	40.0	56.0	NP	SM	----	----	----	----	----	----	----	----
TP6-1	8	9	14.0	----	2.69	0.0	84.5	4.1	11.4	NON-PLASTIC			SM	----	----	----	----	----	----	----	----
TP7-1	6	6.5	26.4	----	----	0.0	44.7	12.8	42.5	40.0	19.0	21.0	CL	----	----	----	----	----	----	----	----
	6	6.5	----	----	----	----	----	----	----	40.0	19.0	21.0	ML	----	----	----	----	----	----	----	----
TP8-1	5	6	23.8	----	----	0.0	36.1	16.9	47.0	43.0	21.0	22.0	CL	----	----	----	----	----	----	----	----
	5	6	----	----	----	----	----	----	----	45.0	54.0	NP	ML	----	----	----	----	----	----	----	----
TP8-3	8	8.5	8.1	----	2.61	0.0	93.0	1.5	5.5	NON-PLASTIC			SP-SM	----	----	----	----	----	----	----	----
TP9-2	2.7	3	18.7	----	2.65	0.0	61.1	9.8	29.1	27.0	16.0	11.0	SC	----	----	----	----	----	----	----	----
TP9-3	4	5	20.3	----	----	0.0	60.6	11.7	27.7	26.0	18.0	8.0	SC	----	----	----	----	----	----	----	----
	3.5	5	----	----	----	----	----	----	----	26.0	15.0	11.0	SC	----	----	----	----	----	----	----	----
TP10-2	3	5	19.3	----	----	0.0	62.6	6.6	30.8	28.0	16.0	12.0	SC	----	----	----	----	----	----	----	----
	3	5	----	----	----	----	----	----	----	25.0	12.0	13.0	SC	----	----	----	----	----	----	----	----
TP11-1	1.8	4	17.5	----	----	0.0	57.2	13.9	28.9	29.0	16.0	13.0	SC	----	----	----	----	----	----	----	----
	1.8	4	----	----	----	----	----	----	----	30.0	10.0	20.0	SC	----	----	----	----	----	----	----	----
TP11-2	5.5	7	15.8	----	2.69	0.0	89.2	1.0	9.8	NON-PLASTIC			SP-SM	----	----	----	----	----	----	----	----
TP14-3	6.5	7	27.1	----	----	0.0	43.1	15.8	41.1	35.0	17.0	18.0	CL	----	----	----	----	----	----	----	----
	6.5	7	----	----	----	----	----	----	----	29.0	15.0	14.0	CL	----	----	----	----	----	----	----	----
TP16-1	0.4	1.8	25.2	----	----	0.0	34.0	12.5	53.5	48.0	22.0	26.0	CL	----	----	----	----	----	----	----	----
	0.4	1.8	----	----	----	----	----	----	----	49.0	18.0	31.0	CL	----	----	----	----	----	----	----	----

SAMPLE	DEPTH (ft)		INDICES			GRAIN SIZE (%)				ATTERBERG LIMITS				MOD.PROCTOR		PERMEABILITY			CONSOLIDATION		
LOCATION	TOP	BOT	% M	DD	Gs	GRVL	SAND	SILT	CLAY	LL	PL	PI	CLASS	MDD	OMC	% M	DD	k	% M	DD	Cc
TP1-3	1.1	2.6	----	----	----	----	----	----	----	----	----	----	----	----	----	16.7	100.7	1.1E-07	----	----	----
	1.1	2.6	----	----	----	----	----	----	----	----	----	----	----	----	----	21.1	101.7	1.1E-08	----	----	----
COMPOSITE	----	----	----	----	----	----	----	----	----	----	----	----	----	122.8	11.1	10.9	110.0	3.5E-06	----	----	----
	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	14.0	109.5	1.1E-05	----	----	----
	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	16.9	109.7	2.8E-08	----	----	----
COMPOSITE	----	----	----	----	----	----	----	----	----	----	----	----	----	119.4	13.2	14.2	105.8	5.6E-06	----	----	----
	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	17.8	107.1	1.9E-08	----	----	----
COMPOSITE	----	----	----	----	----	----	----	----	----	----	----	----	----	117.3	13.5	13.6	104.7	2.3E-07	----	----	----
	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	18.8	104.3	5.0E-08	----	----	----

RMT Soils Laboratory - Moisture Content Determination

PROJECT: WEYERHAEUSER

JOB #: 467.42

			by	date
Tech:	GTF	06/12/90	QC	6-12-90
Input:	GTF	06/12/90	QA	6-12-90

BORING	SAMPLE	DEPTH	TARE	WET WT	DRY WT	% MOISTURE
TP16-1		0.4-1.8	79.89	286.02	244.48	25.2
TP1-3		1.1-2.6	80.18	297.49	253.20	25.6
TP8-1		5.0-6.0'	77.05	324.41	276.78	23.8
TP7-1		6.0-6.5'	77.90	362.82	303.27	26.4
TP14-3		6.5-7.0'	77.41	369.55	307.23	27.1
TP4-2		4.5-5.2'	77.45	325.85	284.64	19.9
TP11-1		1.8-4.0'	78.71	395.45	348.33	17.5
TP9-3		4.0-5.0'	78.58	420.67	363.05	20.3
TP10-2		3.0-5.0'	78.07	381.69	332.64	19.3

RMT Soils Laboratory - Moisture Content Determination

PROJECT: WEYERHAEUSER

JOB #: 467.42

				by	date
Tech:	JPH	06/27/90	QC	JPH	6/27/90
Input:	HJW	06/27/90	QA	DH	6/27/90

BORING	SAMPLE	DEPTH	TARE	WET WT	DRY WT	% MOISTURE
OW-1		20-22'	80.50	333.69	275.86	29.6
MW-8		20-22'	76.49	404.25	316.21	36.7

RMT Soils Laboratory - Moisture Content Determination

PROJECT: Weyerhaeuser

JOB #: 467.42

Tech: GTF 5/18/90 QC HW 5-21-90
Input: JPH 05/21/90 QA [illegible] 6-4-90

BORING	SAMPLE	DEPTH	TARE	WET WT	DRY WT	% MOISTURE
OW-3	S5		76.55	145.05	135.48	16.2
TP2-5		6.0-6.5'	77.21	174.92	158.81	19.7
TP9-2		2.7-3.0'	77.99	141.74	131.69	18.7
TP8-3		8.0-8.5'	78.58	362.79	341.41	8.1
MW1A	S8		77.01	128.56	115.49	34.0
MW-8	S8		77.80	135.62	119.14	39.9
TP11-2		5.5-7.0'	76.05	374.65	333.80	15.8
MW-1A	S10		78.92	351.21	317.23	14.3
TP6-1		8-9'	76.87	398.27	358.68	14.0

RMT Soils Laboratory - Dry Density Determination

PROJECT: Weyerhaeuser

JOB #: 462.42

			by	date
Tech:	JPH	5/18/90 QC	[illegible]	5-21-90
Input:	GTF	05/21/90 QA	JPH	6-4-90

BORING #	MW-1A	MW-8
SAMPLE #	S8	S8
DEPTH		
% MOISTURE	34.0	39.9
WET DENSITY	115.3	111.3
DRY DENSITY	86.0	79.6
TARE WT	77.01	77.8
WET WT+TARE	128.56	135.62
DRY WT+TARE	115.49	119.14
TARE WT	0	0
DIAMETER	1.45	1.45
HEIGHT	3.42	2.87
WET WT+TARE	171.0	138.6

RMT Soils Laboratory - Specific Gravity Determination

PROJECT: WEYERHAEUSER

JOB #: 467.42

Tech: GTF 06/0890
Input: GTF 06/12/90

QC GTF 6/18/90
QA [illegible]

FLASK VOL @20 C	250	
AIR REMOVAL	VACUUM	
BORING #	OW-1	MW-8
SAMPLE #		
DEPTH	4-6'	2-4'
WT FLASK+H20	355.25	352.51
WT DRY SOIL	26.92	26.35
WT FLASK+SOIL+H20	371.8	368.69
TEMP C	22	22
SPECIFIC GRAVITY	2.59	2.59

RMT Soils Laboratory - Specific Gravity Determination

PROJECT: Weyerhaeuser

JOB #: 467.42

Tech: GTF 6-4-90
Input: GTF 06/04/90

QC
QA

FLASK VOL @20 C 250
AIR REMOVAL VACUUM

BORING #	OW-3	TP2-5	TP9-2	MW-1A	MW-8
SAMPLE #					
DEPTH	S-5	6.0-6.5'	2.7-3.0'	S8	S8
WT FLASK+H20	355.14	352.48	351.38	354.05	353.52
WT DRY SOIL	26.41	26.87	26.22	25.83	26.30
WT FLASK+SOIL+H20	371.6	369.1	367.69	370.36	369.99
TEMP C	21.5	21.5	21.5	21.5	21.5
SPECIFIC GRAVITY	2.65	2.62	2.65	2.71	2.67

RMT Soils Laboratory - Specific Gravity Determination

PROJECT: weyerhaeuser

JOB #: 467.42

Tech: GTF 5-29-90

Input: GTF 05/30/90

QC [illegible] 6/4/90

QA JOH 6-7-90

FLASK VOL @20 C	250	
AIR REMOVAL	VACUUM	
BORING #	OW-1	MW-8
SAMPLE #		
DEPTH	8-10'	20-22'
WT FLASK+H20	352.37	351.45
WT DRY SOIL	26.2	27.24
WT FLASK+SOIL+H20	368.68	368.5
TEMP C	22	22
SPECIFIC GRAVITY	2.65	2.67

RMT Soils Laboratory - Specific Gravity Determination

PROJECT: Weyerhaeuser

JOB #: 467.42

Tech: GAP 5/22/90 QC GTF 5-23-90
Input: GAP 05/22/90 QA 6-4-90

FLASK VOL @20 C	250 ml			
AIR REMOVAL	VACUUM			
BORING #	TP-8-3	TP-11-2	MW-1A	TP-6-1
SAMPLE #			S10	
DEPTH	8-8.5'	5.5-7.0'		8-9.0'
WT FLASK+H20	355.43	352.63	351.63	353.99
WT DRY SOIL	25.33	20.88	25	25.16
WT FLASK+SOIL+H20	371.06	365.74	367.13	369.81
TEMP C	21.5	21.5	21.5	21.5
SPECIFIC GRAVITY	2.61	2.69	2.63	2.69

RMT Soils Laboratory - Specific Gravity Determination

PROJECT: weyerhaeuser

JOB #: 467.42

Tech: GTF 5-31-90
Input: GTF 05/31/90

QC GAP 6/4/90
QA JGH 6/4/90

FLASK VOL @20 C	250	
AIR REMOVAL	VACUUM	
BORING #	MW-1A	SB-9
SAMPLE #		
DEPTH	22-24.0'	18-20.2'
WT FLASK+H2O	355.22	352.39
WT DRY SOIL	26.82	27.16
WT FLASK+SOIL+H2O	371.89	369.19
TEMP C	22	22
SPECIFIC GRAVITY	2.64	2.62

RMT Soils Laboratory - Specific Gravity Determination

PROJECT: Weyerhaeuser

JOB #: 467.42

Tech: GTF 6-4-90

Input: GTF 06/04/90

QC [illegible] 6-6-90

QA [illegible] 6-20-90

FLASK VOL @20 C	250			
AIR REMOVAL	VACUUM			
BORING #	OW-3	OW-3	OW-2	OW-1
SAMPLE #				
DEPTH	9-11.0'	15-16.5'	13-15.0'	20-22.0'
WT FLASK+H20	355.28	352.56	351.49	354.05
WT DRY SOIL	29.24	26.02	28.75	26.78
WT FLASK+SOIL+H20	373.34	368.74	369.47	370.62
TEMP C	21.5	21.5	21.5	21.5
SPECIFIC GRAVITY	2.61	2.64	2.67	2.62

RMT Soils Laboratory - Atterberg Limit Determination

PROJECT: WEYERHAEUSER

				By	Date
	Tech:	GTF	06/01/90 QC	JAJ	6/4/90
JOB #: 467.42	Input:	GTF	06/01/90 QA	JAJ	6/4/90

PROJECT: WEYERHAEUSER JOB #: 467.42

BORING: MW-1A DEPTH: 22-24'

	Natural Moisture	LIQUID LIMIT	LIQUID LIMIT	OVEN LL	PLASTIC LIMIT
TARE		115.21	114.69		115.29
BLOWS		28	28		
WET WT		137.89	139.61		142.24
DRY WT		130.84	131.75		135.69
% WATER		45.7	46.7		32.1

BORING	MW-1A
DEPTH	22-24'
% WATER	
LL	46
PL	32
PI	14
CLASS	ML

PROJECT: WEYERHAEUSER JOB #: 467.42

BORING: SB-9 DEPTH: 18-20.0'

	Natural Moisture	LIQUID LIMIT	LIQUID LIMIT	OVEN LL	PLASTIC LIMIT
TARE					
BLOWS					
WET WT		NON-PLASTIC MATERIAL			
DRY WT					
% WATER					

BORING	SB-9
DEPTH	18-20.0'
% WATER	
LL	
PL	0
PI	
CLASS	NP

PROJECT: WEYERHAEUSER JOB #: 467.42

BORING: TP11-2 DEPTH: 5.5-7.0'

	Natural Moisture	LIQUID LIMIT	LIQUID LIMIT	OVEN LL	PLASTIC LIMIT
TARE					
BLOWS					
WET WT		NON-PLASTIC MATERIAL			
DRY WT					
% WATER					

BORING	TP11-2
DEPTH	5.5-7.0'
% WATER	
LL	
PL	0
PI	
CLASS	NP

RMT Soils Laboratory - Atterberg Limit Determination

PROJECT: WEYERHAEUSER

			By	Date
	Tech: GTF	06/01/90	QC	6-4-90
JOB #: 467.42	Input: GTF	06/01/90	QA	6-4-90

PROJECT: WEYERHAEUSER JOB #: 467.42

BORING: TP6-1 DEPTH: 8-9'

Natural Moisture	LIQUID LIMIT	OVEN LL	PLASTIC LIMIT
TARE			
BLOWS			
WET WT	NON-PLASTIC MATERIAL		
DRY WT			
% WATER			

BORING	TP6-1
DEPTH	8-9'
% WATER	
LL	
PL	0
PI	
CLASS	NP

PROJECT: WEYERHAEUSER JOB #: 467.42

BORING: TP8-3 DEPTH: 8-8.5'

Natural Moisture	LIQUID LIMIT	OVEN LL	PLASTIC LIMIT
TARE			
BLOWS			
WET WT	NON-PLASTIC MATERIAL		
DRY WT			
% WATER			

BORING	TP8-3
DEPTH	8-8.5'
% WATER	
LL	
PL	0
PI	
CLASS	NP

RMT Soils Laboratory - Atterberg Limit Determination

PROJECT: WEYERHAEUSER

JOB #: 467.42

			By	Date
Tech:	GTF	06/08/90	QC	6-12-90
Input:	GTF	06/28/90	QA	6-12-90

PROJECT: WEYERHAEUSER JOB #: 467.42

BORING: TP16-1 DEPTH: 0.4-1.8'

BORING	TP16-1
DEPTH	0.4-1.8'
% WATER	
LL	48
PL	22
PI	26
CLASS	CL

	Natural Moisture	LIQUID LIMIT		OVEN LL	PLASTIC LIMIT
TARE		115.00	114.99		115.37
BLOWS		25	23		
WET WT		139.93	139.99		140.29
DRY WT		131.81	131.89		135.85
% WATER		48.3	47.5		21.7

PROJECT: WEYERHAEUSER JOB #: 467.42

BORING: TP1-3 DEPTH: 1.1-2.6'

BORING	TP1-3
DEPTH	1.1-2.6'
% WATER	
LL	55
PL	25
PI	30
CLASS	CH

	Natural Moisture	LIQUID LIMIT		OVEN LL	PLASTIC LIMIT
TARE		115.23	115.42		115.08
BLOWS		23	22		
WET WT		140.36	139.41		137.37
DRY WT		131.36	130.81		132.95
% WATER		55.2	55.0		24.7

PROJECT: WEYERHAEUSER JOB #: 467.42

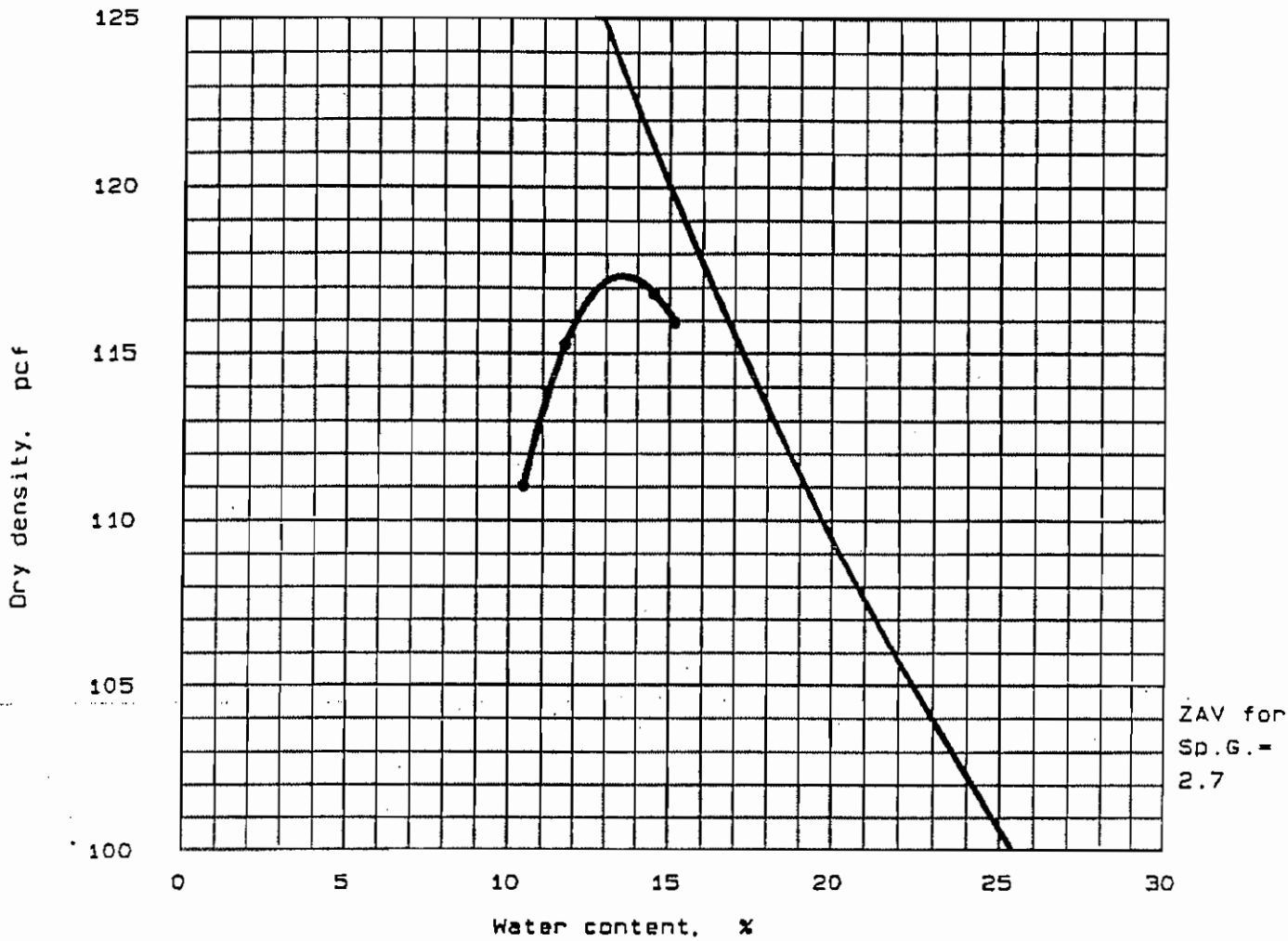
BORING: TP8-1 DEPTH: 5.0-6.0'

BORING	TP8-1
DEPTH	5.0-6.0'
% WATER	
LL	43
PL	21
PI	22
CLASS	CL

	Natural Moisture	LIQUID LIMIT		OVEN LL	PLASTIC LIMIT
TARE		115.07	114.90		115.22
BLOWS		23	24		
WET WT		138.92	143.14		137.98
DRY WT		131.74	134.67		134.07
% WATER		42.6	42.6		20.7

JDN 6-18-90

PROCTOR TEST REPORT



"Modified" Proctor, ASTM D 1557, Method A

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 13.5 % Maximum dry density = 117.3 pcf	

Project No.: 467.42

Project: WEYERHAEUSER

Location: TP-8-1, 5.0'-6.0'; TP-7-1, 6.0'-6.5'

Date: 6-18-1990

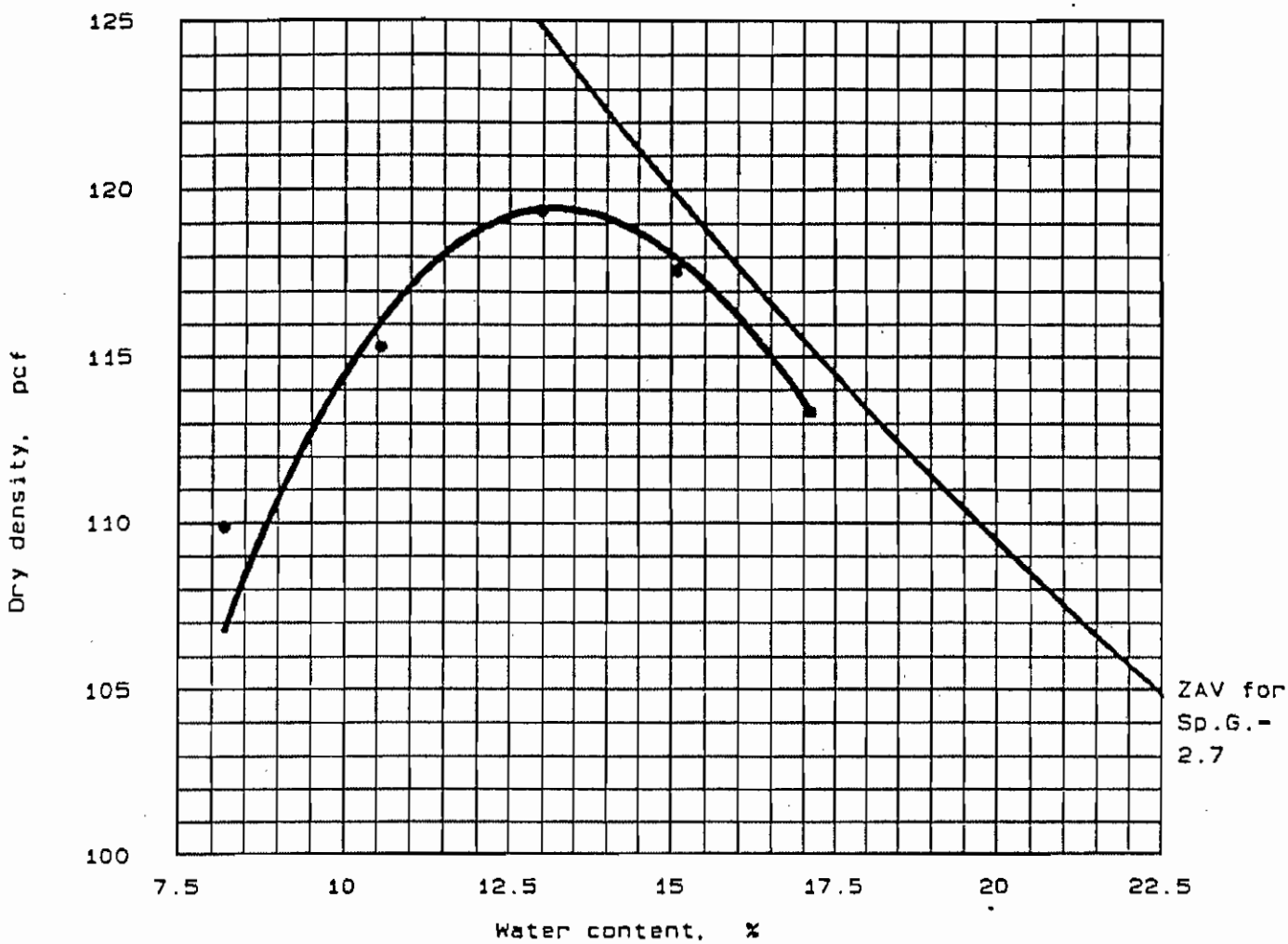
Remarks:

PROCTOR TEST REPORT

RMT Inc.

Figure No. _____

PROCTOR TEST REPORT



"Modified" Proctor, ASTM D 1557, Method A

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 13.2 % Maximum dry density = 119.4 pcf	

Project No.: 467.42

Project: WEYERHAEUSER

Location: TP4-2 4.5-5.2'

TP14-3 6.5-7.0'

Date: 6-15-1990

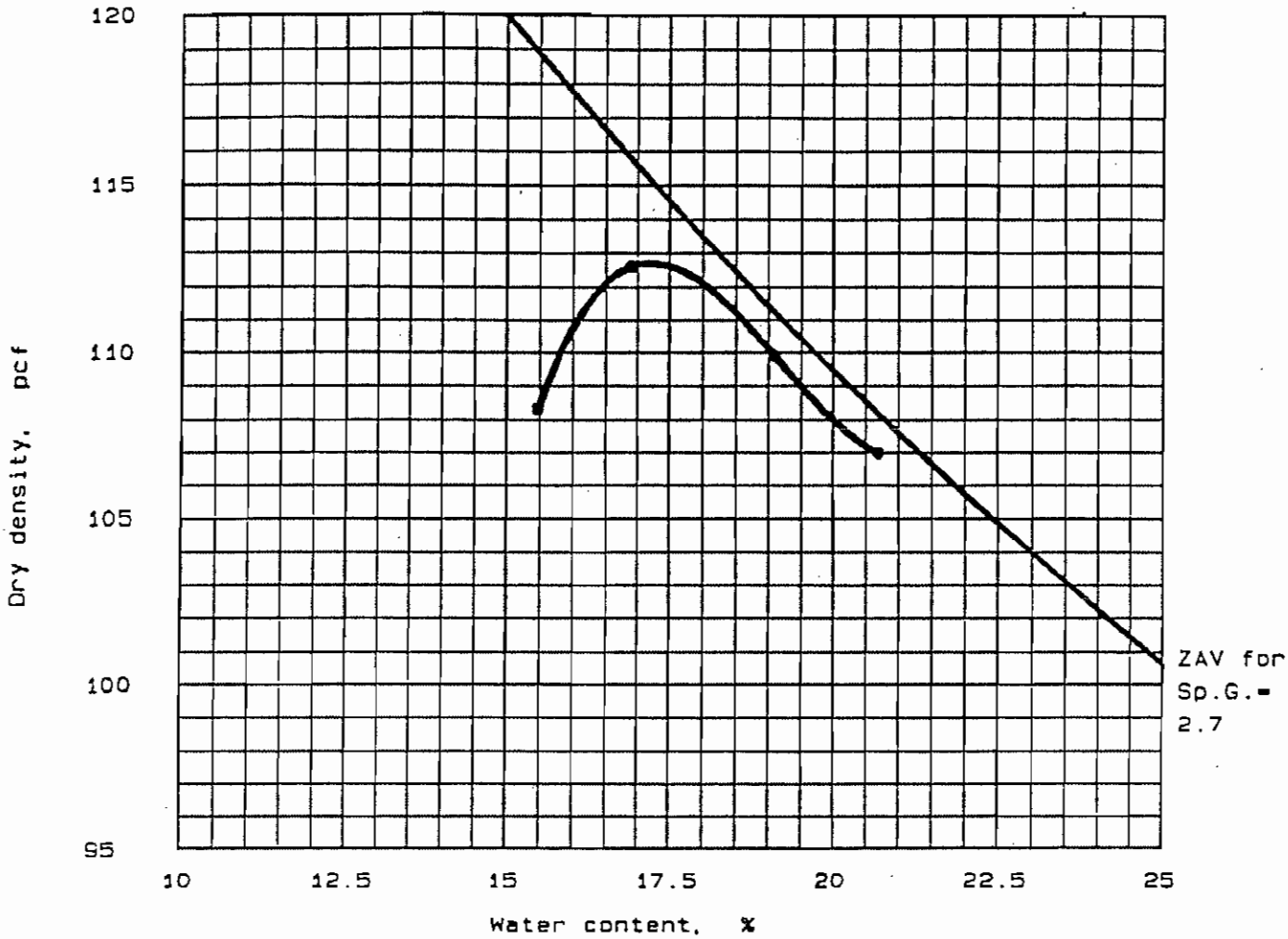
Remarks:

PROCTOR TEST REPORT

RMT Inc.

Figure No. _____

PROCTOR TEST REPORT



"Modified" Proctor, ASTM D 1557, Method A

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 17.2 % Maximum dry density = 112.7 pcf	

Project No.: 467.42

Project: WEYERHAEUSER

Location: TP1-3 1.1-2.6'

Date: 6-14-1990

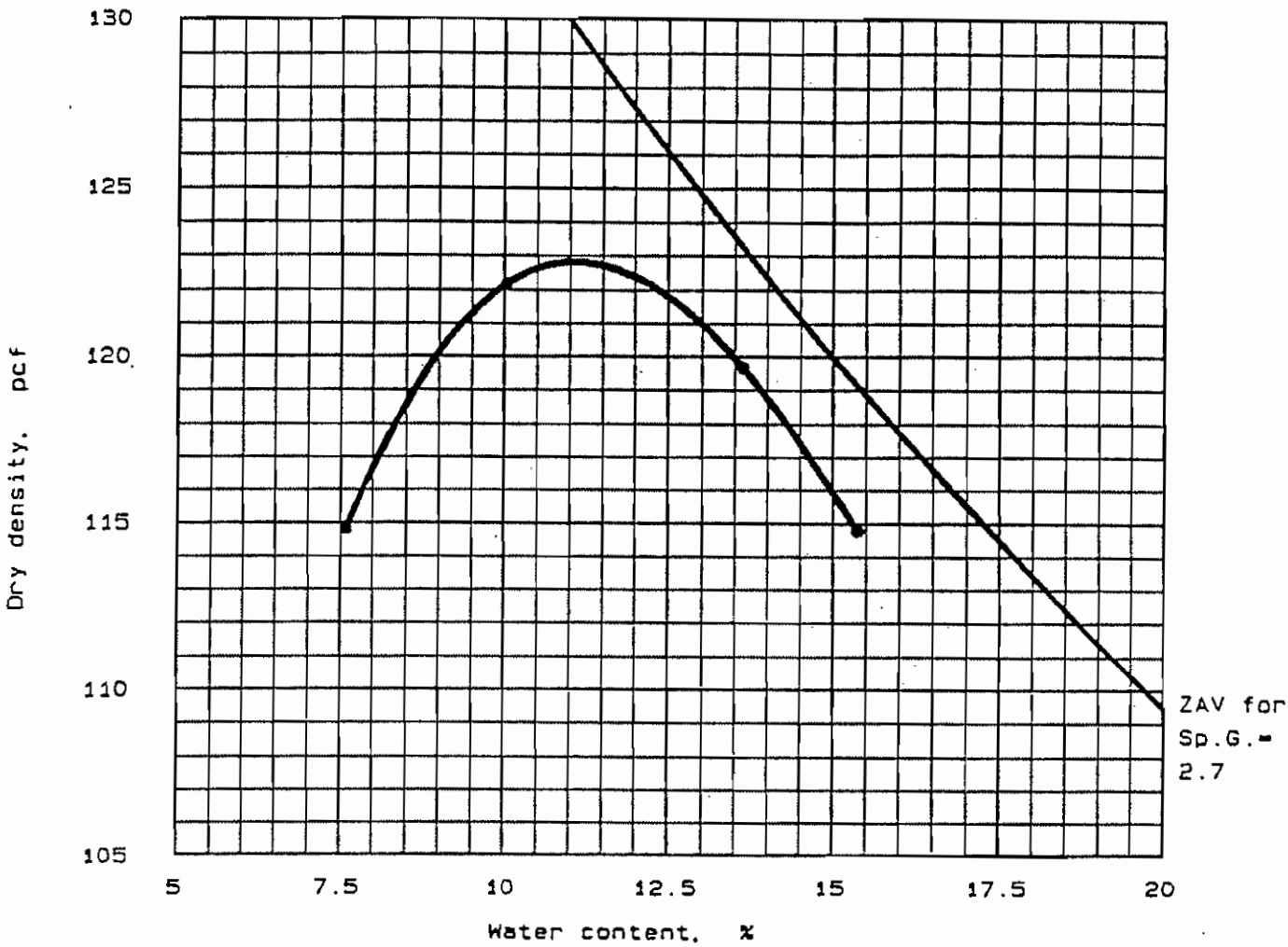
Remarks:

PROCTOR TEST REPORT

RMT Inc.

Figure No. _____

PROCTOR TEST REPORT



"Modified" Proctor, ASTM D 1557, Method A

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.20
	USCS	AASHTO						

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 11.1 % Maximum dry density = 122.8 pcf	

Project No.: 467.42

Project: WEYERHAEUSER

Location: TP11-1 1.8-4.0 TP9-3 4.0-5.0'
TP10-2 3.0-5.0

Date: 6-21-1990

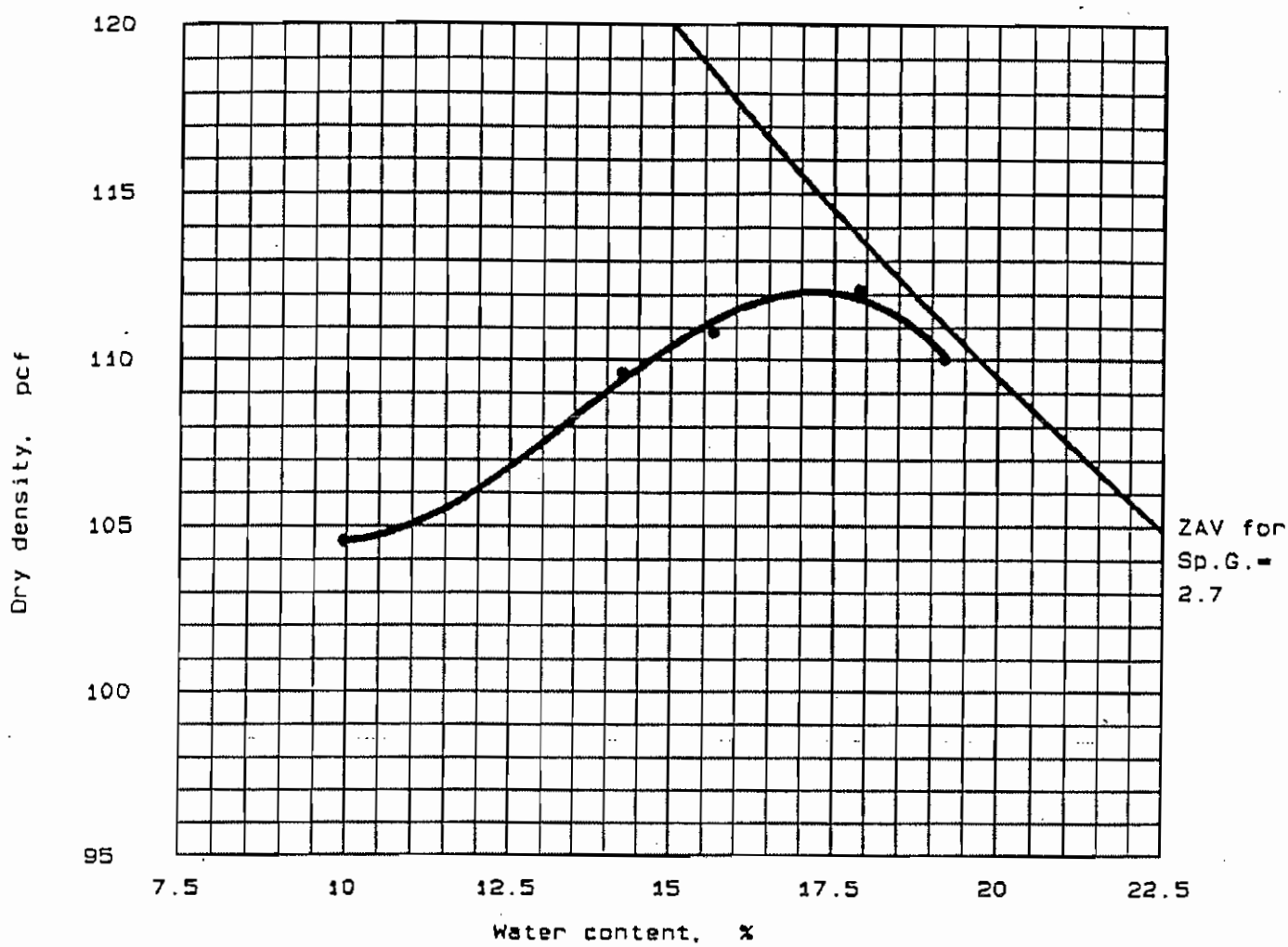
Remarks:

PROCTOR TEST REPORT

RMT Inc.

Figure No. _____

PROCTOR TEST REPORT



"Modified" Proctor, ASTM D 1557, Method A

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.20(
	USCS	AASHTO						

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 17.2 % Maximum dry density = 112.0 pcf	
Project No.: 467.42 Project: WEYERHAEUSER Location: TP-16-1 Date: 6-18-1990	Remarks:
PROCTOR TEST REPORT RMT Inc.	Figure No. _____

✓ JFI 6-27-90

RMT, Inc.
Falling Head Permeability Test

Job: WEYERHAEUSER
Job #: 467.42
Sample: MW-1A 22-24.0'
:
Visual Descript:

Date: 21-Jun-90
Tech: HJW
File: WER1
Cell #: 9S

INPUT VALUES

	INIT.	FINAL			
Sample Dia. (in)	2.87	2.86	Permeant:	WATER	
Sample Ht. (in)	2.39	2.39	Permeant Specific Gravity:	1.00	
Tare & Wet (g)	221.0	549.9	Sample Specific Gravity:	2.64	EST.
Tare & Dry (g)	192.5	422.7	Confining Pressure (psi):	100.0	
Tare (g)	115.0	78.7	Burette Diameter (in):	0.250	
Sample Wt. (g)	466.7	471.3	Burette Zero (cm):	100.0	

CALCULATED VALUES

MOISTURE (%)	36.7	37.0	MAXIMUM GRADIENT:	11.2
WET DENS. (pcf)	115.0	116.9	AVERAGE GRADIENT:	10.2
DRY DENS. (pcf)	84.1	85.4	MAX. EFFECT. STRESS (psi):	6.3
SATURATION (%)	101.1	105.0	MIN. EFFECT. STRESS (psi):	4.6
			AVE. EFFECT. STRESS (psi):	5.1

Date YY	MM	DD	Time HH	MM	Temp *	Press.(psi) BOT	TOP	Readings (cm) CHAM	BOT	TOP	Flow Dif. %	Kv cm/sec	Ave. 0,1
90	5	30	8	19	0	95	95	7.30	4.55	98.70			
90	5	31	7	46	21	95	95	20.20	8.40	96.30	23.2	1.9E-08	
90	6	1	7	38	20	95	95	23.80	11.50	93.75	9.7	1.8E-08	
90	6	1	16	20	22	95	95	24.90	12.65	92.90	15.0	1.8E-08	
90	6	4	7	39	21	95	95	48.80	19.70	87.50	13.3	1.7E-08	
90	6	5	8	9	21	95	95	50.00	22.00	85.60	9.5	1.7E-08	1
90	6	6	7	38	21	95	95	52.50	24.00	83.80	5.3	1.7E-08	1
90	6	7	7	47	20	95	95	53.00	25.85	82.10	4.2	1.6E-08	1

Average Kv for those rows with a 1 in the Ave. column 1.7E-08 cm/sec
6.6E-09 in/sec

Termination determined by stable Kv and low flow differential
* A zero in this column starts a series of measurements

JPI 6-27-90

RMT, Inc.
Falling Head Permeability Test

Job: WEYERHAEUSER
Job #: 467.42
Sample: MW-8 20-22.0'
:
Date: 21-Jun-90
Tech: HJW
File: WER2
Cell #: 10S

Visual Descript: BLUE GRAY SILTY CLAY

INPUT VALUES

	INIT.	FINAL			
Sample Dia. (in)	2.87	2.86	Permeant:	WATER	
Sample Ht. (in)	2.37	2.35	Permeant Specific Gravity:	1.00	
Tare & Wet (g)	224.6	569.2	Sample Specific Gravity:	2.67	EST.
Tare & Dry (g)	196.0	445.6	Confining Pressure (psi):	100.0	
Tare (g)	115.3	103.2	Burette Diameter (in):	0.250	
Sample Wt. (g)	460.2	466.0	Burette Zero (cm):	100.0	

CALCULATED VALUES

MOISTURE (%)	35.4	36.1	MAXIMUM GRADIENT:	16.1
WET DENS. (pcf)	114.3	117.6	AVERAGE GRADIENT:	8.8
DRY DENS. (pcf)	84.4	86.4	MAX. EFFECT. STRESS (psi):	6.1
SATURATION (%)	97.2	103.8	MIN. EFFECT. STRESS (psi):	4.7
			AVE. EFFECT. STRESS (psi):	5.4

Date YY	MM	DD	Time HH	MM	Temp *	Press.(psi) BOT	TOP	Readings (cm) CHAM	BOT	TOP	Flow Dif. %	Kv cm/sec	Ave. 0.1
90	5	29	8	32	0	95	95	20.35	3.00	97.85			
90	5	29	15	25	22	95	95	20.60	5.70	95.55	8.0	5.0E-08	
90	5	30	8	3	21	95	95	23.30	11.40	90.40	5.1	4.9E-08	
90	5	31	8	47	21	95	95	21.10	18.30	84.20	5.3	4.6E-08	
90	6	1	7	37	20	95	95	21.50	23.80	79.00	2.8	4.9E-08	
90	6	1	16	19	22	95	95	20.00	25.70	77.40	8.6	4.8E-08	1
90	6	4	7	45	21	95	95	22.60	35.55	68.35	4.2	4.5E-08	1
90	6	4	13	57	0	95	95	21.90	2.85	99.20			
90	6	5	8	10	21	95	95	21.80	9.40	93.50	6.9	4.7E-08	1

Average Kv for those rows with a 1 in the Ave. column 4.7E-08 cm/sec
1.8E-08 in/sec

Termination determined by stable Kv and low flow differential
* A zero in this column starts a series of measurements

✓ JJ? 6-27-90

RMT, Inc.
Falling Head Permeability Test

Job: WEYERHAEUSER
Job #: 467.42
Sample: OW-1, 8-10.0'
:
Date: 21-Jun-90
Tech: HJW
File: WER3
Cell #: 17S

Visual Descript: YELLOW GRAY CLAYEY SILTY SAND

INPUT VALUES

	INIT.	FINAL			
Sample Dia. (in)	2.87	2.87	Permeant:	WATER	
Sample Ht. (in)	2.33	2.26	Permeant Specific Gravity:	1.00	
Tare & Wet (g)	274.1	555.6	Sample Specific Gravity:	2.65	EST.
Tare & Dry (g)	236.4	448.3	Confining Pressure (psi):	100.0	
Tare (g)	115.0	103.2	Burette Diameter (in):	0.250	
Sample Wt. (g)	460.6	452.5	Burette Zero (cm):	100.0	

CALCULATED VALUES

MOISTURE (%)	31.1	31.1	MAXIMUM GRADIENT:	17.0
WET DENS. (pcf)	116.4	117.9	AVERAGE GRADIENT:	12.7
DRY DENS. (pcf)	88.8	89.9	MAX. EFFECT. STRESS (psi):	6.1
SATURATION (%)	95.6	98.2	MIN. EFFECT. STRESS (psi):	4.7
			AVE. EFFECT. STRESS (psi):	5.4

Date YY MM DD	Time HH MM	Temp *	Press.(psi) BOT	TOP	Readings (cm) CHAM	BOT	TOP	Flow Dif. %	Kv cm/sec	Ave. 0,1
90 5 29	8 19	0	95	95	22.30	3.00	101.10			
90 5 29	10 26	0	95	95	22.40	4.20	100.50			
90 5 29	10 31	21	95	95	22.40	9.80	94.70	-1.8	9.1E-06	
90 5 29	10 38	21	95	95	22.30	16.40	88.00	-0.8	8.8E-06	
90 5 29	10 46	21	95	95	22.30	22.40	82.00	0.0	8.3E-06	
90 5 29	10 54	21	95	95	22.20	27.20	77.10	-1.0	8.1E-06	
90 5 29	11 10	21	95	95	22.20	34.30	70.00	0.0	7.6E-06	
90 5 30	8 45	0	95	95	25.00	2.60	98.80			
90 5 30	8 49	21	95	95	25.20	13.90	87.00	-2.2	2.5E-05	
90 5 30	9 3	21	95	95	25.20	22.00	78.80	-0.6	6.5E-06	
90 5 30	9 12	21	95	95	25.10	27.90	72.80	-0.8	9.5E-06	
90 5 31	8 0	0	95	95	22.90	2.90	101.80			
90 5 31	8 7	21	95	95	23.20	12.80	91.40	-2.5	1.2E-05	
90 5 31	8 14	21	95	95	23.20	20.10	84.00	-0.7	1.1E-05	
90 5 31	8 21	21	95	95	23.20	25.70	78.70	2.8	9.7E-06	
90 6 1	8 7	0	95	95	23.50	3.00	100.35			
90 6 1	8 13	20	95	95	23.80	11.70	91.20	-2.5	1.2E-05	1
90 6 1	8 18	20	95	95	23.80	17.40	85.40	-0.9	1.1E-05	1
90 6 1	8 22	0	95	95	23.80	19.70	83.70			
90 6 1	8 28	20	95	95	23.80	26.20	76.80	-3.0	1.4E-05	1

Average Kv for those rows with a 1 in the Ave. column 1.3E-05 cm/sec
5.0E-06 in/sec

Termination determined by stable Kv and low flow differential
* A zero in this column starts a series of measurements

✓ GTF 6-21-90
✓ JJF 6-27-90

RMT, Inc.
Falling Head Permeability Test

Job: WEYERHAEUSER
Job #: 467.42
Sample: SB-9, 18-20.0'
:
Visual Descript: LT BRN SILTY CLAY WITH SAND LENSES

Date: 21-Jun-90
Tech: HJW
File: WER4
Cell #: 18S

INPUT VALUES

	INIT.	FINAL
Sample Dia. (in)	2.87	2.86
Sample Ht. (in)	2.33	2.31
Tare & Wet (g)	225.7	598.3
Tare & Dry (g)	207.6	509.0
Tare (g)	115.4	102.8
Sample Wt. (g)	493.4	495.5

Permeant:	TAP WATER	
Permeant Specific Gravity:	1.00	
Sample Specific Gravity:	2.62	EST.
Confining Pressure (psi):	100.0	
Burette Diameter (in):	0.250	
Burette Zero (cm):	100.0	

CALCULATED VALUES

MOISTURE (%)	19.6	22.0
WET DENS. (pcf)	124.7	127.2
DRY DENS. (pcf)	104.3	104.3
SATURATION (%)	90.4	101.5

MAXIMUM GRADIENT:	16.7
AVERAGE GRADIENT:	11.5
MAX. EFFECT. STRESS (psi):	6.3
MIN. EFFECT. STRESS (psi):	4.9
AVE. EFFECT. STRESS (psi):	5.5

Date YY	MM	DD	Time HH	MM	Temp *	Press.(psi) BOT	TOP	Readings (cm) CHAM	BOT	TOP	Flow Dif. %	Kv cm/sec	Ave. 0,1
90	5	30	8	11	0	95	95	7.80	4.00	98.20			
90	5	31	8	1	0	95	95	9.80	2.50	100.50			
90	5	31	8	8	21	95	95	10.00	16.50	87.20	2.6	1.7E-05	
90	5	31	8	12	21	95	95	10.00	22.20	81.50	-0.0	1.6E-05	
90	5	31	8	17	21	95	95	10.00	28.10	75.60	-0.0	1.7E-05	
90	5	31	11	4	0	95	95	9.80	1.90	101.30			
90	5	31	11	7	21	95	95	10.00	12.60	90.40	-0.9	3.1E-05	
90	5	31	11	10	21	95	95	10.00	20.70	82.50	1.2	2.9E-05	
90	5	31	11	13	21	95	95	10.00	26.40	76.40	-3.4	2.6E-05	
90	6	1	8	8	0	95	95	10.70	2.65	99.70			
90	6	1	8	12	20	95	95	10.90	21.40	80.80	-0.4	4.6E-05	1
90	6	1	8	15	20	95	95	10.90	30.10	72.00	-0.6	4.3E-05	1
90	6	4	10	22	0	95	95	12.10	2.20	100.40			
90	6	4	10	25	21	95	95	12.10	16.90	85.20	-1.7	4.5E-05	1
90	6	4	10	28	21	95	95	12.10	26.80	75.20	-0.5	4.3E-05	1

Average Kv for those rows with a 1 in the Ave. column — 4.4E-05 cm/sec
1.7E-05 in/sec

Termination determined by stable Kv and low flow differential
* A zero in this column starts a series of measurements

✓ JAV 6-27-90

RMT, Inc.
Falling Head Permeability Test

Job: WEYERHAEUSER
Job #: 467.42
Sample: OW-3, 9-11.0'
:
Date: 21-Jun-90
Tech: HJW
File: WER6
Cell #: 12S
Visual Descript: TANNISH GRAY SILTY CLAY WITH SAND LENSES

INPUT VALUES

	INIT.	FINAL			
Sample Dia. (in)	2.87	2.87	Permeant:	TAP WATER	
Sample Ht. (in)	2.38	2.36	Permeant Specific Gravity:	1.00	
Tare & Wet (g)	265.2	597.0	Sample Specific Gravity:	2.61	EST.
Tare & Dry (g)	235.3	496.4	Confining Pressure (psi):	100.0	
Tare (g)	115.2	106.3	Burette Diameter (in):	0.250	
Sample Wt. (g)	486.1	490.8	Burette Zero (cm):	100.0	

CALCULATED VALUES

MOISTURE (%)	24.9	25.8	MAXIMUM GRADIENT:	14.8
WET DENS. (pcf)	120.3	122.5	AVERAGE GRADIENT:	11.3
DRY DENS. (pcf)	96.3	97.4	MAX. EFFECT. STRESS (psi):	6.2
SATURATION (%)	94.0	100.0	MIN. EFFECT. STRESS (psi):	4.8
			AVE. EFFECT. STRESS (psi):	5.4

Date YY	MM	DD	Time HH	MM	Temp *	Press.(psi) BOT	TOP	Readings (cm) CHAM	BOT	TOP	Flow Dif. %	Kv cm/sec	Ave. 0,1
90	6	1	7	41	0	95	95	15.80	4.30	98.45			
90	6	1	12	35	22	95	95	15.70	11.75	91.30	2.1	2.2E-07	
90	6	[illegible]	16	18	22	95	95	14.40	16.15	87.25	4.1	1.9E-07	
90	6	4	11	40	0	95	95	17.20	3.15	98.30			
90	6	4	13	39	21	95	95	16.80	6.40	95.20	2.4	2.2E-07	
90	6	5	8	11	21	95	95	16.70	24.50	77.50	1.1	1.8E-07	
90	6	6	7	47	0	95	95	18.30	3.90	98.80			
90	6	6	9	40	20	95	95	18.30	6.90	95.85	0.8	2.2E-07	
90	6	7	7	48	20	95	95	18.20	27.50	75.85	1.5	1.7E-07	
90	6	8	8	4	0	95	95	17.80	2.65	99.10			
90	6	8	9	57	21	95	95	17.90	5.65	96.20	1.7	2.1E-07	
90	6	8	16	45	21	95	95	16.71	14.20	87.85	1.2	1.9E-07	
90	6	11	8	14	0	95	95	18.10	4.30	98.30			
90	6	11	9	17	20	95	95	18.10	5.70	96.90	0.0	1.8E-07	
90	6	11	10	18	20	95	95	17.90	7.00	95.70	4.0	1.7E-07	
90	6	11	11	21	21	95	95	17.95	8.25	94.40	-2.0	1.8E-07	1
90	6	11	12	58	21	95	95	17.30	10.00	92.70	1.4	1.6E-07	1
90	6	11	14	41	21	95	95	17.15	11.95	90.85	2.6	1.7E-07	1
90	6	12	8	7	21	95	95	17.50	26.45	76.80	1.6	1.6E-07	1

Average Kv for those rows with a 1 in the Ave. column 1.7E-07 cm/sec
6.6E-08 in/sec

Termination determined by stable Kv and low flow differential
* A zero in this column starts a series of measurements

RMT, Inc.
Falling Head Permeability Test

Job: WEYERHAEUSER
Job #: 467.42
Sample: OW-1, 20-22.0'
:
Visual Descript: BLUE GRAY SILTY CLAY

Date: 21-Jun-90
Tech: HJW
File: WER7
Cell #: 8S

INPUT VALUES

	INIT.	FINAL
Sample Dia. (in)	2.87	2.85
Sample Ht. (in)	2.36	2.33
Tare & Wet (g)	443.7	548.7
Tare & Dry (g)	320.4	424.0
Tare (g)	0.0	103.5
Sample Wt. (g)	443.7	445.2

Permeant:	TAP WATER	
Permeant Specific Gravity:	1.00	
Sample Specific Gravity:	2.62	EST.
Confining Pressure (psi):	100.0	
Burette Diameter (in):	0.250	
Burette Zero (cm):	100.0	

CALCULATED VALUES

MOISTURE (%)	38.5	38.9
WET DENS. (pcf)	110.7	114.1
DRY DENS. (pcf)	79.9	82.1
SATURATION (%)	96.5	102.9

MAXIMUM GRADIENT:	15.7
AVERAGE GRADIENT:	8.6
MAX. EFFECT. STRESS (psi):	6.3
MIN. EFFECT. STRESS (psi):	4.8
AVE. EFFECT. STRESS (psi):	5.5

Date YY	MM	DD	Time HH	MM	Temp *	Press.(psi) BOT	TOP	Readings (cm) CHAM	BOT	TOP	Flow Dif. %	Kv cm/sec	Ave. 0,1
90	6	1	16	27	0	95	95	8.80	2.70	98.70			
90	6	4	7	38	21	95	95	14.10	17.75	87.60	15.1	3.2E-08	
90	6	5	8	8	21	95	95	13.00	21.15	84.20	0.0	2.6E-08	
90	6	6	7	37	21	95	95	14.70	24.25	81.20	1.6	2.7E-08	
90	6	7	9	10	20	95	95	14.30	27.25	78.50	5.3	2.6E-08	
90	6	8	8	1	20	95	95	14.50	29.45	76.30	-0.0	2.5E-08	1
90	6	8	16	47	21	95	95	13.20	30.30	75.60	9.7	2.4E-08	1
90	6	11	8	15	20	95	95	14.70	35.50	70.80	4.0	2.5E-08	1
90	6	11	8	19	0	95	95	14.70	3.20	98.40			
90	6	11	12	59	0	95	95	13.85	4.55	97.50			
90	6	12	8	6	21	95	95	14.00	8.10	94.25	4.4	2.5E-08	1

Average Kv for those rows with a 1 in the Ave. column 2.5E-08 cm/sec
9.8E-09 in/sec

Termination determined by stable Kv and low flow differential
* A zero in this column starts a series of measurements

RMT, Inc.
Falling Head Permeability Test

Job: WEYERHAEUSER
Job #: 467.42
Sample: MW-8A, 2-4.0'
:
Date: 21-Jun-90
Tech: HJW
File: WER10
Cell #: 18S

Visual Descript: TAN MOTTLED SILTY CLAY

INPUT VALUES

	INIT.	FINAL			
Sample Dia. (in)	2.87	2.85	Permeant:	TAP WATER	
Sample Ht. (in)	2.38	2.36	Permeant Specific Gravity:	1.00	
Tare & Wet (g)	483.2	591.0	Sample Specific Gravity:	2.65	EST.
Tare & Dry (g)	386.9	489.8	Confining Pressure (psi):	100.0	
Tare (g)	0.0	102.8	Burette Diameter (in):	0.250	
Sample Wt. (g)	483.2	488.1	Burette Zero (cm):	100.0	

CALCULATED VALUES

MOISTURE (%)	24.9	26.2	MAXIMUM GRADIENT:	11.5
WET DENS. (pcf)	119.5	123.5	AVERAGE GRADIENT:	9.7
DRY DENS. (pcf)	95.7	97.9	MAX. EFFECT. STRESS (psi):	6.3
SATURATION (%)	90.6	100.6	MIN. EFFECT. STRESS (psi):	4.9
			AVE. EFFECT. STRESS (psi):	5.5

Date YY	MM	DD	Time HH	MM	Temp *	Press.(psi) BOT	TOP	Readings (cm) CHAM	BOT	TOP	Flow Dif. %	Kv cm/sec	Ave. 0,1
90	6	5	7	59	0	95	95	10.00	1.75	101.75			
90	6	5	13	3	22	95	95	8.70	3.40	100.25	4.8	4.0E-08	
90	6	6	7	36	21	95	95	12.10	8.00	95.80	1.7	3.4E-08	
90	6	7	7	44	20	95	95	12.30	12.75	91.35	3.3	2.9E-08	
90	6	8	8	0	20	95	95	12.30	16.60	87.40	-1.3	2.8E-08	
90	6	8	16	48	21	95	95	10.90	17.90	86.60	23.8	2.2E-08	
90	6	11	8	20	20	95	95	12.60	25.50	79.00	0.0	2.5E-08	1
90	6	11	13	1	21	95	95	12.00	25.95	78.50	-5.3	2.5E-08	1
90	6	12	8	5	21	95	95	12.00	27.75	76.80	2.9	2.3E-08	1

Average Kv for those rows with a 1 in the Ave. column 2.4E-08 cm/sec
9.6E-09 in/sec

Termination determined by stable Kv and low flow differential
* A zero in this column starts a series of measurements

✓ JTH 6-6-90

RMT, Inc.
Falling Head Permeability Test

Job: WEYERHAEUSER
Job #: 467.42
Sample: OW-1, 4-6.0'
:
Visual Descript: TAN SILTY CLAY WITH SAND LENSES

Date: 21-Jun-90
Tech: HJW
File: WER9
Cell #: 15S

INPUT VALUES

	INIT.	FINAL
Sample Dia. (in)	2.87	2.84
Sample Ht. (in)	2.37	2.34
Tare & Wet (g)	169.1	551.4
Tare & Dry (g)	158.1	449.2
Tare (g)	115.2	77.5
Sample Wt. (g)	474.7	473.9

Permeant:	TAP WATER	
Permeant Specific Gravity:	1.00	
Sample Specific Gravity:	2.59	EST.
Confining Pressure (psi):	100.0	
Burette Diameter (in):	0.250	
Burette Zero (cm):	100.0	

CALCULATED VALUES

MOISTURE (%)	25.7	27.5
WET DENS. (pcf)	117.9	121.8
DRY DENS. (pcf)	93.8	95.5
SATURATION (%)	92.2	102.9

MAXIMUM GRADIENT:	16.4
AVERAGE GRADIENT:	14.5
MAX. EFFECT. STRESS (psi):	6.1
MIN. EFFECT. STRESS (psi):	4.7
AVE. EFFECT. STRESS (psi):	5.4

Date YY	MM	DD	Time HH	MM	Temp *	Press.(psi) BOT	TOP	Readings (cm) CHAM	BOT	TOP	Flow Dif. %	Kv cm/sec	Ave. 0,1
90	6	5	8	7	0	95	95	22.40	2.65	102.15			
90	6	5	10	34	22	95	95	21.70	14.80	90.00	-0.0	7.3E-07	
90	6	5	12	45	22	95	95	21.45	22.65	82.20	0.3	6.8E-07	
90	6	5	14	7	22	95	95	21.60	26.50	78.25	-1.3	6.6E-07	
90	6	6	7	44	0	95	95	24.90	2.40	102.20			
90	6	6	9	41	21	95	95	24.90	11.55	92.80	-1.3	6.7E-07	
90	6	7	8	28	0	95	95	25.20	2.40	101.60			
90	6	7	9	5	20	95	95	25.20	6.70	97.10	-2.3	9.6E-07	
90	6	8	7	59	0	95	95	25.00	2.80	101.75			
90	6	8	8	49	20	95	95	25.00	8.50	95.70	-3.0	9.7E-07	
90	6	8	10	48	21	95	95	25.10	15.25	89.05	0.7	5.4E-07	
90	6	11	8	54	0	95	95	25.00	3.80	101.00			
90	6	11	9	14	20	95	95	25.70	6.25	98.50	-1.0	1.0E-06	1
90	6	11	9	28	20	95	95	25.70	7.80	96.90	-1.6	9.5E-07	1
90	6	11	9	48	20	95	95	25.60	10.00	94.70	-0.0	9.7E-07	1
90	6	11	10	2	20	95	95	25.60	11.50	93.25	1.7	9.7E-07	1
90	6	11	10	15	20	95	95	25.50	12.80	91.90	-1.9	9.7E-07	1
90	6	11	10	31	20	95	95	25.50	14.20	90.40	-3.4	9.0E-07	1

Average Kv for those rows with a 1 in the Ave. column 9.6E-07 cm/sec
3.8E-07 in/sec

Termination determined by stable Kv and low flow differential
* A zero in this column starts a series of measurements

RMT, Inc.
Falling Head Permeability Test

Job: WEYERHAEUSER
Job #: 467.42
Sample: OW-3 15-16.5'
:
Visual Descript: TAN FINE TO MEDIUM SAND TO SILTY SAND

Date: 21-Jun-90
Tech: HJW
File: WER5
Cell #: 15S

INPUT VALUES

	INIT.	FINAL			
Sample Dia. (in)	2.87	2.87	Permeant:	TAP WATER	
Sample Ht. (in)	2.37	2.32	Permeant Specific Gravity:	1.00	
Tare & Wet (g)	255.4	617.0	Sample Specific Gravity:	2.64	EST.
Tare & Dry (g)	236.0	530.4	Confining Pressure (psi):	100.0	
Tare (g)	115.8	106.3	Burette Diameter (in):	0.250	
Sample Wt. (g)	498.3	510.7	Burette Zero (cm):	100.0	

CALCULATED VALUES

MOISTURE (%)	16.1	20.4	MAXIMUM GRADIENT:	16.3
WET DENS. (pcf)	123.8	129.6	AVERAGE GRADIENT:	10.7
DRY DENS. (pcf)	106.6	107.6	MAX. EFFECT. STRESS (psi):	6.2
SATURATION (%)	78.0	101.6	MIN. EFFECT. STRESS (psi):	4.8
			AVE. EFFECT. STRESS (psi):	5.5

Date YY	MM	DD	Time HH	MM	Temp *	Press.(psi) BOT	TOP	Readings (cm) CHAM	BOT	TOP	Flow Dif. %	Kv cm/sec	Ave. 0,1
90	5	31	8	58	0	95	95	14.20	3.80	101.30			
90	5	31	8	58.5	21	95	95	14.20	16.60	88.50	0.0	2.3E-04	
90	5	31	8	59	21	95	95	14.20	25.90	79.20	0.0	2.2E-04	
90	5	31	8	59.5	21	95	95	14.20	32.60	72.50	0.0	2.2E-04	
90	5	31	11	41	0	95	95	14.40	5.70	100.60			
90	5	31	11	41.5	21	95	95	14.40	18.10	88.20	0.0	2.3E-04	
90	5	31	11	42	21	95	95	14.40	27.60	78.70	0.0	2.4E-04	
90	5	31	11	42.5	21	95	95	14.40	34.30	72.00	-0.0	2.3E-04	
90	6	1	8	5	0	95	95	15.80	4.25	100.25			
90	6	1	8	5.5	20	95	95	15.80	16.50	88.00	0.0	2.2E-04	1
90	6	1	8	6	20	95	95	15.80	26.10	78.40	0.0	2.3E-04	1
90	6	1	8	6.5	20	95	95	15.80	33.10	71.40	0.0	2.3E-04	1

Average Kv for those rows with a 1 in the Ave. column 2.3E-04 cm/sec
9.0E-05 in/sec

Termination determined by stable Kv and low flow differential
* A zero in this column starts a series of measurements

✓ AH 6-20-90

RMT, Inc.
Falling Head Permeability Test

Job: WEYERHAEUSER
Job #: 467.42
Sample: OW-2, 13'-15.0'
:
Visual Descript:

Date: 18-Jun-90
Tech: HJW
File: WER8
Cell #: 13S

INPUT VALUES

	INIT.	FINAL
Sample Dia. (in)	2.87	2.83
Sample Ht. (in)	2.34	2.22
Tare & Wet (g)	454.8	546.5
Tare & Dry (g)	341.2	444.3
Tare (g)	0.0	103.1
Sample Wt. (g)	454.8	443.4

Permeant:	TAP WATER
Permeant Specific Gravity:	1.00
Sample Specific Gravity:	2.67
Confining Pressure (psi):	100.0
Burette Diameter (in):	0.250
Burette Zero (cm):	100.0

CALCULATED VALUES

MOISTURE (%)	33.3	29.9
WET DENS. (pcf)	114.5	121.0
DRY DENS. (pcf)	85.9	93.1
SATURATION (%)	94.5	101.2

MAXIMUM GRADIENT:	17.3
AVERAGE GRADIENT:	14.2
MAX. EFFECT. STRESS (psi):	6.4
MIN. EFFECT. STRESS (psi):	4.9
AVE. EFFECT. STRESS (psi):	5.6

Date YY	MM	DD	Time HH	MM	Temp *	Press.(psi) BOT	TOP	Readings (cm) CHAM	BOT	TOP	Flow Dif. %	Kv cm/sec	Ave. 0,1
90	6	4	9	23	0	95	95	2.60	2.00	102.20			
90	6	4	13	34	21	95	95	2.40	5.60	98.40	-2.7	1.1E-07	
90	6	5	8	0	21	95	95	3.70	18.10	86.20	1.2	1.0E-07	
90	6	5	12	47	22	95	95	2.50	20.75	83.60	1.0	1.0E-07	
90	6	6	7	35	21	95	95	6.00	29.05	75.40	0.6	9.9E-08	
90	6	7	7	42	20	95	95	6.90	36.80	67.90	1.6	1.0E-07	
90	6	7	8	27	0	95	95	6.90	2.10	102.20			
90	6	8	7	57	20	95	95	7.60	19.30	85.00	-0.0	1.1E-07	
90	6	8	16	45	21	95	95	7.60	23.95	80.50	1.6	1.0E-07	
90	6	11	8	24	0	95	95	10.00	4.00	101.30			
90	6	11	10	56	20	95	95	9.50	6.15	99.05	-2.3	1.1E-07	1
90	6	11	13	2	21	95	95	9.10	7.80	97.40	0.0	1.1E-07	1
90	6	11	14	39	21	95	95	9.00	9.00	96.15	-2.0	1.0E-07	1
90	6	12	8	4	21	95	95	9.75	20.20	85.10	0.7	1.0E-07	1

Average Kv for those rows with a 1 in the Ave. column 1.1E-07 cm/sec
4.2E-08 in/sec

Termination determined by stable Kv and low flow differential
* A zero in this column starts a series of measurements

RMT, Inc.
Falling Head Permeability Test

Job: WEYERHAEUSER
Job #: 467.42
Sample: TP1-3, 1.1'-2.6'
:
Visual Descript:

Date: 28-Jun-90
Tech: GAP
File: WEYREM1
Cell #: 11S

INPUT VALUES

	INIT.	FINAL
Sample Dia. (in)	2.50	2.50
Sample Ht. (in)	2.32	2.34
Tare & Wet (g)	152.8	457.4
Tare & Dry (g)	146.3	378.3
Tare (g)	115.4	76.8
Sample Wt. (g)	368.1	380.6

Permeant:	TAP WATER	
Permeant Specific Gravity:	1.00	
Sample Specific Gravity:	2.70	EST.
Confining Pressure (psi):	100.0	
Burette Diameter (in):	0.250	
Burette Zero (cm):	100.0	

CALCULATED VALUES

	INIT.	FINAL
MOISTURE (%)	21.1	26.2
WET DENS. (pcf)	123.1	126.2
DRY DENS. (pcf)	101.7	100.0
SATURATION (%)	86.7	103.4

MAXIMUM GRADIENT:	14.6
AVERAGE GRADIENT:	13.4
MAX. EFFECT. STRESS (psi):	6.3
MIN. EFFECT. STRESS (psi):	5.0
AVE. EFFECT. STRESS (psi):	5.6

Date YY	MM	DD	Time HH	MM	Temp *	Press.(psi) BOT	TOP	Readings (cm) CHAM	BOT	TOP	Flow Dif. %	Kv cm/sec	Ave. 0,1
90	6	20	7	47	0	95	95	4.65	3.50	97.40			
90	6	20	15	34	23	95	95	4.00	4.55	96.60	13.5	2.1E-08	
90	6	21	7	17	21	95	95	5.75	6.00	96.00	41.5	1.2E-08	
90	6	22	7	35	21	95	95	6.30	7.90	94.80	22.6	1.2E-08	
90	6	25	10	11	21	95	95	5.60	12.80	91.15	14.6	1.1E-08	1
90	6	26	8	25	23	95	95	4.60	14.05	90.10	8.7	1.1E-08	1
90	6	27	6	5	21	95	95	3.90	15.30	89.15	13.6	1.1E-08	1
90	6	27	13	32	22	95	95	2.50	15.70	88.85	14.3	1.1E-08	1

Average Kv for those rows with a 1 in the Ave. column 1.1E-08 cm/sec
4.4E-09 in/sec

Termination determined by stable Kv and low flow differential
* A zero in this column starts a series of measurements

RMT, Inc.
Falling Head Permeability Test

Job: WEYERHAEUSER
Job #: 467.42
Sample: TP1- 3, 1.1'-2.6'
:
Visual Descript:

Date: 28-Jun-90
Tech: GAP
File: WEYREM4
Cell #: 6P

INPUT VALUES

	INIT.	FINAL			
Sample Dia. (in)	2.50	2.50	Permeant:	TAP WATER	
Sample Ht. (in)	2.32	2.36	Permeant Specific Gravity:	1.00	
Tare & Wet (g)	153.8	464.5	Sample Specific Gravity:	2.72	EST.
Tare & Dry (g)	148.3	382.2	Confining Pressure (psi):	100.0	
Tare (g)	115.5	79.6	Burette Diameter (in):	0.250	
Sample Wt. (g)	351.3	384.9	Burette Zero (cm):	100.0	

CALCULATED VALUES

MOISTURE (%)	16.7	27.2	MAXIMUM GRADIENT:	16.3
WET DENS. (pcf)	117.5	126.6	AVERAGE GRADIENT:	12.4
DRY DENS. (pcf)	100.7	99.5	MAX. EFFECT. STRESS (psi):	6.3
SATURATION (%)	66.2	104.8	MIN. EFFECT. STRESS (psi):	4.8
			AVE. EFFECT. STRESS (psi):	5.5

Date YY MM DD	Time HH MM	Temp *	Press.(psi) BOT	TOP	Readings (cm) CHAM	BOT	TOP	Flow Dif. %	Kv cm/sec	Ave. 0,1
90 6 20	7 29	0	95	95	3.40	1.40	98.15			
90 6 20	15 29	23	95	95	4.80	7.45	93.20	10.0	1.3E-07	
90 6 20	16 7	23	95	95	4.80	7.90	92.85	12.5	1.2E-07	
90 6 21	7 10	21	95	95	5.50	16.75	85.20	7.3	1.2E-07	
90 6 22	7 21	21	95	95	8.00	27.15	75.70	4.5	1.2E-07	
90 6 25	9 45	0	95	95	15.15	1.80	101.00			
90 6 25	10 18	21	95	95	15.25	2.20	100.50	-11.1	1.4E-07	
90 6 25	10 46	21	95	95	15.30	2.45	100.20	-9.1	1.0E-07	
90 6 26	8 17	23	95	95	16.10	14.70	88.20	1.0	1.1E-07	1
90 6 26	10 48	22	95	95	17.00	15.90	87.00	-0.0	1.1E-07	1
90 6 26	13 27	22	95	95	17.00	17.05	85.80	-2.1	1.1E-07	1
90 6 27	5 57	21	95	95	17.20	23.80	79.20	1.1	1.1E-07	1

Average Kv for those rows with a 1 in the Ave. column 1.1E-07 cm/sec
4.3E-08 in/sec

Termination determined by stable Kv and low flow differential
* A zero in this column starts a series of measurements

RMT, Inc.
Falling Head Permeability Test

Job: WEYERHAEUSER
Job #: 467.42
Sample: TP4-2, 4.5'-5.2'
: TP14-3, 6.5'-7.0'
Visual Descript:

Date: 28-Jun-90
Tech: GAP
File: WEYREM2
Cell #: 7S

INPUT VALUES

	INIT.	FINAL
Sample Dia. (in)	2.50	2.49
Sample Ht. (in)	2.32	2.32
Tare & Wet (g)	156.1	467.0
Tare & Dry (g)	150.0	400.1
Tare (g)	116.0	79.7
Sample Wt. (g)	377.2	387.3

Permeant:	TAP WATER	
Permeant Specific Gravity:	1.00	
Sample Specific Gravity:	2.65	EST.
Confining Pressure (psi):	100.0	
Burette Diameter (in):	0.250	
Burette Zero (cm):	100.0	

CALCULATED VALUES

MOISTURE (%)	17.8	20.9
WET DENS. (pcf)	126.2	130.6
DRY DENS. (pcf)	107.1	108.0
SATURATION (%)	86.7	104.3

MAXIMUM GRADIENT:	15.2
AVERAGE GRADIENT:	13.3
MAX. EFFECT. STRESS (psi):	6.3
MIN. EFFECT. STRESS (psi):	4.9
AVE. EFFECT. STRESS (psi):	5.5

Date YY	MM	DD	Time HH	MM	Temp *	Press.(psi) BOT	TOP	Readings (cm) CHAM	BOT	TOP	Flow Dif. %	Kv cm/sec	Ave. 0,1
90	6	20	7	45	0	95	95	5.30	1.90	97.00			
90	6	20	15	34	23	95	95	5.60	3.00	95.60	-12.0	2.8E-08	
90	6	21	7	17	21	95	95	8.70	4.80	94.40	20.0	1.7E-08	
90	6	22	7	34	21	95	95	10.45	7.50	92.10	8.0	2.0E-08	1
90	6	25	10	7	21	95	95	12.65	14.55	85.90	6.4	1.9E-08	1
90	6	26	8	24	23	95	95	12.20	16.45	84.10	2.7	2.0E-08	1

Average Kv for those rows with a 1 in the Ave. column 1.9E-08 cm/sec
7.6E-09 in/sec

Termination determined by stable Kv and low flow differential
* A zero in this column starts a series of measurements

6-28-90

RMT, Inc.
Falling Head Permeability Test

Job: WEYERHAEUSER
Job #: 467.42
Sample: TP4-2, 4.5'-5.2'
: TP14-3, 6.5'-7.0'
Visual Descript:

Date: 28-Jun-90
Tech: GAP
File: WEYREM6
Cell #: 4P

INPUT VALUES

	INIT.	FINAL			
Sample Dia. (in)	2.50	2.49	Permeant:	TAP WATER	
Sample Ht. (in)	2.32	2.33	Permeant Specific Gravity:	1.00	
Tare & Wet (g)	150.1	468.7	Sample Specific Gravity:	2.70	EST.
Tare & Dry (g)	145.7	397.6	Confining Pressure (psi):	100.0	
Tare (g)	115.2	80.4	Burette Diameter (in):	0.250	
Sample Wt. (g)	361.3	388.3	Burette Zero (cm):	100.0	

CALCULATED VALUES

MOISTURE (%)	14.2	22.4	MAXIMUM GRADIENT:	13.6
WET DENS. (pcf)	120.9	130.4	AVERAGE GRADIENT:	10.5
DRY DENS. (pcf)	105.8	106.5	MAX. EFFECT. STRESS (psi):	6.2
SATURATION (%)	64.7	103.9	MIN. EFFECT. STRESS (psi):	4.8
			AVE. EFFECT. STRESS (psi):	5.4

Date YY	MM	DD	Time HH	MM	Temp *	Press.(psi) BOT	TOP	Readings (cm) CHAM	BOT	TOP	Flow Dif. %	Kv cm/sec	Ave. 0,1
90	6	20	7	24	0	95	95	10.75	2.40	98.50			
90	6	20	15	23	0	95	95	13.50	3.20	100.20			
90	6	20	15	49	23	95	95	13.30	17.90	85.40	-0.3	6.9E-06	
90	6	20	16	8	23	95	95	13.40	25.00	77.80	-3.4	6.4E-06	
90	6	21	7	27	0	95	95	15.35	2.50	98.60			
90	6	21	7	58	21	95	95	15.20	18.00	82.90	-0.6	6.3E-06	
90	6	21	8	30	21	95	95	15.40	28.85	72.10	0.2	6.3E-06	
90	6	22	7	19	0	95	95	17.20	2.20	98.80			
90	6	22	7	51	21	95	95	17.85	17.50	83.00	-1.6	6.0E-06	
90	6	22	14	31	0	95	95	18.55	1.65	98.60			
90	6	22	14	35	21	95	95	18.60	3.90	96.10	-5.3	6.2E-06	
90	6	22	14	46	21	95	95	18.70	9.80	90.10	-0.8	6.2E-06	
90	6	22	14	50	21	95	95	18.70	11.60	88.30	0.0	5.7E-06	1
90	6	22	14	59	21	95	95	18.60	15.15	84.80	0.7	5.3E-06	1
90	6	22	15	34	21	95	95	18.50	26.90	73.00	-0.2	5.9E-06	1

Average Kv for those rows with a 1 in the Ave. column 5.6E-06 cm/sec
2.2E-06 in/sec

Termination determined by stable Kv and low flow differential
* A zero in this column starts a series of measurements

6-28-90

RMT, Inc.
Falling Head Permeability Test

Job: WEYERHAEUSER
Job #: 467.42
Sample: TP8-1, 5.0'-6.0'
: TP7-1, 6.0'-6.5'
Visual Descript:

Date: 28-Jun-90
Tech: GAP
File: WEYREM7
Cell #: 3P

INPUT VALUES

	INIT.	FINAL
Sample Dia. (in)	2.50	2.51
Sample Ht. (in)	2.32	2.35
Tare & Wet (g)	160.7	467.2
Tare & Dry (g)	153.4	391.2
Tare (g)	115.1	78.6
Sample Wt. (g)	370.7	388.7

Permeant:	TAP WATER
Permeant Specific Gravity:	1.00
Sample Specific Gravity:	2.65 EST.
Confining Pressure (psi):	100.0
Burette Diameter (in):	0.250
Burette Zero (cm):	100.0

CALCULATED VALUES

MOISTURE (%)	18.8	24.3
WET DENS. (pcf)	124.0	127.3
DRY DENS. (pcf)	104.3	102.4
SATURATION (%)	85.4	104.9

MAXIMUM GRADIENT:	10.2
AVERAGE GRADIENT:	9.6
MAX. EFFECT. STRESS (psi):	6.4
MIN. EFFECT. STRESS (psi):	4.6
AVE. EFFECT. STRESS (psi):	5.4

Date YY	MM	DD	Time HH	MM	Temp *	Press.(psi) BOT	TOP	Readings (cm) CHAM	BOT	TOP	Flow Dif. %	Kv cm/sec	Ave. 0,1
90	6	20	7	21	0	95	95	2.60	1.10	98.50			
90	6	20	15	3	23	95	95	2.60	17.40	95.90	72.5	2.3E-07	
90	6	20	15	15	0	95	95	33.30	4.30	99.95			
90	6	20	16	9	23	95	95	32.70	5.40	99.40	33.3	1.6E-07	
90	6	21	8	27	0	95	95	24.60	4.50	99.70			
90	6	22	7	37	0	95	95	8.90	8.25	98.45			
90	6	22	9	50	21	95	95	7.20	13.10	96.90	51.6	2.7E-07	
90	6	22	15	0	0	95	95	8.60	1.35	97.30			
90	6	22	15	30	21	95	95	7.60	2.80	97.35	107.1	2.4E-07	
90	6	22	16	15	21	95	95	5.20	5.95	97.20	90.9	3.9E-07	
90	6	25	10	46	0	95	95	22.40	10.00	96.90			
90	6	25	14	37	21	95	95	20.50	13.00	95.70	42.9	1.1E-07	
90	6	26	8	16	23	95	95	21.20	22.80	85.50	-2.0	1.3E-07	
90	6	26	10	43	22	95	95	19.50	25.60	85.00	69.7	1.8E-07	
90	6	26	11	0	0	95	95	24.00	21.40	83.90			
90	6	26	13	25	0	95	95	25.30	21.00	83.00			
90	6	26	15	0	22	95	95	25.70	21.15	82.60	-45.5	4.6E-08	
90	6	26	17	0	22	95	95	25.65	21.50	82.15	-12.5	5.4E-08	
90	6	27	5	56	21	95	95	26.60	23.50	79.60	-12.1	5.0E-08	1
90	6	27	8	50	22	95	95	27.50	24.00	79.05	-4.8	5.4E-08	1
90	6	27	13	30	22	95	95	27.50	24.70	78.30	-3.4	4.7E-08	1

Average Kv for those rows with a 1 in the Ave. column 5.0E-08 cm/sec
2.0E-08 in/sec

Termination determined by stable Kv and low flow differential
* A zero in this column starts a series of measurements

RMT, Inc.
Falling Head Permeability Test

Job: WEYERHAEUSER
Job #: 467.42
Sample: TP8-1, 5.0'-6.0'
: TP7-1, 6.0'-6.5'
Visual Descript:

Date: 28-Jun-90
Tech: GAP
File: WEYREM3
Cell #: 16S

INPUT VALUES

	INIT.	FINAL			
Sample Dia. (in)	2.50	2.51	Permeant:	TAP WATER	
Sample Ht. (in)	2.32	2.36	Permeant Specific Gravity:	1.00	
Tare & Wet (g)	155.4	469.7	Sample Specific Gravity:	2.70	EST.
Tare & Dry (g)	150.6	393.2	Confining Pressure (psi):	100.0	
Tare (g)	115.5	78.6	Burette Diameter (in):	0.250	
Sample Wt. (g)	355.7	391.1	Burette Zero (cm):	100.0	

CALCULATED VALUES

MOISTURE (%)	13.6	24.3	MAXIMUM GRADIENT:	16.6
WET DENS. (pcf)	119.0	127.6	AVERAGE GRADIENT:	11.6
DRY DENS. (pcf)	104.7	102.6	MAX. EFFECT. STRESS (psi):	6.4
SATURATION (%)	60.4	102.3	MIN. EFFECT. STRESS (psi):	4.9
			AVE. EFFECT. STRESS (psi):	5.5

Date YY MM DD	Time HH MM	Temp *	Press.(psi) BOT	TOP	Readings (cm) CHAM	BOT	TOP	Flow Dif. %	Kv cm/sec	Ave. 0,1
90 6 20	7 44	0	95	95	1.70	1.90	98.70			
90 6 20	15 32	23	95	95	1.80	12.40	87.40	-3.7	2.7E-07	
90 6 20	16 5	23	95	95	1.75	13.00	86.75	-4.0	2.5E-07	
90 6 21	7 16	21	95	95	4.50	26.30	73.20	-0.9	2.5E-07	
90 6 22	7 34	21	95	95	6.40	37.65	61.30	-2.4	2.3E-07	
90 6 25	10 3	0	95	95	8.45	2.50	101.25			
90 6 25	10 48	21	95	95	8.05	3.50	99.75	-20.0	2.8E-07	
90 6 26	8 23	23	95	95	7.80	24.85	78.15	-0.6	2.3E-07	1
90 6 26	13 30	22	95	95	6.60	28.30	74.65	-0.7	2.3E-07	1
90 6 27	6 4	0	95	95	7.70	1.80	101.60			
90 6 27	7 32	22	95	95	7.80	3.70	99.50	-5.0	2.3E-07	1

Average Kv for those rows with a 1 in the Ave. column 2.3E-07 cm/sec
9.0E-08 in/sec

Termination determined by stable Kv and low flow differential
* A zero in this column starts a series of measurements

✓ JPA 6-28-90

RMT, Inc.
Falling Head Permeability Test

Job: WEYERHAEUSER
Job #: 467.42
Sample: TP11-1,1.8-4.0';TP9-3,4-5'
: TP10-2, 3.0'-5.0'
Visual Descript:

Date: 28-Jun-90
Tech: GAP
File: WEYREM9
Cell #: 1P

INPUT VALUES

	INIT.	FINAL
Sample Dia. (in)	2.50	2.50
Sample Ht. (in)	2.32	2.29
Tare & Wet (g)	163.4	467.8
Tare & Dry (g)	156.5	409.3
Tare (g)	115.4	80.1
Sample Wt. (g)	383.4	387.7

Permeant:	TAP WATER	
Permeant Specific Gravity:	1.00	
Sample Specific Gravity:	2.65	EST.
Confining Pressure (psi):	100.0	
Burette Diameter (in):	0.250	
Burette Zero (cm):	100.0	

CALCULATED VALUES

MOISTURE (%)	16.9	17.8
WET DENS. (pcf)	128.3	131.4
DRY DENS. (pcf)	109.7	111.6
SATURATION (%)	88.2	97.6

MAXIMUM GRADIENT:	15.8
AVERAGE GRADIENT:	13.1
MAX. EFFECT. STRESS (psi):	6.3
MIN. EFFECT. STRESS (psi):	5.0
AVE. EFFECT. STRESS (psi):	5.5

Date YY	MM	DD	Time HH	MM	Temp *	Press.(psi) BOT	TOP	Readings (cm) CHAM	BOT	TOP	Flow Dif. %	Kv cm/sec	Ave. 0,1
90	6	20	7	17	0	95	95	4.80	2.80	98.50			
90	6	20	15	2	23	95	95	7.20	4.15	96.50	-19.4	3.7E-08	
90	6	20	16	10	23	95	95	7.00	4.30	96.20	-33.3	3.5E-08	
90	6	21	7	4	21	95	95	8.60	6.75	93.90	3.2	2.9E-08	1
90	6	22	7	11	21	95	95	11.20	10.30	90.40	0.7	2.8E-08	1
90	6	25	8	55	21	95	95	16.75	19.20	81.60	0.6	2.7E-08	1

Average Kv for those rows with a 1 in the Ave. column 2.8E-08 cm/sec
1.1E-08 in/sec

Termination determined by stable Kv and low flow differential
* A zero in this column starts a series of measurements

RMT, Inc.
Falling Head Permeability Test

Job: WEYERHAEUSER Date: 28-Jun-90
Job #: 467.42 Tech: GAP
Sample: TP11-1,1.8-4.0';TP9-3,4'-5' File: WEYREM5
: TP10-2,3.0'-5.0' Cell #: 5P
Visual Descript:

INPUT VALUES

	INIT.	FINAL			
Sample Dia. (in)	2.50	2.50	Permeant:	TAP WATER	
Sample Ht. (in)	2.32	2.33	Permeant Specific Gravity:	1.00	
Tare & Wet (g)	156.5	480.6	Sample Specific Gravity:	2.70	EST.
Tare & Dry (g)	151.5	416.9	Confining Pressure (psi):	100.0	
Tare (g)	115.4	79.6	Burette Diameter (in):	0.250	
Sample Wt. (g)	373.5	401.0	Burette Zero (cm):	100.0	

CALCULATED VALUES

MOISTURE (%)	14.0	18.9	MAXIMUM GRADIENT:	15.0
WET DENS. (pcf)	124.9	133.6	AVERAGE GRADIENT:	8.1
DRY DENS. (pcf)	109.5	112.4	MAX. EFFECT. STRESS (psi):	6.3
SATURATION (%)	70.5	102.0	MIN. EFFECT. STRESS (psi):	4.8
			AVE. EFFECT. STRESS (psi):	5.5

Date YY MM DD	Time HH MM	Temp *	Press.(psi) BOT	TOP	Readings (cm) CHAM	BOT	TOP	Flow Dif. %	Kv cm/sec	Ave. 0,1
90 6 20	7 26	0	95	95	3.85	2.80	98.00			
90 6 20	15 26	0	95	95	7.35	4.20	102.30			
90 6 20	15 50	22	95	95	7.30	24.90	80.85	-1.8	1.2E-05	
90 6 20	16 7	23	95	95	7.40	34.15	71.40	-1.1	1.2E-05	
90 6 21	7 28	0	95	95	9.90	2.90	98.20			
90 6 21	7 57	21	95	95	9.80	26.00	74.50	-1.3	1.1E-05	
90 6 21	8 31	21	95	95	10.00	39.20	61.30	0.0	1.1E-05	
90 6 22	7 20	0	95	95	12.40	3.00	98.80			
90 6 22	7 52	21	95	95	12.40	27.40	73.70	-1.4	1.1E-05	
90 6 22	14 32	0	95	95	13.10	2.40	98.70			
90 6 22	14 35	21	95	95	13.15	5.95	94.45	-9.0	1.4E-05	
90 6 22	14 47	21	95	95	13.20	16.55	83.60	-1.2	1.1E-05	1
90 6 22	14 57	21	95	95	13.10	23.40	76.80	0.4	1.1E-05	1
90 6 22	15 35	21	95	95	13.10	38.70	61.40	-0.3	1.1E-05	1

Average Kv for those rows with a 1 in the Ave. column 1.1E-05 cm/sec
4.4E-06 in/sec

Termination determined by stable Kv and low flow differential
* A zero in this column starts a series of measurements

✓ JPA 6-25-90

RMT, Inc.
Falling Head Permeability Test

Job: WEYERHAEUSER
Job #: 467.42
Sample: TP11-1,1.8-4.0';TP9-3,4-5'
: TP10-2,3.0-5.0'
Visual Descript:

Date: 28-Jun-90
Tech: GAP
File: WEYREM8
Cell #: 2P

INPUT VALUES

	INIT.	FINAL
Sample Dia. (in)	2.50	2.50
Sample Ht. (in)	2.32	2.28
Tare & Wet (g)	157.7	465.1
Tare & Dry (g)	153.6	399.7
Tare (g)	115.5	78.8
Sample Wt. (g)	364.6	386.4

Permeant:	DEAIRED WATER
Permeant Specific Gravity:	1.00
Sample Specific Gravity:	2.70 EST.
Confining Pressure (psi):	100.0
Burette Diameter (in):	0.250
Burette Zero (cm):	100.0

CALCULATED VALUES

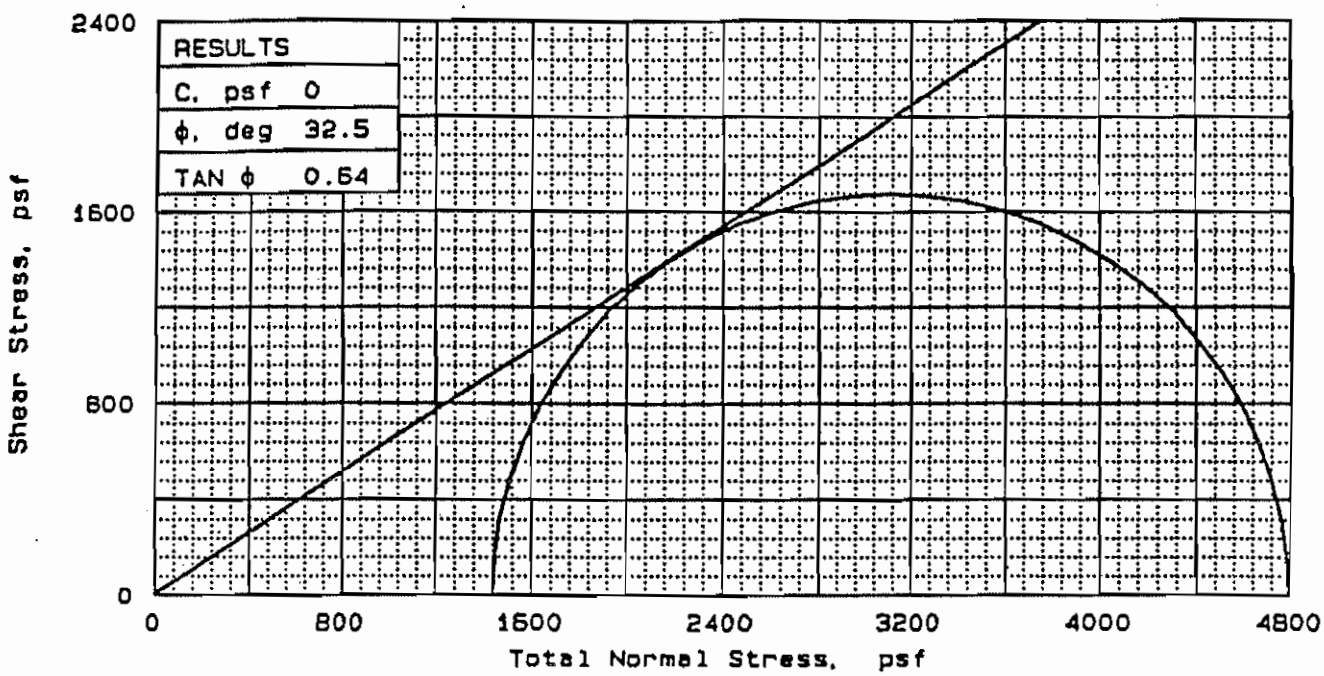
	INIT.	FINAL
MOISTURE (%)	10.9	20.4
WET DENS. (pcf)	122.0	131.5
DRY DENS. (pcf)	110.0	109.2
SATURATION (%)	55.3	101.5

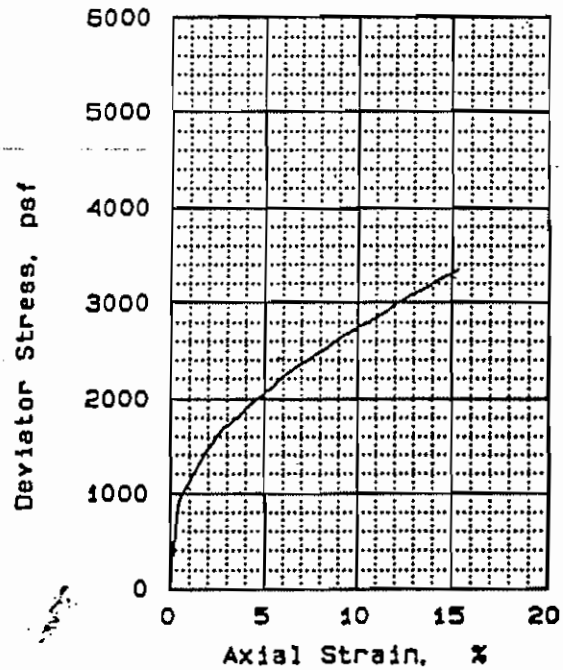
MAXIMUM GRADIENT:	10.6
AVERAGE GRADIENT:	8.4
MAX. EFFECT. STRESS (psi):	6.4
MIN. EFFECT. STRESS (psi):	4.6
AVE. EFFECT. STRESS (psi):	5.4

Date YY MM DD	Time HH MM	Temp *	Press.(psi) BOT	TOP	Readings (cm) CHAM	BOT	TOP	Flow Dif. %	Kv cm/sec	Ave. 0,1
90 6 20	7 19	0	95	95	2.50	2.20	99.20			
90 6 20	15 1	0	95	95	9.00	5.50	102.60			
90 6 21	7 8	0	95	95	13.90	17.70	100.20			
90 6 21	8 10	21	95	95	14.15	38.70	79.60	1.0	5.5E-06	
90 6 21	8 28	21	95	95	14.30	42.30	76.10	1.4	5.1E-06	
90 6 22	7 13	0	95	95	20.50	1.40	99.60			
90 6 22	7 50	21	95	95	20.60	15.35	85.60	-0.2	4.4E-06	
90 6 22	14 28	0	95	95	22.20	1.50	98.80			
90 6 22	14 34	21	95	95	22.30	4.10	96.10	-1.9	4.5E-06	
90 6 22	14 39	21	95	95	22.40	6.40	93.80	0.0	5.0E-06	
90 6 22	14 49	21	95	95	22.50	10.00	90.30	1.4	4.1E-06	
90 6 22	14 59	21	95	95	22.40	13.20	87.20	1.6	3.9E-06	
90 6 22	15 30	21	95	95	22.40	20.55	80.00	1.0	3.4E-06	
90 6 25	8 59	21	95	95	33.40	2.80	101.30	-9.1	-6.2E-08	
90 6 25	9 10	21	95	95	33.55	7.15	96.90	-0.6	4.1E-06	
90 6 25	9 23	21	95	95	33.55	11.20	93.10	3.2	3.4E-06	
90 6 25	9 37	21	95	95	33.70	15.80	88.60	1.1	4.1E-06	
90 6 25	9 48	21	95	95	33.65	18.80	85.60	0.0	3.8E-06	
90 6 25	9 58	21	95	95	33.60	21.60	82.85	0.9	4.2E-06	
90 6 25	10 15	21	95	95	33.75	25.35	79.15	0.7	3.7E-06	1
90 6 25	10 32	21	95	95	33.70	28.55	76.15	3.2	3.5E-06	1
90 6 25	10 44	21	95	95	33.75	30.50	74.20	-0.0	3.4E-06	1
90 6 25	11 2	21	95	95	33.70	33.20	71.60	1.9	3.5E-06	1

Average Kv for those rows with a 1 in the Ave. column 3.5E-06 cm/sec
1.4E-06 in/sec

Termination determined by stable Kv and low flow differential
* A zero in this column starts a series of measurements





SAMPLE NO.		1	2
INITIAL	WATER CONTENT, %	105.9	
	DRY DENSITY, pcf	32.2	
	SATURATION, %	73.3	
	VOID RATIO	2.950	
	DIAMETER, in	2.87	
	HEIGHT, in	6.50	
AT TEST	WATER CONTENT, %	86.3	
	DRY DENSITY, pcf	46.1	
	SATURATION, %	100.0	
	VOID RATIO	1.761	
	DIAMETER, in	2.40	
	HEIGHT, in	5.47	
BACK PRESSURE, psf		8640	
CELL PRESSURE, psf		10080	
FAILURE STRESS, psf		3351	
PORE PRESSURE, psf		9576	
STRAIN RATE, %/min.		1.000	
ULTIMATE STRESS, psf			
PORE PRESSURE, psf			
$\bar{\sigma}_1$ FAILURE, psf		3855	
$\bar{\sigma}_3$ FAILURE, psf		504	

TYPE OF TEST:
CU with pore pressures
SAMPLE TYPE: REMOLDED
DESCRIPTION:

LL= PL= PI=
SPECIFIC GRAVITY= 2.04
REMARKS:

FIG. NO.

CLIENT: WEYERHAEUSER

PROJECT: WEYERHAEUSER

SAMPLE LOCATION: SLUDGE @ 45% SOLIDS

PROJ. NO.: 467.41 DATE: 6-29-90

TRIAXIAL COMPRESSION TEST

RMT, INC.

APPENDIX E

RMT, INC.

HYDROCON - 1.01
HYDRAULIC CONDUCTIVITY
Bouwer and Rice Method

Well: OW-2

PROJECT NAME: WeyCo
PROJECT NUMBER: 467.42
FIELD WORK DATE(S): 23 May 1990

USER NAME: CVC
DATE: 1 June 1990

Rw - BORING RADIUS (IN): 2.37
Rc - WELL RADIUS (IN): 1
L - SCREEN LENGTH (FT): 10
D - AQUIFER THICKNESS (FT): 19
H - SCREEN BASE TO WATER TABLE (FT): 7.5
STATIC WATER LEVEL READING (FT): 7.2
START TIME (H,M,S): 0,0,0

Rc was corrected for response in well screen filter material to 1.544 inches

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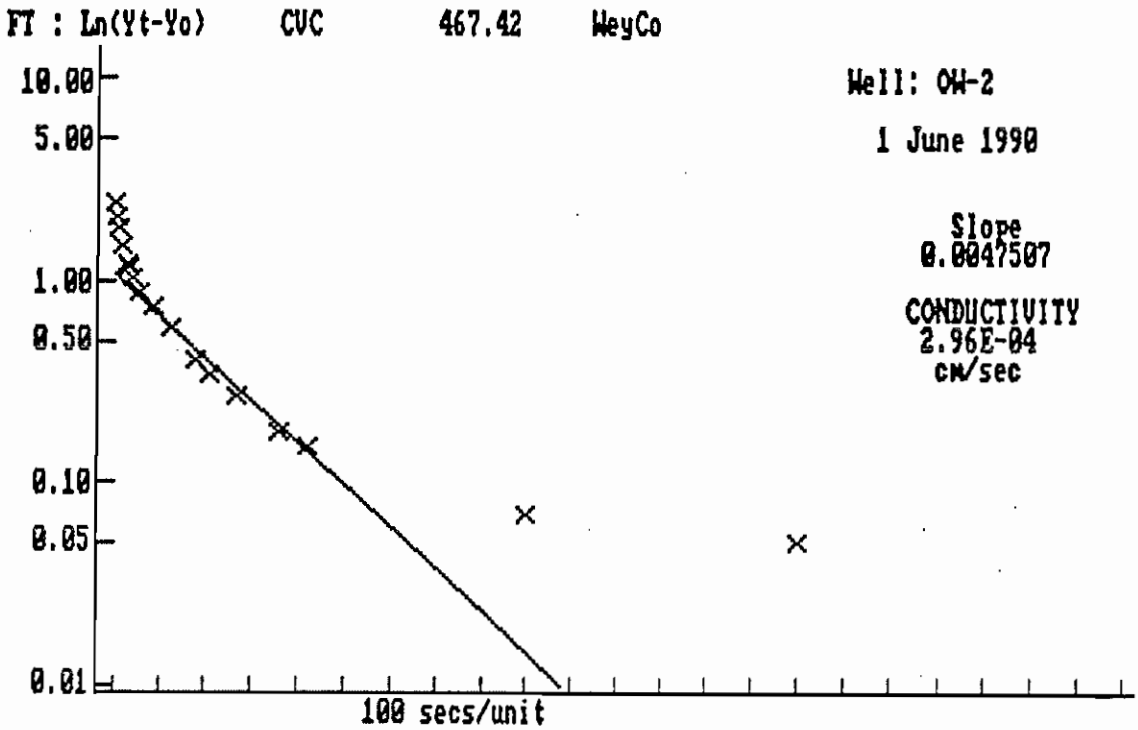
TIME (H,M,S)	DEPTH (FT)
0,0,0	9.59
0,0,2	9.28
0,0,7	9
0,0,15	8.71
0,0,28	8.39
0,0,30	8.35
0,0,40	8.21
0,0,55	8.09
0,1,25	7.95
0,2,5	7.79
0,3,0	7.61
0,3,30	7.55
0,4,30	7.47
0,6,0	7.38
0,7,0	7.35
0,15,0	7.27
0,25,0	7.25

(1/t) (ln(Yo/Yt))= 0.0047507

PARTIALLY PENETRATING: A= 3.07 B= 0.52

HYDRAULIC CONDUCTIVITY: 9.71E-06 ft/sec
2.96E-04 cm/sec


FT : Ln(Yt-Yo)
CVC
467.42
WeyCo
Well: OW-2
1 June 1990
Slope
0.0047507
CONDUCTIVITY
2.96E-04
cm/sec
10.00
5.00
1.00
0.50
0.10
0.05
0.01
100 secs/unit

RMT, INC.

HYDROCON - 1.01
HYDRAULIC CONDUCTIVITY
Bouwer and Rice Method

Well: OW-3

PROJECT NAME: WeyCo
PROJECT NUMBER: 467.42
FIELD WORK DATE(S): 23 May 1990

USER NAME: CVC
DATE: 1 June 1990

Rw - BORING RADIUS (IN): 5.7
L - SCREEN LENGTH (FT): 10
H - SCREEN BASE TO WATER TABLE (FT): 6.2
START TIME (H,M,S): 0,0,0

Rc - WELL RADIUS (IN): 1
D - AQUIFER THICKNESS (FT): 14.7
STATIC WATER LEVEL READING (FT): 17.9

Rc was corrected for response in well screen filter material to 3.232 inches

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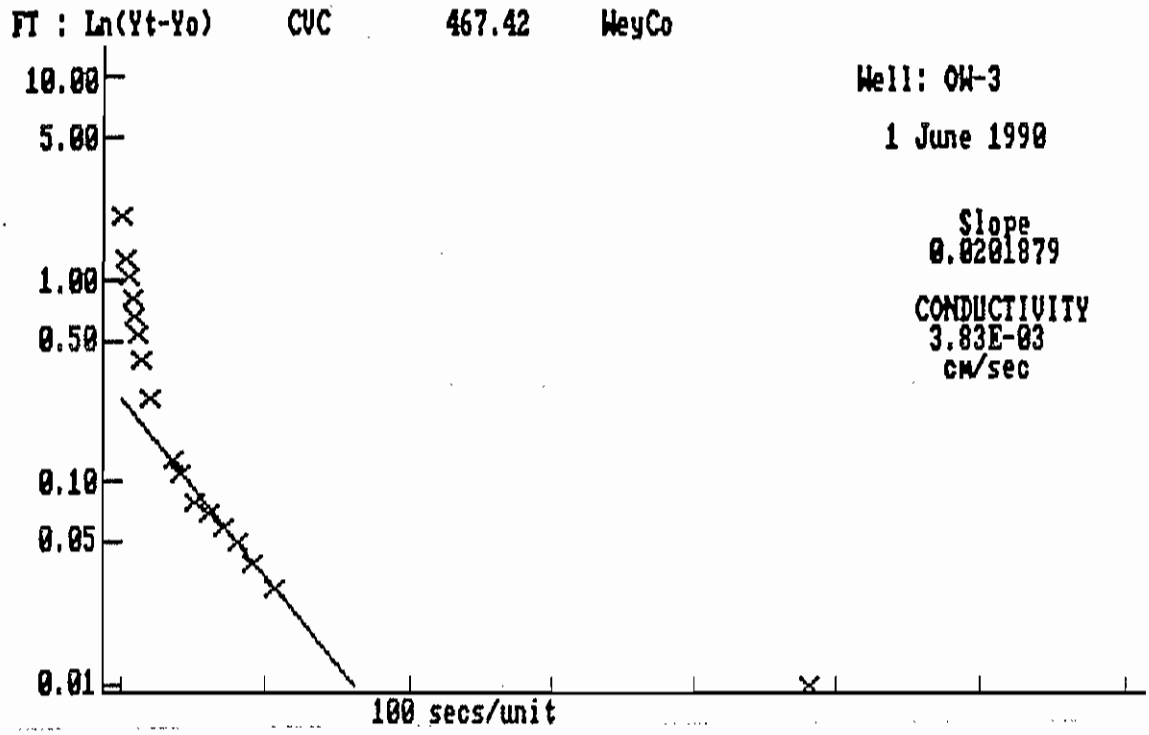
TIME (H,M,S)	DEPTH (FT)
0,0,0	19.99
0,0,3	19.16
0,0,5	18.91
0,0,7	18.72
0,0,9	18.56
0,0,11	18.43
0,0,14	18.31
0,0,20	18.16
0,0,36	18.03
0,0,41	18.01
0,0,51	17.98
0,1,1	17.97
0,1,11	17.96
0,1,21	17.95
0,1,31	17.94
0,1,46	17.93
0,8,1	17.91

(1/t) (ln(Yo/Yt))= 0.0201879

PARTIALLY PENETRATING: A= 2.23 B= 0.35

HYDRAULIC CONDUCTIVITY: 1.26E-04 ft/sec
3.83E-03 cm/sec


FT : Ln(Yt-Yo)
CVC
467.42
WeyCo
Well: OW-3
1 June 1990
Slope
0.0201879
CONDUCTIVITY
3.83E-03
cm/sec
10.00
5.00
1.00
0.50
0.10
0.05
0.01
100 secs/unit

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

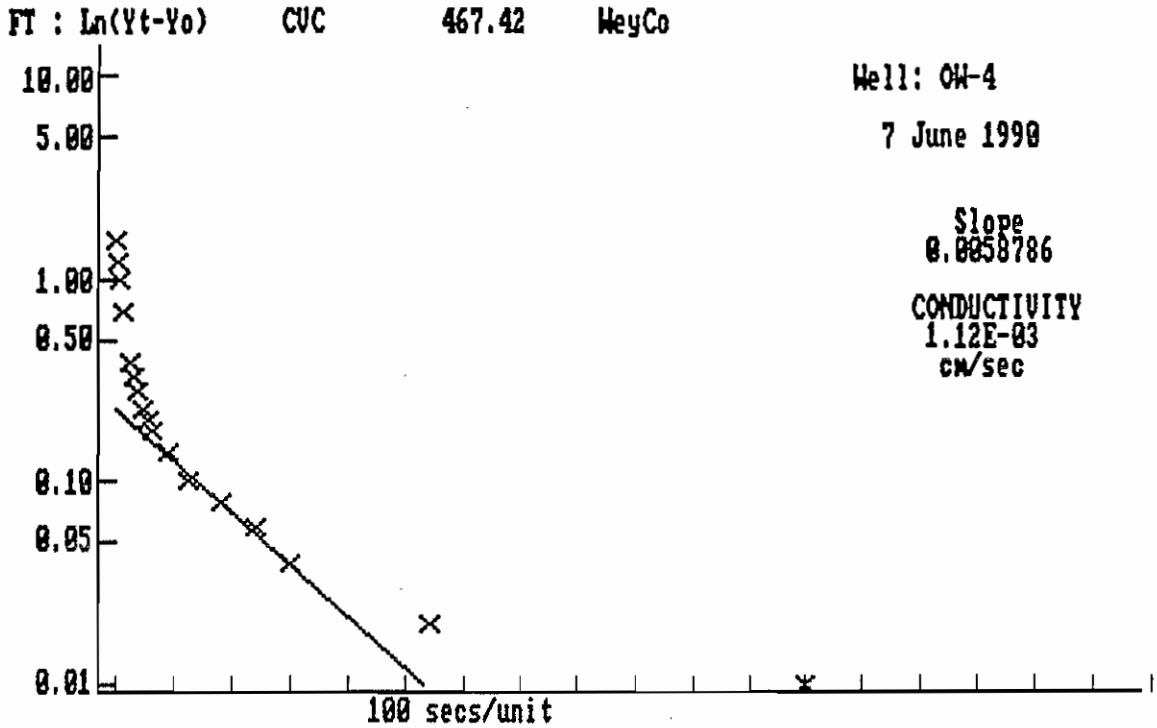
---

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
Well: OW-4
7 June 1990
Slope
0.0058786
CONDUCTIVITY
1.12E-03
cm/sec
10.00
5.00
1.00
0.50
0.10
0.05
0.01
100 secs/unit

RMT, INC.

HYDROCON - 1.01
HYDRAULIC CONDUCTIVITY
Bouwer and Rice Method

Well: OW-5

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): 4.49
L - SCREEN LENGTH (FT): 10
H - SCREEN BASE TO WATER TABLE (FT): 9.61
START TIME (H,M,S): 0,0,0

Rc - WELL RADIUS (IN): 1
D - AQUIFER THICKNESS (FT): 9.61
STATIC WATER LEVEL READING (FT): 14

Rc was corrected for response in well screen filter material to 2.598 inches

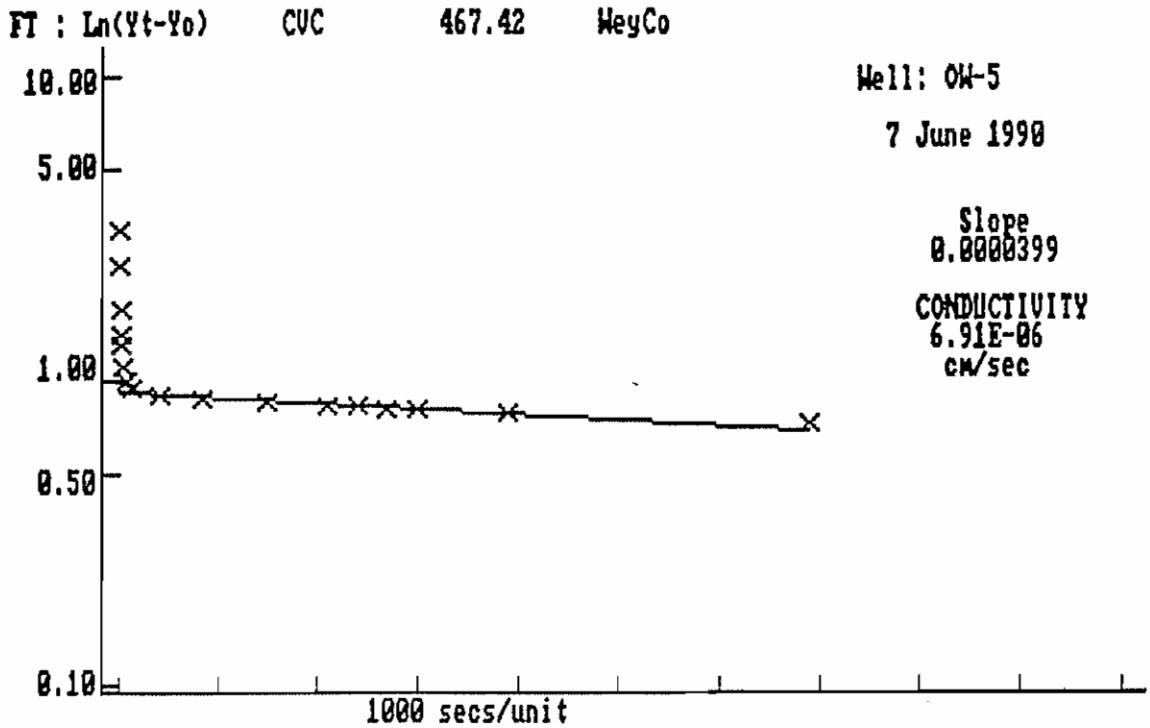
---

TIME (H,M,S)	DEPTH (FT)
0,0,0	17.1
0,0,6	16.36
0,0,15	15.73
0,0,21	15.44
0,0,25	15.3
0,0,35	15.12
0,1,5	15
0,2,0	14.95
0,7,0	14.9
0,14,0	14.87
0,25,0	14.85
0,35,0	14.83
0,40,0	14.82
0,45,0	14.81
0,50,0	14.8
1,5,0	14.79
1,55,0	14.73

(1/t) (ln(Yo/Yt))= 0.0000399

FULLY PENETRATING: C= 1.97

HYDRAULIC CONDUCTIVITY: 2.27E-07 ft/sec
6.91E-06 cm/sec


FT : Ln(Yt-Yo)
CVC
467.42
WeyCo
Well: OW-5
7 June 1990
Slope
0.0000399
CONDUCTIVITY
6.91E-06
cm/sec
10.00
5.00
1.00
0.50
0.10
1000 secs/unit

RMT, INC.

HYDROCON - 1.01
HYDRAULIC CONDUCTIVITY
Bouwer and Rice Method

Well: OW-6

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): 1.31
L - SCREEN LENGTH (FT): 10
H - SCREEN BASE TO WATER TABLE (FT): 1.35
START TIME (H,M,S): 0,0,0

Rc - WELL RADIUS (IN): 1
D - AQUIFER THICKNESS (FT): 6.85
STATIC WATER LEVEL READING (FT): 26.95

Rc was corrected for response in well screen filter material to 1.102 inches

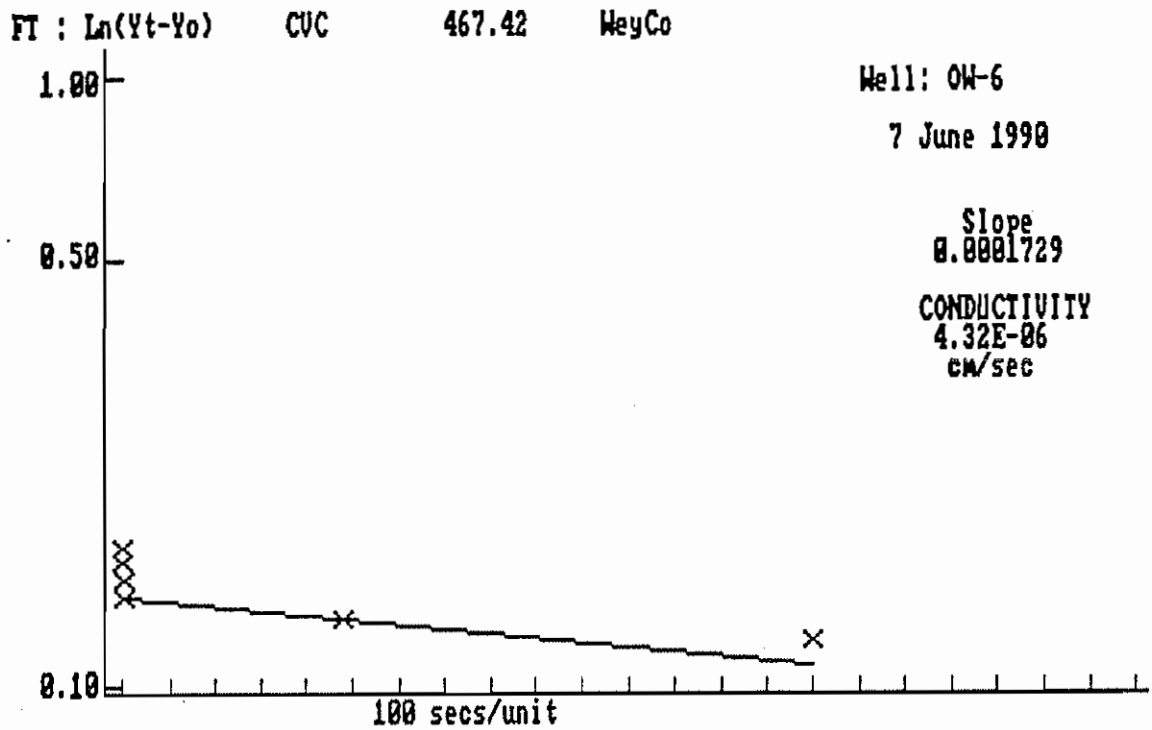
---

TIME (H,M,S)	DEPTH (FT)
0,0,0	27.12
0,0,1	27.11
0,0,2	27.1
0,0,3	27.09
0,8,0	27.08
0,25,0	27.07

(1/t) (ln(Yo/Yt))= 0.0001729

PARTIALLY PENETRATING: A= 4.15 B= 0.75

HYDRAULIC CONDUCTIVITY: 1.42E-07 ft/sec
4.32E-06 cm/sec


FT : Ln(Yt-Yo)
CUC
467.42
WeyCo
1.00
0.50
0.10
Well: OW-6
7 June 1990
Slope
0.0001729
CONDUCTIVITY
4.32E-06
cm/sec
100 secs/unit

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

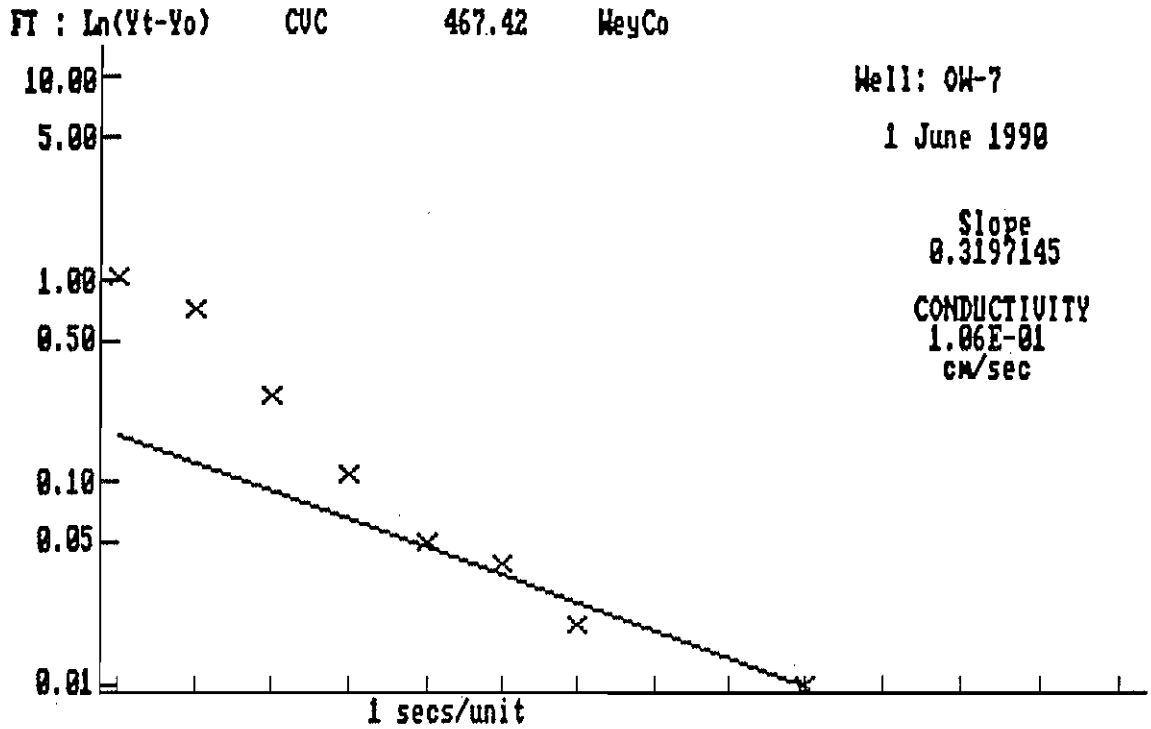
---

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
Well: OW-7
1 June 1990
Slope
0.3197145
CONDUCTIVITY
1.06E-01
cm/sec
10.00
5.00
1.00
0.50
0.10
0.05
0.01
1 secs/unit

Weyerhaeuser-Plymouth.....MW-1A

TIME (seconds)	WATER LEVEL (feet)	DRAWDOWN (feet)	H/HO
12	27.17	1.33	.3643836
18	26.66	0.82	.2246576
30	26.2	0.36	9.863042E-02
48	25.93	0.09	2.465793E-02
60	25.9	0.06	1.643848E-02

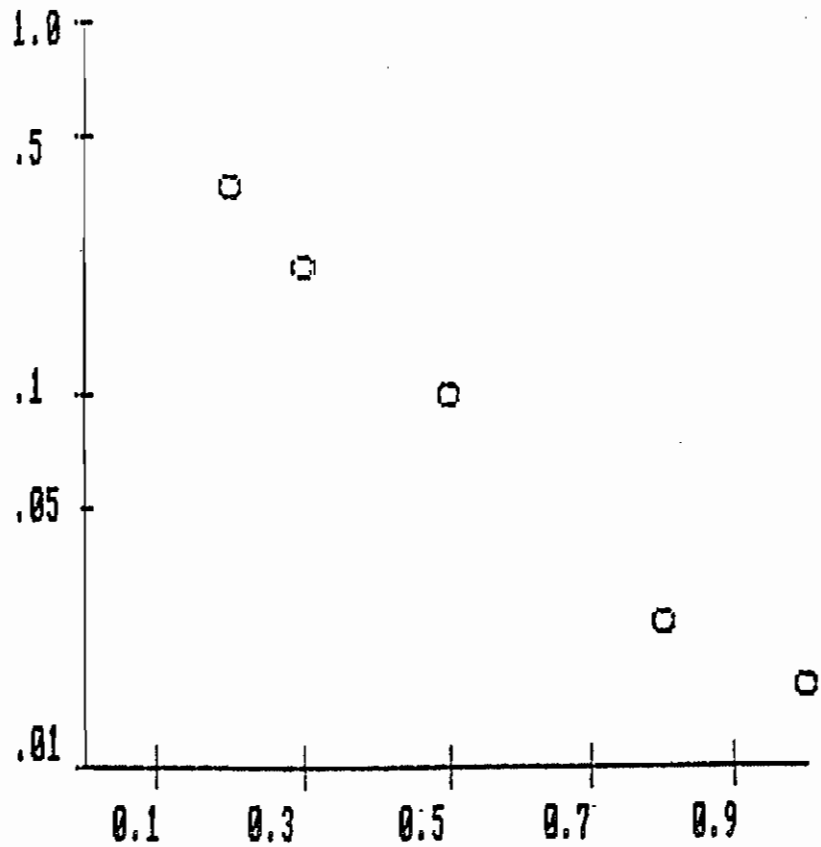
CONFINED AQUIFER, PARTIALLY PENETRATING CONDITION

K = 0.40E-02 cm/sec
= 84.3 gpd/ft2
= 0.13E-03 ft/sec
= 11.3 ft/day

REGRESSION COEFFICIENT = -.9941326

WEYERHAEUSER-PLYMOUTH

MW-1A



X AXIS:
TIME, min

Y AXIS:
LOG (H"'9)

RMT, INC.

HYDROCON - 1.01
HYDRAULIC CONDUCTIVITY
Bouwer and Rice Method

Well: MW-6A

PROJECT NAME: WeyCo
PROJECT NUMBER: 467.42
FIELD WORK DATE(S): 23 May 1990

USER NAME: CVC
DATE: 1 June 1990

Rw - BORING RADIUS (IN): 3
L - SCREEN LENGTH (FT): 5
H - SCREEN BASE TO WATER TABLE (FT): 43.94
START TIME (H,M,S): 0,0,0

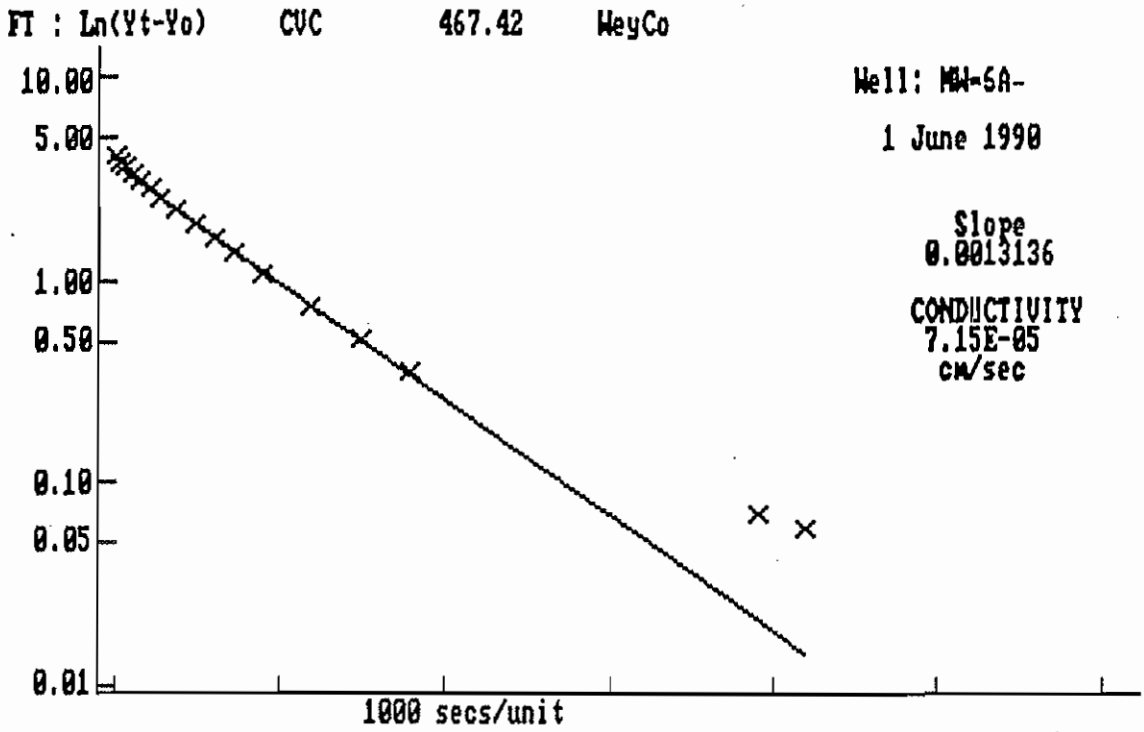
Rc - WELL RADIUS (IN): 1
D - AQUIFER THICKNESS (FT): 55
STATIC WATER LEVEL READING (FT): 9.92

TIME (H,M,S)	DEPTH (FT)
0,0,0	13.99
0,0,17	13.74
0,0,56	13.48
0,1,36	13.25
0,2,26	12.99
0,3,26	12.72
0,4,26	12.48
0,5,56	12.16
0,7,56	11.81
0,9,56	11.51
0,11,56	11.29
0,14,56	11
0,19,56	10.66
0,24,56	10.43
0,29,56	10.28
1,4,56	9.99
1,9,56	9.98

(1/t) (ln(Yo/Yt))= 0.0013136

PARTIALLY PENETRATING: A= 2.20 B= 0.35

HYDRAULIC CONDUCTIVITY: 2.34E-06 ft/sec
7.15E-05 cm/sec


FT : Ln(Yt-Yo)
CVC
467.42
WeyCo
Well: MW-5A-
1 June 1990
Slope
0.0013136
CONDUCTIVITY
7.15E-05
cm/sec
10.00
5.00
1.00
0.50
0.10
0.05
0.01
1000 secs/unit

Weyerhaeuser-Plymouth.....MW-8

TIME (seconds)	WATER LEVEL (feet)	DRAWDOWN (feet)	H/HO
0	31.04	3.09	1
6	29.74	1.79	.579287
12	28.93	0.98	.3171521
18	28.52	0.57	.1844655
24	28.27	0.32	.1035599
30	28.2	0.25	.0809056
42	28.03	0.08	2.589048E-02

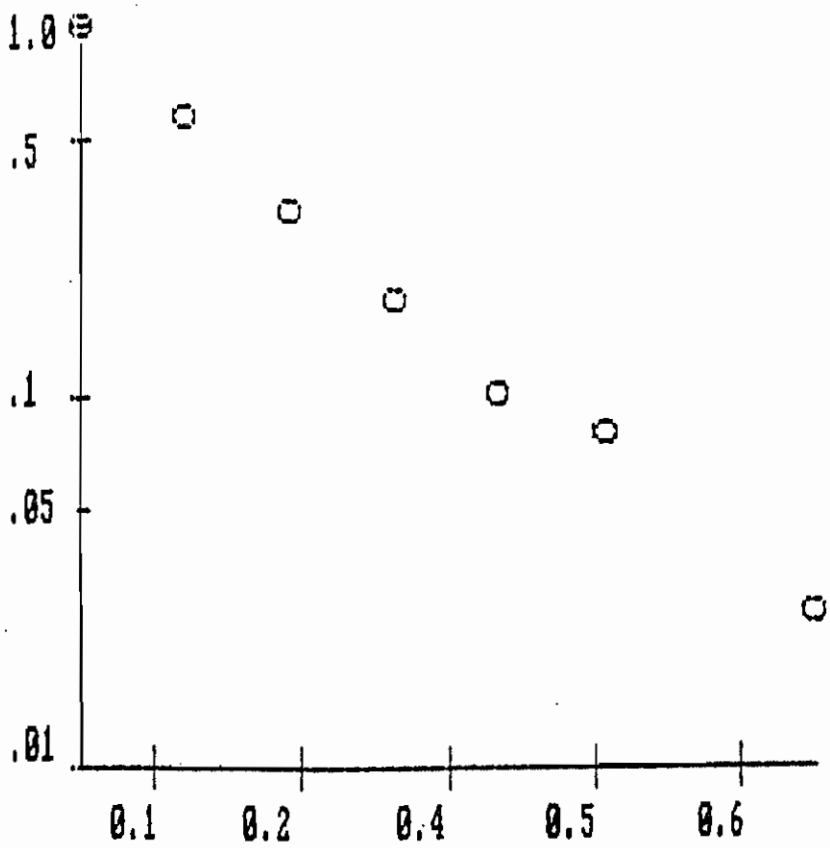
CONFINED AQUIFER, PARTIALLY PENETRATING CONDITION

K = 0.57E-02 cm/sec
= 121.1 gpd/ft2
= 0.19E-03 ft/sec
= 16.2 ft/day

REGRESSION COEFFICIENT = -.9972722

WEYERHAEUSER-PLYMOUTH

MW-8



X AXIS:
TIME, min

Y AXIS:
LOG (H/H0)

APPENDIX F

Hydraulic Conductivity

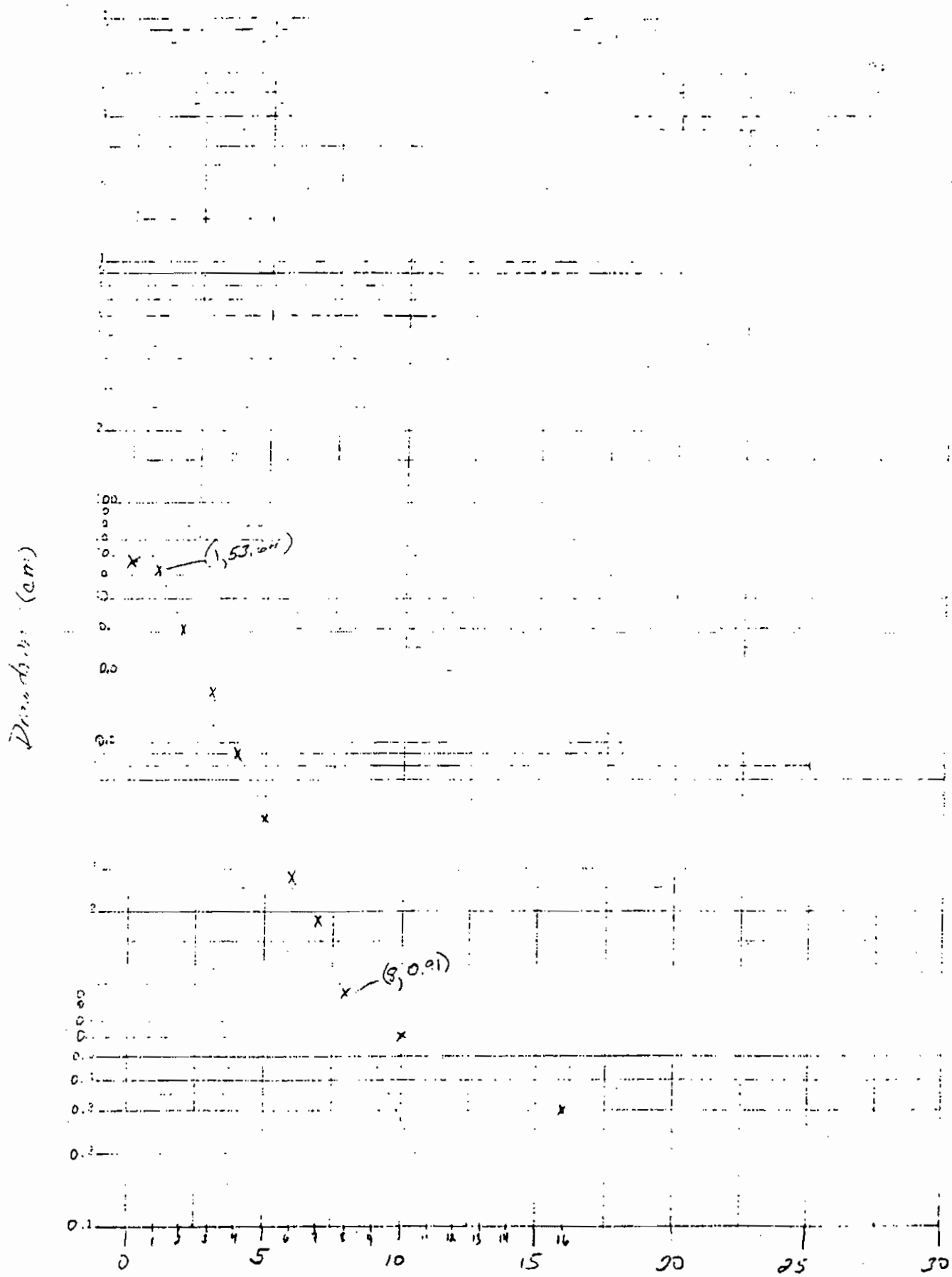
Well: OW-1
Project Name: WeyCo
Project Number: 467.42
Field Work Date: 23-May-1990

$$k = \frac{r^2 \ln(L_2/R)}{2L_2\,(t_2-t_1)} \ln \frac{S_1}{S_2}$$

$r = 2.54$ cm
$R = 2.54$ cm
$L_2 = 246.89$ cm
$t_1 = 1$ s
$t_2 = 8$ s
$S_1 = 53.64$ cm
$S_2 = 0.91$ cm

$$k = 3.4829 \times 10^{-2}$$

OW-1



WORKSHEET FOR CALCULATING VERTICAL GROUND WATER FLOW RATES

PROJECT/CLIENT: WeyCo
PROJECT NO.: 467.42
WELL PAIR: MW-7/OW-1
DATE: June 14,1990
BY: CVC

DATA INPUTS	Shallow Well	Deep Well
Ground Surface Elevation:	34.20	34.52
Depth to the bottom of the bentonite seal:	8.00	36.10
Elevation of the bottom of the bentonite seal:(E1)	26.20	-1.58
Depth to the bottom of the well screen:	20.10	44.70
Elevation of the bottom of the well screen:(E2)	14.10	-10.18
Water table elevation:(E3)	27.35	9.71

SHALLOW WELL		DEEP WELL	
E1 or E3	26.20	E1 or E3	-1.58
E2	14.10	E2	-10.18
E3	27.35	E3	9.71

where:

E1 - Elevation of the bottom of the bentonite seal
E2 - Elevation of the bottom of the well screen
E3 - Water table elevation

THE VERTICAL GROUND WATER FLOW GRADIENT IS -0.67767

WORKSHEET FOR CALCULATING VERTICAL GROUND WATER FLOW RATES

PROJECT/CLIENT: WeyCo
PROJECT NO.: 467.42
WELL PAIR: OW-4/MW-8
DATE: June 14,1990
BY: CVC

DATA INPUTS	Shallow Well	Deep Well
Ground Surface Elevation:	34.34	34.30
Depth to the bottom of the bentonite seal:	4.00	34.00
Elevation of the bottom of the bentonite seal:(E1)	30.34	0.30
Depth to the bottom of the well screen:	15.80	43.00
Elevation of the bottom of the well screen:(E2)	18.54	-8.70
Water table elevation:(E3)	23.04	7.72

SHALLOW WELL		DEEP WELL	
E1 or E3	23.04	E1 or E3	0.30
E2	18.54	E2	-8.70
E3	23.04	E3	7.72

where:

E1 - Elevation of the bottom of the bentonite seal
E2 - Elevation of the bottom of the well screen
E3 - Water table elevation

THE VERTICAL GROUND WATER FLOW GRADIENT IS -0.61304

WORKSHEET FOR CALCULATING VERTICAL GROUND WATER FLOW RATES

PROJECT/CLIENT: WeyCo
PROJECT NO.: 467.42
WELL PAIR: MW-1/1A
DATE: June 14,1990
BY: CVC

DATA INPUTS	Shallow Well	Deep Well
Ground Surface Elevation:	34.78	34.97
Depth to the bottom of the bentonite seal:	8.50	36.90
Elevation of the bottom of the bentonite seal:(E1)	26.28	-1.93
Depth to the bottom of the well screen:	20.00	44.00
Elevation of the bottom of the well screen:(E2)	14.78	-9.03
Water table elevation:(E3)	31.92	11.80

SHALLOW WELL		DEEP WELL	
E1 or E3	26.28	E1 or E3	-1.93
E2	14.78	E2	-9.03
E3	31.92	E3	11.80

where:

E1 - Elevation of the bottom of the bentonite seal
E2 - Elevation of the bottom of the well screen
E3 - Water table elevation

THE VERTICAL GROUND WATER FLOW GRADIENT IS -0.77354

WORKSHEET FOR CALCULATING VERTICAL GROUND WATER FLOW RATES

PROJECT/CLIENT: WEYCO - Plymouth
PROJECT NO.: 467.42
WELL PAIR: MW-6/6A
DATE: June 14, 1990
BY: DAB

DATA INPUTS	Shallow Well	Deep Well
Ground Surface Elevation:	11.22	11.52
Depth to the bottom of the bentonite seal:	7.80	42.00
Elevation of the bottom of the bentonite seal:(E1)	3.42	-30.48
Depth to the bottom of the well screen:	20.00	50.00
Elevation of the bottom of the well screen:(E2)	-8.78	-38.48
Water table elevation:(E3)	3.25	3.36

SHALLOW WELL		DEEP WELL	
E1 or E3	3.25	E1 or E3	-30.48
E2	-8.78	E2	-38.48
E3	3.25	E3	3.36

where:

E1 - Elevation of the bottom of the bentonite seal
E2 - Elevation of the bottom of the well screen
E3 - Water table elevation

THE VERTICAL GROUND WATER FLOW GRADIENT IS 0.003468

APPENDIX G

COMPUTATION SHEET

RMT INC.

SHEET 1. OF 11.

744 Heartland Trail P.O. Box 8923 Madison, WI 53708-8923 (608) 831-4444 FAX: (608) 831-3334

PROJECT / PROPOSAL NAME	PREPARED		CHECKED		PROJECT/PROPOSAL NO.
WEYERHAEUSER - PLYMOUTH	By: D. GENTHE	Date: 7/3/90	By: JOH	Date: 7/3/90	467.42

CONSOLIDATION TEST RESULTS:

PROBLEM: ESTIMATE THE SAMPLE OVERBURDEN PRESSURE & DETERMINE IF THE GIVEN SAMPLES ARE NORMALLY CONSOLIDATED OR OVERCONSOLIDATED

ASSUME: * IN-SITU OVERBURDEN SOILS DENSITY = 115 pcf

NOTE SHELBY TUBE SAMPLES OW-1 @ 20-22 feet AND MW-1A @ 22-24 feet INDICATED DENSITIES OF 111 pcf AND 113 pcf, RELATIVELY

* WATERTABLE NEAR SURFACE.

SOLUTION:

AT 24 FEET BELOW SURFACE

$$24' \times (115\ pcf - 62.4\ pcf) = 1262\ psf$$

GIVEN: CONSOLIDATION TEST RESULTS

OW-1 @ 20-22' ⇒ Compression Index, C_c = 0.48
Recompression Index, C_R = 0.15
Initial Void Ratio, e_o = 1.3
Preconsolidation Pressure, P_c = 1.3 tsf
Overburden Pressure, P_o = 0.6 tsf

$P_c > P_o$ ✓ ∴ OVERCONSOLIDATED CLAY

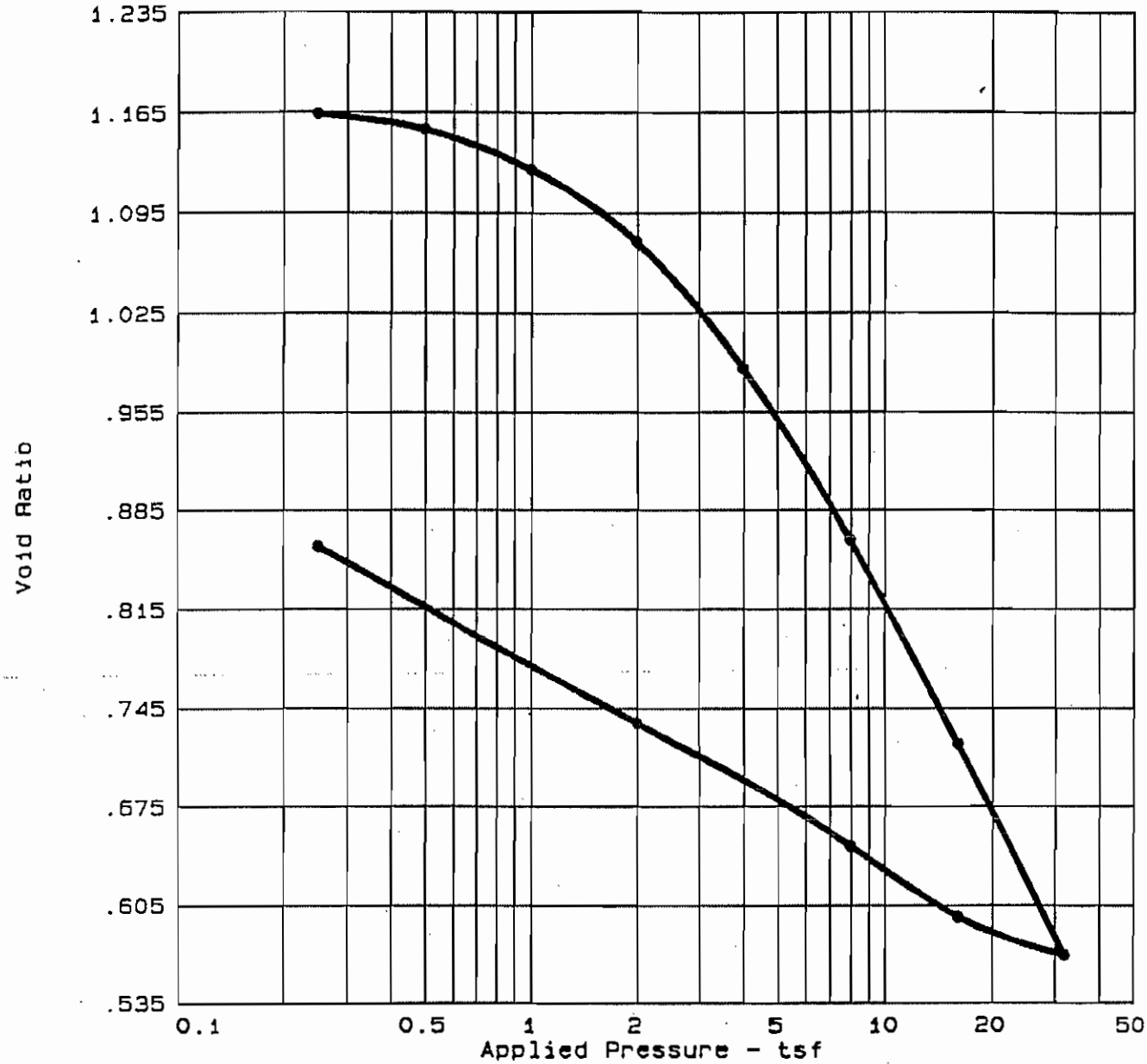
MW-1A @ 22-24' ⇒ C_c = 0.49
C_R = 0.14
e_o = 1.2
P_c = 3.0 tsf
P_o = ~0.6 tsf

$P_c > P_o$ ✓ ∴ OVERCONSOLIDATED CLAY

-GTF 7-6-90

GA✓ JOH 7-9-9

CONSOLIDATION TEST REPORT



Swell press.	Nat. Sat.	Nat. Moist.	Dry Density	LL	PI	Sp.Gr.	Initial void ratio
	103.2 %	44.5	78.1			2.71	1.1673

TEST RESULTS	MATERIAL DESCRIPTION
	BLUE GRAY SILTY CLAY

Project No.: 467.42
Project: WEYERHAEUSER
Location: MW-1A, 22-24.0'

Date: 6-04-90

Remarks:
Initial Dial Reading
= 1.019 inches

CONSOLIDATION TEST REPORT

RMT, INC.

Fig. No._____

07:24, 6-21-1990 CONSOLIDATION TEST PROJECT DATA Test No. 17

Project Number: 467.42
Project: WEYERHAEUSER
Date: 6-04-90
Location 1: MW-1A, 22-24.0'
2:
Remarks 1:
2:
3:
4:
5:
Material 1: BLUE GRAY SILTY CLAY
description 2:
Classification:
Liquid limit:
Plasticity index:
Figure Number:

CONSOLIDATION TEST SPECIMEN DATA

TOTAL SAMPLE		BEFORE TEST		AFTER TEST	
Wet w+t	= 145.29 g.	Oedometer No.	= 2	Wet w+t	= 214.53 g.
Dry w+t	= 100.58 g	Machine No.	= N/A	Dry w+t	= 181.02 g.
Tare wt.	= 0.00 g.	Spec. Gravity	= 2.71 EST.	Tare wt.	= 80.44 g.
Height	= 1.00 in.	Height	= 1.00 in.		
Diameter	= 2.50 in.	Diameter	= 2.50 in.		
Weight	= 145.29 g.				
Moisture	= 44.5 %	Ht. Solids	= 0.46 in.	Moisture	= 33.3 %
Wet Den.	= 112.8 pcf	Dry wt.	= 100.58 g.	Dry wt.	= 100.58 g. *
Dry Den.	= 78.1 pcf	Void ratio	= 1.1673	Void ratio	= 0.8592
		Saturation	= 103.2 %	Saturation	= 105. %

Specific Gravity Reported in report is from a separate sample in same tube.

* Final dry weight used in calculations

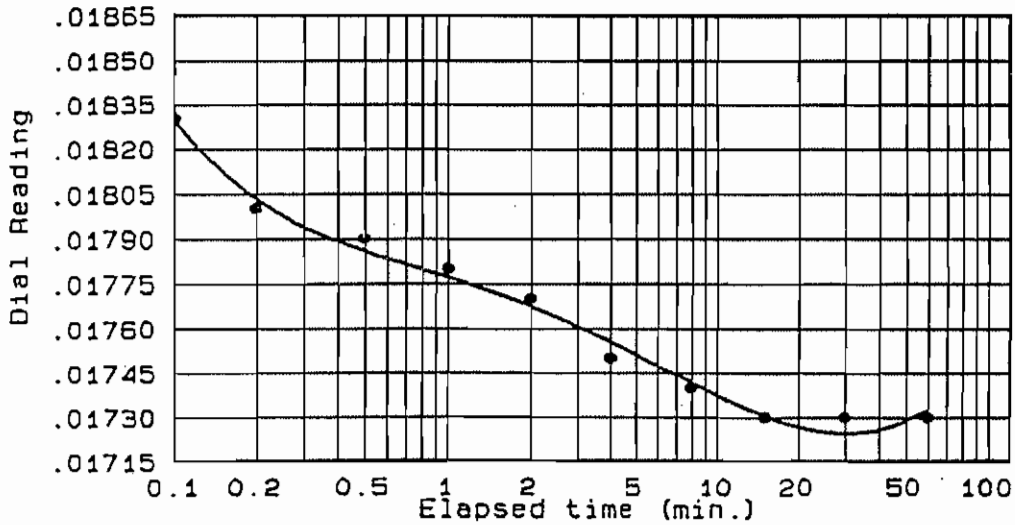
CONSOLIDATION TEST READINGS SUMMARY

LOAD (tsf)	DIAL (in.)	DEFLECTION (in.)	CORRECTED DIAL (in.)	VOID RATIO	% SWELL/CONSOL.
Initial	1.01900			1.1673	
0.25	1.01730	0.0000	1.01730	1.1637	0.2 Consol.
0.50	1.01230	0.0000	1.01230	1.1528	0.7 Consol.
1.00	0.99940	0.0000	0.99940	1.1249	2.0 Consol.
2.00	0.97600	0.0000	0.97600	1.0742	4.3 Consol.
4.00	0.93520	0.0000	0.93520	0.9857	8.4 Consol.
8.00	0.87880	0.0000	0.87880	0.8635	14.0 Consol.
16.00	0.81210	0.0000	0.81210	0.7189	20.7 Consol.
32.00	0.74290	0.0000	0.74290	0.5689	27.6 Consol.
16.00	0.75550	0.0000	0.75550	0.5963	26.4 Consol.

Dial Reading vs. Time

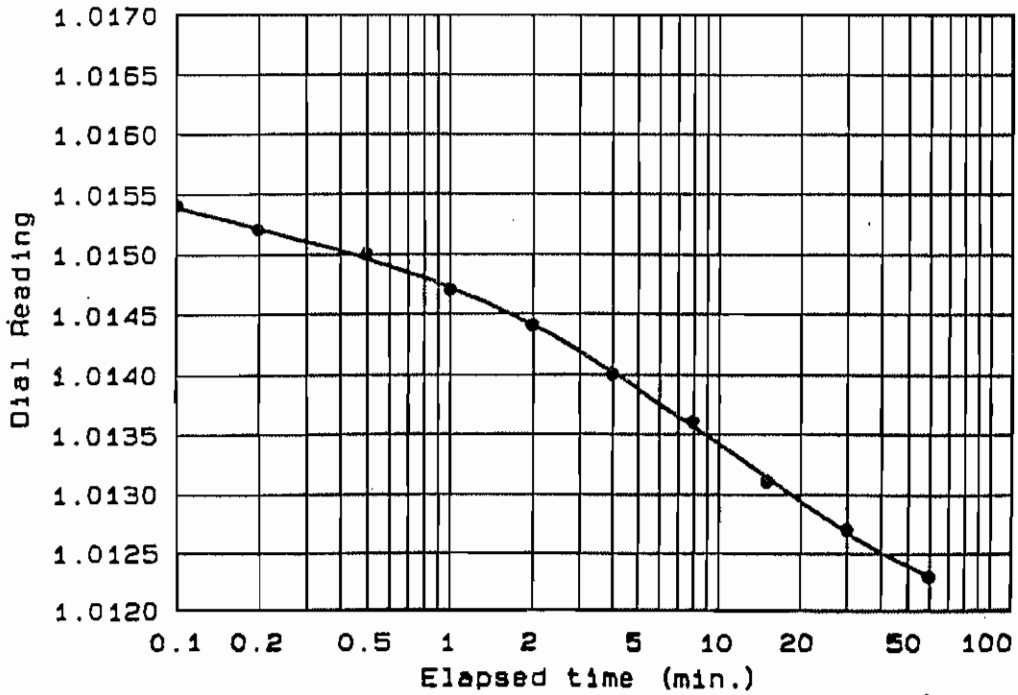
Project No.: 467.42
Project: WEYERHAEUSER
Location: MW-1A, 22-24.0'

Date: 6-04-90



Load No.= 1
Load= 0.25 tsf
D_0 = 1.0187
D_{50} = 1.0179
D_{100}= 1.0172
T_{50}= 0.29 min.

C_v @ T_{50} =
0.17 in.^{2}/min.



Load No.= 2
Load= 0.50 tsf
D_0 = 1.0158
D_{50} = 1.0142
D_{100}= 1.0127
T_{50}= 2.76 min.

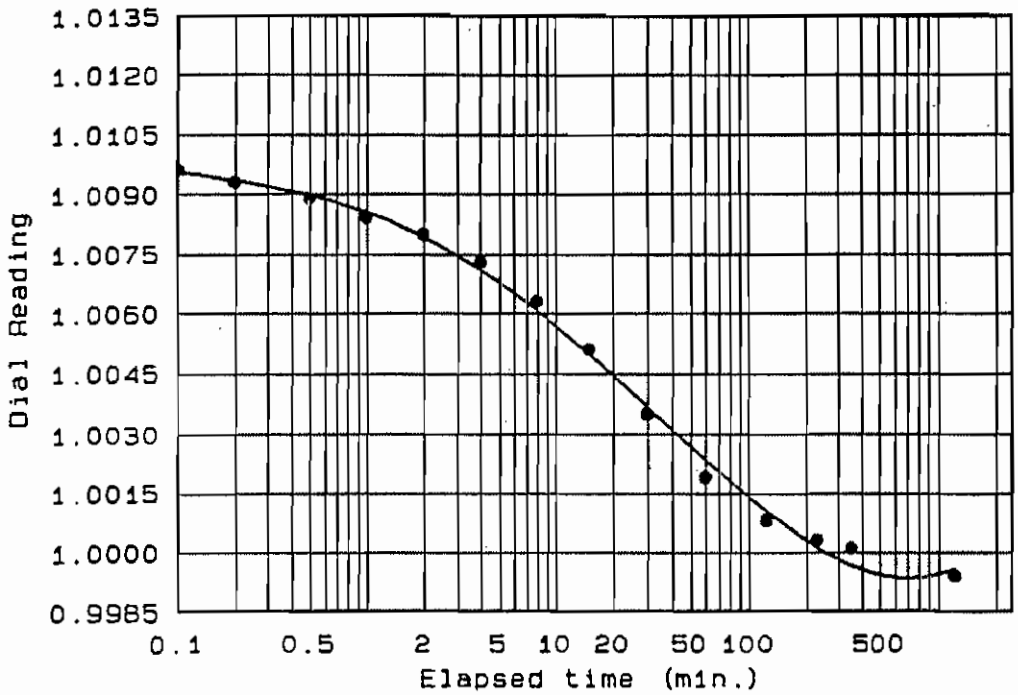
C_v @ T_{50} =
0.02 in.^{2}/min.

RMT, INC.

Dial Reading vs. Time

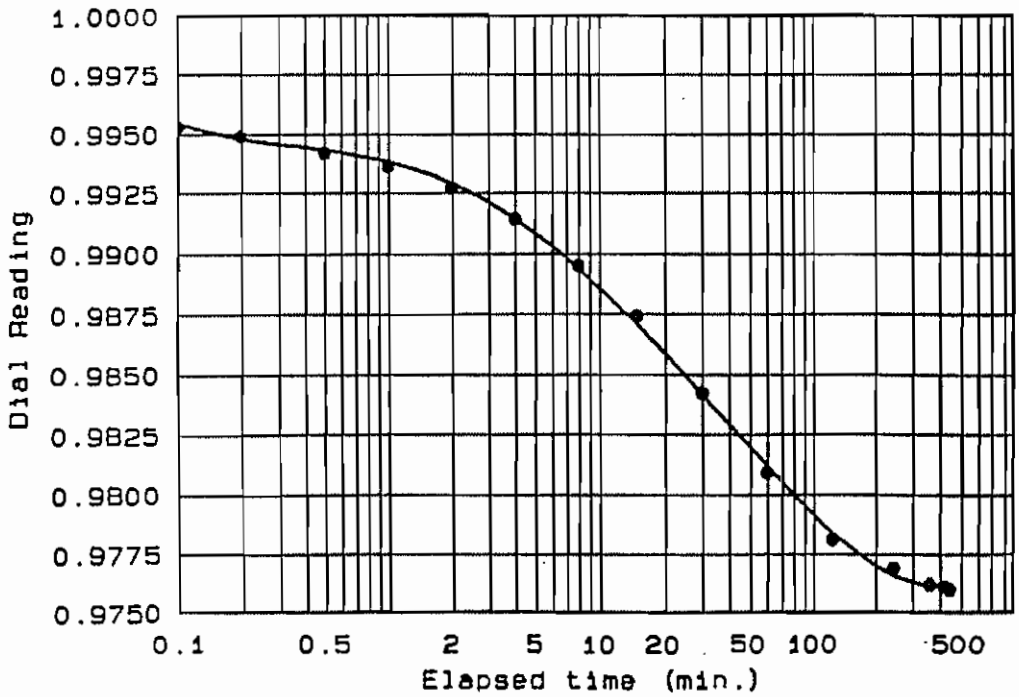
Project No.: 467.42
Project: WEYERHAEUSER
Location: MW-1A, 22-24.0'

Date: 6-04-90



Load No.= 3
Load= 1.00 tsf
D_0 = 1.0100
D_{50} = 1.0047
D_{100}= 0.9994
T_{50}= 17.13 min.

C_v @ T_{50} =
0.003 in.^{2}/min.



Load No.= 4
Load= 2.00 tsf
D_0 = 0.9965
D_{50} = 0.9862
D_{100}= 0.9759
T_{50}= 18.29 min.

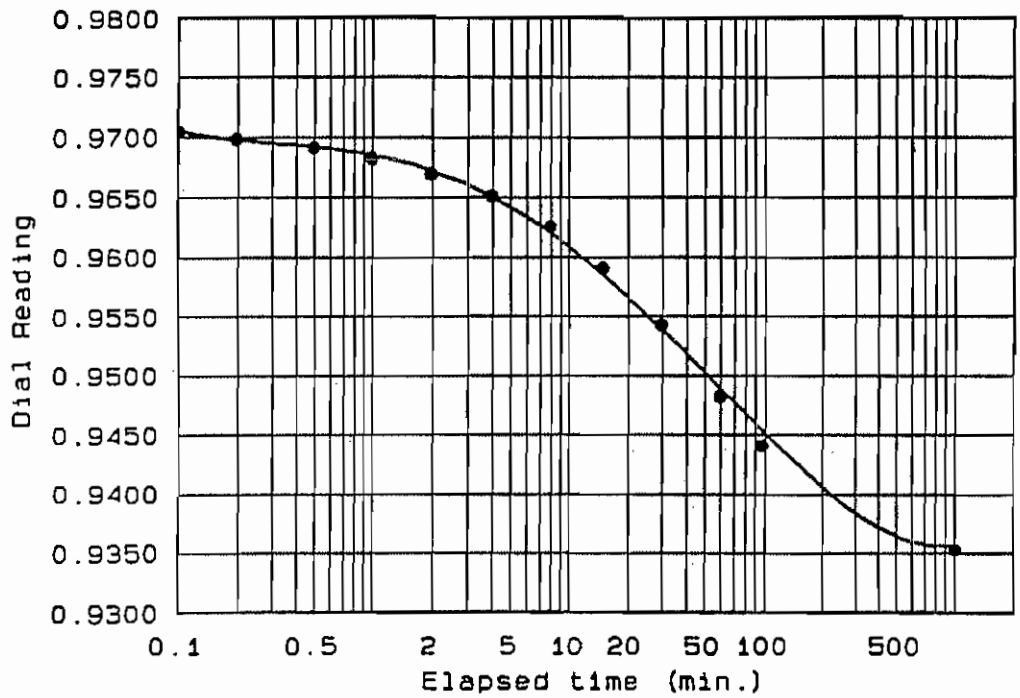
C_v @ T_{50} =
0.003 in.^{2}/min.

RMT, INC.

Dial Reading vs. Time

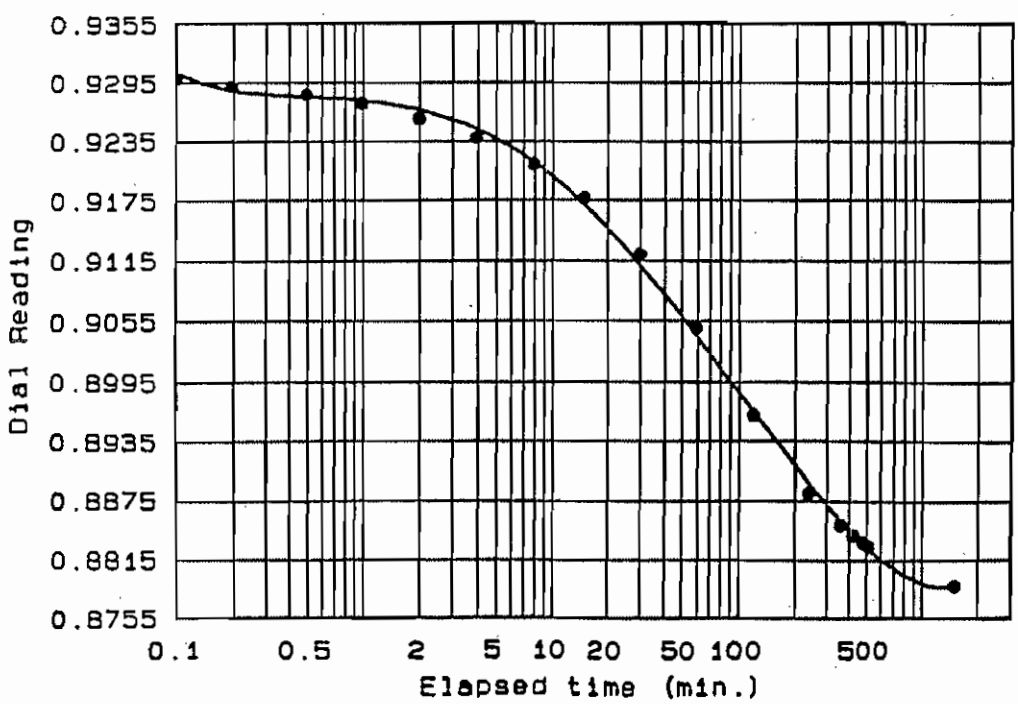
Project No.: 467.42
Project: WEYERHAEUSER
Location: MW-1A, 22-24.0'

Date: 6-04-90



Load No.= 5
Load= 4.00 tsf
D_0 = 0.9717
D_{50} = 0.9547
D_{100}= 0.9377
T_{50}= 26.55 min.

C_v @ T_{50} =
0.002in.^{2}/min.



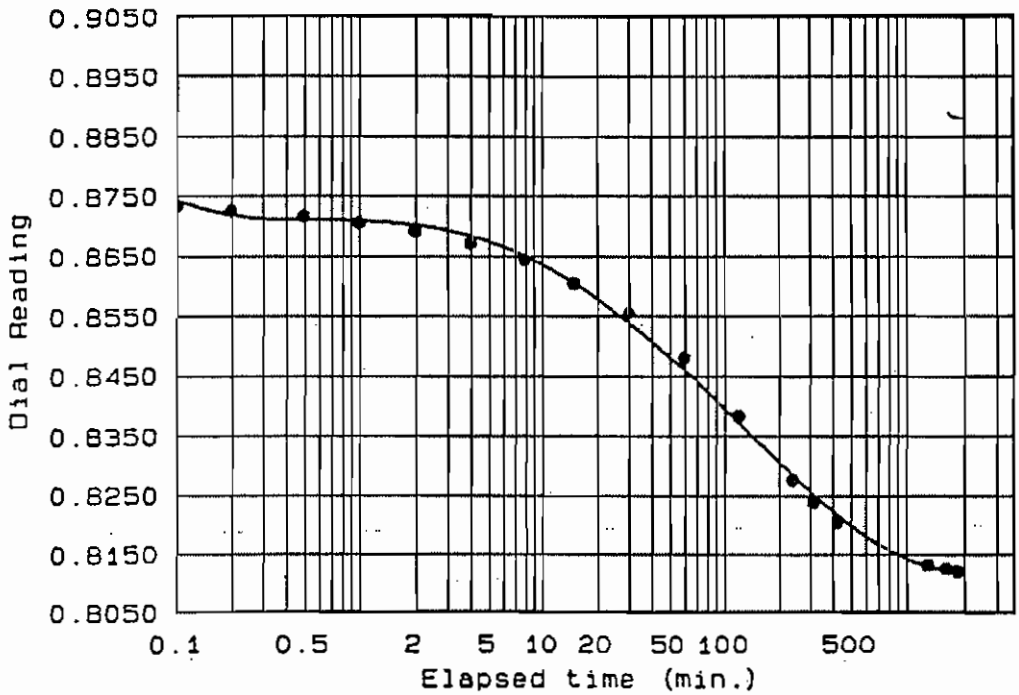
Load No.= 6
Load= 8.00 tsf
D_0 = 0.9330
D_{50} = 0.9076
D_{100}= 0.8822
T_{50}= 42.52 min.

C_v @ T_{50} =
0.001in.^{2}/min.

Dial Reading vs. Time

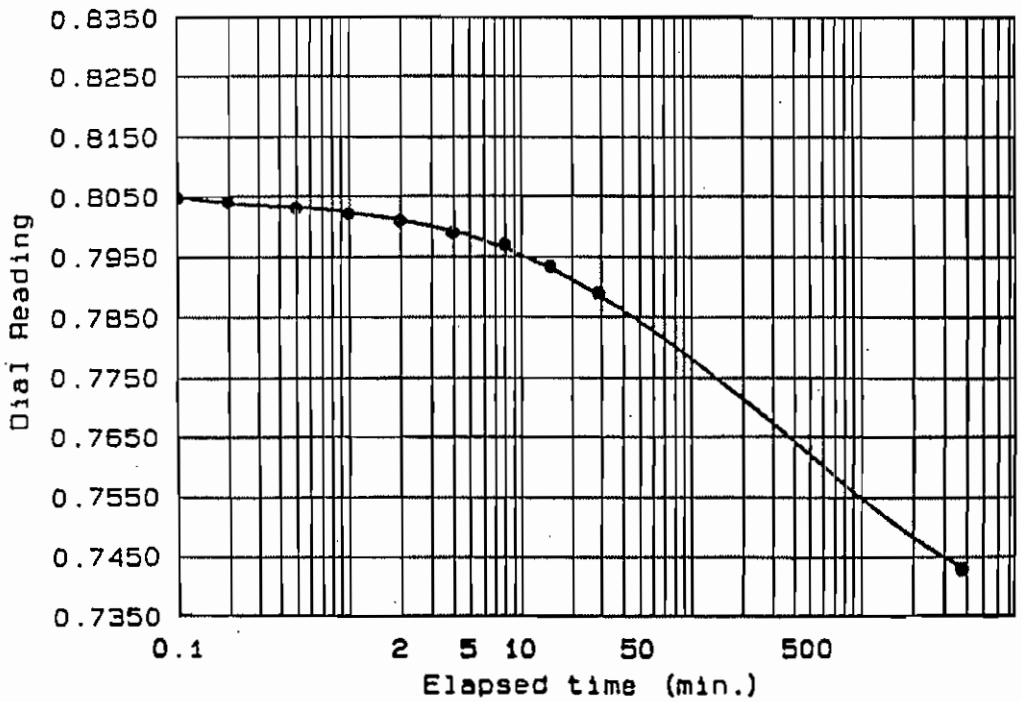
Project No.: 467.42
Project: WEYERHAEUSER
Location: MW-1A, 22-24.0'

Date: 5-04-90



Load No.= 7
Load= 16.00 tsf
D_0 = 0.8775
D_{50} = 0.8453
D_{100}= 0.8131
T_{50}= 63.69 min.

C_v @ T_{50} =
0.0005in.^{2}/min.

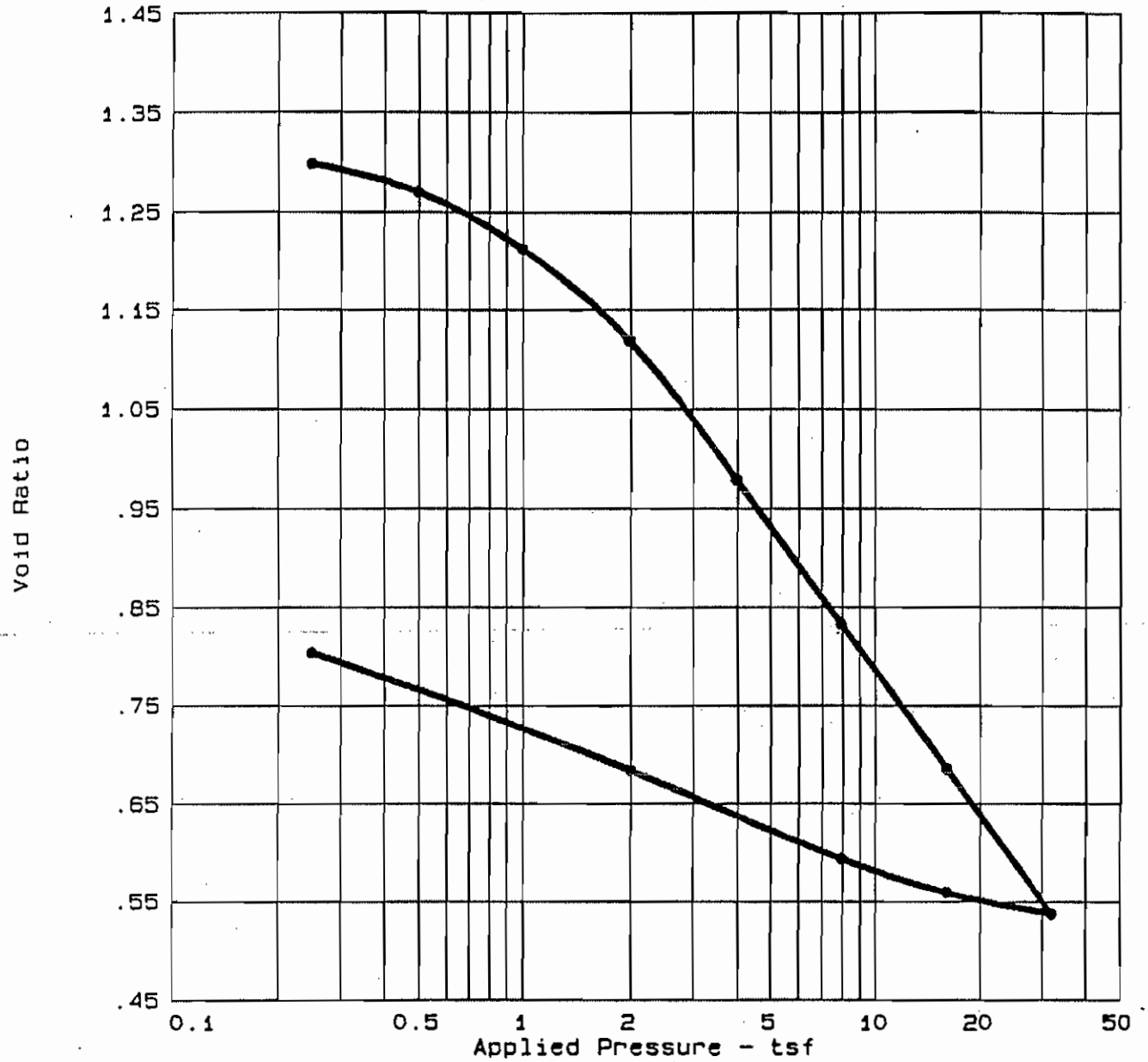


Load No.= 8
Load= 32.00 tsf
D_0 = 0.8064
D_{50} = 0.7795
D_{100}= 0.7525
T_{50}= 86.67 min.

C_v @ T_{50} =
0.0003in.^{2}/min.

✓GTF 6-21-90
✓ JPH 6-27-90
GAV JDH 6-27-90

CONSOLIDATION TEST REPORT



Swell press.	Nat. Sat.	Nat. Moist.	Dry Density	LL	PI	Sp.Gr.	Initial void ratio
	98.6 %	46.0	75.9			2.81	1.3119

TEST RESULTS	MATERIAL DESCRIPTION
	BLUE GRAY SILTY CLAY

Project No.: 467.42
Project: WEYERHAEUSER
Location: OW-1, 20-22.0'

Date: 6-04-90

Remarks:
Initial Dial Reading =
= 1.03530

CONSOLIDATION TEST REPORT

RMT. INC.

07:41, 6-21-1990 CONSOLIDATION TEST PROJECT DATA Test No. 16

Project Number: 467.42
Project: WEYERHAEUSER
Date: 6-04-90
Location 1: OW-1, 20-22.0'
2:
Remarks 1:
2:
3:
4:
5:
Material 1: BLUE GRAY SILTY CLAY
description 2:
Classification:
Liquid limit:
Plasticity index:
Figure Number:

CONSOLIDATION TEST SPECIMEN DATA

TOTAL SAMPLE		BEFORE TEST		AFTER TEST	
Wet w+t	= 142.76 g.	Oedometer No.	= 1	Wet w+t	= 206.52 g.
Dry w+t	= 97.77 g	Machine No.	= N/A	Dry w+t	= 177.87 g.
Tare wt.	= 0.00 g.	Spec. Gravity	= 2.81 EST.	Tare wt.	= 80.10 g.
Height	= 1.00 in.	Height	= 1.00 in.		
Diameter	= 2.50 in.	Diameter	= 2.50 in.		
Weight	= 142.76 g.				
Moisture	= 46.0 %	Ht. Solids	= 0.43 in.	Moisture	= 29.3 %
Wet Den.	= 110.8 pcf	Dry wt.	= 97.77 g.	Dry wt.	= 97.77 g. *
Dry Den.	= 75.9 pcf	Void ratio	= 1.3119	Void ratio	= 0.8033
		Saturation	= 98.6 %	Saturation	= 102. %

Specific Gravity Reported in report is from a separate sample in same tube

* Final dry weight used in calculations

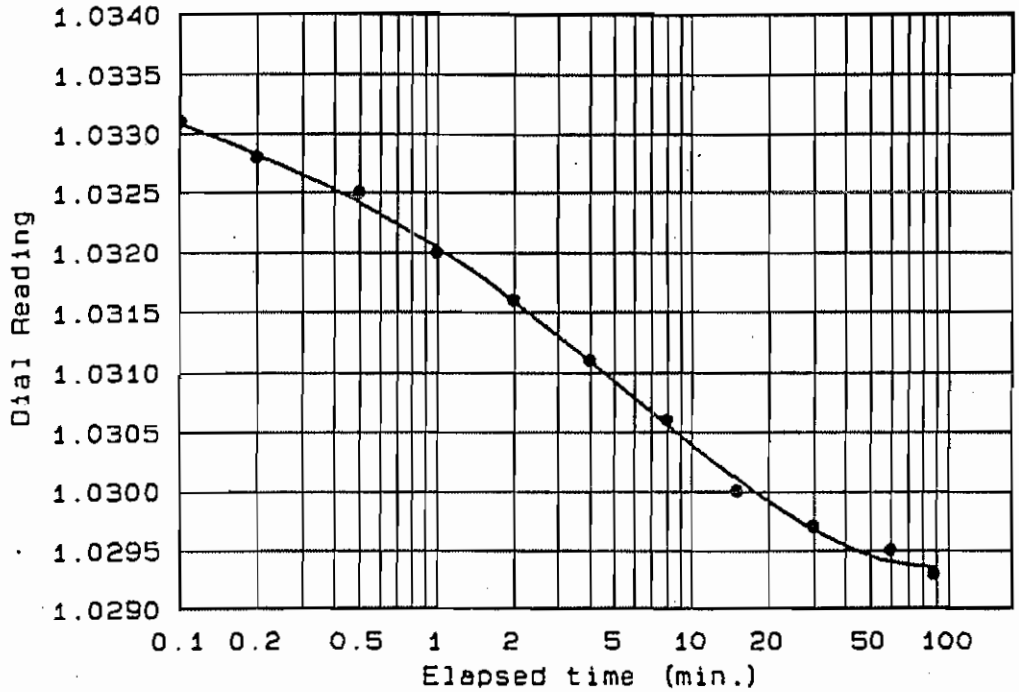
CONSOLIDATION TEST READINGS SUMMARY

LOAD (tsf)	DIAL (in.)	DEFLECTION (in.)	CORRECTED DIAL (in.)	VOID RATIO	% SWELL/CONSOL.
Initial	1.03530			1.3119	
0.25	1.02930	0.0000	1.02930	1.2980	0.6 Consol.
0.50	1.01720	0.0000	1.01720	1.2701	1.8 Consol.
1.00	0.99200	0.0000	0.99200	1.2118	4.3 Consol.
2.00	0.95150	0.0000	0.95150	1.1182	8.4 Consol.
4.00	0.89090	0.0000	0.89090	0.9781	14.4 Consol.
8.00	0.82800	0.0000	0.82800	0.8327	20.7 Consol.
16.00	0.76430	0.0000	0.76430	0.6854	27.1 Consol.
32.00	0.70000	0.0000	0.70000	0.5367	33.5 Consol.
16.00	0.70940	0.0000	0.70940	0.5585	32.6 Consol.

Dial Reading vs. Time

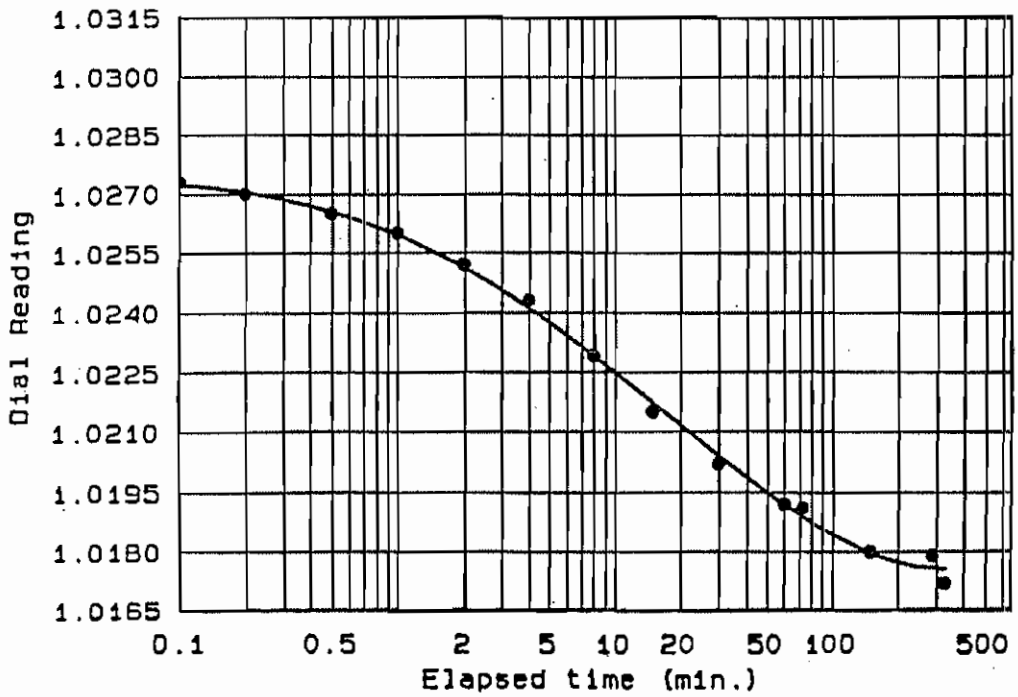
Project No.: 467.42
Project: WEYERHAEUSER
Location: OW-1, 20-22.0'

Date: 6-04-90



Load No.= 1
Load= 0.25 tsf
D_0 = 1.0336
D_{50} = 1.0316
D_{100}= 1.0295
T_{50}= 2.11 min.

C_v @ T_{50} =
0.023 in.^{2}/min.



Load No.= 2
Load= 0.50 tsf
D_0 = 1.0278
D_{50} = 1.0227
D_{100}= 1.0177
T_{50}= 8.79 min.

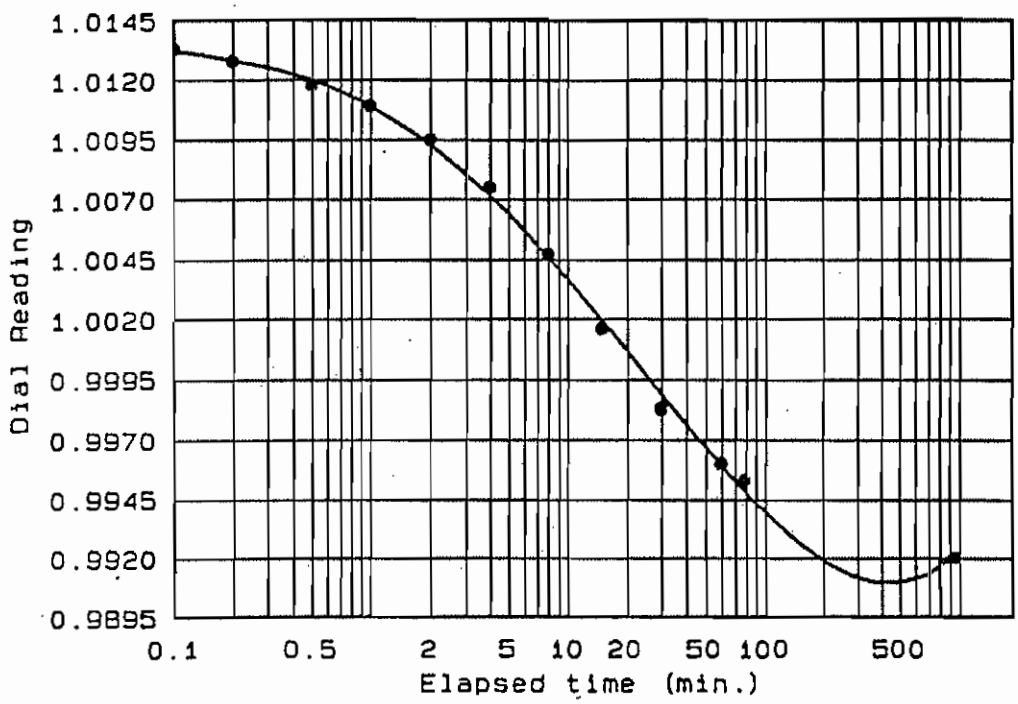
C_v @ T_{50} =
0.005
~~0.01~~ in.^{2}/min.

RMT, INC.

Dial Reading vs. Time

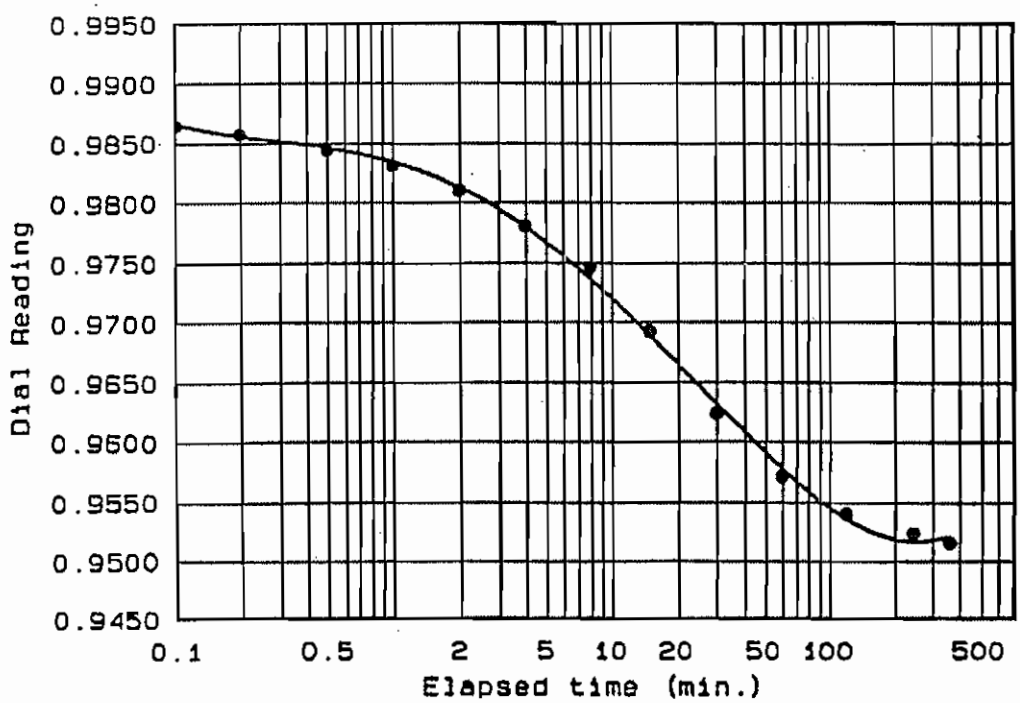
Project No.: 467.42
Project: WEYERHAEUSER
Location: DW-1, 20-22.0'

Date: 6-04-90



Load No.= 3
Load= 1.00 tsf
D_0 = 1.0142
D_{50} = 1.0033
D_{100}= 0.9925
T_{50}= 10.86 min.

C_v @ T_{50} = 0.004 in.^{2}/min.



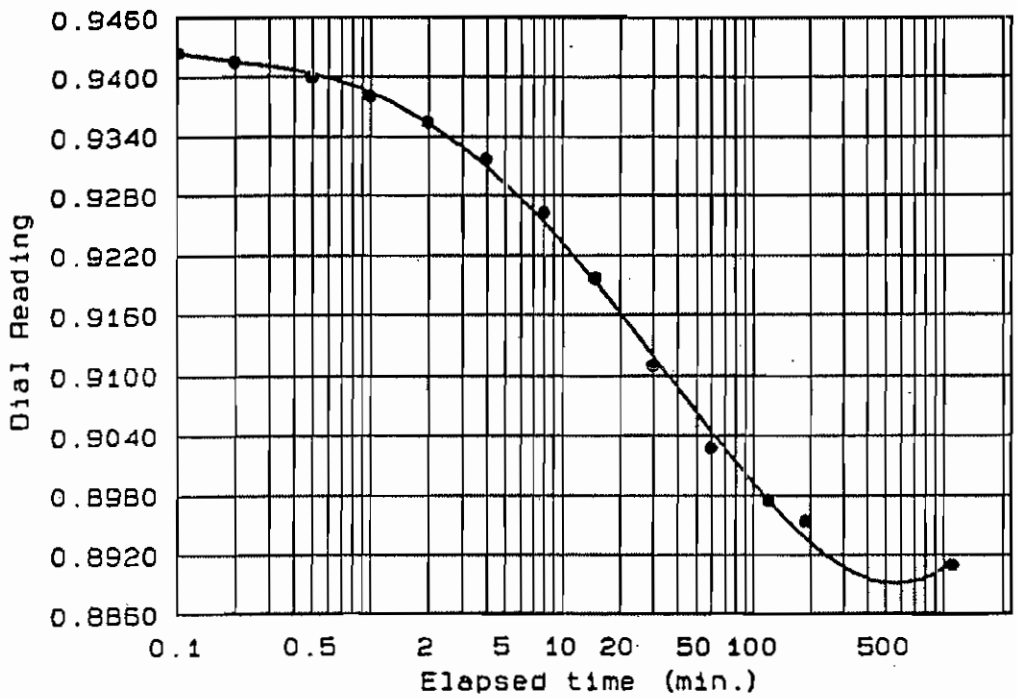
Load No.= 4
Load= 2.00 tsf
D_0 = 0.9883
D_{50} = 0.9695
D_{100}= 0.9507
T_{50}= 13.74 min.

C_v @ T_{50} = 0.003 in.^{2}/min.

Dial Reading vs. Time

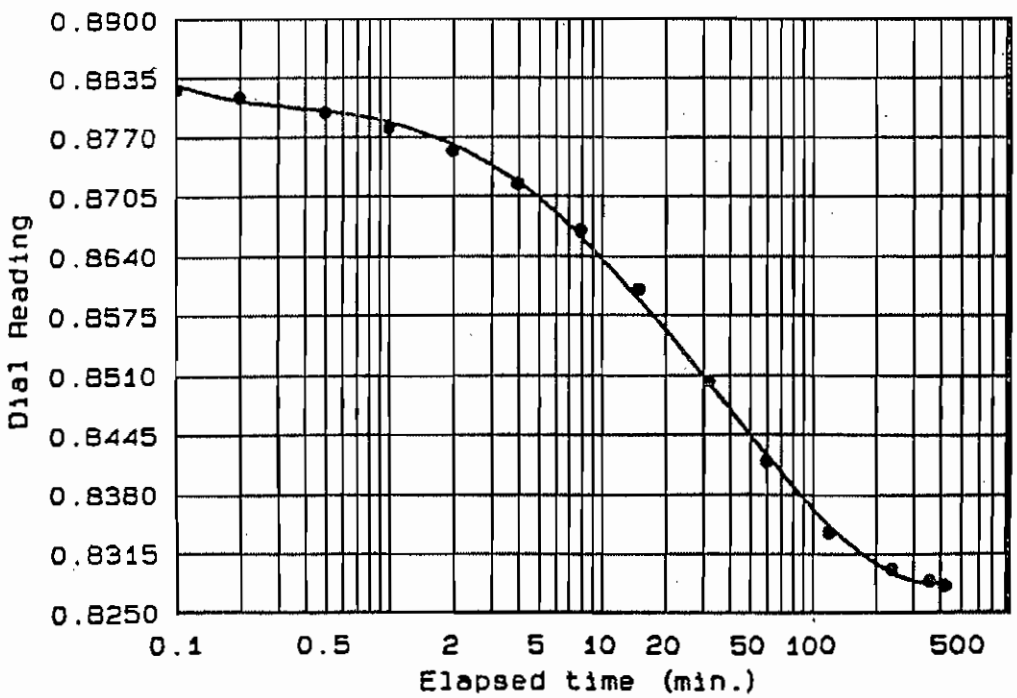
Project No.: 467.42
Project: WEYERHAEUSER
Location: DW-1, 20-22.0'

Date: 6-04-90



Load No.= 5
Load= 4.00 tsf
D_0 = 0.9440
D_{50} = 0.9174
D_{100}= 0.8908
T_{50}= 17.89 min.

C_v @ T_{50} =
0.002in.^{2}/min.



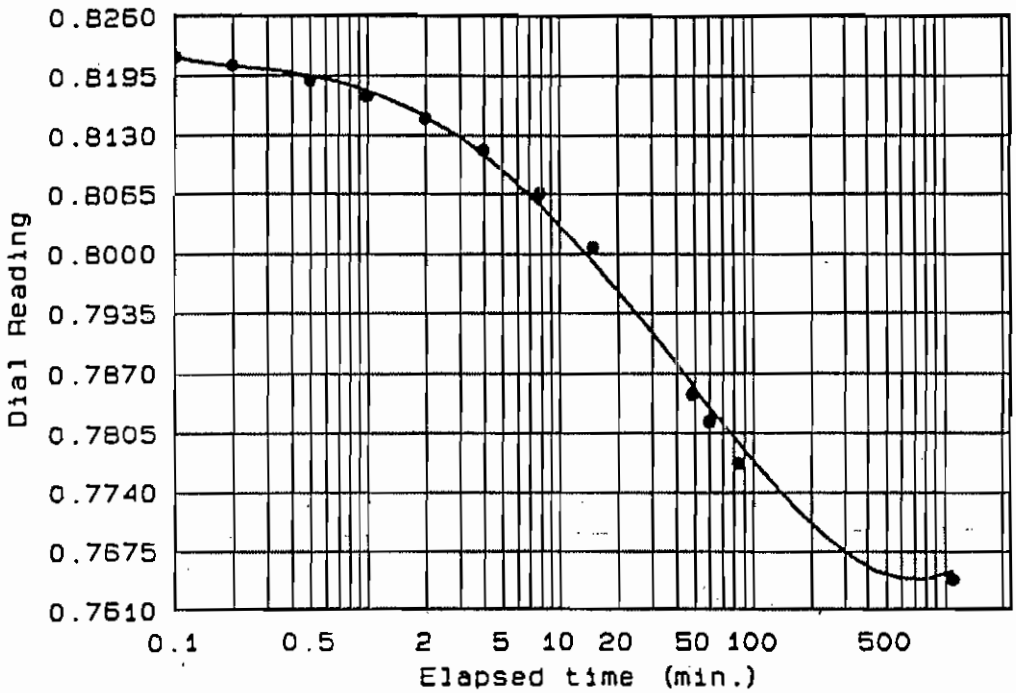
Load No.= 6
Load= 8.00 tsf
D_0 = 0.8855
D_{50} = 0.8567
D_{100}= 0.8280
T_{50}= 18.69 min.

C_v @ T_{50} =
0.002in.^{2}/min.

Dial Reading vs. Time

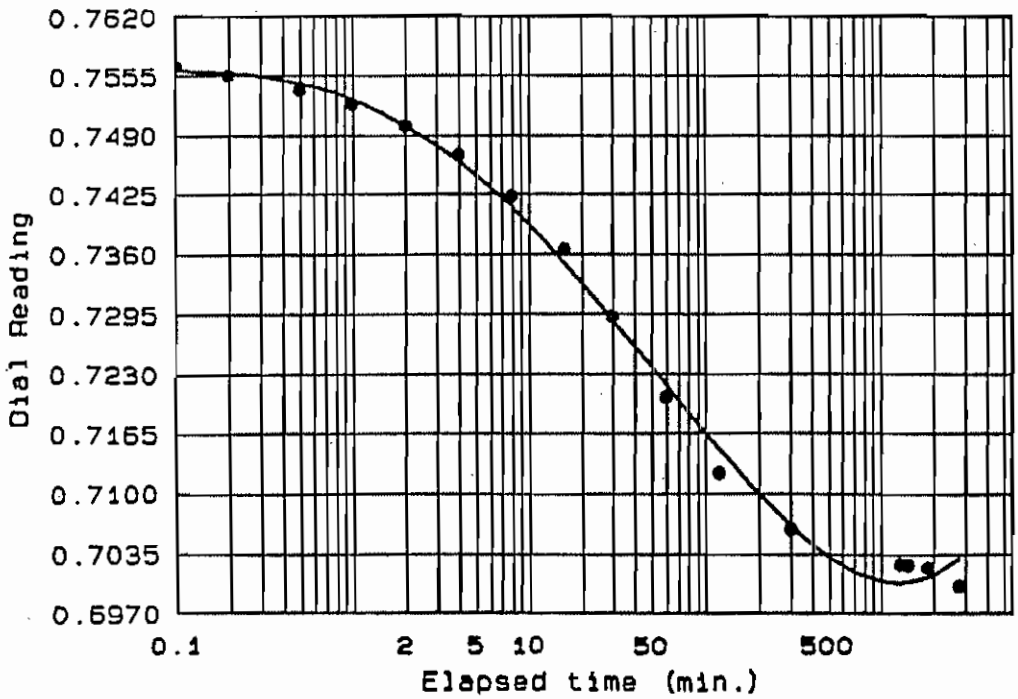
Project No.: 467.42
Project: WEYERHAEUSER
Location: OW-1, 20-22.0'

Date: 6-04-90



Load No.= 7
Load= 16.00 tsf
D_0 = 0.8232
D_{50} = 0.7946
D_{100}= 0.7661
T_{50}= 22.50 min.

C_v @ T_{50} =
0.001 in.^{2}/min.



Load No.= 8
Load= 32.00 tsf
D_0 = 0.7572
D_{50} = 0.7267
D_{100}= 0.6961
T_{50}= 37.25 min.

C_v @ T_{50} =
0.001 in.^{2}/min.

RMT, INC. O

SUPPLEMENT TO APPENDIX B

APPENDIX A

FIELD LOGS

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. MW-1
SHEET NO. 1 OF 1

PROJECT NAME WEYERHAEUSER
PROJECT NO. 467.37
LOCATION PLYMOUTH, NC
INSTALLATION
CONTRACTOR LAW ENGINEERING
SURFACE ELEV. 34.8
DRILLING METHOD MUD ROTARY
BOREHOLE DIA. 3 IN.

SAMPLING NOTES						VISUAL CLASSIFICATION AND GENERAL OBSERVATIONS
INTERVAL NO.	TYPE	RECOVERY N		MOISTURE	DEPTH	
1	SS	4-4-3				SILT (ML) - tan to brown; organics.
2	SS	4-2-3			5	SILTY SAND (SM) - fine grained; trace of clay and mica; orange-brown; mottled gray.
3	SS	5-5-9			10	- with gray silty clay partings and wood fragments.
4	SS	WOH			15	SILTY CLAY (CL) - trace of sand; soft; gray; thin (0.1 ft. thick) fine grained clayey sand layers.
5	SS	17-15-20			20	SAND (SP) - fine grained; trace of silt; gray silt layer from 18.5 - 19.0 ft.
6	SS	8-10-10			25	SILTY CLAY (CL) - No sample recovered; blue/green-gray clay on drill bit and spoon.
					30	BORING TERMINATED AT 25.0 FEET.
					35	

GENERAL NOTES

DATE STARTED 20 JUN 89
DATE COMPLETED 20 JUN 89
RIG CME 5-50
CREW CHIEF C. CORNELISSEN
LOGGED DEMc CHECKED

WATER LEVEL OBSERVATIONS

WHILE DRILLING ⊻ -----
AT COMPLETION ⊻ 3.8 ft. BGS
AFTER DRILLING
CAVE-IN: DATE/TIME ----- DEPTH -----
WATER: DATE/TIME ----- DEPTH -----

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. MW-2
SHEET NO. 1 OF 1
PROJECT NO. 467.37
INSTALLATION
SURFACE ELEV. 24.9
BOREHOLE DIA. 4 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	N			DEPTH	
1	SS	4-10-11				SILT (ML) - orange-brown; some fine grained sand and sandy clay.
2	SS	3-5-5			5	SILTY CLAY (CL) - firm; gray to brown; clayey sand at 3.5 ft.
3	SS	19-23-30			10	SAND (SP) - fine grained; trace of silt; tan to gray to orange-brown; some mica; thin zones of gray silty clay and clayey sand; very dense.
4	SS	8-8-12			15	
5	UD					
6	SS	7-13-13			20	
7	SS	10-12-15			25	BORING TERMINATED AT 25.0 FEET.
					30	
					35	

GENERAL NOTES

DATE STARTED 21 JUN 89
DATE COMPLETED 21 JUN 89
RIG CME 5-50
CREW CHIEF C. CORNELISSEN
LOGGED DEMc CHECKED

WATER LEVEL OBSERVATIONS

WHILE DRILLING ⊻ -----
AT COMPLETION ⊻ 18.5 ft. BGS
AFTER DRILLING
CAVE-IN: DATE/TIME ----- DEPTH -----
WATER: DATE/TIME ----- DEPTH -----

LOG OF TEST BORING

F-203 (R 01-87)

PROJECT NAME	WEYERHAEUSER	BORING NO.	MW-3
LOCATION	PLYMOUTH, NC	SHEET NO.	1 OF 1
CONTRACTOR	LAW ENGINEERING	PROJECT NO.	467.37
DRILLING METHOD	MUD ROTARY	INSTALLATION	
		SURFACE ELEV.	8.3
		BOREHOLE DIA.	4 IN.

SAMPLING NOTES						VISUAL CLASSIFICATION AND GENERAL OBSERVATIONS
INTERVAL		RECOVERY		MOISTURE		
NO.	TYPE	N			DEPTH	
1	SS	3-4-4				SILT (ML) - tan; trace of mica; clayey at the top.
2	SS	7-5-3			5	- light gray.
3	UD					
4	SS	4-3-3			10	- brown; trace of clay; scattered thin (0.01 ft. thick) clay layers.
5	UD					
						14.0
6	SS	6-26-23			15	SILTY SAND (SM) - fine grained, trace of medium and coarse grained; very dense; quartz pebbles; gray to brown.
7	SS	24-43-34			20	- red-brown to orange-brown with iron oxide layer.
8	SS	14-16-17			25	- quartz pebbles to 1/2 in. diameter.
9	SS	5-4-5				- dark gray; interbeds of 0.2 ft. thick silty clay, soft with mica.
					30	BORING TERMINATED AT 30.0 FEET.
					35	

GENERAL NOTES

DATE STARTED 22 JUN 89

DATE COMPLETED 22 JUN 89

RIG CME 5-50

CREW CHIEF C. CORNELISSEN

LOGGED DEMc CHECKED

WATER LEVEL OBSERVATIONS

WHILE DRILLING ⊽ -----

AT COMPLETION ⊽ 4.2 ft. BGS

AFTER DRILLING

CAVE-IN: DATE/TIME ----- DEPTH -----

WATER: DATE/TIME ----- DEPTH -----

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. MW-4
SHEET NO. 1 OF 1

PROJECT NAME WEYERHAEUSER
PROJECT NO. 467.37
LOCATION PLYMOUTH, NC
INSTALLATION
CONTRACTOR LAW ENGINEERING
SURFACE ELEV. 9.8
DRILLING METHOD MUD ROTARY
BOREHOLE DIA. 4 IN.

SAMPLING NOTES						VISUAL CLASSIFICATION AND GENERAL OBSERVATIONS
INTERVAL		RECOVERY	MOISTURE			
NO.	TYPE	N			DEPTH	
1	SS	3-4-7				SILTY SAND (SM) - fine grained; trace of clay; some silt; tan; wood fragments at 1.5 ft.
2	SS	3-4-4				CLAYEY SAND (SC) - fine; tan with gray molting; some silt; moist; stiff.
3	UD				5	
4	SS	3-4-4				- thin gray silty clay layers (0.01 ft. thick).
5	UD				10	
6	SS	12-15-17				SILTY SAND (SM) - fine grained; dense; light orange-brown; gray micaceous silt from 13.5-14.0 ft.
					15	
7	SS	22-30-31				- fine to medium grained, trace of coarse grained; very dense; iron oxide layer at 19.5 ft.; orange-brown.
					20	
8	SS	16-17-15				SAND (SP) - fine to medium grained; trace of silt; dense; orange-brown; iron oxide staining.
					25	BORING TERMINATED AT 25.0 FEET.
					30	
					35	

GENERAL NOTES

DATE STARTED 27 JUN 89
DATE COMPLETED 27 JUN 89
RIG CME 5-50
CREW CHIEF C. CORNELISSEN
LOGGED DEMc CHECKED

WATER LEVEL OBSERVATIONS

WHILE DRILLING ∇ -----
AT COMPLETION ▼ 5.3 ft. BGS
AFTER DRILLING
CAVE-IN: DATE/TIME ----- DEPTH -----
WATER: DATE/TIME ----- DEPTH -----

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. MW-5
SHEET NO. 1 OF 1
PROJECT NO. 467.37
INSTALLATION
SURFACE ELEV. 36.9
BOREHOLE DIA. 4 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	N			DEPTH	
1	SS	11-11-7				SILT (ML) - light tan to orange-brown; firm; organics; clayey at the bottom.
2	SS	5-4-6			5	SILTY CLAY (CL) - clayey sand interbeds; orange-brown and gray.
3	UD					
4	SS	4-4-5			10	SILTY SAND (SM) - fine grained; light orange-brown; some clay.
5	UD					
6	SS	4-3-2			15	- with gray, soft, SILTY CLAY (CL) at 14.2 ft.
7	UD					
8	SS	11-11-10			20	- tan to red-brown below 20.0 ft.
9	UD					SILTY CLAY (CL) - blue/green-gray; trace of mica and sand; firm to stiff.
10	SS	3-4-5			25	BORING TERMINATED AT 25.0 FEET.
					30	
					35	

GENERAL NOTES

DATE STARTED 20 JUN 89
DATE COMPLETED 20 JUN 89
RIG CME 5-50
CREW CHIEF C. CORNELISSEN
LOGGED DEMc CHECKED

WATER LEVEL OBSERVATIONS

WHILE DRILLING ∇ -----
AT COMPLETION ∇ 11.1 ft. BGS
AFTER DRILLING
CAVE-IN: DATE/TIME ----- DEPTH -----
WATER: DATE/TIME ----- DEPTH -----

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. MW-6
SHEET NO. 1 OF 1

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

PROJECT NO. 467.37
INSTALLATION
SURFACE ELEV. 11.2
BOREHOLE DIA. 4 IN.

SAMPLING NOTES						VISUAL CLASSIFICATION AND GENERAL OBSERVATIONS
INTERVAL NO.	TYPE	RECOVERY N		MOISTURE	DEPTH	
1	SS	2-2-4				SILT (ML) - tan; organics.
2	SS	4-5-4			5	
3	SS	6-4-4			10	SILTY SAND (SM) - fine grained, trace of medium grained; trace of mica; thin silty layers; orange-brown and gray.
4	SS	3-4-6			15	- alternating silt and sandy clay layers; soft at 15 ft.
5	SS	8-6-7			20	
6	SS	9-6-11			25	SAND (SP) - fine grained, trace of medium grained; micaceous; trace of silt; some clay.
						BORING TERMINATED AT 25.0 FEET.
					30	
					35	

GENERAL NOTES

DATE STARTED 21 JUN 89
DATE COMPLETED 21 JUN 89
RIG CME 5-50
CREW CHIEF C. CORNELISSEN
LOGGED DEMc CHECKED

WATER LEVEL OBSERVATIONS

WHILE DRILLING -----
AT COMPLETION 9.1 ft. BGS
AFTER DRILLING
CAVE-IN: DATE/TIME ----- DEPTH -----
WATER: DATE/TIME ----- DEPTH -----

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. MW-7
SHEET NO. 1 OF 1
PROJECT NO. 467.37
INSTALLATION
SURFACE ELEV. 34.2
BOREHOLE DIA. 4 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	N			DEPTH	
1	SS	4-5-6				SILT (ML) - brown; organics; some fine grained sand. 0.7
2	SS	4-6-9			5	SILTY CLAY (CL) - light brown; micaceous; stiff. - mottled gray and tan; some fine grained sand.
3	SS	1-1-1			10	CLAYEY SILT (ML) - gray; some fine-grained sand.
4	SS	3-8-15			15	SAND (SP) - fine grained; trace of silt and mica; gray.
5	SS	3-5-5			20	SILTY CLAY (CL) - blue/green-gray; trace of mica; firm to stiff.
6	SS	5-3-4			25	- No sample recovered.
					30	BORING TERMINATED AT 25.0 FEET.
					35	

GENERAL NOTES

DATE STARTED 15 JUN 89
DATE COMPLETED 15 JUN 89
RIG CME 5-50
CREW CHIEF C. CORNELISSEN
LOGGED DEMc CHECKED

WATER LEVEL OBSERVATIONS

WHILE DRILLING ∇ -----
AT COMPLETION ▼ 8.4 ft. BGS
AFTER DRILLING
CAVE-IN: DATE/TIME ----- DEPTH -----
WATER: DATE/TIME ----- DEPTH -----

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. SB-1
SHEET NO. 1 OF 1
PROJECT NO. 467.37
INSTALLATION
SURFACE ELEV. 15.0
BOREHOLE DIA. 6 IN.

PROJECT NAME WEYERHAEUSER
LOCATION PLYMOUTH, NC
CONTRACTOR LAW ENGINEERING
DRILLING METHOD H.S. AUGER

SAMPLING NOTES						VISUAL CLASSIFICATION AND GENERAL OBSERVATIONS
INTERVAL		RECOVERY	MOISTURE			
NO.	TYPE	N			DEPTH	
1	SS	3-3-3				SILT (ML) - light tan; micaceous; some clayey silt.
2	SS	5-4-4			5	SILTY SAND (SM) - fine grained; trace of clayey sand; light orange-brown to light tan. 9.5
3	SS	6-7-7			10	SAND (SP) - fine to medium grained; some mica; light tan to gray.
4	SS	8-9-9			15	- fine grained, silty in part; light tan to orange-brown.
5	SS	7-16-23			20	
6	SS	13-20-23			25	- some coarse grained; quartz pebbles to 1/4 in. diameter.
7	SS	18-22-26			30	BORING TERMINATED AT 30.0 FEET.
					35	

GENERAL NOTES

DATE STARTED 16 JUN 89
DATE COMPLETED 16 JUN 89
RIG CME 5-50
CREW CHIEF C. CORNELISSEN
LOGGED DEMc CHECKED

WATER LEVEL OBSERVATIONS

WHILE DRILLING ▽ 8.5 ft. BGS
AT COMPLETION ▼ -----
AFTER DRILLING
CAVE-IN: DATE/TIME ----- DEPTH -----
WATER: DATE/TIME ----- DEPTH -----

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. SB-2
SHEET NO. 1 OF 1

PROJECT NAME WEYERHAEUSER
PROJECT NO. 467.37
LOCATION PLYMOUTH, NC
INSTALLATION
CONTRACTOR LAW ENGINEERING
SURFACE ELEV. 40.5
DRILLING METHOD H.S. AUGER
BOREHOLE DIA. 6 IN.

SAMPLING NOTES						VISUAL CLASSIFICATION AND GENERAL OBSERVATIONS
INTERVAL		RECOVERY	MOISTURE			
NO.	TYPE	N			DEPTH	
1	SS	2-2-3				SAND (SP) - fine grained; trace of silt; organics; brown to light tan. 4.5
2	SS	3-5-5			5	SILTY SAND (SM) - fine grained; trace of clay; orange-brown.
3	SS	3-4-5			10	- sandy clay interbeds; gray; 1 in. thick.
4	SS	1-5-14			15	- thin, scattered gray clay zones; some fine to medium grained sand at 15.0 ft.
5	SS	0-1-2			20	SILTY CLAY (CL) - soft; dark gray; some sand and sandy clay.
6	SS	5-9-12			25	SILTY SAND (SM) - fine grained; trace of medium grained; dark gray; some clayey sand and thin gray clay; wood fragments.
7	SS	3-4-4			30	SILTY CLAY (CL) - blue/green-gray; firm to stiff; micaceous.
					35	BORING TERMINATED AT 30.0 FEET.

GENERAL NOTES

DATE STARTED 16 JUN 89
DATE COMPLETED 16 JUN 89
RIG CME 5-50
CREW CHIEF C. CORNELISSEN
LOGGED DEMc CHECKED

WATER LEVEL OBSERVATIONS

WHILE DRILLING ▽ 13.0 ft. BGS
AT COMPLETION ▼ -----
AFTER DRILLING
CAVE-IN: DATE/TIME ----- DEPTH -----
WATER: DATE/TIME ----- DEPTH -----

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. SB-3
SHEET NO. 1 OF 1
PROJECT NO. 467.37
INSTALLATION
SURFACE ELEV. 38.4
BOREHOLE DIA. 6 IN.

PROJECT NAME WEYERHAEUSER
LOCATION PLYMOUTH, NC
CONTRACTOR LAW ENGINEERING
DRILLING METHOD H.S. AUGER

SAMPLING NOTES						VISUAL CLASSIFICATION AND GENERAL OBSERVATIONS
INTERVAL		RECOVERY		MOISTURE		
NO.	TYPE	N			DEPTH	
1	SS	3-5-4				SILTY SAND (SM) - fine grained; tan.
2	SS	4-5-6			5	CLAYEY SAND (SC) - fine grained; trace of mica; silty; tan, mottled gray.
3	SS	4-3-2			10	SILTY SAND (SM) - fine grained; micaceous; light tan to gray with orange-brown mottling.
4	SS	1-4-3			15	- gray, silty clay layers, 0.1 - 0.2 ft. thick.
5	SS	2-2-1			20	- trace of clay in sand; thin (< 0.1 ft. thick) gray clay.
6	SS	5-6-7			25	SILTY CLAY (CL) - blue/green-gray; trace of mica; firm.
7	SS	5-5-4				
					30	BORING TERMINATED AT 30.0 FEET.
					35	

GENERAL NOTES

DATE STARTED 16 JUN 89
DATE COMPLETED 16 JUN 89
RIG CME 5-50
CREW CHIEF C. CORNELISSEN
LOGGED DEMc CHECKED

WATER LEVEL OBSERVATIONS

WHILE DRILLING ▽ 13.5 ft. BGS
AT COMPLETION ▼ -----
AFTER DRILLING
CAVE-IN: DATE/TIME ----- DEPTH -----
WATER: DATE/TIME ----- DEPTH -----

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. SB-4
SHEET NO. 1 OF 1

PROJECT NAME WEYERHAEUSER
LOCATION PLYMOUTH, NC
CONTRACTOR LAW ENGINEERING
DRILLING METHOD H.S. AUGER

PROJECT NO. 467.37
INSTALLATION
SURFACE ELEV. 40.3
BOREHOLE DIA. 6 IN.

SAMPLING NOTES						VISUAL CLASSIFICATION AND GENERAL OBSERVATIONS
INTERVAL		RECOVERY	MOISTURE			
NO.	TYPE	N			DEPTH	
1	SS	4-4-4				SILT (ML) - tan.
2	SS	4-4-4			5	SILTY SAND (SM) - fine grained; trace of mica and clay.
3	SS	5-5-6			10	CLAYEY SAND (SC) - fine grained; trace of mica; some silty sand; light orange-brown mottled gray.
4	SS	5-5-6			15	- thin (0.1 ft. thick) silty sand and silty clay layers.
5	SS	2-2-2			20	SILTY SAND (SM) - fine grained; some clayey sand; orange-brown to gray.
6	SS	2-3-5			25	SILTY CLAY (CL) - blue/green-gray; micaceous; wood fragments; soft to stiff.
7	SS	3-4-5				
					30	BORING TERMINATED AT 30.0 FEET.
					35	

GENERAL NOTES

DATE STARTED 16 JUN 89
DATE COMPLETED 16 JUN 89
RIG CME 5-50
CREW CHIEF C. CORNELISSEN
LOGGED DEMc CHECKED

WATER LEVEL OBSERVATIONS

WHILE DRILLING ▽ 13.0 ft. BGS
AT COMPLETION ▼ -----
AFTER DRILLING
CAVE-IN: DATE/TIME ----- DEPTH -----
WATER: DATE/TIME ----- DEPTH -----

HA - 1

Date: 9/07/89		Depth of Casing (ft):	9.0
By: Z.B.		Casing Stickup (ft):	1.0
		G.W. @ completion (ft):	7.5

Location:
Southwesterly inside corner of south pine forrest plantation
Elevation estimated to be 38' msl from topo

	DEPTH (ft)	SAMPLED (ft)	USCS	DESCRIPTION
0.00	0		SP-SM	SAND, fine, silty, dark brown (10YR3/3),
0.25				dry, some fine roots, non-plastic
0.50				-light brown (10YR8/3), trace fine
0.75				roots, and moist below 0.5'
1.00				
1.25				
1.50	1.5		SM-SC	SAND,silty fine, some clay,
1.75				yellowish red (5YR4/6), moist, sl. plastic.
2.00		-2		-w/ some silt and trace clay, n.p. @ 2'
2.25				
2.50				
2.75				
3.00	3		SP_SM	SAND, fine, silty, light brown
3.25				(10yr8/3), moist, n.p.
3.50				
3.75				
4.00				-medium to fine w/ trace silt below 4'
4.25				
4.50				
4.75				
5.00	5	-5	CL	CLAY, silty, stiff, reddish brown
5.25				(10R3/6) w/ light gray (N7) mottling,
5.50				moist, tough, plastic
5.75				-grading to Lt.G and wet with depth
6.00				-ground water @ 6'
6.25				
6.50				
6.75				
7.00	7		SP-SC	SAND, med. to fine, some clay, Br.Y
7.25				(10YR6/8), wet w/ tr. free water, sl.
7.50				plastic
7.75				
8.00			SP-SM	-grading more silty with depth
8.25				
8.50	8.5	-8.5	SW	SAND, medium, trace silt, Br.Y
8.75				(10YR6/8), wet w/ free water, n.p.
9.00				-grading coarser w/ depth
9.25				-Caving at -8
9.50	9.5		---------T.D.	

HA - 2

Date: 9/07/89	Depth of Casing (ft): 9.0
By: Z.B.	Casing Stickup (ft): 1.0
	G.W. @ completion (ft): 7.5

Location:

Approx. 275' paces west of HA-1 down south perimiter road; Elevation estimated to be 36' msl from topo & visual est.

DEPTH (ft)	SAMPLED (ft)	USCS	DESCRIPTION
0.00	0	SP-SM	SAND, fine, silty, dark brown (10YR3/3),
0.25			dry, some fine roots, non-plastic
0.50			-light brown (10YR8/3), trace fine
0.75			roots, and moist below 0.5'
1.00			
1.25			
1.50	1.5	CL-SC	CLAY and SAND, stiff, R.Br (10R3/6), moist,
1.75			mod. tough.
2.00			
2.25			-grading less clay with depth
2.50			
2.75			
3.00			
3.25			
3.50			
3.75			
4.00	4	SC-CL	SAND, clayey, R.Br. (10R3/6), with Lt.G.
4.25			(N7) SAND and CLAY nodules, moist+
4.50			
4.75			
5.00			
5.25			
5.50			
5.75			
6.00	6	SW	SAND, med. to fine, trace silt, R.Br.
6.25			(10R3/6) mottled with Lt.G. (N7) silty
6.50			SAND, moist +, no free water.
6.75			
7.00			-coarse to medium w/ tr. fine gravel @ 7'
7.25			-trace free water @ 7'
7.50			-ground water @ 7.5'
7.75			
8.00	8	-8	SAND, med to fine, R.Br. (10R3/6)
8.25			intermixed w/ soft sandy CLAY pkts,
8.50			saturated, slow dilatancy, sl. plastic,
8.75			low toughness.
9.00	9	CH	CLAY, firm, some silt, Lt.G. (N7), moist,
9.25			mod. tough.
9.50			-caving to 9.5
9.75			-@ 10 very soft, no recovery
10.00	10		---------T.D.

HA - 3

Date: 9/07/89		Depth of Casing (ft):	9.7
By: Z.B.		Casing Stickup (ft):	0.3
		G.W. @ completion (ft):	8.2

Location:

Approximately 350' [153 paces] west of HA-1 at end of access in clearing within pine forrest; Elevation estimated to be 36' msl from topo

	DEPTH (ft)	SAMPLED (ft)	USCS	DESCRIPTION
0.00	0		SP-SM	SAND and SILT, fine, Dk.Br. (10YR3/3),
0.25				dry, tr. fine roots and some med. gravel.
0.50				
0.75				
1.00	1		CL-CH	CLAY, silty, stiff, R.Br. (10R3/6) w/
1.25				Lt.G. (N7) mottling, dry-moist, tough.
1.50				-moist @ 1.5'
1.75				
2.00				
2.25				
2.50				-w/ trace fine sand @ 2.5'
2.75				
3.00				
3.25				
3.50		3.5	CL	CLAY, some med. to fine sand, Lt.G. (N7),
3.75				moist, tough.
4.00				
4.25				
4.50				- grading to sandy CLAY with depth
4.75				
5.00				
5.25				
5.50	5.5		SP-SM	SAND, med-fine, some silt and clay, Lt.G.
5.75				(N7) w/ Lt.Br. (10YR8/3) mottling, wet+,
6.00				sl. plastic to n.p.
6.25				-trace free water @ ~6'
6.50				-clayey @ ~6.5'
6.75				-below ~6.5' interbedded R.Br. (10R3/6)
7.00				silty SAND with Lt.G. (N7) silty CLAY with
7.25				occasional silty CLAY partings
7.50				
7.75				
8.00				-grading more sandy below ~8', w/ free water
8.25				-caving @ ~8'
8.50				
8.75				
9.00	9		SP	SAND, fine, some silt, trace clay, Lt.G.
9.25				(N7), dilatancy quick, n.p.
9.50				
10.00	10		---------T.D.	

HA - 4

Date: 9/07/89	Depth of Casing (ft): 10.0
By: Z.B.	Casing Stickup (ft): 0.0
	G.W. @ completion (ft): 6.5

Location:

Southerly limit along south pine forrest/plantation perimeter road, on north side, @ ~250' [95 paces] west of MW-1; Elevation estimated to be ~38' msl from topo.

DEPTH (ft)	SAMPLED (ft)	USCS	DESCRIPTION
0.00	0	CL	CLAY and SAND, fine, stiff, Dk.Gr.G.
0.25			(5G6/1), dry, with tr. fine roots.
0.50			-below 6" stiff, moist, mod. plastic, Gr.G.
0.75			(5G6/1) w/ occ. R.Br. (10R3/6) mottling
1.00			
1.25			
1.50			-grading more sandy with depth
1.75			
2.00			
2.25			
2.50			
2.75			
3.00	3	3 SC-CL	SAND, med to fine, clayey, R.Br. (10R3/6)
3.25			w/ occ. Lt.G. (N7) mottling, mod. tough,
3.50			sl. plastic, slow dilatancy.
3.75			-trace free water @ ~3.5'
4.00			-wet below 4'
4.25			
4.50			-decreasing clay content with depth
4.75			
5.00		5	-very wet and mod dilatancy below 5'
5.25			
5.50			
5.75			
6.00	6	SP-SC	SAND, fine, trace silt and clay, Lt.G.
6.25			(N7) interbedded w/ R.Br. (10R3/6) fine
6.50			sandy CLAY seams, dilatancy quick, low
6.75			toughness, n.p.
7.00			
7.25			
7.50			-caving @ ~7.5'
7.75			
8.00			
8.25			
8.50			
8.75			
9.00			
9.25			
9.50			
10.00	10	---------T.D.	

HA - 5

Date: 9/07/89		Depth of Casing (ft):	8.7
By: Z.B.		Casing Stickup (ft):	1.3
		G.W. @ completion (ft):	6.3

Location:
Approximately 0.1 mi [by odometer] north of MW-1 on west side of main N-S plantation road; Elevation estimated to be 36' msl from topo.

	DEPTH (ft)	SAMPLED (ft)	USCS	DESCRIPTION
0.00		0	SM	SAND, fine, silty, Lt.Br. (10YR8/3), dry,
0.25				w/ trace fine roots, n.p.
0.50				- below 6" dry-moist w/ few roots
0.75				
1.00				
1.25				
1.50		1.5	CL-SC	CLAY and SAND, fine, stiff, Br.Y.
1.75				(10YR6/8), moist, with occ. fine roots.
2.00				
2.25				-grading more sandy w/ depth
2.50				
2.75				
3.00		3	SC-SP	SAND, med to fine, clayey, R.Br. (10R3/6),
3.25				moist, mod. tough, low plasticity.
3.50				
3.75				-grading less clayey with depth
4.00				
4.25				
4.50				
4.75				
5.00				
5.25				
5.50				
5.75				
6.00				-below 6' moist+ w/ trace free water, mod
6.25				dilatancy, mod tough
6.50				
6.75				
7.00				
7.25				-below 7'very soft SAND with some clay
7.50				-caving @ ~7.5'
7.75				
8.00		8	SP	SAND, med to fine, trace silt, R.Br. (10R3/
8.25				
8.50				
8.75				
9.00				
9.25				
9.50		9.5	---------T.D.	

HA - 6

Date: 9/07/89		Depth of Casing (ft):	13.7
By: Z.B.		Casing Stickup (ft):	1.3
		G.W. @ completion (ft):	12.7

Location:
Western half of plantation, approximately 600' west of N-S access road; Elevation estimated to be 40' msl from topo.

	DEPTH (ft)	SAMPLED (ft)	USCS	DESCRIPTION
0.00	0		SP-SM	SAND, fine, some silt, Dk.Br. (10YR3/3),
0.25				dry to moist, some fine roots, n.p.
0.50				-below -6" Lt.Br. (10YR8/3), moist, with
0.75				occ fine roots
1.00				
1.25				
1.50				
1.75				
2.00				
2.25				
2.50	2.5		CL-CH	CLAY, some sand, stiff, R.Br. (10R3/6),
2.75				moist, mod. tough.
3.00				
3.25				
3.50	3.5		SP-SM	SAND, fine, some silt, trace clay, R.Br.
3.75				(10R3/6), dry to moist, n.p.
4.00				
4.25				
4.50				
4.75				
5.00	5		CL-SC	SAND, some clay, firm to stiff, R.Br.
5.25				(10R3/3), moist, low tough, sl. plastic.
5.50				
5.75				
6.00	6		CL	CLAY and SAND, fine, stiff, Lt.Br.
6.25				(10YR3/3), moist, mod tough.
6.50				
6.75				
7.00				
7.25				
7.50				-@ -7.5 w/ R.Br. (10R3/6) med. SAND pockets
7.75				
8.00	8		SP-SM	SAND,fine, silty, mottled Gr.G. (5G6/1)
8.25				and R.Br. (10R3/3), moist-, n.p.
8.50				
8.75				
9.00				-Lt.G. (N7) and moist below 9'
9.25				
9.50				-grading less silt with depth
10.00				

HA - 6 (continued)

Date: 9/07/89	Depth of Casing (ft): 13.7
By: Z.B.	Casing Stickup (ft): 1.3
	G.W. @ completion (ft): 12.7

Location:
Western half of plantation, approximately 600' west of N-S access road; Elevation estimated to be 40' msl from topo.

	DEPTH (ft)	SAMPLED (ft)	USCS	DESCRIPTION
10.25				
10.50				
10.75				
11.00				-wet w/ R.Br. (10R3/3) clayey SAND
11.25				partings @ 11'
11.50				
11.75				
12.00	12		SP	SAND, med to fine, trace silt, Lt.G. (N7),
12.25				wet, trace free water, w/ R.Br. (10R3/3)
12.50				clayey SAND partings.
12.75				-caving @ ~12.5'
13.00			SW	-below ~13' grading to SW
13.25				
13.50				
13.75				
14.00	14			---------T.D.

HA - 7

Date: 9/07/89		Depth of Casing (ft):	9.7
By: Z.B.		Casing Stickup (ft):	0.3
		G.W. @ completion (ft):	8.4

Location:
In western half of plantation, approximately 250' south of SB-2 or 0.1 mi south of west access road leading to HA-7; Elevation estimated to be 39' msl from topo.

	DEPTH (ft)	SAMPLED (ft)	USCS	DESCRIPTION
0.00	0		SP-SM	SAND, fine, silty, Dk.Br. (10YR3/3), dry,
0.25				occ. fine roots.
0.50				
0.75				
1.00				
1.25				
1.50	1.5	1.5	CL-SC	CLAY and SAND fine, firm, R.Br. (10R3/6),
1.75				moist; mod. tough, mod plastic.
2.00				
2.25				
2.50				-grading more silt and less clay with depth
2.75				
3.00				
3.25				
3.50	3.5		SM-SP	SAND, fine, silty, R.Br. (10R3/6), dry to
3.75				moist, with Br.Y. (10YR6/8) clayey SAND
4.00				partings and nodules.
4.25				
4.50				-moist below ~4.5'
4.75				
5.00				
5.25				
5.50				
5.75				
6.00	6		CL-CH	CLAY, some fine sand and silt, stiff,
6.25				R.Br. (10R3/6) intermixed w/ Lt.G. (N7)
6.50				mohling moist, tough.
6.75				
7.00				-grading more sandy below ~7'
7.25				
7.50	7.5		SC-CL	CLAY and SAND, trace silt, firm, Lt.G.
7.75				(N7) mottled R.Br. (10R3/6), moist +, low
8.00				toughness.
8.25				-grading more sandy and wet below ~8'
8.50				
8.75				-caving @ 9'
9.00	9		SP-SM	SAND, fine, trace medium, some silt, Lt.G.
9.25				(N7), dripping wet, dilatant, n.p.
9.50				
10.00	10		---------T.D.	

HA - 8

Date: 9/07/89		Depth of Casing (ft):	9.0
By: Z.B.		Casing Stickup (ft):	1.0
		G.W. @ completion (ft):	7.0

Location:

Approximately 190 south of SB-3 on east side of N-S plantation access road across from power line pole; Elevation estimated to be 37' msl from topo.

	DEPTH (ft)	SAMPLED (ft)	USCS	DESCRIPTION
0.00	0		SM-ML	SAND and SILT, fine, Dk.Br. (10YR3/3),
0.25				dry, some fine roots.
0.50				-Lt.Br. (10YR8/3) below ~6"
0.75				
1.00				
1.25				
1.50	1.5		CL	CLAY and SAND, fine, trace silt, firm, Br.Y.
1.75				(10YR6/8), dry to moist, mod tough.
2.00				
2.25				
2.50				-moist below ~2.5'
2.75				
3.00				
3.25				
3.50				
3.75				
4.00	4		SP	SAND, med. to fine, trace some silt, R.Br.
4.25				(10R3/6), moist, n.p.
4.50				
4.75	4.75		CH	CLAY, some fine sand, stiff, Lt.G. (N7),
5.00				moist, very tough.
5.25				
5.50	5.5		SP-SM	SAND, fine, some silt, trace clay, Lt.G.
5.75				(N7) mottled R.Br. (10R3/6), moist+, sl.
6.00				plastic.
6.25				
6.50				-below ~6.5' very wet
6.75				-ground water @ ~7'
7.00				
7.25				
7.50				-@ ~7.5' some sandy CLAY nodules
7.75				
8.00				-@ 8' 1-inch dia. fresh root
8.25				
8.50	8.5		SW	SAND, coarse to fine, trace silt, Lt.G.
8.75				(N7), wet w/ free water.
9.00	9		---------T.D.	

HA - 9

Date: 9/07/89		Depth of Casing (ft):	12.8
By: Z.B.		Casing Stickup (ft):	2.2
		G.W. @ completion (ft):	11.8

Location:

Approximately 475' north of HA-8 up main N-S plantation access road on west side at intersection with western access road; Elevation estimated to be 40' msl from topo.

	DEPTH (ft)	SAMPLED (ft)	USCS	DESCRIPTION
0.00		0	SP-SM	SAND, fine, some silt, Dk.Br. (10YR3/3),
0.25				dry, some fine roots.
0.50				-Lt.Br. (10YR8/3), dry to moist below 6"
0.75				
1.00				
1.25				
1.50		1.5	CL-SC	CLAY and SAND, fine, firm, R.Br. (10R3/6),
1.75				dry to moist, mod tough, mod plastic.
2.00				
2.25				
2.50				-grading more fine sand with depth
2.75				
3.00				
3.25				
3.50				
3.75				
4.00		4	SP-SC	SAND, fine, some clay, R.Br. (10R3/6),
4.25				moist-, sl. plastic to n.p.
4.50				
4.75				
5.00				-medium SAND below 5'
5.25				
5.50				
5.75				
6.00				-w/ occ. fine roots @ 6'
6.25				
6.50				
6.75				
7.00		7	CL-CH	CLAY, some fine sand, stiff, Y.R. (5YR4/6)
7.25				w/ tr. Lt. G. (N7) mottling, moist-.
7.50				
7.75				
8.00		8	SP-SC	SAND, some clay and silt, R.Br. (10R3/6),
8.25				moist, sl. plastic.
8.50				-grading less clay and n.p. w/ depth
8.75				
9.00				-below 9' intermixed Lt.G. (N7) and R.Br.
9.25				(10R3/6), moist
9.50				
9.75				

HA - 9 (continued)

Date: 9/07/89	Depth of Casing (ft): 12.8
By: Z.B.	Casing Stickup (ft): 2.2
	G.W. @ completion (ft): 11.8

Location:

Approximately 475' north of HA-8 up main N-S plantation access road on west side at intersection with western access road; Elevation estimated to be 40' msl from topo.

	DEPTH (ft)	SAMPLED (ft)	USCS	DESCRIPTION
10.00				-@ 10' clayey and wet
10.25				
10.50	10.5		SP-SW	SAND, med. to fine, trace silt, mottled
10.75				Lt.G. (N7) and Lt.Br. (10YR8/3), moist+.
11.00				-grading coarser with depth to SW
11.25				
11.50				-dilatancy quick @ 11.5'
11.75				
12.00				-caving @ 12'
12.25				
12.50				-@ 12.5' mottled Y.R. (5YR4/6) and Lt.G.
12.75				(N7) w/ silty CLAY partings
13.00	13		---------	T.D.

HA - 10

Date: 9/08/89	Depth of Casing (ft): 9.3
By: Z.B.	Casing Stickup (ft): 0.7
	G.W. @ completion (ft): 6.7

Location:

Along south plantation boundary road in south east corner approximately 600 feet south of MW-7 @ alignment break, on plantation side of road; Elevation estimated to be 34' msl from topo.

	DEPTH (ft)	SAMPLED (ft)	USCS	DESCRIPTION
0.00	0		SP-SM	SAND, fine, some silt, Dk.Br. (10YR3/3),
0.25				dry, some fine roots.
0.50				-Lt.Br. (10YR8/3), dry to moist below 6"
0.75				
1.00	1		CL-SC	CLAY and SAND, firm, Br.Y. (10R6/8),
1.25				moist, tough.
1.50				
1.75				
2.00				
2.25				
2.50	2.5		SC-CL	SAND, fine, clayey, firm, Br.Y. (10R6/8),
2.75				moist-, sl. plastic.
3.00				
3.25				-grading less clay w/ depth
3.50				
3.75				
4.00				
4.25				
4.50				
4.75				
5.00	5		CL-CH	CLAY, trace fine sand stiff, mottled Lt.G.
5.25				(N7) and Br.Y. (10YR6/8), moist-, very tough.
5.50	5.5		SP	SAND, medium to fine, trace silt, Br.Y.
5.75				(10YR6/8), moist-, n.p.
6.00		6		-moist w/ Lt.G. (N7) mottling below 6'
6.25				
6.50				
6.75				
7.00				-med dilatancy @ 7' w/ free water
7.25				
7.50				-trace silty CLAY ptngs below 7.5'
7.75				
8.00				-caving @ 8'
8.25				
8.50				
8.75				
9.00	9		SW	SAND, well, Lt.Br. (10YR8/3), wet.
9.50				
10.00	10		---------T.D.	

HA - 11

Date: 9/08/89		Depth of Casing (ft):	8.0
By: Z.B.		Casing Stickup (ft):	2.0
		G.W. @ completion (ft):	6.3

Location:

Along south east plantation boundary road approximately 325 feet north of HA-11 and 225 south of MW-7 @ at corner of road on plantation side of road; Elevation estimated to be 36' msl from topo.

	DEPTH (ft)	SAMPLED (ft)	USCS	DESCRIPTION
0.00				
	0		SP-SM	SAND, fine, some silt, Dk.Br. (10YR3/3),
0.25				dry, some fine roots.
0.50				-below 6" Lt.Br. (10YR8/3) and dry to moist
0.75	0.75		CL-SC	CLAY and SAND, fine, stiff, Br.Y. (10R6/8)
1.00				w/ occ. Lt.G. (N7) mottling, moist, tough.
1.25				
1.50				
1.75				
2.00				
2.25				
2.50				-@ 2.5' 3/8" fresh root
2.75				
3.00	3		CL-ML	CLAY, silty, trace fine sand, firm, Br.Y.
3.25				(10R6/8) w/ Lt.G. mottling, moist, mod tough.
3.50				
3.75				
4.00				
4.25				
4.50				
4.75				
5.00	5		CL-CH	CLAY, very stiff, mottled Lt.G. (N7) and
5.25				Br.Y. (10R6/8), dry to moist, very tough.
5.50	5.5		SP-SM	SAND, fine, trace silt, Br.Y. (10YR6/8),
5.75				moist.
6.00				-grading coarser w/ depth
6.25				
6.50				-below 6.5' moist w/ Lt.G. (N7) mottling
6.75				
7.00				-medium grained below 7'
7.25				-caving @ -7'
7.50				-wet below -7.5'
7.75				
8.00	8		---------T.D.	

HA - 12

Date: 9/08/89		Depth of Casing (ft):	10.0
By: Z.B.		Casing Stickup (ft):	0.0
		G.W. @ completion (ft):	9.2

Location:
Approximately 325' from main N-S access road towards MW-7 along east access road in eastern half of plantation; Elevation estimated to be 37' msl from topo.

	DEPTH (ft)	SAMPLED (ft)	USCS	DESCRIPTION
0.00		0	SP-SM	SAND, fine, some silt, Dk.Br. (10YR3/3),
0.25				dry, some fine roots.
0.50				-Lt.Br. (10YR8/3), dry to moist below 6"
0.75				
1.00				
1.25				
1.50		1.5	CL	CLAY, silty, trace fine sand, firm to stiff,
1.75				Br.Y. (10YR6/8), moist, tough.
2.00				
2.25				
2.50				
2.75				
3.00		3	CL-SC	CLAY and SAND, fine, firm to stiff, Br.Y.
3.25				(10YR6/8), moist-, mod. tough.
3.50				
3.75				
4.00		4	CL-CH	CLAY, very stiff, Lt.G. (N7) mottled R.Br.
4.25				(10R3/6), moist-, very tough.
4.50				
4.75				
5.00		5	SP	SAND, silty fine, trace clay, Br.Y.
5.25				(10YR6/8), moist, n.p.
5.50				
5.75				
6.00				
6.25				
6.50				-@ 6.5' Lt.G. (N7) w/ Lt.B. (10YR8/3)
6.75				mottling
7.00		7	CL-SC	CLAY and SAND, fine, firm, Br.Y. (10YR6/8) w/
7.25				Lt.G. (N7) SILT partings, moist, mod. tough.
7.50				
7.75		7.75	SP-SM	SAND, fine, silty, Br.Y. (10YR6/8), wet,
8.00				mod. dilatant, Sl. plastic to n.p.
8.25				
8.50				-medium to fine @ 8.5'
8.75				
9.00				-@ 9' coarse to medium and Lt.G. (N7)
9.50				-caving @ ~9.5'
10.00				
10.50		10.5	---------T.D.	

HA - 13

Date: 9/08/89 Depth of Casing (ft):
By: Z.B. Casing Stickup (ft):
G.W. @ completion (ft):

Location:
At southeast toe of landfill, approximately 650 feet south of Fueling Station at outside bend of road; Elevation estimated to be 36' msl from topo.

	DEPTH (ft)	SAMPLED (ft)	USCS	DESCRIPTION
0.00	0		SP-SM	SAND, fine, some silt, Dk.Br. (10YR3/3),
0.25				dry, trace fine roots.
0.50				-Lt.Br. (10YR8/3), dry to moist below 6"
0.75				
1.00				
1.25				
1.50				
1.75				
2.00	2		CL	CLAY, sandy, trace silt, stiff, Y.R.
2.25				(5YR4/6), dry-moist, tough.
2.50				
2.75				-grading more sandy and less clayey
3.00				
3.25				
3.50	3.5		SP-SM	SAND, fine, some silt and clay, Y.R.
3.75				(5YR4/6), dry-moist, n.p.
4.00				-Lt.Br. (10YR8/3) and silty below 4'
4.25				
4.50				
4.75				
5.00				-moist below 5'
5.25				
5.50				-medium fine sand below 5.5'
5.75				
6.00	6		SP-SC	SAND, medium, some clay, Lt.G (N7) w/
6.25				Br.Y. (10YR6/8) stringers, moist, sl. pl.
6.50		6.5		-silty and less clay @ 6.5'
6.75				
7.00				
7.25				
7.50				
7.75				
8.00	8		CL-SC	CLAY and SAND, med sand, stiff, Br.Y.
8.25				(10YR6/8), moist, mod tough, mod. pl.
8.50				
8.75				
9.00				
9.50	9.5		SP-SC	SAND, fine, some silt, Lt.G. (N7) w/ R.Br.
9.75				(10R3/6) mottling, moist, w/ silty clay
10.00				partings, sl. pl.

HA - 13 (continued)

Date: 9/08/89 Depth of Casing (ft):
By: Z.B. Casing Stickup (ft):
G.W. @ completion (ft):

Location:
At southeast toe of landfill, approximately 650 feet south of Fueling Station at outside bend of road; Elevation estimated to be 36' msl from topo.

	DEPTH (ft)	SAMPLED (ft)	USCS	DESCRIPTION
10.25		10	CH-CL	CLAY, trace fine sand, very stiff, Lt.G.
10.50				(N7), moist-, very tough.
10.75				-increasingly sandy w/ depth
11.00				-w/ med to fine SAND partings @ 11'
11.25				-w/ ferrous nodules below 11'
11.50				-@ 11.5' med sand interbedded w/ sandy CLAY
11.75				
12.00		12	SP	SAND, medium to fine, trace silt, Lt.G.
12.25				(N7), dry-moist.
12.50				-grading coarser w/ depth
12.75				
13.00				-R.Br. (10R3/6) below 13'
13.25				
13.50				-Lt.G. (N7) w/ R.Br. (10R3/6) stringers
13.75				and dry-moist @ 13.5'
14.00				-moist below 14'
14.25				
14.50				
14.75				
15.00				
15.25				
15.50				-w/ trace clay nodules @ 15.5'
15.75				
16.00		16		---------T.D.; dry at completion depth

HA - 14

Date: 9/08/89 — Depth of Casing (ft): 11.3
By: B.Neel — Casing Stickup (ft): 1.6
G.W. @ completion (ft): 5.8

Location:
Along northern south plantation perimeter road, approximately 450 feet from refueling station along south side of roadway; Elevation estimated to be 36' (?) msl from topo.

	DEPTH (ft)	SAMPLED (ft)	USCS	DESCRIPTION
0.00	0		SP-SM	SAND, fine, some silt, Dk.Br. (10YR3/3),
0.25				dry, some fine roots.
0.50				-Lt.Br. (10YR8/3), dry to moist below 6"
0.75				
1.00		1		
1.25				
1.50				
1.75				
2.00				
2.25				
2.50				
2.75				
3.00	3	3	CL	CLAY, sandy, trace silt, stiff, Y.R.
3.25				(5YR4/6), dry-moist, tough.
3.50				
3.75				
4.00				
4.25				
4.50				
4.75				
5.00	5	5	SP-SM	SAND, fine, some silt and clay, Lt.G. (N7)
5.25				and Br.Y. (10YR6/8), moist-dry, n.p.
5.50				
5.75				
6.00				
6.25				
6.50				
6.75				
7.00				
7.25				
7.50		7.5		
7.75				
8.00				
8.25				
8.50				
8.75				
9.00		9		-wet below 9'
10.00				
11.00		11		
11.50	11.5		---------T.D.	

HA - 15

Date: 9/08/89	Depth of Casing (ft): 11.2
By: Z.B.	Casing Stickup (ft): 2.2
	G.W. @ completion (ft): 10.9

Location:
In borrow area approximately 275' north of TP-22 and 180' west of TP-23, at intersection of two interior access roads. Elevation estimated to be 35 feet msl from topo.

	DEPTH (ft)	SAMPLED (ft)	USCS	DESCRIPTION
0.00		0	SP-SM	SAND, fine, some silt, Dk.Br. (10YR3/3),
0.25				dry, trace fine roots.
0.50				-Lt.Br. (10YR8/3), dry to moist below 6"
0.75				
1.00		1	CL	CLAY, sandy, trace silt, stiff, Br.Y.
1.25				(10YR6/8), dry-moist, very tough, w/ occ.
1.50				R.Br. (10R3/6) silt pockets.
1.75				
2.00				
2.25				
2.50				
2.75				
3.00				
3.25				
3.50				
3.75				
4.00				
4.25				
4.50		4.5	SP-SM	SAND, fine, some silt, Lt.Br. (10YR8/3),
4.75				dry-moist.
5.00				
5.25				
5.50				
5.75				
6.00				-moist below 6'
6.25				
6.75				
7.00				-occ. clay pocket below 7'
7.25				
7.50				
7.75				
8.00		8	CH-CL	CLAY, silty, very stiff, Lt.G. (N7),
8.25				dry-moist, very tough.
8.50		8.5	SP	SAND, med to fine, trace clay pockets,
9.00				Lt.G. (N7), dry-moist, n.p.
9.50				-R.Br. (10R3/6), silty, and wet below 9.5'
9.75				-grading coarser w/ depth
10.50		10.5	SW	SAND, well, trace silt, R.Br. (10R3/6),
10.75				wet, w/ occ. fine gravel.
11.00		11	---------	T.D.

HA - 16

Date: 9/08/89		Depth of Casing (ft):	11.5
By: Z.B.		Casing Stickup (ft):	1.0
		G.W. @ completion (ft):	6.3

Location:
In borrow area approximately 500' north of TP-24 along main access road at top of knoll just beyond access road leading to TP-26; Elevation estimated to be 24' msl from topo.

DEPTH (ft)	SAMPLED (ft)	USCS	DESCRIPTION
0.00	0	SP-SM	SAND, fine, some silt, Dk.Br. (10YR3/3),
0.25			dry, some fine roots.
0.50			-Lt.Br. (10YR8/3), dry to moist below 6"
0.75			
1.00	1	CL-CH	CLAY, trace sand, trace silt, stiff, R.Br.
1.25			(10R3/6), dry-moist, tough.
1.50			
1.75			
2.00			
2.25			
2.50			
2.75			
3.00		CL	-CLAY and SAND @ 3'
3.25			
3.50			
3.75			
4.00			-Lt.G. (N7) w/ R.Br. (10R3/6) mottling and
4.25			trace fine SAND partings @ 4'
4.50			
4.75			
5.00			
5.25			
5.50			-very stiff and purplish gray below 5.5'
5.75			
6.00			-w/ R.Br. (10R3/6) mottling and ferrous
6.25			stains @ 6'
6.50			
6.75			
7.00			-Lt.G. (N7) w/ SILT partings @ 7'
7.25			
7.50			
7.75			
8.00	8	SP	SAND, med to fine, Lt.Br. (10YR8/3), dry+,
8.25			w/ ferrous staining.
8.50			
8.75			-increasingly well; graded with depth
9.00			-medium SAND @ 9'
9.25			
9.50		SW	-Lt.G (N7) and coarse to medium below 9.5'
9.75			

HA - 16 (continued)

Date: 9/08/89	Depth of Casing (ft): 11.5
By: Z.B.	Casing Stickup (ft): 1.0
	G.W. @ completion (ft): 6.3

Location:

Approximately 500 feet north of TP-24 at top of knoll just beyond access road leading to TP-26; Elevation estimated to be 24' msl from topo.

	DEPTH (ft)	SAMPLED (ft)	USCS	DESCRIPTION
10.00				
10.25				
10.50	10.5		CL	CLAY, silty, very stiff, Lt.G. (N7),
10.75				moist, very tough.
11.00				
11.25				
11.50	11.5			T.D.; dry at completion

LOG OF TEST PIT OR EXCAVATION

RMT INC.

PIT NUMBER TP-21

PROJECT NAME Weyerhaeuser

PROJECT NUMBER 467.38

LOCATION Plymouth, NC

DATE June 28, 1989

CONTRACTOR Hopkins

METHOD Backhoe

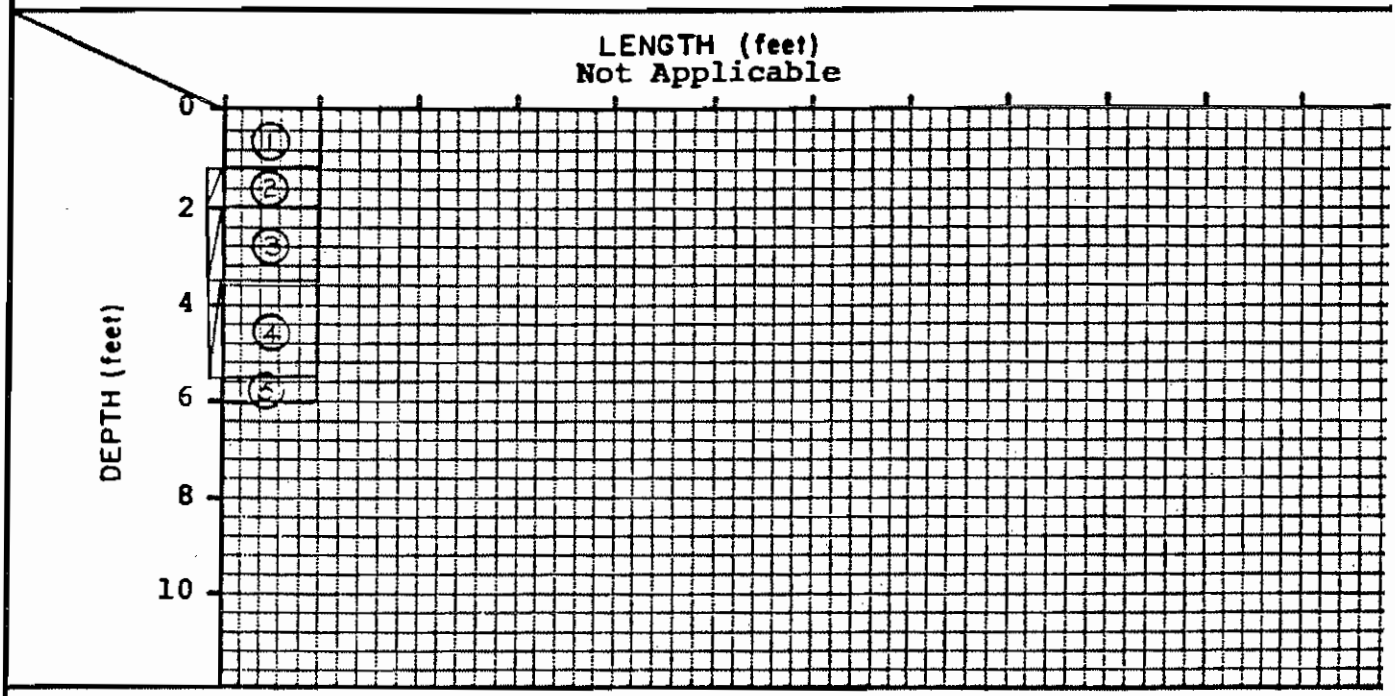
WIDTH

LOGGED BY DEMc

CHECKED BY BB

PAGE 1 OF 1

GRAPHIC REPRESENTATION OF EXCAVATION



ORIENTATION

DESCRIPTION OF UNITS

1) SILT (ML) - gray-brown; sandy; topsoil; organics; piece of glass at 12 inches.

2) SILTY CLAY (CL) - tan; stiff; some fine grained sand; moist.

3) SILTY CLAY (CL) - gray to tan; firm; trace of sand; grading less silty with depth.

4) CLAY (CH) - gray with brown mottling; firm; some silt; some fine grained sand; moist.

5) SILTY SAND (SM) - tan; fine grained; trace of clay.

LEGEND:

Bulk Sample Jar Sample Drive Tube Sample

LOG OF TEST PIT OR EXCAVATION

PIT NUMBER TP-22

PROJECT NAME Weyerhaeuser

PROJECT NUMBER 467.38

LOCATION Plymouth, NC

DATE June 28, 1989

CONTRACTOR Hopkins

METHOD Backhoe

WIDTH

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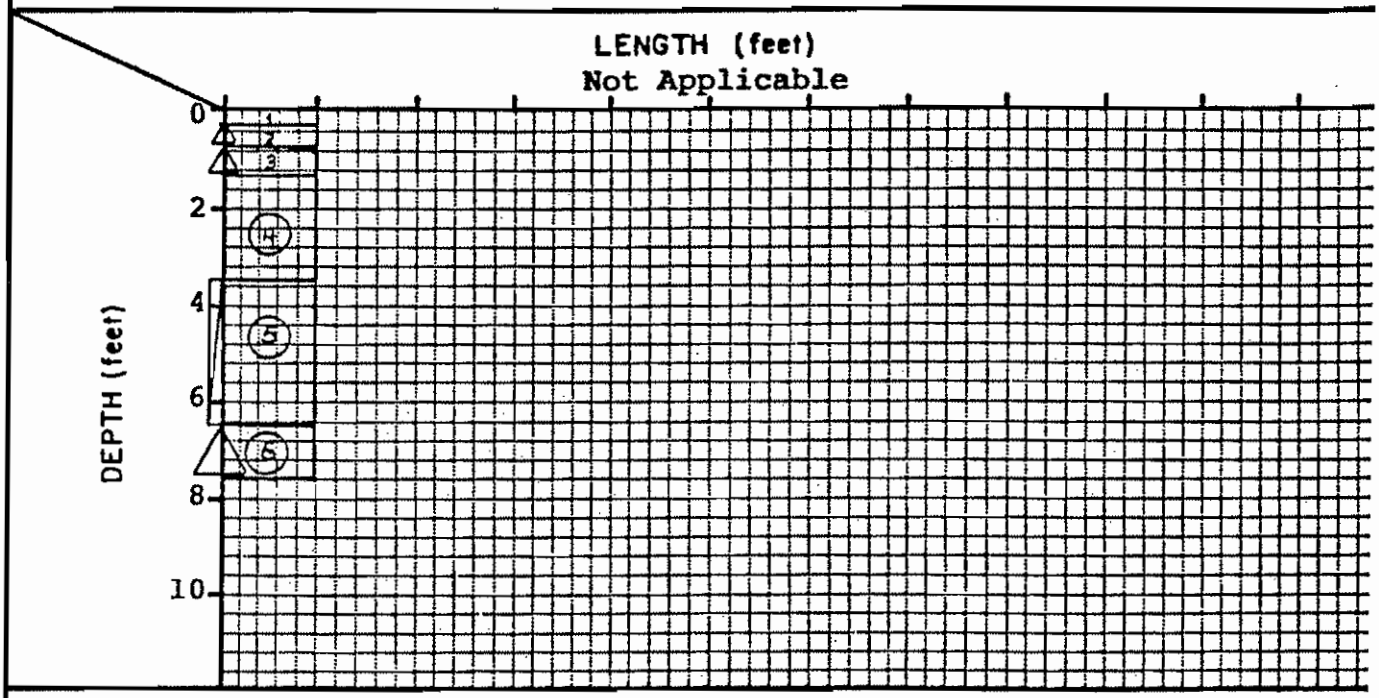
PAGE 1 OF 1

GRAPHIC REPRESENTATION OF EXCAVATION



ORIENTATION

DESCRIPTION OF UNITS

1) SILT (ML) - dark brown; sandy; topsoil; with organics.

2) SILT (ML) - gray-tan; trace of clay; firm; some organics.

3) SILTY SAND (SM) - orange-brown; firm to hard; trace of clay.

4) SILTY CLAY (CL) - orange-brown; firm; trace of sand; micaceous.

5) SILTY SAND (SM) - orange-brown; fine grained; some clay; thin silty clay layers, gray.

6) SILTY SAND (SM) - light gray; some orange-brown; fine grained; micaceous.

LEGEND:

Bulk Sample

Jar Sample

LOG OF TEST PIT OR EXCAVATION

RMT INC.

PIT NUMBER TP-23

PROJECT NAME Weyerhaeuser

PROJECT NUMBER 467.38

LOCATION Plymouth, NC

DATE June 28, 1989

CONTRACTOR Hopkins

METHOD Backhoe

WIDTH

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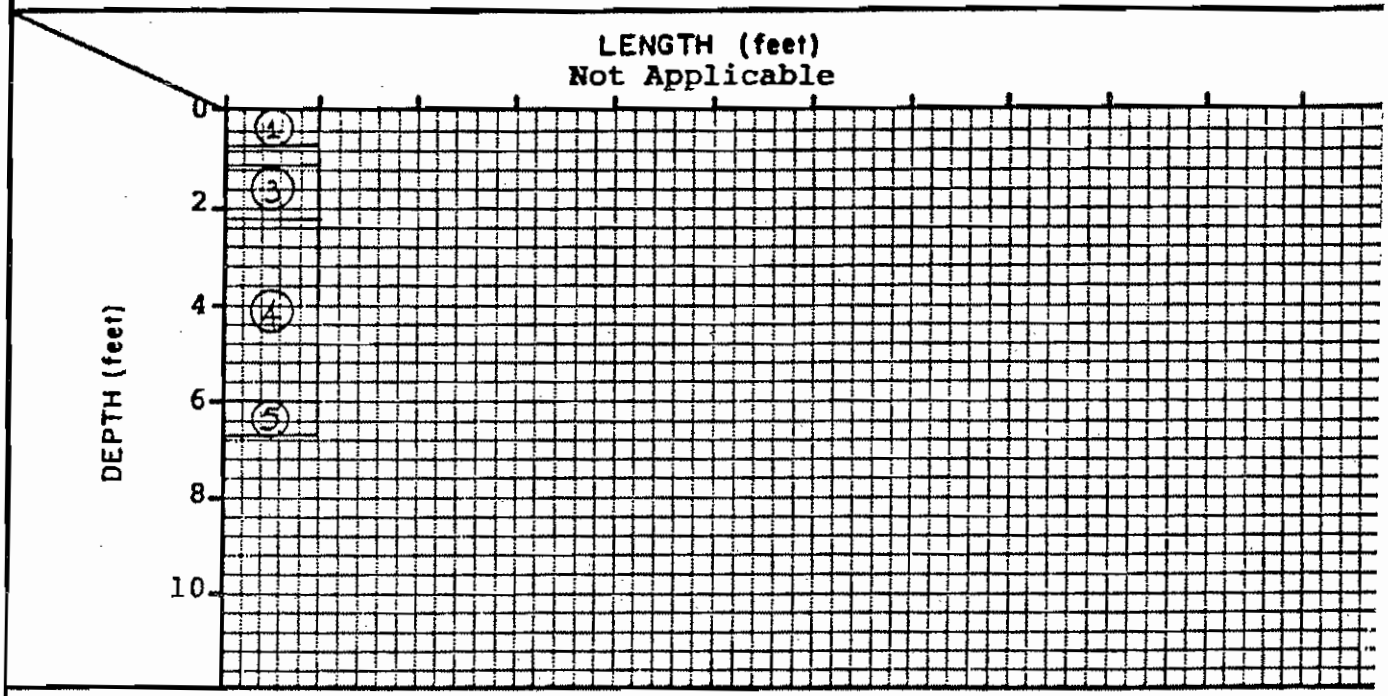
PAGE 1 OF 1

GRAPHIC REPRESENTATION OF EXCAVATION



ORIENTATION

DESCRIPTION OF UNITS

1) SILT (ML) - gray-brown; topsoil; with organics.

2) SILT (ML) - tan to gray-brown; soft to firm; some organics.

3) SILTY SAND (SM) - light orange-brown; firm; fine grianed; trace of clay.

4) SILTY CLAY (CL) - orange-brown; color change at 4 ft. to gray with brown mottling; stiff.

5) SILTY SAND (SM) - light orange-brown to light gray; fine grained; with thin gray clay galls.

LOG OF TEST PIT OR EXCAVATION

PIT NUMBER TP-24

PROJECT NAME Weyerhaeuser

PROJECT NUMBER 467.38

LOCATION Plymouth, NC

DATE June 28, 1989

CONTRACTOR Hopkins

METHOD Backhoe

WIDTH

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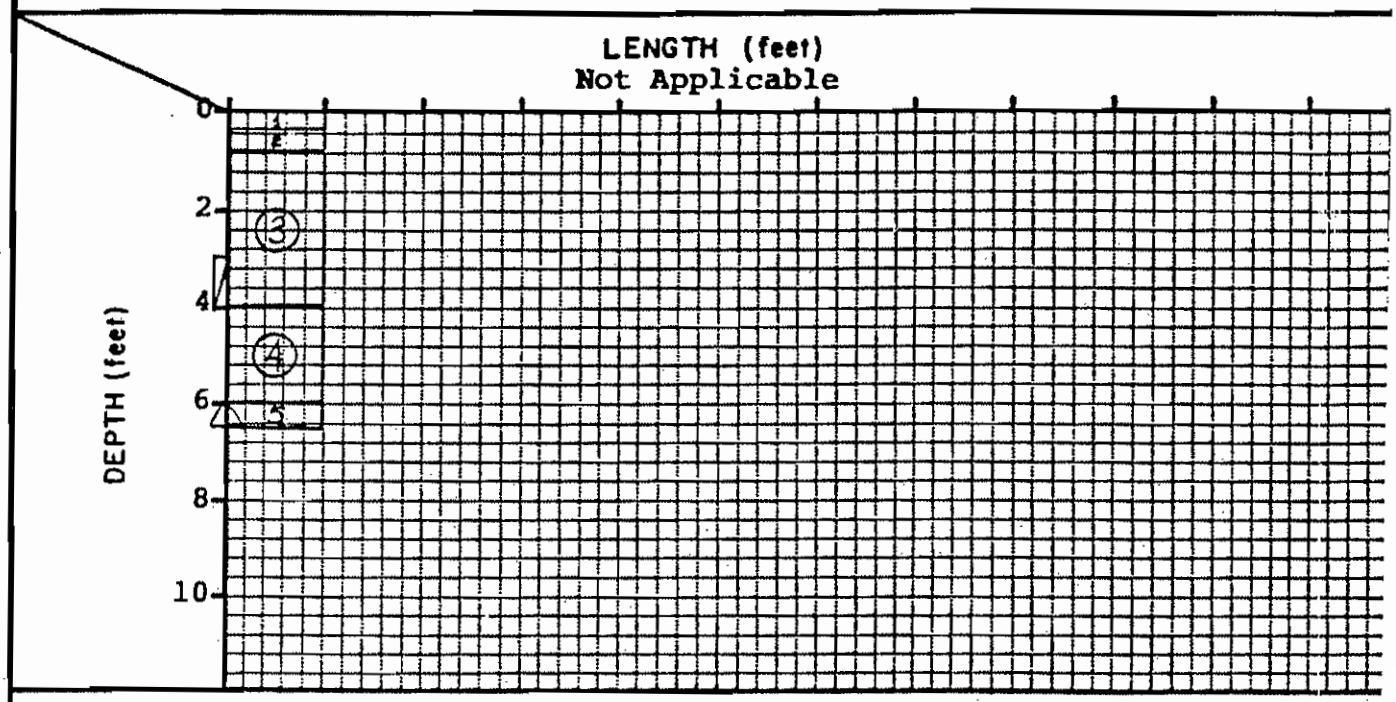
PAGE 1 OF 1

GRAPHIC REPRESENTATION OF EXCAVATION



ORIENTATION

DESCRIPTION OF UNITS

1) SILT (ML) - gray-brown; topsoil; with organics.

2) SILT (ML) - brown to light orange-brown; firm; trace of clay.

3) CLAY (CH) - light orange-brown; soft to firm; thin stringers (< 0.1 ft.) of SANDY CLAY (CL).

4) CLAYEY SAND (SC) - light orange-brown to brown-gray; fine grained; soft.

5) SILTY SAND (SM) - orange-brown; fine grained; with thin clay galls scattered throughout.

LEGEND:

Bulk Sample

Jar Sample

LOG OF TEST PIT OR EXCAVATION

RMT INC.

PIT NUMBER TP-25

PROJECT NAME Weyerhaeuser

PROJECT NUMBER 467.38

LOCATION Plymouth, NC

DATE June 28, 1989

CONTRACTOR Hopkins

METHOD Backhoe

WIDTH

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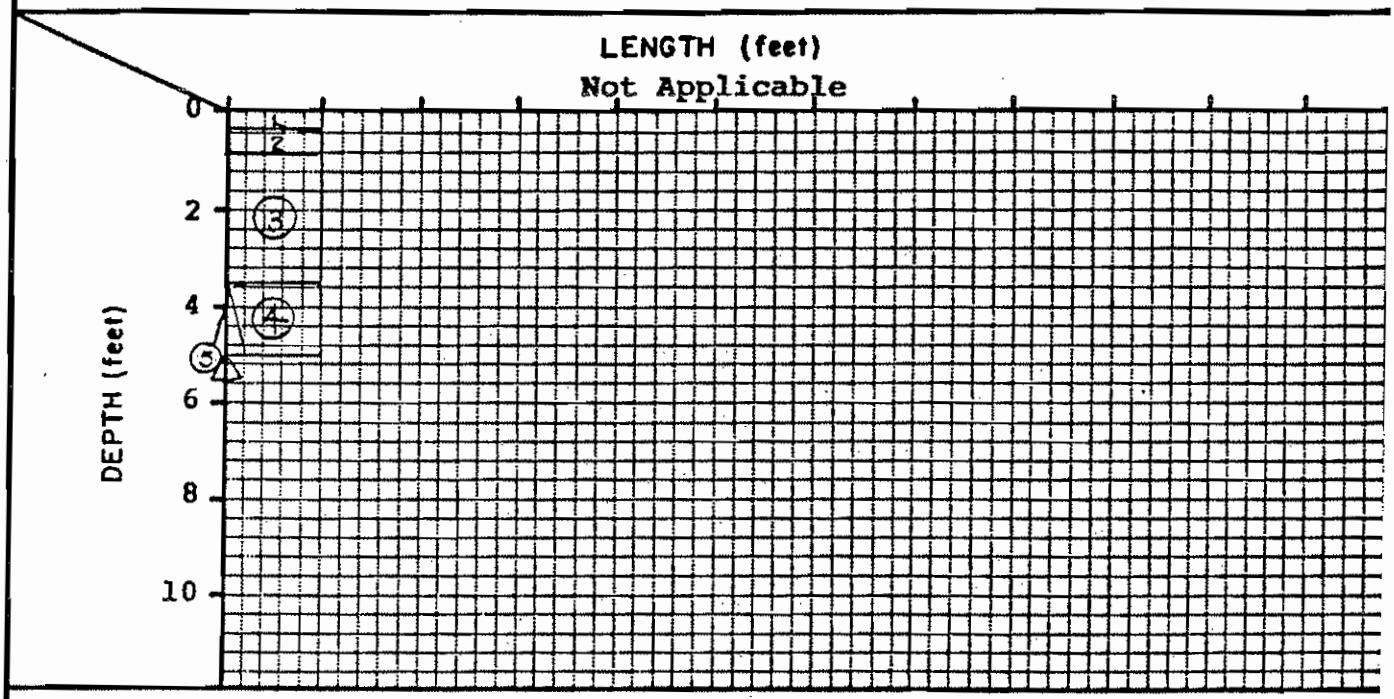
PAGE 1 OF 1

GRAPHIC REPRESENTATION OF EXCAVATION



ORIENTATION

DESCRIPTION OF UNITS

1) SILT (ML) - gray-brown; soft; topsoil; with organics.

2) SILTY SAND to SILT (SM-ML) - gray-brown; firm; trace of clay.

3) SILTY CLAY (CL) - orange-brown; firm to soft.

4) CLAYEY SAND (SC) - orange-brown to light gray; soft to firm.

5) SILTY SAND (SM) - orange-brown to gray; soft; fine grained; scattered clay galls.

LEGEND:

Bulk Sample

Jar Sample

LOG OF TEST PIT OR EXCAVATION

RMT INC.

PIT NUMBER TP-26

PROJECT NAME Weyerhaeuser

PROJECT NUMBER 467.38

LOCATION Plymouth, NC

DATE June 28, 1989

CONTRACTOR Hopkins

METHOD Backhoe

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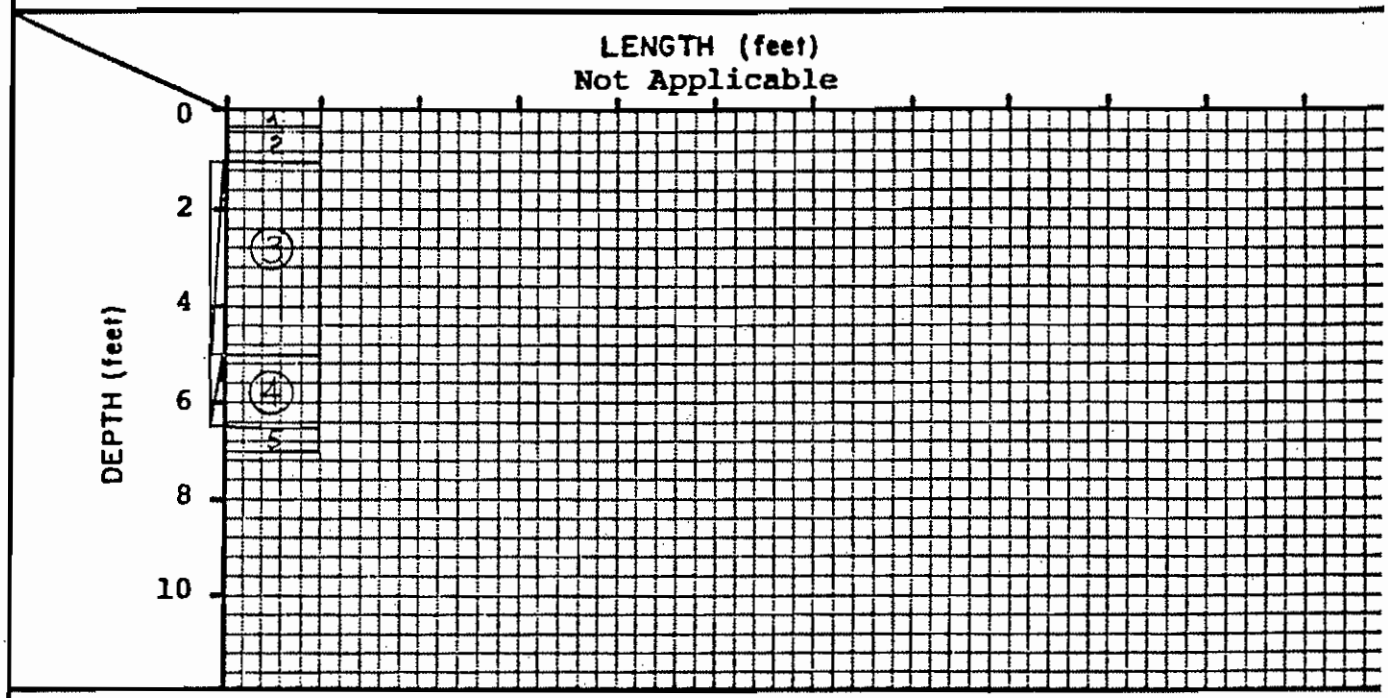
GRAPHIC REPRESENTATION OF EXCAVATION



ORIENTATION

DESCRIPTION OF UNITS

1) SILT (ML) - gray-brown; topsoil.

2) SILT (ML) - brown-gray to orange-brown; trace of clay.

3) SILTY CLAY (CL) -orange-brown; with few scattered, thin (1") SILTY SANDS (SM).

4) CLAYEY SAND (SC) - orange-brown; fine grained; with scattered clayey zones.

5) SILTY SAND (SM) - orange-brown; fine grained; trace of clay; scattered clay galls.

LEGEND:

Bulk Sample

Jar Sample

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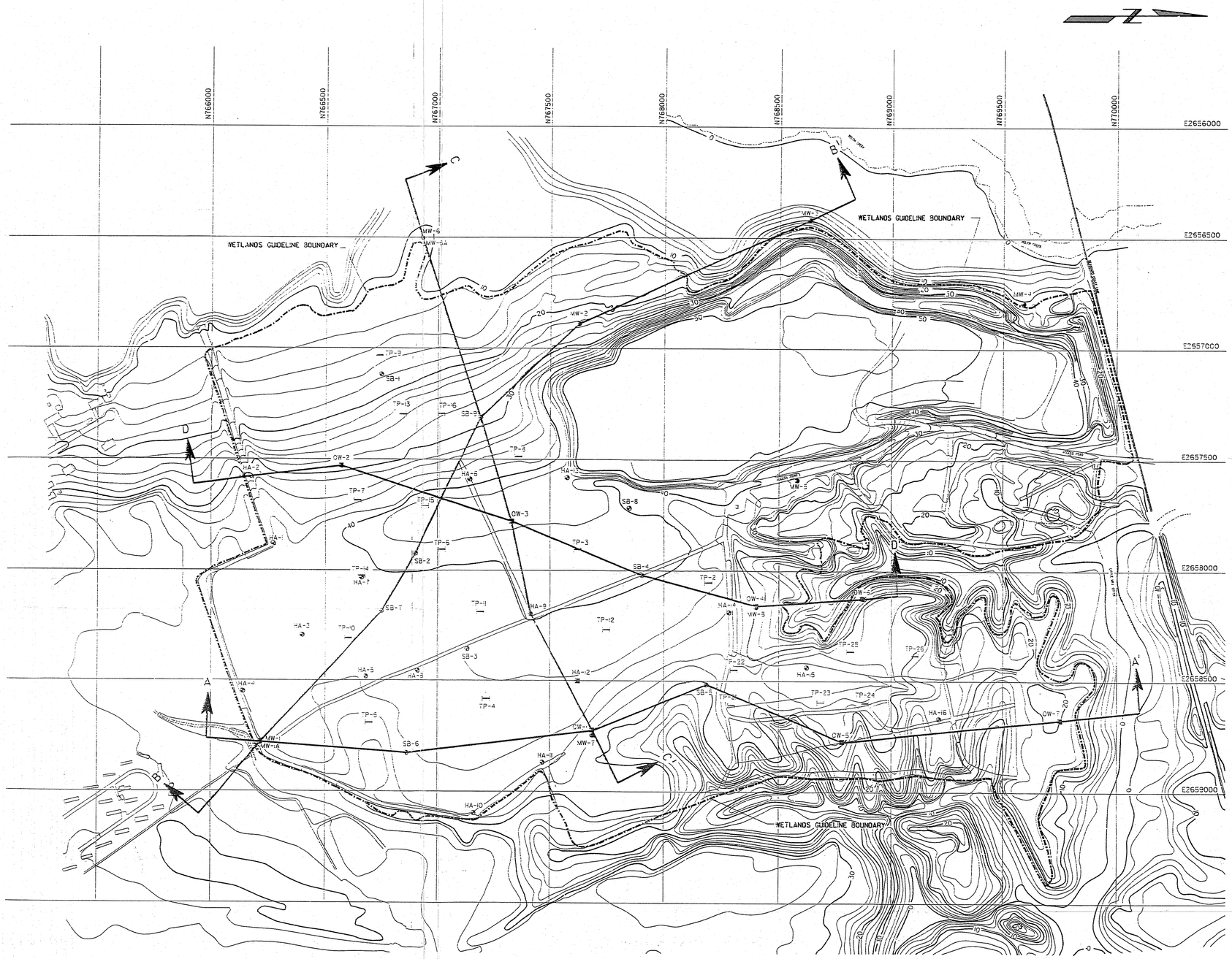


LEGEND

- SOIL BORINGS
- OBSERVATION WELLS
- MONITORING WELLS
- TEST PITS
- 20 — TOPOGRAPHIC CONTOURS. ELEVATION IN FEET ABOVE MEAN SEA LEVEL. CONTOUR INTERVAL IS 2 FEET.
- B B' — GEOLOGIC CROSS SECTION LINE

BASE MAP INFORMATION

ALL DATA POINT LOCATIONS PROVIDED BY DOWNEAST LAND SURVEYS.

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS FOR TWO FOOT CONTOUR INTERVAL MAPPING.

CONTOUR INTERVAL IS TWO FT.; BASED ON MEAN SEA LEVEL DATUM.

HORIZONTAL DATUM BASED ON NORTH CAROLINA STATE PLANE COORDINATE SYSTEM (NAD 27).

BASED ON A MAP PREPARED BY AERO-METRIC ENGINEERING PROJECT NO. 128720.NAD 27).

0 200' 400' 600'

GRAPHIC SCALE

PROJECT MGR:	M.S.T.
PREPARED BY:	D.A.B.
DRAWN BY:	M.P.K.
CHECKED BY:	B.T.G.
APPROVED BY:	DEMC
APPROVED BY:	WTG
APPROVED BY:	MMT
DATE:	JUNE, 1990
JOB NO:	467.42

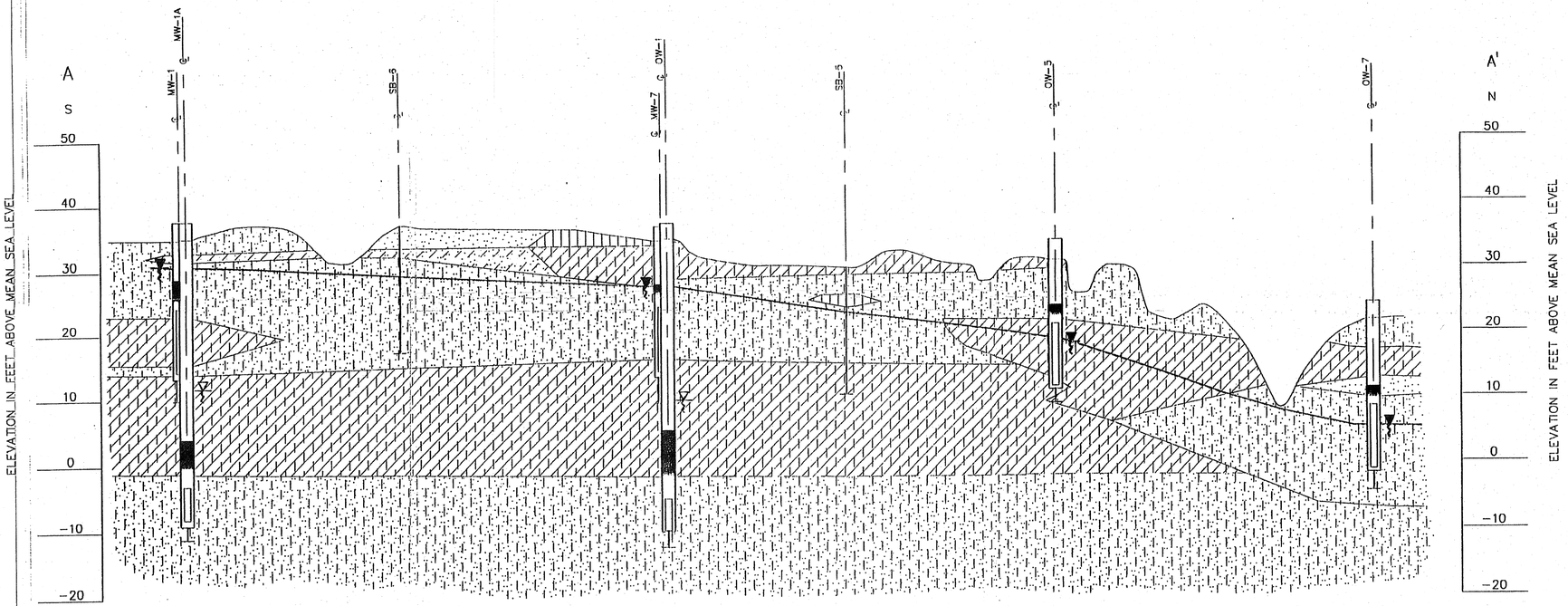
RMT INC.
100 Verdae Boulevard
PO Box 16778
Greenville, SC 29606
(803)281-0030

DATA POINT LOCATION MAP
WEYERHAEUSER PLYMOUTH, N.C.

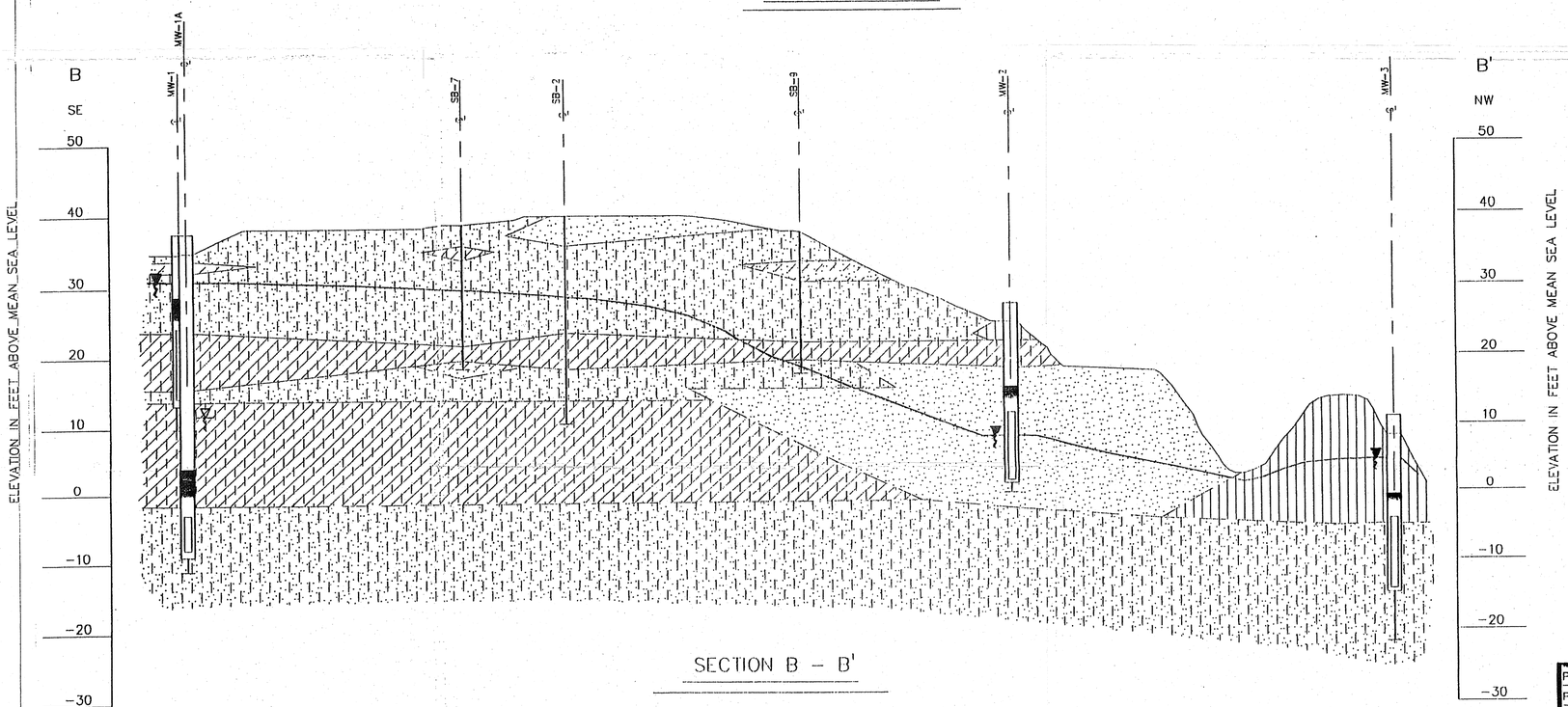
SCALE 1"= 200'

PLATE NO. 1

46742X01



SECTION A – A'



SECTION B – B'

LEGEND

- WELL SCREEN AND BENTONITE SEAL
- WATER TABLE SURFACE (JUNE, 1990)
- POTENTIOMETRIC SURFACE (JUNE, 1990)
- SILTY CLAY – SOFT TO STIFF; OCCASIONAL TRACE FINE TO MEDIUM GRAINED SAND. DEEP CLAYS ARE USUALLY MICACEOUS WITH SOME SAMPLES TESTED AS CLAYEY SILTS
- SILT – OFTEN CLAYEY; OCCASIONAL ORGANIC MATERIAL
- CLAYEY SAND – MOST FINE GRAINED; OFTEN SILTY
- SILTY SAND – MOST FINE GRAINED; OCCASIONAL CLAY WITH FRAGMENTED SHELL ZONES AND POORLY GRADED SAND ZONES
- POORLY GRADED SAND – USUALLY FINE GRAINED; OCCASIONAL THIN CLAYEY ZONES

HORIZONTAL SCALE: 1" = 200'
VERTICAL EXAGGERATION: 20X

PROJECT MGR:	M.S.T.
PREPARED BY:	B.T.G.
DRAWN BY:	M.P.K.
CHECKED BY:	B.T.G.
APPROVED BY:	DEMC
APPROVED BY:	W.T.G
APPROVED BY:	[illegible]
DATE:	JULY, 1990
JOB NO:	467.42

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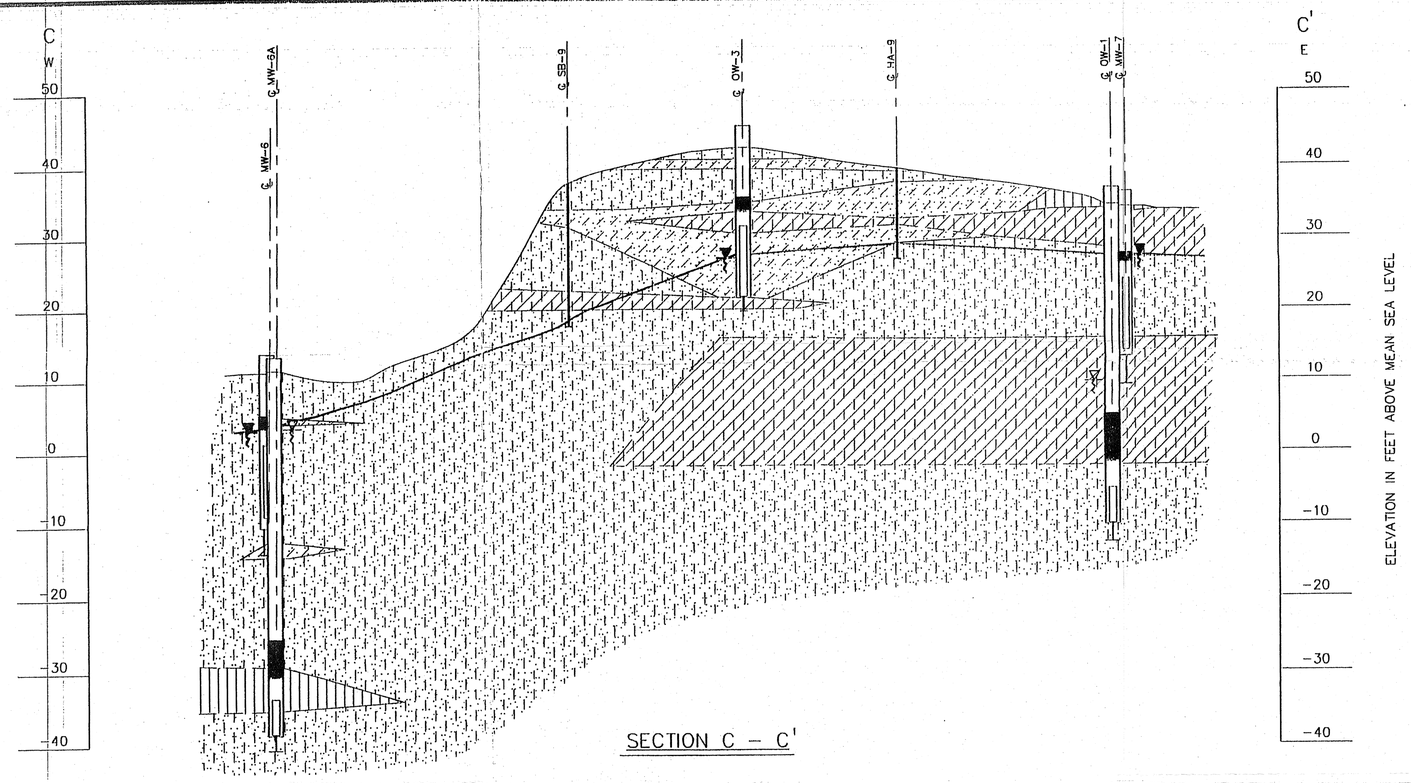
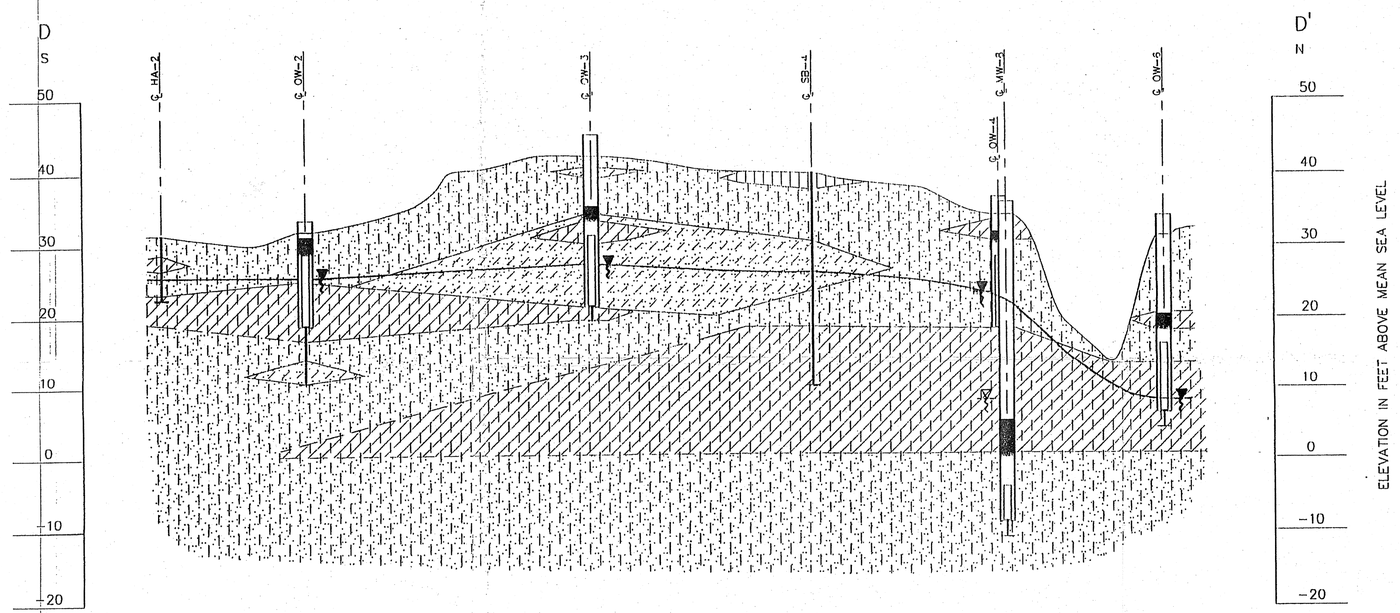
HYDROGEOLOGIC CROSS SECTIONS A-A' AND B-B'
WEYERHAEUSER PLYMOUTH, NC

SCALE	SHEET	PLATE NO.
AS SHOWN		2

46742X02



SECTION C – C'



SECTION D – D'

LEGEND

WELL SCREEN AND BENTONITE SEAL

WATER TABLE SURFACE (JUNE, 1990)

POTENTIOMETRIC SURFACE (JUNE, 1990)

SILTY CLAY – SOFT TO STIFF; OCCASIONAL TRACE FINE TO MEDIUM GRAINED SAND. DEEP CLAYS ARE USUALLY MICACEOUS WITH SOME SAMPLES TESTED AS CLAYEY SILTS

SILT – OFTEN CLAYEY; OCCASIONAL ORGANIC MATERIAL

CLAYEY SAND – MOST FINE GRAINED; OFTEN SILTY

SILTY SAND – MOST FINE GRAINED; OCCASIONAL CLAY WITH FRAGMENTED SHELL ZONES AND POORLY GRADED SAND ZONES

HORIZONTAL SCALE: 1" = 200'
VERTICAL EXAGGERATION: 20X

PROJECT MGR:	M.S.T.
PREPARED BY:	B.T.G.
DRAWN BY:	D.K.J.
CHECKED BY:	B.T.G.
APPROVED BY:	DEMC
APPROVED BY:	WJG
APPROVED BY:	MWH
DATE:	JULY, 1990
JOB NO:	467.42

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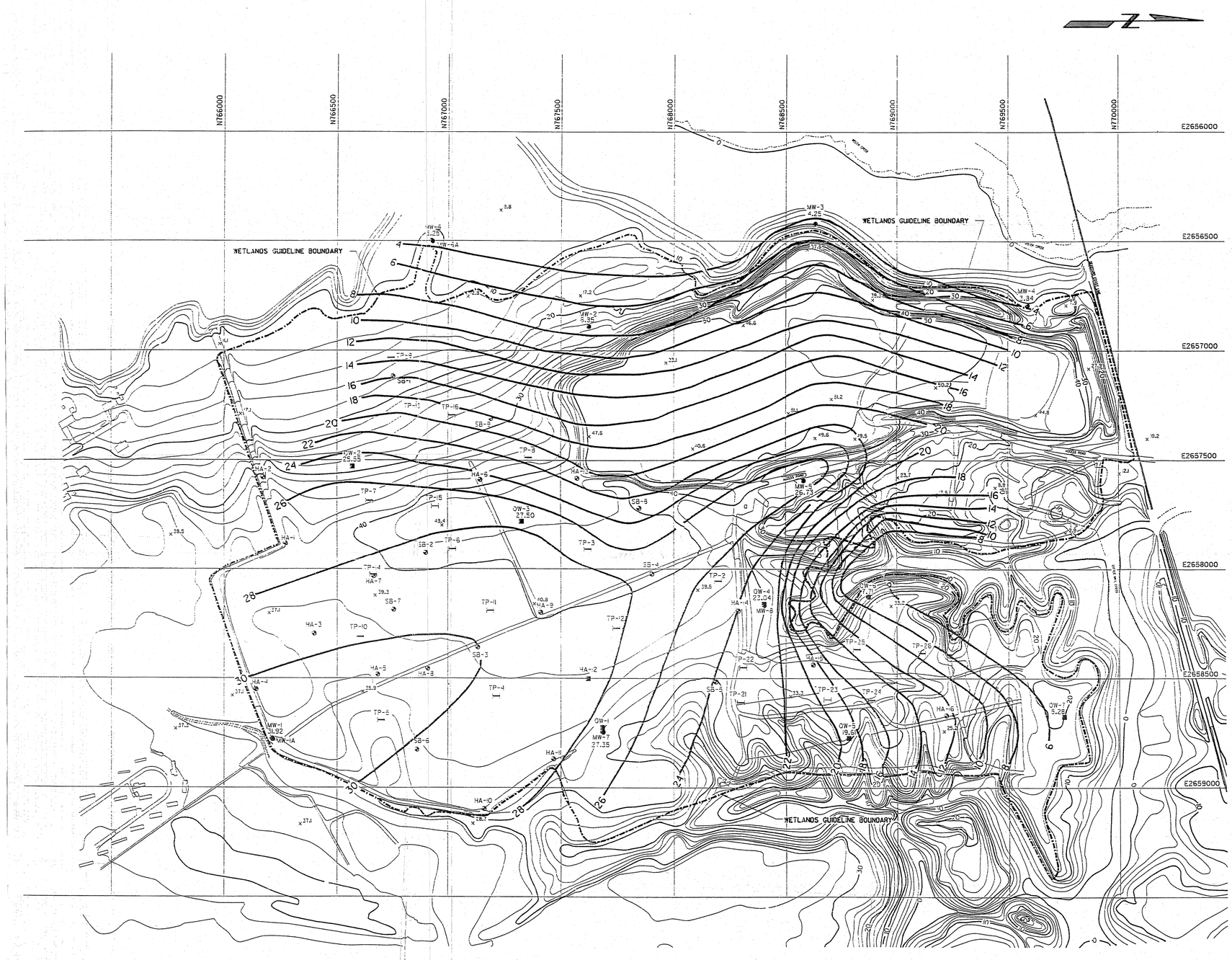
(803)281-0030

HYDROGEOLOGIC CROSS SECTIONS C–C' AND D–D'
WEYERHAEUSER PLYMOUTH, NC

SCALE	SHEET	PLATE NO.
AS SHOWN		3

E:\GRAPHIC\46742\46742004.WTB



LEGEND

- SOIL BORINGS
- OBSERVATION WELLS
- MONITORING WELLS
- TEST PITS
- 20 — TOPOGRAPHIC CONTOURS. ELEVATION IN FEET ABOVE MEAN SEA LEVEL. CONTOUR INTERVAL IS 2 FEET.
- 14 — WATER TABLE SURFACE IN FEET ABOVE MEAN SEA LEVEL. CONTOUR INTERVAL IS 2 FEET.

BASE MAP INFORMATION

ALL DATA POINT LOCATIONS PROVIDED BY DOWNEAST LAND SURVEYS.

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS FOR TWO FOOT CONTOUR INTERVAL MAPPING.

CONTOUR INTERVAL IS TWO FT.; BASED ON MEAN SEA LEVEL DATUM.

HORIZONTAL DATUM BASED ON NORTH CAROLINA STATE PLANE COORDINATE SYSTEM (NAD 27).

BASED ON A MAP PREPARED BY AERO-METRIC ENGINEERING PROJECT NO. 128720.NAD 27).

0 200' 400' 600'

GRAPHIC SCALE

PROJECT MGR:	M.S.T.
PREPARED BY:	D.A.B.
DRAWN BY:	M.P.K.
CHECKED BY:	B.T.G.
APPROVED BY:	DENE
APPROVED BY:	WFG
APPROVED BY:	
DATE:	JUNE, 1990

RMT INC.
100 Verdae Boulevard
PO Box 16778
Greenville, SC 29606
(803)281-0030

WATER TABLE CONFIGURATION
JUNE, 1990
WEYERHAEUSER PLYMOUTH, NC

SCALE 1" = 200'

PLATE NO. 4

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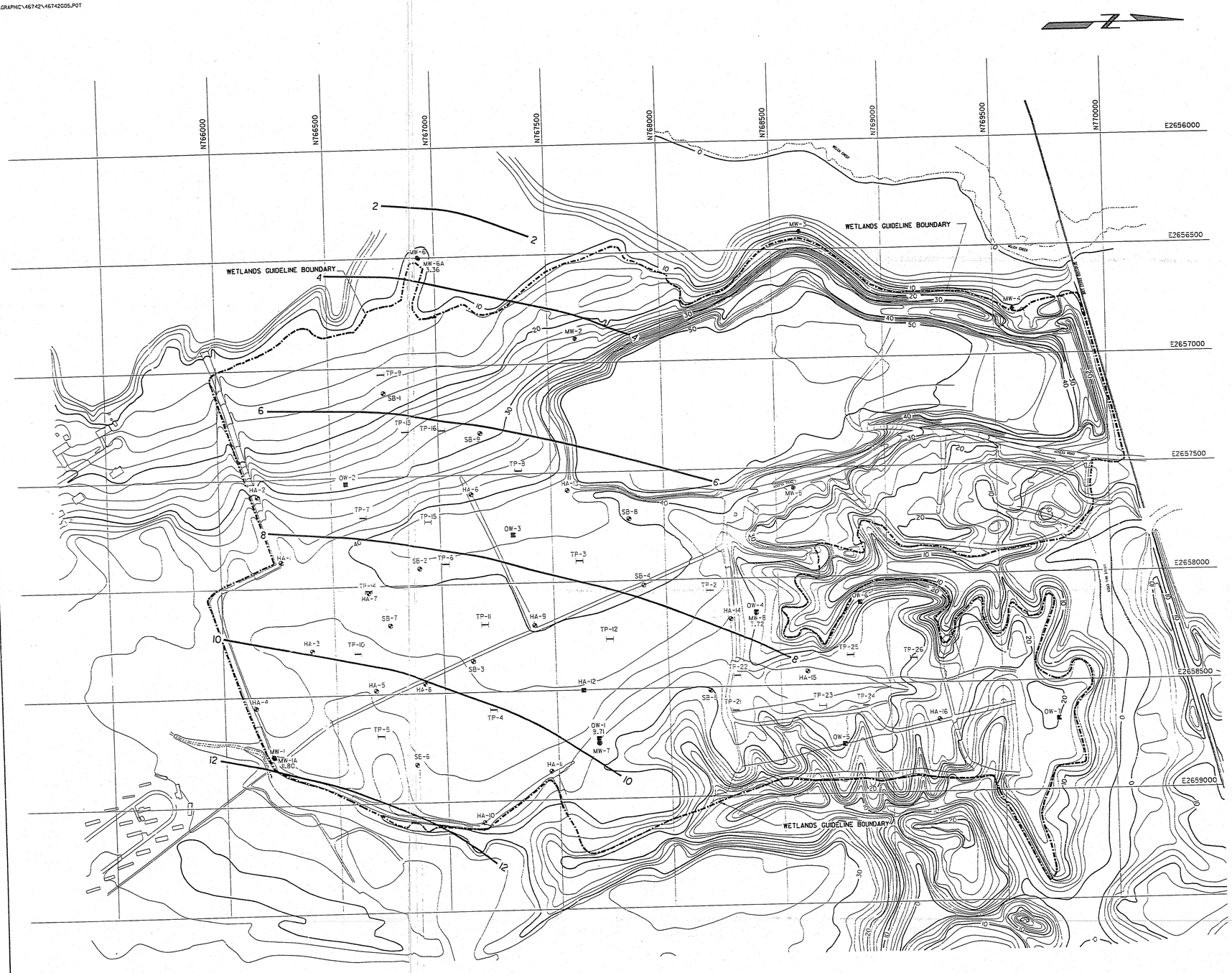

LEGEND

- SOIL BORINGS
- OBSERVATION WELLS
- MONITORING WELLS
- TEST PITS
- —20— TOPOGRAPHIC CONTOURS. ELEVATION IN FEET ABOVE MEAN SEA LEVEL. CONTOUR INTERVAL IS 2 FEET.
- —12— POTENTIOMETRIC SURFACE ELEVATION IN FEET ABOVE MEAN SEA LEVEL. CONTOUR INTERVAL IS 2 FEET.

BASE MAP INFORMATION

ALL DATA POINT LOCATIONS PROVIDED BY DOWNEAST LAND SURVEYS.

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS FOR TWO FOOT CONTOUR INTERVAL MAPPING.

CONTOUR INTERVAL IS TWO FT.; BASED ON MEAN SEA LEVEL DATUM.

HORIZONTAL DATUM BASED ON NORTH CAROLINA STATE PLANE COORDINATE SYSTEM (NAD 27).

BASED ON A MAP PREPARED BY AERO-METRIC ENGINEERING PROJECT NO. 128720.NAD 27).

0 200' 400' 600'

GRAPHIC SCALE

PROJECT MGR:	M.S.T.
PREPARED BY:	D.A.B.
DRAWN BY:	M.P.K.
CHECKED BY:	BTG
APPROVED BY:	DEMc
APPROVED BY:	WJG
APPROVED BY:	MMT
DATE:	JUNE, 1990
JOB NO:	467.42

RMT INC.

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PO Box 16778
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POTENTIOMETRIC SURFACE
JUNE, 1990
WEYERHAEUSER PLYMOUTH, N.C.

SCALE 1"= 200'

PLATE NO. 5

Appendix C
Subgrade Settlement Calculations

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SHEET 1 OF 3

PROJECT/PROPOSAL NAME/LOCATION: DOMTAR PLYMOUTH		PROJECT/PROPOSAL NO.
SUBJECT: ELASTIC SETTLEMENT CALCULATIONS DOMTAR		
PREPARED BY: JLH	DATE: 21 JAN 2008	FINAL ☐
CHECKED BY: RKN	DATE: 1/23/08	REVISION ☐

SCHMERTMAN & HARTMAN (1978)

$$S_E = C_1 C_2 (\bar{q} - q) \sum_0^{2B} \left[\frac{\bar{I}_z}{E_s} \cdot \Delta z \right]$$

$q = d\gamma = 0 \cdot \gamma = 0$ ✓

$C_1 = 1 + 0.5 (q / \bar{q} - q) = 1 + 0.5 (0/\bar{q} - 0) = 1$

$C_2 = 1 + 0.2 \log (t/0.1) = 1.6$ for $t = 100$ yrs ✓

$\bar{q} = h_w \gamma_w = 95' \cdot (70 pcf) = 6650 psf$ ✓

$\bar{I}_z = \frac{0.10 + 0.26}{2} = \underline{0.18}$

$S_E = (1)(1.6)(\bar{q} - 0)(0.18)(12''/ft)\left(\sum \frac{\Delta z}{E_s}\right)$

$S_E = (3.456)(\bar{q})\left[\sum \frac{\Delta z}{E_s}\right]$

Δz = thickness of soil stratum

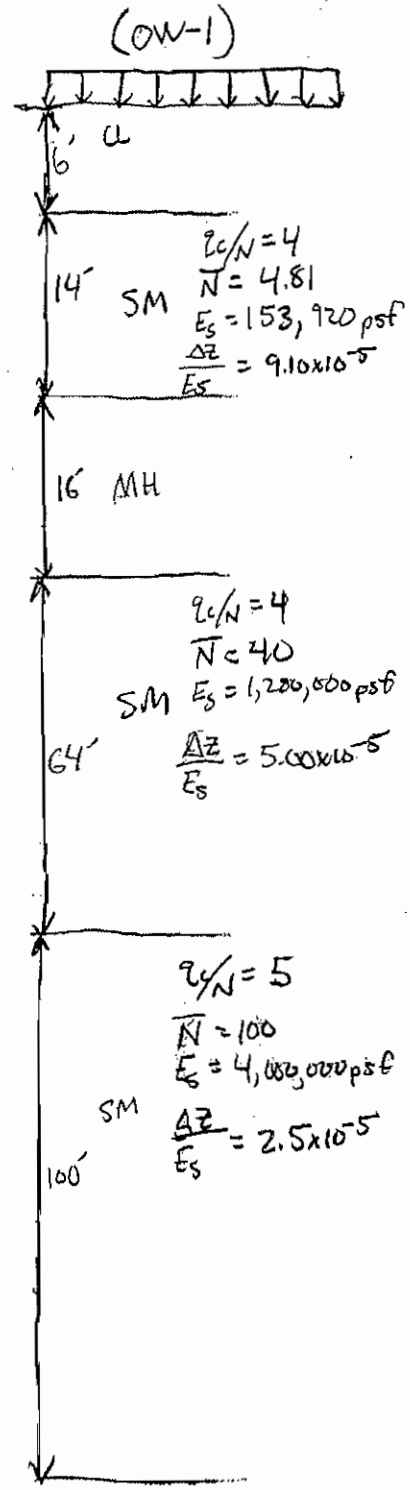
E_s = Young's Modulus

$E_s = 4 (qc/N) \bar{N} (2000 lbs/ton)$

$\bar{q} = (h\gamma)_{waste}$

$S_E = (3.456)(6650 psf)(1.66 \times 10^{-4})$

$S_E = \underline{\underline{3.81 \text{ inches}}}$



31

Table 13.4 Approximate Relationship between Cone Penetration Resistance (q_c) and Standard Penetration Number (N)

Soil type	q_c/N	
	q_c = kN/m²	q_c = ton/ft²
Fine sand and silt	150–350	1.5–3.5
Fine to medium sand	350–500	3.5–5.0
Coarse sand	500–750	5.0–7.5
Gravel	750–1500	7.5–15.0

form (Figure 13.16) to obtain the shear strength parameters (that is, cohesion c and angle of friction ϕ) of the soil. The shear strength parameters obtained in this manner are likely to represent those of a consolidated drained test (Chapter 8).

13.7 Rock Coring

It may be necessary to core rock if bedrock is encountered at a certain depth during drilling. It is always desirable that coring be done for at least 10 ft (≈3 m). If the bedrock is weathered or irregular, the coring may need to be extended to a greater depth. For coring, a core barrel is attached to the drilling rod. A coring bit is attached to the bottom of the core barrel. The cutting element in the bit may be diamond, tungsten, or carbide. The coring is advanced by rotary drilling. Water is circulated through the drilling rod during coring and the cuttings are washed out. Figure 13.17 shows a diagram of rock coring by the use of a single-tube core barrel. Rock cores obtained by single-tube core barrels can be fractured due to torsion. To avoid this problem, double-tube core barrels can be used. Table 13.5 gives the details of various types of casings and core barrels, diameters of core barrel bits, and the diameters of core samples obtained. The core samples smaller than the BX size tend to break away during coring.

Based on the length of rock core obtained from each run, the following quantities can be obtained for evaluation of the quantity of rock.

$$\text{a. recovery ratio} = \frac{\text{length of rock core recovered}}{\text{length of coring}} \tag{13.18}$$

$$\text{b. rock quality designation } (RQD) = \frac{\Sigma \text{ length of rock pieces recovered having lengths of 4 in. (101.6 mm) or more}}{\text{length of coring}} \tag{13.19}$$

When the recovery ratio is equal to one, it indicates intact rock. However, highly fractured rocks give a recovery ratio of 0.5 or less. Deere (1953) has

4/

Table 1
Estimation of Compressibility Index
from Su/Po' (4)

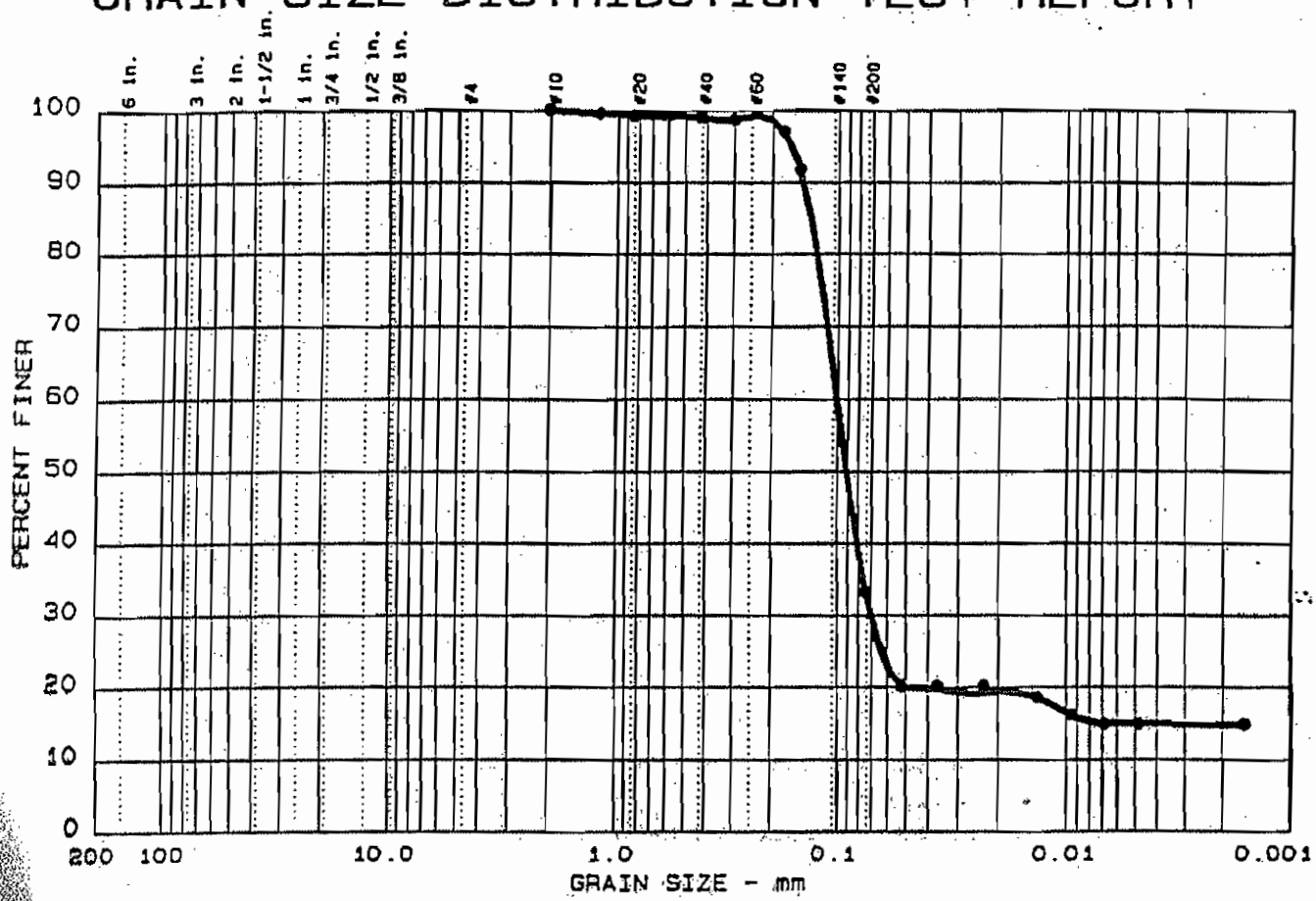
Su/Po'	Approx. OCR	Cc/1+eo (Schmert. 1978)	Cc/1+eo (SETTLE)
0 - 0.1	less than 1	greater than 0.4 (still consolidating)	0.7
0.1 - 0.25	1	0.4	0.4
0.26 - 0.50	1 to 1.5 (assume 1)	0.3	0.3
0.51 - 1.0	3	0.15	0.15
1 - 4	6	0.10	0.10
Over 4	greater than 6	0.05	0.05

Table 2
qc/N Conversion Factors (1)

	Soil Behavior Type	qc/N (tsf)
	sensitive fine grained	2
	organic material	1
CL/CH	clay	1
(CL-ML) to (CL)	silty clay to clay	1.5
(ML-CL) to (ML-CH)	clayey silt to silty clay	2
(ML) to (ML-CH)	sandy silt to clayey silt	2.5
(SM) to (ML)	silty sand to sandy silt	3
(SP) to (SM)	sand to silty sand	4
(SP)	sand	5
(GW) to (SW)	gravelly sand to sand	6
	very stiff fine grained *	1
	sand to clayey sand *	2

* overconsolidated or cemented

GRAIN SIZE DISTRIBUTION TEST REPORT



Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
13	0.0	0.0	66.9	18.2	14.9

LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
		0.13	0.10	0.09	0.070	0.0070			

MATERIAL DESCRIPTION	USCS	AASHTO

Project No.: 457.42
Project: WEYERHAEUSER
Location: DW-1 8-10'

Date: 6-1-90

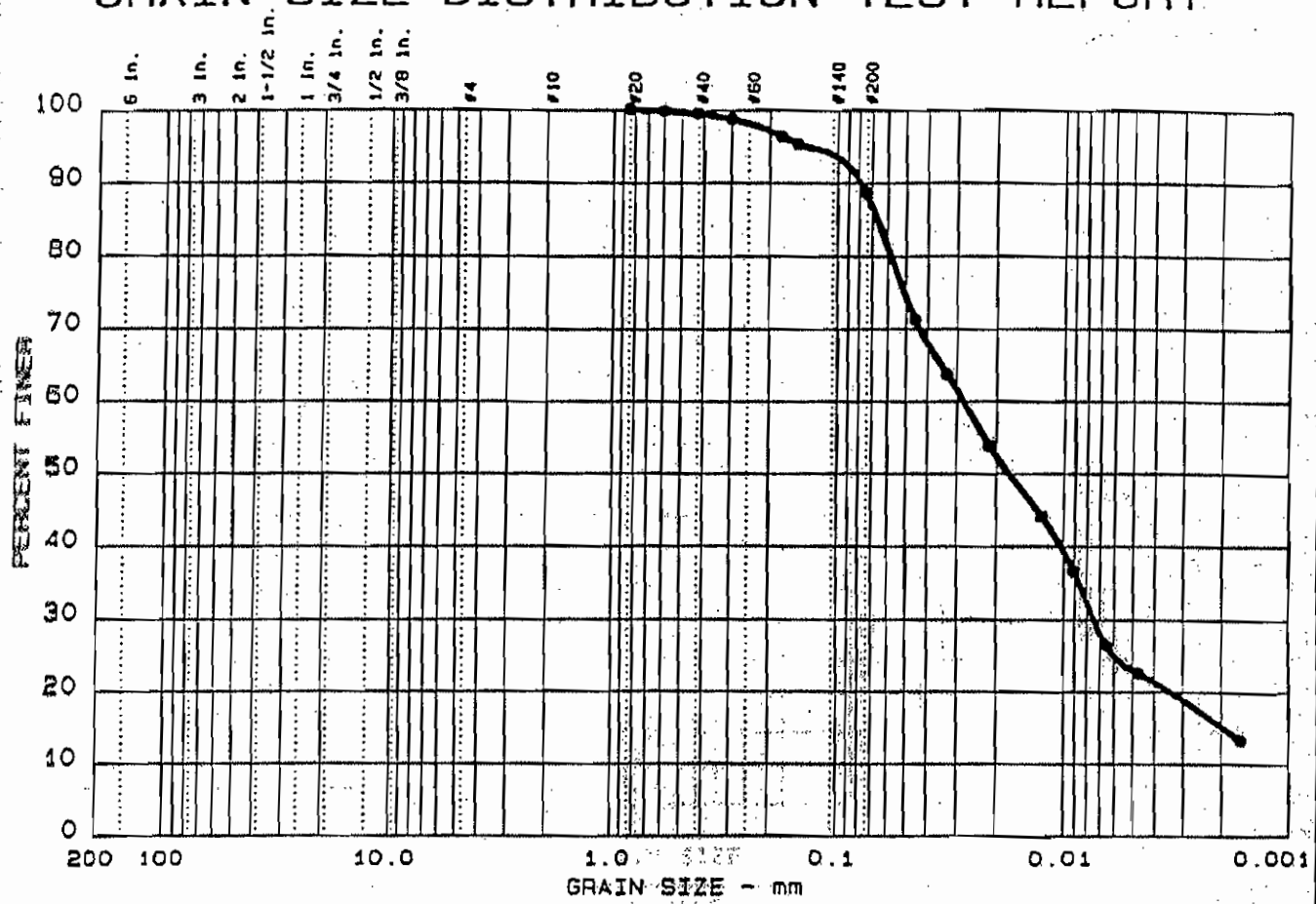
GRAIN SIZE DISTRIBUTION TEST REPORT

RMT, INC.

Remarks:

Figure No. _____

GRAIN SIZE DISTRIBUTION TEST REPORT



Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
* 1B	0.0	0.0	11.3	65.6	23.1

LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
*				0.02	0.007	0.0019			

MATERIAL DESCRIPTION	USCS	AASHTO
*		

Project No.: 467.42
Project: WEYERHAEUSER
* Location: OW-1 20-22'

Date: 6-6-90

Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT

RMT. INC.

Figure No. _____

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SHEET 2 OF 3

PROJECT/PROPOSAL NAME/LOCATION: DOMTAR PLYMOUTH		PROJECT/PROPOSAL NO.
SUBJECT: CONSOLIDATION SETTLEMENT CALCS		
PREPARED BY: JLH	DATE: 21 JAN 2008	FINAL ☐
CHECKED BY: RKN	DATE: 1/23/08	REVISION ☐

$\Delta\sigma' = h_w\gamma_w = (95)(70) = 6650\,psf\left(\frac{1\,ton}{2000\,lbs}\right) = 3.33\,tsf$

FROM OW-1 CONSOLIDATION TEST GRAPH:

$\sigma_c' = 1.2\,tsf$

$e_o = 1.29$

slope $\frac{e_a - e_b}{\log\sigma_b' - \log\sigma_a'} \Rightarrow (\sigma_b' = 10\sigma_a') \Rightarrow$ slope $= e_a - e_b$

$C_c = 1.21 - 0.79$ $\quad C_r = 0.74 - 0.58$

$C_c = 0.42$ $\quad C_r = 0.16$

FOR CL LAYER:

$\sigma_o' = \gamma z = (75.9)(3)\left(\frac{1\,ton}{2000\,lbs}\right) = 0.11\,tsf$

$\sigma_o' << \Delta\sigma'$

$0.11 << 3.33 \therefore$ O.C.

$\Delta H = \frac{HC_r}{1+e_o}\log\left(\frac{\sigma_o' - \Delta\sigma'}{\sigma_o}\right)$

$= \frac{3(0.16)}{1+1.29}\log\left(\frac{0.11+3.33}{0.11}\right)$

$= (0.21)(1.50)$

$= 0.31\,ft$

$\Delta H = 3.77$ inches ✓

FOR MH LAYER:

$\sigma_o' = \gamma z = (75.9)(8)\left(\frac{1\,ton}{2000\,lbs}\right)$

$\sigma_o' = 0.30\,tsf$

$\sigma_o' << \Delta\sigma'$

$0.30\,tsf << 3.33\,tsf \therefore$ O.C.

$\Delta H = \frac{HC_r}{1+e_o}\log\left(\frac{\sigma_o' - \Delta\sigma'}{\sigma_o}\right)$

$\Delta H = \frac{8(0.16)}{1+1.29}\log\left(\frac{0.30+3.33}{0.30}\right)$

$\Delta H = (0.56)(1.08)$

$= 0.61\,ft$

$\Delta H = 7.26$ inches ✓

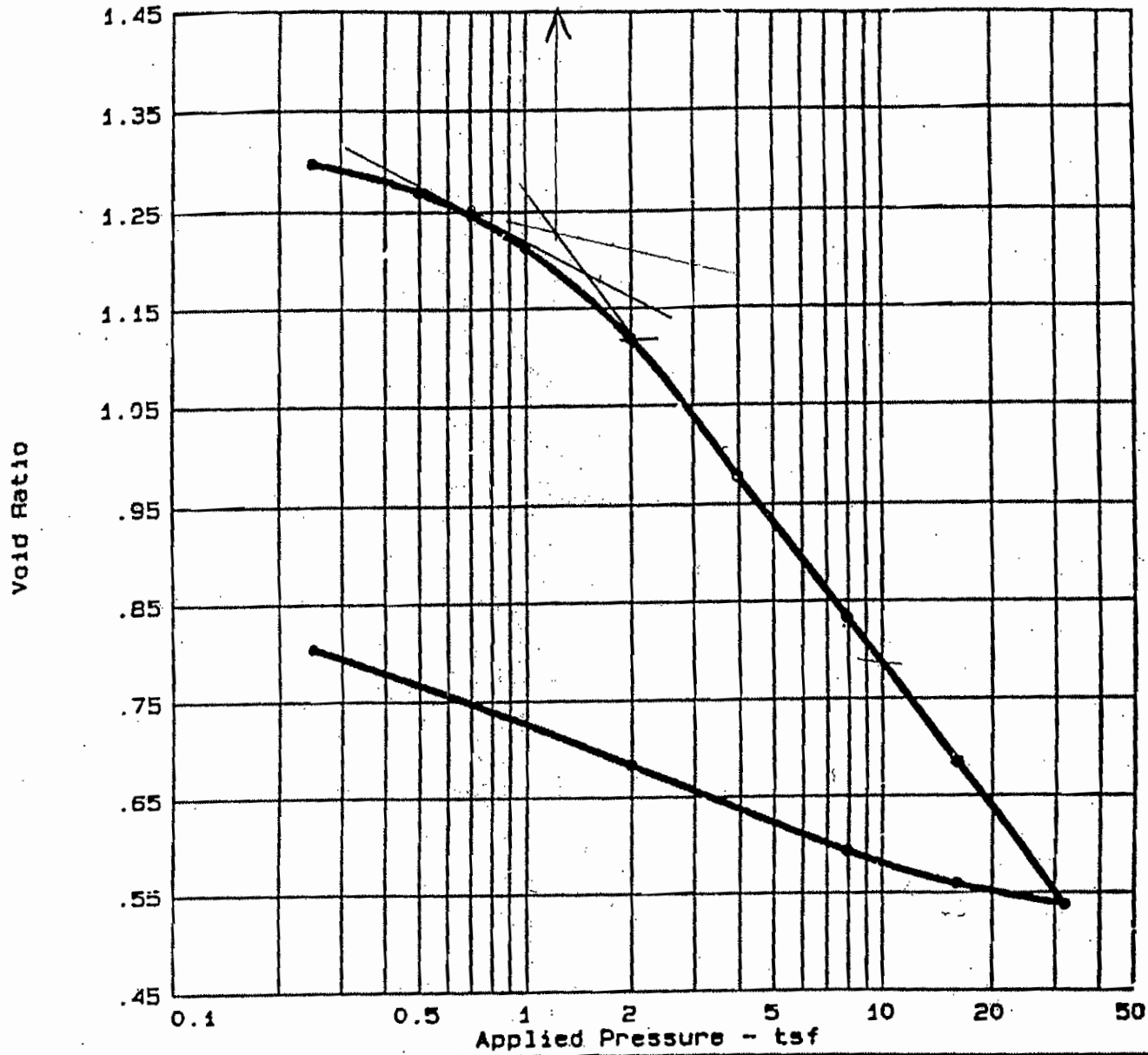
TOTAL CONSOLIDATION SETTLEMENT:

$\Delta H_{CL} + \Delta H_{MH} = 3.77 + 7.26$

$\Delta H_{TOTAL} = 11.03$ inches ✓

$P_c' \approx 1.2$ tsf ≈ 2400 psf ✓ JPN 6-27-90

CONSOLIDATION TEST REPORT



Swell press.	Nat. Sat.	Nat. Moist.	Dry Density	LL	PI	Sp.Gr.	Initial void ratio
	98.6 %	46.0	75.9			2.81	1.3119

TEST RESULTS	MATERIAL DESCRIPTION
	BLUE GRAY SILTY CLAY

Project No.: 467.42
Project: WEYERHAEUSER
Location: DW-1, 20-22.0'

Date: 6-04-90

Remarks:
Initial Dial Reading =
= 1.03590

CONSOLIDATION TEST REPORT

AMT, INC.

Fig. No.

DESIGN SHEET

RMT

SHEET ____ OF ____

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

PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER PLYMOUTH	SJK	6/15/99	BKN	6/16/99	05101.01

ESTIMATE MAXIMUM STRAIN OF LINER DUE TO DIFFERENTIAL SETTLEMENT. THE HYDROGEOLOGICAL AND GEOTECHNICAL SITE CHARACTERIZATION FOR A PROPOSED LANDFILL, INDICATES THE THICK UNIFORM DEEP CLAY AQUITARD LATERALLY TERMINATES ABRUPTLY AS AN EROSIONAL UNCONFORMITY (RESEMBLING A SCARP), RATHER THAN AS A DEPOSITIONAL PINCHOUT (TO THE WEST). BASED ON OUR UNDERSTANDING OF THE SITE GEOLOGY, WE EXPECT THE SLOPE OF THE SCARP TO RANGE FROM 2 HORIZONTAL: 1 VERTICAL TO 4H:1V. THEREFORE WE SELECTED USING A 1.5H:1V SLOPE TO BE VERY CONSERVATIVE

- → USE SECTION DD, TOTAL $\Delta S = 41.2$ IN
- → ASSUME SLOPE OF CLAY SCARP (1.5H:1V)
- → THICKNESS OF BOTTOM CLAY STRATUM = 15 FT.
- → ESTIMATE SETTLEMENT 23 FEET WEST OF SECTION DD, ASSUME $q = 12{,}600$ & 15 FT OF BOTTOM CLAY STRATUM IS REPLACED BY 15 FT OF SAND (SM) WITH $E_s = 1{,}344{,}000$

$$S_e = 3.456\,(12{,}600)\left[(1.67\times10^{-4}) + (1.12\times10^{-5})\right]$$

$$S_e = 7.8 \text{ INCHES}$$

$$S_c = S_{c\,upper} + S_{c\,lower} = 11.5'' + 0 = 11.5''$$

$$S_{TOTAL\,(23'\,WEST\,OF\,DD)} = S_c + S_e = 11.5'' + 7.8'' = 19.3''$$

$$S_{TOTAL\,(DD)} = 41.2''$$

$$\epsilon = \Delta S_{TOTAL}/23\,ft = \left(\frac{41.2'' - 19.3''}{23\,ft}\right)\left(\frac{1\,ft}{12\,in}\right)\cdot 100\%$$

$(\epsilon \approx 8\%)$

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PROJECT/PROPOSAL NAME/LOCATION: DOMTAR PLYMOUTH		PROJECT/PROPOSAL NO.
SUBJECT: TOTAL SETTLEMENT		
PREPARED BY: JLH	DATE:	FINAL ☐
CHECKED BY: RKN	DATE: 1/23/07	REVISION ☐

$S_E + \Delta H$ = TOTAL SETTLEMENT

3.81 in + 11.03 in = **14.84 inches = TOTAL SETTLEMENT**

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. OW-1
SHEET NO. 2 OF 3
PROJECT NO. 467.42
INSTALLATION
SURFACE ELEV. 34.5
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 NO.	TYPE	RECOVERY BLOWS		MOISTURE	DEPTH	
9	UD		100			green, tan.
						SILT (MH) - as determined from laboratory analysis.
					25	
10	SS	33-5-6-6	85			Change to 5 7/8 in. bit at 21.5 ft.
11	SS	3-3-4-6	100		30	
12	SS	4-4-4-5	100			
						SILTY CLAY (CL) - as above; with trace fine grained sand.
13	SS	3-4-4-6	100		35	
						SILTY SAND (SM) - fine grained; gray. 37.3
14	SS	23-43-47-54	50			SILTY SAND (SM) - fine to medium grained; trace coarse grained sand; laminated; tan; trace shell fragments.
					40	

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. OW-1
SHEET NO. 3 OF 3
PROJECT NO. 467.42
INSTALLATION
SURFACE ELEV. 34.5
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	
15	SS	28-32-41-52	65		45	
						BORING TERMINATED AT 47.0 FEET
					50	
					55	
					60	
					65	

Appendix D
Waste Characterization and Analysis

Attachment D1	**Waste Characterization and Analysis Report**
Attachment D2	**ASB Wastewater solids TCLP Report**
Attachment D3	**Technical Memorandum Dated June 16, 1999, from Sharon Korleski**
Attachment D4	**Letter Dated September 2, 1998, From Kiber Environmental Services, Inc.**

Attachment D1
Waste Characterization and Analysis Report

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WASTE CHARACTERIZATION AND ANALYSIS

Plymouth Mill
Weyerhaeuser Paper Company
Plymouth, N.C.

Issued: July 1990
Revised: December 1990

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TABLE OF CONTENTS

Section **Page**

EXECUTIVE SUMMARY i

1. INTRODUCTION 1
   1.1 Background 1
   1.2 Purpose 1
   1.3 Scope 1

2. FINDINGS AND CONCLUSIONS 3
   2.1 Chemical Testing 3
   2.2 Physical Testing 4
   2.3 Testing Summary 6

3. RECOMMENDATIONS 7

4. WASTE CLASSIFICATION 8
   4.1 Production Processes 8
   4.2 Quantification 10
   4.3 Percentage of Waste Components in Composite Samples 10

5. SAMPLING AND ANALYSIS PROCEDURES 14
   5.1 General Description 14
   5.2 Sample Descriptions and Sampling Methods 14
   5.3 Sample Analysis 15

6. ANALYTICAL RESULTS 17
   6.1 Chemical Analytical Results 17
   6.2 Implications of Leach Test Data for Landfill Design 21
   6.3 Physical Test Results 22
   6.4 Implications of Physical Test Data for Landfill Design 26

List of Tables

Table 1 Wastes Generated in 1989 11
Table 2 Waste Components of Composite Sample #1 13
Table 3 Paper Waste Component of Composite Sample #2 13
Table 4 Waste Components of Composite Sample #3 13
Table 5 TCLP Analysis 18
Table 6 Volatile Organics Analysis 19
Table 7 ASTM Analysis 20
Table 8 Summary of Physical Test Results 23

TABLE OF CONTENTS (continued)

Section **Page**

List of Figures

Figure 1 Location Map 2
Figure 2 Waste Sources 9

List of Appendicea

Appendix A Chemical Analytical Results
Appendix B Physical Testing Results

EXECUTIVE SUMMARY

Background data have been collected for the purpose of designing a new landfill to replace the existing facility in three to five years. Chemical and physical properties of waste samples were evaluated.

Chemical Testing

Various wastes were subjected to acid and water leaching to determine whether hazardous constituents might be released from the landfill to the environment. In the acid leaching tests, nearly all of the wastes tested exceeded one of the United States Environmental Protection Agency (US EPA) primary or secondary drinking water standards. However, none of the variances were greater than the "ten times" action level typically used by the North Carolina Department of Environment, Health and Natural Resources. Only selenium exceeded the primary standard among the water leach samples.

The wastes to be disposed in the landfill are nonhazardous. The level of environmental barrier needed for the new landfill, such as a liner or leachate collection system, can be evaluated on the basis of the data collected.

Physical Testing

Index properties, shear strengths, and consolidation properties were determined for ash and dewatered sludge which are the major wastes that will be disposed of in the landfill. Test results indicate that an ash landfill can be constructed with relatively steep slopes. The addition of dewatered sludge only slightly reduces the strength of the material. Consolidation of the waste due to loading will result in the release of pore water, or leachate. Methods for handling this leachate will be addressed in the landfill design.

Section 1

INTRODUCTION

1.1 Background

The Weyerhaeuser Paper Company (Weyerhaeuser) facility in Plymouth, North Carolina, consists of an integrated kraft process pulp and paper mill and a wood products plant. The solid waste generated by the Plymouth mill is currently disposed of in a state permitted solid waste landfill. Both the manufacturing facility and the existing landfill are shown in Figure 1.

1.2 Purpose

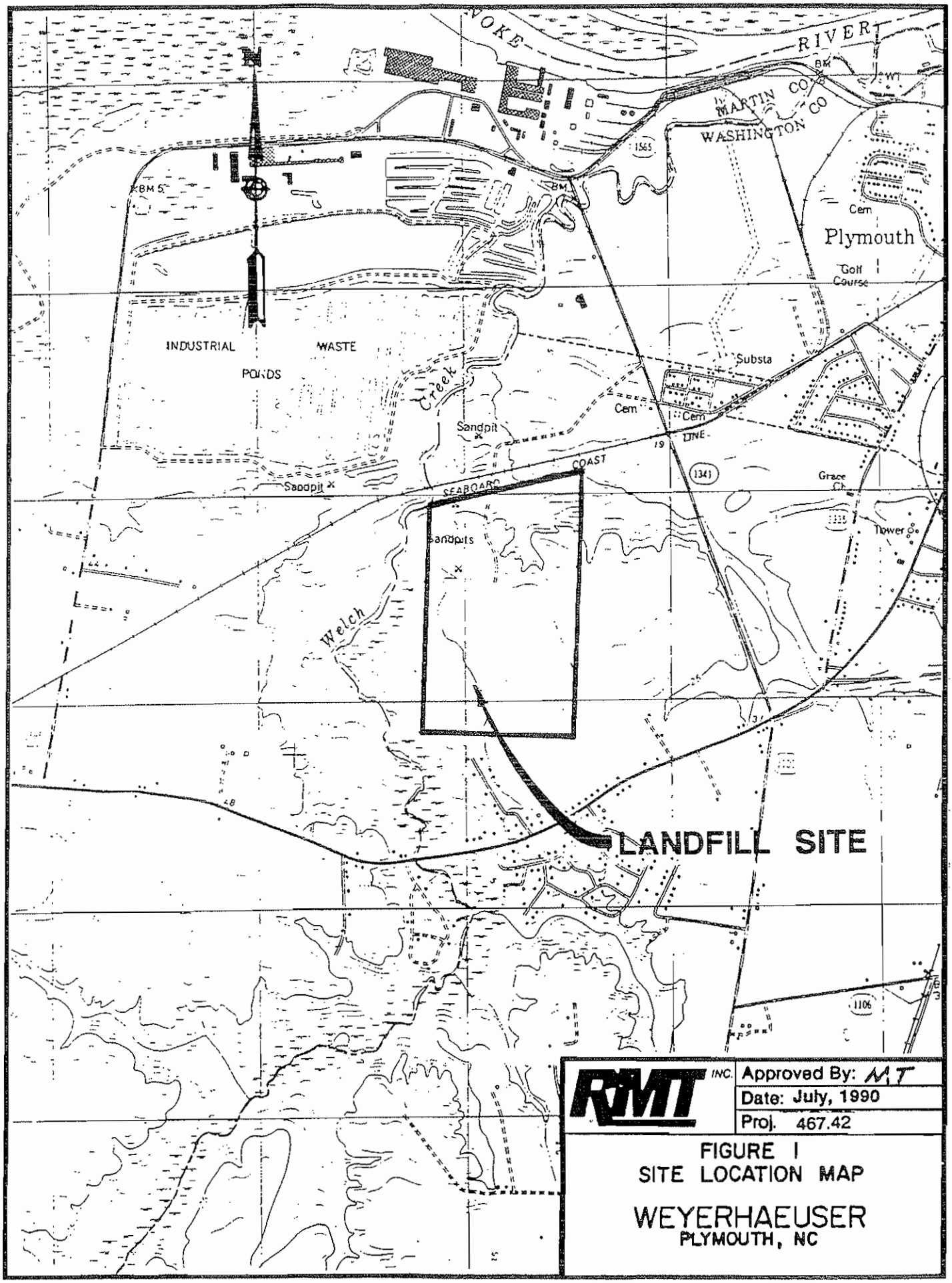
The existing landfill was recently repermitted with a vertical expansion that provides three to five years of capacity. To meet long-term solid waste disposal needs, Weyerhaeuser is in the process of developing and implementing plans for a new landfill. The sampling program described in this report was designed to accomplish the following:

- Document the types and volumes of wastes that are generated at the facility,
- Investigate leaching characteristics of the wastes to facilitate engineering design of the landfill and to help predict leachate characteristics, and
- Obtain information on the physical and engineering properties of wastes to evaluate landfill operation, to determine constructive use of wastes as liner, berm, or cover material, and identify needs for waste segregation or blending.

1.3 Scope

The following Scope of Services was implemented by RMT to meet the objectives of this project.

- Review existing Weyerhaeuser information on raw materials, process flow, materials handling, waste generation, and waste quantities and characteristics.
- Update the Materials Flow Diagram that RMT prepared for inclusion in the Landfill Vertical Expansion permit.
- Develop a sampling and analysis program for physical and chemical characterization of plant wastes.
- Prepare a Waste Characterization and Analysis Report summarizing the results of this work.


ROANOKE RIVER
MARTIN CO
WASHINGTON CO
Plymouth
Golf Course
Cem
INDUSTRIAL WASTE PONDS
Creek
Sandpit
Substa
Cem
LINE
COAST
SEABOARD
Grace Ch
Tower
Sandpits
Welch
LANDFILL SITE
RMT INC.
Approved By: M.T
Date: July, 1990
Proj. 467.42
FIGURE I
SITE LOCATION MAP
WEYERHAEUSER
PLYMOUTH, NC

Section 2

FINDINGS AND CONCLUSIONS

The findings and conclusions presented in this section resulted from project investigation activities.

2.1 Chemical Testing

- Individual waste samples consisted of ash and dewatered sludge. Composite waste samples consisted of a paper, rejects, and miscellaneous wood waste composite, a grits, dregs, and lime waste composite, and an overall waste composite. The composites were tested using the Toxicity Characteristic Leaching Procedure (TCLP). None of the samples released constituents above the associated hazardous waste limits. Additionally, only three of the volatile organic compounds and none of the pesticides in the TCLP analysis were detected above laboratory analytical detection limits.

- The Plymouth Mill solid wastes, which were tested, are classified as nonhazardous wastes for the characteristics of TCLP.

- The results of TCLP tests that were conducted on the individual wastes or the composite waste samples may be summarized as follows:

  - Barium was detected slightly above the primary drinking water standard of 1 mg/L in the three samples. The primary drinking water standards are the enforceable maximum contaminant levels (MCLs), which are set by the US EPA using health based criteria.

  - Cadmium was detected above the primary drinking water standard of 0.01 mg/L in two samples. The ash leached 0.056 mg/L of cadmium, and the overall composite leached 0.014 mg/L of cadmium, which is probably from the ash.

  - Arsenic was detected above the primary drinking water standard of 0.05 mg/L in one sample. The overall composite leached 0.086 mg/L of arsenic.

  - Selenium was detected above the primary drinking water standard of 0.01 mg/L in two samples. The ash leached 0.27 mg/L of selenium, and the overall composite leached a proportionate amount.

- The results of analyses for the extended parameter list on TCLP leachate from the ash, the dewatered sludge, and the overall composite can be summarized as follows:

  - The total dissolved solids in the ash, the dewatered sludge and the overall composite were 7300, 5100, and 6100 mg/L respectively. These are above the secondary drinking water standard of 500 mg/L. The secondary drinking water standards are nonenforceable guidelines for the public water supply.

The constituents in the secondary drinking water standards primarily affect the aesthetic qualities of drinking water.

- The ash leached 17 mg/L of manganese, and the overall composite leached a proportionate amount, 6.6 mg/L. These are above the secondary drinking water standard of 0.05 mg/L; however, based on US EPA's acceptable intake for chronic exposure (AIC) for oral intake of manganese through drinking water, the acceptable concentration of manganese is 7.6 mg/L. The AIC limits have been established to assess the health risks of drinking ground water that contain certain constituents.

- ASTM water leachate tests were performed on the ash, the dewatered sludge, and the overall composite. In the overall composite, selenium leached at 0.027 mg/L, which is about twice the primary drinking water standard of 0.01 mg/L. The total dissolved solids in the ash and total composite leachates slightly exceeded the secondary drinking water standard. The pH of these two leachates was also above the secondary drinking water standard.

2.2 Physical Testing

- Testing of the two major waste types, ash, dewatered sludge, and a 1:1 composite of ash and sludge, yielded the following results:

  - The initial moisture content of the ash was 29 percent (71 percent solids).

  - The moisture content of dewatered sludge that was "resaturated" in standing water was 68 to 69 percent (31 to 32 percent solids).

  - The specific gravity of dewatered sludge, ash and sludge/ash composite were determined to be 1.77, 2.13 and 2.04, respectively.

  - The maximum dry unit weights were determined: sludge, 27 to 35 pcf; ash, 37 to 39 pcf; and sludge/ash composite, 36 to 40 pcf.

- Bench scale shear strength test results were as follows:

  - Dewatered sludge at 38, 45 and 50 percent solids exhibited peak internal friction angles ranging from 22 to 32 degrees, and cohesion values ranging from 0 to 371 psf.

  - Ash yielded anomalously low values of both friction angle (15 degrees) and cohesion (66 psf).

  - Two sludge/ash composites (38 percent solids plus ash and 45 percent solids plus ash) exhibited friction angles of 23 and 24 degrees and cohesion values of 45 and 90 psf, respectively.

- Direct shear strength test results were as follows:
  - Sludge samples (38 and 45 percent solids) exhibited friction angles of 31 and 34 degrees, and cohesion values ranging from 54 to 464 psf.
  - Ash produced a friction angle of 35 degrees and 252 psf cohesion.
  - The composite samples produced friction angles of 35 to 36 degrees and 189 to 284 psf cohesion.
- Triaxial shear strength test results were as follows:
  - Dewatered sludge was tested under unconsolidated-undrained (UU) conditions that yield friction angles equal to zero, and had 228 to 953 psf cohesion.
  - Ash, tested under consolidated-undrained (CU) conditions, indicated a friction angle of 22 degrees with 470 psf cohesion.
  - Sludge ash/composite samples (38 and 45 percent solids) indicated an internal angle of friction of 28 to 30 degrees, with cohesion values between 0 and 12 psf.
- Consolidation tests on sludge at 45 percent solids, ash, and a 1:1 composite of each, produced the following results:
  - The compression index for sludge, ash, and sludge/ash composite were 1.00, 1.05 and 0.80, respectively.
  - The recompression index for sludge, ash, and sludge/ash composite were 0.17, 0.10 and 0.09, respectively.
  - The compression ratio for the sludge, ash, and sludge/ash composite were 0.27, 0.25 and 0.21, respectively.
  - The coefficient of the consolidation for the sludge, ash and sludge/ash composite were 1.6, 5.6 and 3.3 square feet per day, respectively.
- The strength of the materials over the range of various solids contents was nearly constant.
- The sludge/ash composite exhibited approximately equivalent strength to the ash.
- The projected waste mixture should be stable at slopes up to 3:1.
- Consolidation of the waste due to the waste load placed above will result in the release of pore water (leachate) that should be collected by a leachate collection system.

2.3 Testing Summary

- Leaching tests indicate that an ash monofill would have relatively low leaching potential, while an ash/sludge landfill would generate more acidic leachate and possess greater leaching potential.

- A mixture of dewatered sludge and ash exhibits nearly the same shear strengths as ash alone.

- Whether ash and sludge are segregated or codisposed, the potential environmental impacts of either waste mix can be managed with standard landfill engineering technology.

Section 3

RECOMMENDATIONS

RMT recommends that ash generated by the incineration of dewatered sludge be tested in the same manner as the materials discussed in this report. In addition, RMT recommends that the results of this study be used to:

- Define the need for environmental barriers, such as liners, for the new landfill.
- Determine if waste can be used in construction or capping of the new landfill.
- Perform stability calculations prior to designing the new landfill.

Section 4

WASTE CLASSIFICATION

4.1 Production Processes

The products of the integrated kraft process include bleached fluff pulp, fine paper, liner board, and corrugated medium. A secondary fiber operation, which recovers fibers from baled waste paper products, supplies pulp for paper board production. A process flow diagram highlighting the waste generation units is presented in Figure 2.

Pulp for papermaking is produced on-site by digesting mixed hardwood and softwood. The kraft process involves cooking wood chips with an alkaline solution called "white liquor" at elevated temperature and pressure in digesters. The digestion extracts some of the wood components, such as lignin, resin, and turpentine, and changes the structure of the cellulose. After digestion, the solution is passed through a series of screens and washers to isolate the fiber stock from the liquid components. The solution that remains after fibers have been removed is known as "weak black liquor."

Washed fiber stock is concentrated. A part of it is bleached for the production of fine paper and fluff pulp. The remainder is used for unbleached products and is combined with pulp from the secondary fiber operation, which recycles paper products. Paper is made from bleached and unbleached stock on five paper machines. Most broke and butt-end rolls are recycled, but some are sent to the landfill.

Weak black liquor is concentrated and burned to recover and recycle the chemicals used in the digestion. A series of evaporators is used to concentrate the black liquor. The concentrated black liquor contains sufficient amounts of combustible material for burning in a recovery boiler for steam generation. The non-combustible materials form a molten smelt that falls into dissolving tanks at the bottom of the boiler. The resulting solution, called green liquor, is purified in a clarifier. Solids that settle in the clarifier, or "dregs," are sent to the landfill. The clarified green liquor is reacted with lime in the slaker. "Grits," a dark green insoluble material from the slaking process, are also sent to the landfill for disposal. The resulting solution is the "white liquor" that is used for digestion.

Lime mud (calcium carbonate) is recovered from the slaker in a clarifier. The mud is washed, filtered, and heated in a high temperature kiln to liberate carbon dioxide and to recover lime (CaO). The recovered lime is recycled to the slaking process. Lime mud is occasionally sent to the landfill in unusual circumstances (e.g., when the kiln is out of service).

Currently, primary wastewater treatment sludge is stored in a lagoon. In the future, this sludge will be dewatered by a "screw press". Most of the dewatered sludge will be burned, but some may be sent to the landfill. Bench-scale tests for sludge dewatering equipment were conducted during 1987. Dewatered sludge from these tests was used for waste characterization.

Bark and undersized woodchips are burned, along with coal, in the mill power plant. Fly ash generated at the power plant and some wood waste are sent to the landfill. Other solid wastes, including demolition debris and miscellaneous mill trash, are also disposed of in the landfill.

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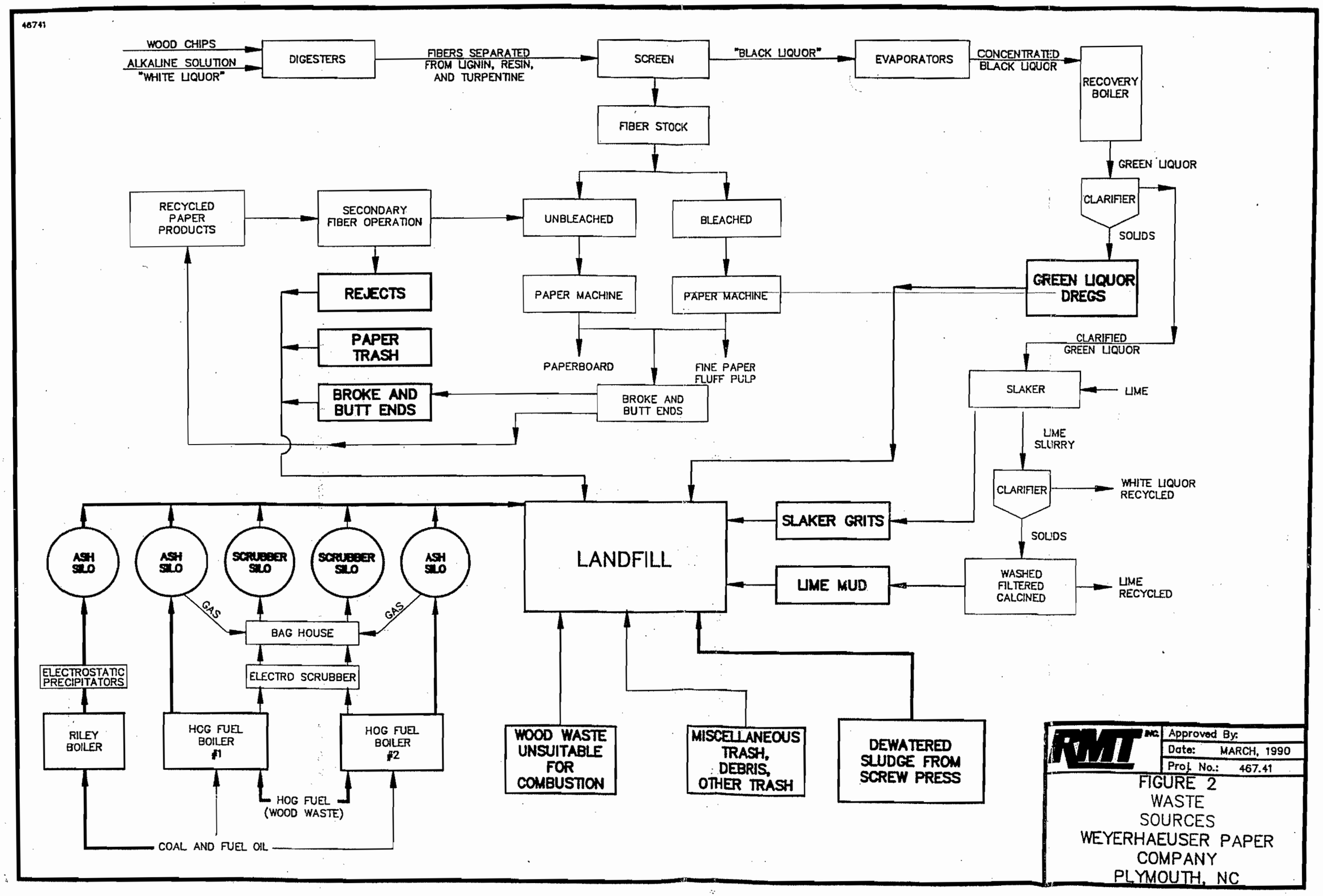

RMT INC.

Approved By:	
Date:	MARCH, 1990
Proj. No.:	467.41

FIGURE 2
WASTE
SOURCES
WEYERHAEUSER PAPER
COMPANY
PLYMOUTH, NC

4.2 Quantification

Major sources of solid waste disposed of in the existing landfill include the following:

Fly Ash - ash entrained in the combustion air from burning coat in the Riley boiler and bark and wood waste in the hog fuel boilers.

Wood Waste - logs, bark, scrap plywood, pallets, etc.

Fiber Waste - paperboard trash, waste pulp, broke, and butt rolls.

Rejects - plastic, metal wire, and general trash from the secondary fiber plant.

Grits - waste from the lime slaker.

Dregs - sediment from the green liquor clarifiers.

Lime and Lime Mud - CaO and $CaCO_3$ that are not successfully reclaimed at the slaker.

Dewatered Sludge - primary wastewater treatment sludge, which is principally wood fiber, dewatered in a screw press.

Other - demolition debris and miscellaneous mill trash.

The actual volume of solid waste generated each day varies. Waste generation data for 1989 provided by Weyerhaeuser were used to formulate the daily average of approximately 700 cubic yards per day currently generated at the plant. This data is summarized in Tables 1 and 3. Based on the dewatering study, the dewatered sludge was assumed to be 180 tons/day at 45 percent solids, with a density of 20 lb/ft^3, which is based on a National Council of the Paper Industry for Air and Stream Improvement, Inc. (NCASI) Report. This represents about 670 additional cubic yards per day.

The actual bulk density of the dewatered sludge used in the analytical program was between 30 and 35 lbs/ft^3 and the solids content was between 55 and 60 percent. This did not significantly change the composition of Composite #3.

4.3 Percentage of Waste Components In Composite Samples

Composite samples (#1, #2, #3) were prepared by mixing waste components in the approximate relative quantities in which they will be disposed at the landfill.

Composite #1: Slaker grits, green liquor dregs, lime, and lime mud (all alkaline).

Composite #2: Broke, butt rolls, waste pulp, rejects, and wood waste.

Composite #3: All waste components.

Tables 2, 3, and 4 show the percentage of each waste component in the composite samples. These tables were prepared from the data presented in Table 1, plus a projected production of 180 tons per day of dewatered sludge.

TABLE 1

WASTES GENERATED IN 1989
WEYERHAEUSER PLYMOUTH MILL, NORTH CAROLINA
Assumed 350 Working Days/Year

WASTE TYPE		TOTAL QUANTITY cubic yards/year	APPROXIMATE DAILY GENERATION cubic yards/day
FLYASH		150,000	410
WOODWASTES		32,460	90
Bark	7,100		
Chips	660		
Sawdust	740		
Log/Branches	460		
Mixed wood	23,500		
MILL TRASH		45,060	125
General Trash	41,000		
Drums	200		
Dirt	945		
Metal Trash	1,760		
Plastics	600		
Concrete	160		
Demolition w/o Brick	35		
Other Waste	360		
SLAKER GRITS		1,460	4
GREEN LIQUOR DREGS		8,285	23
LIME/LIME MUD		5,000	14
Lime/Lime Mud	4,800		
Lime Mud	150		
Lime	50		

TABLE 1 (continued)

WASTES GENERATED IN 1989
WEYERHAEUSER FACILITY, PLYMOUTH NORTH CAROLINA
Assumed 350 Working Days/Year

WASTE TYPE		TOTAL QUANTITY cubic yards/year	APPROXIMATE DAILY GENERATION cubic yards/day
PULP AND PAPER WASTE		12,910	35
Paper and paper board	10,500		
Pulp/rejects	1,990		
Paper	410		
Paper board	10		

TABLE 2

WASTE COMPONENTS OF COMPOSITE SAMPLE #1

Waste Component	Cubic Yards/Day	Percentage
Slaker grits	4	10
Green liquor dregs	23	56
Lime/lime mud	14	34
	41	100

TABLE 3

PAPER WASTE COMPONENT OF COMPOSITE SAMPLE #2

Waste Component	Cubic Yards/Day	Percentage
Paper and paper board	10,500	81
Rejects	1,990	15
Paper	410	3
Paper board	10	1
	12,910	100

TABLE 4

WASTE COMPONENTS OF COMPOSITE SAMPLE #3

Waste Components	Cubic Yards/Day	Percentage
Fly ash	410	32
Wood wastes	90	7
Pulp and paper	35	3
Slaker grits	4	3
Green liquor dregs	23	2
Lime/lime mud	14	1
Dewatered sludge	670	52
	1,250	100

Section 5

SAMPLING AND ANALYSIS PROCEDURES

5.1 General Description

Discrete samples of the various materials that are to be landfilled were collected by RMT from areas of the mill that were accessible on April 5, 1990. To minimize mixing the wastes for chemical testing, the samples were collected as near the generation point as possible. These material samples were composited on a volume basis to represent the proportionate contribution of each area to the overall landfill mass.

A Weyerhaeuser representative assisted RMT in collecting samples. However, considering the variability of types of materials and the availability of these materials at the time, the composites may vary from the actual material that will be placed in the landfill.

Sample composition was accurately documented. This information, as well as chain-of-custody documentation, is available for review at RMT offices in Greenville, South Carolina. Samples for chemical analyses were packed in ice and shipped by overnight courier to RMT Laboratories in Madison, Wisconsin.

5.2 Sample Descriptions and Sampling Methods

Five samples were collected for chemical analysis: ash, dewatered sludge, Composite #1, Composite #2, and Composite #3. These samples are described as follows:

Fly ash: The fly ash sample was collected by Weyerhaeuser personnel from the five ash silos. RMT received the samples at the plant on April 5, 1990, in 10 amber glass jars (two from each silo) and five 5-gallon buckets. Bottom ash (heavies) was not part of the sample.

Dewatered Sludge : The dewatered sludge sample was provided by Weyerhaeuser from material generated during screw press tests that occurred at the facility. Pure sludge samples for chemical analyses were prepared by combining frozen material contained in Ziploc bags into one sample. Two 5-gallon buckets of dewatered sludge were also collected from a 55 gallon drum. More than a foot of rainwater was standing on top of the sludge in the drum. This material was used to prepare Composite #3, and for physical testing.

Composite #1: Composite #1 was prepared by mixing slaker grits, green liquor dregs, lime, and lime mud in a stainless steel bowl in a 1:4:1:1 volume (1:4:2:2 by weight) proportional ratio. Stainless steel scoops were used to take the samples.

The samples of both grits and dregs had been in the waste canisters, from which they were taken, for approximately two days. The recovery boiler went down on April 4, 1990, and was not operating at the time of sampling on April 5th. Neither grits nor dregs are produced when the boiler is down. The grits sample was removed from under water that was standing in the canister. Plant personnel indicated that dregs would not have been thoroughly washed due to the process interruption. This resulted in an elevated pH and sodium content.

Lime was sampled from a dumpster. Lime mud was collected adjacent to a sump beside a large silo. These samples should not be affected by the recovery boiler shutdown.

Composite #2: Composite #2 contained wood waste, paper waste, and rejects from the secondary fiber plant in a 9:4:1 volume (14:1:1 weight) ratio. Wood waste was collected from the wood yard and from the hog fuel pile in the power recovery area. Paper waste was collected from dumpsters behind the mill. Secondary fiber rejects, consisting of waste bleached pulp and plastic from the "ragtail," were sampled at the secondary fiber plant.

In the wood yard, three quart jars of wood and bark were collected randomly from a large pile that had been pushed up by a front-end loader. This material was sampled by hand using latex gloves and stainless steel scoops, and placed in a stainless steel bucket. While this pile could have been "contaminated" with oil from the loader and asphalt from the wood yard, neither of these materials were observed in the sample. Four hand-packed quart jars of wood waste from the hog fuel pile, plus one stainless steel scoop of metal and plastic trash, were added to the composite sample.

The paper component of Composite #2 was collected from two trash dumpsters. The samples were collected by hand with latex gloves. One quart jar of broke, paperboard, butt roll, and core material from the first dumpster was added to the bucket. Two quart jars of fine paper broke and linerboard were collected from the second dumpster and added to the bucket.

Composite #3: Composite #3 was prepared with fly ash, dewatered sludge, Composite #1, and Composite #2 in a 4:3:1.5:1 weight ratio, respectively. A triple beam balance was used to weigh components of this composite.

In addition to the five samples mentioned above, five 5-gallon buckets of fly ash and two 5-gallon buckets of dewatered sludge were sent to RMT Laboratories for physical property testing.

5.3 Sample Analyses

Chemical testing was conducted on the samples to determine leaching characteristics of the wastes. Physical testing determined compaction characteristics of dewatered sludge, ash, and sludge/ash composites, and the relationship between sludge moisture, density, and shear strength.

Chemical Testing

Samples were analyzed as described below:

Test	Fly Ash	Sludge	Composites #1	#2	#3
TCLP	X	X	X	X	X
20 parameters on TCLP acid leachate	X	X			X
8 drinking water metals on ASTM water leachate	X	X			X
20 parameters on ASTM water leachate	X	X			X
Compositional testing		X			

NOTES:
- The 20 parameters are Na, K, Ca, Mg, Ni, Cu, Zn, Fe, Mn, P, nitrate, chloride, sulfate, ammonia, fluoride, phenols, alkalinity, pH, TOC, TDS
- Compositional testing includes TOC, TKN, P, and ash content only
- Composite #1: slaker grits, green liquor dregs, lime, and lime mud
- Composite #2: broke, butt rolls, cores, linerboard, and secondary fiber rejects
- Composite #3: each major waste in the approximate relative quantities that will occur in the landfill
- Testing procedures: TCLP - 40 CFR 268 Appendix I
  Water leach - ASTM D-3987-85

Physical Testing

The samples listed below were tested for the following physical properties:

Test	Dewatered Sludge #1	#2	Ash	Composites #1	#2
Direct shear	X	X	X	X	X
3-point triaxial shear			X		X
1-point triaxial shear	X		X		X
Bucket shear	X	X	X	X	X
Consolidation	X	X			
Permeability	X	X	X		
Specific gravity	X	X	X	X	X

NOTES:
- Two samples of dewatered sludge were prepared at different densities and moisture contents based on the results of the two initial tests.
- One sample of ash was tested to evaluate ash monofill conditions.
- Two composites of ash and sludge were made to approximate actual landfill conditions.

Section 6

ANALYTICAL RESULTS

6.1 Chemical Analytical Results

The results of the TCLP tests are shown in Tables 5 and 6. The results of ASTM water leaching tests are shown in Table 7. Appendix A contains analytical chemical data. Samples are classified as nonhazardous on the basis of TCLP. Traces of some inorganics were found in both the acid and water leachates, but virtually no volatiles were detected in the TCLP leachates.

Dewatered sludge and ash account for 75-80 percent of the waste to be landfilled at Plymouth. The overall composite showed very low leaching potential in the acid and water leach tests.

- arsenic, 0.086 mg/L (drinking water standard, 0.05 mg/L);
- barium, 1.5 mg/L (drinking water standard, 1.0 mg/L);
- cadmium, 0.014 mg/L (drinking water standard, 0.01 mg/L); and
- selenium, 0.088 mg/L (drinking water standard, 0.01 mg/L);

The primary drinking water standards are the enforceable maximum contaminant levels (MCLs), which are set by the US EPA using health based criteria.

In 1988, discussions between RMT and the North Carolina Department of Environmental Management indicated that a level of 10 times the primary drinking water standard in an acid leach test suggests that the parameter should be examined more closely. In the Plymouth samples, no constituent exceeded 10 times the primary drinking water standard. Selenium was the highest at 8.8 times the standard. Cadmium, arsenic, and barium were approximately 1.5 times the standard in the overall composite. Selenium exceeded the primary drinking water standard by more than 10 times in the ash sample. Because ash makes up approximately 40 percent of the solid waste that is sent to the landfill, the leaching of metals should be further monitored.

Barium and arsenic are common in leachates from papermill wastes. Barium is found in wood ash, lime residue, and wood wastes. The most common sources of arsenic are pulp waste and ash; however, the Plymouth results do not suggest a specific source of arsenic and barium in the overall composite. The barium and arsenic concentrations in the TCLP leachate at Plymouth are typical of papermill wastes.

The major source of the cadmium and selenium appears to be the ash. Cadmium and selenium do not typically leach from wood ash at these levels; therefore, they probably come from the coal that is burned in the Riley Boiler.

TABLE 5

TCLP ANALYSIS
(mg/L)

Parameter	Flyash	Dewatered Sludge	Composites #1	Composites #2	Composites #3	TCLP Limit	Drinking Water
Primary Drinking Water Parameters							
Arsenic	0.02	<0.003	<0.003	0.005	0.086	5.0	0.05
Barium	0.24	0.31	1.2	1.2	1.5	100	1.0
Cadmium	0.056	<0.005	<0.005	<0.005	0.014	1.0	0.01
Chromium	0.03	<0.01	<0.01	<0.01	0.02	5.0	0.05
Fluoride	4.1	<0.50			<0.50		4.0
Lead	<0.1	<0.1	<0.1	<0.1	<0.1	5.0	0.05
Mercury	<0.0002	<0.0002	0.0002	<0.0002	<0.0002	0.2	0.002
Nitrate	0.5	0.56			0.56		10.0
Selenium	0.27	<0.003	<0.003	<0.003	0.088	1.0	0.01
Silver	<0.01	<0.01	<0.01	<0.01	<0.01	5.0	0.05
Secondary Drinking Water Parameters							
Chloride	69	11			32		250
Copper	0.05	<0.02			<0.02		1.0
Iron	<0.1	0.9			0.1		0.3
Manganese	15	0.92			6.6		0.05
Sulfate	810	<20			160		250
Zinc	3.2	2.0			3.3		
Total Solids as Dissolved	7,300	5,100			6,100		500
Additional Parameters							
Alkalinity (as CaCO3)	3,000	2,600			2,900		
Ammonia	0.26	1.00			0.41		
Calcium	1,300	26			1,200		
Magnesium	98	2.5			48		
Nickel	0.3	0.08			0.17		
Phosphorus, Total	<2.0	0.20			2.00		
Potassium	250	1.2			70		
Sodium	34	1,200			96		
Phenol	0.17	0.23			<0.062		
Solution Parameters							
pH (5 min)	12.2	6.0	12.6	6.8	10.8		
pH (after heating)	9.2	1.7	11.8	1.8	7.6		
pH (final)	4.9	4.9	6.8	5.2	5.2		
Extract Solution	2	1	2	1	2		
Extraction pH	2.9	5	2.9	4.9	2.9		

NOTE: Shaded analyses exceed drinking water standards

TABLE 6

VOLATILE ORGANICS ANALYSIS
(mg/L)

CAS #	TCLP EXTRACT Parameter	MDL	Flyash	Dewatered Sludge	Composites #1	#2	#3
75-01-4	Vinyl chloride	10	U	U	U	U	U
75-09-2	Methylene chloride	5	U	7	U	4 J	2 J
107-13-1	Acrylonitrile	200	U	U	U	U	U
75-15-0	Carbon disulfide	5	U	U	12	U	U
75-35-4	1,1-Dichloroethene	5	U	U	U	U	U
67-66-3	Chloroform	5	U	U	U	U	U
107-02-2	1,2-Dichloroethane	5	U	U	U	U	U
78-93-3	2-Butanone	10	U	U	U	11	U
71-55-6	1,1,1-Trichloroethane	5	U	U	U	U	U
78-83-1	Isobutanol	2000	U	U	U	U	U
56-23-5	Carbon tetrachloride	5	U	U	U	U	U
79-01-6	Trichloroethene	5	U	U	U	U	U
79-00-5	1,1,2-Trichloroethane	5	U	U	U	U	U
71-43-2	Benzene	5	U	U	U	U	U
127-18-4	Tetrachloroethene	5	U	U	U	U	U
79-34-5	1,1,2,2-Tetrachloroethane	5	U	U	U	U	U
630-20-6	1,1,1,2-Tetrachloroethane	10	U	U	U	U	U
108-88-3	Toluene	5	U	U	1 J	U	U
108-90-7	Chlorobenzene	5	U	U	U	U	U

MDL = Method Detection Limit *U = Undetected* *J = Below MDL*

CAS #	WATER Parameter	MDL	Flyash	Dewatered Sludge	Composites #1	#2	#3
106-46-7	1,4-Dichlorobenzene	10	U	U	U	U	U
95-48-7	2-Methylphenol	10	U	U	5 J	7 J	U
108-39-4	3-Methylphenol	10	U	U	U	U	U
106-44-5	4-Methylphenol	10	U	U	U	3 J	U
67-72-1	Hexachloroethane	10	U	U	U	U	U
118-74-1	Hexachlorobenzene	10	U	U	U	U	U
98-59-1	Nitrobenzene	10	U	U	U	U	U
87-68-3	Hexachlorobutadiene	10	U	U	U	U	U
88-06-2	2,4,6-Trichlorophenol	10	U	U	U	U	U
95-95-4	2,4,5-Trichlorophenol	50	U	U	U	U	U
87-86-5	Pentachlorophenol	50	U	U	U	U	U
108-95-2	Phenol	10	U	U	U	U	U
95-50-1	1,2-Dichlorobenzene	10	U	U	U	U	U
935-95-5	2,3,4,6-Tetrachlorophenol	50	U	U	U	U	U
110-86-1	Pyridine	10	U	U	U	U	U
121-14-2	2,4-Dinitrotoluene	10	U	U	U	U	U

MDL = Method Detection Limit *U = Undetected* *J = Below MDL*

TABLE 7

ASTM ANALYSIS
(mg/L)

Parameter	Flyash	Dewatered Sludge	Composite #3	Drinking Water
Primary Drinking Water Parameters				
Arsenic	<0.003	<0.003	0.028	0.05
Barium	0.35	<0.005	0.1	1.0
Cadmium	<0.03	<0.03	<0.03	0.01
Chromium	0.03	<0.001	<0.001	0.05
Fluoride	0.67	<0.5	<0.5	4.0
Lead	<0.003	<0.003	<0.003	0.05
Mercury	<0.0002	<0.0002	<0.0002	0.002
Nitrate, Nitrogen	5.6	5.6	1.9	10.0
Selenium	<0.003	<0.003	0.022	0.01
Silver	<0.001	<0.001	<0.001	0.05
Secondary Drinking Water Parameters				
Chloride	66	8	44	250
Copper	<0.02	<0.02	0.07	1.0
Iron	<0.1	0.4	0.2	0.3
Manganese	0.006	0.16	0.027	0.05
Sulfate	340	<10	140	250
Zinc	0.02	0.30	0.02	5.0
Total Solids as Dissolved	1,500	190	680	500
Additional Parameters				
Alkalinity (as $CaCO_3$)	530	<20	180	
Ammonia, Nitrogen	0.32	0.68	0.38	
Calcium	244	4	35	
Magnesium	<0.5	<0.5	0.3	
Nickel	<0.02	<0.02	<0.02	
Phosphorus, Total	<0.2	<0.2	0.37	
Potassium	0.23	0.70	51	
Sodium	25	11	81	
Phenol	<0.012	0.013	0.011	
Total Organic Carbon	0.58	65	71	
Solution Parameters				
pH (initial)	11.9	6.5	10.4	
pH (final)	12.1	5.8	10.8	

Compositional Analysis – Dewatered Sludge	
Percent Ash	35%
Kjeldahl Nitrogen, Total	3,100 mg/kg dry wt
Phosphorus,Total	140 mg/kg dry wt
Solids, Total	57%
Total Organic Carbon	>16,000 mg/kg dry wt

NOTE: Shaded analyses exceed drinking water standards

In the ASTM water leachate for the overall composite, the selenium concentration was 0.022 mg/L, which is slightly more than the primary drinking water standard of 0.01 mg/L. The selenium concentration in the ash leachate was below the analytical detection limit. The reason might be the higher pH of the ash leachate. No other parameters exceeded the primary drinking water standards.

The concentrations of most constituents on the extended parameter list that were detected in the overall composite are typical for papermill wastes. Phosphorous and sulfate were a little higher than is typically observed, but they were not at levels of concern. Two constituents exceeded the secondary drinking water standards. The secondary drinking water standards are nonenforceable guidelines for the public water supply. The constituents in the secondary drinking water standards primarily affect the color and clarity of drinking water.

The constituents that exceeded the secondary drinking water standards in the TCLP leachate of the overall composite are as follows:

- total dissolved solids, 6100 mg/L (secondary drinking water standard, 500 mg/L);
- manganese, 6.6 mg/L (secondary drinking water standard, 0.05 mg/L. Based on US EPA's acceptable intake for chronic exposure (AIC) for oral intake of manganese through drinking water, the acceptable concentration of manganese is 7.6 mg/L. The AIC limits have been established to assess the health risks of drinking ground water containing certain constituents.)

The principal source of manganese appears to be the ash. The TCLP leachate from the ash also exceeded the secondary drinking water standards for sulfate. Iron in the TCLP leachate from the dewatered sludge was slightly higher than the secondary drinking water standard.

In the water leaching tests, much lower leaching potential was demonstrated for most of the constituents. Only the pH and total dissolved solids exceeded the secondary drinking water standards. High pH in the ash, and probably in the lime waste, and high dissolved solids in the ash appear to be the principal sources.

6.2 Implications of Leach Test Data for Landfill Design

Based on test results, the mill solid wastes appear to be suitable for disposal in a nonhazardous solid waste landfill.

In the overall composite, none of the primary drinking water parameters exceeded the standard by more than 10 times in the TCLP leachate; however, selenium in the ash leachate measured more than 10 times the drinking water standard. Also, selenium in the ASTM water leachate of the overall composite slightly exceeded the drinking water standard.

The leaching environment in a landfill where inorganic (such as ash) and organic (such as primary sludge) wastes are codisposed is typically acidic. The pH will probably not be as low as in the TCLP test, but the leaching time is generally longer and the solid-to-liquid ratio is lower. Therefore, the TCLP in most cases predicts the constituents that may leach from the waste, but not necessarily the

concentrations of the constituent in the leachate. Often, the concentration is higher in the landfill leachate than in the TCLP leachate.

If the proposed disposal facility is an inorganic monofill, it can be expected that neutral or slightly basic leaching conditions will prevail. These leaching conditions will likely reduce the leaching potential of the waste so that the water leach tests are more indicative of the landfill leachate. Thus, based on test results, the mill's solid wastes, which were identified, appear to be suitable for disposal in the proposed solid waste disposal facility.

6.3 Physical Test Results

To evaluate the physical characteristics of the wastes generated at the Plymouth Mill, RMT conducted a physical testing program on the two major waste types. Table 4 contains solid waste types and approximate generation rates at the mill.

Physical properties of the wastes critical for landfill design and operation are strength, consolidation, and pore water release. The screw press sludge used for physical testing was obtained from a simulated screw press operation. The operation was performed using waste from the mill and the additives that will be used at the proposed site during the dewatering process. The ash tested was fly ash from the existing mill operation. The physical tests performed were standard tests for soils or adaptations of standard tests to make them more applicable to the wastes being tested. Table 8 summarizes the physical testing results of the sludge, ash, and sludge/ash composite wastes. Laboratory calculations and data sheets are contained in Appendix B.

6.3.1 Index Tests

Index tests are used to indicate which physical characteristics can be considered typical of a given material. They are also used to help estimate how material will react under given circumstances (i.e., during construction). The laboratory data sheets for index tests are contained in Appendix B, and a discussion of the results is presented below.

Moisture Content - The initial moisture content of the composite ash samples was 29 percent of the total weight and 40 percent of the solids weight. Initial moisture content of the screw press sludge was not obtained. The sludge was stored in a 55-gallon drum for several months prior to testing. Upon obtaining the sludge samples, approximately 12 inches of free-standing rainwater were decanted from the drum of sludge. The moisture content of the sludge in this state varied from 68 to 69 percent of the total weight, and 212 to 225 percent of the solids weight.

Solids Content - The initial solids content of the ash samples was 71 percent. The solids content of the screw press sludge after drum storage was between 31 and 32 percent.

Specific Gravity - The specific gravities of the sludge, ash, and sludge/ash composite samples were determined to be 1.77, 2.13, and 2.04, respectively.

Dry Density Relationships - In order to test the waste samples at or near field conditions, the samples were remolded to an estimated "field" density. The variability of the possible densities that would be achieved when placing the waste into the landfill was estimated by generating moisture-density relationships. Three methods, each with different compaction levels of effort,

TAB. 3

SUMMARY OF PHYSICAL TEST RESULTS

Parameter	Sludge			Ash	Sludge/Ash Composite	
Index Tests:						
Initial Moisture Content ^1 (percent)	68-69			29	NA	
	(212-225)			(40)		
Initial Solids Content (percent)	31-32			71	NA	
Specific Gravity	1.77			2.13	2.04	
Percent Solids ^2	38%	45%	50%	71%	38%	45%
Maximum Dry Density Relationships (pcf)						
Standard Proctor Method, ASTM D-968	27	32	35	39	39	40
5-15 Method ^3	27	32	32	39	37	38
5-10 Method ^4	27	31	31	37	36	37
Strength Tests:						
Bench-scale Method						
Internal Angle of Friction, (degrees)	26	22-27	32	15	23	24
Cohesion, (psf)	20	371-28	0	66	45	95
Direct Shear						
Internal Angle of Friction, (degrees)	34	31-32	---	35	35	36
Cohesion, (psf)	54	464-158	---	252	284	189
Triaxial Shear ^5						
Internal Angle of Friction, (degrees)	0	0	---	22	28	30
Cohesion, (psf)	228	953	---	470	0	12
Consolidation Tests:						
Initial void ratio, e (unitless)	2.70			3.20	2.76	
Compression Index, Cc (unitless)	1.00			1.05	0.80	
Recompression Index, Cr (unitless)	0.17			0.10	0.09	
Compression Ratio, CR (unitless)	0.27			0.25	0.21	
Coeff. of consolidation @ 1 tsf, Cv (sq ft/day)	1.6			5.6	3.3	
Permeability (cm/sec)						
	3.6E-06			7.3E-04	3.5E-04	

Notes:

1. Moisture content has been calculated by two definitions as follows: : - % Moisture= Weight of Liquid/Total Weight
   -(% Moisture= Weight of Liquid/Weight of Solids)
2. Two composite samples mixed at a 1:1 by weight mix ratio were tested. The ash component was mixed at 71% solids content for both samples. The sludge was mixed at 38% solids content for one mix and 45% solids content for the other mix.
3. Standard Proctor Method (ASTM D-968) modified to a 15 blows/lift versus 25 blows/lift compaction effort.
4. Standard Proctor Method (ASTM D-968) modified to a 10 blows/lift versus 25 blows/lift compaction effort.
5. Sludge was tested under unconsolidated-Undrained (UU) conditions. Ash & sludge/ash composite samples were tested under consolidated-undrained (CU) conditions.

were used to develop the moisture-density relationships at 38 percent, 45 percent, and 50 percent solids content for the sludge samples; at 71 percent solids content for the ash samples; and at 38 percent and 45 percent solids content for the sludge/ash composite samples. The Standard Proctor Method for Moisture-Density Relationships of Soils and Soil-Aggregate Mixtures using a 5.5-pound rammer and 12-inch drop, as per the American Society for Testing and Materials (ASTM) designation D-698, was used as the maximum compaction effort. Lower compaction efforts were performed by reducing the 25 blows per lift procedure dictated in ASTM D-698 (Standard Proctor Method) to 15 blows per lift and 10 blows per lift.

The maximum dry unit weight of the sludge samples ranged from 27 to 35 pounds per cubic foot (pcf). The maximum dry unit weights of the ash samples ranged from 37 to 39 pcf, and the maximum dry unit weights of the sludge/ash composite samples ranged from 36 to 40 pcf.

6.3.2 Shear Strength Testing

The shear strength of the waste was determined by three strength testing methods. The first method was a bench-scale method which simulates the traditional field vane test. The second and third methods used were traditional soil testing methods. They include the direct shear test and the triaxial (unconsolidated - undrained and consolidated - undrained) shear test.

Bench-scale Method - The bench-scale method was used in conjunction with standard soil testing methods to simulate field conditions as much as possible in the laboratory. A large waste sample was used with this method which allows different fabric orientation of the waste to be tested (i.e., clods, clumps, etc.). The bench-scale method determines the shear strength of the waste by relating the torque required to turn a vane embedded in the waste to the applied vertical pressure on the sample. Based on the configuration of the vane and the applied torque, the shear stress on the failure surface was calculated. The concept of the embedded vane shear is similar to the field vane test which is an accepted method for field investigation of soils. Strength results are reported as an internal angle of friction and a cohesion.

Samples of sludge were moisture-conditioned to a solids content of 38 percent, 45 percent, and 50 percent. Each was tested to compare strength characteristics at varying solids contents. The solid contents were selected based on the 45 percent solids specification for the sludge screw press to be used during the dewatering process.

The first series of samples at 38 percent and 45 percent solids content were placed loosely into the bench-scale device without any initial compaction effort, and the second series of samples at 45 percent and 50 percent solids content were tamped into place. The peak internal angle of friction for both series ranged from 22 to 32 degrees with a cohesion value of 0 to 371 psf.

Next, samples of ash at 71 percent solids content were tested. The ash was tamped into place initially. The internal angle of friction was determined to be approximately 15 degrees with a cohesion value of 66 psf. RMT experience with similar materials indicates that these results are low. Users of this information should refer to the direct shear and triaxial shear testing results that follow.

Finally, tests were conducted on two composite samples of sludge and ash mixed at a 1:1 ratio by weight: the first sample was composed of sludge moisture-conditioned to 38 percent solids content and ash at 71 percent solids, and the second sludge at 45 percent solids content and ash at 71 percent solids. The peak internal angle of friction for the samples were 23 and 24 degrees, with a cohesion value of 45 and 95 pcf, respectively.

Direct Shear Method (ASTM D3080) - The test equipment for the direct shear method consists of a metal shear box in which the sample is placed. The samples are about 4 inches square and about 1 inch high. The box is split horizontally into two halves. The samples of sludge, ash, and sludge/ash composite were prepared and tested in a similar manner to the bench-scale method. To approximate worst-case and optimum sludge moisture conditions, samples of sludge moisture-conditioned to 38 percent solids and 45 percent solids were tested. A sample at 50 percent solids was neither prepared nor tested.

The sludge samples produced internal angles of friction ranging from 31 to 34 degrees with a cohesion value of 54 to 464 psf. The ash sample produced an angle of internal friction of 35 degrees and 252 psf cohesion. The sludge/ash composite samples produced internal angles of friction of 35 to 36 degrees and 189 to 284 psf cohesion.

Triaxial Shear Method (ASTM D2850) - The triaxial shear method tests a sample that is approximately 3 inches in diameter and 6 inches in height. The sample is encased by a thin rubber membrane and placed in a plastic cylindrical chamber that is filled with water. The sample is subjected to a confining pressure by compression of the fluid in the chamber. Shear failure in the sample is caused by axial stress applied through a vertical ram.

As discussed for the direct shear method of testing, the samples of sludge, ash, and sludge/ash composite were prepared and tested in a similar manner to the bench-scale method. A sludge sample moisture-conditioned to 50 percent solids content was neither prepared nor tested.

The sludge samples were tested under unconsolidated-undrained (UU) conditions. This type of test yields an internal angle of friction equal to zero degrees and some cohesion value. The test result for the sludge samples indicated cohesion values of between 228 to 953 psf.

The ash sample and the sludge/ash composite were tested under consolidated-undrained (CU) conditions. The results of the ash testing indicated an internal angle of friction of 22 degrees with 470 psf cohesion. The sludge/ash composite samples indicated an internal angle of friction of 28 to 30 degrees with cohesion values between 0 and 12 psf.

6.3.3 Consolidation Tests (ASTM D2435)

Consolidation properties were measured by monitoring the deformation of the waste over time after applying a series of known load increments to the waste. Conventional consolidometers were used to perform the tests.

Three consolidation tests were performed. The sludge and ash samples were each tested at solid contents of 45 and 71 percent, respectively. The sludge/ash composite sample was comprised of a 1:1 mix of the 45 percent solids content sludge and 71 percent solids content ash by weight.

The compression index (C_c) and the recompression index (C_r) determined from consolidation testing are used to estimate the field settlement due to consolidation. These indices are directly proportional to settlement. As the index values increase, settlement calculations indicate a greater settlement potential. The "C_c" values for the sludge, ash, and composite samples were calculated to be 1.00, 1.05, and 0.80, respectively. The "C_r" values for the sludge, ash, and composite samples were calculated to be 0.17, 0.10, and 0.09, respectively. Typical compression index values for clay soils range from 0.1 to 0.4. Typical recompression index values are 10 to 20 percent of the compression index values.

The compression ratio (CR) is the ratio of the compression index (C_c) to the sum of one plus the initial void ratio (e_o). The compression ratio is also directly proportional to settlement. The "CR" values for the sludge, ash, and sludge/ash composite samples were calculated to be 0.27, 0.25, and 0.21, respectively.

The coefficient of consolidation (C_v) was calculated for each consolidation test. The "C_v" value was determined for each load during each test. The one ton per square foot load C_v values for the sludge, ash, and sludge/ash composite samples were calculated to be 1.6, 5.6, and 3.3 square feet per day, respectively.

6.4 Implications of Physical Test Data for Landfill Design

Overall, test results indicated that the strength of the materials over the range of various solids contents was reasonably close. The samples with higher moisture contents exhibit slightly lower strength characteristics. The ash samples contained slightly higher strength values than sludge. The sludge/ash composite samples showed approximately equivalent strength to the ash samples. This is explained by the fact that ash composes the majority of the mix by volume.

The friction angle of 28 degrees and cohesion of zero psf is the most conservative strength parameter for the sludge/ash composite based on 38 to 45 percent sludge solids contents, and 71 percent ash solids contents mixed at a 1:1 ratio by weight. Therefore, these values are recommended for use in future stability calculations, provided the waste stream does not change significantly.

The waste should be stable at slopes of up to 3:1. Because of the low shear strength of the waste when not confined, vehicle traffic on top of the waste may be limited to low contact pressure tracked vehicles. Roads constructed on the waste will require sufficient base course thickness or special reinforcement to distribute loads. Fly ash, bottom ash, other non-sludge waste, or geotextiles may be required to help provide road stability.

The sludge samples were more compressible than the sludge/ash composite sample, due to the removal of the ash waste which is less compressible than the sludge. The sludge/ash composite sample appears to be the least compressible, probably due to the smaller ash particles filling some of the void spaces in the sludge sample producing a more well-graded mix. Consolidation of the waste due to the waste load placed above will result in the release of pore water which should be collected by a leachate collection system over time.

APPENDIX A

CHEMICAL ANALYTICAL RESULTS

NOTE: This Appendix is arranged by sample in the following order:

1. Fly Ash
2. Dewatered Sludge
3. Composite Nos. 1, 2 and 3

RMT INC
LABORATORIES

CLIENT: Weyerhaeuser
PROJECT #: 467.41
DATE: 05/10/90

Project Narrative

RE: The application of Wet Chemistry on TCLP leachate.

TCLP data, when compared with the ASTM data on common samples, exhibits a wide variation. This may be attributed to several factors:

1. TCLP leachate will have a higher ionic strength which is contributed by the acetic acid. This can cause matrix interferences with color developed chemistry and the ion specific electrode method.

2. Samples extracted with solution #1 are buffered with NaOH, therefore contributing to the Na background found in the TCLP extract.

3. TCLP extract is filtered through a 0.7 micron filter as opposed to a 0.45 micron filter on the ASTM extract. This would attribute the higher solids content of the TCLP leachate.

Reviewed By: Eric L Thomas
Eric L. Thomas
Supervisor
Inorganic Chemistry

RMT INC.
LABORATORIES

CLIENT: WEYERHAEUSER
SAMPLE #: 49119
PROJECT #: 00467.41
WORK ORDER #: 900406-0046741

REPORT DATE: 06/06/90
COLLECTION DATE: 04/05/90
STATION ID: FLYASH
SAMPLE COLLECTOR: MB

TOXICITY CHARACTERISTIC LEACHING PROCEDURE

PARAMETER	RESULT	UNITS
Alkalinity	3000	mg/1 as CaCO3
Ammonia	0.26	mg/1
Chloride	69	mg/1
Fluoride	4.1	mg/1
Nitrate	0.50	mg/1
Phenol	0.17	mg/1
Phosphorus, Total	<2.0*	mg/1
Sulfate	810	mg/1
Total Solids as Dissolved	7300	mg/1
Arsenic	0.020	mg/1
Barium	0.24	mg/1
Cadmium	0.056	mg/1
Calcium	1300	mg/1
Chromium	0.03	mg/1
Copper	0.05	mg/1
Iron	<0.1	mg/1
Lead	<0.1	mg/1
Magnesium	98	mg/1
Manganese	15	mg/1
Mercury	<0.0002	mg/1
Nickel	0.30	mg/1
Potassium	250	mg/1
Selenium	0.27	mg/1
Silver	<0.01	mg/1
Sodium	34	mg/1
Zinc	3.2	mg/1
Sample Wt.	100.0	grams
pH (5 min)	12.2	pH units
pH (after heating)	9.2	pH units
Extraction Solution	2	
Final pH	4.9	pH units

RMT INC.
LABORATORIES

CLIENT: WEYERHAEUSER
SAMPLE #: 49119
PROJECT #: 00467.41
WORK ORDER #: 900406-0046741

REPORT DATE: 06/06/90
COLLECTION DATE: 04/05/90
STATION ID: FLYASH
SAMPLE COLLECTOR: MB

TOXICITY CHARACTERISTIC LEACHING PROCEDURE

PARAMETER	RESULT	UNITS
Extraction pH	2.9	pH units

Additional analysis is listed under lab #49134
* High detect limit based on matrix interference.

H. Mitchell Rubenstein, Ph.D., Technical Director

RMT INC.
LABORATORIES

VOLATILE ORGANICS ANALYSIS DATA SHEET
TCLP EXTRACT
Report Date: 05/15/90

RMT SAMPLE NO.
49119

Client Name: WEYERHAEUSER Project #467.41

Matrix: (soil/water) TCLP EXTRACT
Sample wt/vol: 5 (g/mL) ML
Level: (low/med) LOW
Extraction Date: 04/19-20/90
Column: (pack/cap) PACK

Field Sample ID: FLYASH
Lab File ID: >ABB02
Sampling Date: 04/05/90
Analysis Date: 04/28/90
Dilution Factor: 1.00000

CONCENTRATION UNITS: UG/L

CAS NO.	COMPOUND	Conc. *MDL	Code
75-01-4	Vinyl Chloride	10.	U
75-09-2	Methylene Chloride	5.	UX
107-13-1	Acrylonitrile	200.	UX
75-15-0	Carbon Disulfide	5.	UX
75-35-4	1,1-Dichloroethene	5.	U
67-66-3	Chloroform	5.	U
107-02-2	1,2-Dichloroethane	5.	U
78-93-3	2-Butanone	10.	U
71-55-6	1,1,1-Trichloroethane	5.	UX
78-83-1	Isobutanol	2000.	UX
56-23-5	Carbon Tetrachloride	5.	U
79-01-6	Trichloroethene	5.	U
79-00-5	1,1,2-Trichloroethane	5.	UX
71-43-2	Benzene	5.	U
127-18-4	Tetrachloroethene	5.	U
79-34-5	1,1,2,2-Tetrachloroethane	5.	UX
630-20-6	1,1,1,2-Tetrachloroethane	10.	UX
108-88-3	Toluene	5.	UX
108-90-7	Chlorobenzene	5.	U

FORM I VOA

ALAN DOUGHTY, PH.D., LABORATORY DIRECTOR

RMT INC.®
LABORATORIES

THE FOLLOWING ARE CODES THAT ARE USED ON THE DATA SHEET:

U = Undetected

B = Present in Blank

J = Estimated Concentration

M = Matrix Spike Compound

E = Exceeds Calibration Limit

D = Value is from a Diluted Run

*MDL = Method Detection Limit -corrected for moisture fraction when sample is a soil

Z = Present in the ZHE extract blank for that day.

X = Recently removed from the list of regulated TCLP volatile constituents. A screen was performed for these compounds.

RMT INC.
LABORATORIES

CLIENT: WEYERHAEUSER
SAMPLE #: 49119
PROJECT #: 00467.41
WORK ORDER #: 900406-0046741

REPORT DATE: 05/07/90
COLLECTION DATE: 04/05/90
STATION ID: FLYASH
SAMPLE COLLECTOR: MB

PESTICIDE ANALYSIS REPORT

PARAMETER	RESULT	UNITS
2,4-D	<2000	ug/l
2,4,5-TP	<200	ug/l

Alan Doughty, Ph.D., Laboratory Director

744 Heartland Trail, P.O. Box 8923, Madison, WI 53708-8923, Ph:(608)831-44

RMT INC.
LABORATORIES

CLIENT: WEYERHAEUSER
SAMPLE #: 49119
PROJECT #: 00467.41
WORK ORDER #: 900406-0046741

REPORT DATE: 05/07/90
COLLECTION DATE: 04/05/90
STATION ID: FLYASH
SAMPLE COLLECTOR: MB

PESTICIDE ANALYSIS REPORT

PARAMETER	RESULT	UNITS
LINDANE	<80	ug/l
HEPTACHLOR	<1.6	ug/l
HEPTACHLOR EPOXIDE	<1.6	ug/l
CHLORDANE	<6.0	ug/l
ENDRIN	<4.0	ug/l
METHOXYCHLOR	<2000	ug/l
TOXAPHENE	<100	ug/l

Alan Doughty, Ph.D., Laboratory Director

744 Heartland Trail, P.O. Box 8923, Madison, WI 53708-8923, Ph:(608)831-444

RMT INC.
LABORATORIES

CLIENT: WEYERHAEUSER
SAMPLE #: 49134
PROJECT #: 00467.41
WORK ORDER #: 900406-0046741

REPORT DATE: 05/07/90
COLLECTION DATE: 04/05/90
STATION ID: FLYASH
SAMPLE COLLECTOR: MB

ASTM ANALYSIS REPORT

PARAMETER	RESULT	UNITS
Alkalinity	530	mg/l
Ammonia, Nitrogen	0.32	mg/l
Chloride	66	mg/l
Fluoride	0.67	mg/l
Nitrate, Nitrogen	5.6	mg/l
Phenols	<0.012	mg/l
Phosphorus, Total	<0.20	mg/l
Sulfate	340	mg/l
Total Organic Carbon	0.58	mg/l
Total Solids	1500	mg/l
Calcium	244000	ug/l
Copper	<20	ug/l
Iron	<100	ug/l
Magnesium	<500	ug/l
Manganese	6	ug/l
Nickel	<20	ug/l
Potassium	230	ug/l
Sodium	25000	ug/l
Zinc	20	ug/l
Total Weight	100.0	gm
Initial pH	11.9	pH units
Final pH	12.1	pH units

Additional analysis is listed under lab #49119

Alan Doughty, Ph.D., Laboratory Director

RMT INC.
LABORATORIES

CLIENT: WEYERHAEUSER
SAMPLE #: 51756
PROJECT #: 00467.41
WORK ORDER #: 900613-0046741

REPORT DATE: 06/22/90
COLLECTION DATE: 04/05/90
STATION ID: FLYASH
SAMPLE COLLECTOR: MB

ASTM ANALYSIS REPORT

PARAMETER	RESULT	UNITS
Arsenic	<3	ug/l
Barium	350	ug/l
Cadmium	<0.3	ug/l
Chromium	30	ug/l
Lead	<3	ug/l
Mercury	<0.2	ug/l
Selenium	<3	ug/l
Silver	<10	ug/l

Previous analysis is listed under lab #49134

Alan Doughty, Ph.D., Laboratory Director

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RMT INC.
LABORATORIES

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
Report Date: 05/16/90

RMT SAMPLE NO.
49119

Client Name: WEYERHAEUSER Project # 467.41

Matrix: (soil/water) WATER
Sample wt/vol: 1000 (g/mL) ML
Level: (low/med) LOW
GPC Cleanup: (Y/N) NO
Moisture: --. %
Column: (pack/cap) CAP

Field Sample ID: FLYASH
Lab File ID: >MFH26::D5
Sampling Date: 04/05/90
Date Extracted: 04/23/90.
Analysis Date: 5/04/90
Dilution Factor: 1.00000

CONCENTRATION UNITS:UG/L

CAS NO.	COMPOUND	Conc.	*MDL	Code
106-46-7	1,4-Dichlorobenzene		10.	U
95-48-7	2-Methylphenol		10.	U
108-39-4	3-Methylphenol		10.	S
106-44-5	4-Methylphenol		10.	U
67-72-1	Hexachloroethane		10.	U
118-74-1	Hexachlorobenzene		10.	U
98-59-1	Nitrobenzene		10.	U
87-68-3	Hexachlorobutadiene		10.	U
88-06-2	2,4,6-Trichlorophenol		10.	U
95-95-4	2,4,5-Trichlorophenol		50.	U
87-86-5	Pentachlorophenol		50.	U
108-95-2	Phenol		10.	U
95-50-1	1,2,-Dichlorobenzene		10.	U
935-95-5	2,3,4,6-Tetrachlorophenol		50.	U
110-86-1	Pyridine		10.	U
121-14-2	2,4-Dinitrotoluene		10.	U

ALAN DOUGHTY, PH.D., LABORATORY DIRECTOR

RMT INC.
LABORATORIES

THE FOLLOWING ARE CODES THAT ARE USED ON THE DATA SHEET:

U = Undetected

B = Present in Blank

J = Estimated Concentration

M = Matrix Spike Compound

E = Exceeds Calibration Limit

D = Value is from a Diluted Run

S =Cannot be separated from 2-Methylphenol

*MDL = Method Detection Limit -corrected for moisture fraction when sample is a soil.

RMT INC.
LABORATORIES

CLIENT: WEYERHAEUSER
SAMPLE #: 49121
PROJECT #: 00467.41
WORK ORDER #: 900406-0046741

REPORT DATE: 06/06/90
COLLECTION DATE: 04/05/90
STATION ID: DWT SLG
SAMPLE COLLECTOR: MB

TOXICITY CHARACTERISTIC LEACHING PROCEDURE

PARAMETER	RESULT	UNITS
Alkalinity	2600	mg/1 as CaCO3
Ammonia	1.0	mg/1
Chloride	11	mg/1
Fluoride	<0.50	mg/1
Nitrate	0.56	mg/1
Phenol	0.23	mg/1
Phosphorus, Total	0.20	mg/1
Sulfate	<20	mg/1
Total Solids as Dissolved	5100	mg/1
Arsenic	<0.003	mg/1
Barium	0.31	mg/1
Cadmium	<0.005	mg/1
Calcium	26	mg/1
Chromium	<0.01	mg/1
Copper	<0.02	mg/1
Iron	0.9	mg/1
Lead	<0.1	mg/1
Magnesium	2.5	mg/1
Manganese	0.92	mg/1
Mercury	<0.0002	mg/1
Nickel	0.08	mg/1
Potassium	1.2	mg/1
Selenium	<0.003	mg/1
Silver	<0.01	mg/1
Sodium	1200	mg/1
Zinc	2.0	mg/1
Sample Wt.	100.0	grams
pH (5 min)	6.0	pH units
pH (after heating)	1.7	pH units
Extraction Solution	1	
Final pH	4.9	pH units

RMT INC.
LABORATORIES

CLIENT: WEYERHAEUSER
SAMPLE #: 49121
PROJECT #: 00467.41
WORK ORDER #: 900406-0046741

REPORT DATE: 06/06/90
COLLECTION DATE: 04/05/90
STATION ID: DWT SLG
SAMPLE COLLECTOR: MB

TOXICITY CHARACTERISTIC LEACHING PROCEDURE

PARAMETER	RESULT	UNITS
Extraction pH	5.0	pH units

Additional analysis is listed under lab #49136

H. Mitchell Rubenstein, Ph.D., Technical Director

RMT INC.
LABORATORIES

VOLATILE ORGANICS ANALYSIS DATA SHEET
TCLP EXTRACT
Report Date: 05/15/90

RMT SAMPLE NO.
49121

Client Name: WEYERHAEUSER Project #467.41

Matrix: (soil/water) TCLP EXTRACT Field Sample ID: DWT SLG
Sample wt/vol: 5 (g/mL) ML Lab File ID: >ABB04
Level: (low/med) LOW Sampling Date: 04/05/90
Extraction Date: 04/19-20/90 Analysis Date: 04/28/90
Column: (pack/cap) PACK Dilution Factor: 1.00000

CONCENTRATION UNITS: UG/L

CAS NO.	COMPOUND	Conc.	*MDL	Code
75-01-4	Vinyl Chloride		10.	U
75-09-2	Methylene Chloride	7.	5.	X
107-13-1	Acrylonitrile		200.	UX
75-15-0	Carbon Disulfide		5.	UX
75-35-4	1,1-Dichloroethene		5.	U
67-66-3	Chloroform		5.	U
107-02-2	1,2-Dichloroethane		5.	U
78-93-3	2-Butanone		10.	U
71-55-6	1,1,1-Trichloroethane		5.	UX
78-83-1	Isobutanol		2000.	UX
56-23-5	Carbon Tetrachloride		5.	U
79-01-6	Trichloroethene		5.	U
79-00-5	1,1,2-Trichloroethane		5.	UX
71-43-2	Benzene		5.	U
127-18-4	Tetrachloroethene		5.	U
79-34-5	1,1,2,2-Tetrachloroethane		5.	UX
630-20-6	1,1,1,2-Tetrachloroethane		10.	UX
108-88-3	Toluene		5.	UX
108-90-7	Chlorobenzene		5.	U

FORM I VOA

ALAN DOUGHTY, PH.D., LABORATORY DIRECTOR

RMT INC.
LABORATORIES

THE FOLLOWING ARE CODES THAT ARE USED ON THE DATA SHEET:

U = Undetected

B = Present in Blank

J = Estimated Concentration

M = Matrix Spike Compound

E = Exceeds Calibration Limit

D = Value is from a Diluted Run

*MDL = Method Detection Limit -corrected for moisture fraction when sample is a soil

Z = Present in the ZHE extract blank for that day.

X = Recently removed from the list of regulated TCLP volatile constituents. A screen was performed for these compounds.

RMT INC
LABORATORIES

CLIENT: WEYERHAEUSER
SAMPLE #: 49121
PROJECT #: 00467.41
WORK ORDER #: 900406-0046741

REPORT DATE: 05/07/90
COLLECTION DATE: 04/05/90
STATION ID: DWT SLG
SAMPLE COLLECTOR: MB

PESTICIDE ANALYSIS REPORT

PARAMETER	RESULT	UNITS
2,4-D	<2000	ug/l
2,4,5-TP	<200	ug/l

Alan Doughty, Ph.D., Laboratory Director

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RMT INC.
LABORATORIES

CLIENT: WEYERHAEUSER
SAMPLE #: 49121
PROJECT #: 00467.41
WORK ORDER #: 900406-0046741

REPORT DATE: 05/07/90
COLLECTION DATE: 04/05/90
STATION ID: DWT SLG
SAMPLE COLLECTOR: MB

PESTICIDE ANALYSIS REPORT

PARAMETER	RESULT	UNITS
LINDANE	<80	ug/l
HEPTACHLOR	<1.6	ug/l
HEPTACHLOR EPOXIDE	<1.6	ug/l
CHLORDANE	<6.0	ug/l
ENDRIN	<4.0	ug/l
METHOXYCHLOR	<2000	ug/l
TOXAPHENE	<100	ug/l

Alan Doughty, Ph.D., Laboratory Director

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RMT INC
LABORATORIES

CLIENT: WEYERHAEUSER
SAMPLE #: 49136
PROJECT #: 00467.41
WORK ORDER #: 900406-0046741

REPORT DATE: 05/07/90
COLLECTION DATE: 04/05/90
STATION ID: DWT SLG
SAMPLE COLLECTOR: MB

ASTM ANALYSIS REPORT

PARAMETER	RESULT	UNITS
Alkalinity	<20	mg/l
Ammonia, Nitrogen	0.68	mg/l
Chloride	8.1	mg/l
Fluoride	<0.50	mg/l
Nitrate, Nitrogen	5.6	mg/l
Phenols	0.013	mg/l
Phosphorus, Total	<0.20	mg/l
Sulfate	<10	mg/l
Total Organic Carbon	65	mg/l
Total Solids	190	mg/l
Calcium	3900	ug/l
Copper	<20	ug/l
Iron	400	ug/l
Magnesium	<500	ug/l
Manganese	160	ug/l
Nickel	<20	ug/l
Potassium	700	ug/l
Sodium	11000	ug/l
Zinc	300	ug/l
Total Weight	100.0	gm
Initial pH	6.5	pH units
Final pH	5.8	pH units

Add'l analysis is listed under lab #49121 * Concentration exceeds upper limit of instrument quantitation.

Alan Doughty, Ph.D., Laboratory Director

RMT INC.
LABORATORIES

CLIENT: WEYERHAEUSER
SAMPLE #: 51758
PROJECT #: 00467.41
WORK ORDER #: 900613-0046741

REPORT DATE: 06/22/90
COLLECTION DATE: 04/05/90
STATION ID: DWT SLG
SAMPLE COLLECTOR: MB

ASTM ANALYSIS REPORT

PARAMETER	RESULT	UNITS
Arsenic	<3	ug/l
Barium	<50	ug/l
Cadmium	<0.3	ug/l
Chromium	<10	ug/l
Lead	<3	ug/l
Mercury	<0.2	ug/l
Selenium	<3	ug/l
Silver	<10	ug/l

Previous analysis is listed under lab #49136

Alan Doughty, Ph.D., Laboratory Director

RMT INC.
LABORATORIES

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
Report Date: 05/16/90

RMT SAMPLE NO.
49121

Client Name: WEYERHAEUSER Project # 467.41

Matrix: (soil/water) WATER
Sample wt/vol: 1000 (g/mL) ML
Level: (low/med) LOW
GPC Cleanup: (Y/N) NO
Moisture: --. %
Column: (pack/cap) CAP

Field Sample ID: DWT SLG
Lab File ID: >MFH04::D5
Sampling Date: 04/05/90
Date Extracted: 04/23/90.
Analysis Date: 4/23/90
Dilution Factor: 1.00000

CONCENTRATION UNITS:UG/L

CAS NO.	COMPOUND	Conc.	*MDL	Code
106-46-7	1,4-Dichlorobenzene		10.	U
95-48-7	2-Methylphenol		10.	U
108-39-4	3-Methylphenol		10.	S
106-44-5	4-Methylphenol		10.	U
67-72-1	Hexachloroethane		10.	U
118-74-1	Hexachlorobenzene		10.	U
98-59-1	Nitrobenzene		10.	U
87-68-3	Hexachlorobutadiene		10.	U
88-06-2	2,4,6-Trichlorophenol		10.	U
95-95-4	2,4,5-Trichlorophenol		50.	U
87-86-5	Pentachlorophenol		50.	U
110-86-1	Pyridine		10.	U
108-95-2	Phenol		10.	U
95-50-1	1,2-Dichlorobenzene		10.	U
935-95-5	2,3,4,6-Tetrachlorophenol		50.	U
121-14-2	2,4-Dinitrotoluene		10.	U

ALAN DOUGHTY, PH.D., LABORATORY DIRECTOR

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LABORATORIES

THE FOLLOWING ARE CODES THAT ARE USED ON THE DATA SHEET:

U = Undetected

B = Present in Blank

J = Estimated Concentration

M = Matrix Spike Compound

E = Exceeds Calibration Limit

D = Value is from a Diluted Run

S =Cannot be separated from 2-Methylphenol

*MDL = Method Detection Limit -corrected for moisture fraction when sample is a soil.

RMT INC
LABORATORIES

CLIENT: WEYERHAEUSER
SAMPLE #: 49136
PROJECT #: 00467.41
WORK ORDER #: 900406-0046741

REPORT DATE: 05/07/90
COLLECTION DATE: 04/05/90
STATION ID: DWT SLG
SAMPLE COLLECTOR: MB

COMPOSITIONAL ANALYSIS REPORT

PARAMETER	RESULT	UNITS
% Ash	35	%
Kjeldahl Nitrogen, Total	3100	mg/kg dry wt.
Phosphorus, Total	140	mg/kg dry wt.
Solids, Total	57	%
Total Organic Carbon	>16000*	mg/kg dry wt.

Add'l analysis is listed under lab #49121 * Concentration exceeds upper limit of instrument quantitation.

Alan Doughty, Ph.D., Laboratory Director

RMT INC.
LABORATORIES

CLIENT: WEYERHAEUSER
SAMPLE #: 49122
PROJECT #: 00467.41
WORK ORDER #: 900406-0046741

REPORT DATE: 05/07/90
COLLECTION DATE: 04/05/90
STATION ID: COMP 1
SAMPLE COLLECTOR: MB

TOXICITY CHARACTERISTIC LEACHING PROCEDURE

PARAMETER	RESULT	UNITS
Arsenic	<0.003	mg/l
Barium	1.2	mg/l
Cadmium	<0.005	mg/l
Chromium	<0.01	mg/l
Lead	<0.1	mg/l
Mercury	0.0002	mg/l
Selenium	<0.003	mg/l
Silver	<0.01	mg/l
Sample Wt.	100.0	grams
pH (5 min)	12.6	pH units
pH (after heating)	11.8	pH units
Extract Sol 'N	2	
Final pH	6.8	pH units
Extraction pH	2.9	pH units

Alan Doughty, Ph.D., Laboratory Director

RMT INC.
LABORATORIES

VOLATILE ORGANICS ANALYSIS DATA SHEET
TCLP EXTRACT
Report Date: 05/15/90

RMT SAMPLE NO.
49122

Client Name: WEYERHAEUSER

Project #467.41

Matrix: (soil/water) TCLP EXTRACT
Sample wt/vol: 5 (g/mL) ML
Level: (low/med) LOW
Extraction Date: 04/19-20/90
Column: (pack/cap) PACK

Field Sample ID: COMP 1
Lab File ID: >ABB05
Sampling Date: 04/05/90
Analysis Date: 04/28/90
Dilution Factor: 1.00000

CONCENTRATION UNITS:UG/L

CAS NO.	COMPOUND	Conc.	*MDL	Code
75-01-4	Vinyl Chloride		10.	U
75-09-2	Methylene Chloride		5.	UX
107-13-1	Acrylonitrile		200.	UX
75-15-0	Carbon Disulfide	12.	5.	X
75-35-4	1,1-Dichloroethene		5.	U
67-66-3	Chloroform		5.	U
107-02-2	1,2-Dichloroethane		5.	U
78-93-3	2-Butanone		10.	U
71-55-6	1,1,1-Trichloroethane		5.	UX
78-83-1	Isobutanol		2000.	UX
56-23-5	Carbon Tetrachloride		5.	U
79-01-6	Trichloroethene		5.	U
79-00-5	1,1,2-Trichloroethane		5.	UX
71-43-2	Benzene		5.	U
127-18-4	Tetrachloroethene		5.	U
79-34-5	1,1,2,2-Tetrachloroethane		5.	UX
630-20-6	1,1,1,2-Tetrachloroethane		10.	UX
108-88-3	Toluene	1.	5.	XJ
108-90-7	Chlorobenzene		5.	U

FORM I VOA

ALAN DOUGHTY, PH.D., LABORATORY DIRECTOR

RMT INC.
LABORATORIES

THE FOLLOWING ARE CODES THAT ARE USED ON THE DATA SHEET:

U = Undetected

B = Present in Blank

J = Estimated Concentration

M = Matrix Spike Compound

E = Exceeds Calibration Limit

D = Value is from a Diluted Run

*MDL = Method Detection Limit -corrected for moisture fraction when sample is a soil

Z = Present in the ZHE extract blank for that day.

X = Recently removed from the list of regulated TCLP volatile constituents. A screen was performed for these compounds.

RMT INC.
LABORATORIES

CLIENT: WEYERHAEUSER
SAMPLE #: 49122
PROJECT #: 00467.41
WORK ORDER #: 900406-0046741

REPORT DATE: 05/07/90
COLLECTION DATE: 04/05/90
STATION ID: COMP 1
SAMPLE COLLECTOR: MB

PESTICIDE ANALYSIS REPORT

PARAMETER	RESULT	UNITS
2,4-D	<2000	ug/l
2,4,5-TP	<200	ug/l

Alan Doughty, Ph.D., Laboratory Director

744 Heartland Trail, P.O. Box 8923, Madison, WI 53708-8923, Ph:(608)831-4444

RMT INC.
LABORATORIES

CLIENT: WEYERHAEUSER
SAMPLE #: 49122
PROJECT #: 00467.41
WORK ORDER #: 900406-0046741

REPORT DATE: 05/07/90
COLLECTION DATE: 04/05/90
STATION ID: COMP 1
SAMPLE COLLECTOR: MB

PESTICIDE ANALYSIS REPORT

PARAMETER	RESULT	UNITS
LINDANE	<80	ug/l
HEPTACHLOR	<1.6	ug/l
HEPTACHLOR EPOXIDE	<1.6	ug/l
CHLORDANE	<6.0	ug/l
ENDRIN	<4.0	ug/l
METHOXYCHLOR	<2000	ug/l
TOXAPHENE	<100	ug/l

Alan Doughty, Ph.D., Laboratory Director

744 Heartland Trail, P.O. Box 8923, Madison, WI 53708-8923, Ph:(608)831-4444

RMT INC.
LABORATORIES

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
Report Date: 05/16/90

RMT SAMPLE NO.
49122

Client Name: WEYERHAEUSER Project # 467.41

Matrix: (soil/water) WATER
Sample wt/vol: 1000 (g/mL) ML
Level: (low/med) LOW
GPC Cleanup: (Y/N) NO
Moisture: --. %
Column: (pack/cap) CAP

Field Sample ID: COMP 1
Lab File ID: >MFH03::D5
Sampling Date: 04/05/90
Date Extracted: 04/23/90.
Analysis Date: 4/23/90
Dilution Factor: 1.00000

CONCENTRATION UNITS:UG/L

CAS NO.	COMPOUND	Conc.	*MDL	Code
106-46-7	1,4-Dichlorobenzene		10.	U
95-48-7	2-Methylphenol	5.	10.	J
108-39-4	3-Methylphenol		10.	S
106-44-5	4-Methylphenol		10.	U
67-72-1	Hexachloroethane		10.	U
118-74-1	Hexachlorobenzene		10.	U
98-59-1	Nitrobenzene		10.	U
87-68-3	Hexachlorobutadiene		10.	U
88-06-2	2,4,6-Trichlorophenol		10.	U
95-95-4	2,4,5-Trichlorophenol		50.	U
87-86-5	Pentachlorophenol		50.	U
110-86-1	Pyridine		10.	U
108-95-2	Phenol		10.	U
95-50-1	1,2-Dichlorobenzene		10.	U
935-95-5	2,3,4,6-Tetrachlorophenol		50.	U
121-14-2	2,4-Dinitrotoluene		10.	U

ALAN DOUGHTY, PH.D. / LABORATORY DIRECTOR

RMT INC.
LABORATORIES

THE FOLLOWING ARE CODES THAT ARE USED ON THE DATA SHEET:

U = Undetected

B = Present in Blank

J = Estimated Concentration

M = Matrix Spike Compound

E = Exceeds Calibration Limit

D = Value is from a Diluted Run

S =Cannot be separated from 2-Methylphenol

*MDL = Method Detection Limit -corrected for moisture fraction when sample is a soil.

RMT INC.
LABORATORIES

CLIENT: WEYERHAEUSER
SAMPLE #: 49123
PROJECT #: 00467.41
WORK ORDER #: 900406-0046741

REPORT DATE: 05/07/90
COLLECTION DATE: 04/05/90
STATION ID: COMP 2
SAMPLE COLLECTOR: MB

TOXICITY CHARACTERISTIC LEACHING PROCEDURE

PARAMETER	RESULT	UNITS
Arsenic	0.005	mg/1
Barium	1.2	mg/1
Cadmium	<0.005	mg/1
Chromium	<0.01	mg/1
Lead	<0.1	mg/1
Mercury	<0.0002	mg/1
Selenium	<0.003	mg/1
Silver	<0.01	mg/1
Sample Wt.	100.0	grams
pH (5 min)	6.8	pH units
pH (after heating)	1.8	pH units
Extract Sol 'N	1	
Final pH	5.2	pH units
Extraction pH	4.9	pH units

Alan Doughty, Ph.D., Laboratory Director

RMT INC.
LABORATORIES

VOLATILE ORGANICS ANALYSIS DATA SHEET
TCLP EXTRACT
Report Date: 05/15/90

RMT SAMPLE NO.
49123

Client Name: WEYERHAEUSER Project #467.41

Matrix: (soil/water) TCLP EXTRACT
Sample wt/vol: 5 (g/mL) ML
Level: (low/med) LOW
Extraction Date: 04/19-20/90
Column: (pack/cap) PACK

Field Sample ID: COMP 2
Lab File ID: >ABB06
Sampling Date: 04/05/90
Analysis Date: 04/28/90
Dilution Factor: 1.00000

CONCENTRATION UNITS:UG/L

CAS NO.	COMPOUND	Conc.	*MDL	Code
75-01-4	Vinyl Chloride		10.	U
75-09-2	Methylene Chloride	4.	5.	XJ
107-13-1	Acrylonitrile		200.	UX
75-15-0	Carbon Disulfide		5.	UX
75-35-4	1,1-Dichloroethene		5.	U
67-66-3	Chloroform		5.	U
107-02-2	1,2-Dichloroethane		5.	U
78-93-3	2-Butanone	11.	10.	
71-55-6	1,1,1-Trichloroethane		5.	UX
78-83-1	Isobutanol		2000.	UX
56-23-5	Carbon Tetrachloride		5.	U
79-01-6	Trichloroethene		5.	U
79-00-5	1,1,2-Trichloroethane		5.	UX
71-43-2	Benzene		5.	U
127-18-4	Tetrachloroethene		5.	U
79-34-5	1,1,2,2-Tetrachloroethane		5.	UX
630-20-6	1,1,1,2-Tetrachloroethane		10.	UX
108-88-3	Toluene		5.	UX
108-90-7	Chlorobenzene		5.	U

FORM I VOA

ALAN DOUGHTY, PH.D., LABORATORY DIRECTOR

RMT INC.
LABORATORIES

THE FOLLOWING ARE CODES THAT ARE USED ON THE DATA SHEET:

U = Undetected

B = Present in Blank

J = Estimated Concentration

M = Matrix Spike Compound

E = Exceeds Calibration Limit

D = Value is from a Diluted Run

*MDL = Method Detection Limit -corrected for moisture fraction when sample is a soil

Z = Present in the ZHE extract blank for that day.

X = Recently removed from the list of regulated TCLP volatile constituents. A screen was performed for these compounds.

RMT INC.
LABORATORIES

CLIENT: WEYERHAEUSER
SAMPLE #: 49123
PROJECT #: 00467.41
WORK ORDER #: 900406-0046741

REPORT DATE: 05/07/90
COLLECTION DATE: 04/05/90
STATION ID: COMP 2
SAMPLE COLLECTOR: MB

PESTICIDE ANALYSIS REPORT

PARAMETER	RESULT	UNITS
2,4-D	<2000	ug/l
2,4,5-TP	<200	ug/l

Alan Doughty, Ph.D., Laboratory Director

744 Heartland Trail, P.O. Box 8923, Madison, WI 53708-8923, Ph:(608)831-444

RMT INC
LABORATORIES

CLIENT: WEYERHAEUSER
SAMPLE #: 49123
PROJECT #: 00467.41
WORK ORDER #: 900406-0046741

REPORT DATE: 05/07/90
COLLECTION DATE: 04/05/90
STATION ID: COMP 2
SAMPLE COLLECTOR: MB

PESTICIDE ANALYSIS REPORT

PARAMETER	RESULT	UNITS
LINDANE	<80	ug/l
HEPTACHLOR	<1.6	ug/l
HEPTACHLOR EPOXIDE	<1.6	ug/l
CHLORDANE	<6.0	ug/l
ENDRIN	<4.0	ug/l
METHOXYCHLOR	<2000	ug/l
TOXAPHENE	<100	ug/l

Alan Doughty, Ph.D., Laboratory Director

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RMT INC.
LABORATORIES

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
Report Date: 05/16/90

RMT SAMPLE NO.
49123

Client Name: WEYERHAEUSER
Project # 467.41

Matrix: (soil/water) WATER
Sample wt/vol: 1000 (g/mL) ML
Level: (low/med) LOW
GPC Cleanup: (Y/N) NO
Moisture: --. %
Column: (pack/cap) CAP

Field Sample ID: COMP 2
Lab File ID: >MFH24::D5
Sampling Date: 04/05/90
Date Extracted: 04/23/90.
Analysis Date: 5/04/90
Dilution Factor: 1.00000

CONCENTRATION UNITS:UG/L

CAS NO.	COMPOUND	Conc.	*MDL	Code
106-46-7	1,4-Dichlorobenzene		10.	U
95-48-7	2-Methylphenol	7.	10.	J
108-39-4	3-Methylphenol		10.	S
106-44-5	4-Methylphenol	3.	10.	J
67-72-1	Hexachloroethane		10.	U
118-74-1	Hexachlorobenzene		10.	U
98-59-1	Nitrobenzene		10.	U
87-68-3	Hexachlorobutadiene		10.	U
88-06-2	2,4,6-Trichlorophenol		10.	U
95-95-4	2,4,5-Trichlorophenol		50.	U
87-86-5	Pentachlorophenol		50.	U
110-86-1	Pyridine		10.	U
108-95-2	Phenol		10.	U
95-50-1	1,2-Dichlorobenzene		10.	U
935-95-5	2,3,4,6-Tetrachlorophenol		50.	U
121-14-2	2,4-Dinitrotoluene		10.	U

ALAN DOUGHTY, PH.D., LABORATORY DIRECTOR

RMT INC.®
LABORATORIES

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U = Undetected

B = Present in Blank

J = Estimated Concentration

M = Matrix Spike Compound

E = Exceeds Calibration Limit

D = Value is from a Diluted Run

S =Cannot be separated from 2-Methylphenol

*MDL = Method Detection Limit -corrected for moisture fraction when sample is a soil.

RMT INC
LABORATORIES

CLIENT: WEYERHAEUSER
SAMPLE #: 49120
PROJECT #: 00467.41
WORK ORDER #: 900406-0046741

REPORT DATE: 06/06/90
COLLECTION DATE: 04/05/90
STATION ID: COMP 3
SAMPLE COLLECTOR: MB

TOXICITY CHARACTERISTIC LEACHING PROCEDURE

PARAMETER	RESULT	UNITS
Alkalinity	2900	mg/1 as CaCO3
Ammonia	0.41	mg/1
Chloride	32	mg/1
Fluoride	<0.50	mg/1
Nitrate	0.56	mg/1
Phenol	<0.062	mg/1
Phosphorus, Total	2.0*	mg/1
Sulfate	160	mg/1
Total Solids as Dissolved	6100	mg/1
Arsenic	0.086	mg/1
Barium	1.5	mg/1
Cadmium	0.014	mg/1
Calcium	1200	mg/1
Chromium	0.02	mg/1
Copper	<0.02	mg/1
Iron	0.1	mg/1
Lead	<0.1	mg/1
Magnesium	48	mg/1
Manganese	6.6	mg/1
Mercury	<0.0002	mg/1
Nickel	0.17	mg/1
Potassium	70	mg/1
Selenium	0.088	mg/1
Silver	<0.01	mg/1
Sodium	96	mg/1
Zinc	3.3	mg/1
Sample Wt.	100.0	grams
pH (5 min)	10.8	pH units
pH (after heating)	7.6	pH units
Extraction Solution	2	
Final pH	5.2	pH units

RMT INC.
LABORATORIES

CLIENT: WEYERHAEUSER
SAMPLE #: 49120
PROJECT #: 00467.41
WORK ORDER #: 900406-0046741

REPORT DATE: 06/06/90
COLLECTION DATE: 04/05/90
STATION ID: COMP 3
SAMPLE COLLECTOR: MB

TOXICITY CHARACTERISTIC LEACHING PROCEDURE

PARAMETER	RESULT	UNITS
Extraction pH	2.9	pH units

Additional analysis is listed under lab #49135
* High detect limit based on matrix interference.

H. Mitchell Rubenstein, Ph.D., Technical Director

RMT INC.
LABORATORIES

VOLATILE ORGANICS ANALYSIS DATA SHEET
TCLP EXTRACT
Report Date: 05/15/90

RMT SAMPLE NO.
49120

Client Name: WEYERHAEUSER Project #467.41

Matrix: (soil/water) TCLP EXTRACT
Sample wt/vol: 5 (g/mL) ML
Level: (low/med) LOW
Extraction Date: 04/19-20/90
Column: (pack/cap) PACK

Field Sample ID: COMP 3
Lab File ID: >ABB03
Sampling Date: 04/05/90
Analysis Date: 04/28/90
Dilution Factor: 1.00000

CONCENTRATION UNITS:UG/L

CAS NO.	COMPOUND	Conc.	*MDL	Code
75-01-4	Vinyl Chloride		10.	U
75-09-2	Methylene Chloride	2.	5.	XJ
107-13-1	Acrylonitrile		200.	UX
75-15-0	Carbon Disulfide		5.	UX
75-35-4	1,1-Dichloroethene		5.	U
67-66-3	Chloroform		5.	U
107-02-2	1,2-Dichloroethane		5.	U
78-93-3	2-Butanone		10.	U
71-55-6	1,1,1-Trichloroethane		5.	UX
78-83-1	Isobutanol		2000.	UX
56-23-5	Carbon Tetrachloride		5.	U
79-01-6	Trichloroethene		5.	U
79-00-5	1,1,2-Trichloroethane		5.	UX
71-43-2	Benzene		5.	U
127-18-4	Tetrachloroethene		5.	U
79-34-5	1,1,2,2-Tetrachloroethane		5.	UX
630-20-6	1,1,1,2-Tetrachloroethane		10.	UX
108-88-3	Toluene		5.	UX
108-90-7	Chlorobenzene		5.	U

FORM I VOA

ALAN DOUGHTY, PH.D., LABORATORY DIRECTOR

RMT INC.
LABORATORIES

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B = Present in Blank

J = Estimated Concentration

M = Matrix Spike Compound

E = Exceeds Calibration Limit

D = Value is from a Diluted Run

*MDL = Method Detection Limit -corrected for moisture fraction when sample is a soil

Z = Present in the ZHE extract blank for that day.

X = Recently removed from the list of regulated TCLP volatile constituents. A screen was performed for these compounds.

RMT INC.
LABORATORIES

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
Report Date: 05/16/90

RMT SAMPLE NO.
49120

Client Name: WEYERHAEUSER Project # 467.41

Matrix: (soil/water) WATER
Sample wt/vol: 1000 (g/mL) ML
Level: (low/med) LOW
GPC Cleanup: (Y/N) NO
Moisture: --. %
Column: (pack/cap) CAP

Field Sample ID: COMP 3
Lab File ID: >MFH05::D5
Sampling Date: 04/05/90
Date Extracted: 04/23/90.
Analysis Date: 4/23/90
Dilution Factor: 1.00000

CONCENTRATION UNITS:UG/L

CAS NO.	COMPOUND	Conc.	*MDL	Code
106-46-7	1,4-Dichlorobenzene		10.	U
95-48-7	2-Methylphenol		10.	U
108-39-4	3-Methylphenol		10.	S
106-44-5	4-Methylphenol		10.	U
67-72-1	Hexachloroethane		10.	U
118-74-1	Hexachlorobenzene		10.	U
98-59-1	Nitrobenzene		10.	U
87-68-3	Hexachlorobutadiene		10.	U
88-06-2	2,4,6-Trichlorophenol		10.	U
95-95-4	2,4,5-Trichlorophenol		50.	U
87-86-5	Pentachlorophenol		50.	U
110-86-1	Pyridine		10.	U
108-95-2	Phenol		10.	U
95-50-1	1,2-Dichlorobenzene		10.	U
935-95-5	2,3,4,6-Tetrachlorophenol		50.	U
121-14-2	2,4-Dinitrotoluene		10.	U

ALAN DOUGHTY, PH.D., LABORATORY DIRECTOR

RMT INC.®
LABORATORIES

THE FOLLOWING ARE CODES THAT ARE USED ON THE DATA SHEET:

U = Undetected

B = Present in Blank

J = Estimated Concentration

M = Matrix Spike Compound

E = Exceeds Calibration Limit

D = Value is from a Diluted Run

S =Cannot be separated from 2-Methylphenol

*MDL = Method Detection Limit -corrected for moisture fraction when sample is a soil.

RMT INC.
LABORATORIES

CLIENT: WEYERHAEUSER
SAMPLE #: 49120
PROJECT #: 00467.41
WORK ORDER #: 900406-0046741

REPORT DATE: 05/07/90
COLLECTION DATE: 04/05/90
STATION ID: COMP 3
SAMPLE COLLECTOR: MB

PESTICIDE ANALYSIS REPORT

PARAMETER	RESULT	UNITS
2,4-D	<2000	ug/l
2,4,5-TP	<200	ug/l

Alan Doughty, Ph.D., Laboratory Director

744 Heartland Trail, P.O. Box 8923, Madison, WI 53708-8923, Ph:(608)831-4446

RMT INC.
LABORATORIES

CLIENT: WEYERHAEUSER
SAMPLE #: 49120
PROJECT #: 00467.41
WORK ORDER #: 900406-0046741

REPORT DATE: 05/07/90
COLLECTION DATE: 04/05/90
STATION ID: COMP 3
SAMPLE COLLECTOR: MB

PESTICIDE ANALYSIS REPORT

PARAMETER	RESULT	UNITS
LINDANE	<80	ug/l
HEPTACHLOR	<1.6	ug/l
HEPTACHLOR EPOXIDE	<1.6	ug/l
CHLORDANE	<6.0	ug/l
ENDRIN	<4.0	ug/l
METHOXYCHLOR	<2000	ug/l
TOXAPHENE	<100	ug/l

Alan Doughty, Ph.D., Laboratory Director

744 Heartland Trail, P.O. Box 8923, Madison, WI 53708-8923, Ph:(608)831-4444

RMT INC
LABORATORIES

CLIENT: WEYERHAEUSER
SAMPLE #: 49135
PROJECT #: 00467.41
WORK ORDER #: 900406-0046741

REPORT DATE: 05/07/90
COLLECTION DATE: 04/05/90
STATION ID: COMP 3
SAMPLE COLLECTOR: MB

ASTM ANALYSIS REPORT

PARAMETER	RESULT	UNITS
Alkalinity	180	mg/l
Ammonia, Nitrogen	0.38	mg/l
Chloride	44	mg/l
Fluoride	<0.50	mg/l
Nitrate, Nitrogen	1.9	mg/l
Phenols	0.011	mg/l
Phosphorus, Total	0.37	mg/l
Sulfate	140	mg/l
Total Organic Carbon	71	mg/l
Total Solids	680	mg/l
Calcium	35000	ug/l
Copper	70	ug/l
Iron	200	ug/l
Magnesium	300	ug/l
Manganese	27	ug/l
Nickel	<20	ug/l
Potassium	51000	ug/l
Sodium	81000	ug/l
Zinc	20	ug/l
Total Weight	100.0	gm
Initial pH	10.4	pH units
Final pH	10.8	pH units

Additional analysis is listed under lab #49120

Alan Doughty, Ph.D., Laboratory Director

RMT INC.
LABORATORIES

CLIENT: WEYERHAEUSER
SAMPLE #: 51757
PROJECT #: 00467.41
WORK ORDER #: 900613-0046741

REPORT DATE: 06/22/90
COLLECTION DATE: 04/05/90
STATION ID: COMP 3
SAMPLE COLLECTOR: MB

ASTM ANALYSIS REPORT

PARAMETER	RESULT	UNITS
Arsenic	28	ug/l
Barium	100	ug/l
Cadmium	<0.3	ug/l
Chromium	<10	ug/l
Lead	<3	ug/l
Mercury	<0.2	ug/l
Selenium	22	ug/l
Silver	<10	ug/l

Previous analysis is listed under lab #49135

Alan Doughty, Ph.D., Laboratory Director

744 Heartland Trail. P.O. Box 8923. Madison WI 53708-8923 ph.:(608)831-444

APPENDIX B

PHYSICAL TESTING RESULTS

RMT Soils Laboratory - As Received Moisture Content Determination

PROJECT: WEYERHAEUSER

JOB #: 467.41

				by	date
Tech:	JPH	05/10/90	QC	JPH	5/11/90
Input:	GAP	05/11/90	QA	[illegible]	5/11/90

BORING	SAMPLE	DEPTH	TARE	WET WT	DRY WT	% MOISTURE
DEWATERED SLUDGE			107.83	777.80	313.98	225.0
DEWATERED SLUDGE			107.35	691.00	294.72	211.5
ASH			274.75	532.39	458.67	40.1

6-6-90

RMT Soils Laboratory - Specific Gravity Determination

PROJECT:	WEYERHAEUSER				QC	NJW	6-6-90
		Tech:	GTF	6-5-90	QA	JPL	6-20-90
JOB #:	467.42	Input:	GTF	06/06/90			

FLASK VOL @20 C	250
AIR REMOVAL	VACUUM
BORING #	PAPERMILL
SAMPLE #	SLUDGE
DEPTH	
WT FLASK+H20	353.5
WT DRY SOIL	18.36
WT FLASK+SOIL+H20	361.49
TEMP C	22.5
SPECIFIC GRAVITY	1.77

RMT Soils Laboratory - Specific Gravity Determination

PROJECT: WEYERHAEUSER

JOB #: 467.41

Tech: GTF 6-20-90

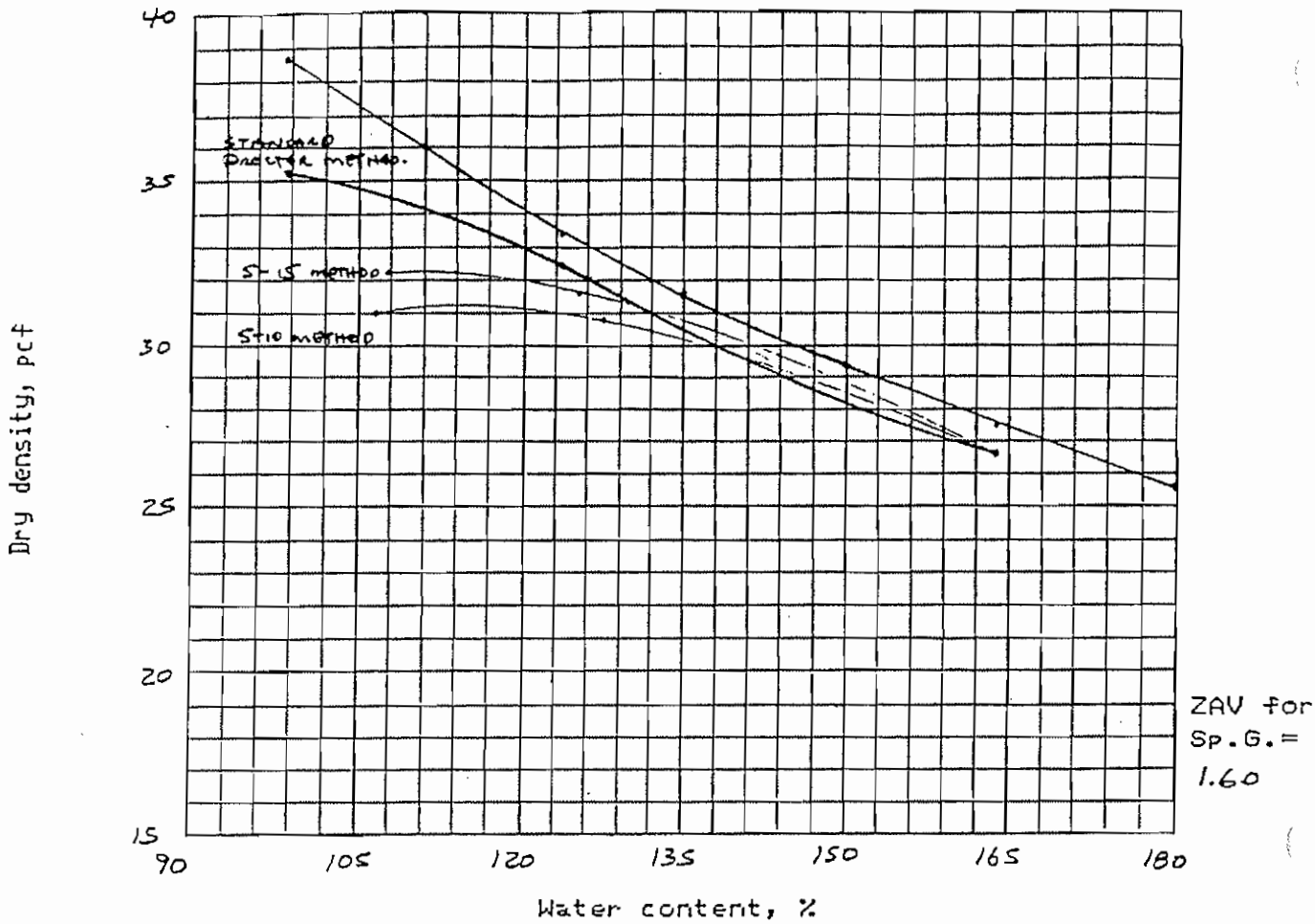
Input: GTF 06/20/90

QC [illegible] 6-20-90

QA [illegible] 6-20-90

FLASK VOL @20 C	250	
AIR REMOVAL	VACUUM	
BORING #	ASH	ASH &
SAMPLE #	COMP	SLUDGE @
DEPTH		45% SOLIDS
WT FLASK+H20	351.74	353.45
WT DRY SOIL	27.87	27.21
WT FLASK+SOIL+H20	366.54	367.35
TEMP C	22.5	22.5
SPECIFIC GRAVITY	2.13	2.04

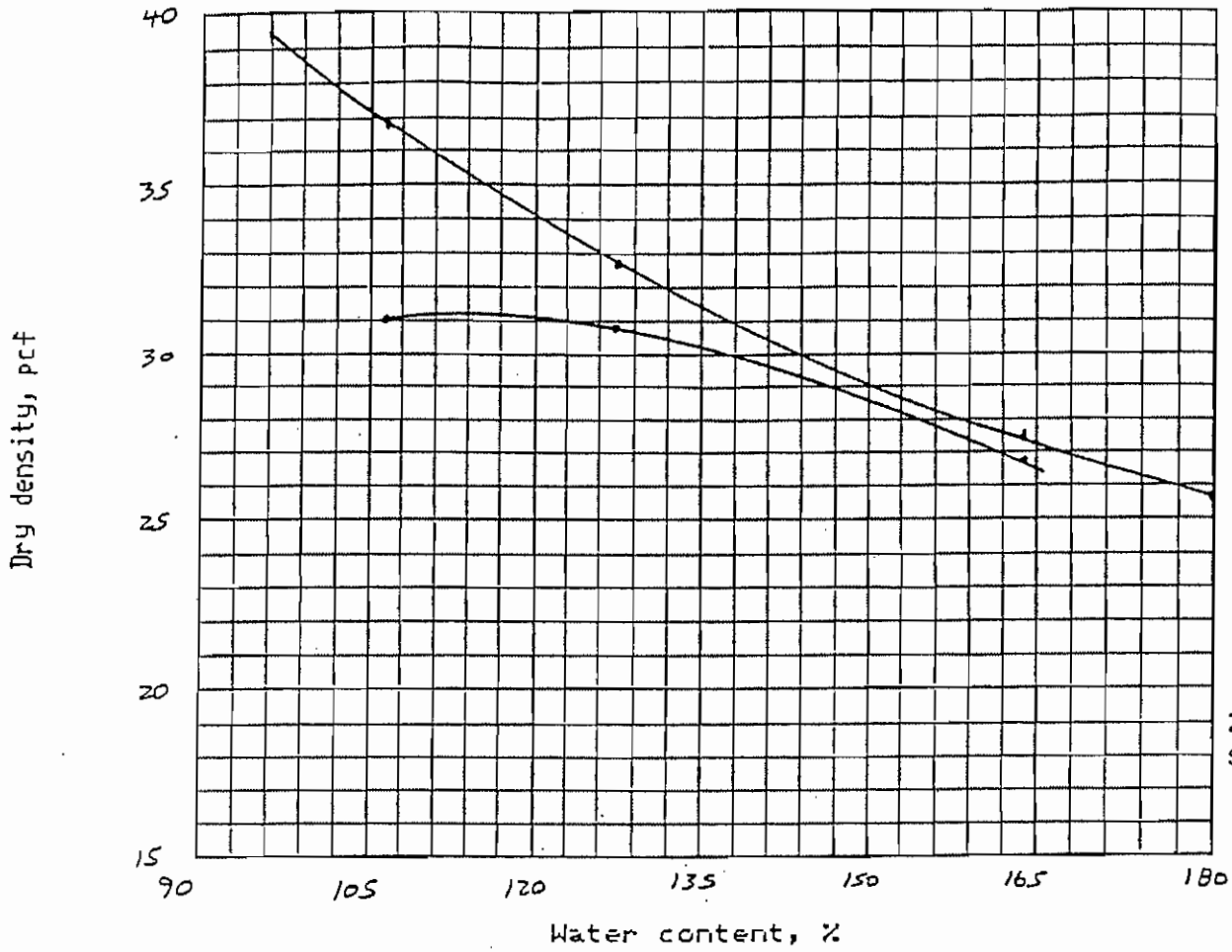
COMPACTION TEST REPORT



Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = Maximum dry density =	Sludge
Project No.: 467.42 Project: Weyerhäuser Location: Date:	Remarks: Standard Proctor Effort
COMPACTION TEST REPORT	Fig. No. ____

COMPACTION TEST REPORT



ZAV fo:
Sp.G. =

Elev/ Depth	Classification USCS	Classification AASHTO	Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.20

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = Maximum dry density =	Sludge

Project No.: 467.41
Project: Weyerhaeuser
Location:

Date:

COMPACTION TEST REPORT

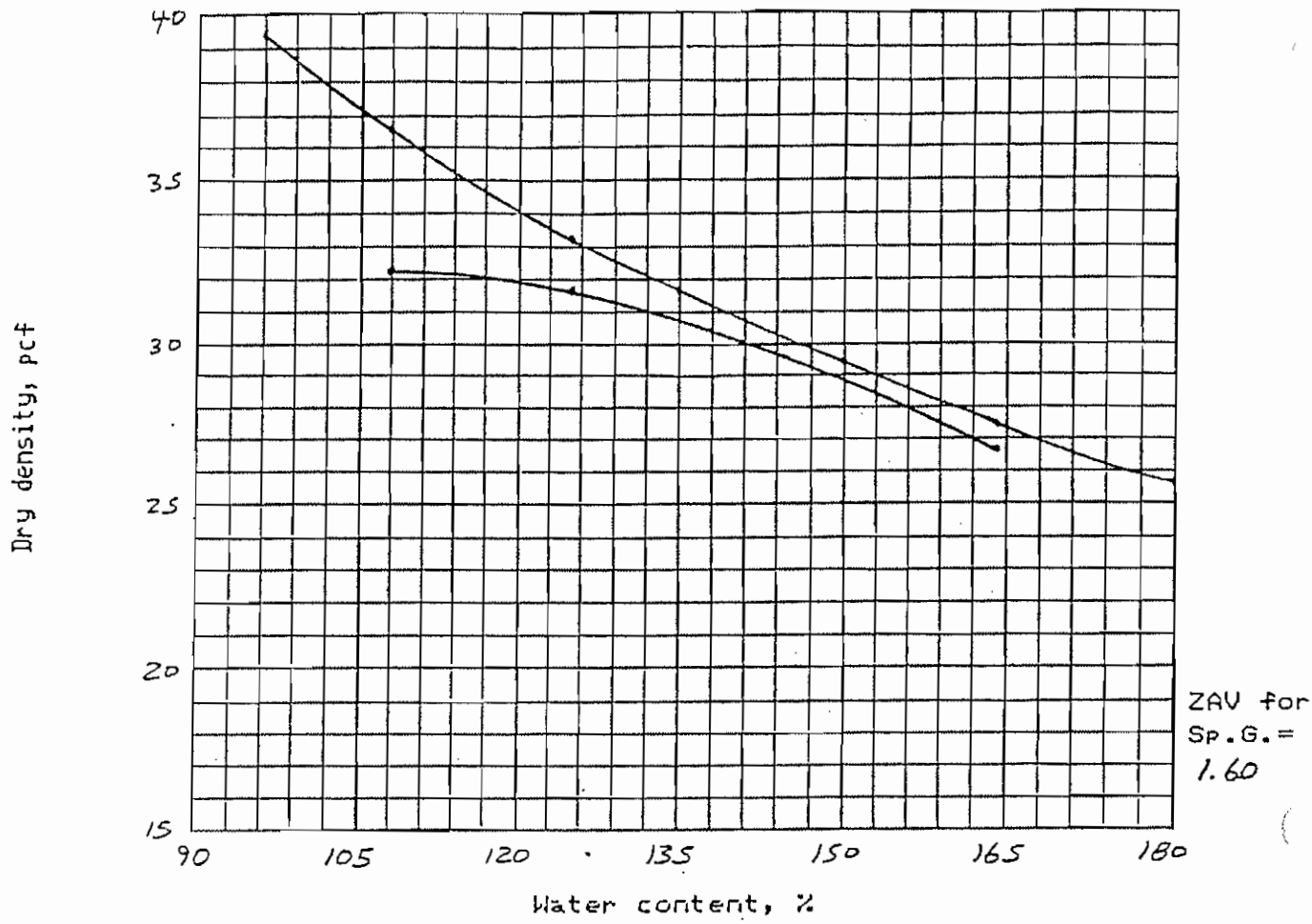
Remarks:

5-10 Method

S.S # Hammer
3 Lifts
1 ft. Drop
10 Blows per Lift

Fig. No. _____

COMPACTION TEST REPORT



Elev/ Depth	Classification USCS	Classification AASHTO	Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
			218 %					

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = Maximum dry density =	Sludge

Project No.: 467.41
Project: Weyerhaeuser
Location:

Date:

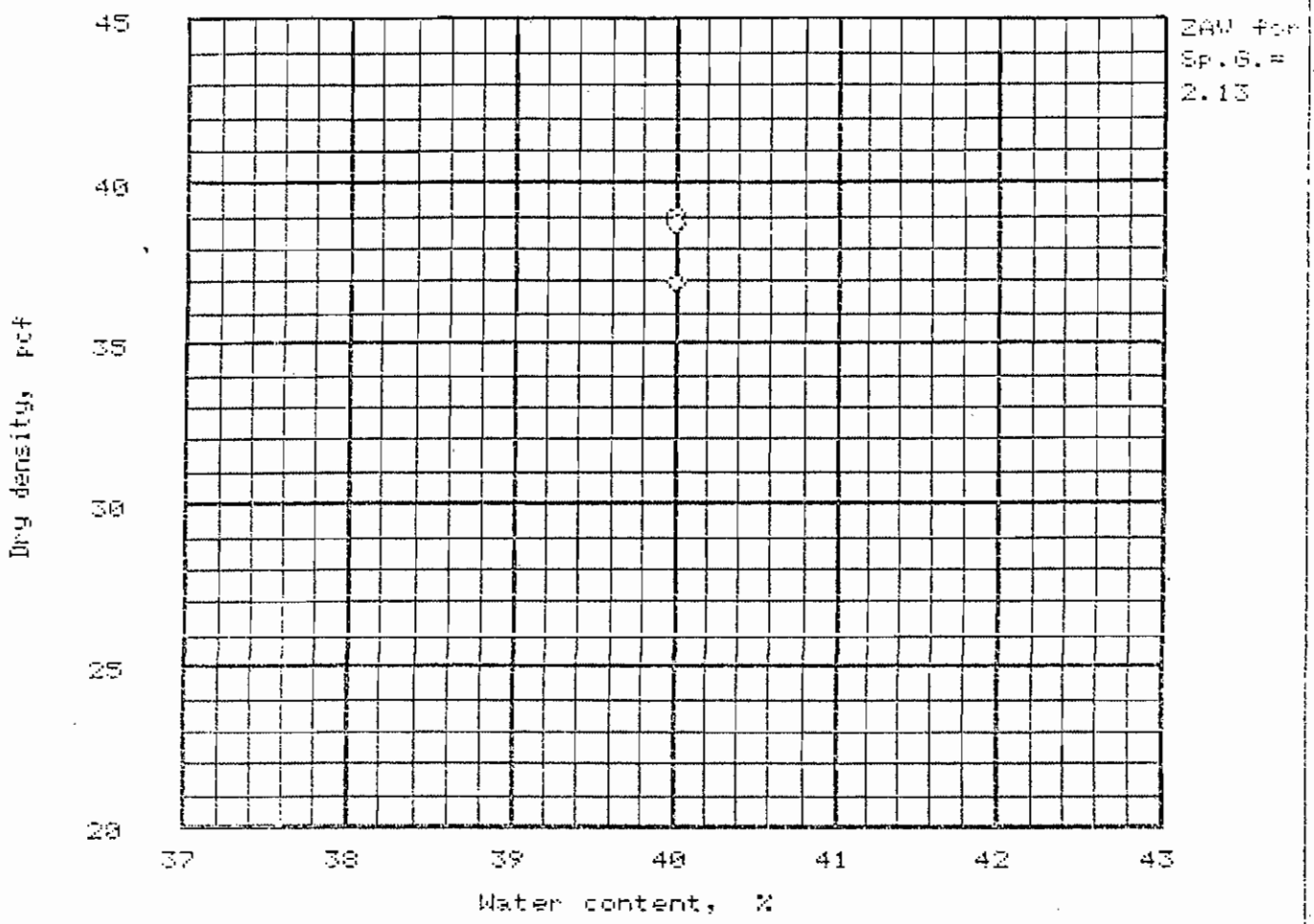
Remarks:

5-15 Method

COMPACTION TEST REPORT

Fig. No. ____

PROCTOR TEST REPORT



"Standard" Proctor, ASTM D 698, Method A

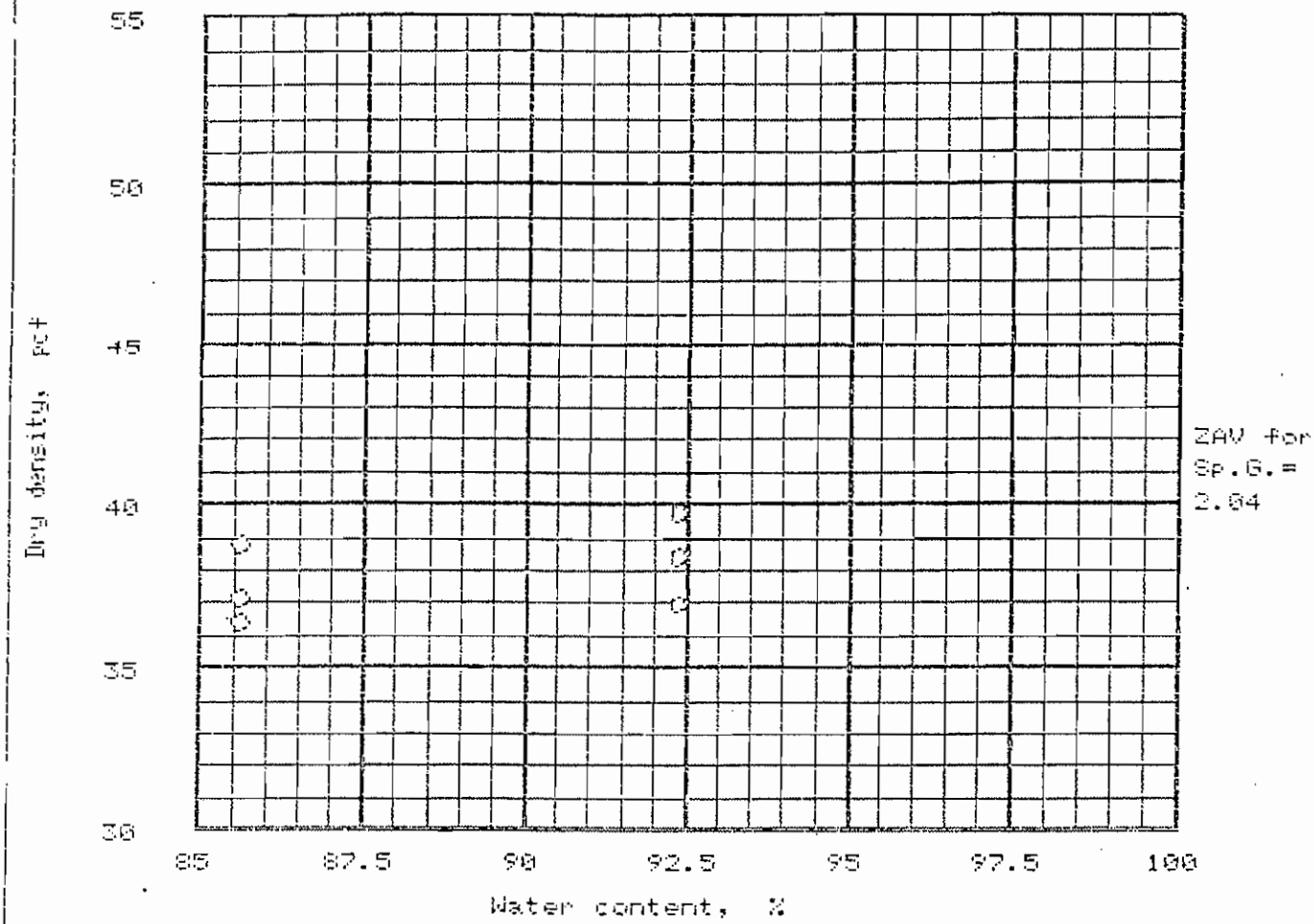
Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
			40 %	2.13				

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = Maximum dry density =	ASH

Project No.: 467.41 Project: WEYERHAEUSER Location: Date: 6-26-1990	Remarks: SAMPLE COMPACTED USING STANDARD PROCTPOR EFFORT ,5-15 & 5-10 EFFORT
PROCTOR TEST REPORT RMT Inc.	Figure No._____

6-26-90 ✓ VI 6.0

PROCTOR TEST REPORT



"Standard" Proctor, ASTM D 698, Method A

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
				2.04				

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = % Maximum dry density = pcf	SLUDGE @ 38% & 45% SOLIDS & ASH COMPOSITES

Project No.: 467.41
Project: WEYERHAEUSER
Location:

Date: 6-26-1990

Remarks:
SAMPLES COMPACTED USING STANDARD PROCTOR EFFORT, 5-15 & 5-10 EFFORT

PROCTOR TEST REPORT

RMT Inc.

Figure No._____

Attachment D2
ASB Wastewater Solids TCLP Report

ASB SLUDGE

Weyerhaeuser Analytical and Testing Services TCLP Report

SR# 03638

Submitted By: Woody Bryant New Bern 121
Service Request Title: Plymouth Sludge samples for dioxin and full TCLP

Date Received: 4/11/97
Date Extracted: 04/23/1997 (4/15/97 for Semivolatile Organics)
Date ZHE Extracted: 4/16/97

EPA #	Constituent	80021 Z1 04/03/97 1700	Quantitation Limit	TCLP Maximum	% Spike Recovery	Method Number
		(mg/L in TCLP extract)				
	pH on 5% Sample	7.3				
	Extraction Fluid Used	#1				
	Metals					
D004	Arsenic	ND	0.1	5.0	93	AM1-1311/ AM1-3010/6010
D005	Barium	0.87	0.01	100	91	AM1-1311/ AM1-3010/6010
D006	Cadmium	ND	0.01	1.0	94	AM1-1311/ AM1-3010/6010
D007	Chromium (total)	0.02	0.01	5.0	91	AM1-1311/ AM1-3010/6010
D008	Lead	ND	0.1	5.0	95	AM1-1311/ AM1-3010/6010
D009	Mercury	ND	0.001	0.2	81	AM1-1311/ AM1-245.1
D010	Selenium	ND	0.005	1.0	102	AM1-1311/ AM1-3010/200.9
D011	Silver	ND	0.01	5.0	76	AM1-1311/ AM1-3010/6010
	Insecticides/Herbicides					
D020	Chlordane	ND	0.002	0.03	NA	AM1-1311/8080
D012	Endrin	ND	0.0001	0.02	88	AM1-1311/8080
D031	Heptachlor	ND	0.0001	0.008	62	AM1-1311/8080
D031	Heptachlor Epoxide	ND	0.00005	0.008	70	AM1-1311/8080
D013	Lindane	ND	0.00005	0.4	67	AM1-1311/8080
D014	Methoxychlor	ND	0.0001	10	80	AM1-1311/8080
D015	Toxaphene	ND	0.005	0.5	NA	AM1-1311/8080
D016	2,4-D	ND	0.004	10		AM1-1311/8150
D017	2,4,5-TP (Silvex)	ND	0.004	1.0		AM1-1311/8150

000007

Approved _____

Report Date 5/21/97

Weyerhaeuser Analytical and Testing Services TCLP Report

SR# 03638

Submitted By: Woody Bryant New Bern 121
Service Request Title: Plymouth Sludge samples for dioxin and full TCLP

Date Received: 4/11/97
Date Extracted: 04/23/1997 (4/15/97 for Semivolatile Organics)
Date ZHE Extracted: 4/16/97

EPA #	Constituent	80021 Z1 04/03/97 1700	Quantitation Limit	TCLP Maximum	% Spike Recovery	Method Number
		(mg/L in TCLP extract)				
	VOAs					
D018	Benzene	ND	0.10	0.5	101	AM1-1311/8240
D019	Carbon Tetrachloride	ND	0.10	0.5	100	AM1-1311/8240
D021	Chlorobenzene	ND	0.10	100	99	AM1-1311/8240
D022	Chloroform	ND	0.10	6.0	104	AM1-1311/8240
D028	1,2-Dichloroethane	ND	0.10	0.5	108	AM1-1311/8240
D029	1,1-Dichloroethylene	ND	0.10	0.7	98	AM1-1311/8240
D035	Methyl ethyl ketone	ND	0.10	200	99	AM1-1311/8240
D039	Tetrachloroethylene	ND	0.10	0.7	99	AM1-1311/8240
D040	Trichloroethylene	ND	0.10	0.5	100	AM1-1311/8240
D043	Vinyl chloride	ND	0.10	0.2	94	AM1-1311/8240
	Semivolatiles					
D023	o-Cresol	ND	0.10	200		AM1-1311/8270
D024	m-Cresol	0.1	0.10	200		AM1-1311/8270
D025	p-Cresol	0.1	0.10	200		AM1-1311/8270
D026	Cresols	0.1	0.10	200		AM1-1311/8270
D027	1,4-Dichlorobenzene	ND	0.10	7.5		AM1-1311/8270
D030	2,4-Dinitrotoluene	ND	0.10	0.13		AM1-1311/8270
D032	Hexachlorobenzene	ND	0.10	0.13		AM1-1311/8270
D033	Hexachlorobutadiene	ND	0.10	0.5		AM1-1311/8270
D034	Hexachloroethane	ND	0.10	3.0		AM1-1311/8270
D036	Nitrobenzene	ND	0.10	2.0		AM1-1311/8270
D037	Pentachlorophenol	ND	0.10	100		AM1-1311/8270
D038	Pyridine	ND	0.10	5.0		AM1-1311/8270
D041	2,4,5-Trichlorophenol	ND	0.10	400		AM1-1311/8270
D042	2,4,6-Trichlorophenol	ND	0.10	2.0		AM1-1311/8270

ND= Not Detected above the Quantitation Limit Listed
* m-cresol and p-cresol are not separated.

Notes: (1) Extraction fluid #1 is always used for VOA (ZHE).

(2) TCLP metals have not been corrected for spike recovery.

(3) The TCLP extraction for sample 80021 was performed 5 days past the holding time for BNAs.

Approved _____

Report Date 5/21/97

Weyerhaeuser Analytical and Testing Services TCLP Report

SR# 03638

Submitted By: Woody Bryant New Bern 121
Service Request Title: Plymouth Sludge samples for dioxin and full TCLP

Date Received: 4/11/97
Date Extracted: 4/23/97
Date ZHE Extracted: NA

EPA #	Constituent	80021RE Z1 04/03/97 1700	Quantitation Limit	TCLP Maximum	% Spike Recovery	Method Number
		(mg/L in TCLP extract)				
	pH on 5% Sample	7.3				
	Extraction Fluid Used	#1				
	Metals					
D004	Arsenic	NA	0.1	5.0		AM1-1311/ AM1-3010/6010
D005	Barium	NA	0.01	100		AM1-1311/ AM1-3010/6010
D006	Cadmium	NA	0.01	1.0		AM1-1311/ AM1-3010/6010
D007	Chromium (total)	NA	0.01	5.0		AM1-1311/ AM1-3010/6010
D008	Lead	NA	0.1	5.0		AM1-1311/ AM1-3010/6010
D009	Mercury	NA	0.001	0.2		AM1-1311/ AM1-245.1
D010	Selenium	NA	0.005	1.0		AM1-1311/ AM1-3010/200.9
D011	Silver	NA	0.01	5.0		AM1-1311/ AM1-3010/6010
	Insecticides/Herbicides					
D020	Chlordane	ND	0.002	0.03		AM1-1311/8080
D012	Endrin	ND	0.0001	0.02		AM1-1311/8080
D031	Heptachlor	ND	0.0001	0.008		AM1-1311/8080
D031	Heptachlor Epoxide	ND	0.00005	0.008		AM1-1311/8080
D013	Lindane	ND	0.00005	0.4		AM1-1311/8080
D014	Methoxychlor	ND	0.0001	10		AM1-1311/8080
D015	Toxaphene	ND	0.005	0.5		AM1-1311/8080
D016	2,4-D	ND	0.004	10		AM1-1311/8150
D017	2,4,5-TP (Silvex)	ND	0.004	1.0		AM1-1311/8150

Approved _____

Report Date 5/21/97

Weyerhaeuser Analytical and Testing Services TCLP Report

SR# 03638

Submitted By: Woody Bryant New Bern 121
Service Request Title: Plymouth Sludge samples for dioxin and full TCLP

Date Received: 4/11/97
Date Extracted: 4/23/97
Date ZHE Extracted: NA

EPA #	Constituent	80021RE Z1 04/03/97 1700	Quantitation Limit	TCLP Maximum	% Spike Recovery	Method Number
		(mg/L in TCLP extract)				
	VOAs					
D018	Benzene	NA	0.10	0.5		AM1-1311/8240
D019	Carbon Tetrachloride	NA	0.10	0.5		AM1-1311/8240
D021	Chlorobenzene	NA	0.10	100		AM1-1311/8240
D022	Chloroform	NA	0.10	6.0		AM1-1311/8240
D028	1,2-Dichloroethane	NA	0.10	0.5		AM1-1311/8240
D029	1,1-Dichloroethylene	NA	0.10	0.7		AM1-1311/8240
D035	Methyl ethyl ketone	NA	0.10	200		AM1-1311/8240
D039	Tetrachloroethylene	NA	0.10	0.7		AM1-1311/8240
D040	Trichloroethylene	NA	0.10	0.5		AM1-1311/8240
D043	Vinyl chloride	NA	0.10	0.2		AM1-1311/8240
	Semivolatiles					
D023	o-Cresol	ND	0.10	200		AM1-1311/8270
D024	m-Cresol	0.1	0.10	200		AM1-1311/8270
D025	p-Cresol	0.1	0.10	200		AM1-1311/8270
D026	Cresols	0.1	0.10	200		AM1-1311/8270
D027	1,4-Dichlorobenzene	ND	0.10	7.5		AM1-1311/8270
D030	2,4-Dinitrotoluene	ND	0.10	0.13		AM1-1311/8270
D032	Hexachlorobenzene	ND	0.10	0.13		AM1-1311/8270
D033	Hexachlorobutadiene	ND	0.10	0.5		AM1-1311/8270
D034	Hexachloroethane	ND	0.10	3.0		AM1-1311/8270
D036	Nitrobenzene	ND	0.10	2.0		AM1-1311/8270
D037	Pentachlorophenol	ND	0.10	100		AM1-1311/8270
D038	Pyridine	ND	0.10	5.0		AM1-1311/8270
D041	2,4,5-Trichlorophenol	ND	0.10	400		AM1-1311/8270
D042	2,4,6-Trichlorophenol	ND	0.10	2.0		AM1-1311/8270

ND= Not Detected above the Quantitation Limit Listed

Notes: (1) Extraction fluid #1 is always used for VOA (ZHE).

(2) TCLP metals have not been corrected for spike recovery.

(3) The TCLP extraction for sample 80021 was performed 5 days past the holding time for BNAs.

Approved _____

Report Date 5/21/97

Weyerhaeuser Analytical and Testing Services TCLP Report

SR# 03638

Submitted By: Woody Bryant New Bern 121
Service Request Title: Plymouth Sludge samples for dioxin and full TCLP

Date Received: 4/11/97
Date Extracted: 04/23/1997 (4/15/97 for Semivolatile Organics)
Date ZHE Extracted: 4/16/97

EPA #	Constituent	80024 Z2 04/03/97 1700	Quantitation Limit	TCLP Maximum	% Spike Recovery	Method Number
		(mg/L in TCLP extract)				
	pH on 5% Sample	7.4				
	Extraction Fluid Used	#1				
	Metals					
D004	Arsenic	ND	0.1	5.0		AM1-1311/ AM1-3010/6010
D005	Barium	0.77	0.01	100		AM1-1311/ AM1-3010/6010
D006	Cadmium	ND	0.01	1.0		AM1-1311/ AM1-3010/6010
D007	Chromium (total)	0.02	0.01	5.0		AM1-1311/ AM1-3010/6010
D008	Lead	ND	0.1	5.0		AM1-1311/ AM1-3010/6010
D009	Mercury	ND	0.001	0.2		AM1-1311/ AM1-245.1
D010	Selenium	ND	0.005	1.0		AM1-1311/ AM1-3010/200.9
D011	Silver	ND	0.01	5.0		AM1-1311/ AM1-3010/6010
	Insecticides/Herbicides					
D020	Chlordane	ND	0.002	0.03		AM1-1311/8080
D012	Endrin	ND	0.0001	0.02		AM1-1311/8080
D031	Heptachlor	ND	0.0001	0.008		AM1-1311/8080
D031	Heptachlor Epoxide	ND	0.00005	0.008		AM1-1311/8080
D013	Lindane	ND	0.00005	0.4		AM1-1311/8080
D014	Methoxychlor	ND	0.0001	10		AM1-1311/8080
D015	Toxaphene	ND	0.005	0.5		AM1-1311/8080
D016	2,4-D	ND	0.004	0.004	110	AM1-1311/8150
D017	2,4,5-TP (Silvex)	ND	0.004	0.004	106	AM1-1311/8150

Approved

Report Date 5/21/97

Weyerhaeuser Analytical and Testing Services TCLP Report

SR# 03638

Submitted By: Woody Bryant New Bern 121
Service Request Title: Plymouth Sludge samples for dioxin and full TCLP

Date Received: 4/11/97
Date Extracted: 04/23/1997 (4/15/97 for Semivolatile Organics)
Date ZHE Extracted: 4/16/97

EPA #	Constituent	80024 Z2 04/03/97 1700	Quantitation Limit	TCLP Maximum	% Spike Recovery	Method Number
		(mg/L in TCLP extract)				
	VOAs					
D018	Benzene	ND	0.10	0.5	97	AM1-1311/8240
D019	Carbon Tetrachloride	ND	0.10	0.5	96	AM1-1311/8240
D021	Chlorobenzene	ND	0.10	100	97	AM1-1311/8240
D022	Chloroform	ND	0.10	6.0	105	AM1-1311/8240
D028	1,2-Dichloroethane	ND	0.10	0.5	106	AM1-1311/8240
D029	1,1-Dichloroethylene	ND	0.10	0.7	98	AM1-1311/8240
D035	Methyl ethyl ketone	ND	0.10	200	100	AM1-1311/8240
D039	Tetrachloroethylene	ND	0.10	0.7	97	AM1-1311/8240
D040	Trichloroethylene	ND	0.10	0.5	98	AM1-1311/8240
D043	Vinyl chloride	ND	0.10	0.2	92	AM1-1311/8240
	Semivolatiles					
D023	o-Cresol	ND	0.10	200		AM1-1311/8270
D024	m-Cresol	ND	0.10	200		AM1-1311/8270
D025	p-Cresol	ND	0.10	200		AM1-1311/8270
D026	Cresols	ND	0.10	200		AM1-1311/8270
D027	1,4-Dichlorobenzene	ND	0.10	7.5		AM1-1311/8270
D030	2,4-Dinitrotoluene	ND	0.10	0.13		AM1-1311/8270
D032	Hexachlorobenzene	ND	0.10	0.13		AM1-1311/8270
D033	Hexachlorobutadiene	ND	0.10	0.5		AM1-1311/8270
D034	Hexachloroethane	ND	0.10	3.0		AM1-1311/8270
D036	Nitrobenzene	ND	0.10	2.0		AM1-1311/8270
D037	Pentachlorophenol	ND	0.10	100		AM1-1311/8270
D038	Pyridine	ND	0.10	5.0		AM1-1311/8270
D041	2,4,5-Trichlorophenol	ND	0.10	400		AM1-1311/8270
D042	2,4,6-Trichlorophenol	ND	0.10	2.0		AM1-1311/8270

ND= Not Detected above the Quantitation Limit Listed

Notes: (1) Extraction fluid #1 is always used for VOA (ZHE).

(2) TCLP metals have not been corrected for spike recovery.

(3) The TCLP extraction for sample 80024 was performed 5 days past the holding time for BNAs.

Approved _____

Report Date 5/21/97

Weyerhaeuser Analytical and Testing Services TCLP Report

SR# 03638

Submitted By: Woody Bryant New Bern 121
Service Request Title: Plymouth Sludge samples for dioxin and full TCLP

Date Received: 4/11/97
Date Extracted: 4/23/97
Date ZHE Extracted: NA

EPA #	Constituent	80024RE Z2 04/03/97 1700	Quantitation Limit	TCLP Maximum	% Spike Recovery	Method Number
		(mg/L in TCLP extract)				
	pH on 5% Sample	7.4				
	Extraction Fluid Used	#1				
	Metals					
D004	Arsenic	NA	0.1	5.0		AM1-1311/ AM1-3010/6010
D005	Barium	NA	0.01	100		AM1-1311/ AM1-3010/6010
D006	Cadmium	NA	0.01	1.0		AM1-1311/ AM1-3010/6010
D007	Chromium (total)	NA	0.01	5.0		AM1-1311/ AM1-3010/6010
D008	Lead	NA	0.1	5.0		AM1-1311/ AM1-3010/6010
D009	Mercury	NA	0.001	0.2		AM1-1311/ AM1-245.1
D010	Selenium	NA	0.005	1.0		AM1-1311/ AM1-3010/200.9
D011	Silver	NA	0.01	5.0		AM1-1311/ AM1-3010/6010
	Insecticides/Herbicides					
D020	Chlordane	ND	0.002	0.03		AM1-1311/8080
D012	Endrin	ND	0.0001	0.02		AM1-1311/8080
D031	Heptachlor	ND	0.0001	0.008		AM1-1311/8080
D031	Heptachlor Epoxide	ND	0.00005	0.008		AM1-1311/8080
D013	Lindane	ND	0.00005	0.4		AM1-1311/8080
D014	Methoxychlor	ND	0.0001	10		AM1-1311/8080
D015	Toxaphene	ND	0.005	0.5		AM1-1311/8080
D016	2,4-D	ND	0.004	10		AM1-1311/8150
D017	2,4,5-TP (Silvex)	ND	0.004	1.0		AM1-1311/8150

Approved _____

Report Date 5/21/97

Weyerhaeuser Analytical and Testing Services TCLP Report

SR# 03638

Submitted By: Woody Bryant New Bern 121
Service Request Title: Plymouth Sludge samples for dioxin and full TCLP

Date Received: 4/11/97
Date Extracted: 4/23/97
Date ZHE Extracted: NA

EPA #	Constituent	80024RE Z2 04/03/97 1700	Quantitation Limit	TCLP Maximum	% Spike Recovery	Method Number
		(mg/L in TCLP extract)				
	VOAs					
D018	Benzene	NA	0.10	0.5		AM1-1311/8240
D019	Carbon Tetrachloride	NA	0.10	0.5		AM1-1311/8240
D021	Chlorobenzene	NA	0.10	100		AM1-1311/8240
D022	Chloroform	NA	0.10	6.0		AM1-1311/8240
D028	1,2-Dichloroethane	NA	0.10	0.5		AM1-1311/8240
D029	1,1-Dichloroethylene	NA	0.10	0.7		AM1-1311/8240
D035	Methyl ethyl ketone	NA	0.10	200		AM1-1311/8240
D039	Tetrachloroethylene	NA	0.10	0.7		AM1-1311/8240
D040	Trichloroethylene	NA	0.10	0.5		AM1-1311/8240
D043	Vinyl chloride	NA	0.10	0.2		AM1-1311/8240
	Semivolatiles					
D023	o-Cresol	ND	0.10	200		AM1-1311/8270
D024	m-Cresol	ND	0.10	200		AM1-1311/8270
D025	p-Cresol	ND	0.10	200		AM1-1311/8270
D026	Cresols	ND	0.10	200		AM1-1311/8270
D027	1,4-Dichlorobenzene	ND	0.10	7.5		AM1-1311/8270
D030	2,4-Dinitrotoluene	ND	0.10	0.13		AM1-1311/8270
D032	Hexachlorobenzene	ND	0.10	0.13		AM1-1311/8270
D033	Hexachlorobutadiene	ND	0.10	0.5		AM1-1311/8270
D034	Hexachloroethane	ND	0.10	3.0		AM1-1311/8270
D036	Nitrobenzene	ND	0.10	2.0		AM1-1311/8270
D037	Pentachlorophenol	ND	0.10	100		AM1-1311/8270
D038	Pyridine	ND	0.10	5.0		AM1-1311/8270
D041	2,4,5-Trichlorophenol	ND	0.10	400		AM1-1311/8270
D042	2,4,6-Trichlorophenol	ND	0.10	2.0		AM1-1311/8270

ND= Not Detected above the Quantitation Limit Listed

Notes: **(1) Extraction fluid #1 is always used for VOA (ZHE).**

(2) TCLP metals have not been corrected for spike recovery.

(3) The TCLP extraction for sample 80024 was performed 5 days past the holding time for BNAs.

Approved _____

Report Date 5/21/97

Weyerhaeuser Analytical and Testing Services TCLP Report

SR# 03638

Submitted By: Woody Bryant New Bern 121
Service Request Title: Plymouth Sludge samples for dioxin and full TCLP

Date Received: 4/11/97
Date Extracted: 4/17/97
Date ZHE Extracted: 4/16/97

EPA #	Constituent	80027 Z3 04/03/97 1700	Quantitation Limit	TCLP Maximum	% Spike Recovery	Method Number
		(mg/L in TCLP extract)				
	pH on 5% Sample	6.8				
	Extraction Fluid Used	#1				
	Metals					
D004	Arsenic	ND	0.1	5.0		AM1-1311/ AM1-3010/6010
D005	Barium	0.66	0.01	100		AM1-1311/ AM1-3010/6010
D006	Cadmium	ND	0.01	1.0		AM1-1311/ AM1-3010/6010
D007	Chromium (total)	0.02	0.01	5.0		AM1-1311/ AM1-3010/6010
D008	Lead	ND	0.1	5.0		AM1-1311/ AM1-3010/6010
D009	Mercury	ND	0.001	0.2		AM1-1311/ AM1-245.1
D010	Selenium	ND	0.005	1.0		AM1-1311/ AM1-3010/200.9
D011	Silver	ND	0.01	5.0		AM1-1311/ AM1-3010/6010
	Insecticides/Herbicides					
D020	Chlordane	ND	0.002	0.03		AM1-1311/8080
D012	Endrin	ND	0.0001	0.02		AM1-1311/8080
D031	Heptachlor	ND	0.0001	0.008		AM1-1311/8080
D031	Heptachlor Epoxide	ND	0.00005	0.008		AM1-1311/8080
D013	Lindane	ND	0.00005	0.4		AM1-1311/8080
D014	Methoxychlor	ND	0.0001	10		AM1-1311/8080
D015	Toxaphene	ND	0.005	0.5		AM1-1311/8080
D016	2,4-D	ND	0.004	10		AM1-1311/8150
D017	2,4,5-TP (Silvex)	ND	0.004	1.0		AM1-1311/8150

Approved _____

Report Date 5/21/97

Weyerhaeuser Analytical and Testing Services TCLP Report

SR# 03638

Submitted By: Woody Bryant New Bern 121
Service Request Title: Plymouth Sludge samples for dioxin and full TCLP

Date Received: 4/11/97
Date Extracted: 4/17/97
Date ZHE Extracted: 4/16/97

EPA #	Constituent	80027 Z3 04/03/97 1700	Quantitation Limit	TCLP Maximum	% Spike Recovery	Method Number
		(mg/L in TCLP extract)				
	VOAs					
D018	Benzene	ND	0.10	0.5	97	AM1-1311/8240
D019	Carbon Tetrachloride	ND	0.10	0.5	93	AM1-1311/8240
D021	Chlorobenzene	ND	0.10	100	93	AM1-1311/8240
D022	Chloroform	ND	0.10	6.0	99	AM1-1311/8240
D028	1,2-Dichloroethane	ND	0.10	0.5	104	AM1-1311/8240
D029	1,1-Dichloroethylene	ND	0.10	0.7	94	AM1-1311/8240
D035	Methyl ethyl ketone	ND	0.10	200	86	AM1-1311/8240
D039	Tetrachloroethylene	ND	0.10	0.7	93	AM1-1311/8240
D040	Trichloroethylene	ND	0.10	0.5	96	AM1-1311/8240
D043	Vinyl chloride	ND	0.10	0.2	89	AM1-1311/8240
	Semivolatiles					
D023	o-Cresol	ND	0.10	200	72	AM1-1311/8270
D024	m-Cresol	ND	0.10	200	72	AM1-1311/8270
D025	p-Cresol	ND	0.10	200	72	AM1-1311/8270
D026	Cresols	ND	0.10	200	72	AM1-1311/8270
D027	1,4-Dichlorobenzene	ND	0.10	7.5	78	AM1-1311/8270
D030	2,4-Dinitrotoluene	ND	0.10	0.13	96	AM1-1311/8270
D032	Hexachlorobenzene	ND	0.10	0.13	72	AM1-1311/8270
D033	Hexachlorobutadiene	ND	0.10	0.5	76	AM1-1311/8270
D034	Hexachloroethane	ND	0.10	3.0	76	AM1-1311/8270
D036	Nitrobenzene	ND	0.10	2.0	88	AM1-1311/8270
D037	Pentachlorophenol	ND	0.10	100	114	AM1-1311/8270
D038	Pyridine	ND	0.10	5.0	68	AM1-1311/8270
D041	2,4,5-Trichlorophenol	ND	0.10	400	80	AM1-1311/8270
D042	2,4,6-Trichlorophenol	ND	0.10	2.0	80	AM1-1311/8270

ND= Not Detected above the Quantitation Limit Listed

Notes: (1) Extraction fluid #1 is always used for VOA (ZHE).

(2) TCLP metals have not been corrected for spike recovery.

Approved _____

Report Date 5/21/97

Weyerhaeuser Analytical and Testing Services TCLP Report

SR# 03638

Submitted By: Woody Bryant New Bern 121
Service Request Title: Plymouth Sludge samples for dioxin and full TCLP

Date Received: 4/11/97
Date Extracted: 4/17/97
Date ZHE Extracted: 4/20/97

EPA #	Constituent	80030 R1 04/07/97 1700	Quantitation Limit	TCLP Maximum	% Spike Recovery	Method Number
		(mg/L in TCLP extract)				
	pH on 5% Sample	6.9				
	Extraction Fluid Used	#1				
	Metals					
D004	Arsenic	ND	0.1			AM1-1311/ AM1-3010/6010
D005	Barium	0.86	0.01			AM1-1311/ AM1-3010/6010
D006	Cadmium	ND	0.01			AM1-1311/ AM1-3010/6010
D007	Chromium (total)	0.01	0.01			AM1-1311/ AM1-3010/6010
D008	Lead	ND	0.1			AM1-1311/ AM1-3010/6010
D009	Mercury	ND	0.001			AM1-1311/ AM1-245.1
D010	Selenium	ND	0.005			AM1-1311/ AM1-3010/200.9
D011	Silver	ND	0.01			AM1-1311/ AM1-3010/6010
	Insecticides/Herbicides					
D020	Chlordane	ND	0.002	0.03		AM1-1311/8080
D012	Endrin	ND	0.0001	0.02		AM1-1311/8080
D031	Heptachlor	ND	0.0001	0.008		AM1-1311/8080
D031	Heptachlor Epoxide	ND	0.00005	0.008		AM1-1311/8080
D013	Lindane	ND	0.00005	0.4		AM1-1311/8080
D014	Methoxychlor	ND	0.0001	10		AM1-1311/8080
D015	Toxaphene	ND	0.005	0.5		AM1-1311/8080
D016	2,4-D	ND	0.004	10		AM1-1311/8150
D017	2,4,5-TP (Silvex)	ND	0.004	1.0		AM1-1311/8150

Approved _____

Report Date 5/21/97

Weyerhaeuser Analytical and Testing Services TCLP Report

SR# 03638

Submitted By: Woody Bryant New Bern 121
Service Request Title: Plymouth Sludge samples for dioxin and full TCLP

Date Received: 4/11/97
Date Extracted: 4/17/97
Date ZHE Extracted: 4/20/97

EPA #	Constituent	80030 R1 04/07/97 1700	Quantitation Limit	TCLP Maximum	% Spike Recovery	Method Number
		(mg/L in TCLP extract)				
	VOAs					
D018	Benzene	ND	0.10	0.5	96	AM1-1311/8240
D019	Carbon Tetrachloride	ND	0.10	0.5	97	AM1-1311/8240
D021	Chlorobenzene	ND	0.10	100	96	AM1-1311/8240
D022	Chloroform	ND	0.10	6.0	96	AM1-1311/8240
D028	1,2-Dichloroethane	ND	0.10	0.5	99	AM1-1311/8240
D029	1,1-Dichloroethylene	ND	0.10	0.7	96	AM1-1311/8240
D035	Methyl ethyl ketone	ND	0.10	200	64	AM1-1311/8240
D039	Tetrachloroethylene	ND	0.10	0.7	90	AM1-1311/8240
D040	Trichloroethylene	ND	0.10	0.5	98	AM1-1311/8240
D043	Vinyl chloride	ND	0.10	0.2	96	AM1-1311/8240
	Semivolatiles					
D023	o-Cresol	ND	0.10	200		AM1-1311/8270
D024	m-Cresol	ND	0.10	200		AM1-1311/8270
D025	p-Cresol	ND	0.10	200		AM1-1311/8270
D026	Cresols	ND	0.10	200		AM1-1311/8270
D027	1,4-Dichlorobenzene	ND	0.10	7.5		AM1-1311/8270
D030	2,4-Dinitrotoluene	ND	0.10	0.13		AM1-1311/8270
D032	Hexachlorobenzene	ND	0.10	0.13		AM1-1311/8270
D033	Hexachlorobutadiene	ND	0.10	0.5		AM1-1311/8270
D034	Hexachloroethane	ND	0.10	3.0		AM1-1311/8270
D036	Nitrobenzene	ND	0.10	2.0		AM1-1311/8270
D037	Pentachlorophenol	ND	0.10	100		AM1-1311/8270
D038	Pyridine	ND	0.10	5.0		AM1-1311/8270
D041	2,4,5-Trichlorophenol	ND	0.10	400		AM1-1311/8270
D042	2,4,6-Trichlorophenol	ND	0.10	2.0		AM1-1311/8270

ND= Not Detected above the Quantitation Limit Listed

Notes: (1) Extraction fluid #1 is always used for VOA (ZHE).

(2) TCLP metals have not been corrected for spike recovery.

Approved _____

Report Date 5/21/97

Weyerhaeuser Analytical and Testing Services TCLP Report

SR# 03638

Submitted By: Woody Bryant New Bern 121
Service Request Title: Plymouth Sludge samples for dioxin and full TCLP

Date Received: 4/11/97
Date Extracted: 4/17/97
Date ZHE Extracted: 4/17/97

EPA #	Constituent	80033 R2 04/07/97 1700	Quantitation Limit	TCLP Maximum	% Spike Recovery	Method Number
		(mg/L in TCLP extract)				
	pH on 5% Sample	6.9				
	Extraction Fluid Used	#1				
	Metals					
D004	Arsenic	ND	0.1	5.0		AM1-1311/ AM1-3010/6010
D005	Barium	1.07	0.01	100		AM1-1311/ AM1-3010/6010
D006	Cadmium	ND	0.01	1.0		AM1-1311/ AM1-3010/6010
D007	Chromium (total)	0.01	0.01	5.0		AM1-1311/ AM1-3010/6010
D008	Lead	ND	0.1	5.0		AM1-1311/ AM1-3010/6010
D009	Mercury	ND	0.001	0.2		AM1-1311/ AM1-245.1
D010	Selenium	ND	0.005	1.0		AM1-1311/ AM1-3010/200.9
D011	Silver	ND	0.01	5.0		AM1-1311/ AM1-3010/6010
	Insecticides/Herbicides					
D020	Chlordane	ND	0.002	0.03		AM1-1311/8080
D012	Endrin	ND	0.0001	0.02		AM1-1311/8080
D031	Heptachlor	ND	0.0001	0.008		AM1-1311/8080
D031	Heptachlor Epoxide	ND	0.00005	0.008		AM1-1311/8080
D013	Lindane	ND	0.00005	0.4		AM1-1311/8080
D014	Methoxychlor	ND	0.0001	10		AM1-1311/8080
D015	Toxaphene	ND	0.005	0.5		AM1-1311/8080
D016	2,4-D	ND	0.004	10		AM1-1311/8150
D017	2,4,5-TP (Silvex)	ND	0.004	1.0		AM1-1311/8150

Approved _____

Report Date 5/21/97

Weyerhaeuser Analytical and Testing Services TCLP Report

SR# 03638

Submitted By: Woody Bryant New Bern 121
Service Request Title: Plymouth Sludge samples for dioxin and full TCLP

Date Received: 4/11/97
Date Extracted: 4/17/97
Date ZHE Extracted: 4/17/97

EPA #	Constituent	80033 R2 04/07/97 1700	Quantitation Limit	TCLP Maximum	% Spike Recovery	Method Number
		(mg/L in TCLP extract)				
	VOAs					
D018	Benzene	ND	0.10	0.5	94	AM1-1311/8240
D019	Carbon Tetrachloride	ND	0.10	0.5	94	AM1-1311/8240
D021	Chlorobenzene	ND	0.10	100	93	AM1-1311/8240
D022	Chloroform	ND	0.10	6.0	95	AM1-1311/8240
D028	1,2-Dichloroethane	ND	0.10	0.5	97	AM1-1311/8240
D029	1,1-Dichloroethylene	ND	0.10	0.7	87	AM1-1311/8240
D035	Methyl ethyl ketone	ND	0.10	200	78	AM1-1311/8240
D039	Tetrachloroethylene	ND	0.10	0.7	96	AM1-1311/8240
D040	Trichloroethylene	ND	0.10	0.5	94	AM1-1311/8240
D043	Vinyl chloride	ND	0.10	0.2	81	AM1-1311/8240
	Semivolatiles					
D023	o-Cresol	ND	0.10	200		AM1-1311/8270
D024	m-Cresol	ND	0.10	200		AM1-1311/8270
D025	p-Cresol	ND	0.10	200		AM1-1311/8270
D026	Cresols	ND	0.10	200		AM1-1311/8270
D027	1,4-Dichlorobenzene	ND	0.10	7.5		AM1-1311/8270
D030	2,4-Dinitrotoluene	ND	0.10	0.13		AM1-1311/8270
D032	Hexachlorobenzene	ND	0.10	0.13		AM1-1311/8270
D033	Hexachlorobutadiene	ND	0.10	0.5		AM1-1311/8270
D034	Hexachloroethane	ND	0.10	3.0		AM1-1311/8270
D036	Nitrobenzene	ND	0.10	2.0		AM1-1311/8270
D037	Pentachlorophenol	ND	0.10	100		AM1-1311/8270
D038	Pyridine	ND	0.10	5.0		AM1-1311/8270
D041	2,4,5-Trichlorophenol	ND	0.10	400		AM1-1311/8270
D042	2,4,6-Trichlorophenol	ND	0.10	2.0		AM1-1311/8270

ND= Not Detected above the Quantitation Limit Listed

Notes: (1) Extraction fluid #1 is always used for VOA (ZHE).

(2) TCLP metals have not been corrected for spike recovery.

Approved _____

Report Date 5/21/97

Laboratory comments for this sample delivery group are listed below. The comments are broken up into categories for ease of explanation.

1. VOA

   a) All samples and blanks contain a response near scan #100 due to carbon dioxide which is not reported as a TIC.

   b) The reported results were limited to those in the TCLP compound list. A sample matrix spike was prepared and analyzed per method requirements.

3. Semivolatile Organics

   a) The TCLP extraction procedure was repeated for samples Z1 and Z2 due to procedural problems for the initial TCLP extraction. The second extraction was performed outside of sample holding time. Both sets of extracts were analyzed for semivolatile organics and results are reported for both analyses.

4. Metals

   a) No comments.

5. TCLP Extraction

   a) Samples Z1 and Z2 were initially extracted with an error in the method. The combined filtrate from the percent solids determination was inadvertently added to the as received sample filtrate after rotation. This added filtrate was not supposed to be used in the analysis. The samples were extracted after this error was noticed, however, due to the fact that the laboratory did not receive these samples until day eight of the fourteen day holding time, these samples were reextracted outside the holding times by five days. Both the sample and the reextracted sample were processed through the remainder of the test and reported.

I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Dennis Catalano
Project Manager

5/22/97
Date

Please feel free to contact me with any questions concerning this data report. I can be reached at (253) 924-6242.

Sincerely,

Dennis Catalano
Weyerhaeuser Analytical & Testing Services

Attachment D3
Technical Memorandum Dated June 16, 1999, from Sharon Korleski

Evaluation of the Shear Strength of Dewatered Wastewater Solids With and Without Ash

Technical Memorandum

Date: June 16, 1999

To: Wynn Shaw

xc: Joe Cloaker, Mac Jones, Woody Bryant, Kent Nilsson, Kathy Huibregtse

From: Sharon Korleski SK

Project No: 5101.01

Subject: Evaluation of the shear strength of de-watered sludge with and without ash

Introduction

In 1994, RMT developed a Construction Plan Application for Weyerhaeuser to permit a new landfill at the Plymouth facility. However, as a result of recent property acquisitions and proposed site drainage improvements, Weyerhaeuser is considering the redesign of the proposed landfill to increase capacity and possibly to upgrade the liner system. In addition, the landfill waste stream will possibly be modified to include 30-year-old dioxin-affected sludge dredged from the wastewater treatment ponds. Weyerhaeuser is currently evaluating various methods for de-watering this sludge.

De-watering Methods

Pilot testing of the sludge de-watering methods has been conducted. A solids content of 40 percent or more was targeted. This translates in to ASTM D 2216 moisture content of 150 percent or less. It is desirous to produce a de-watered sludge with similar physical characteristics to soil, and with similar strength properties to the ash already being landfilled.

Five different methods were used to de-water the sludge:

- Netzsch Run 5, Netzsch Run 6, and JWI #2, plate and frame de-watering
- Andritz Run 12, a belt filter press de-watering
- Dry Vacuum

Shear Strength Testing

Since it is possible that the waste could be entirely or mostly sludge during the initial filling of the landfill, the de-watered sludge was remolded and subjected to triaxial shear strength testing. The shear strength parameters were evaluated to determine the effect that the de-watered sludge would have on the landfill design.

All sludge cake samples were remolded to approximate unit weights representative of the compaction they would receive during fill placement with a bulldozer. A single-point-reduced standard Proctor was used to simulate these field conditions. The reduced standard Proctor unit weight was achieved by remolding the de-watered sludge in a standard Proctor mold. Broken down sludge cake was placed in three equal layers, and each layer was compacted with 15 blows from a 5.5-pound hammer that has a 12-inch drop.

All five de-watered sludge samples were subjected to Undrained Unconsolidated (UU) triaxial shear strength testing and Consolidated Undrained (CU) triaxial shear strength testing with pore pressure measurements. The CU tests were run at both high (10, 20, and 40 psi) and low (2, 4, and 8 psi) confining pressures. The triaxial testing was conducted to determine if any one method of de-watering was superior to the others based on shear strength parameters.

Next, all five de-watered sludge samples were blended with ash at a 60/40 ratio (sludge to ash) based on their total or wet unit weights. These samples were also remolded to unit weights derived from a reduced standard Proctor. They were also subjected to CU testing with pore pressure measurements at the low (2, 4, and 8 psi) confining pressures. This testing was conducted to show the benefit of blending ash with the sludge to improve the shear strength and stability of the waste within the landfill.

Two additional CU tests are being run at the low confining pressures on re-hydrated samples of de-watered, Netzsch Run 5 sludge. The de-watered Netzsch Run 5 sludge will be re-wetted to simulate field conditions of a de-watered sludge deposited at the landfill that would be subjected to precipitation prior placement and compaction. This testing is being conducted to demonstrate how a de-watered sludge could loose its strength when exposed to precipitation, prior to placement and compaction.

Two additional CU tests will be run at the low confining pressures on re-hydrated samples of de-watered, Netzsch Run 5 sludge blended with ash. These samples of re-hydrated sludge will be blended with ash at a 60/40 ratio (sludge to ash) based on the total or wet weights. This testing will be conducted to evaluate any strength loss of de-watered sludge mixed with ash when exposed to precipitation, prior to placement and compaction.

Results

The percent solids, ASTM moisture contents, dry and wet unit weights of the de-watered sludge provided by the various de-watering methods, are presented in Table 1. The unconsolidated and consolidated undrained shear strength parameters of the de-watered remolded sludge are presented in Table 2. This table also presents the consolidated undrained parameters for both low and high confining pressures. Table 3 presents the consolidated undrained parameters for the sludge and the sludge treated with 40 percent ash at low confining pressures, to date. The dry unit weights and moisture contents for the sludge and the ash treated sludge are also shown on Table 3. Table 4 shows the CU triaxial results of de-watered and re-hydrated Run 5 sludge, along with the CU triaxial results of de-watered and re-hydrated Run 5 sludge blend with ash.

Conclusions

All de-watering methods, except Andritz Run 12, de-watered the sludge to the point where acceptable shear strength parameters could be achieved. While de-watered sludge (except Andritz Run 12) has adequate shear strength when compacted immediately after de-watering, experience has found that it often looses substantial amount of shear strength when re-wetted prior to compaction. However, the triaxial testing on re-hydrated samples of Run 5 provided inconclusive results. Therefore, additional testing will be conducted by RMT's laboratory in Madison, Wisconsin. Re-wetting of the de-watered sludge due to precipitation in the field could occur between the time the de-watered sludge is brought to the landfill and the time it is compacted. However, the results suggest that the sludge can be blended with ash to improve its compaction and shear strength characteristics, even when subjected to precipitation.

A stability analysis performed for in-place ash using an internal friction angle of 28 degrees and cohesion of 0 pounds per square foot (psf) resulted in an acceptable factor of safety. An acceptable factor of safety of 1.5 or greater may also be achieved for this landfill configuration, if the in-place sludge has an internal friction angle of at least 19 degrees and cohesion of at least 500 psf.

Recommendations

Once the final de-watering method is selected, additional testing may be required to refine the sludge placement protocol. In this round of testing, the sludge was mixed with ash at a 60 to 40 percent ratio. Additional testing should be conducted to see if a smaller ratio of ash to sludge could achieve the shear strength parameters required to maintain the current landfill design.

Table 1
Results of Reduced Standard Proctor and Moisture Testing

DE-WATERING METHOD	WET UNIT WEIGHT (pcf)	DRY UNIT WEIGHT (pcf)	AS-RECEIVED MOISTURE CONTENT (%)	AS-RECEIVED PERCENT SOLIDS (%)
Netzsch Run 5	69.3	31.8	117.8	45.9
Netzsch Run 6	73.1	27.1	169.8	37.1
Dry Vacuum	68.7	31.2	119.9	45.5
JWI #2	65.8	29.7	121.6	45.1
Andritz Run 12	65.1	16.1	303.9	24.8

pcf pounds per cubic foot

Table 2
Comparison of Strength Testing of Sludge Cake Remolded at "As-Received" Moisture Contents

DEWATERING METHOD	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	UU COHESION [c] (psf)	CU (1) COHESION [c] (psf)	CU (2) COHESION [c] (psf)	UU INTERNAL FRICTION ANGLE (degrees)	CU (1) INTERNAL FRICTION ANGLE (degrees)	CU (2) INTERNAL FRICTION ANGLE (degrees)
Netzsch Run 5	31.8	117.8	228	612	654	28.8	21.5	20.1
Netzsch Run 6	27.1	169.8	726	667	670	17.5	20.9	18.8
Dry Vacuum	31.2	119.9	704	1,017	940	32.5	19.6	19.1
JWI #2	29.7	121.6	1,096	1,151	1,022	25.0	19.1	19.5
Andritz Run 12	16.1	303.9	128	7	25	1.7	23	19.6

(1) Low Confining Pressures of 2, 4, and 8 psi
(2) High Confining Pressures of 10, 20, and 40 psi
UU Unconsolidated Undrained
CU Consolidated Undrained
psf pounds per square foot
pcf pounds per cubic foot

Table3
Comparison of Strength of Sludge vs. Sludge/Ash Mixture (60/40)
Remolded at "As-Received" Moisture Contents

DE-WATERING METHOD	SLUDGE DRY UNIT WT. (pcf)	ASH & SLUDGE DRY UNIT WT. (pcf)	SLUDGE MOISTURE CONTENT (%)	ASH & SLUDGE MOISTURE CONTENT (%)	SLUDGE CU COHESION [C] (psf)	ASH & SLUDGE CU COHESION [C] (psf)	SLUDGE CU INTERNAL FRICTION ANGLE (degrees)	ASH & SLUDGE CU INTERNAL FRICTION ANGLE (degrees)
Netzsch Run 5	31.8	43.3	117.8	63.5	612	945	21.5	31.6
[1]Netzsch Run 6	27.1	50.0	169.8	62.2	667	2,261	20.9	23.6
Dry Vacuum	31.2	43.3	119.9	56.9	1,017	742	19.6	31.6
JWI #2	29.7	45.0	121.6	50.3	1,151	508	19.1	35.7
Andritz Run 12	16.1	38.8	303.9	102.7	7	624	23	10.5

CU Consolidated Undrained
psf pounds per square foot
pcf pounds per cubic foot

[1] Run 6 sludge used in this test was obtained from reprocessed oven dried Run 6 samples. The physical characteristics of the reprocessed oven dried Run 6 sludge is significantly different than the de-watered Run 6 sludge, prior to oven drying.

Attachment D4
Letter Dated September 2, 1998,
From Kiber Environmental Services, Inc.

Plymouth Wastewater Solids Dewatering Project Final Data Package

KIBER
ENVIRONMENTAL
SERVICES

3145 Medlock Bridge Rd.
Norcross, Georgia 30071
tel 770-242-4090
fax 770-242-9198
www.kiber.com

2 September 1998

Mr. Stephen DePiero
Weyerhaeuser Company
1785 Weyerhaeuser Road
Vanceboro, North Carolina 28586

Subject: Plymouth Sludge Dewatering Project
Final Data Package

Dear Mr. DePiero:

Kiber Environmental Services, Inc. (Kiber) is pleased to present Weyerhaeuser Company (Weyerhaeuser) with results of the requested testing performed on dewatered sludge samples collected for the Plymouth Sludge Dewatering project. The objectives of this testing were to obtain a comparison of dewatered sludge materials obtained by various dewatering technologies and to evaluate the treatment of these materials as determined by Triaxial Shear Strength testing. Included as an attachment to this letter are tables and complete data reports for all testing performed during this project.

Kiber received a total of five materials for this project. For each material Kiber received one 5-gallon bucket, with the exception of the sample labeled Run 5, for which two 5-gallon buckets were received. The samples were received by Kiber on 28 May, 1998 and 6 June, 1998. Kiber generated chains of custody (COC) upon receipt of the materials. Copies of the chains of custody are included as Attachment A.

SAMPLE PREPARATION AND TESTING

Upon receipt of the sludge samples, Kiber broke up and crushed chunks of the dewatered sludge (when necessary) and then sieved the material through a # 4 sieve. The material was then homogenized and a reduced proctor point was performed on each material in order to determine remolding parameters for triaxial testing. As recommended by RMT the proctor points were performed using standard proctor compaction effort with the number of blows reduced to 15 blows per layer. Based on data obtained from these proctor points, samples were remolded for triaxial testing. Each of the untreated materials were subjected to two Consolidated Undrained Triaxial Shear tests with pore pressure measurements (CU) performed in accordance with ASTM

D4767. The two CU tests included testing conducted under lower confining pressures of 2, 4 and 8 psi, and testing performed under higher confining pressures of 10, 20 and 40 psi. In addition an Unconsolidated Undrained triaxial shear test (UU) was performed in accordance with ASTM D2850 under the lower confining pressures. Confining pressures applied during triaxial testing were specified by Weyerhaeuser and RMT. Additional triaxial CU testing was performed on the Run 5 material with moisture contents adjusted to two additional points. This additional testing was performed in an effort to generate triaxial shear data over a range of moisture contents for the same material. The additional CU testing was performed under the lower confining pressures.

During the process of moisture adjustment Kiber encountered difficulty mixing water into the soil. The material did not absorb the water easily and the final appearance was very wet. The material was allowed to hydrate for several days but the appearance did not change. The first adjusted moisture point was about 20% lower than the moisture content of Run 6 material, however the appearance of the adjusted material was much wetter, in fact it was similar to the appearance of the Run 12 material which had a moisture content approximately about 150% higher. These concerns were communicated to RMT. To better demonstrate the moisture content / appearance inconsistencies, samples of several materials were forwarded to RMT. As a result of discussions with RMT regarding the moisture content, Kiber performed additional moisture content testing at a temperature of 60°C as oppose to 105°C temperature. The goal of this additional testing was to check whether organic matter was being volatilized during moisture content testing. The results of this testing are presented on the summary tables for the untreated and treated materials along with moisture content results obtained at 105°C. Note that not all materials were available for this moisture content recheck. The 60°C moisture recheck did not prove conclusive and all calculations are based on moisture content results obtained at 105°C. Full data reports pertaining to the untreated material testing are included as Attachment B.

MATERIAL TREATMENT AND TESTING

The treatment of the dewatered sludge consisted of combining an ash composite with the dewatered sludge at a 60% to 40% sludge to ash ratio on a wet weight basis. Specifically, to produce 1,000 g of treated material 600 g of the appropriate sieved sludge material, at it's natural moisture content, was mixed with 400 g of ash and homogenized. Kiber received six project specific ash samples supplied by Weyerhaeuser. The ash samples were labeled No. 1HF Ash, No.1 HF Scrubber, No.2 HF Ash, No.2 HF Scrubber, Riley Ash and Riley Scrubber. As discussed with RMT, these samples were sieved through a #4 sieve and composited by combining equal weight portions of each of the six samples. The ash mixture was than homogenized and combined with the untreated sludge. A reduced proctor point was performed for each treated material to determined remolding parameters for triaxial testing. The Run 5 material was treated and tested at three different moisture points (the natural moisture and two adjusted moisture points). A CU test was performed on each treated material at the lower confining pressures of 2, 4 and 8 psi. As instructed by Weyerhaeuser, the testing results were

forwarded to RMT as they became available via facsimile. All data reports pertaining to treated materials testing are included as Attachment C.

Kiber Environmental Services, Inc. appreciates this opportunity to provide laboratory services to Weyerhaeuser Company. If you have any questions, or require additional information, please contact either of the undersigned at (770) 242-4090.

Sincerely,

KIBER ENVIRONMENTAL SERVICES, INC.

Chana Gilzenrat
Project Manager
(Ext. 236)

Robert Semenak
Treatability Department Manager
Associate
(Ext. 235)

Attachments

cc: Woody Bryant / Weyerhaeuser
cc: Kent Nilsson / RMT
cc: Sharon Korleski / RMT

RMT, Inc.
SHEAR STRENGTH DETERMINATION
BUCKET SHEAR DEVICE

QA: DRG 6/22/90

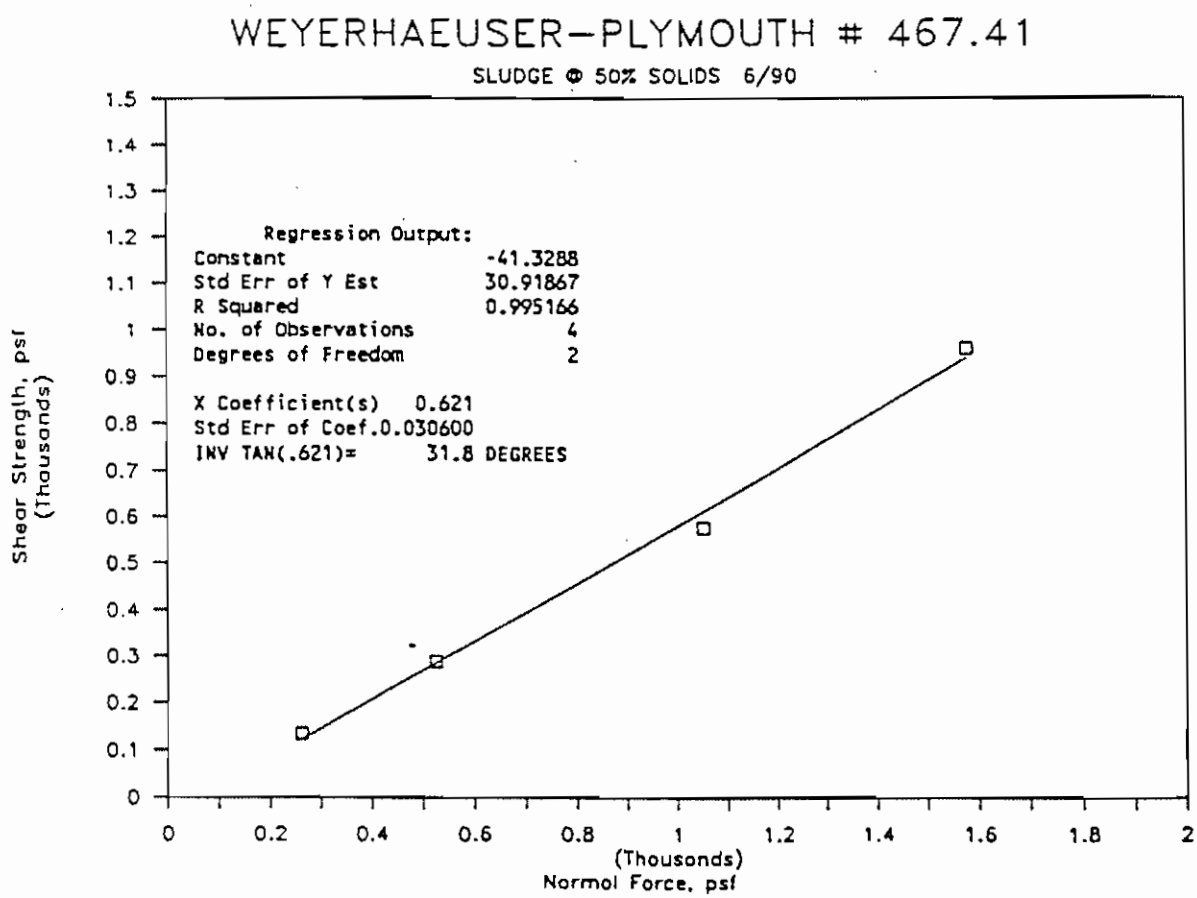
QC: GTF 6-22-90

Tech: JPH

Project: WEYERHAEUSER-PLYMOUTH # 467.41 Filename: WEYSHR01.WKS
Proj. #: 467.41 Date :06/21/90
Sample: SLUDGE @ 50% SOLIDS 6/90

Initial Height: 9.63 in. Moisture Content: 100.0 % (initial)
Weight of Waste: 23.61 lbs 100.0 % (final)
Volume: 0.60 cu ft Shear Plate Dia.: 5.0 inches

Normal Load		Shear Strength		Consol-idation	Strain	Unit Weight*		Comments
Reading (mv)	Sample (psf)	Torque (ft#)	Sample (psf)	Total (inches)	(%)	WET (pcf)	DRY (pcf)	
0	0	--	--	0	100	39.5	19.8	
15	263	14	134	1.4	85	46.3	23.2	
30	526	30	288	2.1	79	50.2	25.1	
60	1052	60	576	2.6	73	54.1	27.1	
90	1579	100	960	3.1	68	58.4	29.2	*No pore water release noted.
	Residual	40	384					



RMT, Inc.
SHEAR STRENGTH DETERMINATION
BUCKET SHEAR DEVICE

QA: DRG 6/22/90

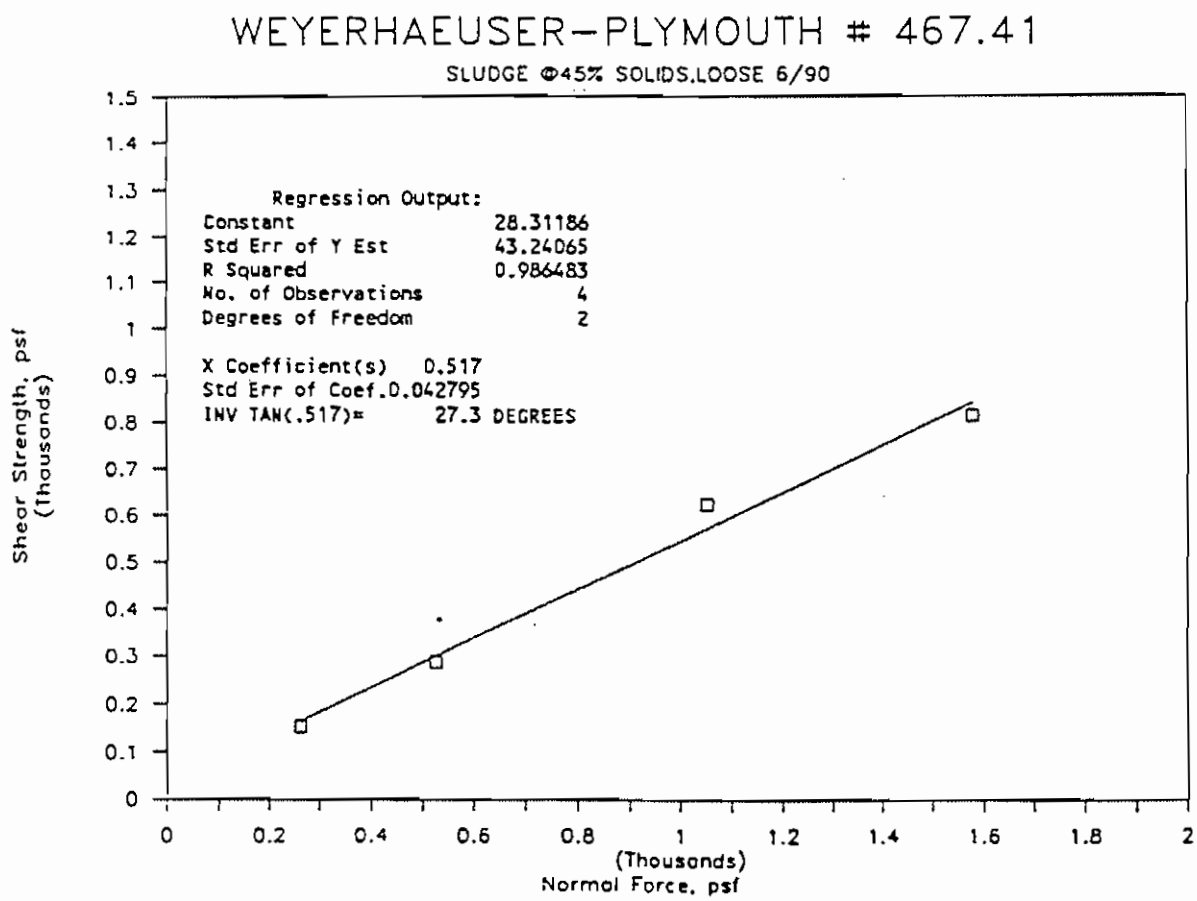
QC: GTF 6-22-90

Tech: JPH

Project: WEYERHAEUSER-PLYMOUTH # 467.41 Filename: WEYSHR02.WKS
Proj. #: 467.41 Date :06/22/90
Sample: SLUDGE @45% SOLIDS,LOOSE 6/90

Initial Height: 9.00 in. Moisture Content: 122.0 % (initial)
Weight of Waste: 26.45 lbs 122.0 % (final)
Volume: 0.56 cu ft Shear Plate Dia.: 5.0 inches

Normal Load		Shear Strength		Consol-idation	Strain	Unit Weight*		Comments
Reading (mv)	Sample (psf)	Torque (ft#)	Sample (psf)	Total (inches)	(%)	WET (pcf)	DRY (pcf)	
0	0	--	--	0	100	47.3	21.3	
15	263	16	154	1.2	86	54.8	24.7	
30	526	30	288	1.9	79	59.9	27.0	
60	1052	65	624	2.6	72	66.1	29.8	
90	1579	85	816	2.8	69	69.0	31.1	*No pore water release noted.
	Residual	40	384					



RMT, Inc.
SHEAR STRENGTH DETERMINATION
BUCKET SHEAR DEVICE

QA: DRG 6/22/90

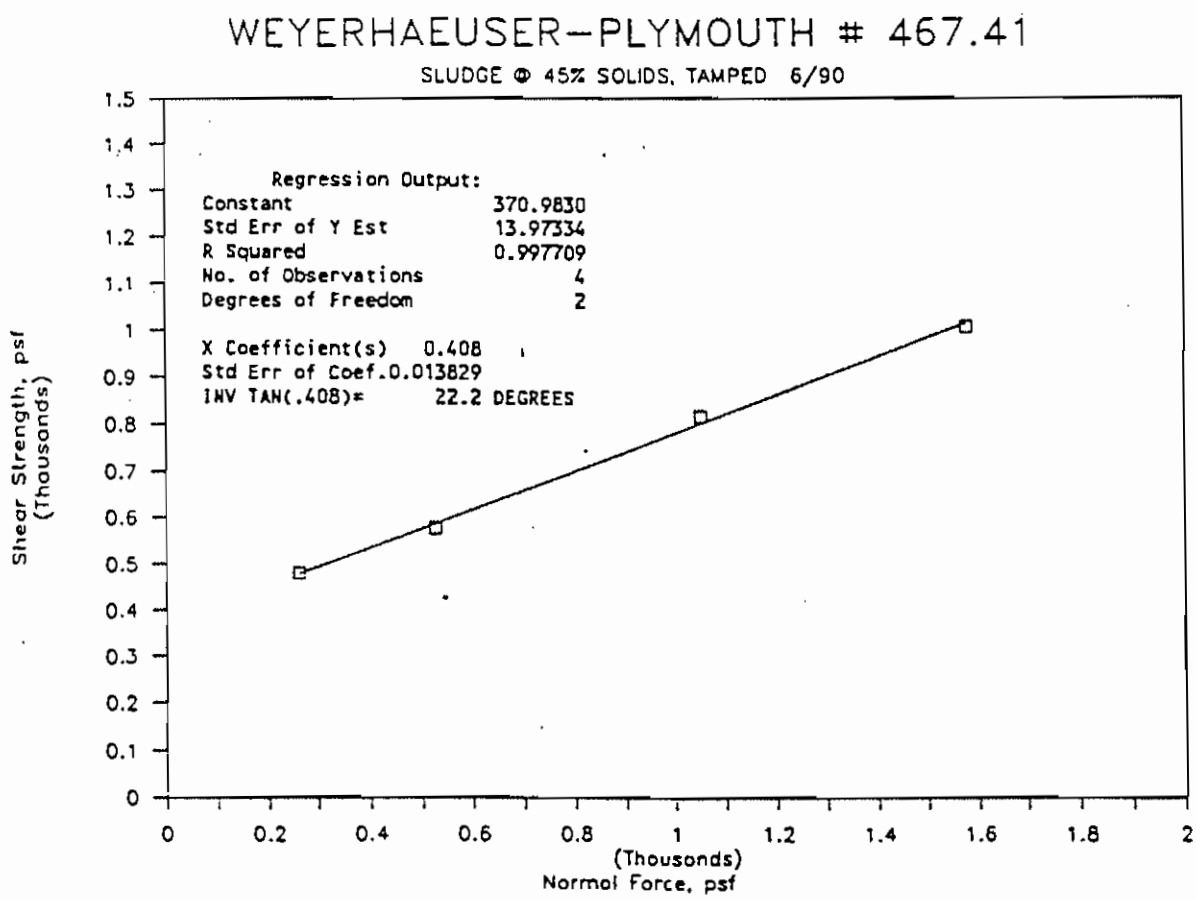
QC: GTF 6-22-90

Tech: JPH

Project: WEYERHAEUSER-PLYMOUTH # 467.41 Filename: WEYSHR03.WKS
Proj. #: 467.41 Date :06/22/90
Sample: SLUDGE @ 45% SOLIDS, TAMPED 6/90

Initial Height: 5.88 in. Moisture Content: 122.0 % (initial)
Weight of Waste: 22.10 lbs 81.3 % (final)
Volume: 0.37 cu ft Shear Plate Dia.: 5.0 inches

Normal Load		Shear Strength		Consol-idation	Strain	Unit Weight*		Comments
Reading (mv)	Sample (psf)	Torque (ft#)	Sample (psf)	Total (inches)	(%)	WET (pcf)	DRY (pcf)	
0	0	--	--	0	100	60.5	27.3	*No pore water release noted.
15	263	50	480	0.1	98	61.8	27.8	*No pore water release noted.
30	526	60	576	0.3	95	63.6	28.6	*No pore water release noted.
60	1052	85	816	0.5	91	66.3	29.9	*No pore water release noted.
90	1579	105	1008	0.7	88	68.8	38.0	*Pore water release noted.
	Residual	50	480					



RMT, Inc.
SHEAR STRENGTH DETERMINATION
BUCKET SHEAR DEVICE

QA: DRG 6/22/90

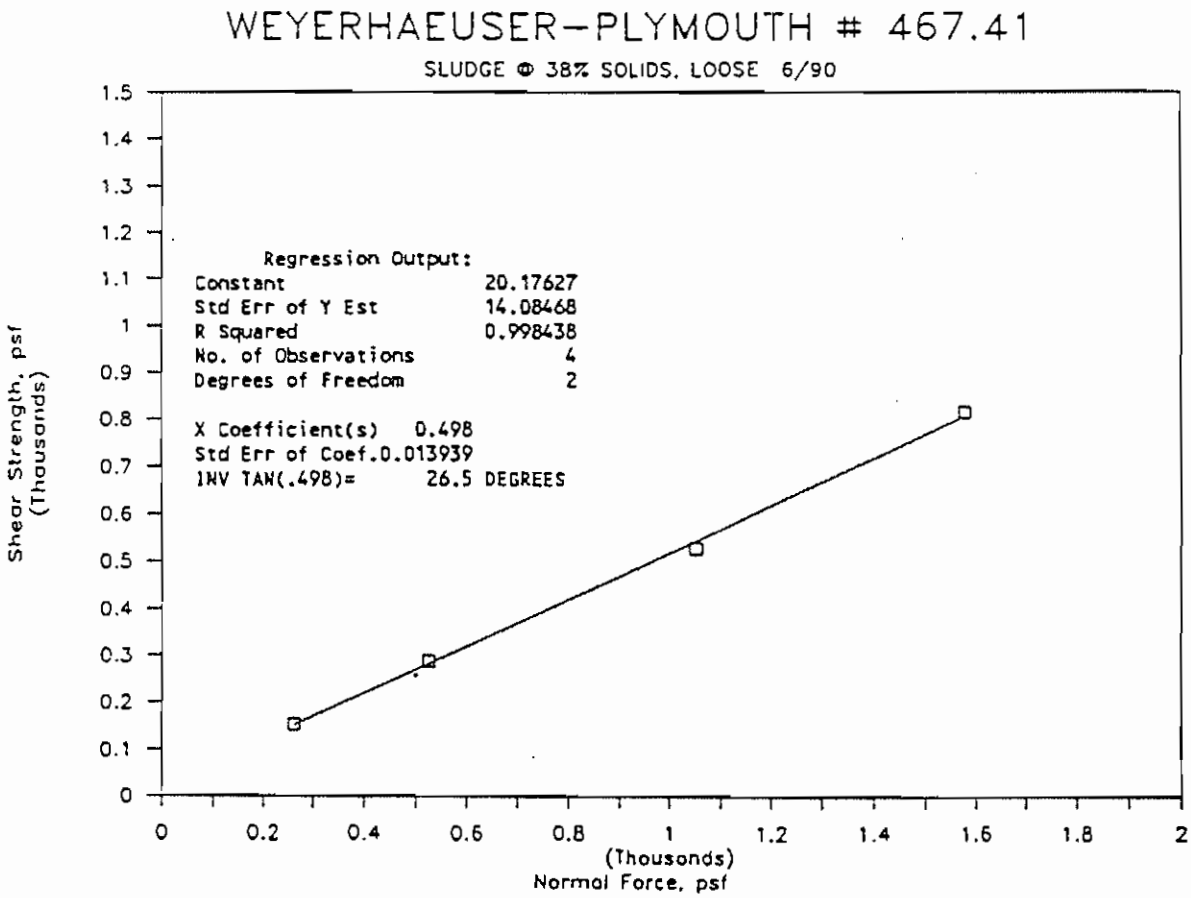
QC: GTF 6-22-90

Tech: JPH

Project: WEYERHAEUSER-PLYMOUTH # 467.41 Filename: WEYSHR04.WKS
Proj. #: 467.41 Date :06/21/90
Sample: SLUDGE @ 38% SOLIDS, LOOSE 6/90

Initial Height: 8.75 in. Moisture Content: 163.0 % (initial)
Weight of Waste: 31.90 lbs 102.1 % (final)
Volume: 0.54 cu ft Shear Plate Dia.: 5.0 inches

Normal Load		Shear Strength		Consol-idation	Strain	Unit Weight*		Comments
Reading (mv)	Sample (psf)	Torque (ft#)	Sample (psf)	Total (inches)	(%)	WET (pcf)	DRY (pcf)	
0	0.	--	--	0	100	58.7	22.3	
15	263	16	154	1.5	82	71.3	?	* Pore water release noted.
30	526	30	288	2.0	77	76.2	?	
60	1052	55	528	2.6	71	83.0	?	
90	1579	85	816	2.9	67	88.0	43.5	
	Residual	55	528					



RMT, Inc.
SHEAR STRENGTH DETERMINATION
BUCKET SHEAR DEVICE

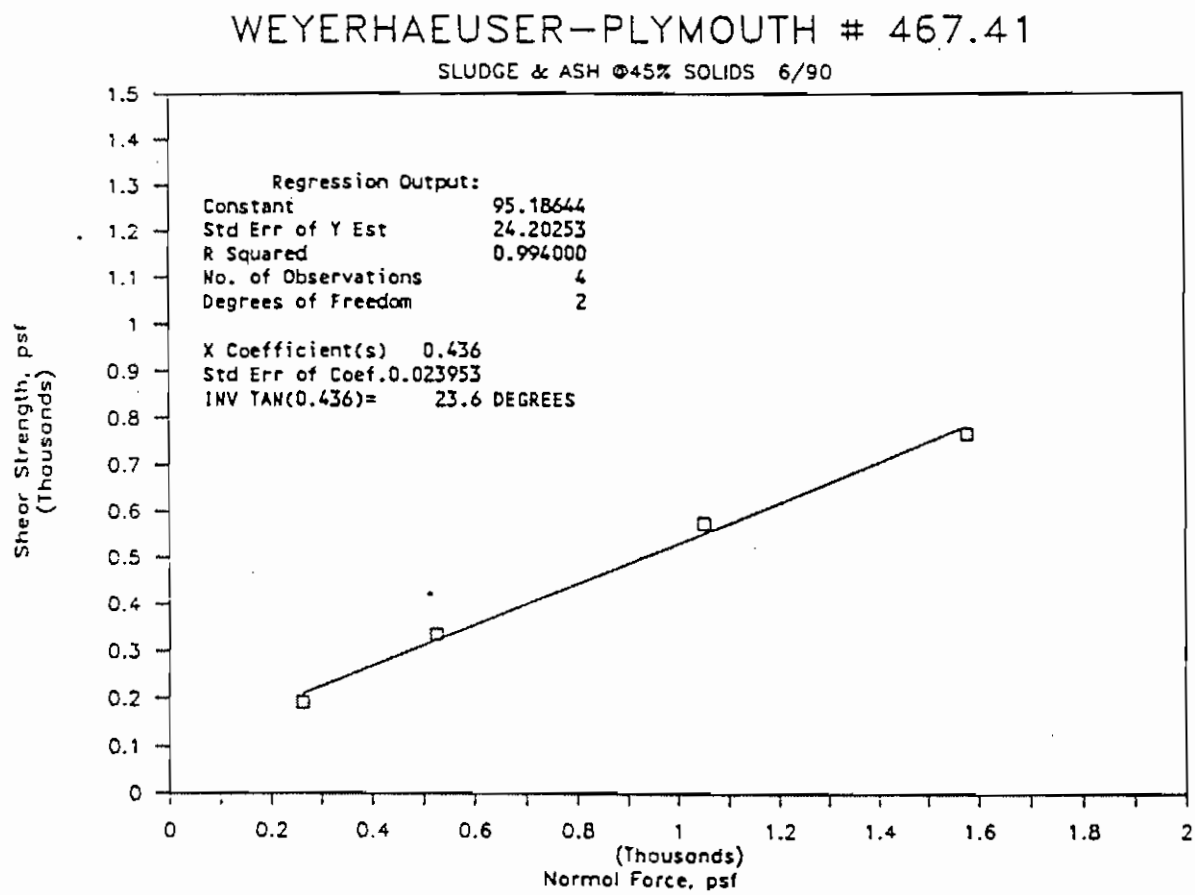
QA: DRG 6/22/90
QC: GTF 6-22-90

Tech: JPH

Project: WEYERHAEUSER-PLYMOUTH # 467.41 Filename: WEYSHR05.WKS
Proj. #: 467.41 Date :06/21/90
Sample: SLUDGE & ASH @45% SOLIDS 6/90

Initial Height: 7.50 in. Moisture Content: 85.8 % (initial)
Weight of Waste: 19.59 lbs 85.4 % (final)
Volume: 0.47 cu ft Shear Plate Dia.: 5.0 inches

Normal Load		Shear Strength		Consol-idation	Strain	Unit Weight*		Comments
Reading (mv)	Sample (psf)	Torque (ft#)	Sample (psf)	Total (inches)	(%)	WET (pcf)	DRY (pcf)	
0	0	--	--	0	100	42.1	22.6	
15	263	20	192	0.6	93	45.4	24.4	
30	526	35	336	0.9	88	47.8	25.7	
60	1052	60	576	1.3	83	50.5	27.2	
90	1579	80	768	1.5	80	52.4	28.2	*No pore water release noted.
	Residual	62	595					



RMT, Inc.
SHEAR STRENGTH DETERMINATION
BUCKET SHEAR DEVICE

QA: JGG 6-22-90

QC: GTT 6-22-90

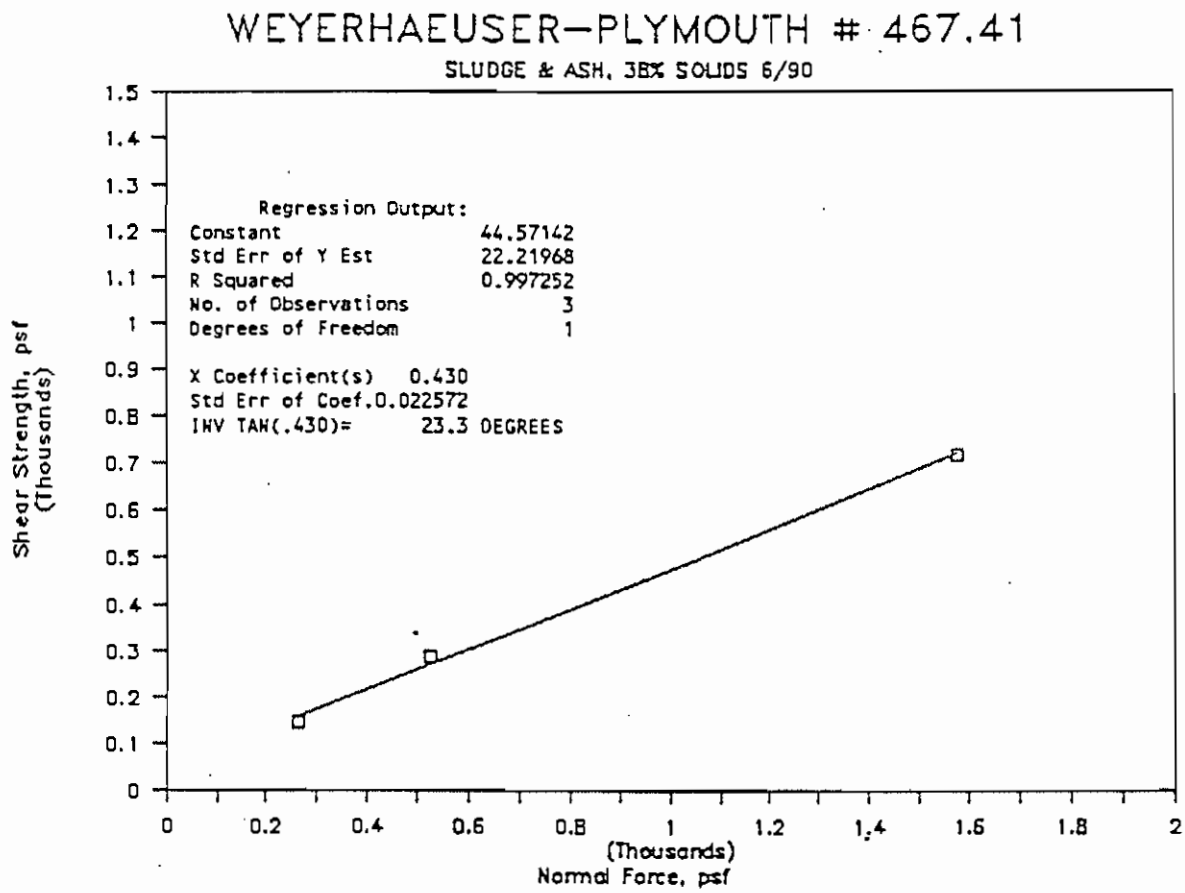
Tech: G.FRIES

Project: WEYERHAEUSER-PLYMOUTH # 467.41 Filename: WEYSHR06.WKS
Proj. #: 467.41 Date :06/22/90
Sample: SLUDGE & ASH, 38% SOLIDS 6/90

Initial Height: 8.50 in. Moisture Content: 93.6 % (initial)
Weight of Waste: 23.30 lbs 91.1 % (final)
Volume: 0.53 cu ft Shear Plate Dia.: 5.0 inches

Normal Load		Shear Strength		Consolidation	Strain	Unit Weight*		Comments
Reading (mv)	Sample (psf)	Torque (ft#)	Sample (psf)	Total (inches)	(%)	WET (pcf)	DRY (pcf)	
0	0	--	--	0	100	44.1	22.8	
15	263	15	144	0.6	94	47.2	24.4	
30	526	30	288	1.0	88	49.9	25.8	
90	1579	75	720	1.8	79	55.8	28.8	
	Residual	46	442					

*No pore water release noted.



RMT, Inc.
SHEAR STRENGTH DETERMINATION
BUCKET SHEAR DEVICE

QA: JRG 6/22/90
QC: GTF 6/22/90

Tech: G.FRIES

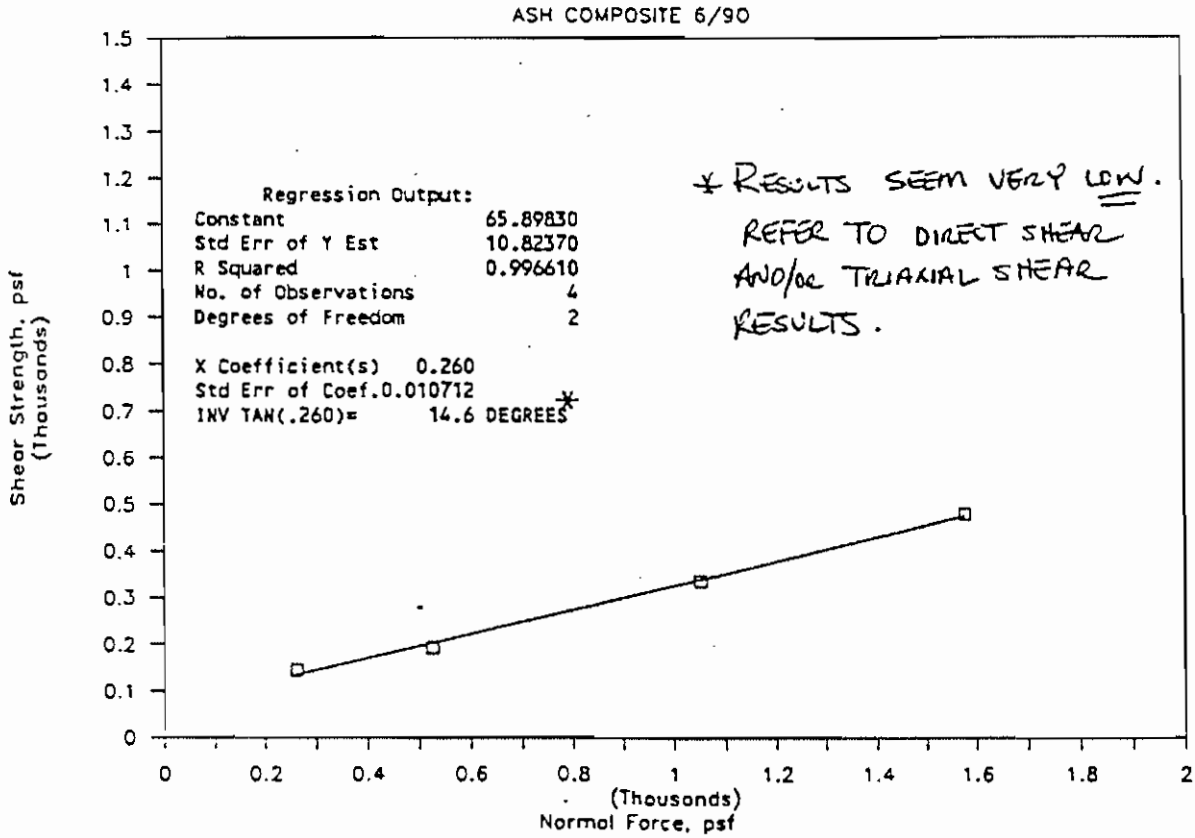
Project: WEYERHAEUSER-PLYMOUTH # 467.41 Filename: WEYSHR07.WKS
Proj. #: 467.41 Date :06/21/90
Sample: ASH COMPOSITE 6/90

Initial Height: 11.38 in. Moisture Content: 40.0 % (initial)
Weight of Waste: 26.43 lbs 40.0 % (final)
Volume: 0.71 cu ft Shear Plate Dia.: 5.0 inches

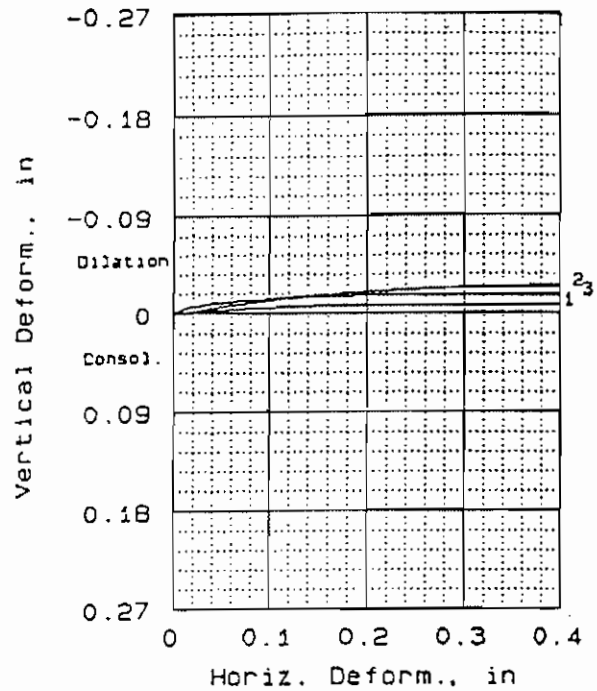
Normal Load		Shear Strength		Consol-idation	Strain	Unit Weight*		Comments
Reading (mv)	Sample (psf)	Torque (ft#)	Sample (psf)	Total (inches)	(%)	WET (pcf)	DRY (pcf)	
0	0	--	--	0	100	37.4	26.7	
15	263	15	144	0.3	97	38.5	27.5	
30	526	20	192	0.6	95	39.5	28.2	
60	1052	35	336	0.9	92	40.5	28.9	
90	1579	50	480	1.1	91	41.2	29.4	*No pore water release noted.
	Residual	10	96					

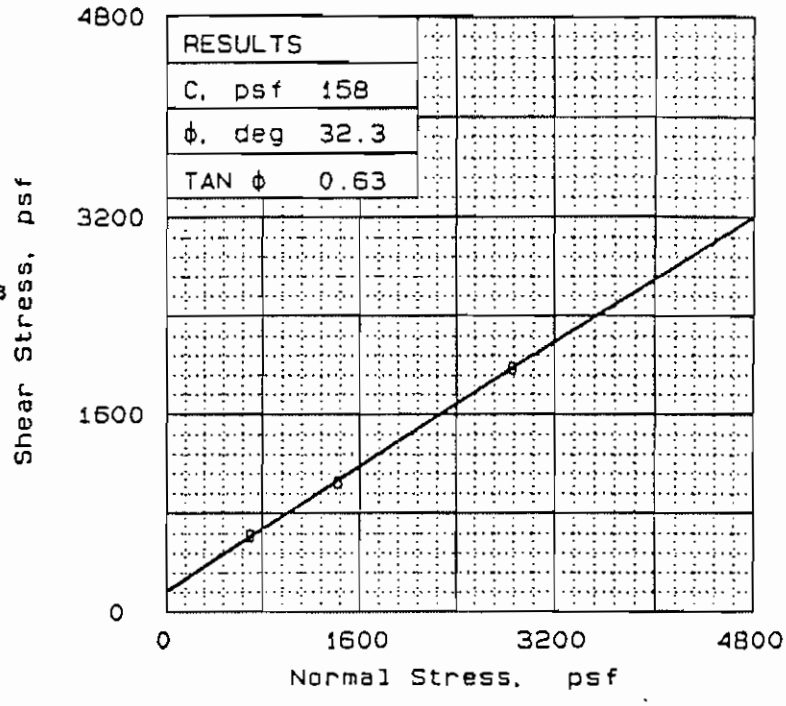
WEYERHAEUSER-PLYMOUTH # 467.41

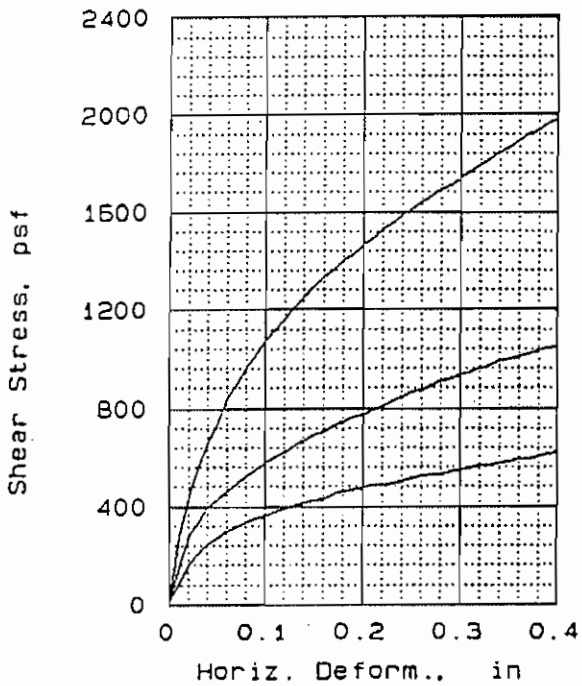
ASH COMPOSITE 6/90



✓JPL 6-26-9







	SAMPLE NO.	1	2	3
INITIAL	WATER CONTENT, %	122.0	122.0	122.0
	DRY DENSITY, pcf	29.2	28.9	28.6
	SATURATION, %	74.0	73.0	72.2
	VOID RATIO	3.365	3.408	3.450
	SIDE LENGTH, in	4.00	4.00	4.00
	HEIGHT, in	1.03	1.04	1.05
AT TEST	WATER CONTENT, %	189.9	180.2	169.4
	DRY DENSITY, pcf	34.2	34.3	40.7
	SATURATION, %	142.1	135.5	162.0
	VOID RATIO	2.727	2.714	2.132
	SIDE LENGTH, in	4.51	4.51	4.51
	HEIGHT, in	0.88	0.88	0.74
NORMAL STRESS, psf		720	1440	2880
MAX. SHEAR, psf		621	1053	1980
STRAIN RATE, %/min.		0.100	0.100	0.100
ULT. SHEAR, psf				

SAMPLE DATA

SAMPLE TYPE:

DESCRIPTION: SLUDGE AT 45%

LL= PL= PI=

SPECIFIC GRAVITY= 2.04

REMARKS:

FIG. NO.

CLIENT: WEYERHAEUSER

PROJECT: WEYERHAEUSER

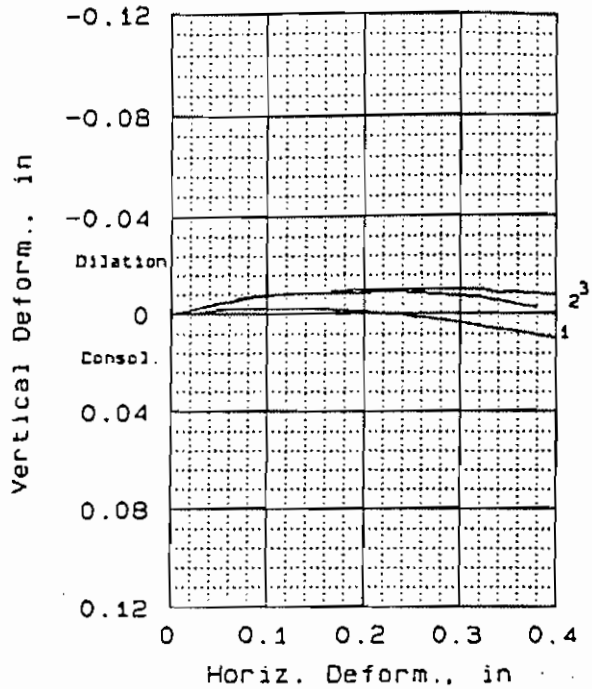
SAMPLE LOCATION: SLUDGE AT 45% SOLIDS

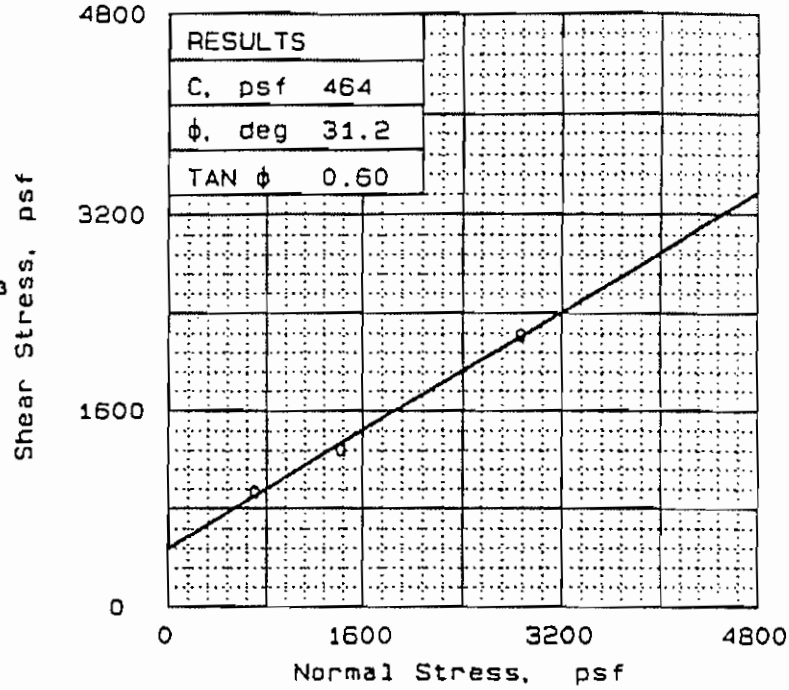
PROJ. NO.: 467.42 DATE: 6-21-90

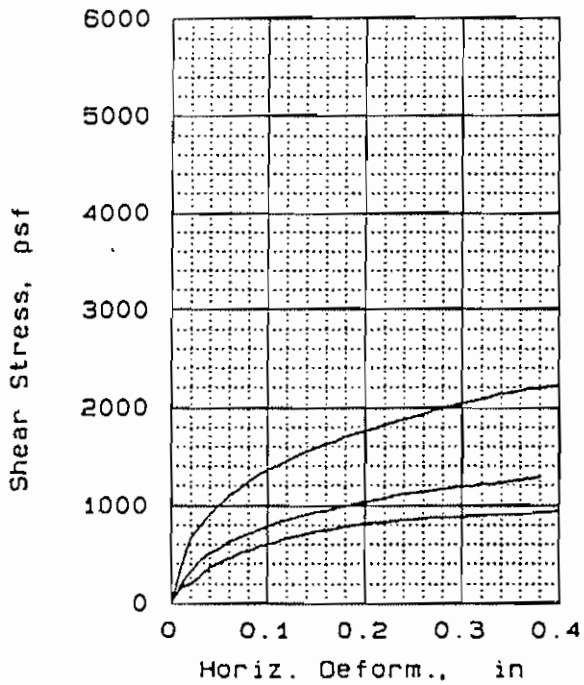
DIRECT SHEAR TEST

RMT, INC.

✓ JDIL 6-26-90







	SAMPLE NO.	1	2	3
INITIAL	WATER CONTENT, %	122.2	122.0	122.0
	DRY DENSITY, pcf	25.7	27.6	28.0
	SATURATION, %	65.4	72.0	73.3
	VOID RATIO	3.307	2.998	2.946
	SIDE LENGTH, in	4.00	4.00	4.00
	HEIGHT, in	0.90	0.92	0.90
AT TEST	WATER CONTENT, %	138.5	147.2	165.7
	DRY DENSITY, pcf	33.2	32.5	38.3
	SATURATION, %	105.5	108.4	155.6
	VOID RATIO	2.323	2.402	1.885
	SIDE LENGTH, in	4.51	4.51	4.51
	HEIGHT, in	0.70	0.78	0.66
NORMAL STRESS, psf		720	1440	2880
MAX. SHEAR, psf		936	1278	2223
STRAIN RATE, %/min.		0.100	0.100	0.100
ULT. SHEAR, psf		936	1278	2223

SAMPLE DATA

SAMPLE TYPE:

DESCRIPTION: SLUDGE @45% SOLIDS
, TAMPED

LL= PL= PI=

SPECIFIC GRAVITY= 1.77

REMARKS:

CLIENT:

PROJECT: WEYERHAEUSER

SAMPLE LOCATION:

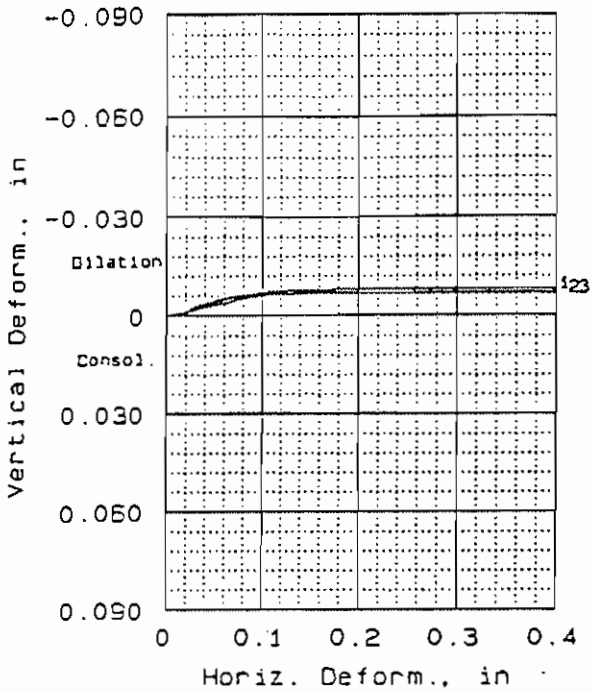
PROJ. NO.: 467.41 DATE: 6-13-90

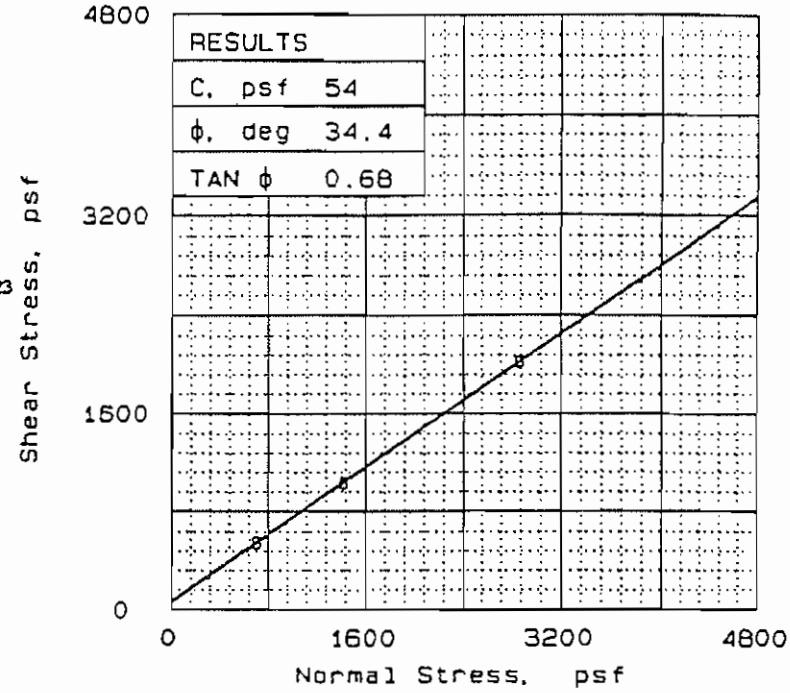
DIRECT SHEAR TEST

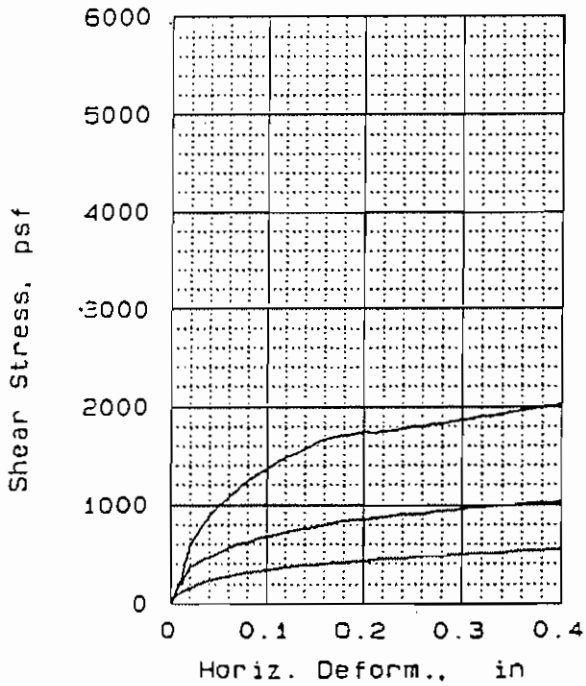
RMT, INC.

FIG. NO.

✓ JPH 6-26-90







	SAMPLE NO.	1	2	3
INITIAL	WATER CONTENT, %	163.2	163.2	163.2
	DRY DENSITY, pcf	23.8	23.8	24.3
	SATURATION, %	76.4	76.5	78.5
	VOID RATIO	4.375	4.375	4.262
	SIDE LENGTH, in	4.00	4.00	4.00
	HEIGHT, in	0.95	0.95	0.93
AT TEST	WATER CONTENT, %	204.7	199.8	181.1
	DRY DENSITY, pcf	29.5	32.6	38.3
	SATURATION, %	125.6	139.9	158.7
	VOID RATIO	3.341	2.928	2.339
	SIDE LENGTH, in	4.51	4.51	4.51
	HEIGHT, in	0.77	0.69	0.59
NORMAL STRESS, psf		720	1440	2880
MAX. SHEAR, psf		549	1035	2025
STRAIN RATE, %/min.		0.100	0.100	0.100
ULT. SHEAR, psf				

SAMPLE DATA

SAMPLE TYPE:

DESCRIPTION:

LL= PL= PI=

SPECIFIC GRAVITY= 2.05

REMARKS:

CLIENT: WEYERHAEUSER

PROJECT:

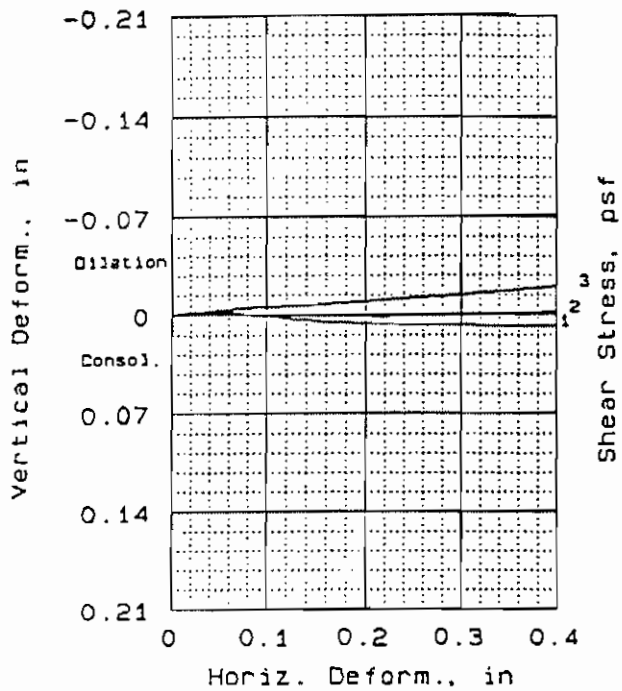
SAMPLE LOCATION: SLUDGE AT 38%

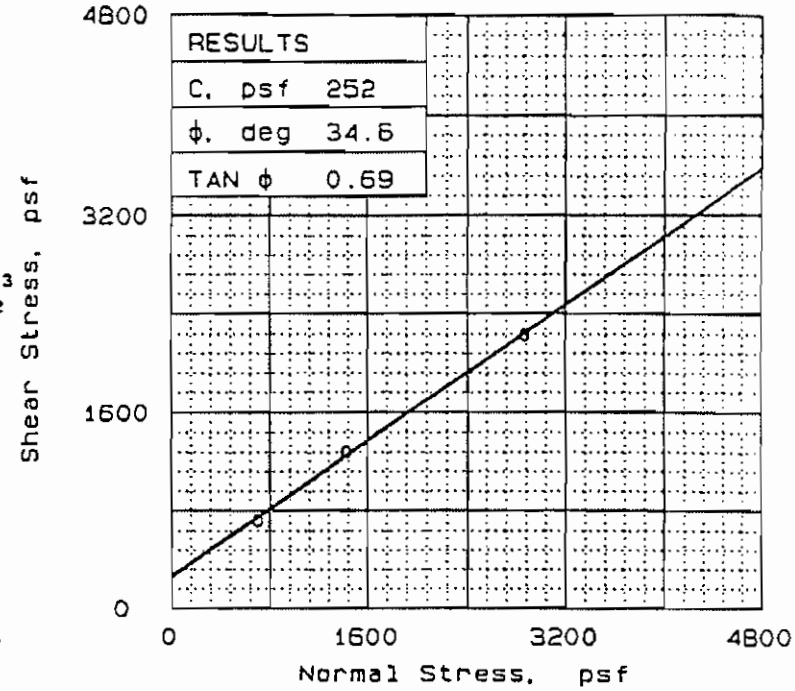
PROJ. NO.: 467.41 DATE: 6-21-90

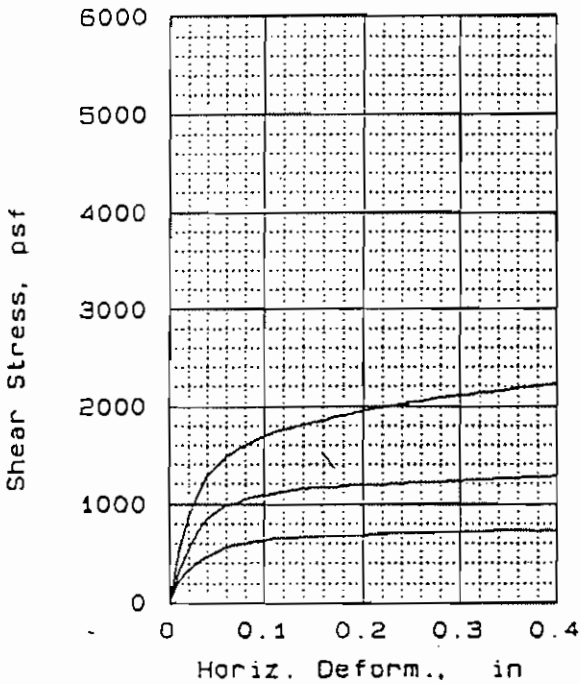
DIRECT SHEAR TEST

RMT, INC.

FIG. NO.







SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	40.0	40.0	40.0
	DRY DENSITY, pcf	33.4	34.0	34.7
	SATURATION, %	28.6	29.4	30.2
	VOID RATIO	2.967	2.889	2.811
	SIDE LENGTH, in	4.00	4.00	4.00
	HEIGHT, in	1.02	1.00	0.98
AT TEST	WATER CONTENT, %	129.5	128.7	124.0
	DRY DENSITY, pcf	34.8	34.2	34.7
	SATURATION, %	97.7	95.2	93.5
	VOID RATIO	2.808	2.866	2.811
	SIDE LENGTH, in	4.51	4.51	4.51
	HEIGHT, in	0.98	0.99	0.98
NORMAL STRESS, psf		720	1440	2880
MAX. SHEAR, psf		729	1278	2232
STRAIN RATE, %/min.		0.100	0.100	0.100
ULT. SHEAR, psf				

SAMPLE DATA

SAMPLE TYPE: DIRECT SHEAR

DESCRIPTION: ASH

LL= PL= PI=

SPECIFIC GRAVITY= 2.12

REMARKS:

FIG. NO.

CLIENT: WEYERHAEUSER

PROJECT: WEYERHAEUSER

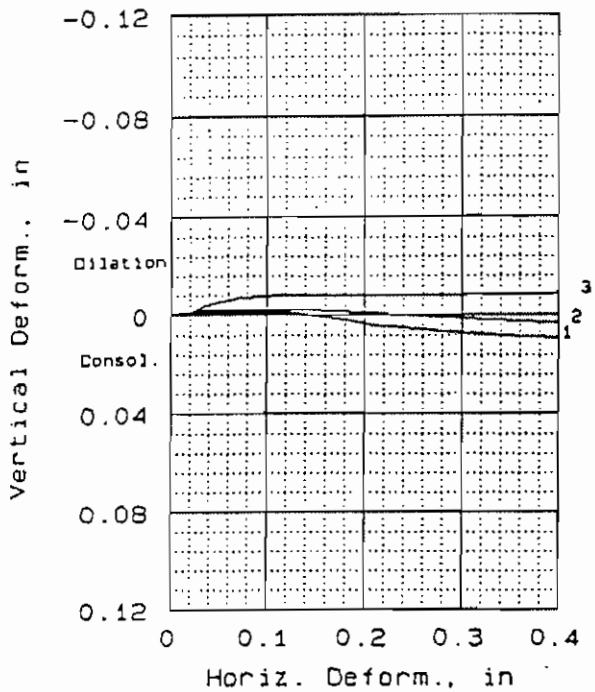
SAMPLE LOCATION:

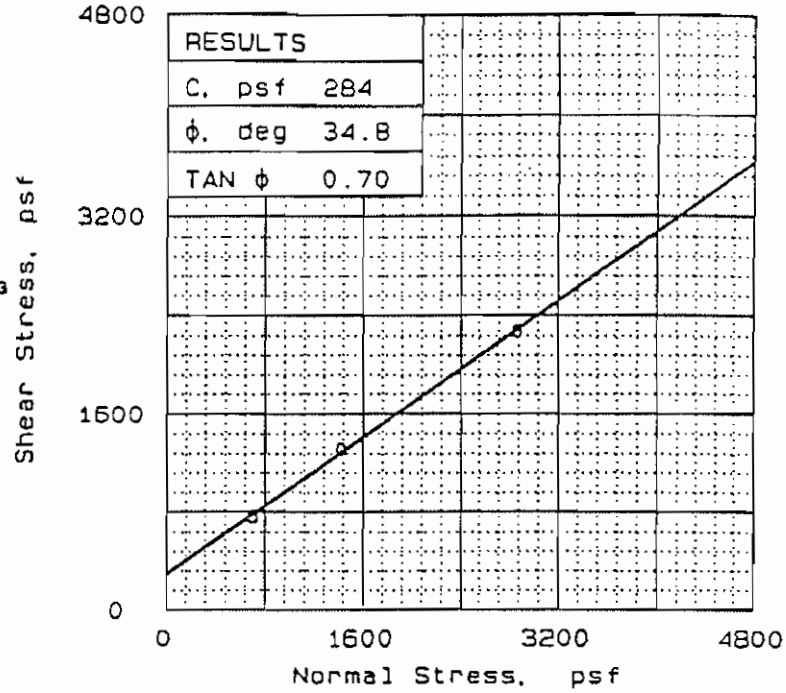
PROJ. NO.: 467.41 DATE: 6-21-90

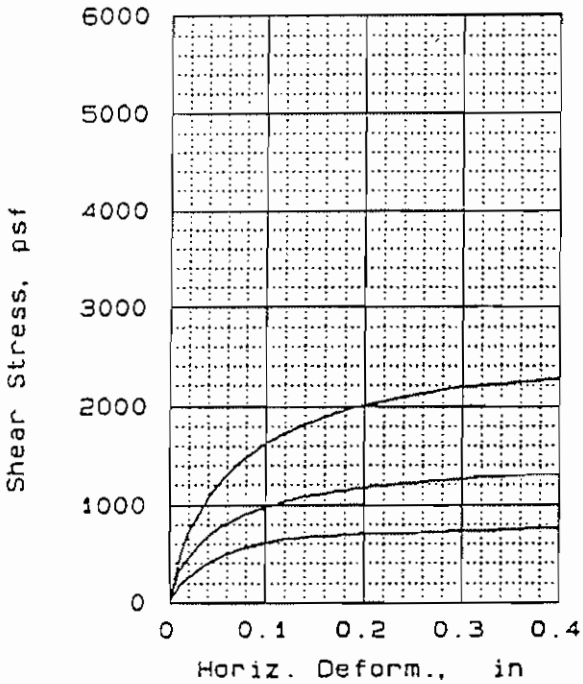
DIRECT SHEAR TEST

RMT, INC.

✓ JPK 6-26-90







	SAMPLE NO.	1	2	3
INITIAL	WATER CONTENT, %	92.4	92.4	92.4
	DRY DENSITY, pcf	35.1	36.2	36.2
	SATURATION, %	71.7	74.9	74.9
	VOID RATIO	2.630	2.518	2.518
	SIDE LENGTH, in	4.00	4.00	4.00
	HEIGHT, in	0.97	0.94	0.94
AT TEST	WATER CONTENT, %	121.5	121.8	118.8
	DRY DENSITY, pcf	36.3	38.2	39.5
	SATURATION, %	98.6	106.4	109.0
	VOID RATIO	2.513	2.335	2.224
	SIDE LENGTH, in	4.51	4.51	4.51
	HEIGHT, in	0.94	0.89	0.86
NORMAL STRESS, psf		720	1440	2880
MAX. SHEAR, psf		765	1314	2277
STRAIN RATE, %/min.		0.100	0.100	0.100
ULT. SHEAR, psf				

SAMPLE DATA

SAMPLE TYPE:

DESCRIPTION: SLUDGE @38% SOLIDS
. & ASH COMPOSITE

LL= PL= PI=

SPECIFIC GRAVITY= 2.04

REMARKS:

CLIENT:

PROJECT: WEYERHAEUSER

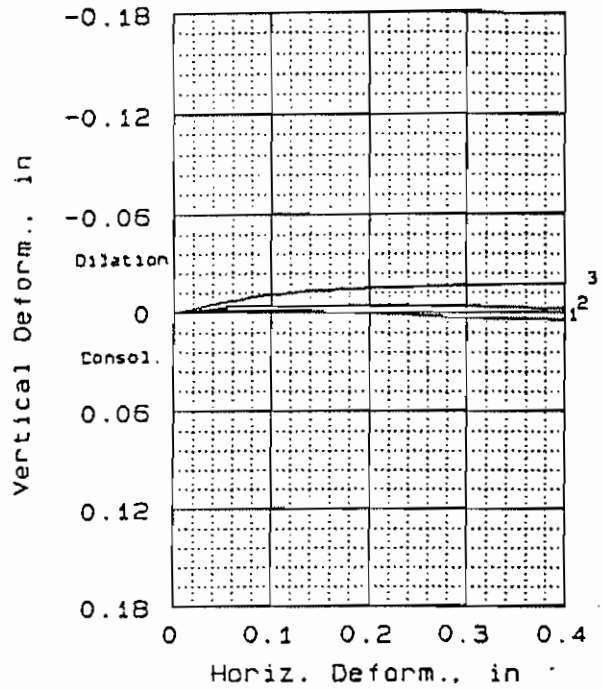
SAMPLE LOCATION:

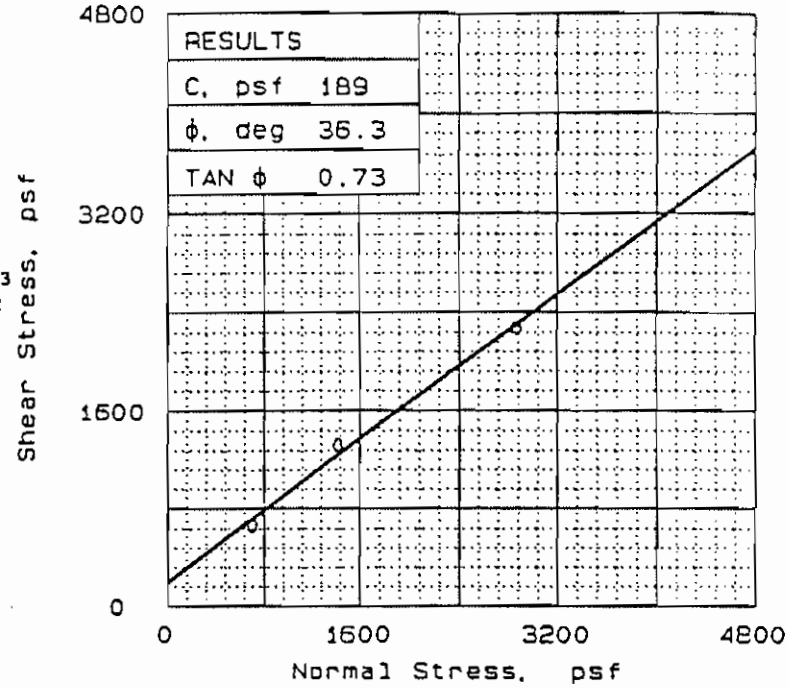
PROJ. NO.: 467.41 DATE: 6-25-90

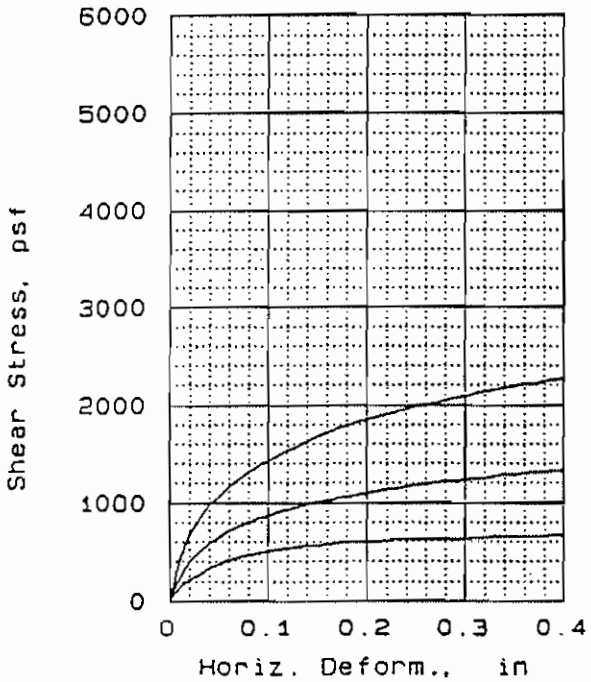
DIRECT SHEAR TEST

RMT, INC.

FIG. NO.







SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	85.6	85.6	85.6
	DRY DENSITY, pcf	34.0	34.0	34.0
	SATURATION, %	63.7	63.7	63.7
	VOID RATIO	2.742	2.742	2.742
	SIDE LENGTH, in	4.00	4.00	4.00
	HEIGHT, in	1.00	1.00	1.00
AT TEST	WATER CONTENT, %	128.6	122.0	121.0
	DRY DENSITY, pcf	35.9	35.9	37.3
	SATURATION, %	102.9	97.6	102.2
	VOID RATIO	2.550	2.549	2.415
	SIDE LENGTH, in	4.51	4.51	4.51
	HEIGHT, in	0.95	0.95	0.91
NORMAL STRESS, psf		720	1440	2880
MAX. SHEAR, psf		666	1323	2277
STRAIN RATE, %/min.		0.100	0.100	0.100
ULT. SHEAR, psf				

SAMPLE DATA

SAMPLE TYPE:

DESCRIPTION: SLUDGE @45% SOLIDS & ASH, COMPOSITE

LL= PL= PI=

SPECIFIC GRAVITY= 2.04

REMARKS:

FIG. NO.

CLIENT: WEYERHAEUSER

PROJECT: WEYERHAEUSER

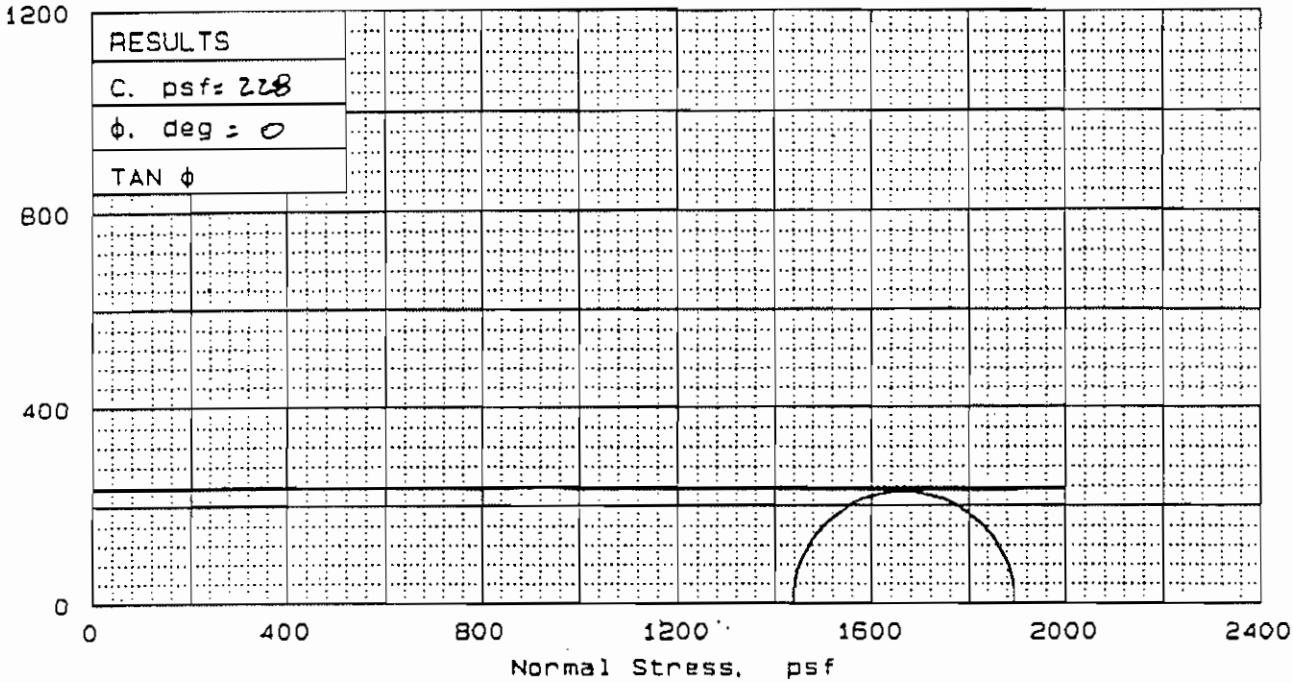
SAMPLE LOCATION:

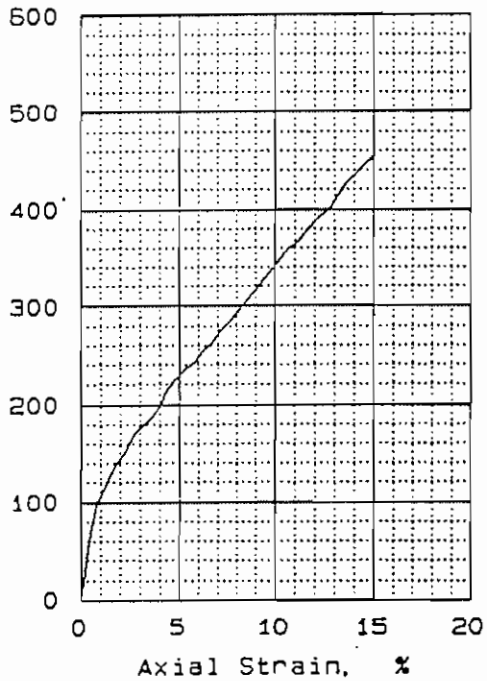
PROJ. NO.: 467.41 DATE: 6-22-90

DIRECT SHEAR TEST

RMT, INC.

✓JPH 6-20-90





SAMPLE NO.		1
INITIAL	WATER CONTENT, %	163.0
	DRY DENSITY, pcf	27.4
	SATURATION, %	95.0
	VOID RATIO	3.038
	DIAMETER, in	2.87
	HEIGHT, in	6.58
AT TEST	WATER CONTENT, %	174.4
	DRY DENSITY, pcf	27.4
	SATURATION, %	101.6
	VOID RATIO	3.038
	DIAMETER, in	2.87
	HEIGHT, in	6.58
BACK PRESSURE, psf		0
CELL PRESSURE, psf		1440
FAILURE STRESS, psf		456
PORE PRESSURE, psf		
STRAIN RATE, %/min.		1.000
ULTIMATE STRESS, psf		
PORE PRESSURE, psf		
σ_1 FAILURE, psf		1896
σ_3 FAILURE, psf		1440

OF TEST:
consolidated undrained
LE TYPE:
RIPTION: SLUDGE @38% SOLIDS
MPED
PL= PI=
IFIC GRAVITY= 1.77
RKS:

NO.

CLIENT:

PROJECT: WEYERHAEUSER

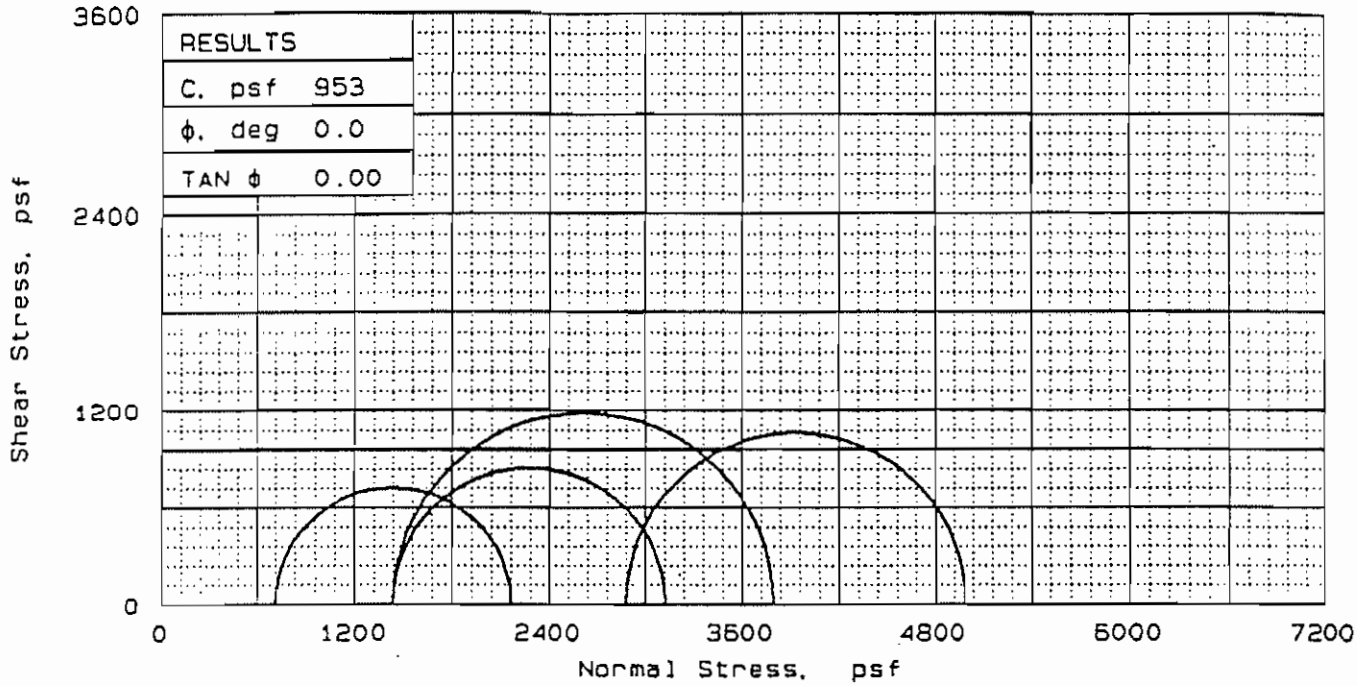
SAMPLE LOCATION:

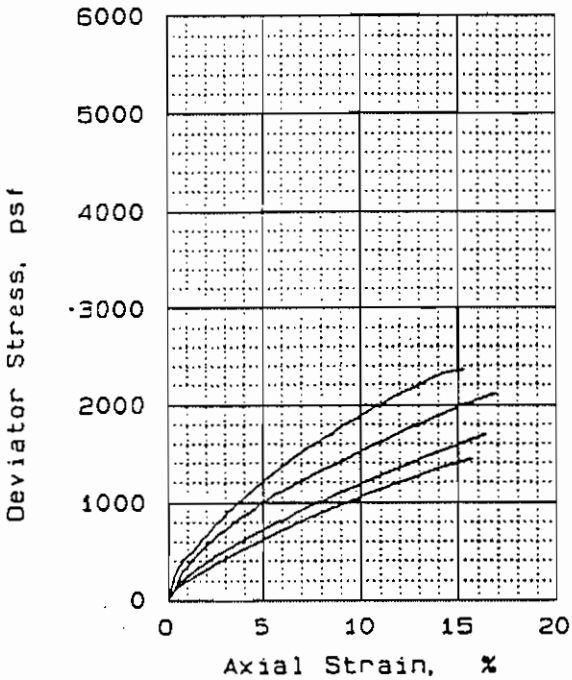
PROJ. NO.: 467.41 DATE: 6-6-90

TRIAXIAL COMPRESSION TEST

RMT, INC.

✓ JOH 6-27-90





SAMPLE NO.		1	2	3	4
INITIAL	WATER CONTENT, %	122.0	122.0	122.0	122.2
	DRY DENSITY, pcf	32.4	32.6	31.9	28.3
	SATURATION, %	89.6	90.2	87.7	74.4
	VOID RATIO	2.411	2.394	2.462	2.908
	DIAMETER, in	2.87	2.87	2.87	2.87
	HEIGHT, in	6.65	6.65	6.75	6.50
AT TEST	WATER CONTENT, %	129.8	131.5	128.4	120.8
	DRY DENSITY, pcf	32.4	32.6	31.9	28.3
	SATURATION, %	95.3	97.2	92.3	73.5
	VOID RATIO	2.411	2.394	2.462	2.908
	DIAMETER, in	2.87	2.87	2.87	2.87
	HEIGHT, in	6.65	6.65	6.75	6.50
BACK PRESSURE, psf		0	0	0	0
CELL PRESSURE, psf		720	1440	2880	1440
FAILURE STRESS, psf		1442	1688	2116	2362
PORE PRESSURE, psf					
STRAIN RATE, %/min.		1.000	1.000	1.000	1.000
ULTIMATE STRESS, psf					
PORE PRESSURE, psf					
σ_1 FAILURE, psf		2162	3128	4996	3802
σ_3 FAILURE, psf		720	1440	2880	1440

TYPE OF TEST:
Unconsolidated undrained

SAMPLE TYPE:

DESCRIPTION: SLUDGE @45% SOLIDS TAMPED

LL= PL= PI=

SPECIFIC GRAVITY= 1.77

REMARKS:

FIG. NO.

CLIENT:

PROJECT: WEYERHAEUSER

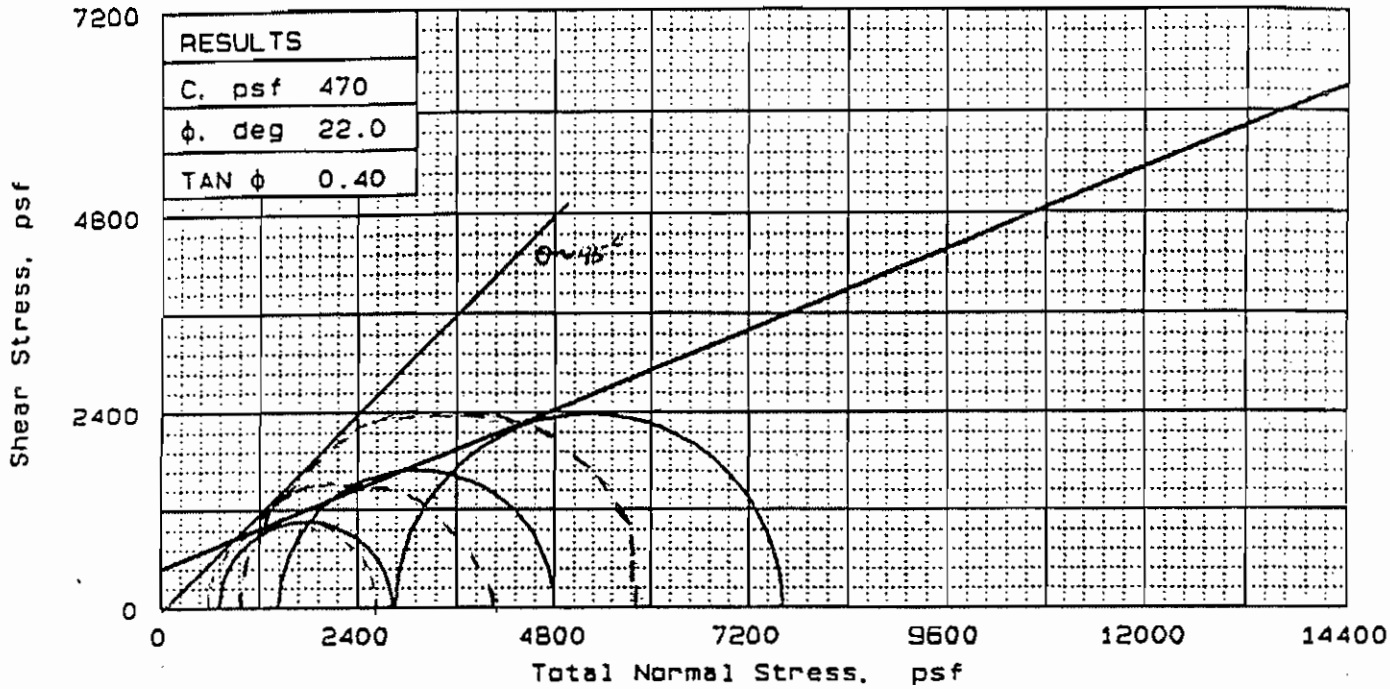
SAMPLE LOCATION:

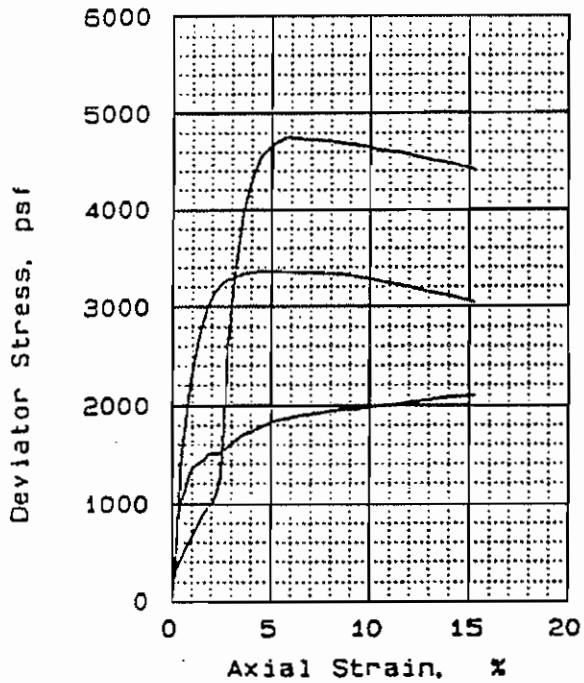
PROJ. NO.: 467.41 DATE: 6-8-90

TRIAXIAL COMPRESSION TEST

RMT, INC.

✓ JDH 6-26-90 6-26-90





SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	53.0	64.3	55.1
	DRY DENSITY, pcf	34.4	33.1	33.3
	SATURATION, %	39.4	45.4	39.2
	VOID RATIO	2.865	3.019	2.993
	DIAMETER, in	2.87	2.87	2.87
	HEIGHT, in	6.50	6.50	6.50
AT TEST	WATER CONTENT, %	45.3	63.0	50.5
	DRY DENSITY, pcf	67.7	56.8	64.0
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	0.964	1.342	1.076
	DIAMETER, in	2.05	2.19	2.07
	HEIGHT, in	6.49	6.49	6.47
BACK PRESSURE, psf		11520	10080	10080
CELL PRESSURE, psf		12240	11520	12960
FAILURE STRESS, psf		2106	3365	4752
PORE PRESSURE, psf		11635	10814	11938
STRAIN RATE, %/min.		1.000	1.000	1.000
ULTIMATE STRESS, psf				
PORE PRESSURE, psf				
$\bar{\sigma}_1$ FAILURE, psf		2711	4070	5774
$\bar{\sigma}_3$ FAILURE, psf		605	706	1022

TYPE OF TEST:
CU with pore pressures
SAMPLE TYPE:
DESCRIPTION: ASH

LL= PL= PI=
SPECIFIC GRAVITY= 2.13
REMARKS:

CLIENT: WEYERHAEUSER

PROJECT: WEYERHAEUSER

SAMPLE LOCATION:

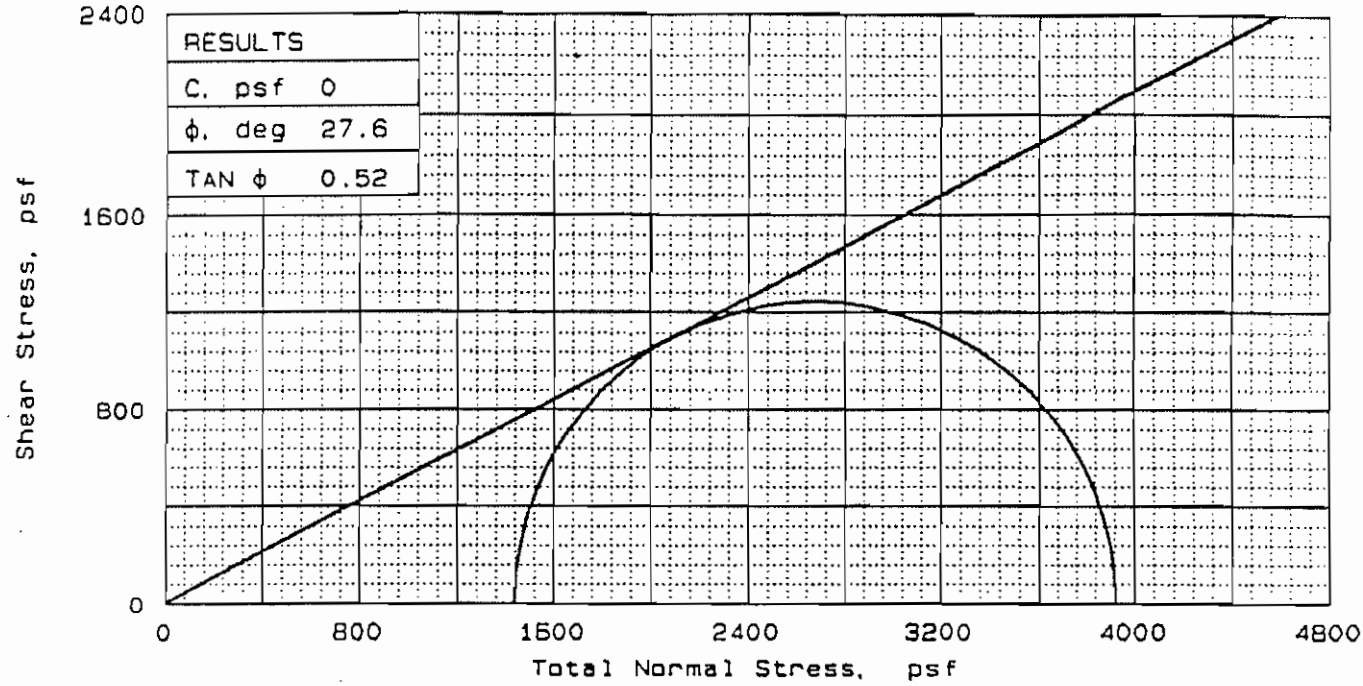
PROJ. NO.: 467.41 DATE: 06/26/90

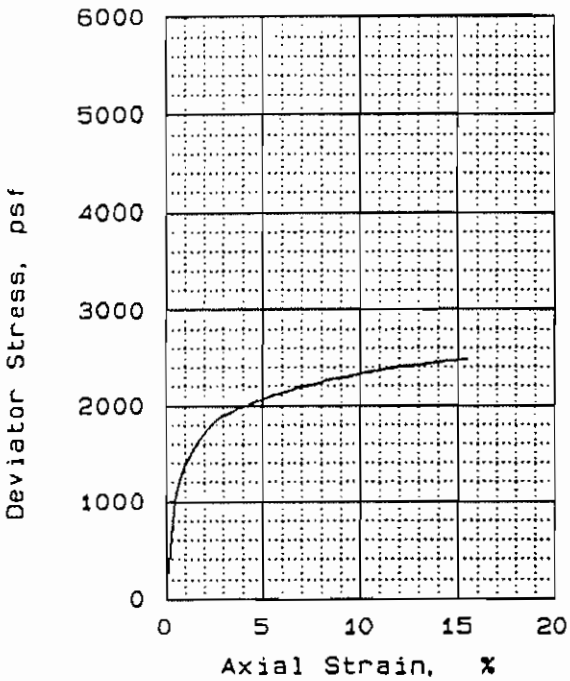
TRIAXIAL COMPRESSION TEST

RMT, INC.

FIG. NO.

✓ JRH 6-27-90





SAMPLE NO.		1
INITIAL	WATER CONTENT, %	88.9
	DRY DENSITY, pcf	34.6
	SATURATION, %	67.5
	VOID RATIO	2.686
	DIAMETER, in	2.87
	HEIGHT, in	6.50
AT TEST	WATER CONTENT, %	76.9
	DRY DENSITY, pcf	49.6
	SATURATION, %	100.0
	VOID RATIO	1.569
	DIAMETER, in	2.41
	HEIGHT, in	6.40
BACK PRESSURE, psf		8640
CELL PRESSURE, psf		10080
FAILURE STRESS, psf		2484
PORE PRESSURE, psf		9677
STRAIN RATE, %/min.		1.000
ULTIMATE STRESS, psf		
PORE PRESSURE, psf		
$\bar{\sigma}_1$ FAILURE, psf		2888
$\bar{\sigma}_3$ FAILURE, psf		403

TYPE OF TEST:
CU with pore pressures

SAMPLE TYPE:

DESCRIPTION: SLUDGE 38% SOLIDS & ASH

LL= PL= PI=

SPECIFIC GRAVITY= 2.04

REMARKS:

CLIENT: WEYERHAEUSER

PROJECT: WEYERHAEUSER

SAMPLE LOCATION:

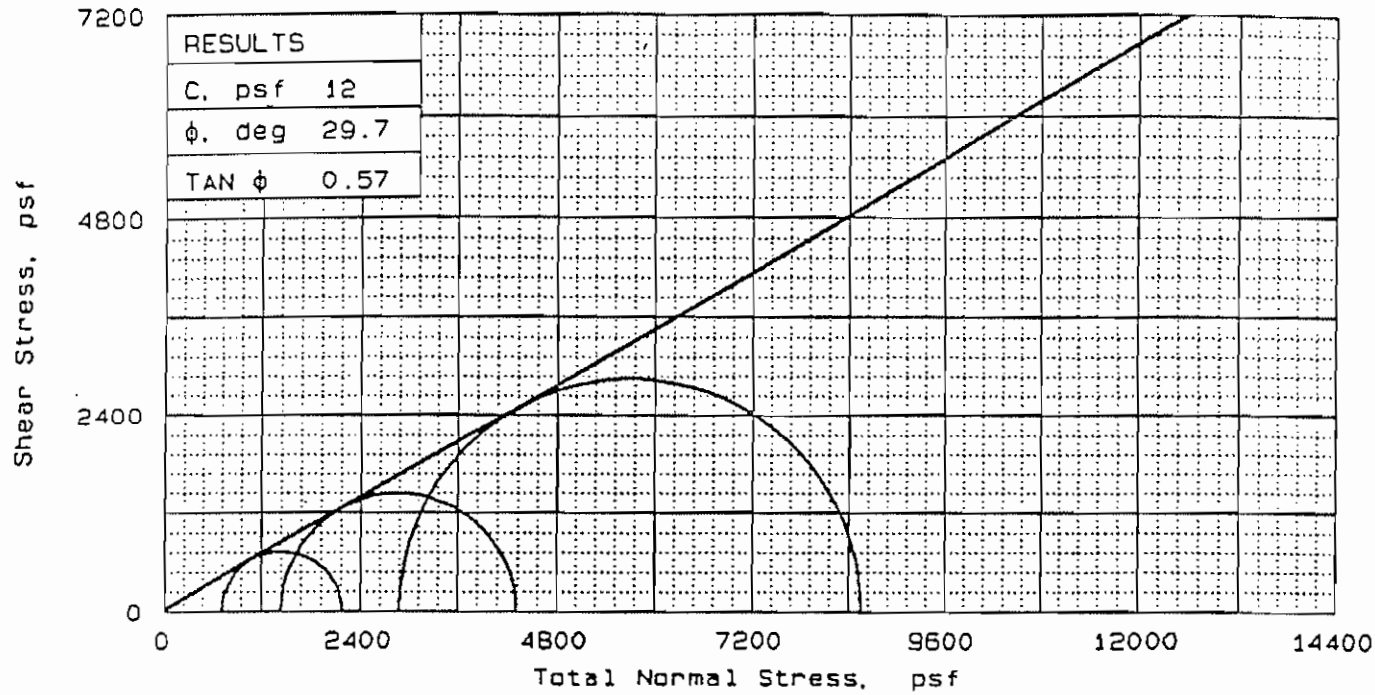
PROJ. NO.: 457.41 DATE: 6-26-90

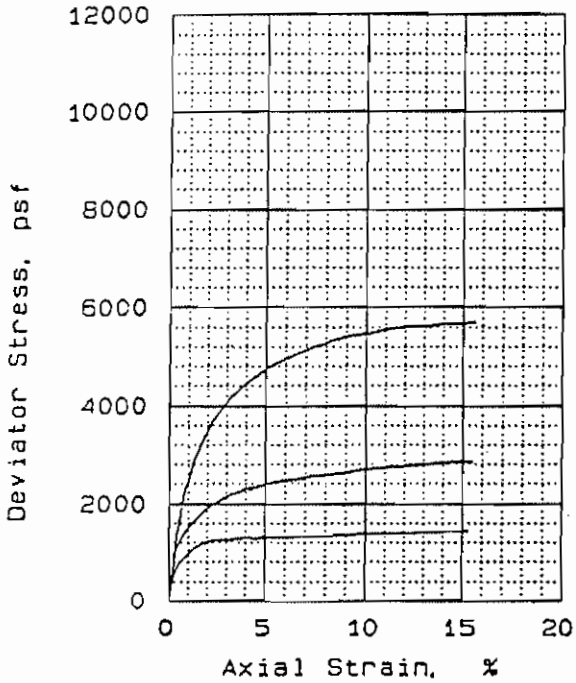
TRIAXIAL COMPRESSION TEST

RMT, INC.

FIG. NO.

✓ JPH 6-26-90 6-26-90





SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	82.4	84.7	83.1
	DRY DENSITY, pcf	34.5	34.2	35.6
	SATURATION, %	62.4	63.3	65.8
	VOID RATIO	2.694	2.728	2.576
	DIAMETER, in	2.87	2.87	2.87
	HEIGHT, in	6.50	6.50	6.50
AT TEST	WATER CONTENT, %	77.5	83.9	73.6
	DRY DENSITY, pcf	49.3	47.0	50.9
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	1.581	1.712	1.502
	DIAMETER, in	2.41	2.45	2.43
	HEIGHT, in	6.42	6.47	6.36
BACK PRESSURE, psf		10080	10080	10080
CELL PRESSURE, psf		11520	10800	12960
FAILURE STRESS, psf		2869	1450	5685
PORE PRESSURE, psf		11218	10526	12125
STRAIN RATE, %/min.		1.000	1.000	1.000
ULTIMATE STRESS, psf				
PORE PRESSURE, psf				
$\bar{\sigma}_1$ FAILURE, psf		3172	1724	6521
$\bar{\sigma}_3$ FAILURE, psf		302	274	835

TYPE OF TEST:
CU with pore pressures
SAMPLE TYPE:
DESCRIPTION: SLUDGE @45% SOLIDS & ASH COMPOSITE
LL= PL= PI=
SPECIFIC GRAVITY= 2.04
REMARKS:

CLIENT: WEYERHAEUSER

PROJECT: WEYERHAEUSER

SAMPLE LOCATION:

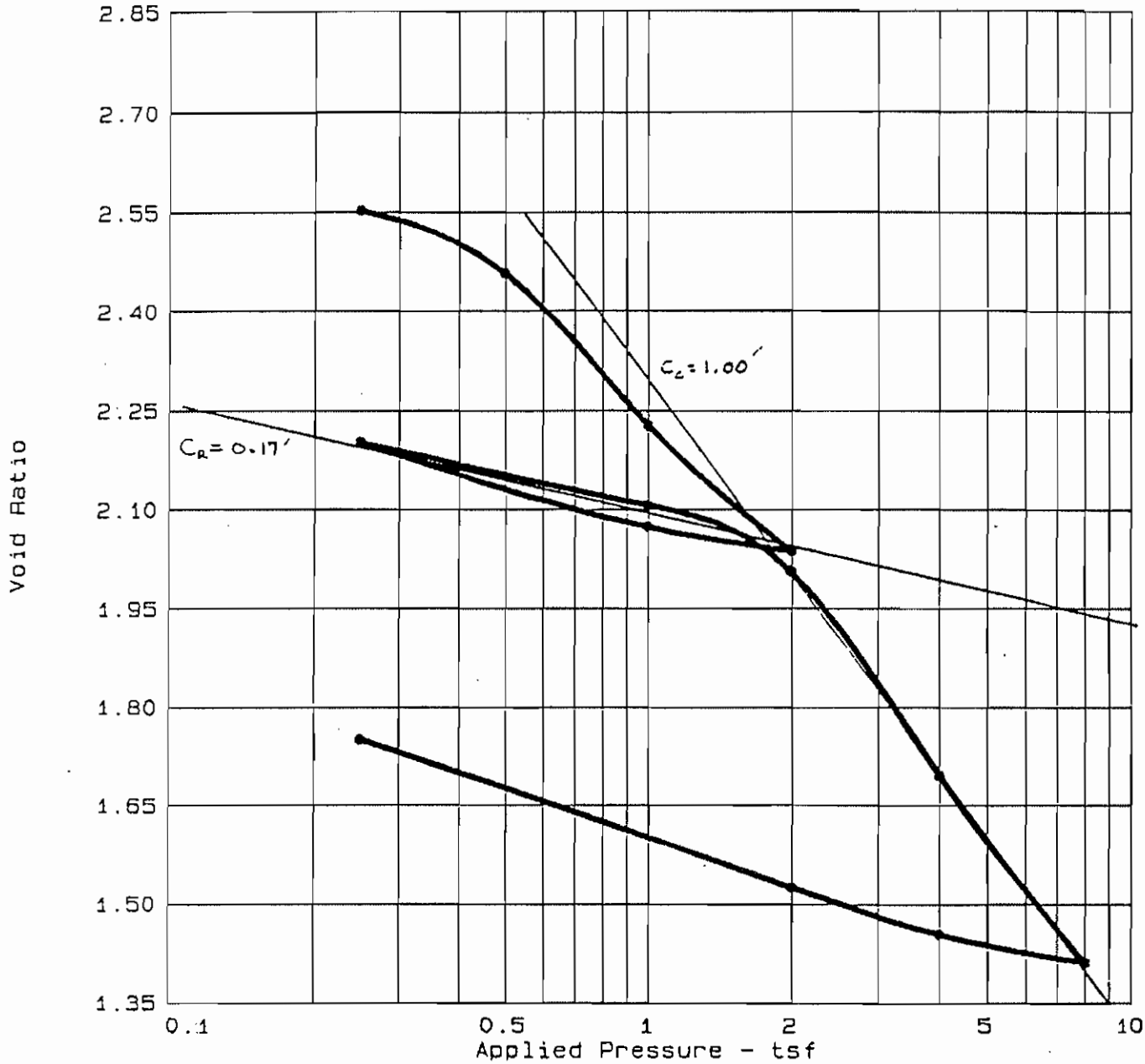
PROJ. NO.: 467.41 DATE: 6-22-90

TRIAXIAL COMPRESSION TEST

RMT, INC.

FIG. NO.

CONSOLIDATION TEST REPORT



Swell press.	Nat. Sat.	Nat. Moist.	Dry Density	LL	PI	Sp.Gr.	Initial void ratio
	85.5 %	130.3	29.9			1.77	2.6972

TEST RESULTS	MATERIAL DESCRIPTION
$CR = \frac{C_c}{1+e_0} = \frac{1.0}{1+2.7} = 0.27$	SLUDGE @45% SOLIDS, TAMPED

Project No.: 467.41
Project: WEYERHAEUSER
Location: SLUDGE @45% SOLIDS, TAMPED

Date: 6-13-90

Remarks:

CONSOLIDATION TEST REPORT

RMT, INC.

Fig. No. _____

✓ JPH 6-20-90

15:43, 6-20-1990 CONSOLIDATION TEST PROJECT DATA Test No. 18

Project Number: 467.41
Project: WEYERHAEUSER
Date: 6-13-90
Location 1: SLUDGE @45% SOLIDS, TAMPED
2:
Remarks 1:
2:
3:
4:
5:
Material 1: SLUDGE @45% SOLIDS,
description 2: TAMPED
Classification:
Liquid limit:
Plasticity index:
Figure Number:

CONSOLIDATION TEST SPECIMEN DATA

TOTAL SAMPLE		BEFORE TEST		AFTER TEST	
Wet w+t =	88.67 g.	Oedometer No. =	1	Wet w+t =	300.57 g.
Dry w+t =	38.51 g	Machine No. =	N/A	Dry w+t =	261.38 g.
Tare wt. =	0.00 g.	Spec. Gravity =	1.77	Tare wt. =	222.87 g.
Height =	1.00 in.	Height =	1.00 in.		
Diameter =	2.50 in.	Diameter =	2.50 in.		
Weight =	88.67 g.				

Moisture =	% 130.3 %	Ht. Solids =	0.27 in.	Moisture =	101. %
Wet Den. =	68.8 pcf	Dry wt. =	38.51 g.	Dry wt. =	38.51 g. *
Dry Den. =	29.9 pcf	Void ratio =	2.6972	Void ratio =	1.7496
		Saturation =	85.5 %	Saturation =	103. %

* Final dry weight used in calculations

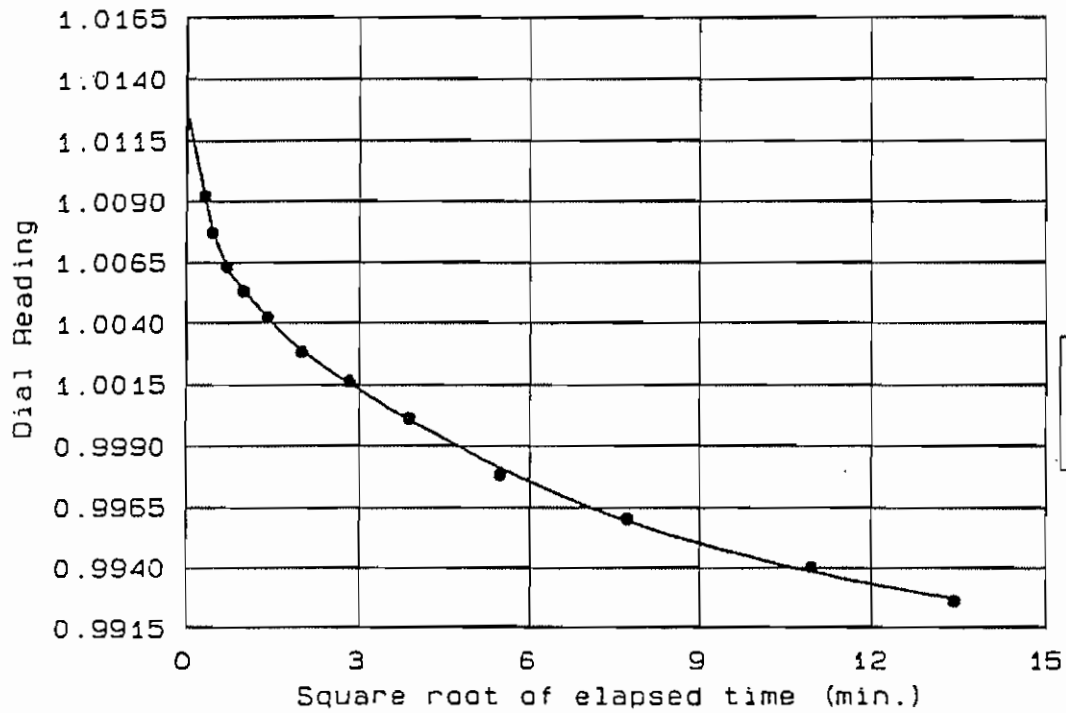
CONSOLIDATION TEST READINGS SUMMARY

LOAD (tsf)	DIAL (in.)	DEFLECTION (in.)	CORRECTED DIAL (in.)	VOID RATIO	% SWELL/CONSOL.
Initial	1.03200			2.6972	
0.25	0.99260	0.0000	0.99260	2.5515	3.9 Consol.
0.50	0.96710	0.0000	0.96710	2.4572	6.5 Consol.
1.00	0.90480	0.0000	0.90480	2.2269	12.7 Consol.
2.00	0.85340	0.0000	0.85340	2.0369	17.9 Consol.
1.00	0.86320	0.0000	0.86320	2.0731	16.9 Consol.
0.25	0.89790	0.0000	0.89790	2.2014	13.4 Consol.
1.00	0.87200	0.0000	0.87200	2.1056	16.0 Consol.
2.00	0.84500	0.0000	0.84500	2.0058	18.7 Consol.
4.00	0.76090	0.0000	0.76090	1.6949	27.1 Consol.

Dial Reading vs. Time

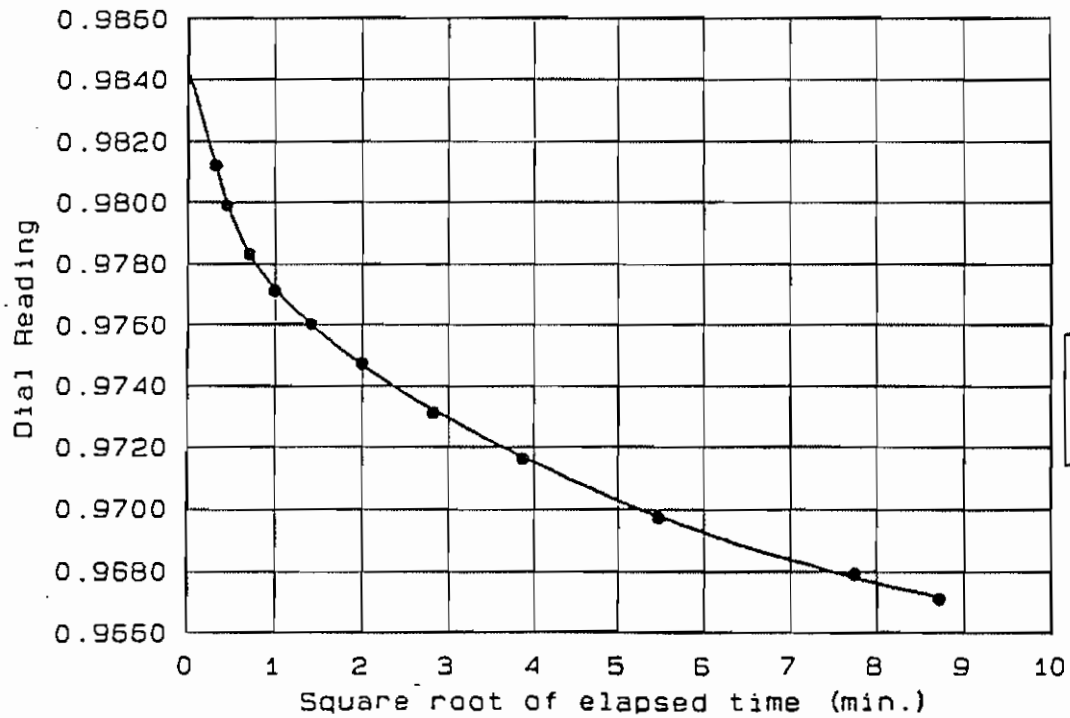
Project No.: 467.41
Project: WEYERHAEUSER
Location: SLUDGE @45% SOLIDS, TAMPED

Date: 6-13-90



Load No.= 1
Load= 0.25 tsf
D_0 = 1.0128
D_{90} = 1.0069
D_{100}= 1.0062
T_{90}= 0.36 min.

C_v @ T_{90} =
5.7 ft^2/day



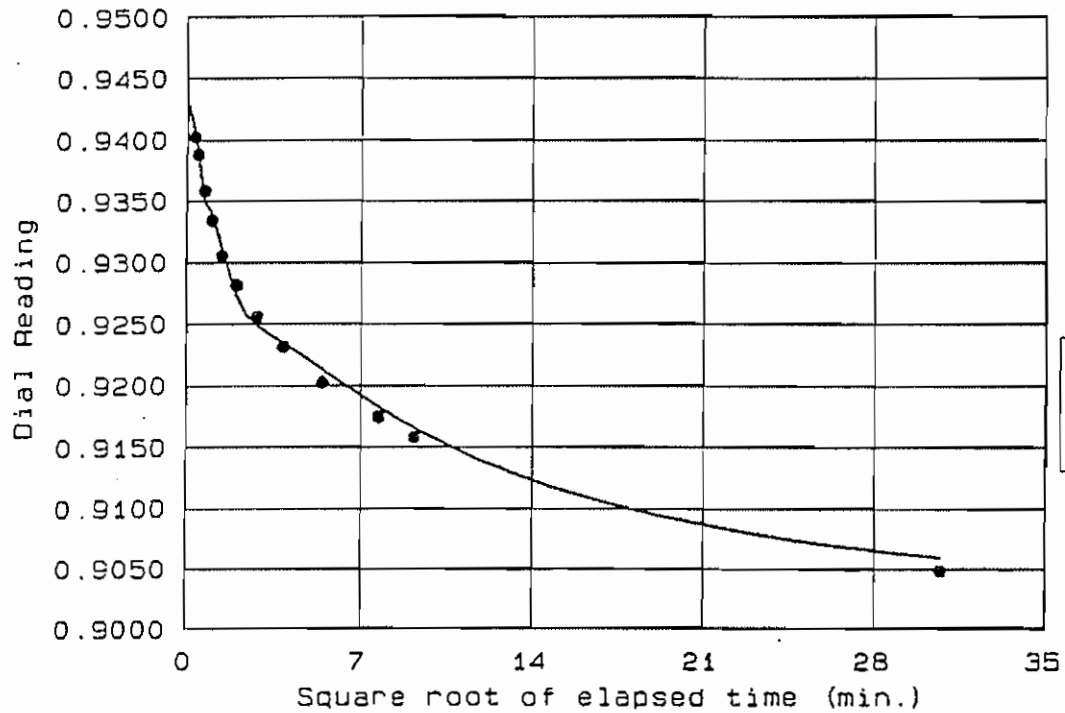
Load No.= 2
Load= 0.50 tsf
D_0 = 0.9843
D_{90} = 0.9783
D_{100}= 0.9777
T_{90}= 0.48 min.

C_v @ T_{90} =
3.9 ft^2/day

Dial Reading vs. Time

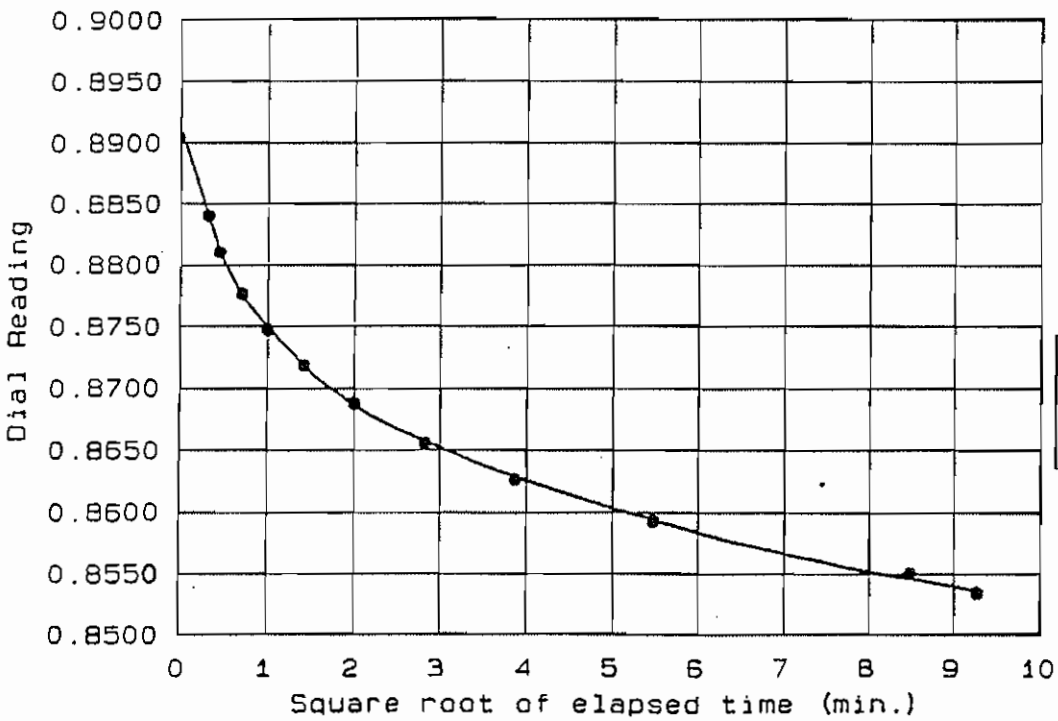
Project No.: 467.41
Project: WEYERHAEUSER
Location: SLUDGE @45% SOLIDS, TAMPED

Date: 6-13-90



Load No.= 3
Load= 1.00 tsf
D_0 = 0.9436
D_{90} = 0.9338
D_{100}= 0.9327
T_{90}= 1.11 min.

C_v @ T_{90} =
1.6 ft^2/day



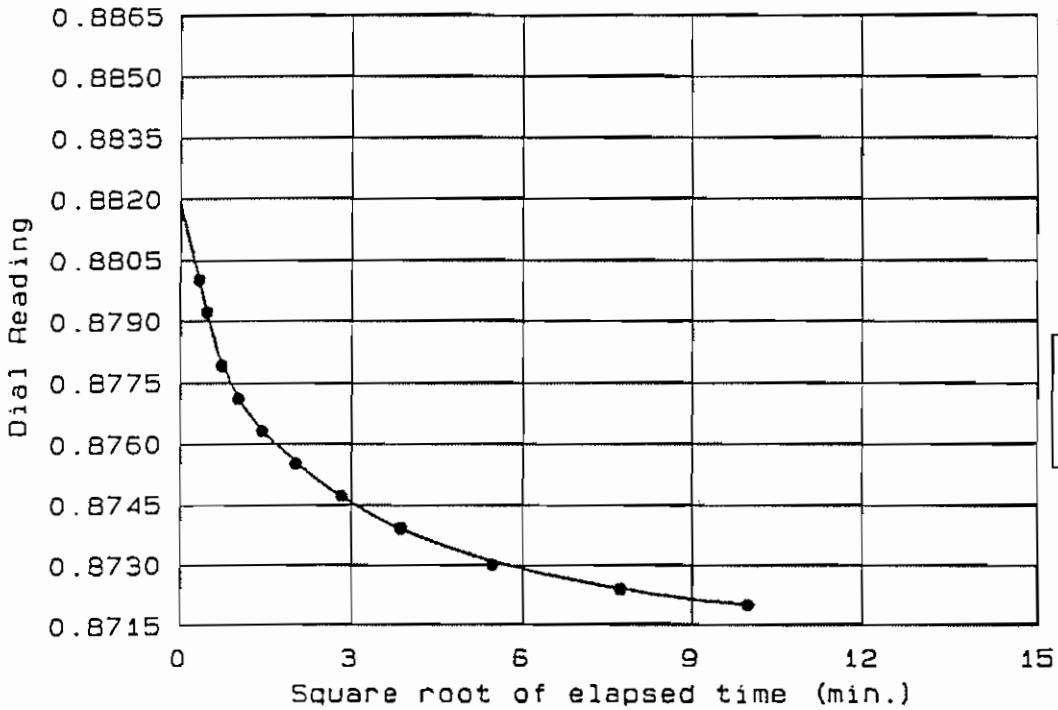
Load No.= 4
Load= 2.00 tsf
D_0 = 0.8912
D_{90} = 0.8779
D_{100}= 0.8765
T_{90}= 0.45 min.

C_v @ T_{90} =
3.4 ft^2/day

Dial Reading vs. Time

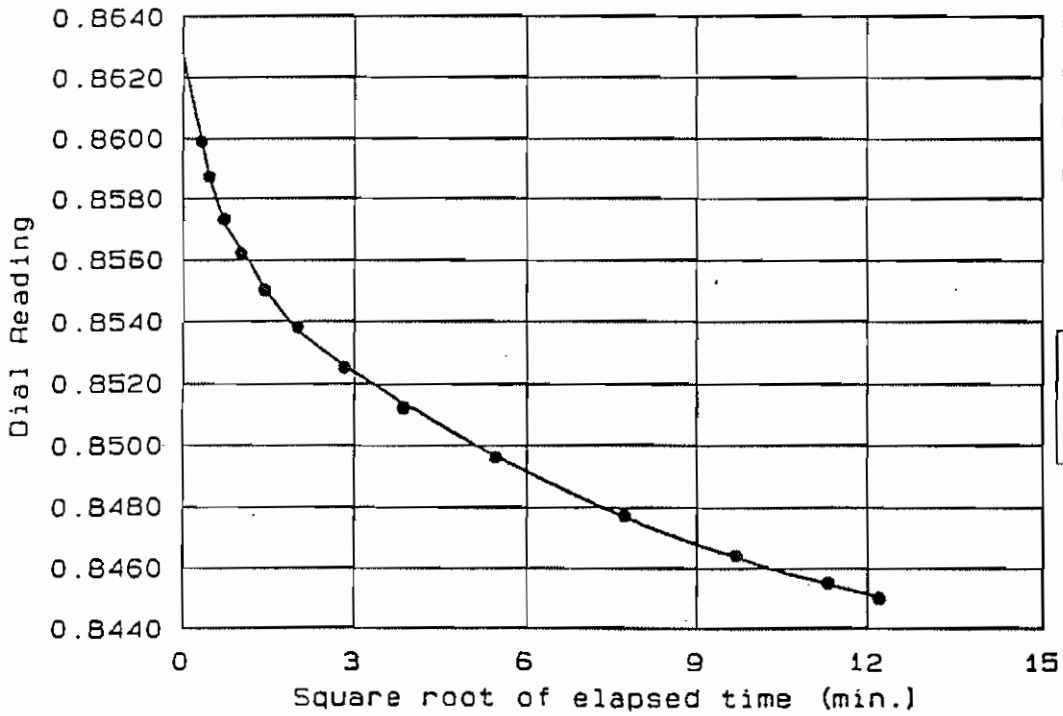
Project No.: 467.41
Project: WEYERHAEUSER
Location: SLUDGE @45% SOLIDS, TAMPED

Date: 6-13-90



Load No.= 7
Load= 1.00 tsf
D_0 = 0.8819
D_{90} = 0.8776
D_{100}= 0.8771
T_{90}= 0.67 min.

C_v @ T_{90} =
2.3 ft^2/day



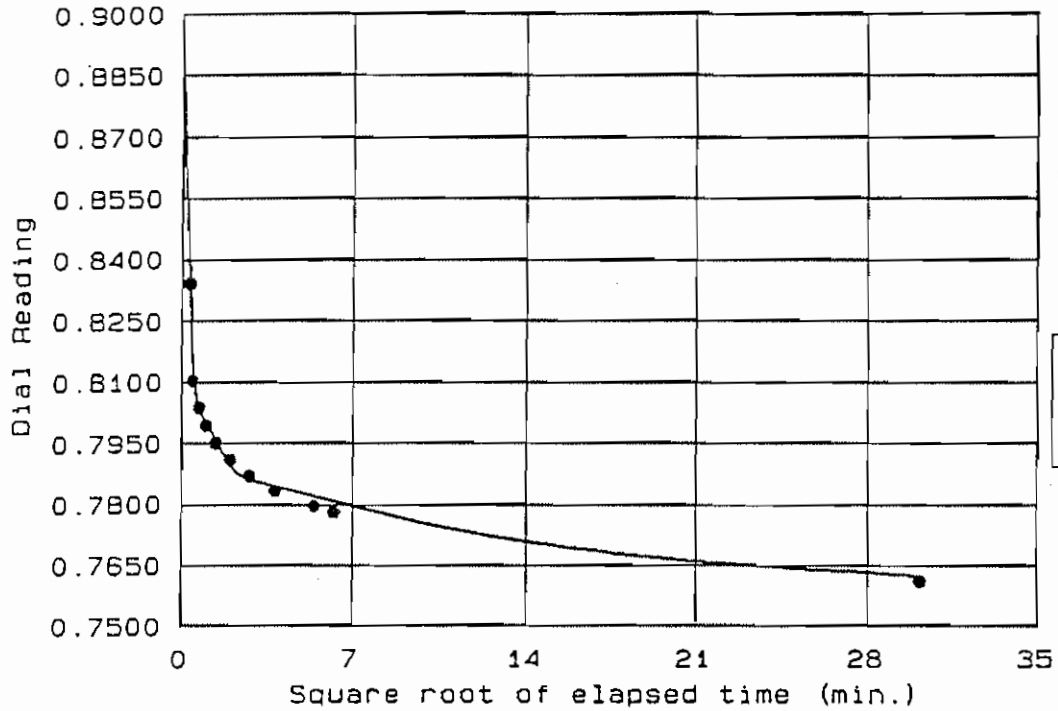
Load No.= 8
Load= 2.00 tsf
D_0 = 0.8628
D_{90} = 0.8572
D_{100}= 0.8566
T_{90}= 0.49 min.

C_v @ T_{90} =
2.9 ft^2/day

Dial Reading vs. Time

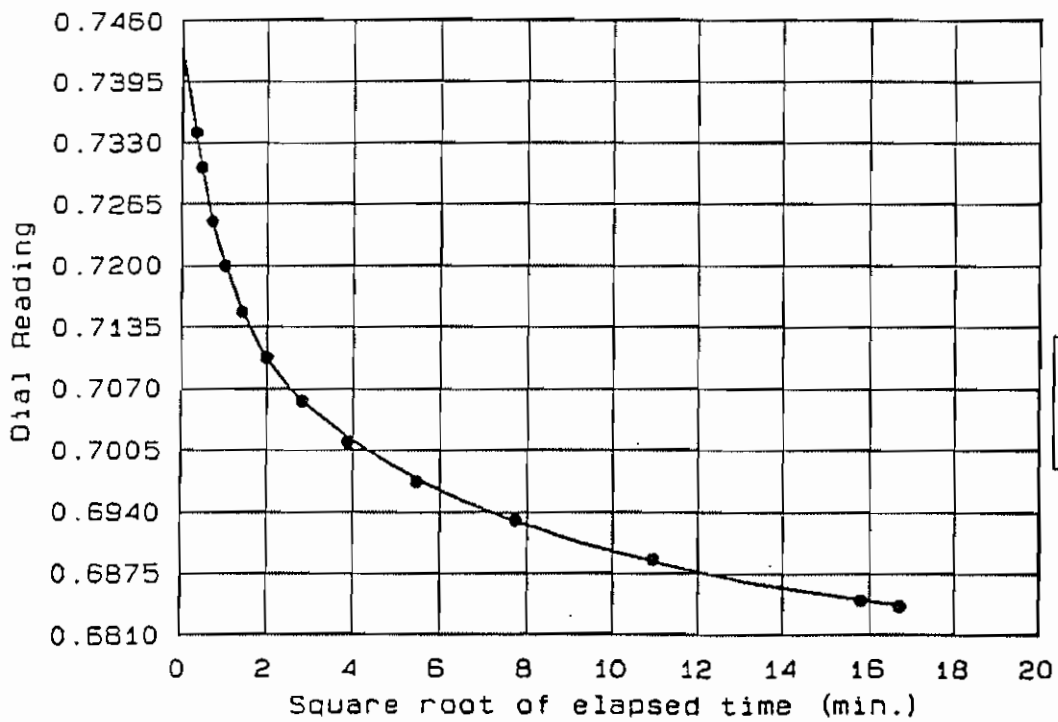
Project No.: 467.41
Project: WEYERHAEUSER
Location: SLUDGE @45% SOLIDS, TAMPED

Date: 6-13-90



Load No.= 9
Load= 4.00 tsf
D_0 = 0.8915
D_{90} = 0.8091
D_{100}= 0.7999
T_{90}= 0.27 min.

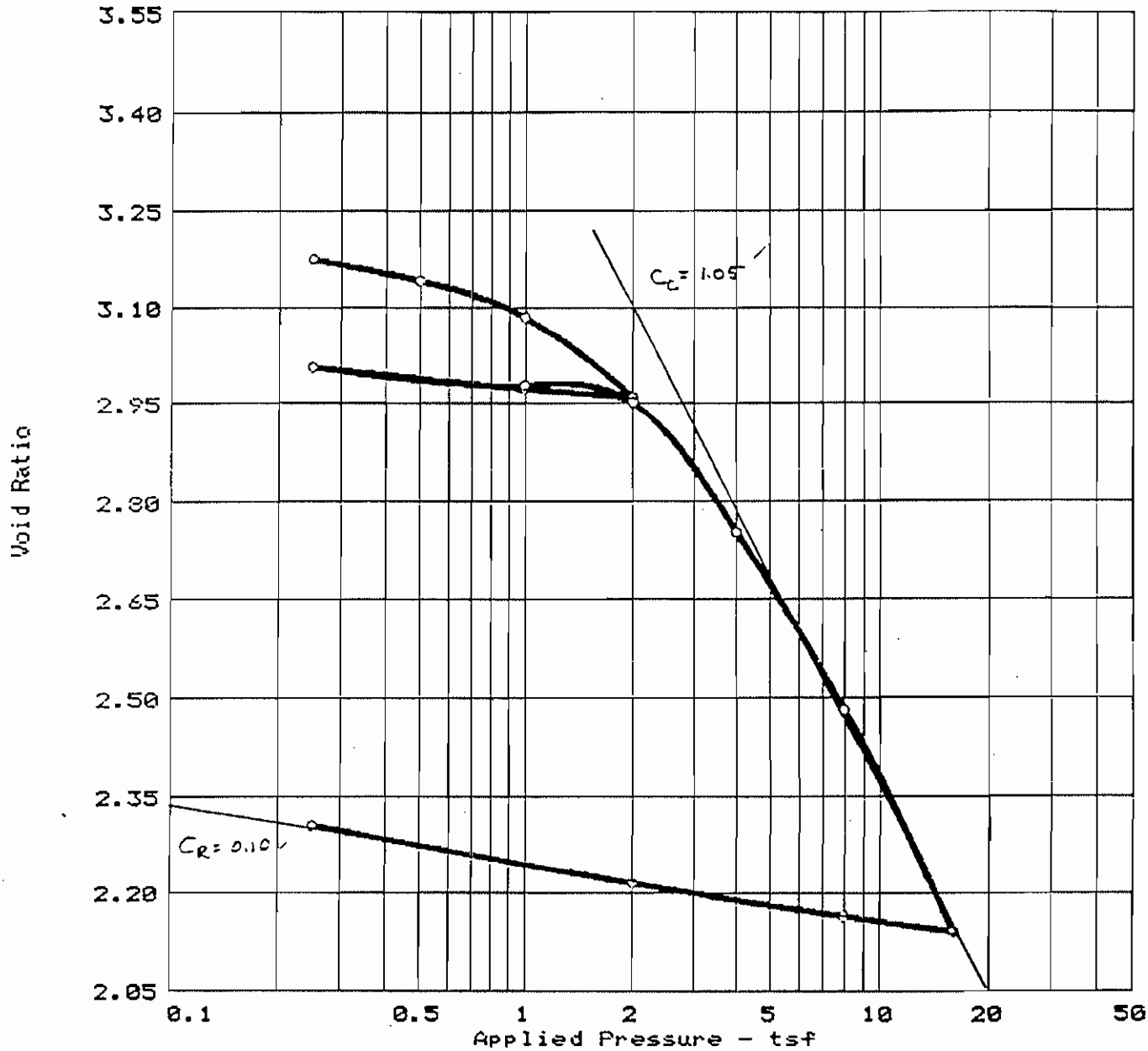
C_v @ T_{90} =
4.7 ft^2/day



Load No.= 10
Load= 8.00 tsf
D_0 = 0.7429
D_{90} = 0.7223
D_{100}= 0.7200
T_{90}= 0.70 min.

C_v @ T_{90} =
1.4 ft^2/day

CONSOLIDATION TEST REPORT



Swell press.	Nat. Sat.	Nat. Moist.	Dry Density	LL	PI	Sp.Gr.	Initial void ratio
	28.2 %	42.5	31.6			2.13	3.2025

TEST RESULTS	MATERIAL DESCRIPTION
$CR = \frac{C_c}{1+e_0} = \frac{1.05}{1+3.2} = 0.25$	ASH
Project No.: 467.41 Project: WEYERHAEUSER Location: Date:	Remarks:
CONSOLIDATION TEST REPORT RMT, INC.	Fig. No._____

✓ 6-26-90

4:36. 6-21-1990 CONSOLIDATION TEST PROJECT DATA Test No. 6

ject Number: 467.41
Project: WEYERHAEUSER
Date:
Location 1:
2:
Remarks 1:
2:
3:
4:
5:
Material 1: ASH COMPOSITE
description 2:
Classification:
Liquid limit:
Plasticity index:
Figure Number:

CONSOLIDATION TEST SPECIMEN DATA

TOTAL SAMPLE	BEFORE TEST	AFTER TEST
t w+t = 58.08 g.	Oedometer No. = 2	Wet w+t = 334.20 g.
v w+t = 40.77 g	Machine No. = N/A	Dry w+t = 292.27 g.
re wt. = 0.00 g.	Spec. Gravity = 2.13	Tare wt. = 251.50 g.
t = 1.00 in.	Height = 1.00 in.	
a. ter = 2.50 in.	Diameter = 2.50 in.	
ight = 58.08 g.		
isture = 42.5 %	Ht. Solids = 0.24 in.	Moisture = 102. %
t Den. = 45.1 pcf	Dry wt. = 40.77 g.	Dry wt. = 40.77 g. *
v Den. = 31.6 pcf	Void ratio = 3.2025	Void ratio = 2.3036
	Saturation = 28.2 %	Saturation = 95.1 %

Final dry weight used in calculations

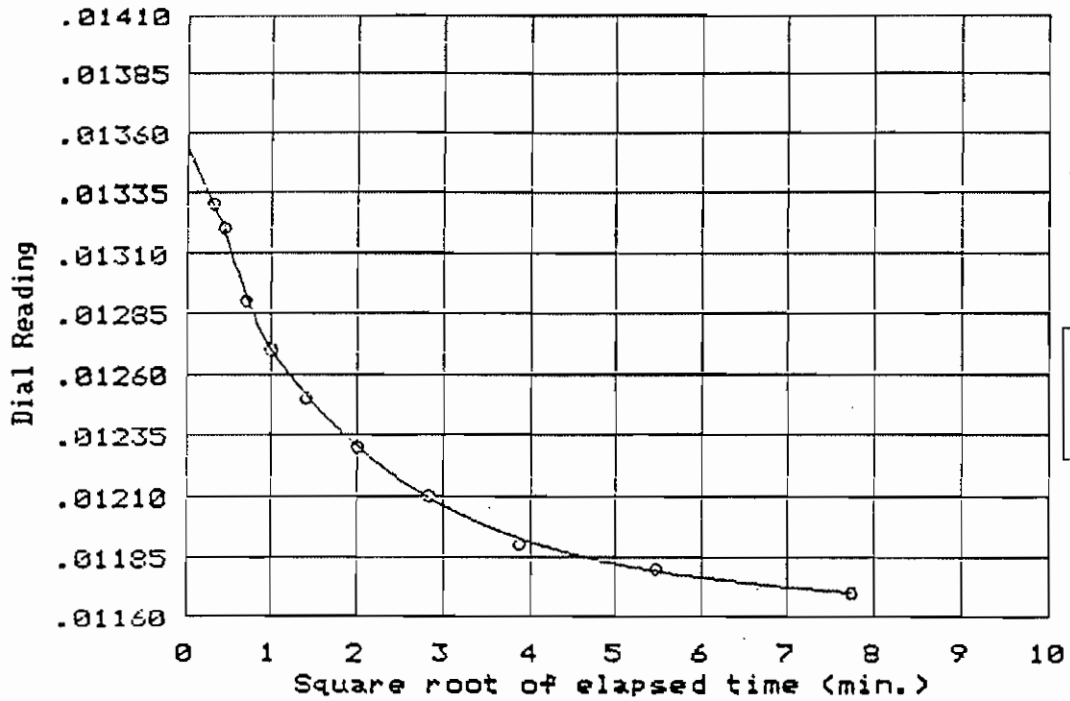
CONSOLIDATION TEST READINGS SUMMARY

LOAD (tsf)	DIAL (in.)	DEFLECTION (in.)	CORRECTED DIAL (in.)	VOID RATIO	% SWELL/CONSOL.
nitial	1.01810			3.2025	
0.25	1.01170	0.0000	1.01170	3.1756	0.6 Consol.
0.50	1.00350	0.0000	1.00350	3.1412	1.5 Consol.
1.00	0.99000	0.0000	0.99000	3.0844	2.8 Consol.
2.00	0.95990	0.0000	0.95990	2.9579	5.8 Consol.
1.00	0.96300	0.0000	0.96300	2.9710	5.5 Consol.
0.25	0.97110	0.0000	0.97110	3.0050	4.7 Consol.
1.00	0.96450	0.0000	0.96450	2.9773	5.4 Consol.
2.00	0.95800	0.0000	0.95800	2.9499	6.0 Consol.
4.00	0.91110	0.0000	0.91110	2.7529	10.7 Consol.
" 00	0.84670	0.0000	0.84670	2.4822	17.1 Consol.
00	0.76520	0.0000	0.76520	2.1397	25.3 Consol.
8.00	0.77090	0.0000	0.77090	2.1637	24.7 Consol.
2.00	0.78300	0.0000	0.78300	2.2145	23.5 Consol.
0.25	0.80420	0.0000	0.80420	2.3036	21.4 Consol.

Dial Reading vs. Time

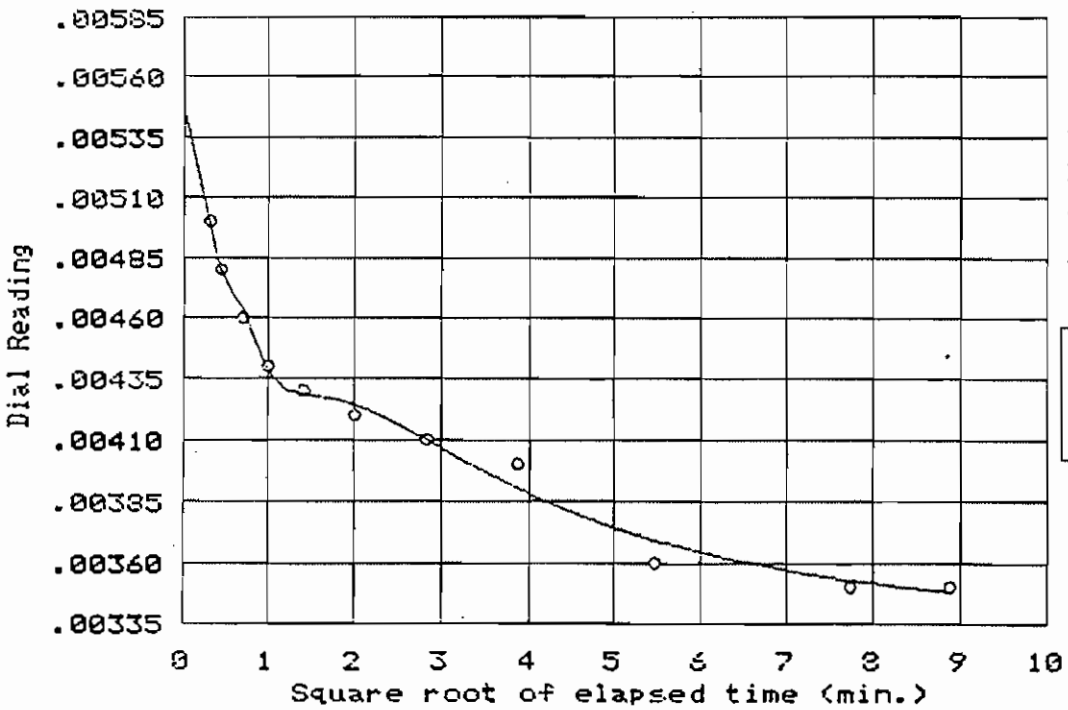
Project No.: 467.41
Project: WEYERHAEUSER
Location:

Date:



Load No.= 1
Load= 0.25 tsf
D_0 = 1.0135
D_{90} = 1.0124
D_{100}= 1.0123
T_{90}= 2.74 min.

C_v @ T_{90} =
0.08 in.^{2}/min.



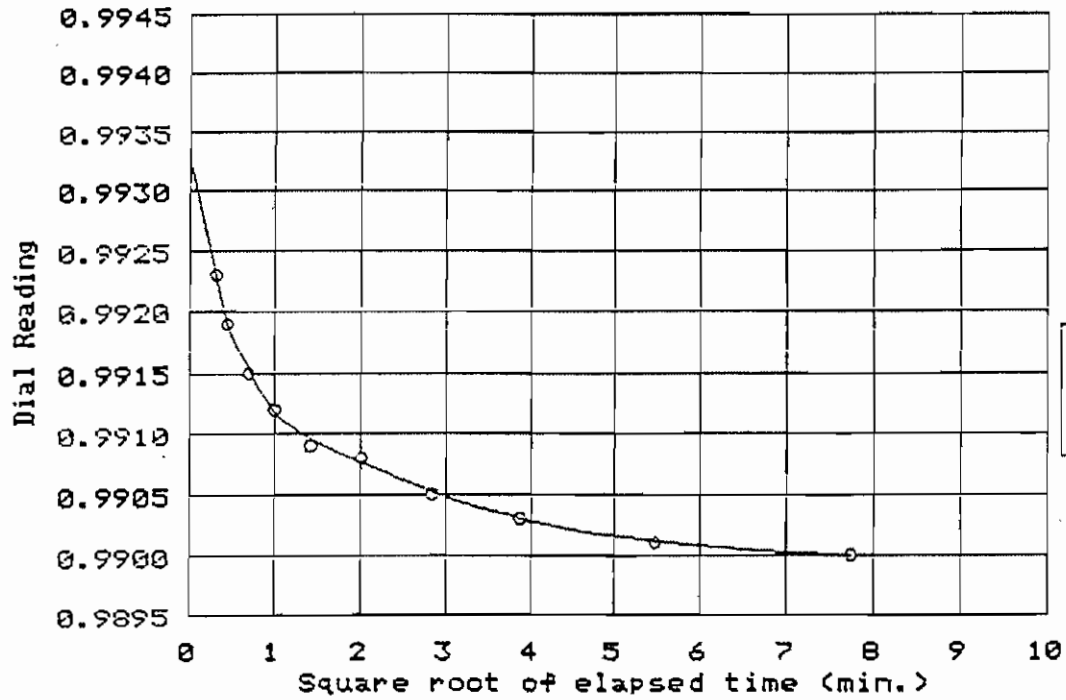
Load No.= 2
Load= 0.50 tsf
D_0 = 1.0055
D_{90} = 1.0047
D_{100}= 1.0046
T_{90}= 0.36 min.

C_v @ T_{90} =
0.57 in.^{2}/min.

Dial Reading vs. Time

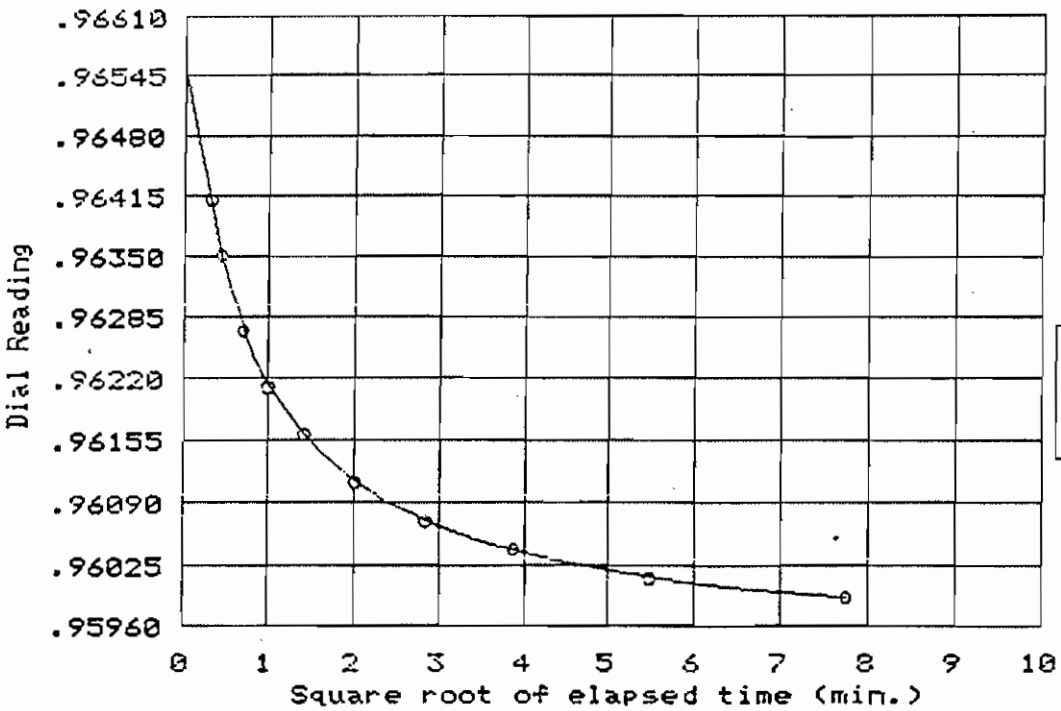
Project No.: 467.41
Project: WEYERHAEUSER
Location:

Date:



Load No.= 3
Load= 1.00 tsf
D_0 = 0.9933
D_{90} = 0.9917
D_{100}= 0.9915
T_{90}= 0.37 min.

C_v @ T_{90} =
0.56 in.^{2}/min.



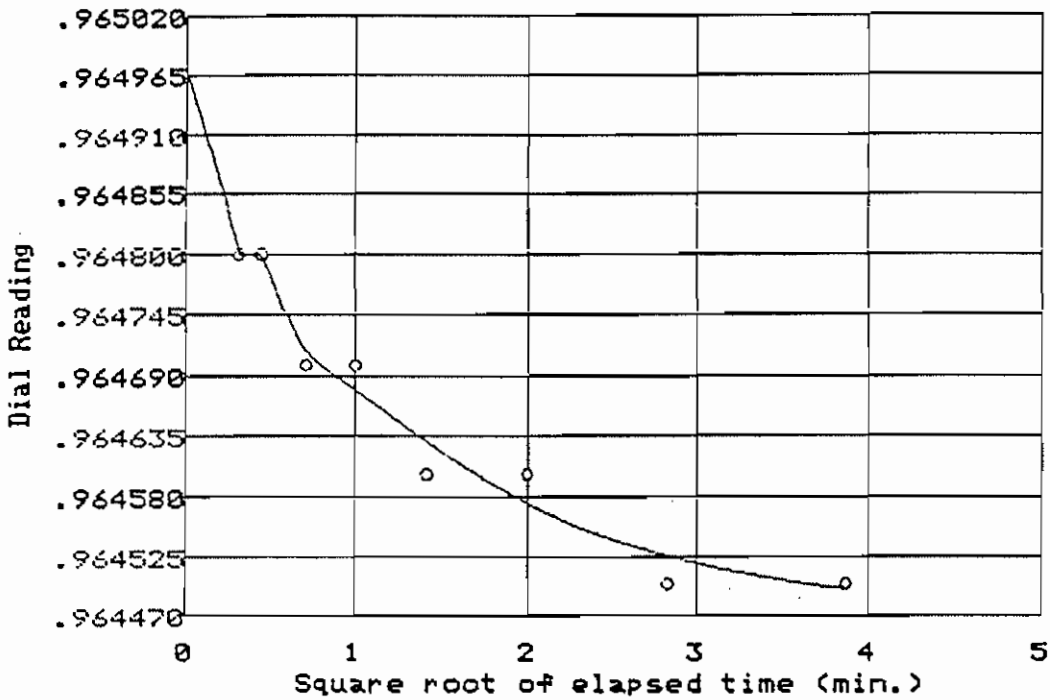
Load No.= 4
Load= 2.00 tsf
D_0 = 0.9655
D_{90} = 0.9627
D_{100}= 0.9624
T_{90}= 0.51 min.

C_v @ T_{90} =
0.38 in.^{2}/min.

Dial Reading vs. Time

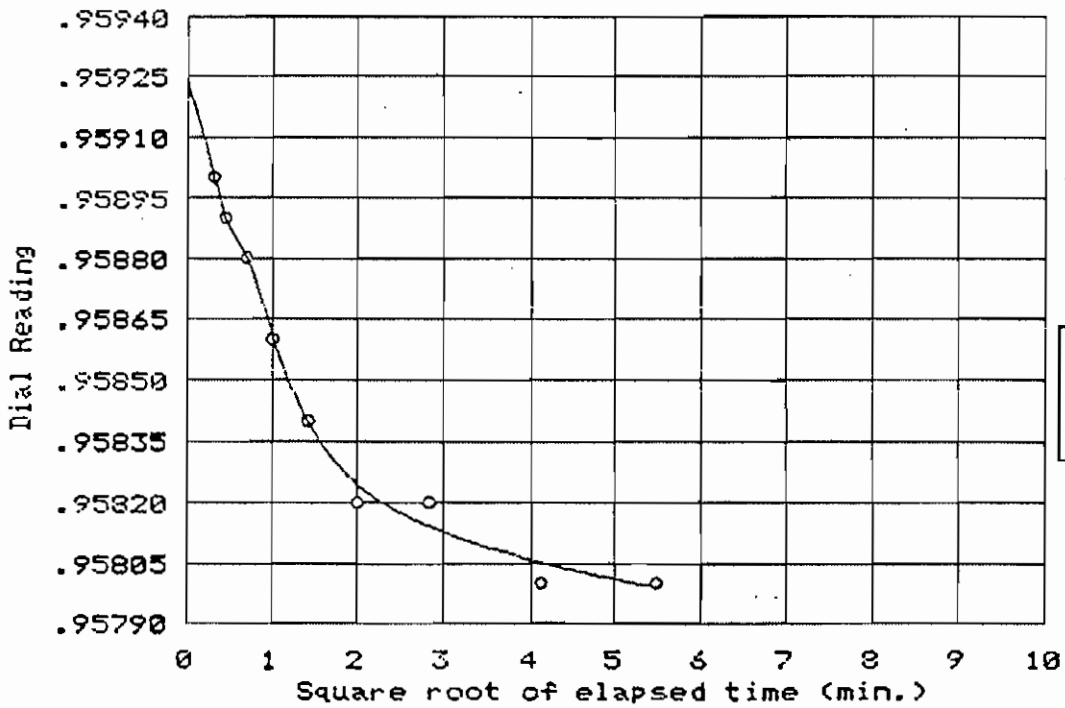
Project No.: 467.41
Project: WEYERHAEUSER
Location:

Date:



Load No.= 7
Load= 1.00 tsf
D_0 = 0.9650
D_{90} = 0.9647
D_{100}= 0.9647
T_{90}= 0.67 min.

C_v @ T_{90} =
0.29 in.^{2}/min.



Load No.= 8
Load= 2.00 tsf
D_0 = 0.9592
D_{90} = 0.9588
D_{100}= 0.9588
T_{90}= 0.36 min.

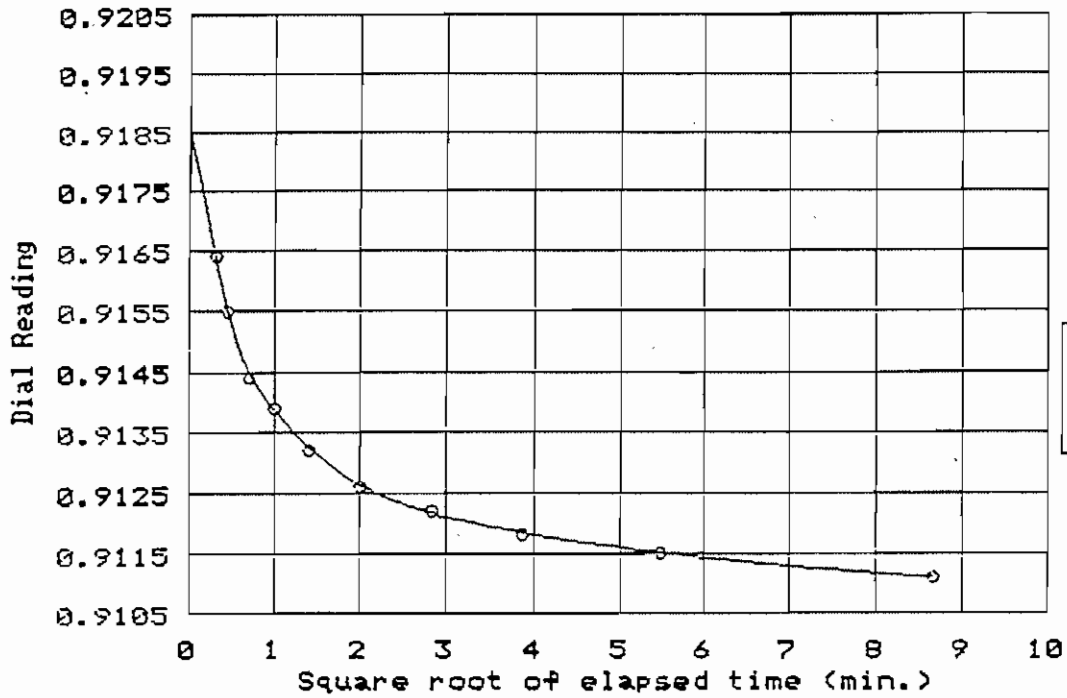
C_v @ T_{90} =
0.52 in.^{2}/min.

RMT, INC.

Dial Reading vs. Time

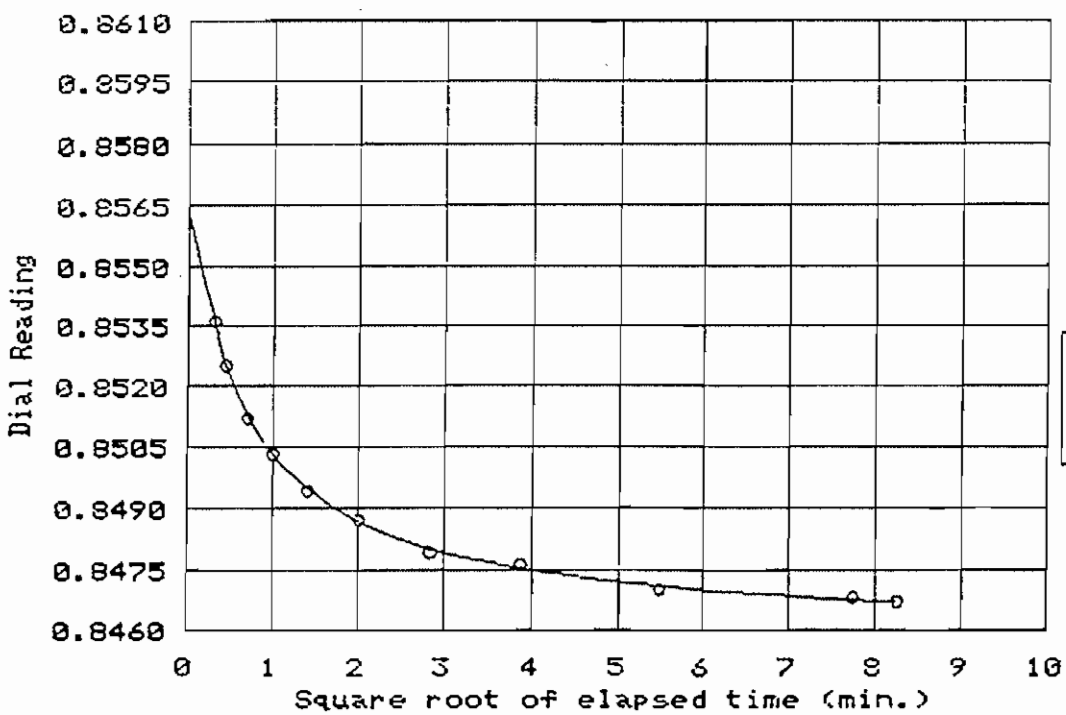
Project No.: 467.41
Project: WEYERHAEUSER
Location:

Date:



Load No.= 9
Load= 4.00 tsf
D_0 = 0.9186
D_{90} = 0.9146
D_{100}= 0.9141
T_{90}= 0.45 min.

C_v @ T_{90} =
0.40 in.^{2}/min.



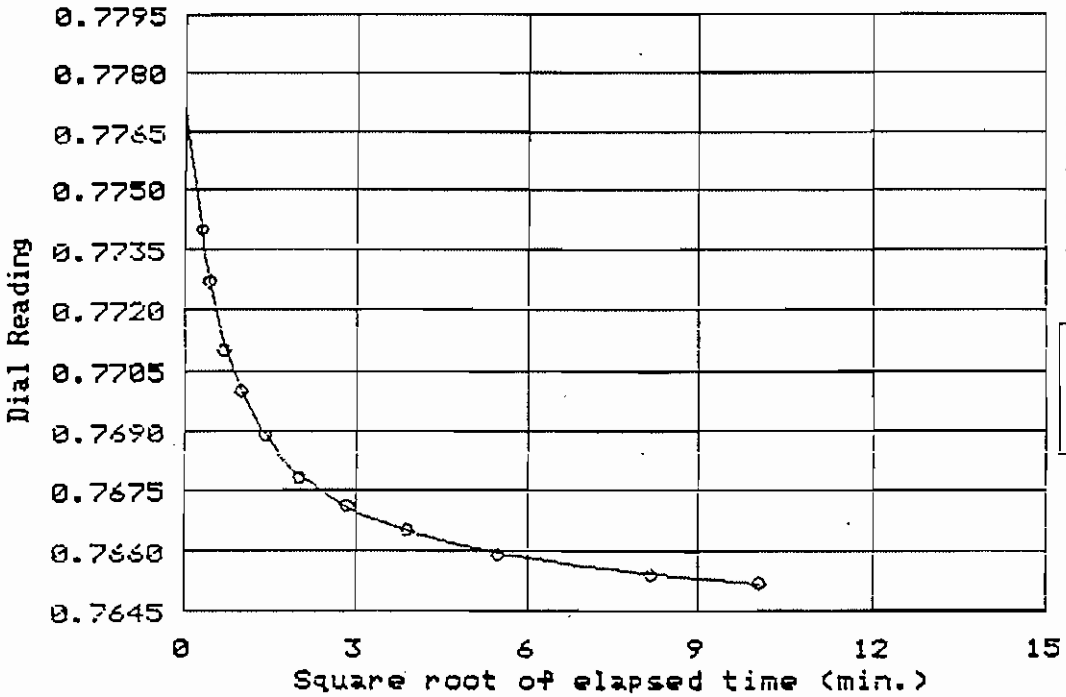
Load No.= 10
Load= 8.00 tsf
D_0 = 0.8563
D_{90} = 0.8515
D_{100}= 0.8509
T_{90}= 0.43 min.

C_v @ T_{90} =
0.36 in.^{2}/min.

Dial Reading vs. Time

Project No.: 467.41
Project: WEYERHAEUSER
Location:

Date:



Load No.= 11

Load= 16.00 tsf

D_0 = 0.7771

D_{90} = 0.7711

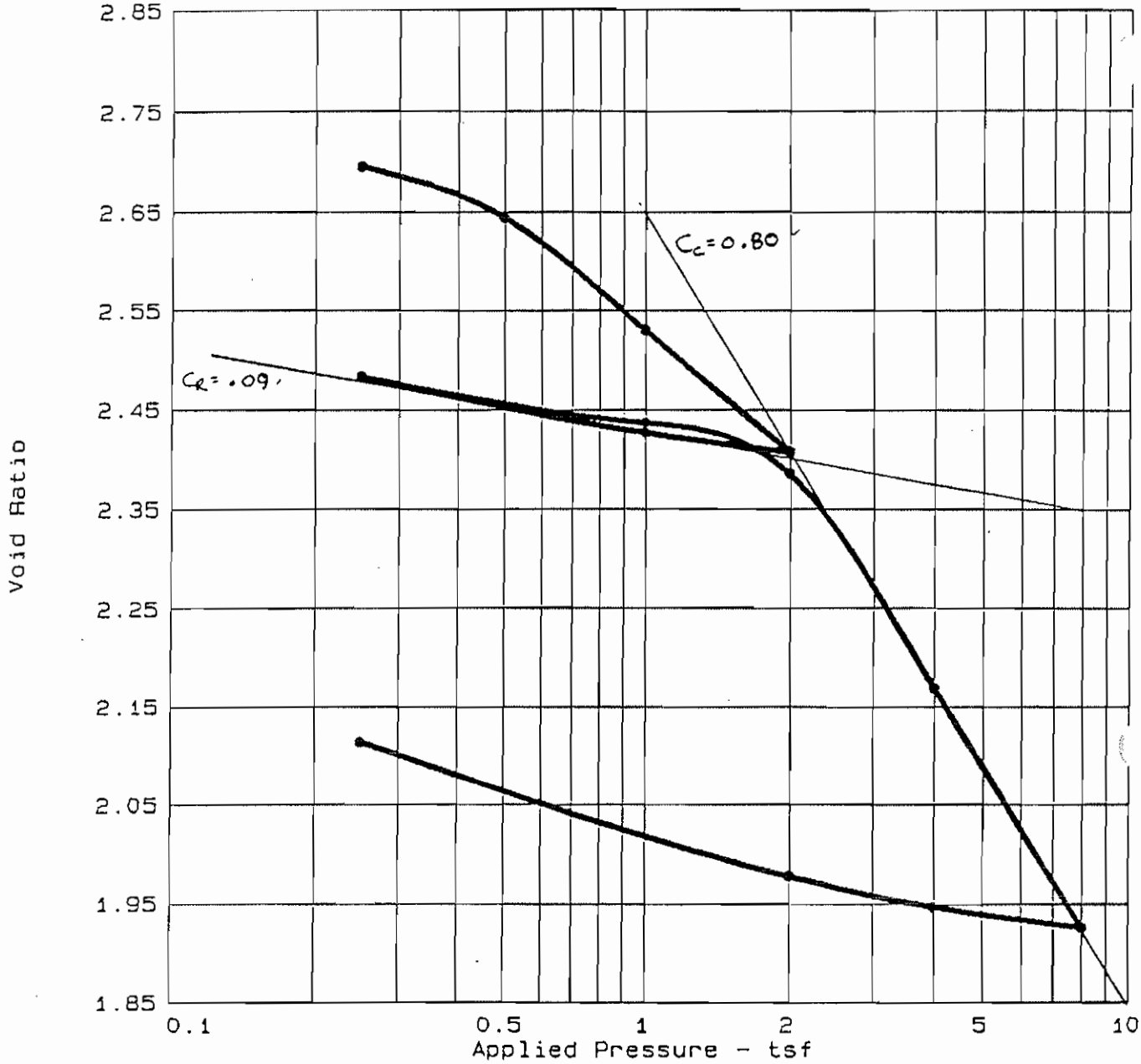
D_{100}= 0.7704

T_{90}= 0.49 min.

C_v @ T_{90} =

0.27 in.^{2}/min.

CONSOLIDATION TEST REPORT



Swell press.	Nat. Sat.	Nat. Moist.	Dry Density	LL	PI	Sp.Gr.	Initial void ratio
	53.8 %	72.7	33.9			2.04	2.7577

TEST RESULTS	MATERIAL DESCRIPTION
$CR = \frac{C_c}{1+e_o} = \frac{0.80}{1+2.74} = 0.21$	COMPOSITE- 50% SLUDGE @ 45% SOLIDS+50%ASH COMP

Project No.: 467.41
Project: WEYERHAEUSER
Location: COMPOSITE OF SLUDGE @ 45% SOLIDS & ASH

Date: 6-13-90

Remarks:

CONSOLIDATION TEST REPORT

RMT, INC.

Fig. No.

/ JPH 6-26-

07:54, 6-21-1990 CONSOLIDATION TEST PROJECT DATA Test No. 19

Project Number: 467.41
Project: WEYERHAEUSER
Date: 6-13-90
Location 1: COMPOSITE OF SLUDGE @ 45% SOLIDS & ASH
2:
Remarks 1:
2:
3:
4:
5:
Material 1: COMPOSITE- 50% SLUDGE @
description 2: 45% SOLIDS+50%ASH COMP
Classification:
Liquid limit:
Plasticity index:
Figure Number:

CONSOLIDATION TEST SPECIMEN DATA

TOTAL SAMPLE		BEFORE TEST		AFTER TEST	
Wet w+t =	75.42 g.	Oedometer No. =	2	Wet w+t =	308.93 g.
Dry w+t =	43.67 g	Machine No. =	N/A	Dry w+t =	264.14 g.
Tare wt. =	0.00 g.	Spec. Gravity =	2.04	Tare wt. =	220.47 g.
Height =	1.00 in.	Height =	1.00 in.		
Diameter =	2.50 in.	Diameter =	2.50 in.		
Weight =	75.42 g.				
Moisture =	72.7 %	Ht. Solids =	0.27 in.	Moisture =	102. %
Wet Den. =	58.5 pcf	Dry wt. =	43.67 g.	Dry wt. =	43.67 g. *
Dry Den. =	33.9 pcf	Void ratio =	2.7577	Void ratio =	2.1132
		Saturation =	53.8 %	Saturation =	99.0 %

* Final dry weight used in calculations

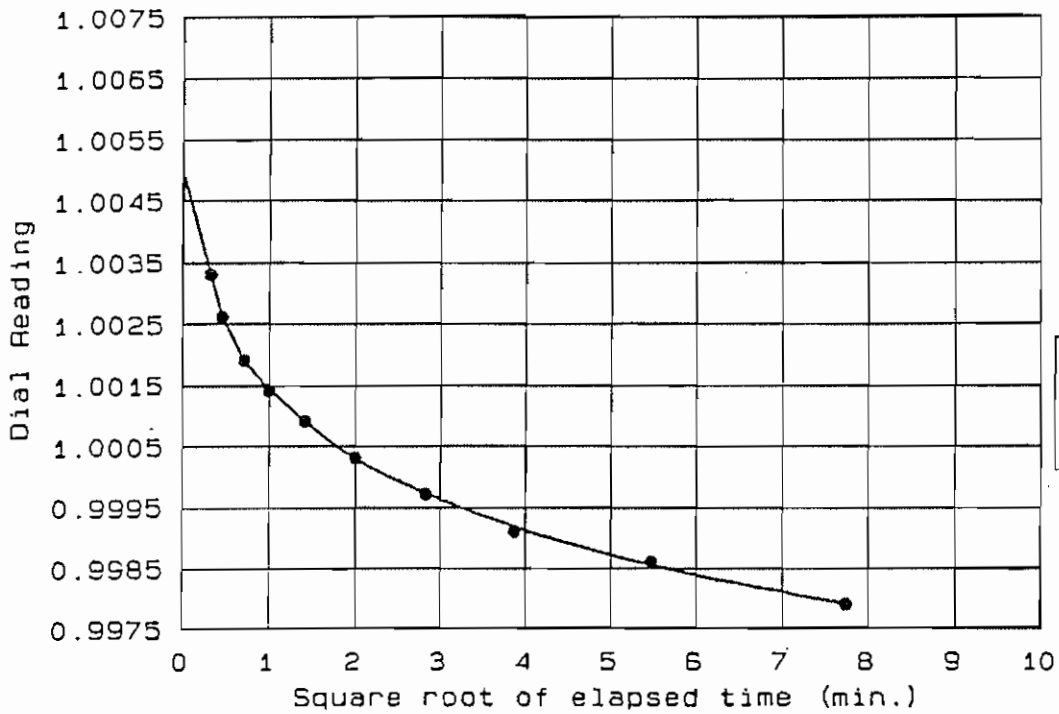
CONSOLIDATION TEST READINGS SUMMARY

LOAD (tsf)	DIAL (in.)	DEFLECTION (in.)	CORRECTED DIAL (in.)	VOID RATIO	% SWELL/CONSOL.
Initial	1.01470			2.7577	
0.25	0.99790	0.0000	0.99790	2.6945	1.7 Consol.
0.50	0.98450	0.0000	0.98450	2.6442	3.0 Consol.
1.00	0.95400	0.0000	0.95400	2.5296	6.1 Consol.
2.00	0.92140	0.0000	0.92140	2.4071	9.3 Consol.
1.00	0.92650	0.0000	0.92650	2.4262	8.8 Consol.
0.25	0.94150	0.0000	0.94150	2.4826	7.3 Consol.
1.00	0.92910	0.0000	0.92910	2.4360	8.6 Consol.
2.00	0.91560	0.0000	0.91560	2.3853	9.9 Consol.
4.00	0.85790	0.0000	0.85790	2.1685	15.7 Consol.

Dial Reading vs. Time

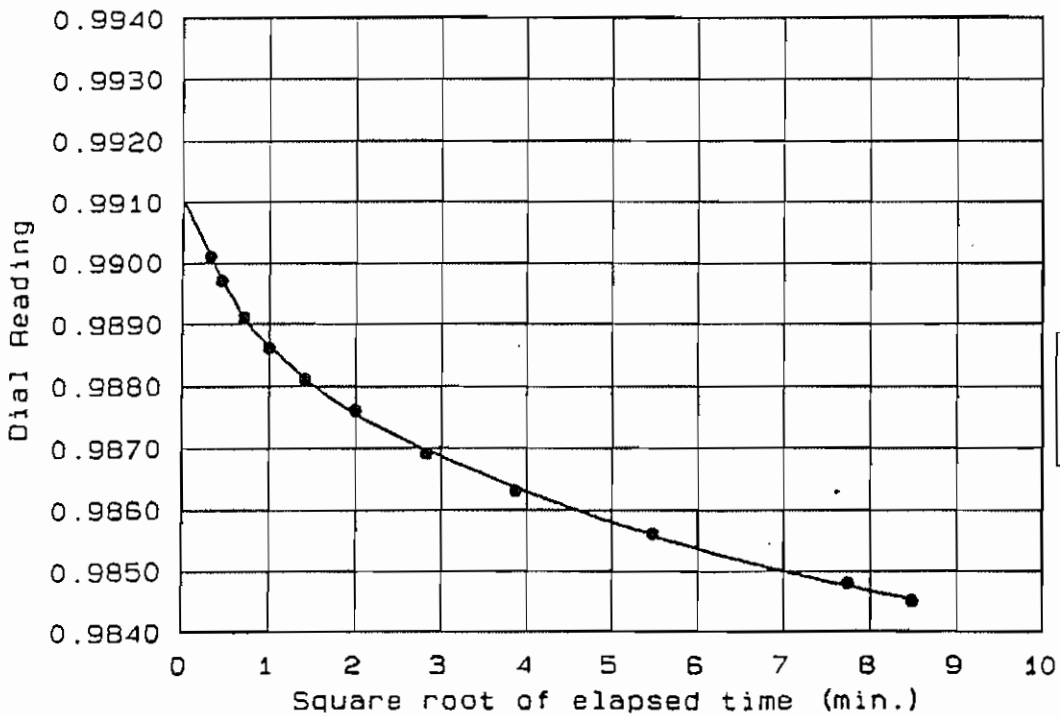
Project No.: 467.41
Project: WEYERHAEUSER
Location: COMPOSITE OF SLUDGE @ 45% SOLIDS & ASH

Date: 6-13-90



Load No.= 1
Load= 0.25 tsf
D_0 = 1.0050
D_{90} = 1.0021
D_{100}= 1.0018
T_{90}= 0.38 min.

C_v @ T_{90} =
5.5 ft^2/day



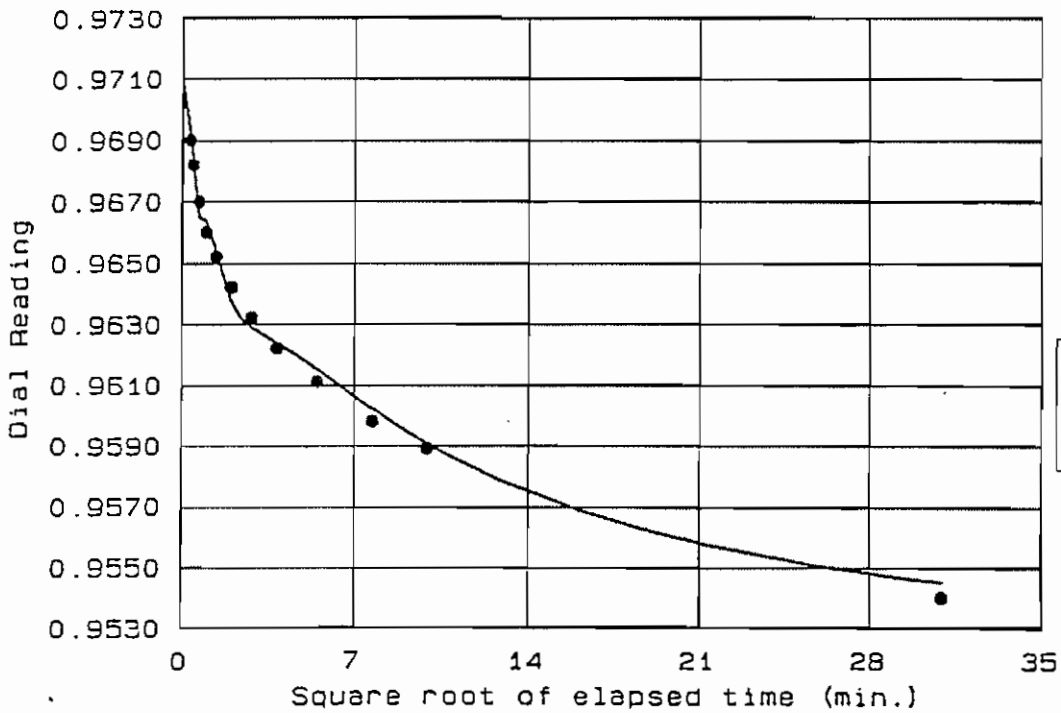
Load No.= 2
Load= 0.50 tsf
D_0 = 0.9911
D_{90} = 0.9889
D_{100}= 0.9886
T_{90}= 0.67 min.

C_v @ T_{90} =
3.0 ft^2/day

Dial Reading vs. Time

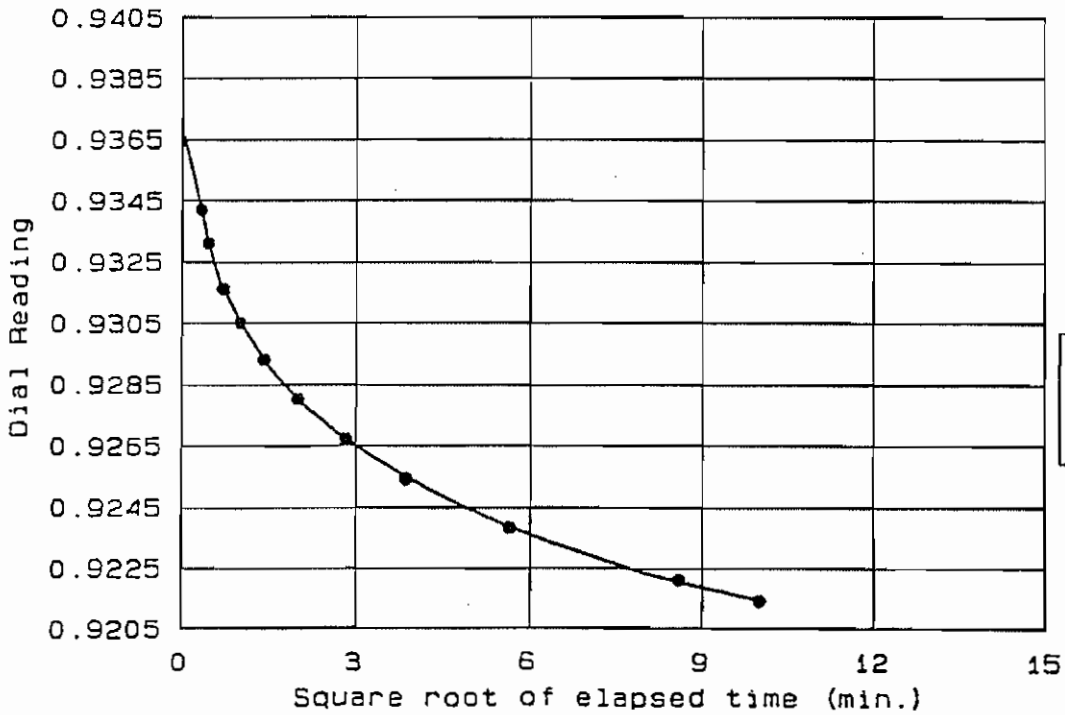
Project No.: 467.41
Project: WEYERHAEUSER
Location: COMPOSITE OF SLUDGE @ 45% SOLIDS & ASH

Date: 6-13-90



Load No.= 3
Load= 1.00 tsf
D_0 = 0.9709
D_{90} = 0.9663
D_{100}= 0.9658
T_{90}= 0.58 min.

C_v @ T_{90} = 3.3 ft^2/day



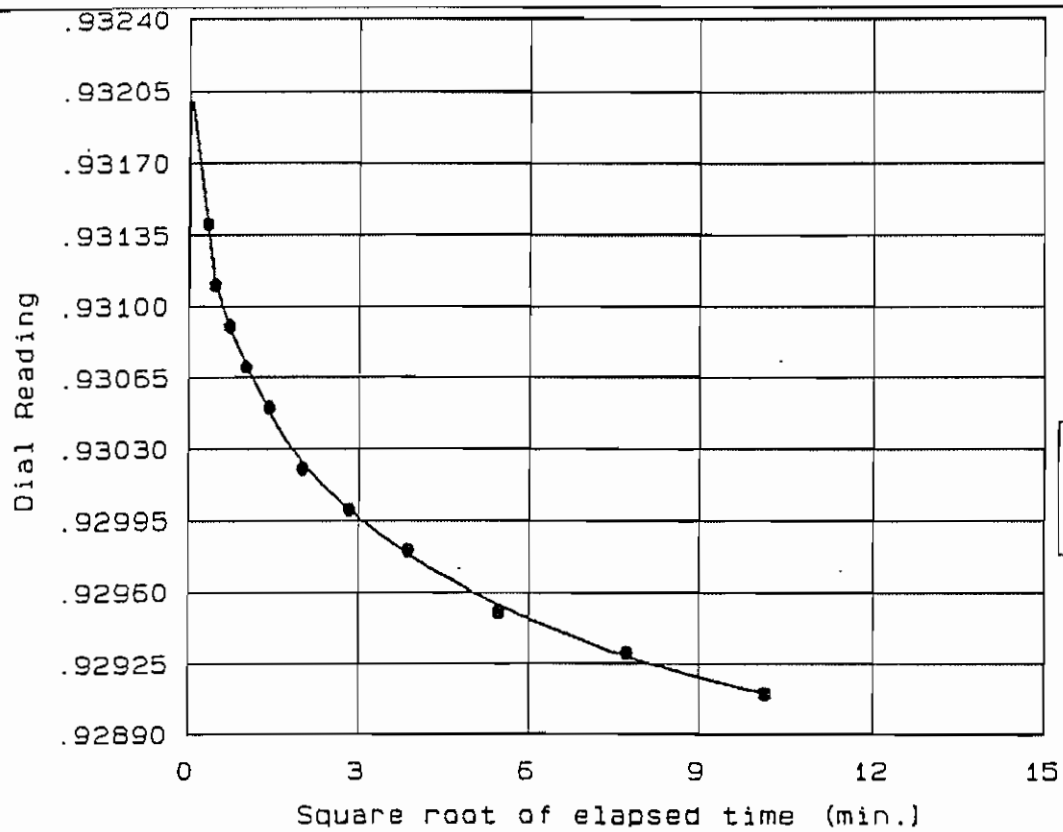
Load No.= 4
Load= 2.00 tsf
D_0 = 0.9369
D_{90} = 0.9314
D_{100}= 0.9308
T_{90}= 0.55 min.

C_v @ T_{90} = 3.3 ft^2/day

Dial Reading vs. Time

Project No.: 467.41
Project: WEYERHAEUSER
Location: COMPOSITE OF SLUDGE @ 45% SOLIDS & ASH

Date: 6-13-90



Load No.= 7

Load= 1.00 tsf

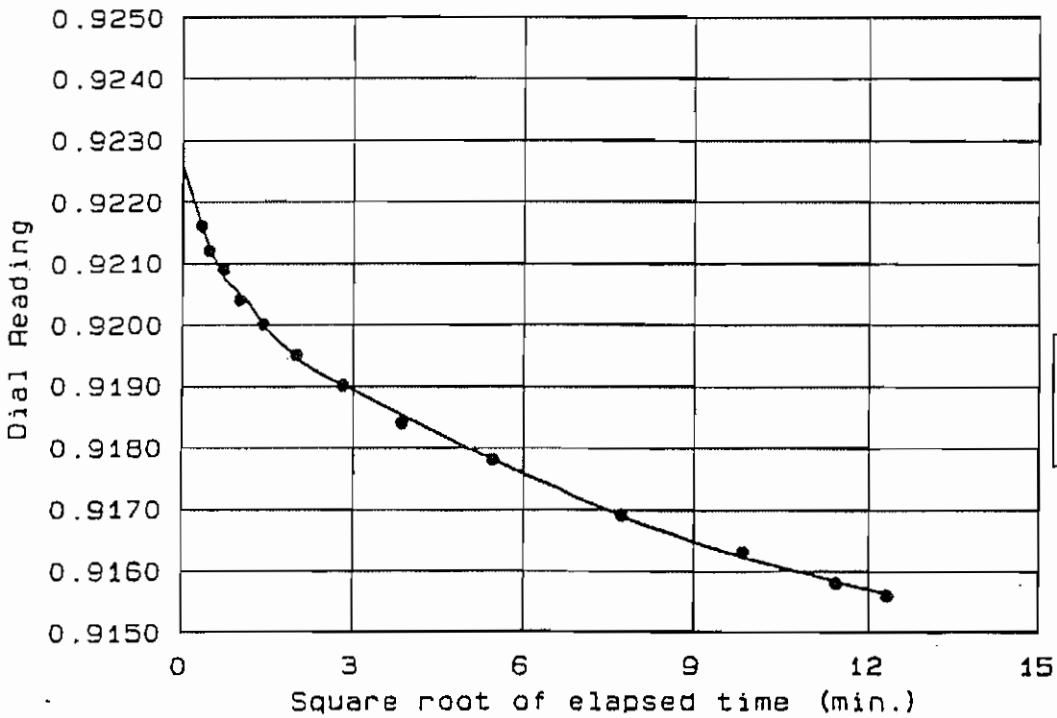
D_0 = 0.9321

D_{90} = 0.9310

D_{100}= 0.9309

T_{90}= 0.31 min.

C_v @ T_{90} = 5.8 ft^2/day



Load No.= 8

Load= 2.00 tsf

D_0 = 0.9226

D_{90} = 0.9213

D_{100}= 0.9211

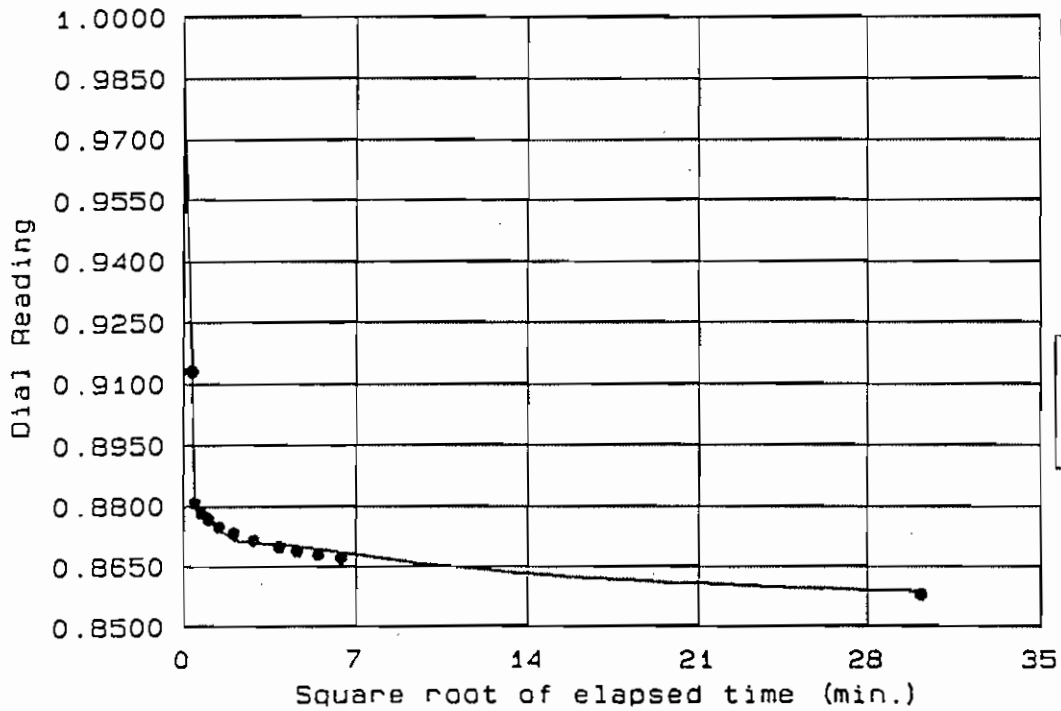
T_{90}= 0.16 min.

C_v @ T_{90} = 11.0 ft^2/day

Dial Reading vs. Time

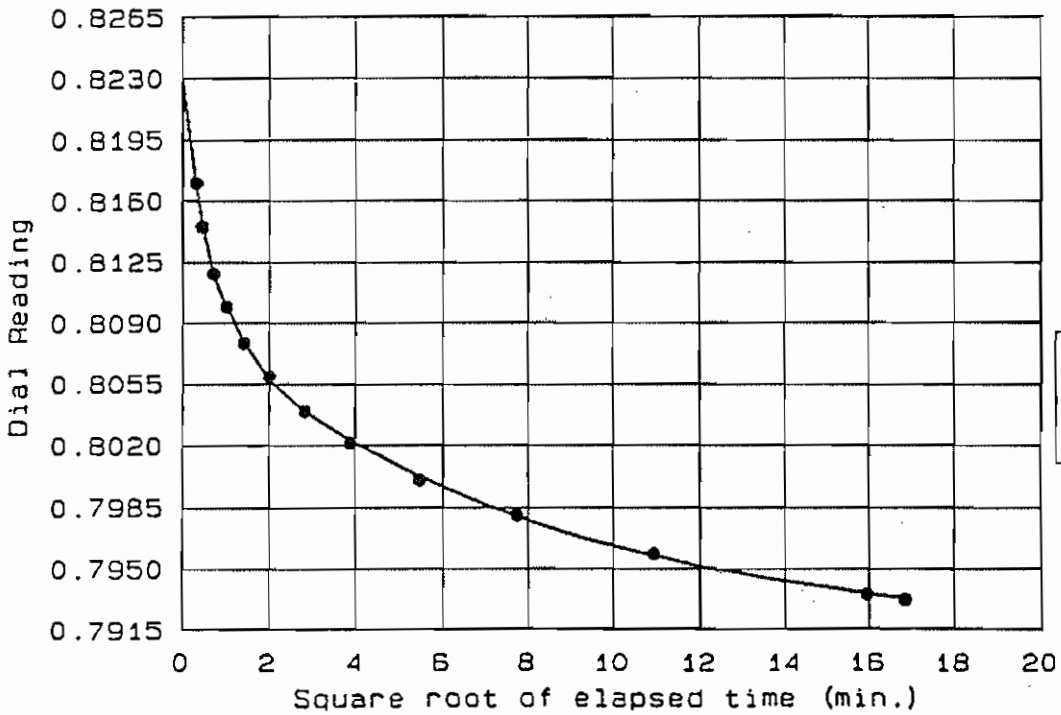
Project No.: 467.41
Project: WEYERHAEUSER
Location: COMPOSITE OF SLUDGE @ 45% SOLIDS & ASH

Date: 6-13-90



Load No.= 9
Load= 4.00 tsf
D_0 = 0.9909
D_{90} = 0.8745
D_{100}= 0.8616
T_{90}= 1.90 min.

C_v @ T_{90} =
0.8 ft^2/day



Load No.= 10
Load= 8.00 tsf
D_0 = 0.8230
D_{90} = 0.8123
D_{100}= 0.8111
T_{90}= 0.42 min.

C_v @ T_{90} =
3.3 ft^2/day

✓ NP 6-20-90

RMT, Inc.
Falling Head Permeability Test

Job: WEYERHAEUSER
Job #: 467.42
Sample: SLUDGE @ 45% SOLIDS
:
Visual Descript:

Date: 18-Jun-90
Tech: HJW
File: WER11
Cell #: 14S

INPUT VALUES

	INIT.	FINAL
Sample Dia. (in)	2.50	2.43
Sample Ht. (in)	2.34	2.24
Tare & Wet (g)	217.8	286.1
Tare & Dry (g)	98.1	174.8
Tare (g)	0.0	76.7
Sample Wt. (g)	212.5	209.3

Permeant:	TAP WATER
Permeant Specific Gravity:	1.00
Sample Specific Gravity:	1.77
Confining Pressure (psi):	100.0
Burette Diameter (in):	0.250
Burette Zero (cm):	100.0

CALCULATED VALUES

MOISTURE (%)	122.0	113.5
WET DENS. (pcf)	70.5	76.8
DRY DENS. (pcf)	31.7	36.0
SATURATION (%)	87.1	97.0

MAXIMUM GRADIENT:	17.5
AVERAGE GRADIENT:	12.8
MAX. EFFECT. STRESS (psi):	6.2
MIN. EFFECT. STRESS (psi):	4.7
AVE. EFFECT. STRESS (psi):	5.4

Date YY	MM	DD	Time HH	MM	Temp *	Press.(psi) BOT	TOP	Readings (cm) CHAM	BOT	TOP	Flow Dif. %	Kv cm/sec	Ave. 0,1
90	6	7	7	39	0	95	95	17.00	3.40	101.70			
90	6	7	8	18	20	95	95	17.10	21.80	83.40	0.3	6.0E-06	
90	6	7	8	30	20	95	95	17.10	25.90	79.40	1.2	5.9E-06	
90	6	7	8	48	20	95	95	17.10	31.20	74.30	1.9	6.0E-06	
90	6	8	7	58	0	95	95	18.70	3.25	101.90			
90	6	8	8	18	20	95	95	18.90	13.30	90.90	-4.5	6.0E-06	
90	6	8	8	32	20	95	95	18.90	19.60	85.00	3.3	6.1E-06	
90	6	8	8	48	20	95	95	18.90	25.15	79.55	0.9	5.8E-06	
90	6	11	8	56	0	95	95	21.20	2.55	101.90			
90	6	11	9	12	20	95	95	21.20	7.55	96.80	-1.0	3.4E-06	1
90	6	11	9	27	20	95	95	21.05	11.90	92.40	-0.6	3.5E-06	1
90	6	11	9	49	20	95	95	21.00	17.70	86.60	-0.0	3.5E-06	1
90	6	11	10	3	20	95	95	21.00	21.10	83.20	0.0	3.7E-06	1
90	6	11	10	17	20	95	95	20.90	24.10	80.25	0.8	3.6E-06	1
90	6	11	10	30	20	95	95	20.90	26.65	77.65	-1.0	3.7E-06	1

Average Kv for those rows with a 1 in the Ave. column 3.6E-06 cm/sec
1.4E-06 in/sec

Termination determined by stable Kv and low flow differential
* A zero in this column starts a series of measurements

v HJW
6-26-91

RMT, Inc.
Falling Head Permeability Test

Job:	WEYERHAEUSER	Date:	26-Jun-90
Job #:	467.41	Tech:	GAP
Sample:	ASH	File:	WEYREM11
:		Cell #:	15S
Visual Descript:			

INPUT VALUES

	INIT.	FINAL			
Sample Dia. (in)	2.86	2.82	Permeant:	TAP WATER	
Sample Ht. (in)	2.29	2.25	Permeant Specific Gravity:	1.00	
Tare & Wet (g)	185.8	373.5	Sample Specific Gravity:	2.13	EST.
Tare & Dry (g)	132.7	206.4	Confining Pressure (psi):	100.0	
Tare (g)	0.0	79.6	Burette Diameter (in):	0.250	
Sample Wt. (g)	185.8	293.9	Burette Zero (cm):	100.0	

CALCULATED VALUES

MOISTURE (%)	40.0	131.8	MAXIMUM GRADIENT:	17.0
WET DENS. (pcf)	48.1	79.7	AVERAGE GRADIENT:	12.7
DRY DENS. (pcf)	34.4	34.4	MAX. EFFECT. STRESS (psi):	6.4
SATURATION (%)	29.7	97.9	MIN. EFFECT. STRESS (psi):	5.0
			AVE. EFFECT. STRESS (psi):	5.6

Date YY	MM	DD	Time HH	MM	Temp *	Press.(psi) BOT	TOP	Readings (cm) CHAM	BOT	TOP	Flow Dif. %	Kv cm/sec	Ave. 0,1
90	6	21	1	0	0	95	95	3.70	1.95	99.90			
90	6	21	1	0.038	21	95	95	3.70	5.00	96.85	-0.0	6.3E-04	
90	6	21	1	0.167	21	95	95	3.70	15.00	86.85	0.0	7.2E-04	
90	6	21	1	0.24	21	95	95	3.70	20.00	81.85	0.0	7.7E-04	
90	6	21	1	0.329	21	95	95	3.70	25.00	76.85	0.0	7.4E-04	
90	6	21	1	0.434	21	95	95	3.70	30.00	71.85	0.0	7.6E-04	
90	6	21	1	0	0	95	95	3.70	2.25	99.35			
90	6	21	1	0.03	21	95	95	3.85	5.00	96.60	0.0	7.3E-04	
90	6	21	1	0.158	21	95	95	3.85	15.00	86.60	0.0	7.2E-04	
90	6	21	1	0.321	21	95	95	3.85	25.00	76.60	0.0	7.5E-04	
90	6	21	1	0	0	95	95	3.85	1.45	99.45			
90	6	21	1	0.042	21	95	95	3.90	5.00	95.90	0.0	6.7E-04	
90	6	21	1	0.17	21	95	95	3.90	15.00	85.90	0.0	7.3E-04	
90	6	21	1	0.333	21	95	95	3.90	25.00	75.90	0.0	7.6E-04	
90	6	21	1	0	0	95	95	3.90	2.50	99.75			
90	6	21	1	0.091	21	95	95	3.90	10.00	92.25	0.0	6.9E-04	1
90	6	21	1	0.157	21	95	95	3.90	15.00	87.25	0.0	7.4E-04	1
90	6	21	1	0.232	21	95	95	3.90	20.00	82.25	0.0	7.4E-04	1
90	6	21	1	0.32	21	95	95	3.90	25.00	77.25	0.0	7.4E-04	1

Average Kv for those rows with a 1 in the Ave. column 7.3E-04 cm/sec
2.9E-04 in/sec

Termination determined by stable Kv and low flow differential
* A zero in this column starts a series of measurements

RMT, Inc.
Falling Head Permeability Test

Job:	WEYERHAEUSER	Date:	26-Jun-90
Job #:	467.41	Tech:	GAP
Sample:	SLUDGE @45% SOLIDS	File:	WEYREM10
:	& ASH COMPOSITE	Cell #:	17S
Visual Descript:			

INPUT VALUES

	INIT.	FINAL			
Sample Dia. (in)	2.87	2.75	Permeant:	TAP WATER	
Sample Ht. (in)	2.32	2.30	Permeant Specific Gravity:	1.00	
Tare & Wet (g)	246.5	376.6	Sample Specific Gravity:	2.04	EST.
Tare & Dry (g)	132.8	214.8	Confining Pressure (psi):	100.0	
Tare (g)	0.0	80.5	Burette Diameter (in):	0.250	
Sample Wt. (g)	246.5	296.1	Burette Zero (cm):	100.0	

CALCULATED VALUES

MOISTURE (%)	85.6	120.4	MAXIMUM GRADIENT:	16.7
WET DENS. (pcf)	62.6	82.6	AVERAGE GRADIENT:	11.3
DRY DENS. (pcf)	33.7	37.5	MAX. EFFECT. STRESS (psi):	6.2
SATURATION (%)	62.9	102.4	MIN. EFFECT. STRESS (psi):	4.7
			AVE. EFFECT. STRESS (psi):	5.4

Date YY	MM	DD	Time HH	MM	Temp *	Press.(psi) BOT	TOP	Readings (cm) CHAM	BOT	TOP	Flow Dif. %	Kv cm/sec	Ave. 0,1
90	6	21	1	0	0	95	95	18.45	6.50	100.00			
90	6	21	1	0.083	21	95	95	18.45	10.00	96.50	0.0	3.8E-04	
90	6	21	1	0.238	21	95	95	18.45	15.00	91.50	0.0	3.2E-04	
90	6	21	1	0.401	21	95	95	18.45	20.00	86.50	0.0	3.5E-04	
90	6	21	1	0.592	21	95	95	18.45	25.00	81.50	0.0	3.4E-04	
90	6	21	1	0.819	21	95	95	18.45	30.00	76.50	0.0	3.5E-04	
90	6	21	1	0	0	95	95	20.40	1.50	99.70			
90	6	21	1	0.089	21	95	95	20.40	5.00	96.20	0.0	3.3E-04	
90	6	21	1	0.218	21	95	95	20.40	10.00	91.20	0.0	3.6E-04	
90	6	21	1	0.369	21	95	95	20.40	15.00	86.20	0.0	3.5E-04	
90	6	21	1	0.537	21	95	95	20.40	20.00	81.20	0.0	3.6E-04	
90	6	21	1	0.739	21	95	95	20.40	25.00	76.20	0.0	3.6E-04	
90	6	21	1	0.979	21	95	95	20.40	30.00	71.20	0.0	3.6E-04	
90	6	21	1	0	0	95	95	22.90	1.90	99.65			
90	6	21	1	0.079	21	95	95	22.90	5.00	96.55	-0.0	3.3E-04	1
90	6	21	1	0.21	21	95	95	22.90	10.00	91.55	0.0	3.6E-04	1
90	6	21	1	0.36	21	95	95	22.90	15.00	86.55	0.0	3.5E-04	1
90	6	21	1	0.53	21	95	95	22.90	20.00	81.55	0.0	3.6E-04	1
90	6	21	1	0.744	21	95	95	22.90	25.00	76.55	0.0	3.3E-04	1
90	6	21	1	0.979	21	95	95	22.90	30.00	71.55	0.0	3.7E-04	1

Average Kv for those rows with a 1 in the Ave. column 3.5E-04 cm/sec
1.4E-04 in/sec

Termination determined by stable Kv and low flow differential
* A zero in this column starts a series of measurements

KIBER ENVIRONMENTAL SERVICES, INC.
WEYERHAEUSER COMPANY
PLYMOUTH SLUDGE DEWATERING TESTING PROJECT

TABLE 2

Reduced Standard Proctor Compaction - Single Check Points (15 blows / layer) and Moisture Content
Treated Sludge(1)-Summary of Results

TESTING		RESULTS						
		Treated Run 5			Treated	Treated	Treated	Treated
PARAMETER	UNIT	Natural MC-P1	Adjusted MC-P2	Adjusted MC-P3	Run 6 (3)	Dry Vac.	JW1 #2	Run #12
Moisture Content @ 110°C (ASTM)	%	54.1	66.3	76.2	62.3	56.9	56.9	102.8
Moisture Content @ 60°C (ASTM)	%	46.2	61.2	72.4	-	52.8	51.3	97.2
Wet Density	lb/ft³	69.0	73.0	78.7	81.1	67.1	68.3	78.8
(2) Dry Density	lb/ft³	44.8	43.9	44.3	50.4	42.7	43.5	38.8

- Data not available
(1) Treatment consisted of combining the untreated sludge with an ash composite at a ratio of 60:40% untreated sludge to ash on a wet weight basis. The mixture was thoroughly homogenized prior to testing.
(2) Dry density calculated based on the moisture content obtained at 110° C.
(3) Treatment was performed on a reprocessed material.

2862_202

KIBER ENVIRONMENTAL SERVICES, INC.
WEYERHAEUSER COMPANY
PLYMOUTH SLUDGE DEWATERING TESTING PROJECT

TABLE 1
Reduced Standard Proctor Compaction - Single Check Points (15 blows / layer) and Moisture Content
Untreated Sludge - Summary of Results

TESTING PARAMETER	UNIT	RESULTS						
		Run 5						
		Natural MC -P1	Adjusted MC -P2	Adjusted MC -P3	Run 6	Dry Vac.	JW1 #2	Run #12
Moisture Content @ 110°C (ASTM)	%	117.8	145.6	157.2	169.8	119.9	121.6	303.9
Moisture Content @ 60°C (ASTM)	%	106.2	128.9	141.5	-	-	-	297.1
Wet Density	lb/ft³	69.3	76.9	77.1	73.1	68.7	65.8	65.1
Dry Density	lb/ft³	31.9	31.31	30.0	27.1	31.2	29.7	16.1

- Data not available
(1) Dry density calculated based on moisture obtained at 110° C

2862_201

ATTACHMENT A

CHAINS OF CUSTODY

SAMPLE CHAIN-OF-CUSTO.. . RECORD

COC

3786 DEKALB TECHNOLOGY PARKWAY
ATLANTA, GEORGIA 30340-3603
(770) 455-3944 FAX (770) 451-0155

CLIENT NAME: Weyerhaeuser

PROJECT NAME: Plymouth Sludge

KES PROJ#: 2862

TAT or DUE DATE:

CONTACT:

KES PROJECT MANAGER: Chana Gilzenrat

PHONE#: EXT.

RECEIVING LAB: Kiber

PO#:

SAMPLED BY:

PRINTED NAME SIGNATURE COMPANY

ANALYSES (indicate target list)

SAMPLE NUMBER	SAMPLE DESCRIPTION	SAMPLE DATE/TIME	Grab/ Comp.	Sample Matrix	Preservative	T	# / Size of Cont.								Remarks
Netzsch Run 5	Unit						1x5gal								
Netzsch Run 6	Unit						1x5gal								

KIBER QA/QC LEVEL REQUESTED: I II III IV

CASE NARRATIVE REQUESTED: YES NO

PM INITIALS

SAMPLES RELINQUISHED BY:	DATE/ TIME	SAMPLES ACCEPTED BY:	DATE/ TIME
FED Ex		[illegible]	5/28/98

COMMENTS:

SAMPLE CHAIN-OF-CUST Y RECORD

CO

3786 DEKALB TECHNOLOGY PARKWAY
ATLANTA, GEORGIA 30340-3603
(770) 455-3944 FAX (770) 451-0155

CLIENT NAME:	PROJECT NAME:	KES PROJ#:
Weyerhaeuser	Plymouth Sludge	2862

TAT or DUE DATE:	CONTACT:	KES PROJECT MANAGER:
		Chana Gilzenrat
	PHONE#: EXT.	RECEIVING LAB: Kiber / PO#:

SAMPLED BY:

PRINTED NAME | SIGNATURE | COMPANY

ANALYSES (indicate target list)

SAMPLE NUMBER	SAMPLE DESCRIPTION	SAMPLE DATE/TIME	Grab/ Comp.	Sample Matrix	Preservative	T	# / Size of Cont.								Remarks
Run # 5 Reserve	Unt.						1x5gal								
Dry Vac	Unt						↓								
Andritz Run 12	↓														
JW1-#2	✓						✓								

KIBER QA/QC LEVEL REQUESTED: I II III IV

CASE NARRATIVE REQUESTED: YES NO

PM INITIALS

SAMPLES RELINQUISHED BY:	DATE/ TIME	SAMPLES ACCEPTED BY:	DATE/ TIME
FED Ex		[signature]	6/5/98

COMMENTS:

ATTACHMENT B

UNTREATED MATERIAL TESTING DATA REPORTS

COMPACTION TEST

REPORT FORM

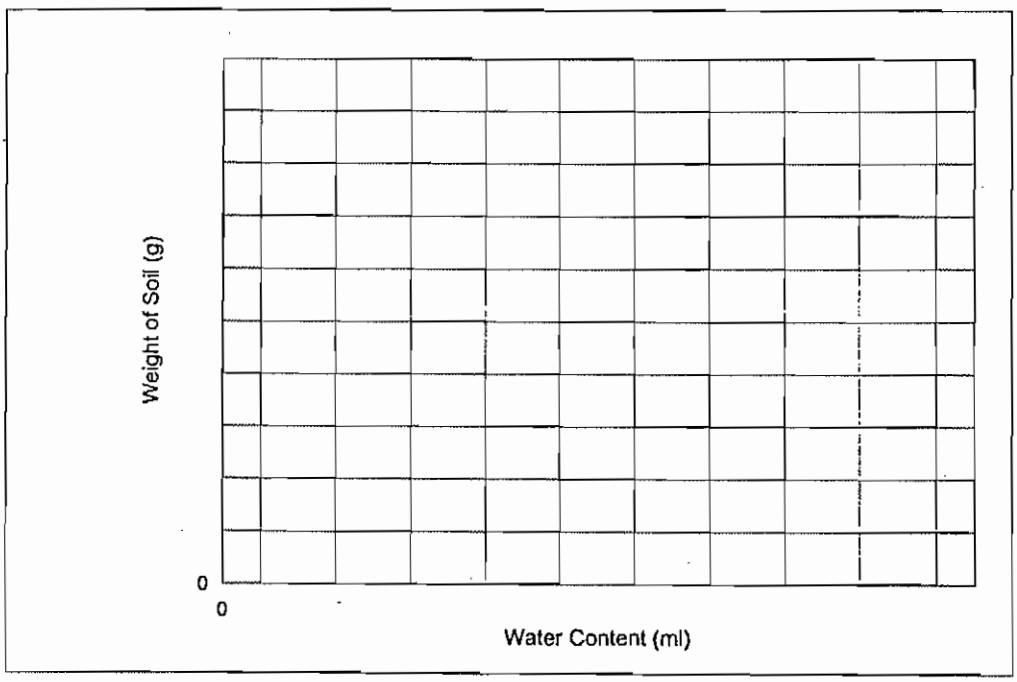
PROJECT:	PLYMOUTH SLUDGE	SAMPLE DESCRIPTION:	UNTREATED
PROJECT NO.:	2862	TESTED BY:	MC
TESTING DATE:	17 JULY 1998	TRACKING CODE:	7850_CM

Type of Proctor: ASTM D 698 Modified

Weight of Mold (g): 2046.5

Mold Volume Factor (1/volume): 30.03

SAMPLE DESCRIPTION	RUN #5 Nat.MC -P1	RUN #5 Adj. MC-P2	RUN #5 Adj. MC-P3	
Wt of Soil + Mold	3095.80 g	3208.90 g	3210.40 g	
Wet Density	69.5 pcf	77.0 pcf	77.1 pcf	
Pan Number	#5	MC #1	MC #2	
Weight of Pan	210.70 g	233.88 g	0.00 g	
Wt of Wet Soil + Pan	459.34 g	304.82 g	778.60 g	
Wt of Dry Soil + Pan	324.84 g	262.76 g	302.76 g	
Wt of Water	134.50 g	42.06 g	475.84 g	
Wt of Dry Soil	114.14 *g*	28.88 *g*	302.76 *g*	
Moisture Content, ASTM	117.84 %	145.64 %	157.17 %	
Dry Density	31.9 pcf	31.3 pcf	30.0 pcf	



COMPACTION TEST

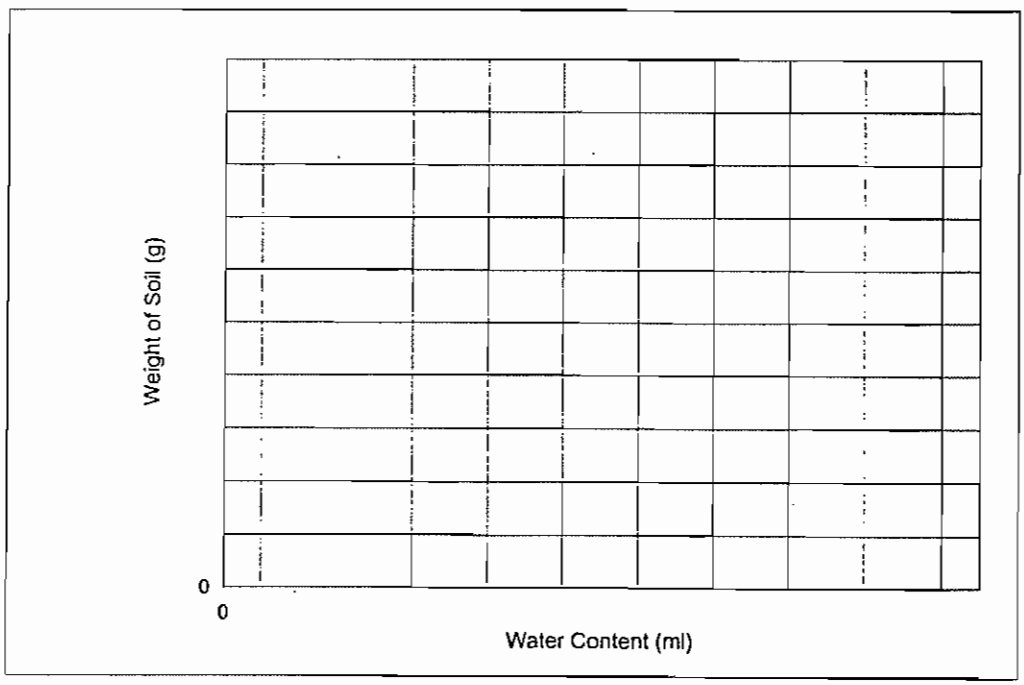
REPORT FORM

PROJECT:	PLYMOUTH SLUDGE	SAMPLE DESCRIPTION:	UNTREATED
PROJECT NO.:	2862	TESTED BY:	MC
TESTING DATE:	27 MAY 1998	TRACKING CODE:	7845_CM

Type of Proctor: ASTM D 698 Modified

Weight of Mold (g): 2048.2 Mold Volume Factor (1/volume) 30.03

SAMPLE IDENTIFICATION	RUN #12 Untreated	RUN #6 Untreated	JW1- #2 Untreated	DRY VAC Untreated
Wt of Soil + Mold	3032.10 g	3153.30 g	3042.70 g	3086.50 g
Wet Density	65.1 pcf	73.2 pcf	65.8 pcf	68.7 pcf
Pan Number	Run #12	#6	JW1-#2	Dry Vac
Weight of Pan	204.28 g	212.90 g	205.71 g	240.46 g
Wt of Wet Soil + Pan	358.89 g	400.60 g	377.55 g	376.90 g
Wt of Dry Soil + Pan	242.56 g	282.46 g	283.26 g	302.50 g
Wt of Water	116.33 g	118.14 g	94.29 g	74.40 g
Wt of Dry Soil	38.28 *g*	69.56 *g*	77.55 *g*	62.04 *g*
Moisture Content, ASTM	303.89 %	169.84 %	121.59 %	119.92 %
Dry Density	16.1 pcf	27.1 pcf	29.7 pcf	31.3 pcf



SOLID SPECIFIC GRAVITY

ASTM D 854
DATA SHEET

PROJECT:	PLYMOUTH SLUDGE
PROJECT No.:	2862
TESTING DATE:	29 MAY 1998
TESTED BY:	DG
TRACKING CODE:	7846_GS2

SOLID SPECIFIC GRAVITY			
1. SAMPLE NUMBER	Run 5	Run 6	
2. FLASK NUMBER	1	3	
3. TEMPERATURE	22.4 g	22.4 °C	°C
4. WT. FLASK & WATER	0.00 g	0.00 g	g
5. WT. WATER, FLASK & SOIL	21.19 g	19.97 g	g
6. WT OF SOIL	21.19 g	19.97 g	g
7. CALIBRATION WATER & FLASK	353.6750 g	352.7769 g	g
8. DEAIRED SAMPLE	364.56 g	363.24 g	g
9. SPECIFIC GRAVITY	2.06	2.10	
10. CORRECTION FACTOR K	0.9995	0.9995	
11. Gs @ 20 °C	2.06	2.10	

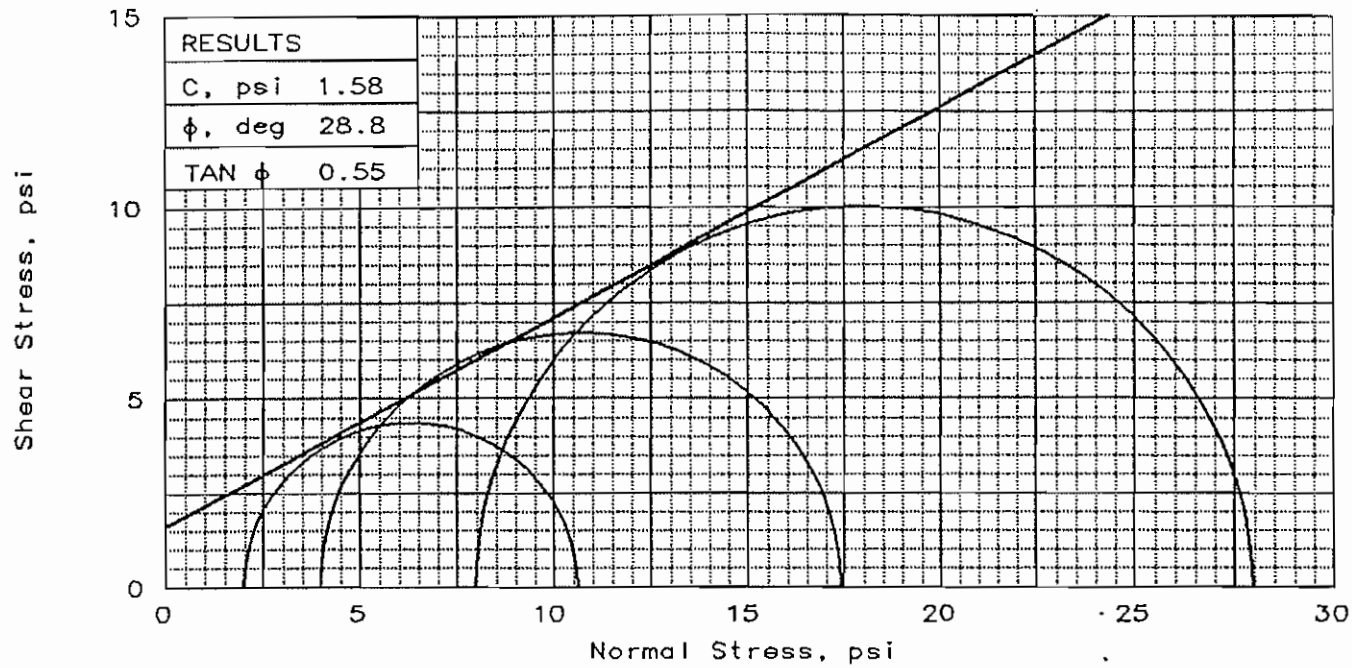
SOLID SPECIFIC GRAVITY

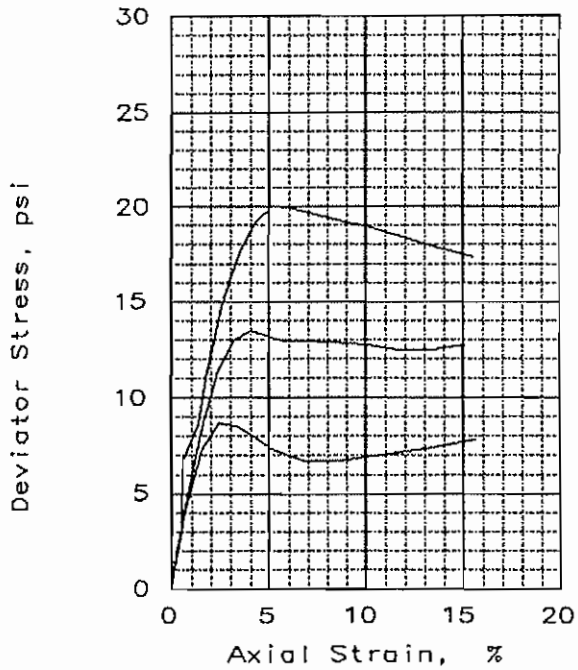
ASTM D 854
DATA SHEET

PROJECT:	PLYMOUTH SLUDGE
PROJECT No.:	2862
TESTING DATE:	25 JUNE 1998
TESTED BY:	DG
TRACKING CODE:	

SOLID SPECIFIC GRAVITY

1. SAMPLE NUMBER	RUN12	JW1 #2	DRY VAC
2. FLASK NUMBER	1	3	2
3. TEMPERATURE	21.2 g	21.6 °C	20.6 °C
4. WT. FLASK & WATER	0.00 g	0.00 g	0.00 g
5. WT. WATER, FLASK & SOIL	23.18 g	28.97 g	25.1 g
6. WT OF SOIL	23.18 g	28.97 g	25.13 g
7. CALIBRATION WATER & FLASK	353.7368 g	352.8189 g	353.38 g
8. DEAIRED SAMPLE	365.40 g	366.97 g	365.75 g
9. SPECIFIC GRAVITY	2.01	1.95	1.97
10. CORRECTION FACTOR K	0.9998	0.9997	0.9999
11. Gs @ 20 °C	2.01	1.95	1.97





SAMPLE NO.:		1	2	3
INITIAL	WATER CONTENT, %	117.8	118.6	117.7
	DRY DENSITY, pcf	32.1	31.6	32.0
	SATURATION, %	80.7	79.7	80.4
	VOID RATIO	3.005	3.065	3.017
	DIAMETER, in	3.03	3.00	3.00
	HEIGHT, in	5.68	5.88	5.81
AT TEST	WATER CONTENT, %	117.8	118.6	117.7
	DRY DENSITY, pcf	32.1	31.6	32.0
	SATURATION, %	80.7	79.7	80.4
	VOID RATIO	3.005	3.065	3.017
	DIAMETER, in	3.03	3.00	3.00
	HEIGHT, in	5.68	5.88	5.81
Strain rate, %/min		0.80	0.80	0.80
BACK PRESSURE, psi		0.0	0.0	0.0
CELL PRESSURE, psi		2.0	4.0	8.0
FAIL. STRESS, psi		8.7	13.4	20.0
STRAIN, %		2.5	4.1	5.2
ULT. STRESS, psi		7.8	12.7	17.3
STRAIN, %				
σ_1 FAILURE, psi		10.7	17.4	28.0
σ_3 FAILURE, psi		2.0	4.0	8.0

TYPE OF TEST:
Unconsolidated Undrained

SAMPLE TYPE: Remolded

DESCRIPTION:

SPECIFIC GRAVITY= 2.06

REMARKS:

Fig. No.: _____

CLIENT: Weyerhaeuser Company

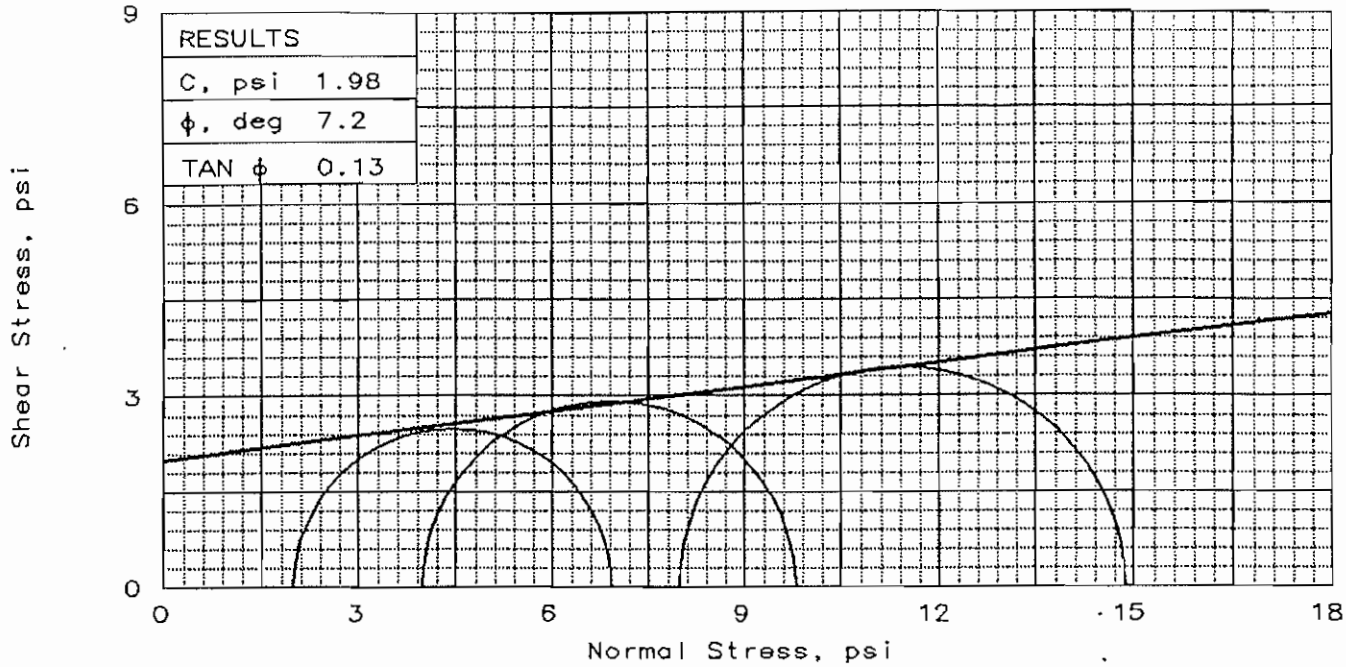
PROJECT: Plymouth Sludge Dewatering

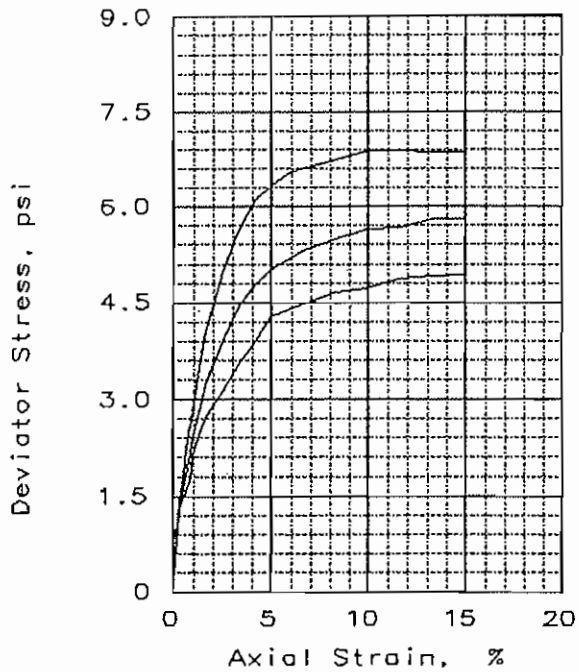
SAMPLE LOCATION: Netzsch Run #5

PROJ. NO.: 2862 DATE: 28 May 1998

TRIAXIAL SHEAR TEST REPORT

KIBER ENVIRONMENTAL SERVICES, INC.





SAMPLE NO.:		1	2	3
INITIAL	WATER CONTENT, %	170.8	170.3	170.6
	DRY DENSITY, pcf	26.6	26.3	26.5
	SATURATION, %	91.4	89.9	90.8
	VOID RATIO	3.925	3.979	3.946
	DIAMETER, in	2.96	2.99	3.00
	HEIGHT, in	6.00	6.00	6.00
AT TEST	WATER CONTENT, %	170.8	170.3	170.6
	DRY DENSITY, pcf	26.6	26.3	26.5
	SATURATION, %	91.4	89.9	90.8
	VOID RATIO	3.925	3.979	3.946
	DIAMETER, in	2.96	2.99	3.00
	HEIGHT, in	6.00	6.00	6.00
Strain rate, %/min		0.80	0.80	0.10
BACK PRESSURE, psi		0.0	0.0	0.0
CELL PRESSURE, psi		2.0	4.0	8.0
FAIL. STRESS, psi		4.9	5.8	6.9
STRAIN, %		15.0	15.0	10.0
ULT. STRESS, psi		4.9	5.8	6.9
STRAIN, %				
σ_1 FAILURE, psi		6.9	9.8	14.9
σ_3 FAILURE, psi		2.0	4.0	8.0

TYPE OF TEST:
Unconsolidated Undrained

SAMPLE TYPE: Remolded

DESCRIPTION:

SPECIFIC GRAVITY= 2.1

REMARKS:

CLIENT: Weyerhaeuser Company

PROJECT: Plymouth Sludge Dewatering

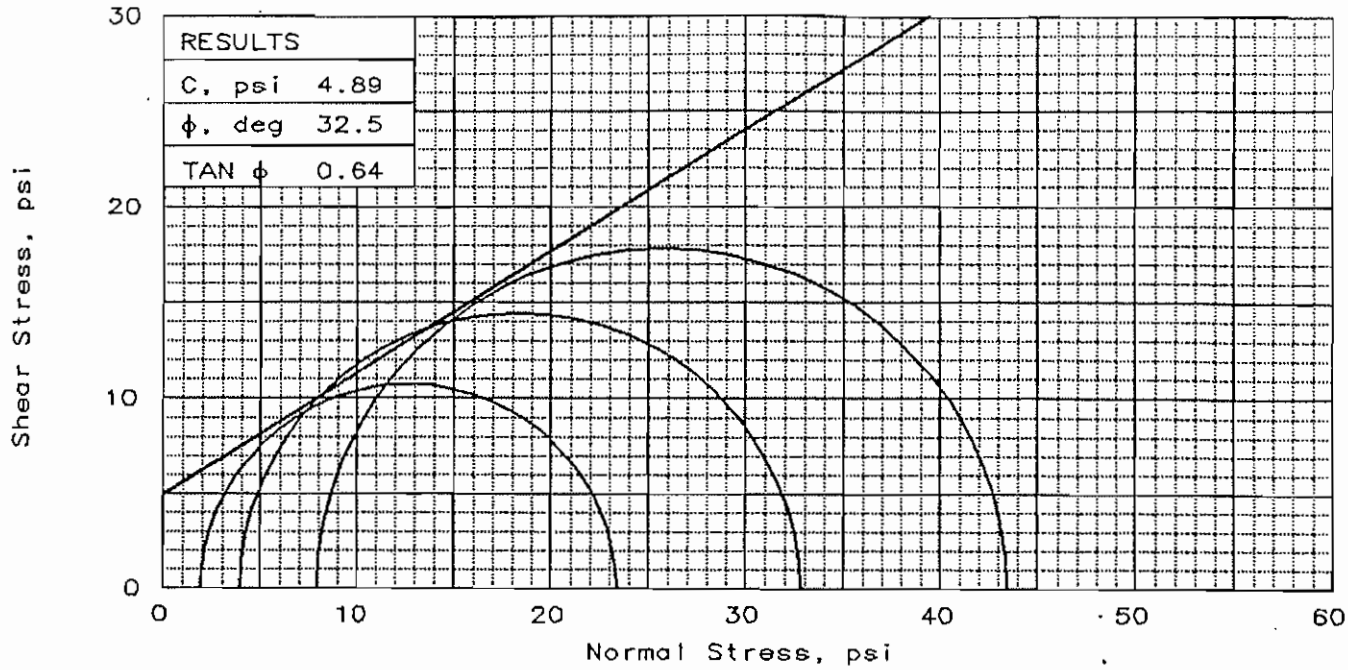
SAMPLE LOCATION: Netzsch Run #6

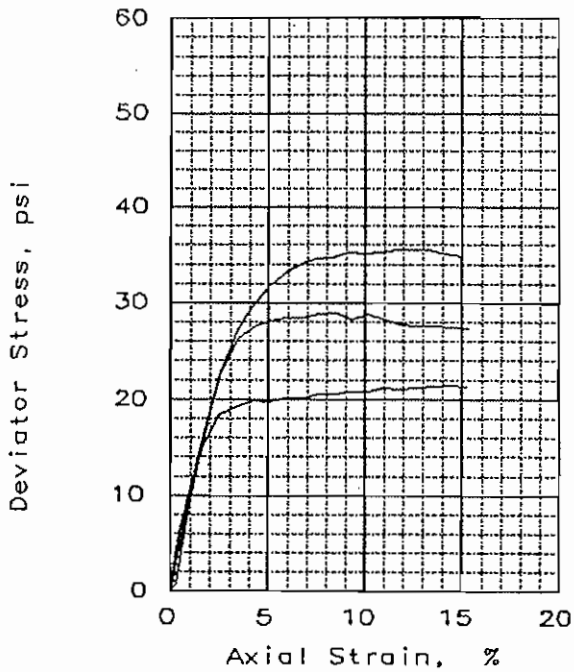
PROJ. NO.: 2862 DATE: May 28,1998

TRIAXIAL SHEAR TEST REPORT

KIBER ENVIRONMENTAL SERVICES, INC.

Fig. No.: _____





SAMPLE NO.:		1	2	3
INITIAL	WATER CONTENT, %	120.5	120.2	120.0
	DRY DENSITY, pcf	31.6	31.8	31.2
	SATURATION, %	82.2	82.5	80.3
	VOID RATIO	2.889	2.870	2.941
	DIAMETER, in	2.87	2.87	2.87
	HEIGHT, in	5.89	5.87	5.98
AT TEST	WATER CONTENT, %	120.5	120.2	118.6
	DRY DENSITY, pcf	31.6	31.8	31.2
	SATURATION, %	82.2	82.5	79.5
	VOID RATIO	2.889	2.870	2.941
	DIAMETER, in	2.87	2.87	2.87
	HEIGHT, in	5.89	5.87	5.98
Strain rate, %/min		0.80	0.80	0.80
BACK PRESSURE, psi		0.0	0.0	0.0
CELL PRESSURE, psi		2.0	4.0	8.0
FAIL. STRESS, psi		21.4	28.8	35.6
STRAIN, %		14.4	8.5	12.5
ULT. STRESS, psi		21.3	27.4	34.9
STRAIN, %				
σ_1 FAILURE, psi		23.4	32.8	43.6
σ_3 FAILURE, psi		2.0	4.0	8.0

TYPE OF TEST:
Unconsolidated Undrained

SAMPLE TYPE: Remolded

DESCRIPTION:

SPECIFIC GRAVITY= 1.97

REMARKS:

CLIENT: Weyerhaeuser Co.

PROJECT: Plymouth Sludge Dewatering

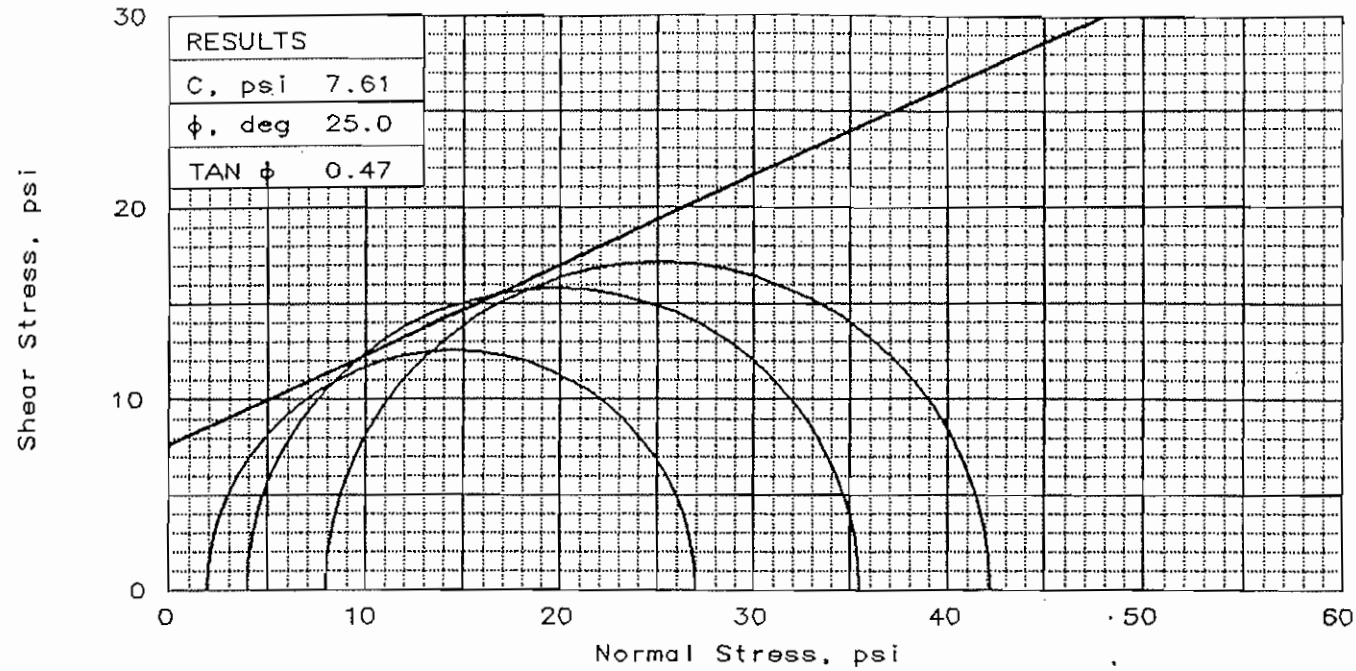
SAMPLE LOCATION: Dry Vac.

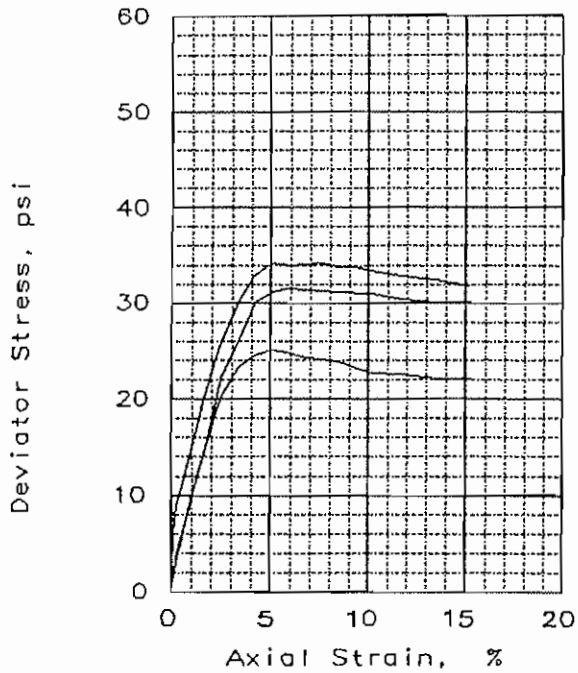
PROJ. NO.: 2862 DATE: June 8, 1998

TRIAXIAL SHEAR TEST REPORT

KIBER ENVIRONMENTAL SERVICES, INC.

Fig. No.: _____





SAMPLE NO.:		1	2	3
INITIAL	WATER CONTENT, %	122.0	122.7	123.0
	DRY DENSITY, pcf	30.8	31.1	28.8
	SATURATION, %	80.6	82.0	74.3
	VOID RATIO	2.951	2.917	3.227
	DIAMETER, in	2.88	2.87	2.97
	HEIGHT, in	5.90	5.89	5.93
AT TEST	WATER CONTENT, %	122.0	122.7	123.0
	DRY DENSITY, pcf	30.8	31.1	28.8
	SATURATION, %	80.6	82.0	74.3
	VOID RATIO	2.951	2.917	3.227
	DIAMETER, in	2.88	2.87	2.97
	HEIGHT, in	5.90	5.89	5.93
Strain rate, %/min		0.80	0.80	0.80
BACK PRESSURE, psi		0.0	0.0	0.0
CELL PRESSURE, psi		2.0	4.0	8.0
FAIL. STRESS, psi		25.1	31.6	34.3
STRAIN, %		5.1	5.9	5.1
ULT. STRESS, psi		22.1	30.1	31.8
STRAIN, %				
σ_1 FAILURE, psi		27.1	35.6	42.3
σ_3 FAILURE, psi		2.0	4.0	8.0

TYPE OF TEST:
Unconsolidated Undrained

SAMPLE TYPE: Remolded

DESCRIPTION:

SPECIFIC GRAVITY= 1.95

REMARKS:

Fig. No.: _____

CLIENT: Weyerhaeuser Company

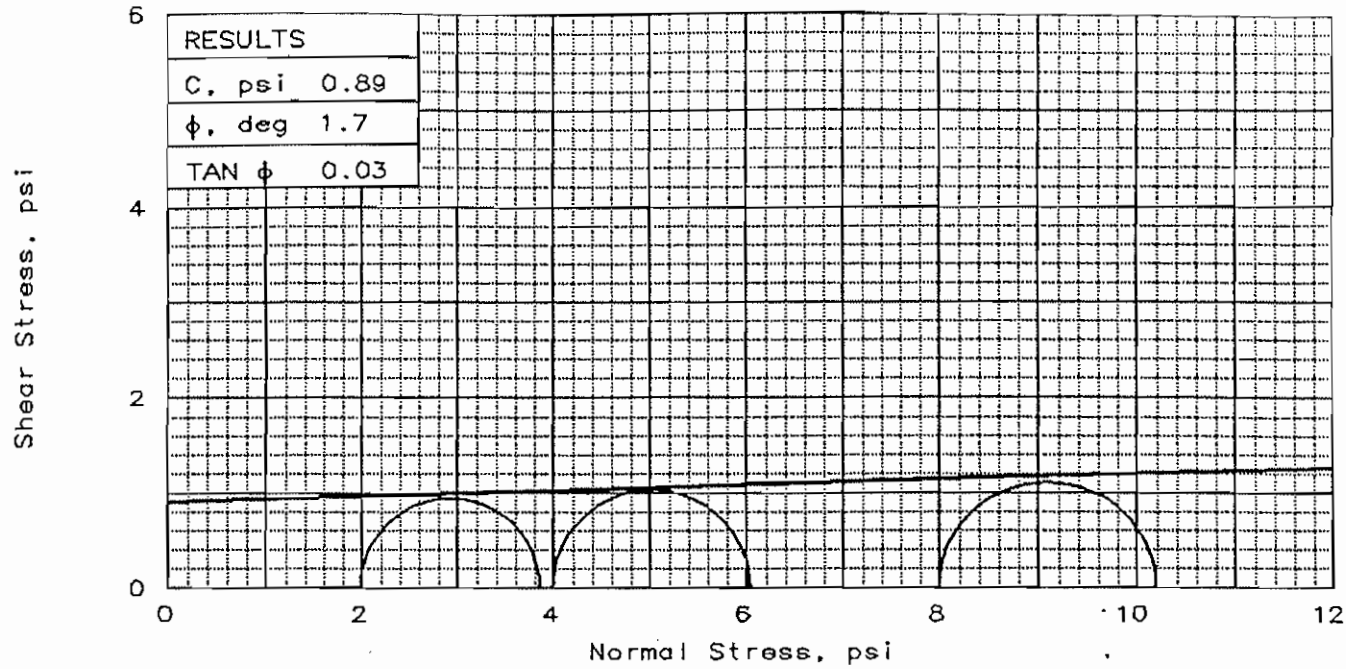
PROJECT: Plymouth Sludge Dewatering

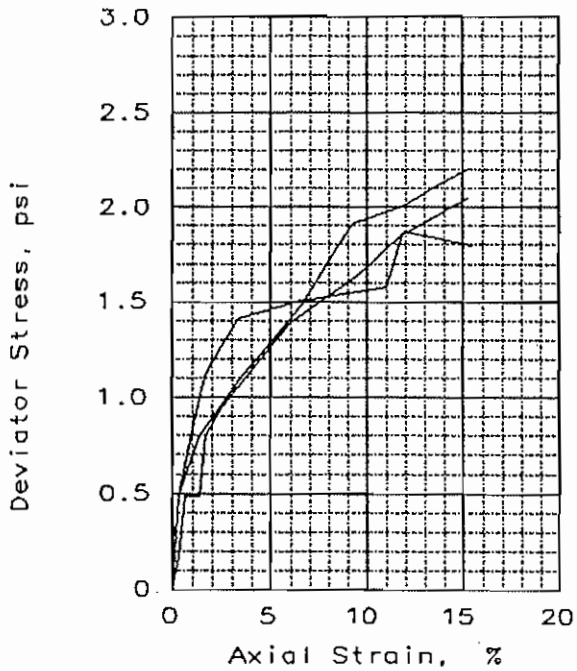
SAMPLE LOCATION: JWI # 2

PROJ. NO.: 2862 DATE: 8 June 1998

TRIAXIAL SHEAR TEST REPORT

KIBER ENVIRONMENTAL SERVICES, INC.





SAMPLE NO.:		1	2	3
INITIAL	WATER CONTENT, %	297.8	298.0	299.4
	DRY DENSITY, pcf	17.5	17.0	17.1
	SATURATION, %	96.8	94.1	95.2
	VOID RATIO	6.183	6.363	6.319
	DIAMETER, in	2.79	2.81	2.80
	HEIGHT, in	5.83	5.89	5.90
AT TEST	WATER CONTENT, %	297.8	298.0	299.4
	DRY DENSITY, pcf	17.5	17.0	17.1
	SATURATION, %	96.8	94.1	95.2
	VOID RATIO	6.183	6.363	6.319
	DIAMETER, in	2.79	2.81	2.80
	HEIGHT, in	5.83	5.89	5.90
Strain rate, %/min		0.80	0.80	0.80
BACK PRESSURE, psi		0.0	0.0	0.0
CELL PRESSURE, psi		2.0	4.0	8.0
FAIL. STRESS, psi		1.9	2.0	2.2
STRAIN, %		12.0	15.3	15.3
ULT. STRESS, psi		1.8	2.0	2.2
STRAIN, %				
σ_1 FAILURE, psi		3.9	6.0	10.2
σ_3 FAILURE, psi		2.0	4.0	8.0

TYPE OF TEST:
Unconsolidated Undrained

SAMPLE TYPE: Remolded

DESCRIPTION:

SPECIFIC GRAVITY= 2.01

REMARKS:

CLIENT: Weyerhaeuser Company

PROJECT: Plymouth Sludge Dewatering

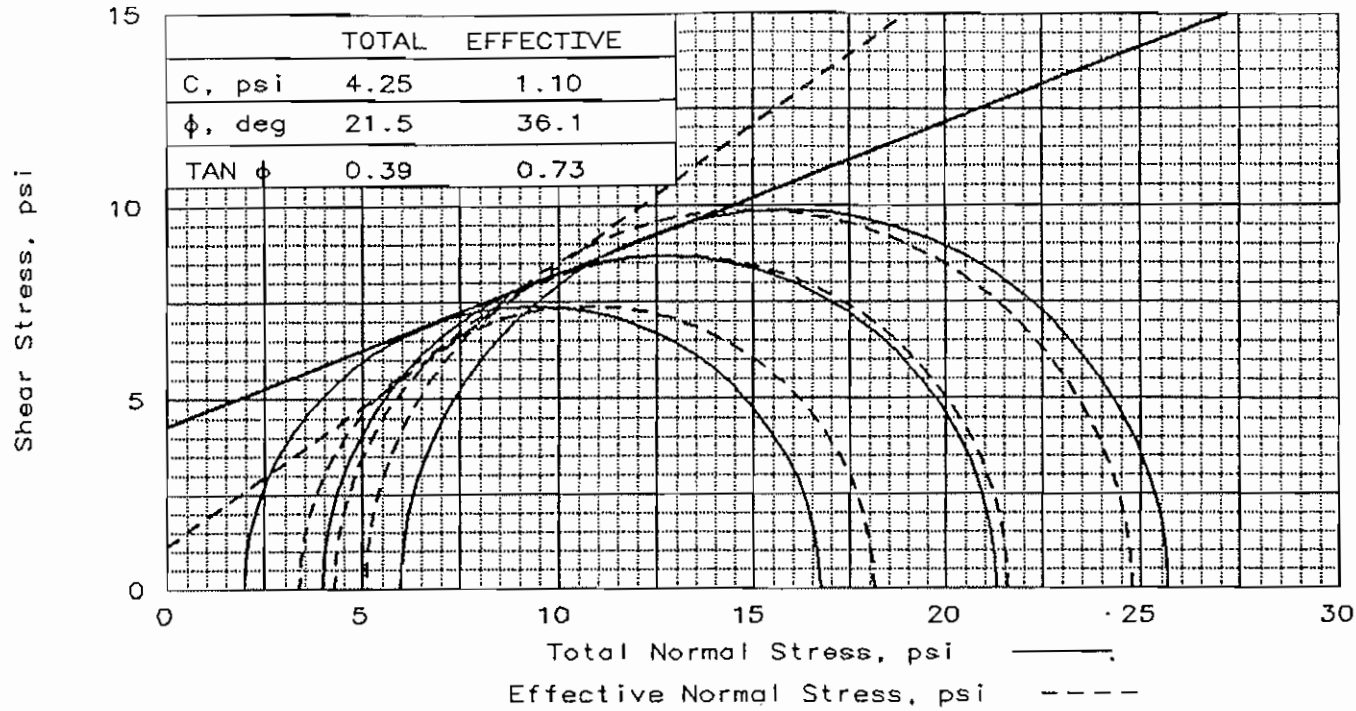
SAMPLE LOCATION: Andritz Run 12

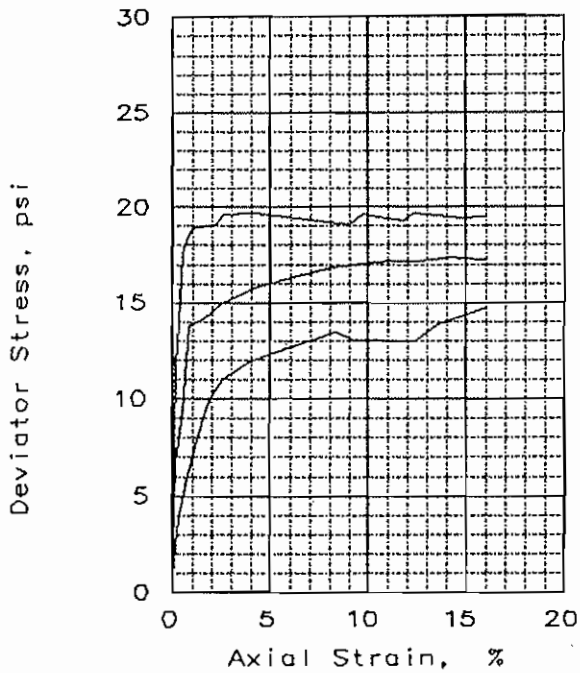
PROJ. NO.: 2892 DATE: 8 June 1998

TRIAXIAL SHEAR TEST REPORT

KIBER ENVIRONMENTAL SERVICES, INC.

Fig. No.: _____





SAMPLE NO.:		1	2	3
INITIAL	WATER CONTENT, %	119.3	120.5	118.1
	DRY DENSITY, pcf	33.2	32.4	32.5
	SATURATION, %	85.4	83.8	81.6
	VOID RATIO	2.878	2.963	3.038
	DIAMETER, in	2.99	3.00	2.99
	HEIGHT, in	5.61	5.74	5.73
AT TEST	WATER CONTENT, %	138.9	133.9	135.8
	DRY DENSITY, pcf	33.3	34.2	34.0
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	2.861	2.759	2.852
	DIAMETER, in	2.99	2.95	2.94
	HEIGHT, in	5.60	5.64	5.64
Strain rate, %/min		0.10	0.10	0.10
EFF CELL PRESSURE, psi		2.0	4.0	6.0
FAIL. STRESS, psi		14.7	17.3	19.7
TOTAL PORE PR., psi		54.1	51.2	47.9
STRAIN, %		16.1	14.3	4.3
ULT. STRESS, psi		14.7	17.2	19.5
TOTAL PORE PR., psi		54.1	51.8	43.3
STRAIN, %		16.1	16.0	16.0
$\bar{\sigma}_1$ FAILURE, psi		18.1	21.6	24.8
$\bar{\sigma}_3$ FAILURE, psi		3.4	4.3	5.1

TYPE OF TEST:
CU with Pore Pressures

SAMPLE TYPE: Remolded

DESCRIPTION:

SPECIFIC GRAVITY= 2.06

REMARKS:

CLIENT: Weyerhaeuser Company

PROJECT: Plymouth Sludge Dewatering

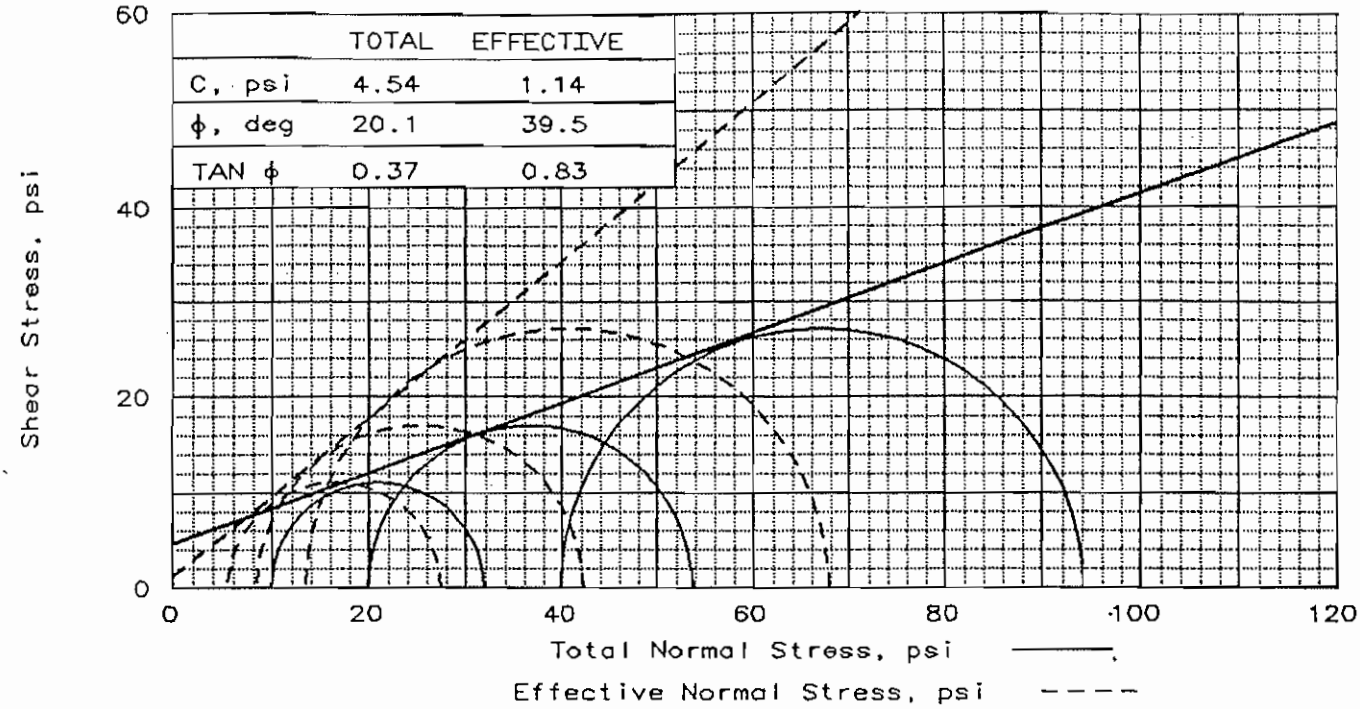
SAMPLE LOCATION: Run 5

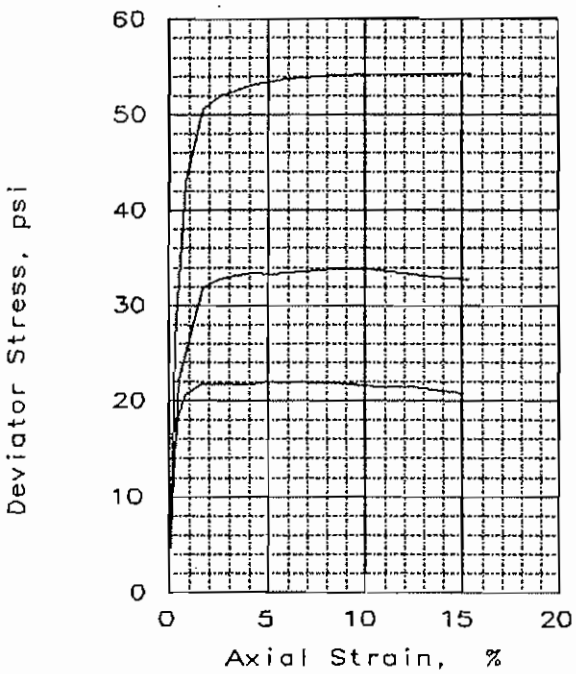
PROJ. NO.: 2862 DATE: 27 May 1998

TRIAXIAL SHEAR TEST REPORT

KIBER ENVIRONMENTAL SERVICES, INC.

Fig. No.: _____





SAMPLE NO.:		1	2	3
INITIAL	WATER CONTENT, %	119.5	119.1	119.7
	DRY DENSITY, pcf	31.1	30.7	31.2
	SATURATION, %	78.5	76.5	78.6
	VOID RATIO	3.135	3.271	3.197
	DIAMETER, in	2.99	3.00	3.00
	HEIGHT, in	6.00	6.00	6.00
AT TEST	WATER CONTENT, %	149.9	144.2	134.9
	DRY DENSITY, pcf	31.5	32.5	34.2
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	3.087	3.029	2.833
	DIAMETER, in	2.98	2.94	2.91
	HEIGHT, in	5.98	5.89	5.82
Strain rate, %/min		0.10	0.10	0.10
EFF CELL PRESSURE, psi		10.0	20.0	40.0
FAIL. STRESS, psi		22.0	33.8	54.3
TOTAL PORE PR., psi		55.4	75.0	78.4
STRAIN, %		6.7	10.2	15.5
ULT. STRESS, psi		20.8	32.8	54.3
TOTAL PORE PR., psi		54.3	74.5	78.4
STRAIN, %		15.1	15.3	15.5
$\bar{\sigma}_1$ FAILURE, psi		27.6	42.3	67.9
$\bar{\sigma}_3$ FAILURE, psi		5.6	8.5	13.6

TYPE OF TEST:
CU with Pore Pressures
SAMPLE TYPE: remolded
DESCRIPTION:

SPECIFIC GRAVITY= 2.06
REMARKS:

Fig. No.: _____

CLIENT: Weyerhaeuser Company

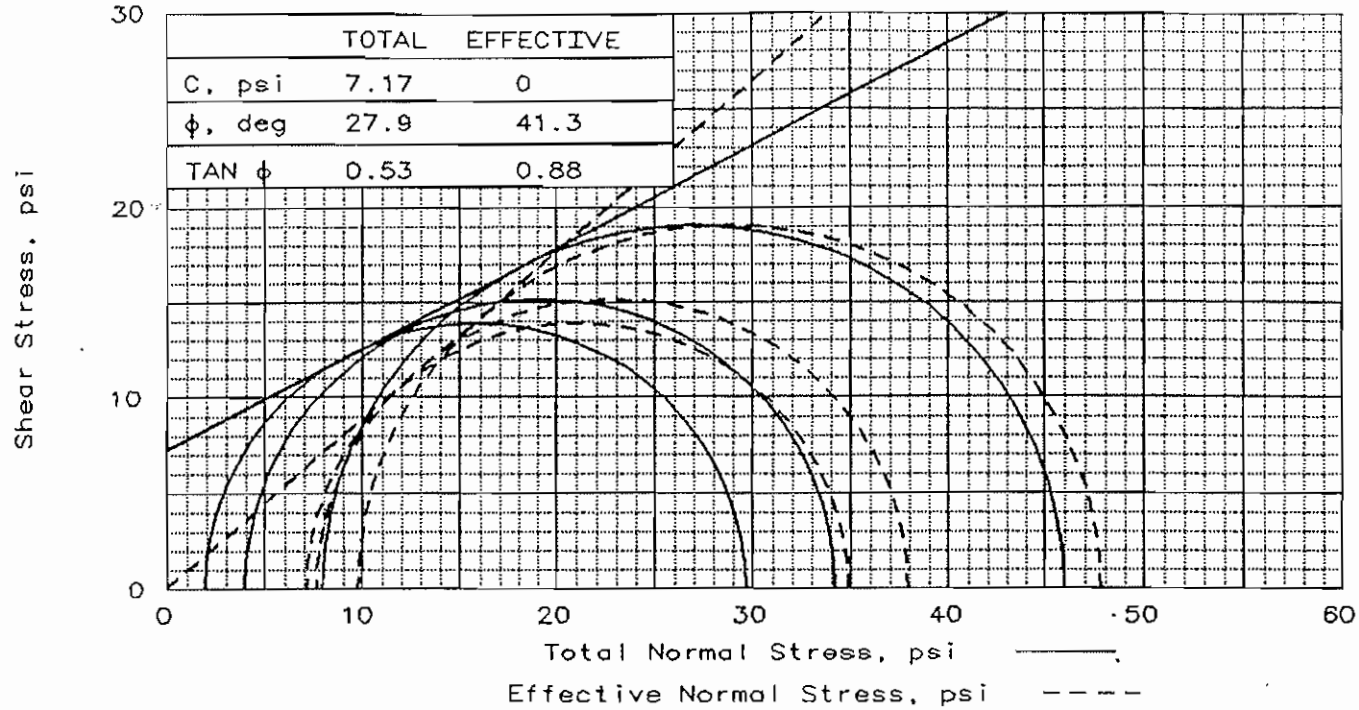
PROJECT: Plymouth Sludge Dewatering

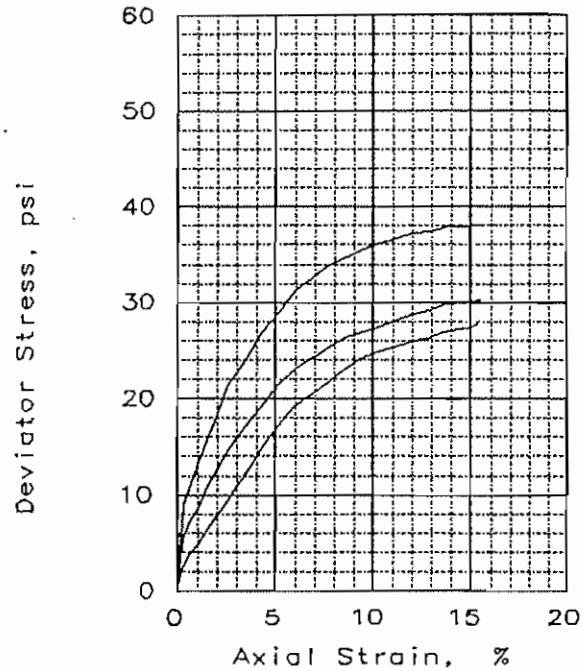
SAMPLE LOCATION: Run 5

PROJ. NO.: 2862 DATE: 28 May, 1998

TRIAXIAL SHEAR TEST REPORT

KIBER ENVIRONMENTAL SERVICES, INC.





SAMPLE NO.:		1	2	3
INITIAL	WATER CONTENT, %	146.0	145.9	147.2
	DRY DENSITY, pcf	31.4	31.6	31.7
	SATURATION, %	97.1	98.1	99.0
	VOID RATIO	3.099	3.064	3.063
	DIAMETER, in	2.87	2.86	2.86
	HEIGHT, in	5.89	5.85	5.86
AT TEST	WATER CONTENT, %	146.1	143.2	140.0
	DRY DENSITY, pcf	32.1	32.6	33.1
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	3.009	2.950	2.884
	DIAMETER, in	2.85	2.83	2.82
	HEIGHT, in	5.85	5.80	5.77
Strain rate, %/min		0.10	0.10	0.10
EFF CELL PRESSURE, psi		2.0	4.0	8.0
FAIL. STRESS, psi		27.7	30.3	38.1
TOTAL PORE PR., psi		39.8	41.3	43.2
STRAIN, %		15.4	15.5	15.6
ULT. STRESS, psi		27.7	30.3	38.1
TOTAL PORE PR., psi		39.8	41.3	43.2
STRAIN, %		15.4	15.5	15.6
$\bar{\sigma}_1$ FAILURE, psi		34.9	38.0	47.9
$\bar{\sigma}_3$ FAILURE, psi		7.2	7.7	9.8

TYPE OF TEST:
CU with Pore Pressures
SAMPLE TYPE: Remolded
DESCRIPTION:

SPECIFIC GRAVITY= 2.06
REMARKS:

CLIENT: Weyerhaeuser Company

PROJECT: PLYMOUTH SLUDGE DEWATERING

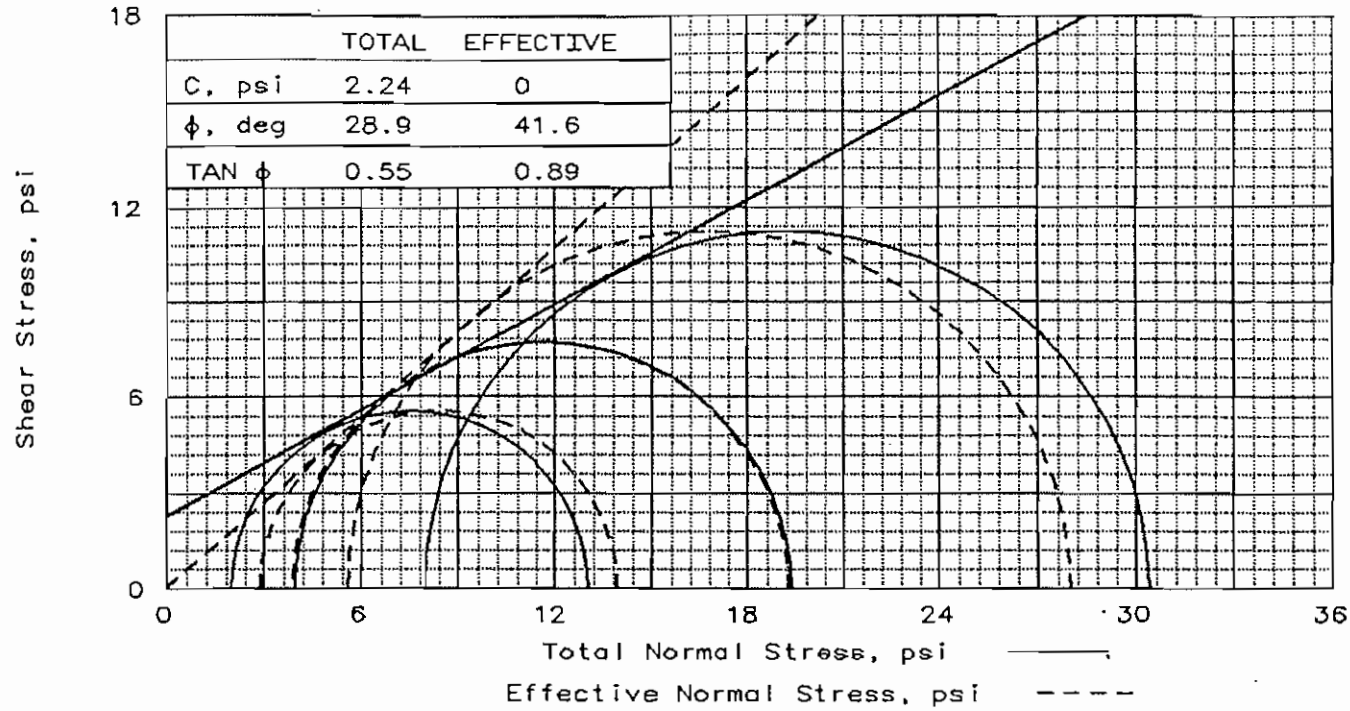
SAMPLE LOCATION: RUN 5 Adjusted Moisture
Moisture Point #2

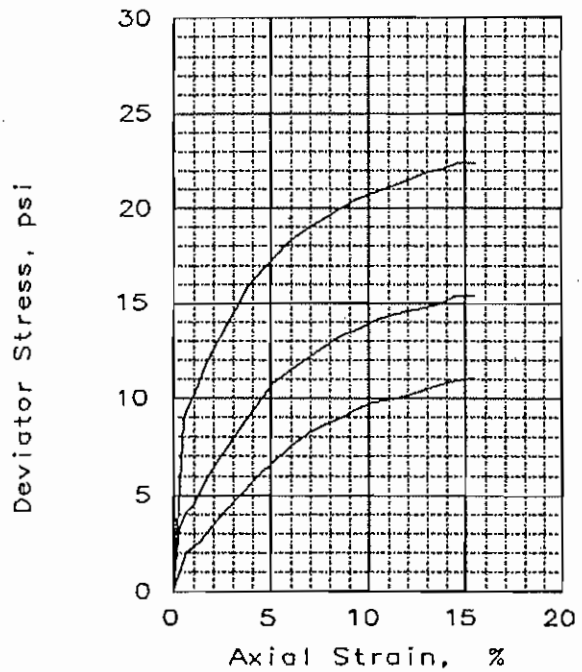
PROJ. NO.: 2682 DATE: 20 JULY 1998

TRIAXIAL SHEAR TEST REPORT

KIBER ENVIRONMENTAL SERVICES, INC.

Fig. No.: _____





SAMPLE NO.:		1	2	3
INITIAL	WATER CONTENT, %	156.2	159.0	158.2
	DRY DENSITY, pcf	30.5	30.1	30.1
	SATURATION, %	99.8	99.9	99.6
	VOID RATIO	3.223	3.279	3.272
	DIAMETER, in	2.88	2.87	2.87
	HEIGHT, in	5.85	5.89	5.89
AT TEST	WATER CONTENT, %	152.6	152.5	148.6
	DRY DENSITY, pcf	31.0	31.1	31.7
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	3.143	3.141	3.061
	DIAMETER, in	2.86	2.84	2.82
	HEIGHT, in	5.81	5.83	5.79
Strain rate, %/min		0.10	0.10	0.10
EFF CELL PRESSURE, psi		2.0	4.0	8.0
FAIL. STRESS, psi		11.1	15.4	22.4
TOTAL PORE PR., psi		34.1	36.1	39.4
STRAIN, %		15.5	14.6	15.5
ULT. STRESS, psi		11.1	15.4	22.4
TOTAL PORE PR., psi		34.1	35.7	39.4
STRAIN, %		15.5	15.4	15.5
$\bar{\sigma}_1$ FAILURE, psi		14.0	19.3	28.0
$\bar{\sigma}_3$ FAILURE, psi		2.9	3.9	5.6

TYPE OF TEST:
CU with Pore Pressures
SAMPLE TYPE: Remolded
DESCRIPTION:

SPECIFIC GRAVITY= 2.06
REMARKS:

Fig. No.: _____

CLIENT: Weyerhaeuser Company

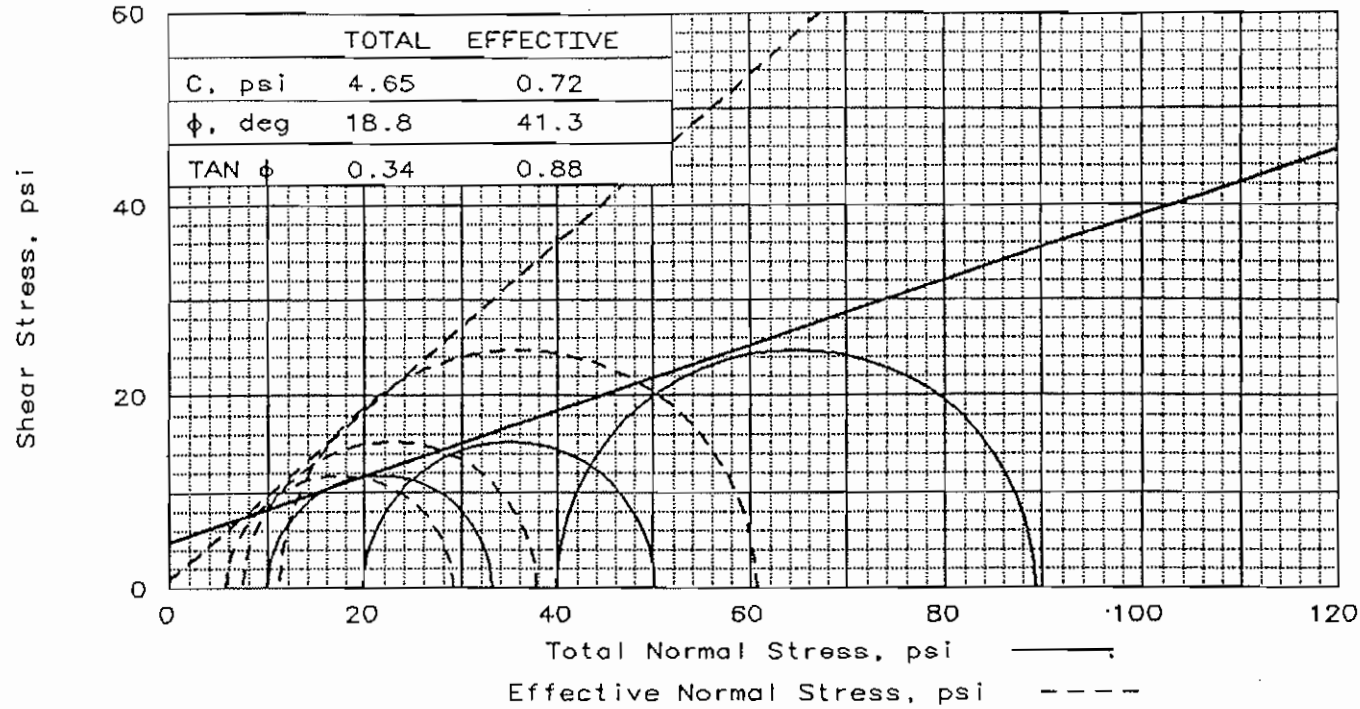
PROJECT: Plymouth Sludge Dewatering

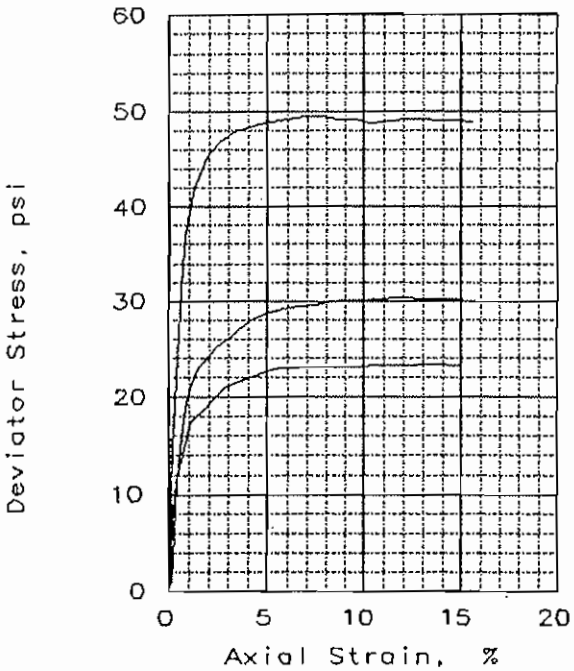
SAMPLE LOCATION: Run 5 Adjusted Moisture
Moisture Point #3

PROJ. NO.: 2862 DATE: 23 July 1998

TRIAXIAL SHEAR TEST REPORT

KIBER ENVIRONMENTAL SERVICES, INC.





SAMPLE NO.:		1	2	3
INITIAL	WATER CONTENT, %	168.9	168.7	167.5
	DRY DENSITY, pcf	26.9	28.2	27.2
	SATURATION, %	91.7	97.0	92.0
	VOID RATIO	3.869	3.633	3.803
	DIAMETER, in	2.98	2.81	2.98
	HEIGHT, in	6.00	6.00	6.00
AT TEST	WATER CONTENT, %	175.6	161.6	155.2
	DRY DENSITY, pcf	28.0	29.8	30.7
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	3.688	3.377	3.245
	DIAMETER, in	2.94	2.76	2.86
	HEIGHT, in	5.93	5.89	5.76
Strain rate, %/min		0.10	0.10	0.10
EFF CELL PRESSURE, psi		10.0	20.0	40.0
FAIL. STRESS, psi		23.3	30.3	49.4
TOTAL PORE PR., psi		45.1	51.4	74.7
STRAIN, %		13.5	11.7	6.9
ULT. STRESS, psi		23.3	30.3	48.9
TOTAL PORE PR., psi		45.0	55.1	74.2
STRAIN, %		15.0	15.1	15.6
$\bar{\sigma}_1$ FAILURE, psi		29.2	37.9	60.7
$\bar{\sigma}_3$ FAILURE, psi		5.9	7.6	11.3

TYPE OF TEST:
CU with Pore Pressures

SAMPLE TYPE: Remolded

DESCRIPTION:

SPECIFIC GRAVITY= 2.1

REMARKS:

Fig. No.: _____

CLIENT: Weyerhaeuser Company

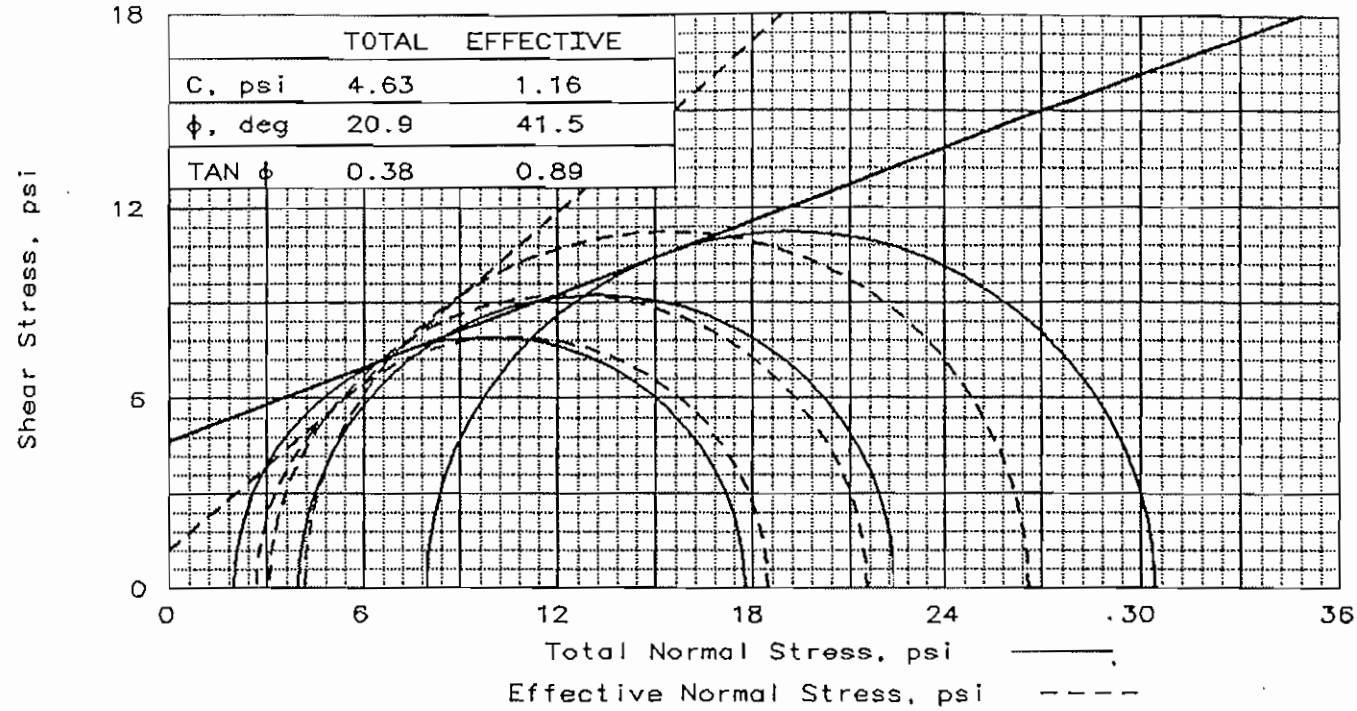
PROJECT: Plymouth Sludge Dewatering

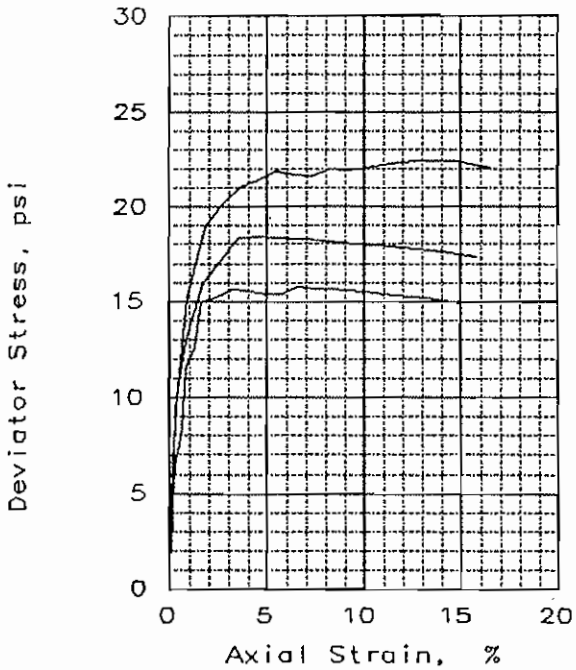
SAMPLE LOCATION: Run #6

PROJ. NO.: 2862 DATE: 29 MAY 1998

TRIAXIAL SHEAR TEST REPORT

KIBER ENVIRONMENTAL SERVICES, INC.





SAMPLE NO.:		1	2	3
INITIAL	WATER CONTENT, %	169.4	166.7	167.1
	DRY DENSITY, pcf	26.9	27.1	26.6
	SATURATION, %	91.8	91.1	89.9
	VOID RATIO	3.876	3.823	3.832
	DIAMETER, in	2.98	2.99	3.00
	HEIGHT, in	6.00	6.00	6.00
AT TEST	WATER CONTENT, %	184.2	148.4	124.4
	DRY DENSITY, pcf	26.9	31.8	36.1
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	3.868	3.101	2.563
	DIAMETER, in	2.98	2.83	2.71
	HEIGHT, in	6.00	5.69	5.44
Strain rate, %/min		0.10	0.10	0.10
EFF CELL PRESSURE, psi		2.0	4.0	8.0
FAIL. STRESS, psi		15.8	18.4	22.4
TOTAL PORE PR., psi		35.3	36.4	50.8
STRAIN, %		6.7	4.8	12.9
ULT. STRESS, psi		14.9	17.4	22.1
TOTAL PORE PR., psi		34.3	34.9	50.5
STRAIN, %		15.0	15.8	16.5
$\bar{\sigma}_1$ FAILURE, psi		18.5	21.5	26.6
$\bar{\sigma}_3$ FAILURE, psi		2.7	3.1	4.2

TYPE OF TEST:
CU with Pore Pressures
SAMPLE TYPE: remolded
DESCRIPTION:

SPECIFIC GRAVITY= 2.1
REMARKS:

Fig. No.: _____

CLIENT: Weyerhaeuser Company

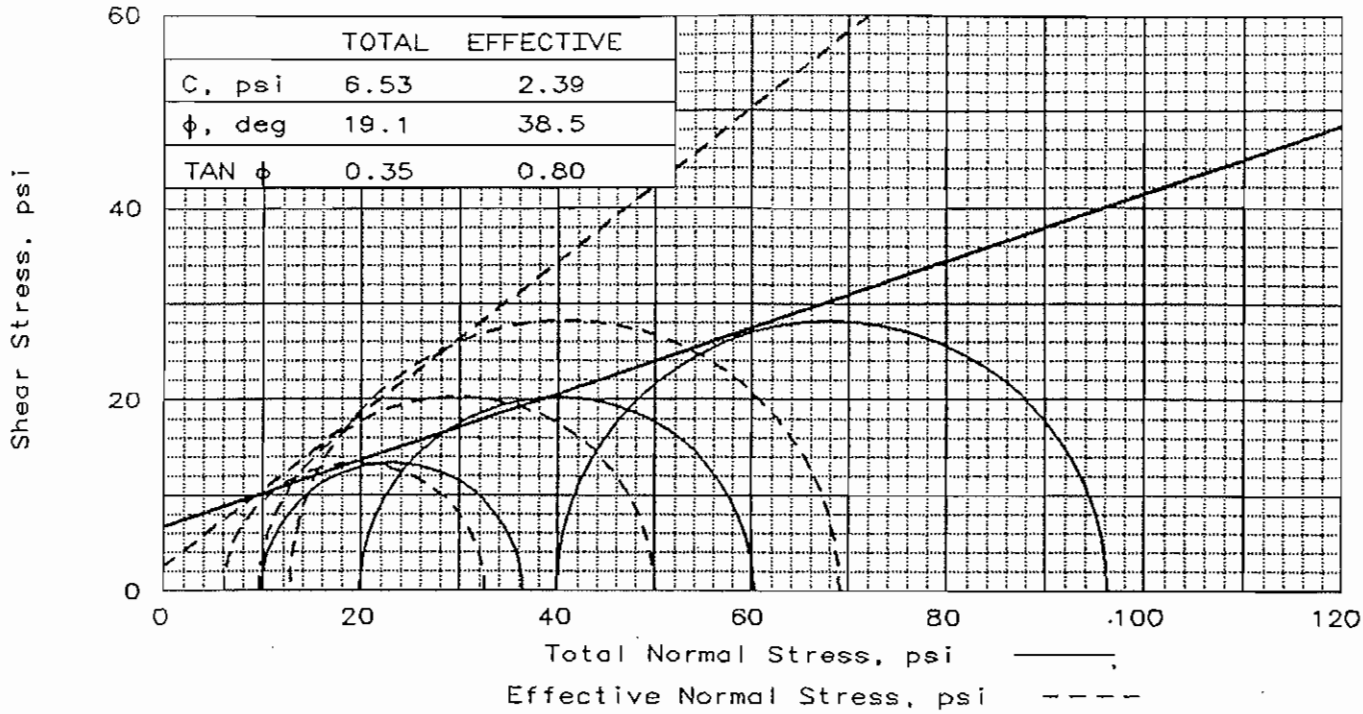
PROJECT: Plymouth Sludge Dewatering

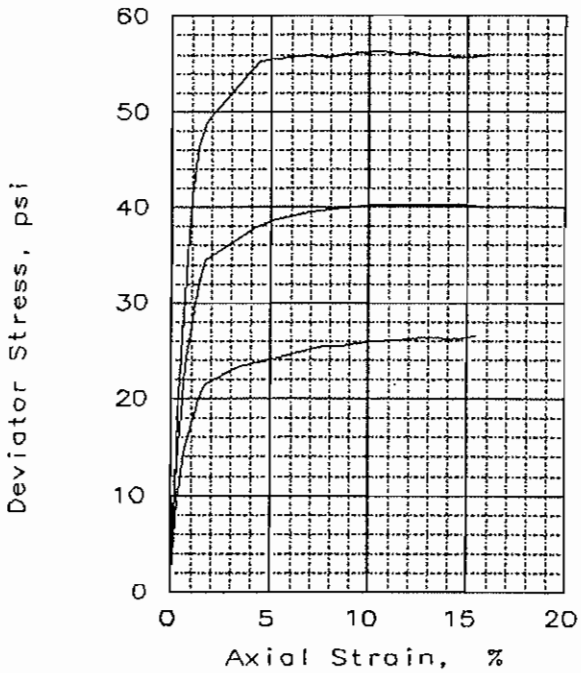
SAMPLE LOCATION: Run 6

PROJ. NO.: 2862 DATE: 1 June 1998

TRIAXIAL SHEAR TEST REPORT

KIBER ENVIRONMENTAL SERVICES, INC.





SAMPLE NO.:		1	2	3
INITIAL	WATER CONTENT, %	119.4	120.0	120.0
	DRY DENSITY, pcf	32.1	32.2	32.2
	SATURATION, %	83.1	83.9	83.8
	VOID RATIO	2.828	2.816	2.820
	DIAMETER, in	2.86	2.86	2.86
	HEIGHT, in	5.88	5.85	5.86
AT TEST	WATER CONTENT, %	137.1	130.2	122.0
	DRY DENSITY, pcf	33.2	34.5	36.1
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	2.700	2.566	2.404
	DIAMETER, in	2.83	2.80	2.75
	HEIGHT, in	5.81	5.72	5.64
Strain rate, %/min		0.10	0.10	0.10
EFF CELL PRESSURE, psi		10.0	20.0	40.0
FAIL. STRESS, psi		26.5	40.4	56.4
TOTAL PORE PR., psi		58.8	65.3	82.2
STRAIN, %		15.5	14.9	10.6
ULT. STRESS, psi		26.5	40.1	55.8
TOTAL PORE PR., psi		58.8	65.2	81.4
STRAIN, %		15.5	15.7	16.0
$\bar{\sigma}_1$ FAILURE, psi		32.7	50.1	69.2
$\bar{\sigma}_3$ FAILURE, psi		6.2	9.7	12.8

TYPE OF TEST:
CU with Pore Pressures
SAMPLE TYPE: Remolded
DESCRIPTION:

SPECIFIC GRAVITY= 1.97
REMARKS:

Fig. No.: _____

CLIENT: Weyerhaeuser Company

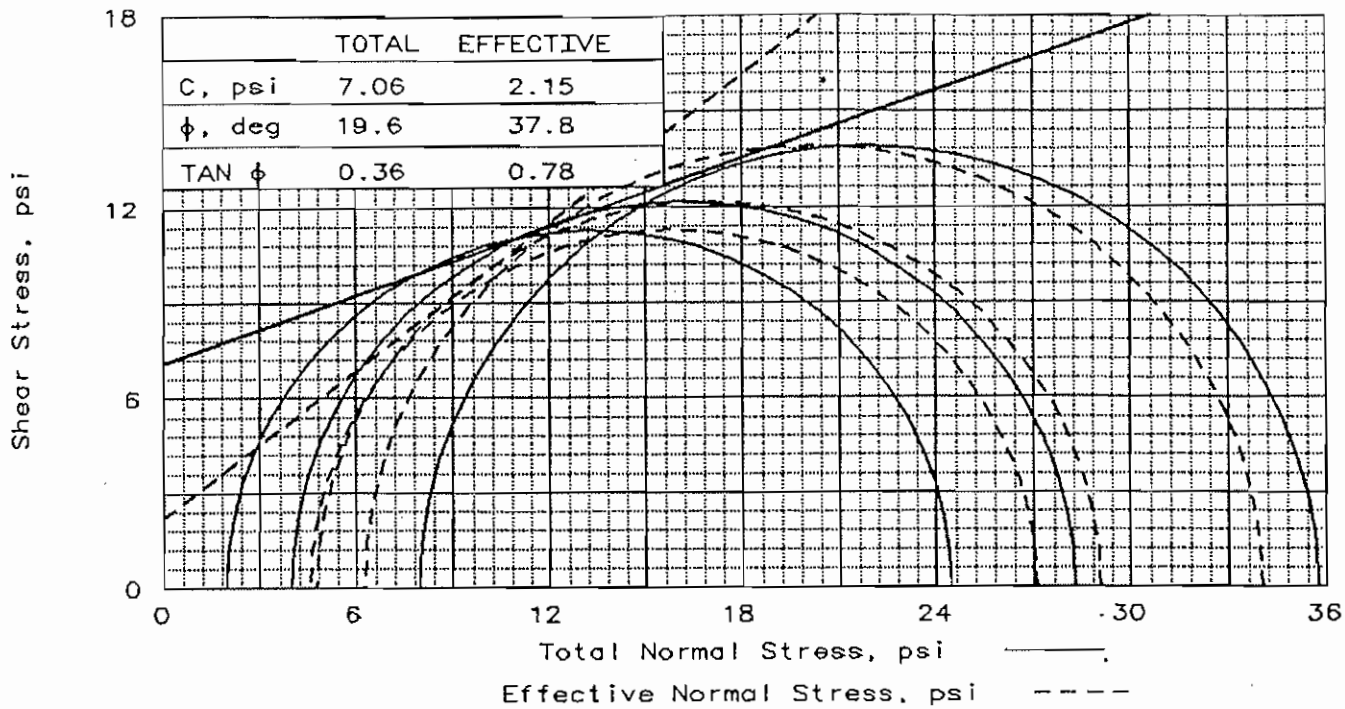
PROJECT: Plymouth Sludge Dewatering

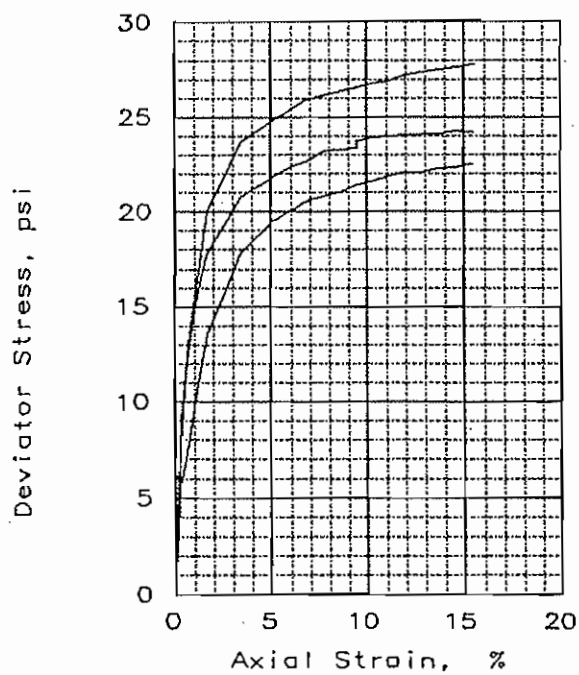
SAMPLE LOCATION: Dry Vac.

PROJ. NO.: 2862 DATE: 17 JUNE 1998

TRIAXIAL SHEAR TEST REPORT

KIBER ENVIRONMENTAL SERVICES, INC.





SAMPLE NO.:		1	2	3
INITIAL	WATER CONTENT, %	121.2	120.0	120.3
	DRY DENSITY, pcf	31.7	31.9	32.3
	SATURATION, %	83.1	83.0	84.4
	VOID RATIO	2.874	2.849	2.807
	DIAMETER, in	2.87	2.87	2.86
	HEIGHT, in	5.86	5.86	5.85
AT TEST	WATER CONTENT, %	142.1	138.3	138.2
	DRY DENSITY, pcf	32.4	33.0	33.0
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	2.799	2.724	2.723
	DIAMETER, in	2.85	2.84	2.84
	HEIGHT, in	5.82	5.80	5.81
Strain rate, %/min		0.10	0.10	0.10
EFF CELL PRESSURE, psi		2.0	4.0	8.0
FAIL. STRESS, psi		22.5	24.3	27.8
TOTAL PORE PR., psi		52.4	53.2	56.7
STRAIN, %		15.5	14.7	15.5
ULT. STRESS, psi		22.5	24.2	27.8
TOTAL PORE PR., psi		52.4	53.1	56.7
STRAIN, %		15.5	15.5	15.5
$\bar{\sigma}_1$ FAILURE, psi		27.1	29.1	34.1
$\bar{\sigma}_3$ FAILURE, psi		4.6	4.8	6.3

TYPE OF TEST:
CU with Pore Pressures
SAMPLE TYPE: remolded
DESCRIPTION:

SPECIFIC GRAVITY= 1.97
REMARKS:

CLIENT: Weyerhaeuser Company

PROJECT: Plymouth Sludge Dewatering

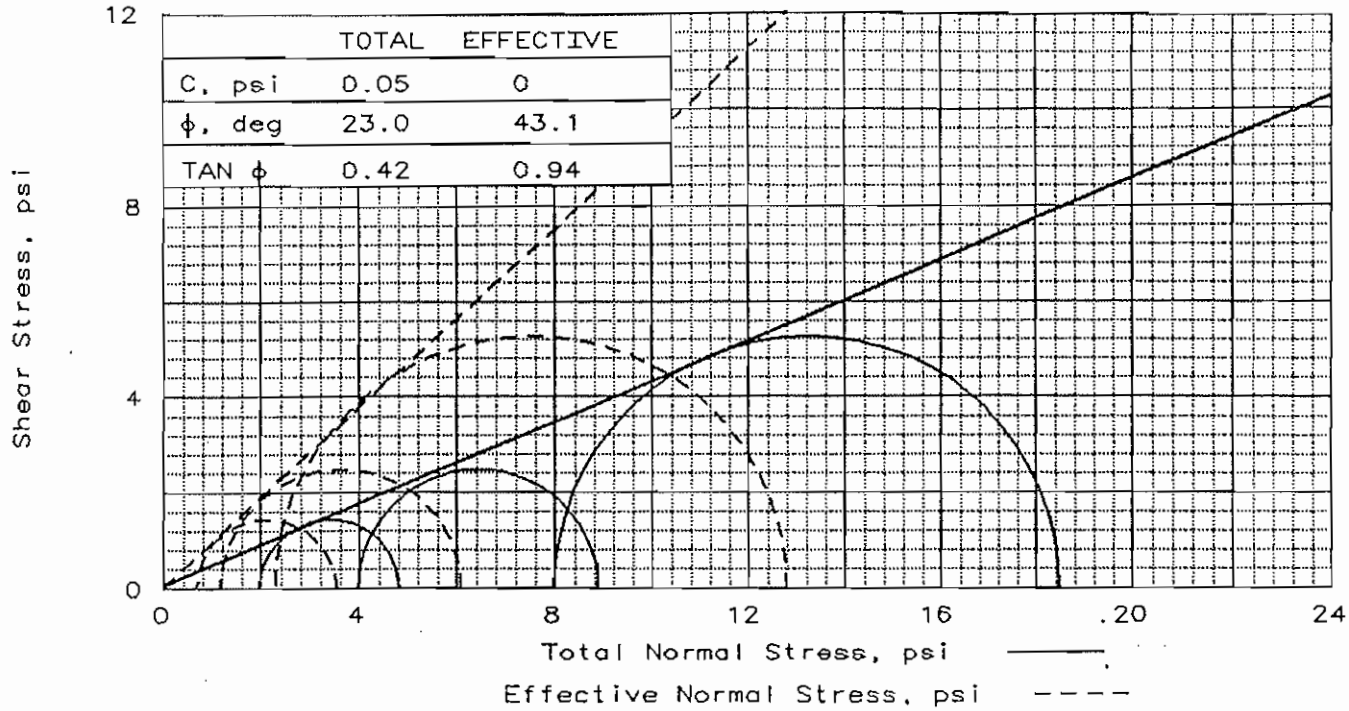
SAMPLE LOCATION: Dry Vac.

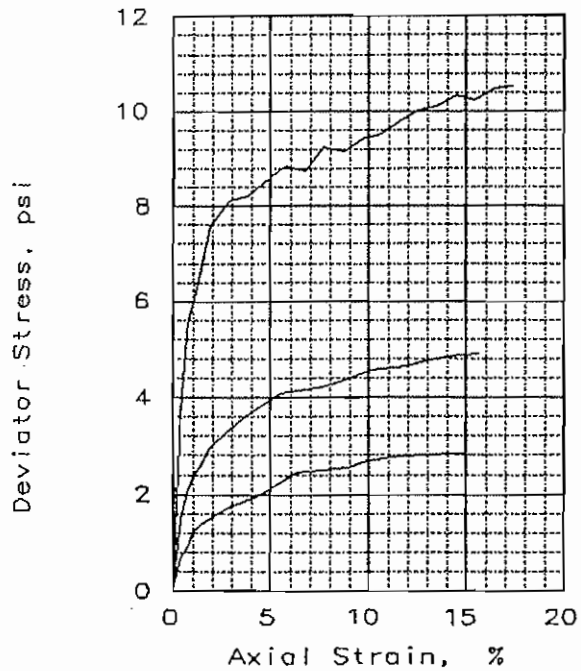
PROJ. NO.: 2862 DATE: 15 June 1998

TRIAXIAL SHEAR TEST REPORT

KIBER ENVIRONMENTAL SERVICES, INC.

Fig. No.: _____





SAMPLE NO.:		1	2	3
INITIAL	WATER CONTENT, %	303.7	305.7	304.7
	DRY DENSITY, pcf	16.3	16.6	16.7
	SATURATION, %	90.9	93.1	93.3
	VOID RATIO	6.715	6.899	6.854
	DIAMETER, in	2.86	2.83	2.83
	HEIGHT, in	5.86	5.87	5.87
AT TEST	WATER CONTENT, %	274.2	246.1	203.4
	DRY DENSITY, pcf	19.3	21.3	24.9
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	5.512	5.168	4.271
	DIAMETER, in	2.70	2.60	2.47
	HEIGHT, in	5.54	5.42	5.17
Strain rate, %/min		0.10	0.10	0.10
EFF CELL PRESSURE, psi		2.0	4.0	8.0
FAIL. STRESS, psi		2.8	4.9	10.5
TOTAL PORE PR., psi		22.3	23.8	30.7
STRAIN, %		14.4	15.7	17.4
ULT. STRESS, psi		2.8	4.9	10.5
TOTAL PORE PR., psi		22.4	23.8	30.7
STRAIN, %		15.3	15.7	17.4
$\bar{\sigma}_1$ FAILURE, psi		3.5	6.1	12.8
$\bar{\sigma}_3$ FAILURE, psi		0.7	1.2	2.3

TYPE OF TEST:
CU with Pore Pressures
SAMPLE TYPE: Remolded
DESCRIPTION:

SPECIFIC GRAVITY= 2.01
REMARKS:

CLIENT: Weyerhaeuser Company

PROJECT: Plymouth Sludge Dewatering

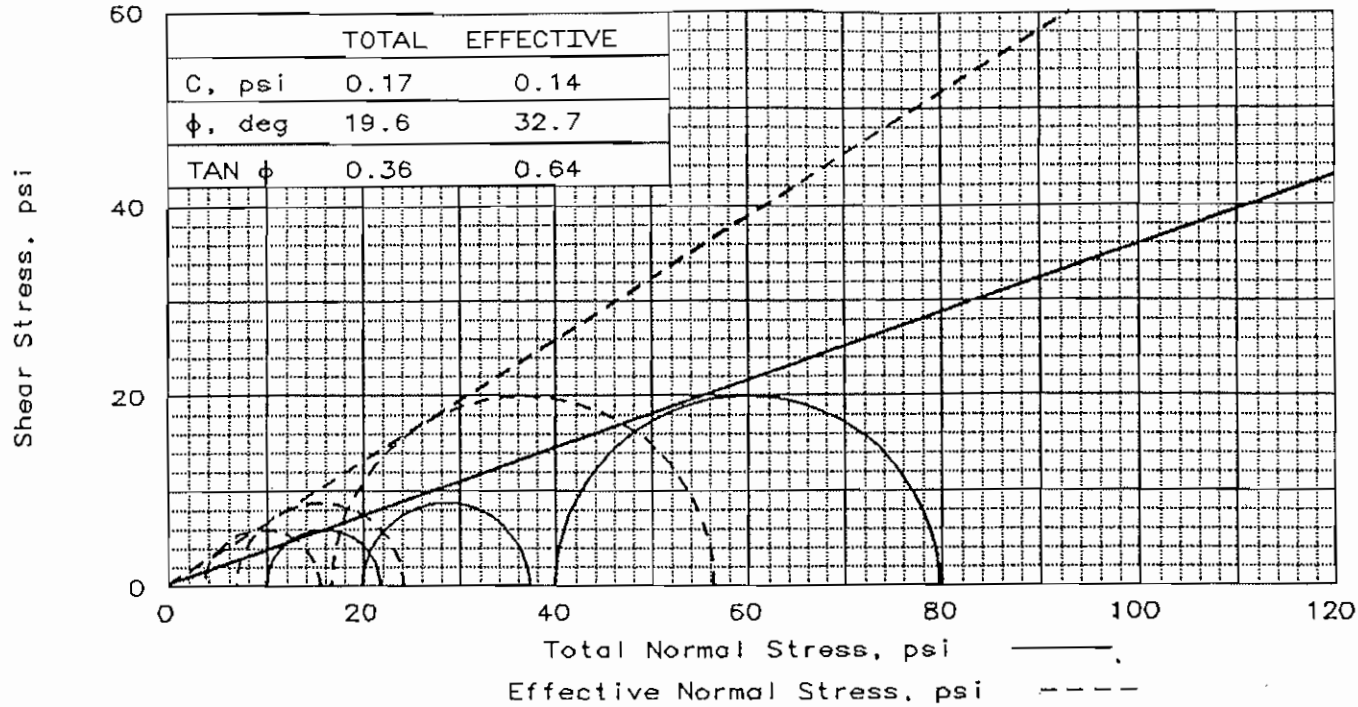
SAMPLE LOCATION: Andritz Run 12

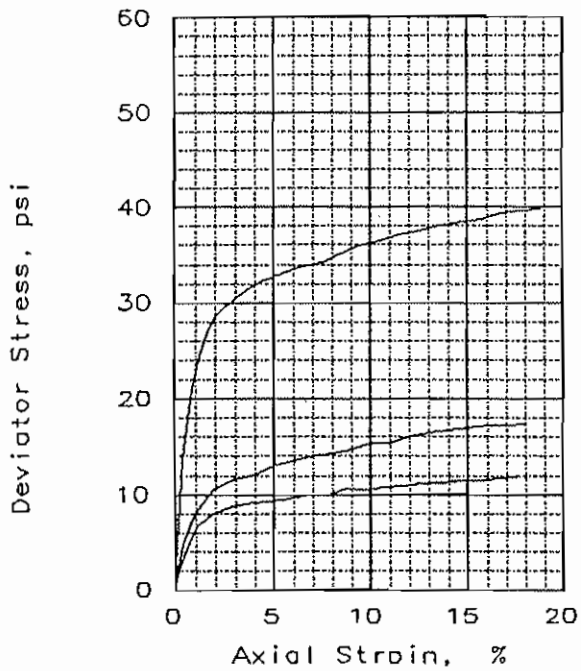
PROJ. NO.: 2862 DATE: 8 June 1998

TRIAXIAL SHEAR TEST REPORT

KIBER ENVIRONMENTAL SERVICES, INC.

Fig. No.: _____





SAMPLE NO.:		1	2	3
INITIAL	WATER CONTENT, %	308.6	309.7	306.9
	DRY DENSITY, pcf	16.4	16.3	16.4
	SATURATION, %	93.1	92.1	92.2
	VOID RATIO	6.663	7.066	6.990
	DIAMETER, in	2.85	2.85	2.85
	HEIGHT, in	5.85	5.87	5.87
AT TEST	WATER CONTENT, %	201.8	179.2	144.9
	DRY DENSITY, pcf	24.8	27.5	32.4
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	4.056	3.762	3.044
	DIAMETER, in	2.47	2.38	2.25
	HEIGHT, in	5.13	4.98	4.76
Strain rate, %/min		0.10	0.10	0.10
EFF CELL PRESSURE, psi		10.0	20.0	40.0
FAIL. STRESS, psi		11.8	17.3	39.8
TOTAL PORE PR., psi		33.3	38.1	43.2
STRAIN, %		17.6	18.1	18.9
ULT. STRESS, psi		11.8	17.3	39.8
TOTAL PORE PR., psi		33.3	38.1	43.2
STRAIN, %		17.6	18.1	18.9
$\bar{\sigma}_1$ FAILURE, psi		15.5	24.2	56.6
$\bar{\sigma}_3$ FAILURE, psi		3.7	6.9	16.8

TYPE OF TEST:
CU with Pore Pressures

SAMPLE TYPE: Remolded

DESCRIPTION:

SPECIFIC GRAVITY= 2.01

REMARKS:

CLIENT: Weyerhaeuser Company

PROJECT: Plymouth Sludge Dewatering

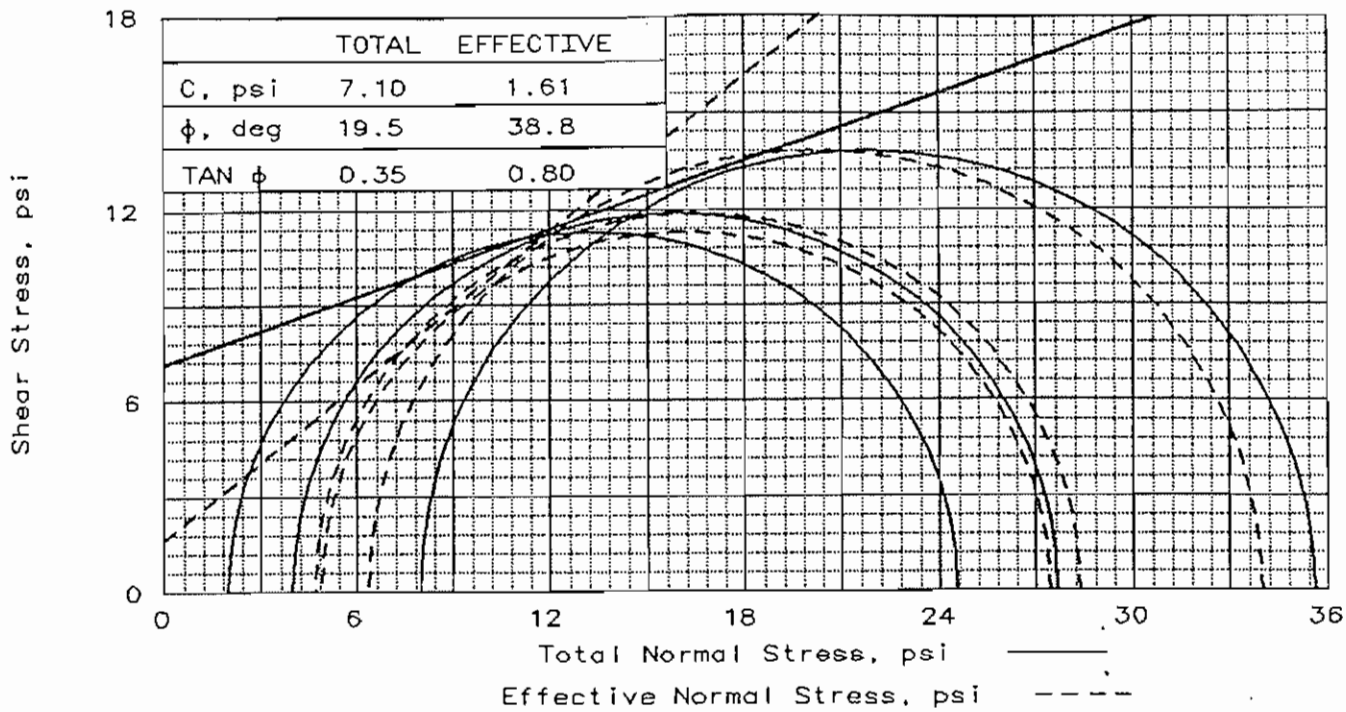
SAMPLE LOCATION: Andritz Run #12

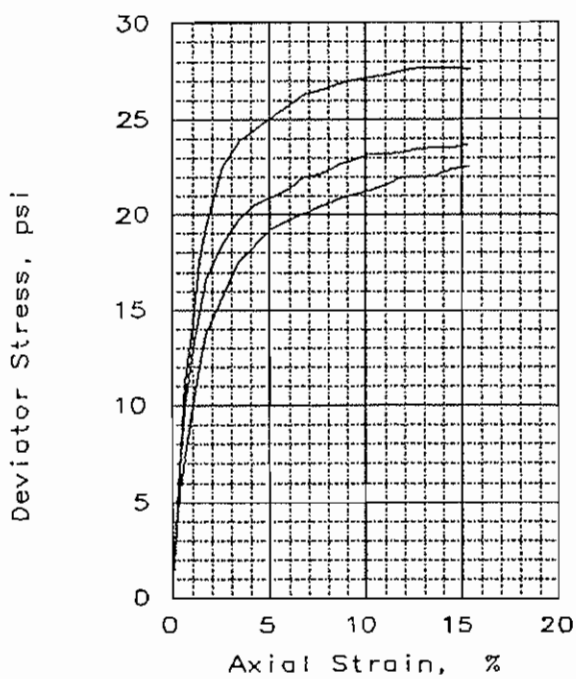
PROJ. NO.: 2862 DATE: 12 June 1998

TRIAXIAL SHEAR TEST REPORT

KIBER ENVIRONMENTAL SERVICES, INC.

Fig. No.: _____





SAMPLE NO.:		1	2	3
INITIAL	WATER CONTENT, %	120.3	120.1	120.0
	DRY DENSITY, pcf	31.6	31.6	31.4
	SATURATION, %	82.3	82.0	81.2
	VOID RATIO	2.850	2.857	2.880
	DIAMETER, in	2.87	2.87	2.88
	HEIGHT, in	5.86	5.87	5.87
AT TEST	WATER CONTENT, %	145.3	146.5	142.6
	DRY DENSITY, pcf	31.8	31.6	32.2
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	2.833	2.857	2.780
	DIAMETER, in	2.87	2.87	2.85
	HEIGHT, in	5.85	5.87	5.82
Strain rate, %/min		0.10	0.10	0.10
EFF CELL PRESSURE, psi		2.0	4.0	8.0
FAIL. STRESS, psi		22.6	23.7	27.6
TOTAL PORE PR., psi		47.1	54.8	52.6
STRAIN, %		15.4	15.3	12.9
ULT. STRESS, psi		22.6	23.7	27.6
TOTAL PORE PR., psi		47.1	54.8	5.2
STRAIN, %		15.4	15.3	15.5
$\bar{\sigma}_1$ FAILURE, psi		27.5	28.4	34.0
$\bar{\sigma}_3$ FAILURE, psi		4.9	4.7	6.4

TYPE OF TEST:
CU with Pore Pressures
SAMPLE TYPE: remolded
DESCRIPTION:

SPECIFIC GRAVITY= 1.95
REMARKS:

Fig. No.: _____

CLIENT: Weyerhaeuser Company

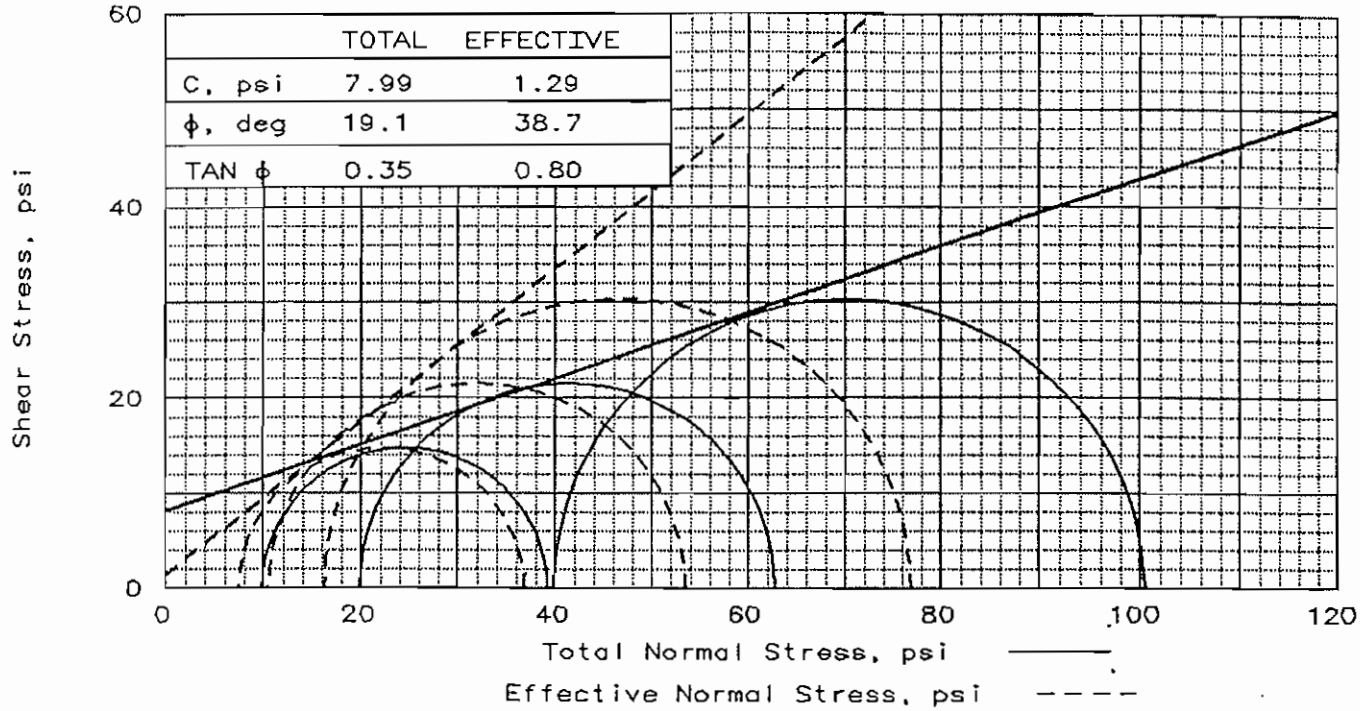
PROJECT: Plymouth Sludge Dewatering

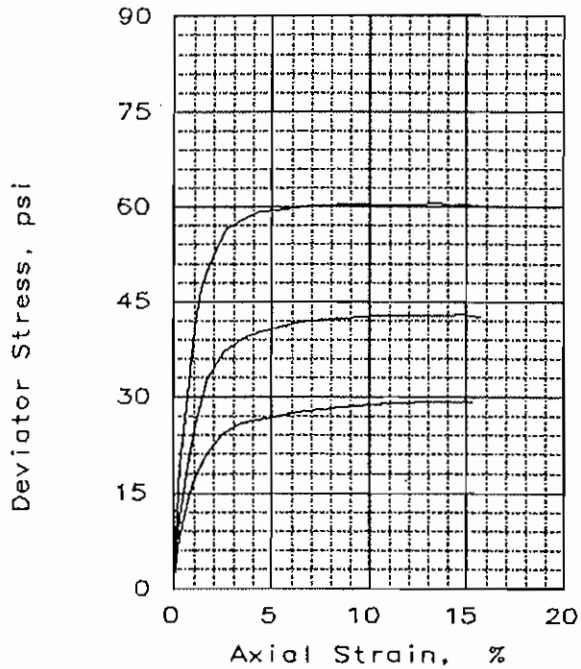
SAMPLE LOCATION: JW1-#2

PROJ. NO.: 2862 DATE: 18 June 1998

TRIAXIAL SHEAR TEST REPORT

KIBER ENVIRONMENTAL SERVICES, INC.





SAMPLE NO.:		1	2	3
INITIAL	WATER CONTENT, %	120.1	120.0	121.0
	DRY DENSITY, pcf	31.8	31.7	31.8
	SATURATION, %	82.9	82.3	83.6
	VOID RATIO	2.826	2.843	2.822
	DIAMETER, in	2.86	2.87	2.86
	HEIGHT, in	5.88	5.86	5.84
AT TEST	WATER CONTENT, %	144.3	132.3	128.2
	DRY DENSITY, pcf	31.9	34.0	34.8
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	2.814	2.579	2.501
	DIAMETER, in	2.86	2.80	2.78
	HEIGHT, in	5.87	5.72	5.67
Strain rate, %/min		0.10	0.10	0.10
EFF CELL PRESSURE, psi		10.0	20.0	40.0
FAIL. STRESS, psi		29.3	42.9	60.6
TOTAL PORE PR., psi		53.4	59.3	73.6
STRAIN, %		15.3	14.8	13.7
ULT. STRESS, psi		29.3	42.6	60.1
TOTAL PORE PR., psi		53.4	59.1	73.2
STRAIN, %		15.3	15.7	15.9
$\bar{\sigma}_1$ FAILURE, psi		36.9	53.6	77.0
$\bar{\sigma}_3$ FAILURE, psi		7.6	10.7	16.4

TYPE OF TEST:
CU with Pore Pressures
SAMPLE TYPE: Remolded
DESCRIPTION:

SPECIFIC GRAVITY= 1.95
REMARKS:

CLIENT: Weyerhaeuser Company

PROJECT: Plymouth Sludge Dewatering

SAMPLE LOCATION: JW1-#2

PROJ. NO.: 2862 DATE: 23 June 1998

TRIAXIAL SHEAR TEST REPORT

KIBER ENVIRONMENTAL SERVICES, INC.

Fig. No.: _____

ATTACHMENT C

TREATED MATERIAL TESTING DATA REPORTS

COMPACTION TEST

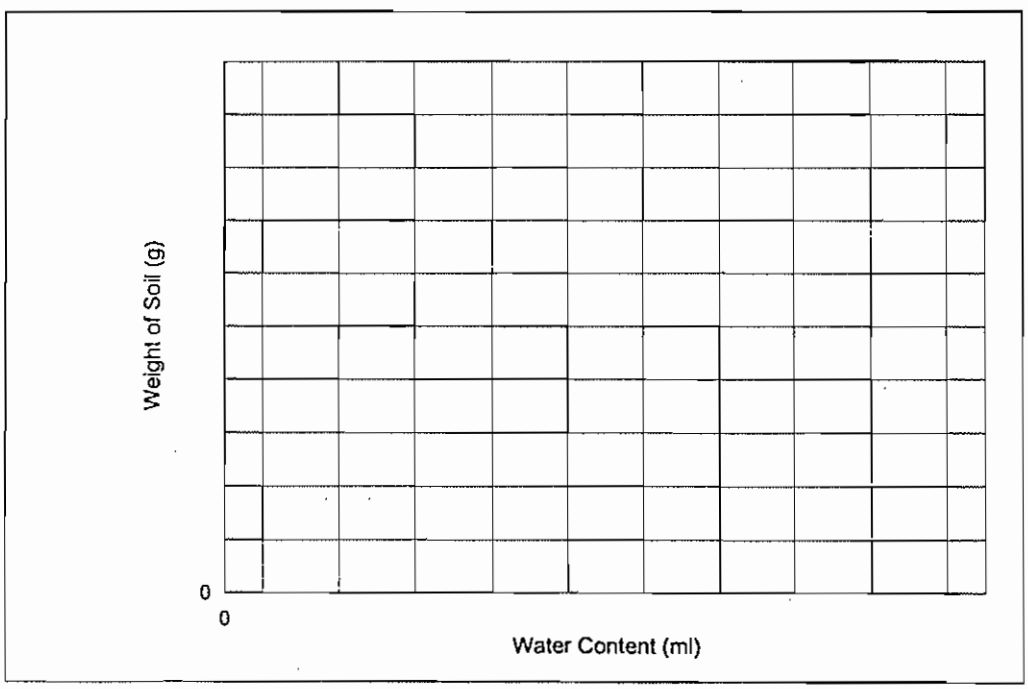
REPORT FORM

PROJECT:	PLYMOUTH SLUDGE	SAMPLE DESCRIPTION:	ASH TREATED
PROJECT NO.:	2862	TESTED BY:	MC
TESTING DATE:	1 JULY 1998	TRACKING CODE:	7849_CM

Type of Proctor: ASTM D 698 Modified

Weight of Mold (g): 2046.5 Mold Volume Factor (1/volume) 30.03

SAMPLE DESCRIPTION	RUN #5 TR. MC#1	RUN #5 TR.MC #2	RUN #5 TR.MC #3	
Wt of Soil + Mold	3089.90 g	3169.90 g	3226.50 g	
Wet Density	69.1 pcf	74.4 pcf	78.1 pcf	
Pan Number	TR5/MC#1	TR5/MC#2	TR5/MC#3	
Weight of Pan	207.63 g	209.83 g	204.11 g	
Wt of Wet Soil + Pan	412.07 g	239.36 g	233.14 g	
Wt of Dry Soil + Pan	340.30 g	227.59 g	220.58 g	
Wt of Water	71.77 g	11.77 g	12.56 g	
Wt of Dry Soil	132.67 *g*	17.76 *g*	16.47 *g*	
Moisture Content, ASTM	54.10 %	66.27 %	76.26 %	
Dry Density	44.8 pcf	44.7 pcf	44.3 pcf	



COMPACTION TEST

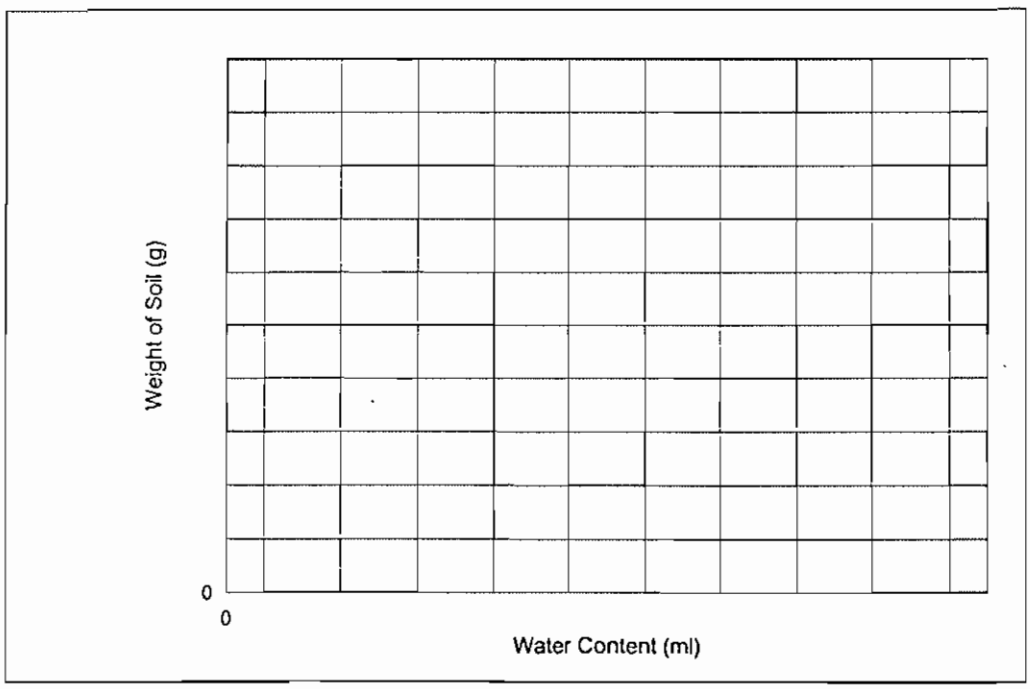
REPORT FORM

PROJECT:	PLYMOUTH SLUDGE	SAMPLE DESCRIPTION:	ASH TREATED
PROJECT NO.:	2862	TESTED BY:	MC
TESTING DATE:	1 JULY 1998	TRACKING CODE:	7849_CM

Type of Proctor: ASTM D 698 Modified

Weight of Mold (g): 2046.5 Mold Volume Factor (1/volume) 30.03

SAMPLE DESCRIPTION	RUN #12 TREATED	RUN #6 TREATED	JW1- #2 TREATED	DRY VAC TREATED
Wt of Soil + Mold	3236.70 g	3281.60 g	3077.80 g	3059.50 g
Wet Density	78.8 pcf	81.8 pcf	68.3 pcf	67.1 pcf
Pan Number	Run #12	#6	JW1-#2	Dry Vac
Weight of Pan	0.00 g	157.81 g	0.00 g	0.00 g
Wt of Wet Soil + Pan	786.30 g	314.74 g	649.88 g	685.90 g
Wt of Dry Soil + Pan	387.67 g	254.50 g	414.20 g	437.20 g
Wt of Water	398.63 g	60.24 g	235.68 g	248.70 g
Wt of Dry Soil	387.67 *g*	96.69 *g*	414.20 *g*	437.20 *g*
Moisture Content, ASTM	102.83 %	62.30 %	56.90 %	56.88 %
Dry Density	38.8 pcf	50.4 pcf	43.5 pcf	42.7 pcf



SOLID SPECIFIC GRAVITY

ASTM D 854
DATA SHEET

PROJECT:	PLYMOUTH SLUDGE
PROJECT No.:	2862
TESTING DATE:	14 JULY 1998
TESTED BY:	DG
TRACKING CODE:	7847a_GS

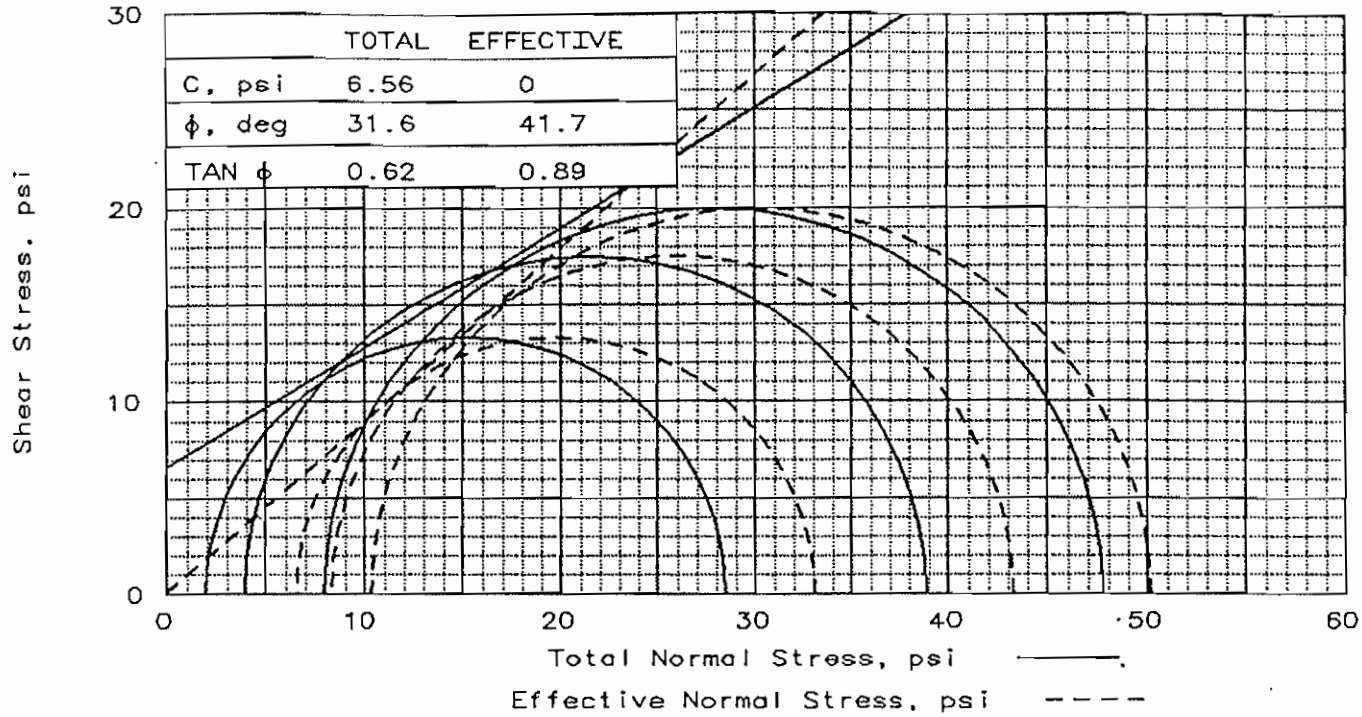
SOLID SPECIFIC GRAVITY			
1. SAMPLE NUMBER	Treated RUN6	Treated JW1 #2	Treated DRY VAC
2. FLASK NUMBER	1	3	2
3. TEMPERATURE	22.5 g	22.6 °C	22.4 °C
4. WT. FLASK & WATER	0.00 g	0.00 g	0.00 g
5. WT. WATER, FLASK & SOIL	28.15 g	26.18 g	27.3 g
6. WT OF SOIL	28.15 g	26.18 g	27.25 g
7. CALIBRATION WATER & FLASK	353.6698 g	352.7663 g	353.28 g
8. DEAIRED SAMPLE	369.71 g	367.15 g	368.22 g
9. SPECIFIC GRAVITY	2.32	2.22	2.21
10. CORRECTION FACTOR K	0.9995	0.9995	0.9995
11. Gs @ 20 °C	2.32	2.22	2.21

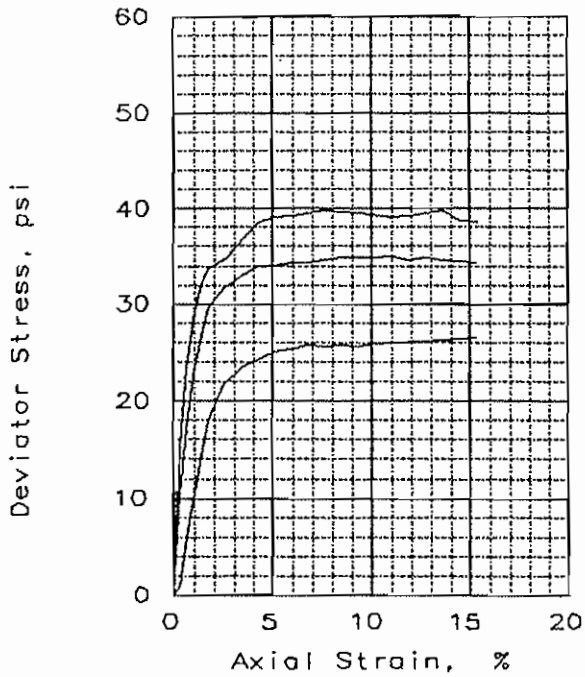
SOLID SPECIFIC GRAVITY

ASTM D 854
DATA SHEET

PROJECT:	PLYMOUTH SLUDGE
PROJECT No.:	2862
TESTING DATE:	14 JULY 1998
TESTED BY:	DG
TRACKING CODE:	7848_GS2

SOLID SPECIFIC GRAVITY			
1. SAMPLE NUMBER	Treated RUN 5	Treated RUN 12	
2. FLASK NUMBER	3	1	
3. TEMPERATURE	21.5 g	21.9 °C	· °C
4. WT. FLASK & WATER	0.00 g	0.00 g	· g
5. WT. WATER, FLASK & SOIL	29.92 g	26.08 g	g
6. WT OF SOIL	29.92 g	26.08 g	g
7. CALIBRATION WATER & FLASK	352.8242 g	353.7007 g	g
8. DEAIRED SAMPLE	369.67 g	368.65 g	g
9. SPECIFIC GRAVITY	2.29	2.34	
10. CORRECTION FACTOR K	0.9997	0.9996	
11. Gs @ 20 °C	2.29	2.34	





SAMPLE NO.:		1	2	3
INITIAL	WATER CONTENT, %	53.9	54.3	54.5
	DRY DENSITY, pcf	45.9	45.9	45.8
	SATURATION, %	58.4	58.7	58.8
	VOID RATIO	2.116	2.117	2.124
	DIAMETER, in	2.87	2.87	2.87
	HEIGHT, in	5.89	5.88	5.88
AT TEST	WATER CONTENT, %	91.7	91.4	91.3
	DRY DENSITY, pcf	46.1	46.2	46.2
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	2.100	2.093	2.092
	DIAMETER, in	2.87	2.86	2.86
	HEIGHT, in	5.88	5.87	5.86
Strain rate, %/min		0.10	0.10	0.10
EFF CELL PRESSURE, psi		2.0	4.0	8.0
FAIL. STRESS, psi		26.5	35.0	39.8
TOTAL PORE PR., psi		51.6	47.2	69.6
STRAIN, %		15.3	11.1	7.7
ULT. STRESS, psi		26.5	34.3	38.6
TOTAL PORE PR., psi		51.6	46.9	68.8
STRAIN, %		15.3	15.3	15.4
$\bar{\sigma}_1$ FAILURE, psi		33.1	43.4	50.2
$\bar{\sigma}_3$ FAILURE, psi		6.6	8.4	10.4

TYPE OF TEST:
CU with Pore Pressures
SAMPLE TYPE: Remolded
DESCRIPTION:

SPECIFIC GRAVITY= 2.29
REMARKS:

CLIENT: Weyerhaeuser Company

PROJECT: Plymouth Sludge Dewatering

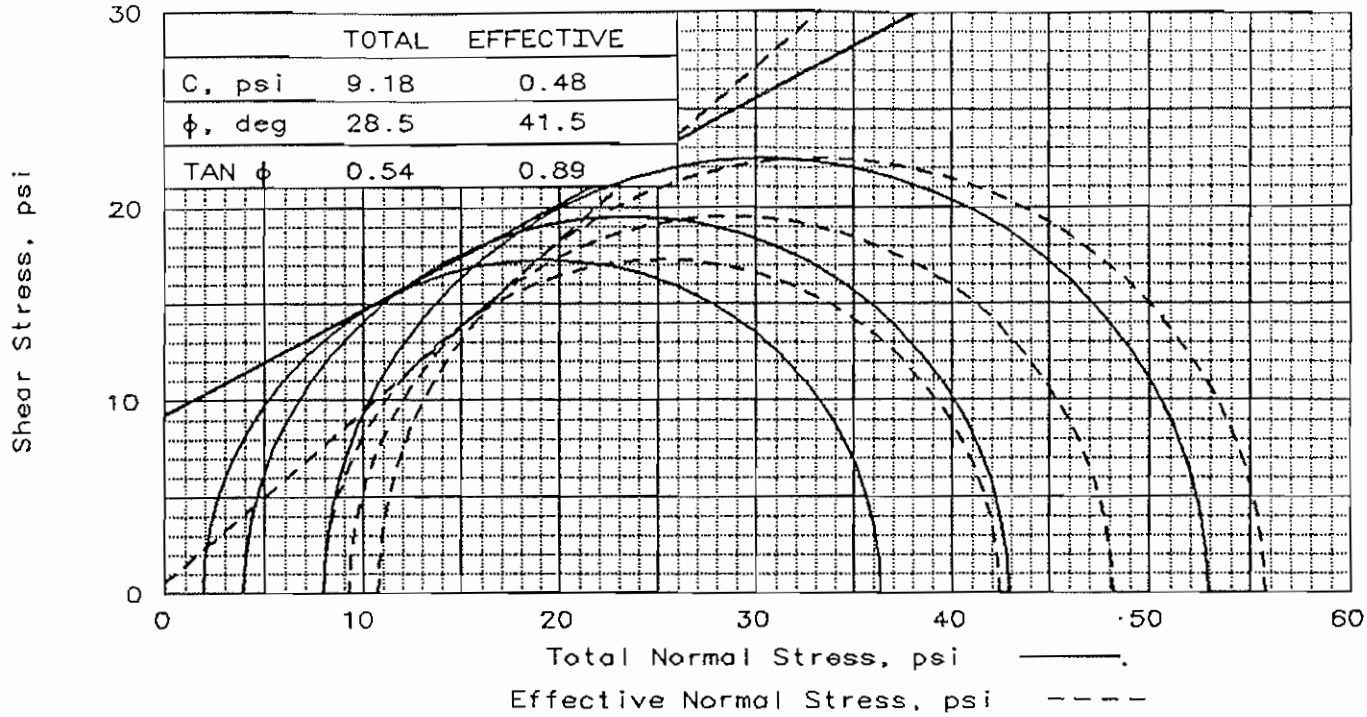
SAMPLE LOCATION: Run 5 Treated

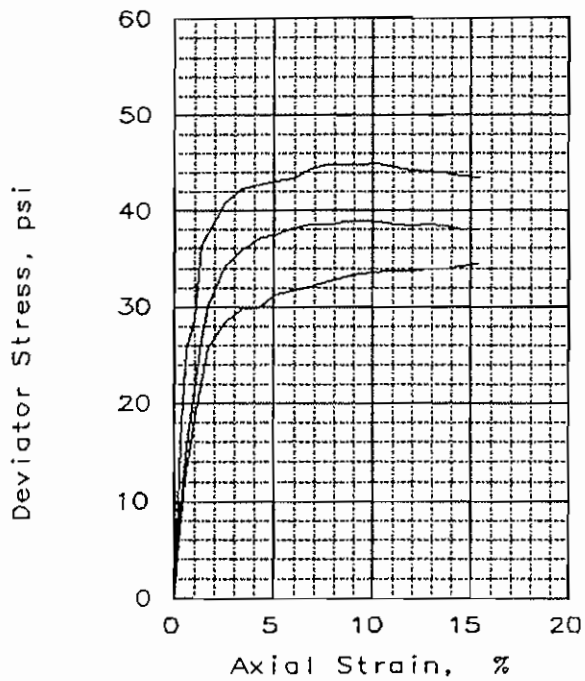
PROJ. NO.: 2862 DATE: 2 July 1998

TRIAXIAL SHEAR TEST REPORT

KIBER ENVIRONMENTAL SERVICES, INC.

Fig. No.: _____





SAMPLE NO.:		1	2	3
INITIAL	WATER CONTENT, %	66.3	66.3	66.6
	DRY DENSITY, pcf	47.9	44.6	44.5
	SATURATION, %	76.6	68.8	68.9
	VOID RATIO	1.983	2.206	2.211
	DIAMETER, in	2.86	2.87	2.86
	HEIGHT, in	5.86	5.85	5.89
AT TEST	WATER CONTENT, %	85.3	94.0	93.4
	DRY DENSITY, pcf	48.4	45.4	45.6
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	1.953	2.152	2.138
	DIAMETER, in	2.85	2.85	2.84
	HEIGHT, in	5.84	5.82	5.85
Strain rate, %/min		0.10	0.10	0.10
EFF CELL PRESSURE, psi		2.0	4.0	8.0
FAIL. STRESS, psi		34.5	38.9	45.0
TOTAL PORE PR., psi		52.5	54.8	58.2
STRAIN, %		15.4	9.5	10.3
ULT. STRESS, psi		34.5	38.0	43.5
TOTAL PORE PR., psi		52.5	54.2	57.9
STRAIN, %		15.4	14.6	15.4
$\bar{\sigma}_1$ FAILURE, psi		42.5	48.2	55.8
$\bar{\sigma}_3$ FAILURE, psi		8.0	9.3	10.8

TYPE OF TEST:
CU with Pore Pressures
SAMPLE TYPE: Remolded
DESCRIPTION:

SPECIFIC GRAVITY= 2.29
REMARKS:

CLIENT: Weyerhaeuser Company

PROJECT: Plymouth Sludge Dewatering

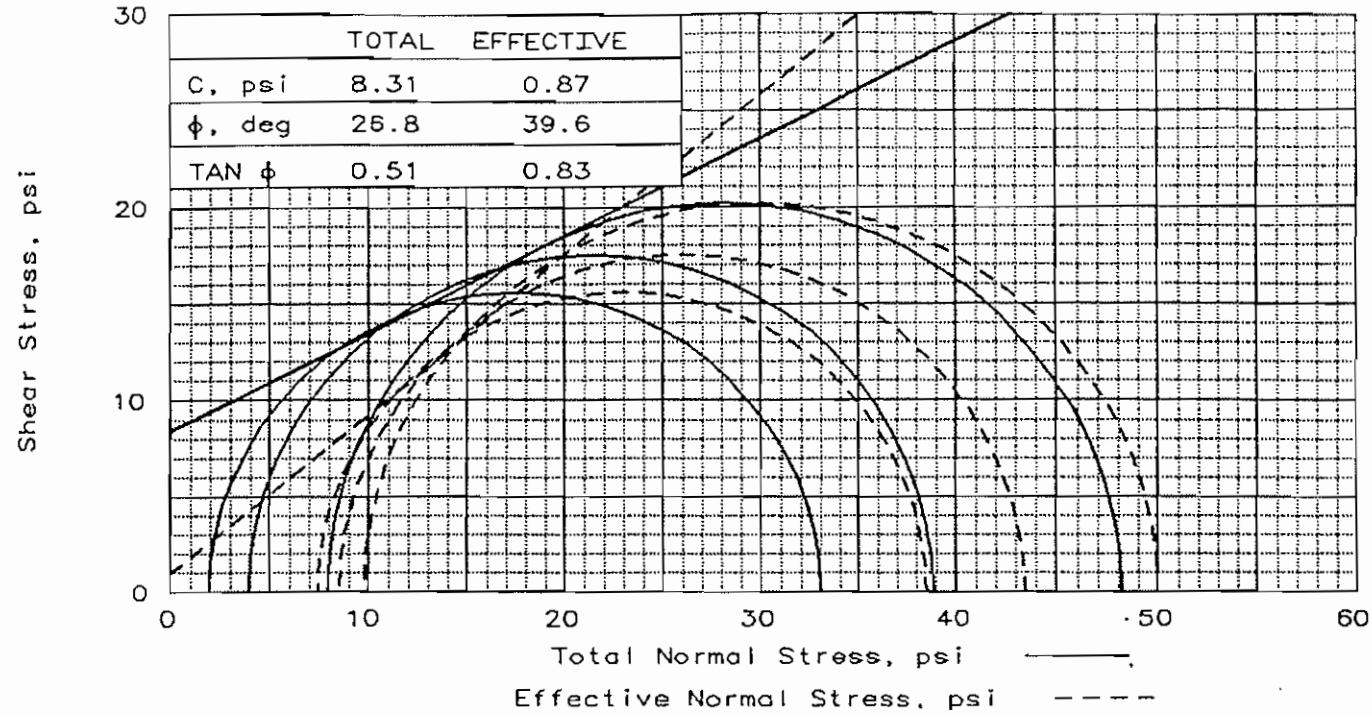
SAMPLE LOCATION: Run5Treated/Adjusted MC
Moisture Point #2

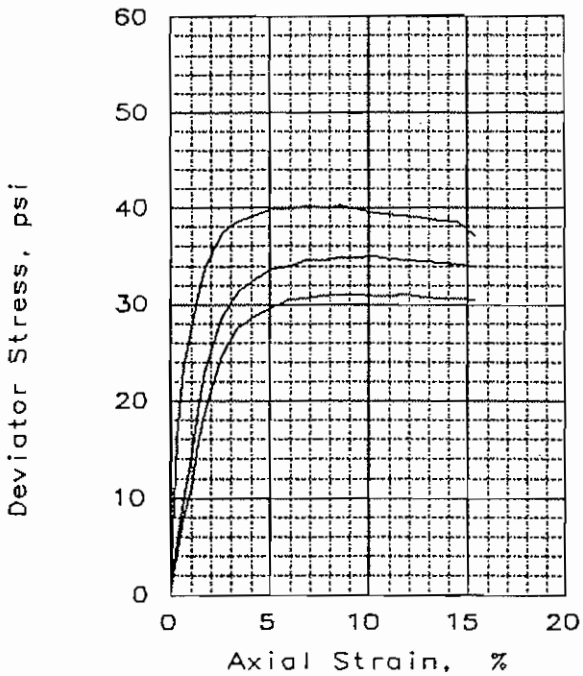
PROJ. NO.: 2682 DATE: July 26,1998

TRIAXIAL SHEAR TEST REPORT

KIBER ENVIRONMENTAL SERVICES, INC.

Fig. No.: _____





SAMPLE NO.:		1	2	3
INITIAL	WATER CONTENT, %	75.0	75.0	75.3
	DRY DENSITY, pcf	45.1	45.4	45.1
	SATURATION, %	79.1	80.1	79.4
	VOID RATIO	2.172	2.146	2.171
	DIAMETER, in	2.87	2.87	2.87
	HEIGHT, in	5.88	5.87	5.89
AT TEST	WATER CONTENT, %	93.2	91.3	92.0
	DRY DENSITY, pcf	45.6	46.3	46.0
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	2.133	2.090	2.106
	DIAMETER, in	2.86	2.85	2.85
	HEIGHT, in	5.86	5.84	5.85
Strain rate, %/min		0.10	0.10	0.10
EFF CELL PRESSURE, psi		2.0	4.0	8.0
FAIL. STRESS, psi		31.1	34.9	40.3
TOTAL PORE PR., psi		49.5	50.4	57.2
STRAIN, %		8.5	10.3	8.5
ULT. STRESS, psi		30.5	34.2	37.1
TOTAL PORE PR., psi		48.7	50.1	54.0
STRAIN, %		15.4	14.6	15.4
$\bar{\sigma}_1$ FAILURE, psi		38.6	43.5	50.1
$\bar{\sigma}_3$ FAILURE, psi		7.5	8.6	9.8

TYPE OF TEST:
CU with Pore Pressures
SAMPLE TYPE: Remolded
DESCRIPTION:

SPECIFIC GRAVITY= 2.29
REMARKS:

CLIENT: Weyerhaeuser Company

PROJECT: Plymouth Sludge Dewatering

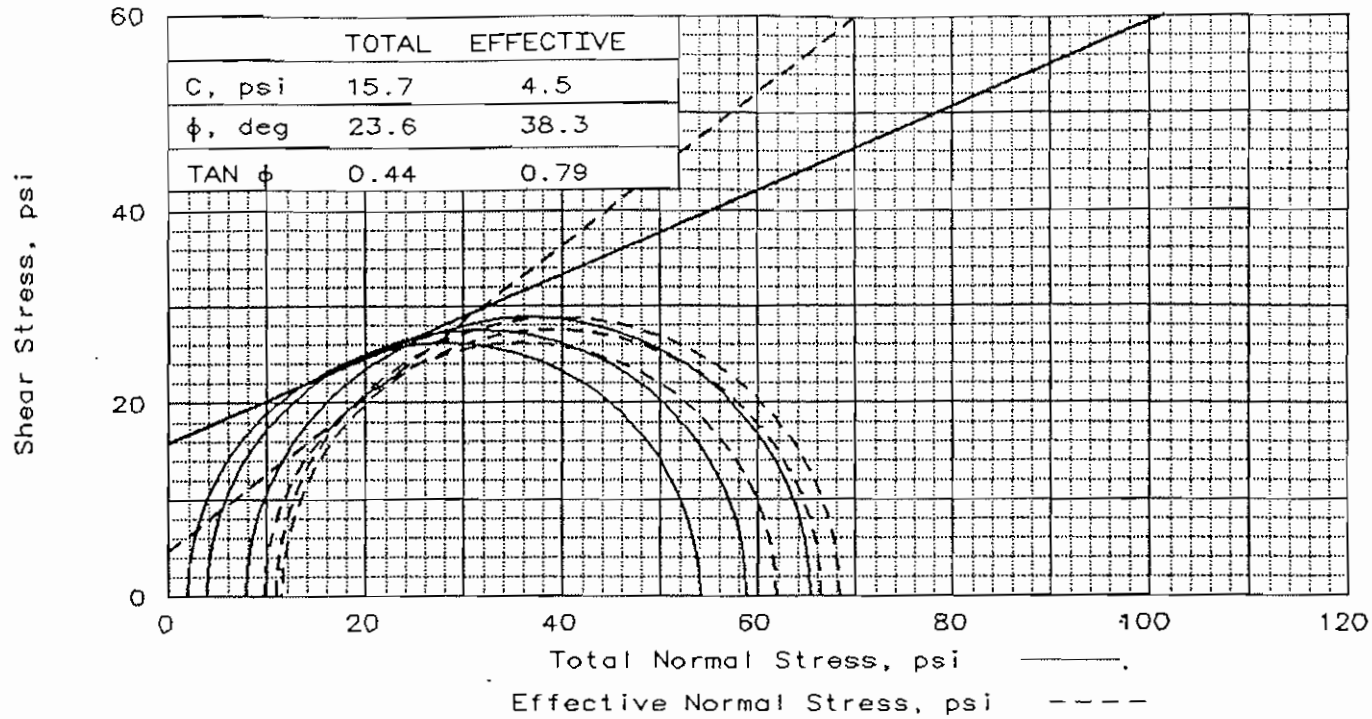
SAMPLE LOCATION: Run5 Treated/Adjusted Moisture Point #3

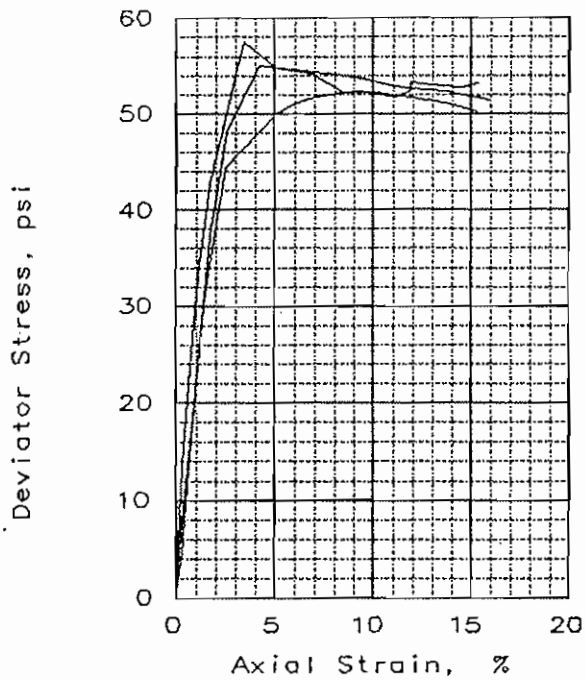
PROJ. NO.: 2682 DATE: July 31,1998

TRIAXIAL SHEAR TEST REPORT

KIBER ENVIRONMENTAL SERVICES, INC.

Fig. No.: _____





SAMPLE NO.:		1	2	3
INITIAL	WATER CONTENT, %	62.6	62.0	61.9
	DRY DENSITY, pcf	49.8	50.1	50.2
	SATURATION, %	76.0	76.0	76.3
	VOID RATIO	1.909	1.893	1.882
	DIAMETER, in	2.87	2.87	2.87
	HEIGHT, in	5.88	5.87	5.85
AT TEST	WATER CONTENT, %	81.8	80.8	79.6
	DRY DENSITY, pcf	50.0	50.4	50.9
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	1.897	1.875	1.847
	DIAMETER, in	2.87	2.86	2.86
	HEIGHT, in	5.87	5.86	5.83
Strain rate, %/min		2.00	0.10	0.10
EFF CELL PRESSURE, psi		2.0	4.0	8.0
FAIL. STRESS, psi		52.2	55.0	57.5
TOTAL PORE PR., psi		57.2	47.4	32.0
STRAIN, %		10.2	4.3	3.4
ULT. STRESS, psi		50.3	53.2	51.5
TOTAL PORE PR., psi		56.6	44.5	28.6
STRAIN, %		15.3	15.4	16.0
$\bar{\sigma}_1$ FAILURE, psi		62.0	66.6	68.5
$\bar{\sigma}_3$ FAILURE, psi		9.8	11.6	11.0

TYPE OF TEST:
CU with Pore Pressures
SAMPLE TYPE: Remolded
DESCRIPTION:

SPECIFIC GRAVITY= 2.32
REMARKS: Testing performed on reprocessed material

CLIENT: Weyerhauser Company

PROJECT: Plymouth Sludge Dewatering

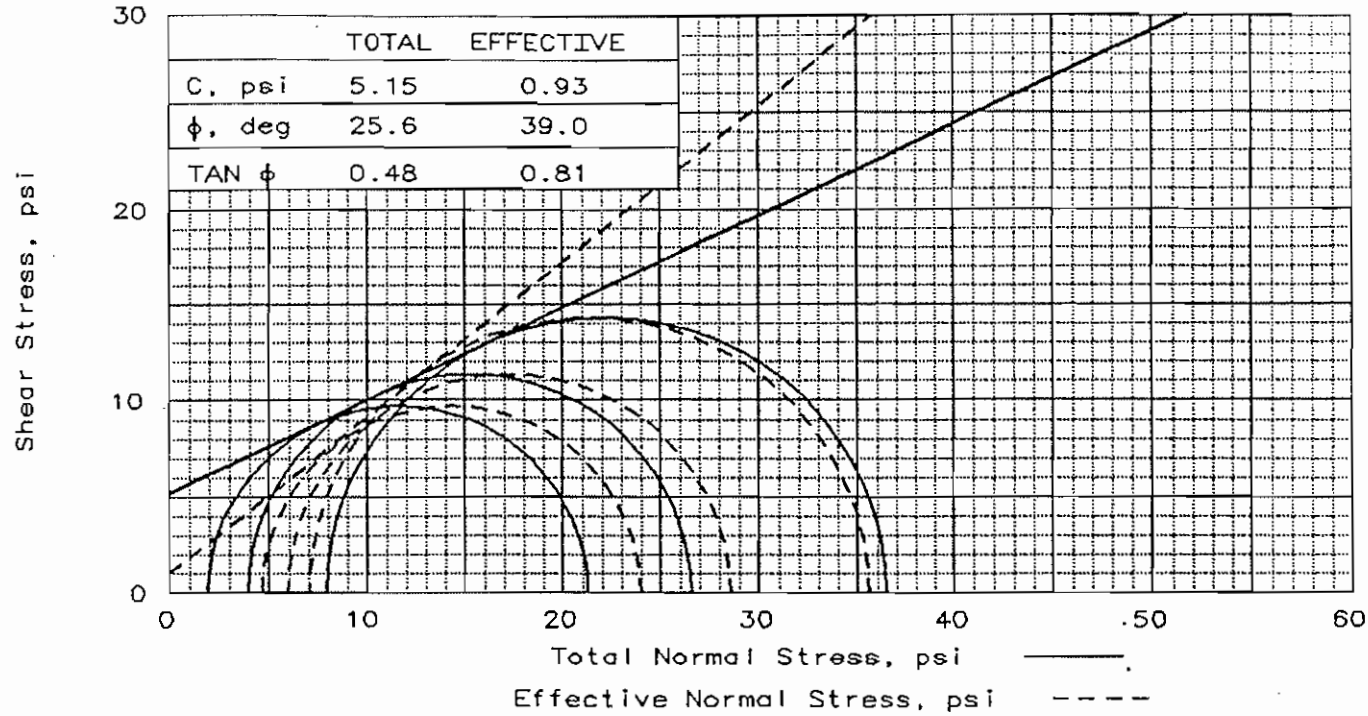
SAMPLE LOCATION: Run 6 Treated

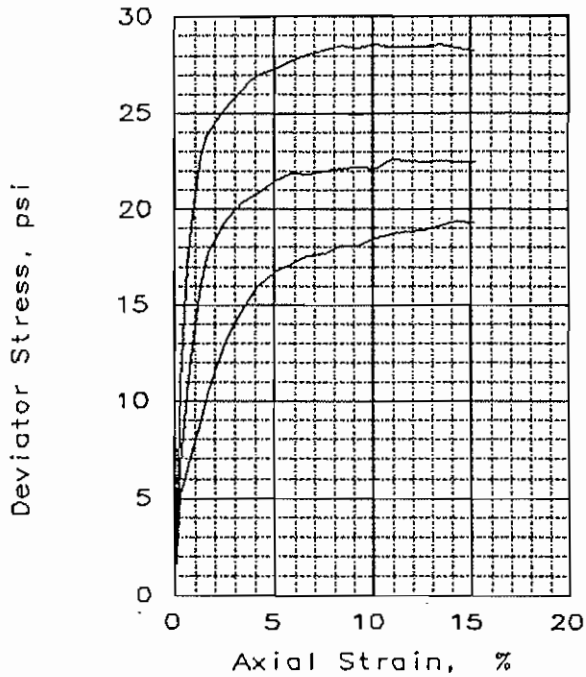
PROJ. NO.: 2862 DATE: 16 July 1998

TRIAXIAL SHEAR TEST REPORT

KIBER ENVIRONMENTAL SERVICES, INC.

Fig. No.: _____





SAMPLE NO.:		1	2	3
INITIAL	WATER CONTENT, %	56.2	55.9	55.9
	DRY DENSITY, pcf	43.5	43.5	43.6
	SATURATION, %	57.2	57.0	57.0
	VOID RATIO	2.174	2.169	2.167
	DIAMETER, in	2.87	2.87	2.87
	HEIGHT, in	5.95	5.95	5.95
AT TEST	WATER CONTENT, %	96.8	94.9	96.6
	DRY DENSITY, pcf	44.0	44.5	44.0
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	2.139	2.097	2.135
	DIAMETER, in	2.86	2.85	2.86
	HEIGHT, in	5.93	5.91	5.93
Strain rate, %/min		0.10	0.10	0.10
EFF CELL PRESSURE, psi		2.0	4.0	8.0
FAIL. STRESS, psi		19.3	22.6	28.5
TOTAL PORE PR., psi		57.3	53.0	52.9
STRAIN, %		14.3	11.0	13.5
ULT. STRESS, psi		19.3	22.5	28.2
TOTAL PORE PR., psi		57.2	52.8	52.8
STRAIN, %		15.2	15.2	15.2
$\bar{\sigma}_1$ FAILURE, psi		24.0	28.6	35.6
$\bar{\sigma}_3$ FAILURE, psi		4.7	6.0	7.1

TYPE OF TEST:
CU with Pore Pressures
SAMPLE TYPE: Remolded
DESCRIPTION:

SPECIFIC GRAVITY= 2.21
REMARKS:

CLIENT: Weyerhaeuser Company

PROJECT: Plymouth Sludge Dewatering

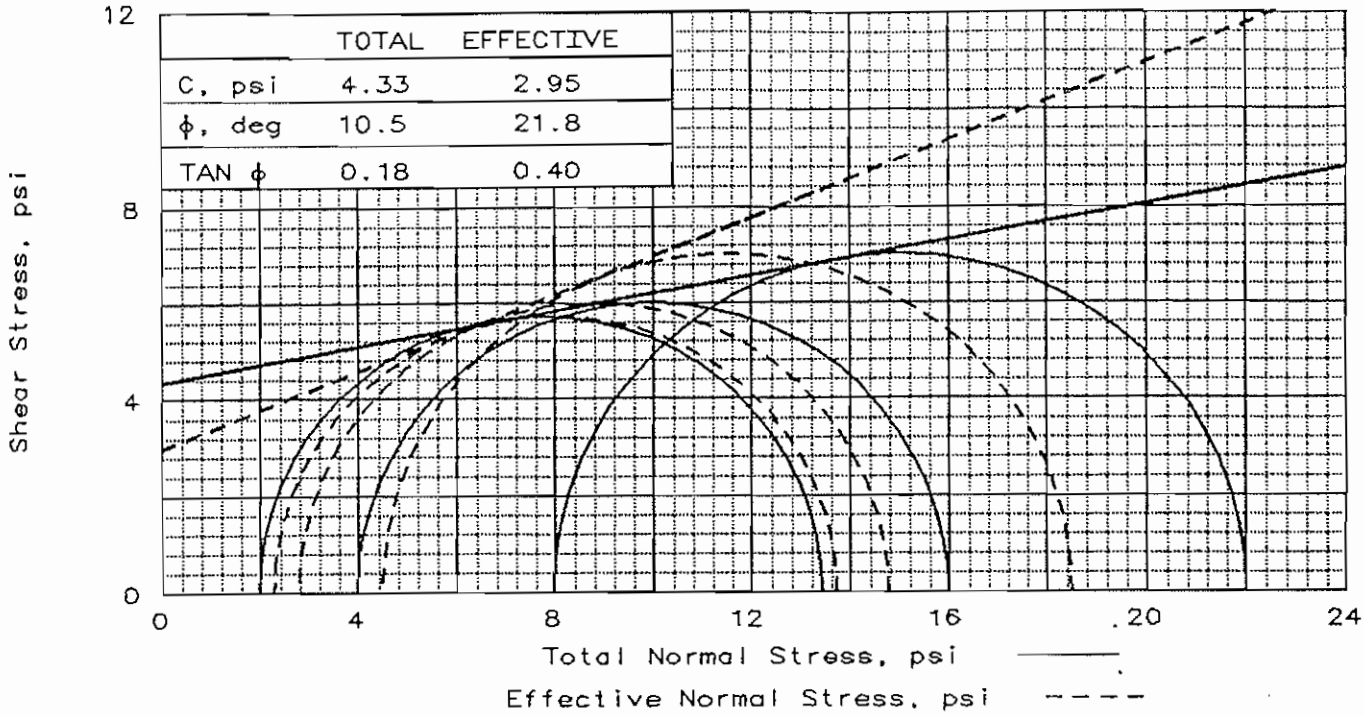
SAMPLE LOCATION: Dry Vac. Treated

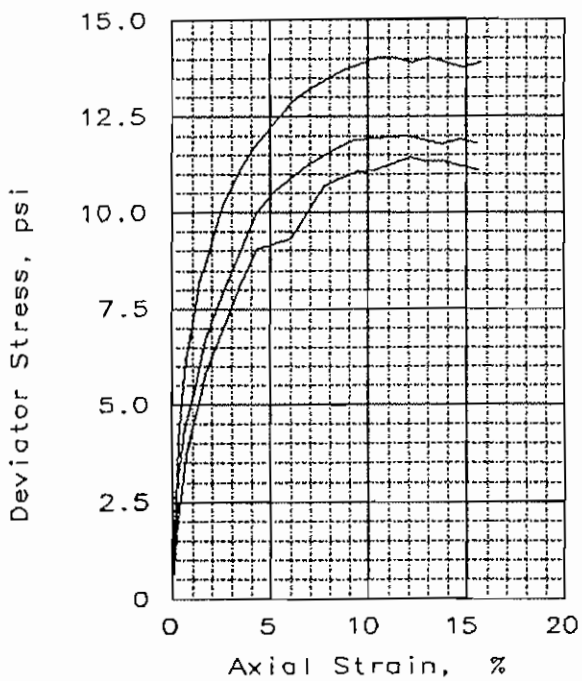
PROJ. NO.: 2862 DATE: 10 July

TRIAXIAL SHEAR TEST REPORT

KIBER ENVIRONMENTAL SERVICES, INC.

Fig. No.: _____





SAMPLE NO.:		1	2	3
INITIAL	WATER CONTENT, %	101.9	103.3	102.8
	DRY DENSITY, pcf	38.9	38.7	38.9
	SATURATION, %	86.5	87.1	87.3
	VOID RATIO	2.756	2.776	2.756
	DIAMETER, in	2.89	2.87	2.87
	HEIGHT, in	5.81	5.87	5.87
AT TEST	WATER CONTENT, %	114.4	112.6	105.5
	DRY DENSITY, pcf	39.7	40.2	42.1
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	2.677	2.634	2.469
	DIAMETER, in	2.87	2.83	2.79
	HEIGHT, in	5.77	5.80	5.72
Strain rate, %/min		0.10	0.10	0.10
EFF CELL PRESSURE, psi		2.0	4.0	8.0
FAIL. STRESS, psi		11.4	12.0	14.0
TOTAL PORE PR., psi		35.7	37.2	42.3
STRAIN, %		12.1	12.1	13.1
ULT. STRESS, psi		11.1	11.8	13.9
TOTAL PORE PR., psi		35.5	36.9	42.1
STRAIN, %		15.6	15.5	15.7
$\bar{\sigma}_1$ FAILURE, psi		13.7	14.8	18.5
$\bar{\sigma}_3$ FAILURE, psi		2.3	2.8	4.5

TYPE OF TEST:
CU with Pore Pressures
SAMPLE TYPE: Remolded
DESCRIPTION:

SPECIFIC GRAVITY= 2.34
REMARKS:

CLIENT: Weyerhaeuser Company

PROJECT: Plymouth Sludge

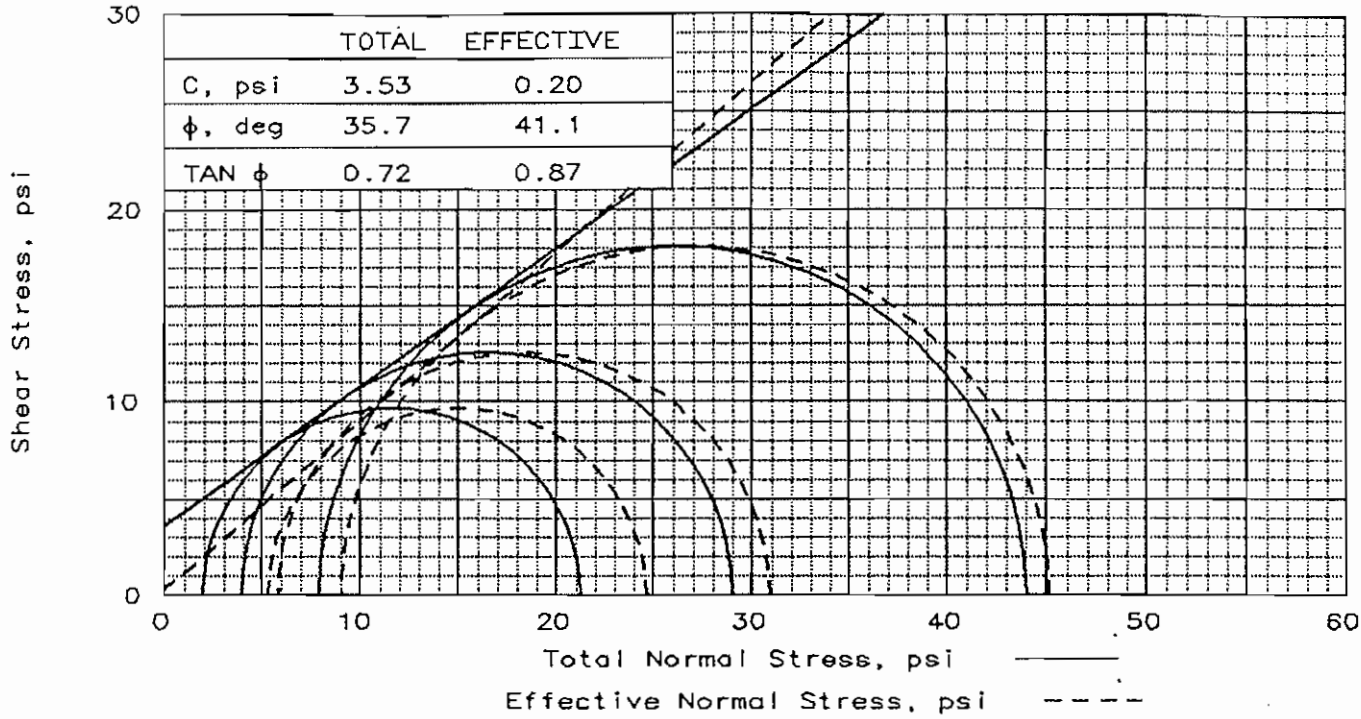
SAMPLE LOCATION: Run 12 Treated

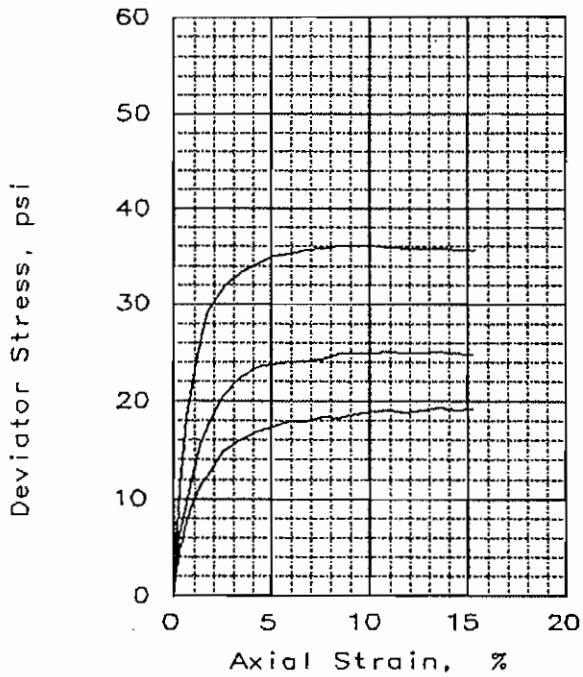
PROJ. NO.: 3862 DATE: 1 July 1998

TRIAXIAL SHEAR TEST REPORT

KIBER ENVIRONMENTAL SERVICES, INC.

Fig. No.: _____





SAMPLE NO.:		1	2	3
INITIAL	WATER CONTENT, %	54.9	56.0	54.9
	DRY DENSITY, pcf	43.7	43.3	43.7
	SATURATION, %	56.2	56.5	56.1
	VOID RATIO	2.169	2.200	2.173
	DIAMETER, in	2.87	2.87	2.87
	HEIGHT, in	5.90	5.91	5.90
AT TEST	WATER CONTENT, %	97.1	98.9	94.4
	DRY DENSITY, pcf	43.9	43.4	44.8
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	2.155	2.196	2.096
	DIAMETER, in	2.87	2.87	2.85
	HEIGHT, in	5.89	5.91	5.85
Strain rate, %/min		0.10	0.10	0.10
EFF CELL PRESSURE, psi		2.0	4.0	8.0
FAIL. STRESS, psi		19.3	25.1	36.1
TOTAL PORE PR., psi		45.6	43.1	48.9
STRAIN, %		13.6	11.0	10.3
ULT. STRESS, psi		19.2	24.8	35.6
TOTAL PORE PR., psi		45.5	42.6	48.5
STRAIN, %		15.3	15.2	15.4
$\bar{\sigma}_1$ FAILURE, psi		24.7	31.0	45.2
$\bar{\sigma}_3$ FAILURE, psi		5.4	5.9	9.1

TYPE OF TEST:
CU with Pore Pressures
SAMPLE TYPE: REMOLDED
DESCRIPTION:

SPECIFIC GRAVITY= 2.22
REMARKS:

CLIENT: Weyerhaeuser Company

PROJECT: PLYMOUTH SLUDGE DEWATERING

SAMPLE LOCATION: JW1-2 TREATED

PROJ. NO.: 2862 DATE: 10 JULY 1998

TRIAXIAL SHEAR TEST REPORT

KIBER ENVIRONMENTAL SERVICES, INC.

Fig. No.: _____

Appendix E
Slope Stability Analysis

Attachment E1	**Slope Stability Findings**
Attachment E2	**SLOPE/W Computer Modeling for Ash and Wastewater Solids – 12 Runs Total**
Attachment E3	**Interface Friction Analysis**

Attachment E1
Slope Stability Findings

Slope Stability Findings

A slope stability analysis of the proposed solid waste facility was conducted using SLOPE/W software developed by GEO-SLOPE International, Ltd. Bishop's method was selected for the slope stability analysis.

This analysis was based on the following assumptions and input parameters:

- The soil borings encountered *in situ* soils that are representative of the site conditions.
- The RMT slope stability analysis evaluated two sections of the proposed landfill: a west section and an east section, both based on geological cross section C-C′ (refer to Sheet No. 7). Cross section C-C′ encompasses the general stratigraphy of the site under the most critical loading condition of the proposed landfill. The west subsurface section is based on borings MW-6, MW-6A, SB-9, OW-3, and HA-9. The east subsurface section is based on borings OW-3, HA-9, OW-1, and MW-7.
- Laboratory shear strength results are representative of site conditions. Physical properties of the proposed waste materials and the *in situ* soils used in the analyses were derived from laboratory test data by Law Engineering, Kiber Environmental Services, Inc., and RMT's past experience with similar materials.
- Since Weyerhaeuser is currently using the Netzsch method for dewatering wastewater solids, the dewatered wastewater solids shear strength parameters used in this analysis were based on the Netzsch trial run No. 6 method of dewatering.
- The groundwater table used in the analyses was based on the April 2, 1993, water table surface. It is considered the high groundwater table and it exists approximately 4 feet below the natural ground surface, based on water level readings from site monitoring and observation wells.
- The bottom of the landfill was modeled to be at least 4 feet above groundwater table surface and follows the general topography of the site. The bottom of the landfill will range in elevation from 12 to 44 feet.
- The liner will consist of a GCL, and a 60-mil HDPE-textured geomembrane, overlying 1 foot of compacted subgrade soil.
- The cap will consist of 12 inches of select ash; a GCL; a 40-mil VFPE-textured geomembrane; a geocomposite drainage layer; 12 inches of general fill (vegetation support layer); and 6 inches of topsoil.
- The perimeter dikes will consist of compacted general fill.

- The waste in the center of the landfill will be approximately 182 feet thick. The landfill's southwest side will be constructed to a maximum height of 212 feet above the existing ground surface elevation at the southwest perimeter berm. The top 10 feet of the landfill will slope away from the center of the landfill at an average slope of approximately 6 percent. The exterior side slope of the landfill will be constructed with a 3 horizontal to 1 vertical side slope that benches inward 15 feet for every 20 feet of height. RMT's analysis was conducted using a 3 horizontal to 1 vertical side slope without the terraces. This was a more conservative approach than modeling the proposed construction geometry.
- Stability was evaluated for CU conditions (short-term condition immediately following construction) and CD conditions (long-term condition sometime after construction).
- The analyses were also conducted under seismic loading conditions for the drained case. A seismic coefficient of 0.07 gravity (g) was used in the analysis. It was selected from a seismic risk map of the United States.
- A piezometric surface was modeled after the groundwater table since the leachate collection system will be designed to allow for more than 1 foot of head above the liner on the bottom of the landfill.
- Landfill waste will predominately consist of ash with some 30-year-old, dewatered wastewater solids dredged from Weyerhaeuser's wastewater treatment ponds.

The input parameters used in the analyses are as follows:

MEASUREMENT	DENSE SP/SM	MEDIUM DENSE SP/SM	LOOSE SP/SM	LOOSE SM	FIRM CL/ML/SC	SOFT CL/ML/SC	ASH	DEWATERED WASTEWATER SOLIDS
C_{CU} (psf)	0	0	0	0	350	140	0	667
ϕ_{CU} (degrees)	35	30	25	25	28	15	28	21
C'_{CD} (psf)	0	0	0	0	350	140	0	167
ϕ'_{CD} (degrees)	35	30	25	25	28	15	41	41
Total Unit Weight (pcf)	140	130	115	125	130	130	70	70

Slope Stability Findings and Conclusions

For the conditions described above, the slope stability analyses resulted in the following minimum factors of safety:

SECTION	WASTE MATERIAL	FACTORS OF SAFETY		
		CU WITHOUT PORE PRESSURE MEASUREMENTS	CU WITH PORE PRESSURE MEASUREMENTS	CU WITH PORE PRESSURE MEASUREMENTS UNDER SEISMIC LOADING CONDITIONS
East C-C'	Ash	2.01	3.08	2.31
West C-C'	Ash	2.04	3.08	2.34

SECTION	WASTE MATERIAL	FACTORS OF SAFETY		
		CU WITHOUT PORE PRESSURE MEASUREMENTS	CU WITH PORE PRESSURE MEASUREMENTS	CU WITH PORE PRESSURE MEASUREMENTS UNDER SEISMIC LOADING CONDITIONS
East C-C'	Dewatered Wastewater Solids	2.20	3.15	2.35
West C-C'	Dewatered Wastewater Solids	2.27	3.13	2.39

These results met or exceeded RMT's recommended minimum Factor of Safety of 1.50. Soil property input parameters and SLOPE/W graphical results of the slope stability analysis are attached. Graphical results and soil properties of the slope stability analysis are attached.

Based on the slope stability analysis, the construction of the proposed facility described herein is feasible. Parameters used in the Slope Stability Analysis Model are valid for the proposed facility at the proposed site for the following reasons:

- Soil parameters were obtained by testing samples from the proposed site.
- Waste parameters were obtained by testing actual samples of ash from Weyerhaeuser's existing landfill and dewatered wastewater solids dredged from Weyerhaeuser's wastewater treatment ponds. No significant change in waste material or landfill operations is expected for the new landfill.
- The highest recorded groundwater readings from the actual site were used to account for a seasonally high fluctuation in groundwater.
- The proposed geometry was based on Weyerhaeuser's needs, but limited by regulatory constraints and the seasonal high groundwater level.

However, the slope stability analysis revealed that the potential for slope failure at this site increases under the following conditions:

- A rise in the groundwater table
- Steeper slopes
- Waste materials that are placed wetter or more loosely than those in the existing landfill or those that were tested
- Actual shear strength parameters significantly less than those used in the RMT analysis
- Subgrade or subsurface soils destabilized due to poor drainage or construction equipment traffic
- Any leachate generated that is not able to adequately drain
- Soil not compacted as recommended

Design feature and operating procedure described in this application have been developed to minimize the potential for slope failures. Recommendations to construct this facility are discussed below and in Section 4.

Slope Stability Recommendations

The following recommendations are based on the subsurface exploration data obtained, the laboratory test results, and RMT's past experience with similar projects:

- Immediately prior to construction of the liner, the subgrade soils should be observed by a qualified geotechnical engineer to confirm that the subgrades are suitable for construction of the landfill.
- Placement and compaction of all controlled fill soil used to construct the landfill and sediment basins should be monitored and tested by qualified geotechnical personnel to verify that the recommended compaction has been attained.
- Careful control of the equipment traffic and drainage should be exercised throughout construction (especially during rainy weather) to prevent destabilization of the subgrade soils.
- Soil used in construction of the perimeter dikes or grading of the site should be placed in 8-inch thick (loose) lifts and compacted to at least 95 percent of the Standard Proctor (ASTM D 698) maximum dry density at ±3 percent of the optimum moisture content.
- Dewater all dredged wastewater solids by plate and frame press immediately prior to placement in landfill.
- Place and compact the waste material in lifts no more than 3 feet thick. Waste material placed in the facility should be compacted by repeated passes of the bulldozer until firm.
- Keep all waste material well drained by sloping the surface of the waste material to allow for stormwater drainage.
- In the event dewatered wastewater solids are subjected to precipitation prior to placement, blend it with ash to improve its shear strength and compaction. The shear strength of a 60/40 dewatered wastewater solids to ash blend is significantly higher than for dewatered wastewater solids alone.
- Conduct additional testing and slope stability analyses if there is a change in the waste material placed or the quality of waste material placed in the landfill.
- Waste placement operations should be such that adequate drainage of any leachate generated should be maintained at all times. RMT recommends that no more than 1 foot of head be allowed to build up within the solid waste facility.

- The side slopes should not exceed 3 horizontal to 1 vertical and the maximum height of the landfill should not exceed 212 feet. The exterior side slope should bench inward 15 feet for every 20 feet rise in height.

The findings of the slope stability analyses were based on laboratory test results from samples that are assumed to be representative. During operations, actual average properties of the ash, dewatered wastewater solids, and fill material may vary. Therefore, RMT recommends that additional laboratory testing be conducted on samples obtained during operations if significant changes are made to the waste generation processes.

Attachment E2
SLOPE/W Computer Modeling for Ash and Wastewater Solids – 12 Runs Total

Weyerhaeuser Landfill No. 3/ East C-C'/ Ash
Consolidated Undrained/ 3H:1V sideslope w/ 15' benches
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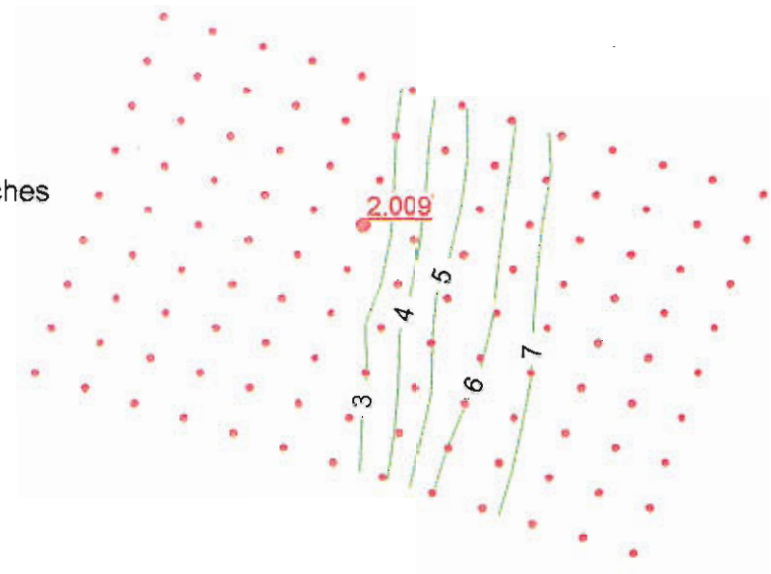

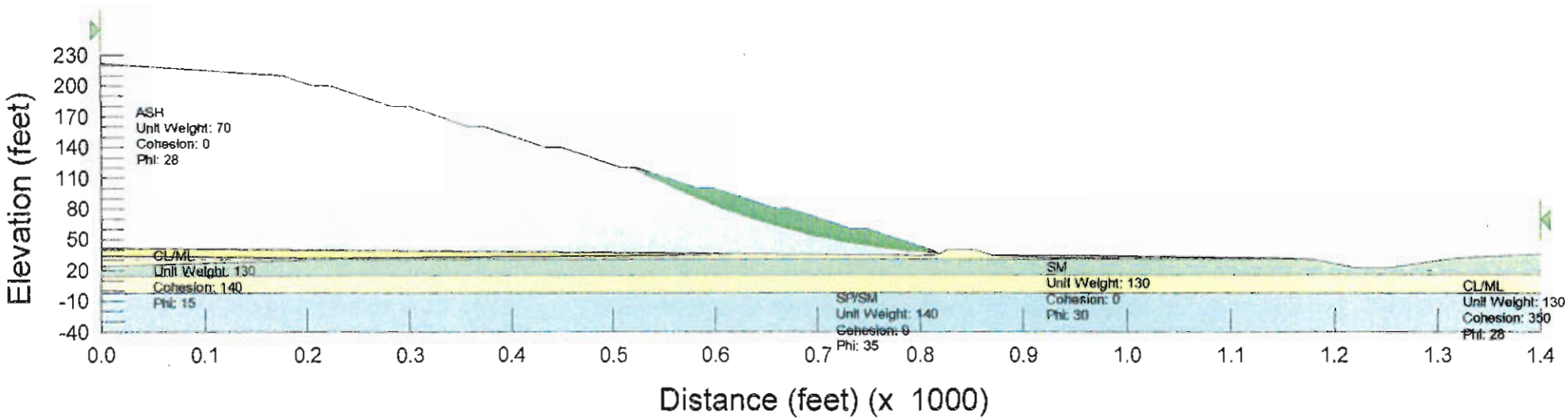

Weyerhaeuser Landfill No. 3/ East C-C'/ Ash
Consolidated Undrained/ 3H:1V sideslope w/ 15' benches
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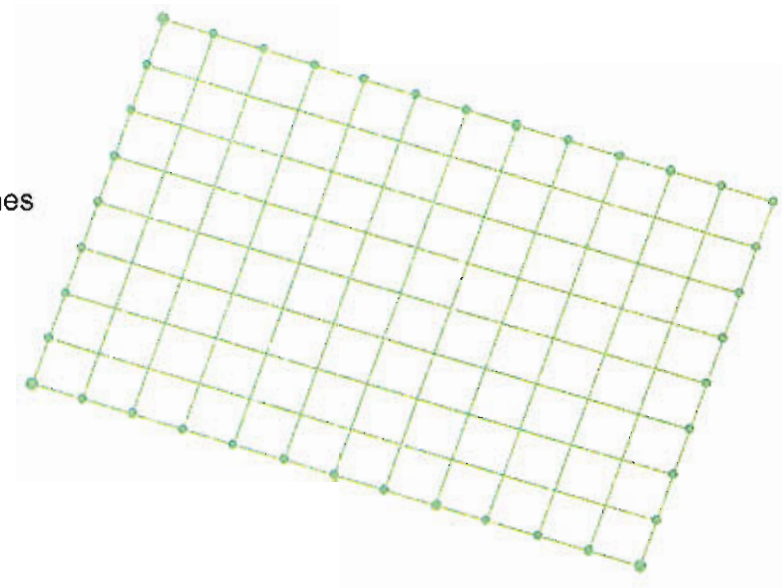

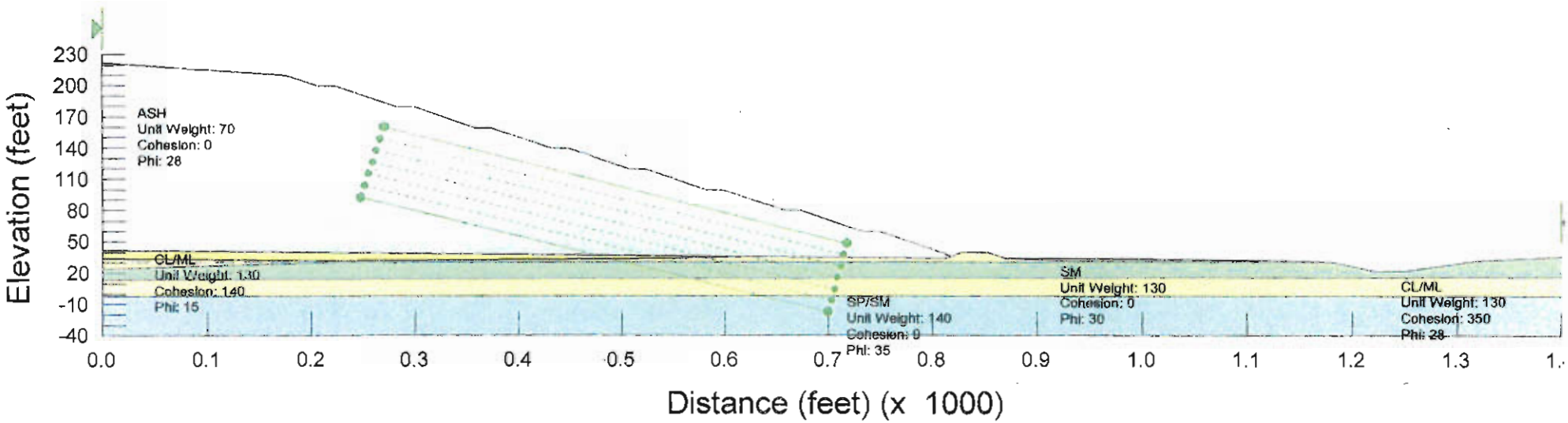

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Soil Model Mohr-Coulomb
Unit Weight 70
Cohesion 0
Phi 28
Piezometric Line # 1
Pore-Air Pressure 0

Soil 2
CL/ML
Soil Model Mohr-Coulomb
Unit Weight 130
Cohesion 140
Phi 15
Piezometric Line # 1
Pore-Air Pressure 0

Soil 3
CL/ML
Soil Model Mohr-Coulomb
Unit Weight 130
Cohesion 350
Phi 28
Piezometric Line # 1
Pore-Air Pressure 0

Soil 4
SM
Soil Model Mohr-Coulomb
Unit Weight 130
Cohesion 0
Phi 30
Piezometric Line # 1
Pore-Air Pressure 0

Soil 5
CL/ML
Soil Model Mohr-Coulomb
Unit Weight 130
Cohesion 350

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Phi     28
Piezometric Line #      1
Pore-Air Pressure       0

Soil 6
SP/SM
Soil Model      Mohr-Coulomb
Unit Weight     140
Cohesion        0
Phi     35
Piezometric Line #      1
Pore-Air Pressure       0

Soil 7
Bedrock
Soil Model      Bedrock
Piezometric Line #      0
Pore-Air Pressure       0
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Weyerhaeuser Landfill No. 3/ East C-C'/ Ash
Consolidated Drained/ 3H:1V sideslope w/ 15' benches
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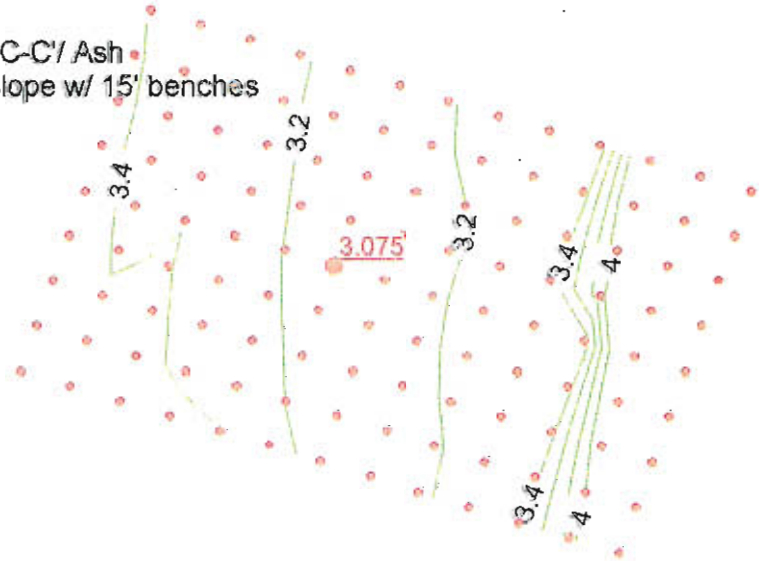

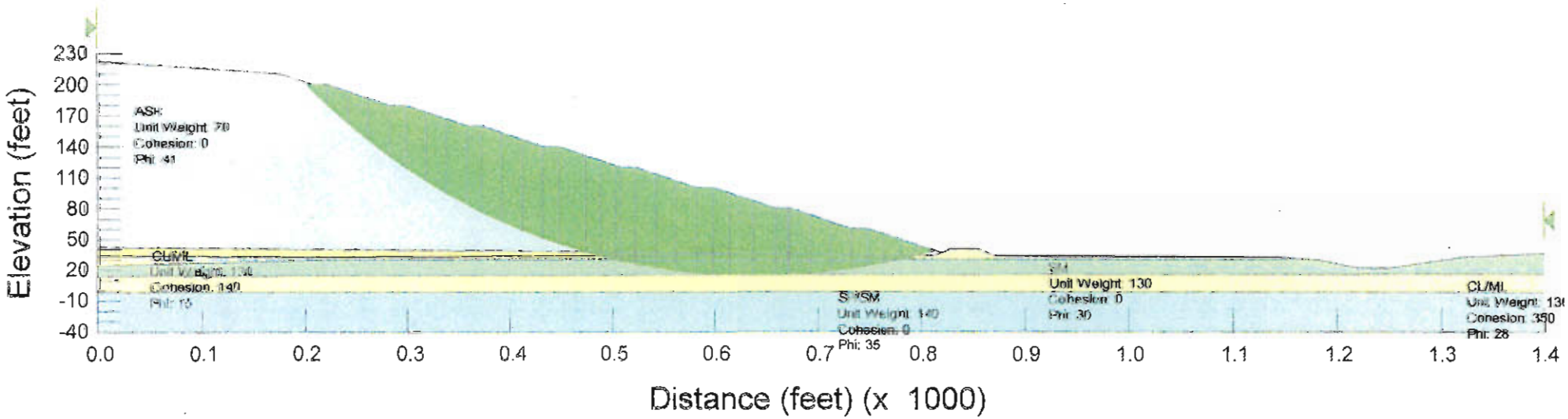

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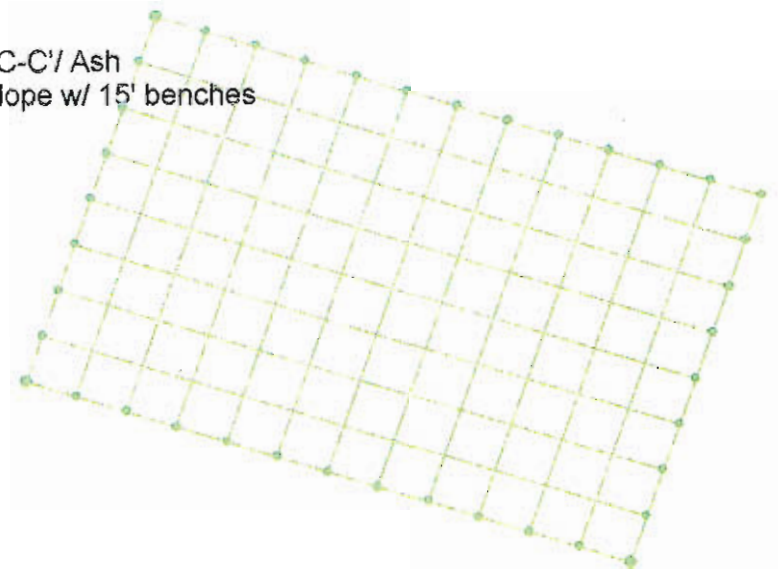

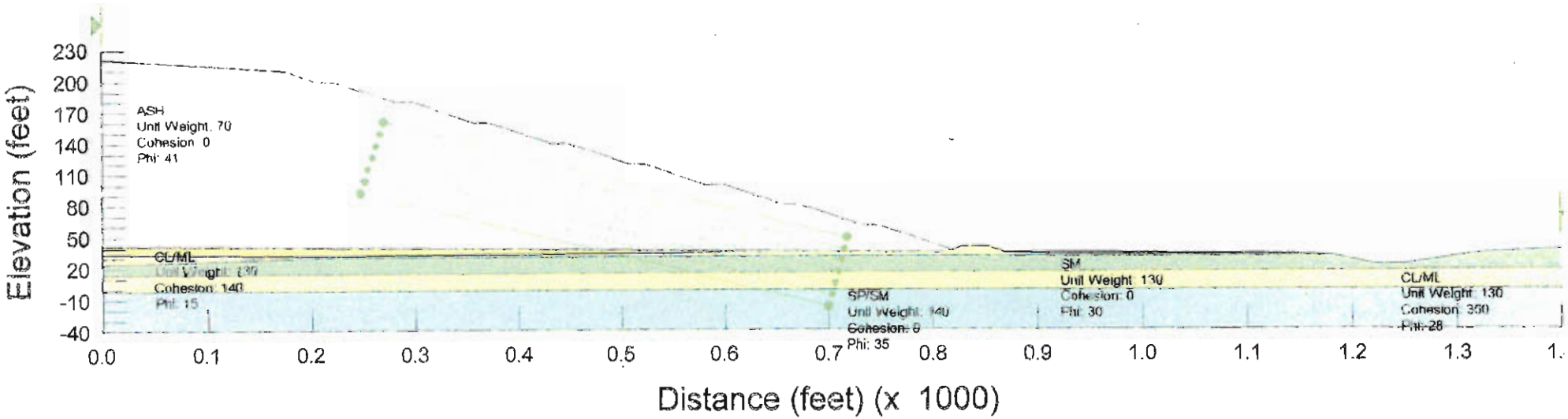

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Phi     41
Piezometric Line #      1
Pore-Air Pressure       0

Soil 2
CL/ML
Soil Model      Mohr-Coulomb
Unit Weight     130
Cohesion        140
Phi     15
Piezometric Line #      1
Pore-Air Pressure       0

Soil 3
CL/ML
Soil Model      Mohr-Coulomb
Unit Weight     130
Cohesion        350
Phi     28
Piezometric Line #      1
Pore-Air Pressure       0

Soil 4
SM
Soil Model      Mohr-Coulomb
Unit Weight     130
Cohesion        0
Phi     30
Piezometric Line #      1
Pore-Air Pressure       0

Soil 5
CL/ML
Soil Model      Mohr-Coulomb
Unit Weight     130
Cohesion        350
```

```
Phi     28
Piezometric Line #      1
Pore-Air Pressure       0

Soil 6
SP/SM
Soil Model      Mohr-Coulomb
Unit Weight     140
Cohesion        0
Phi     35
Piezometric Line #      1
Pore-Air Pressure       0

Soil 7
Bedrock
Soil Model      Bedrock
Piezometric Line #      0
Pore-Air Pressure       0
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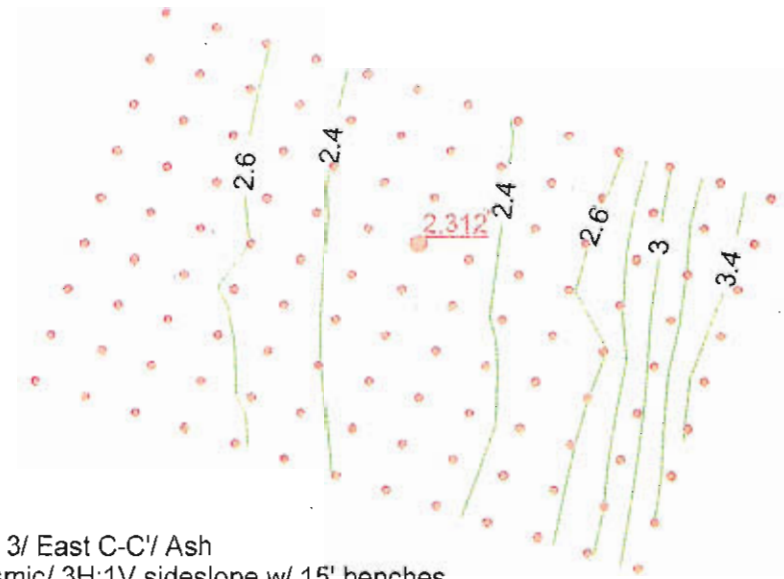

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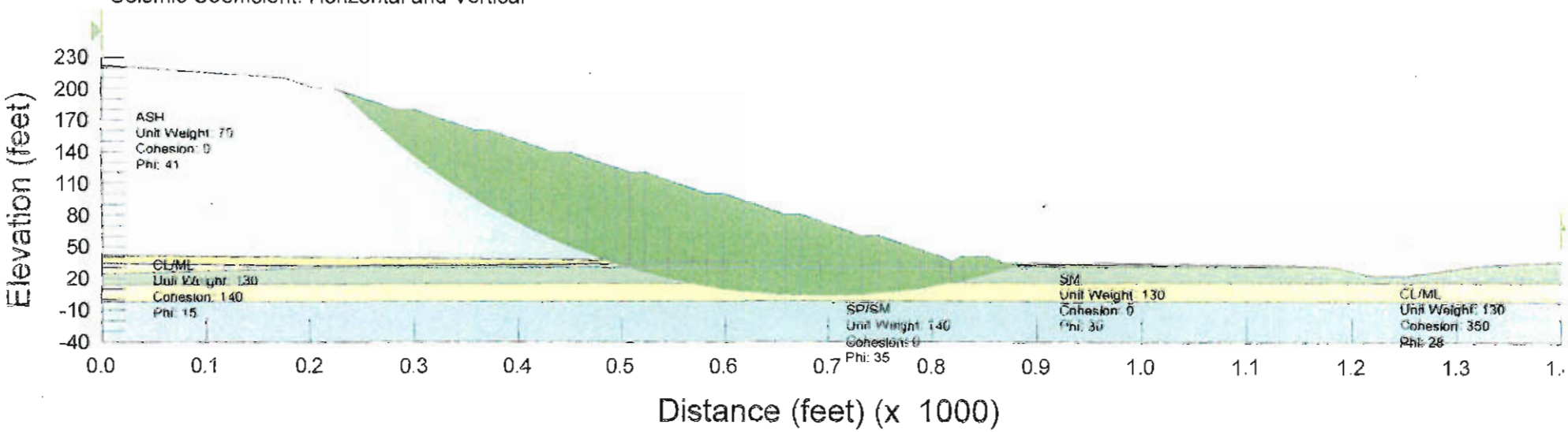

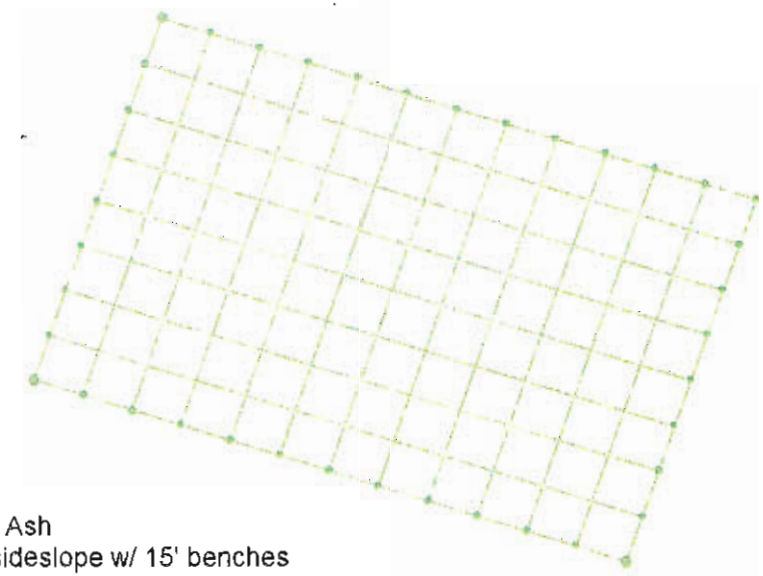

Weyerhaeuser Landfill No. 3/ East C-C'/ Ash
Consolidated Drained--Seismic/ 3H:1V sideslope w/ 15' benches
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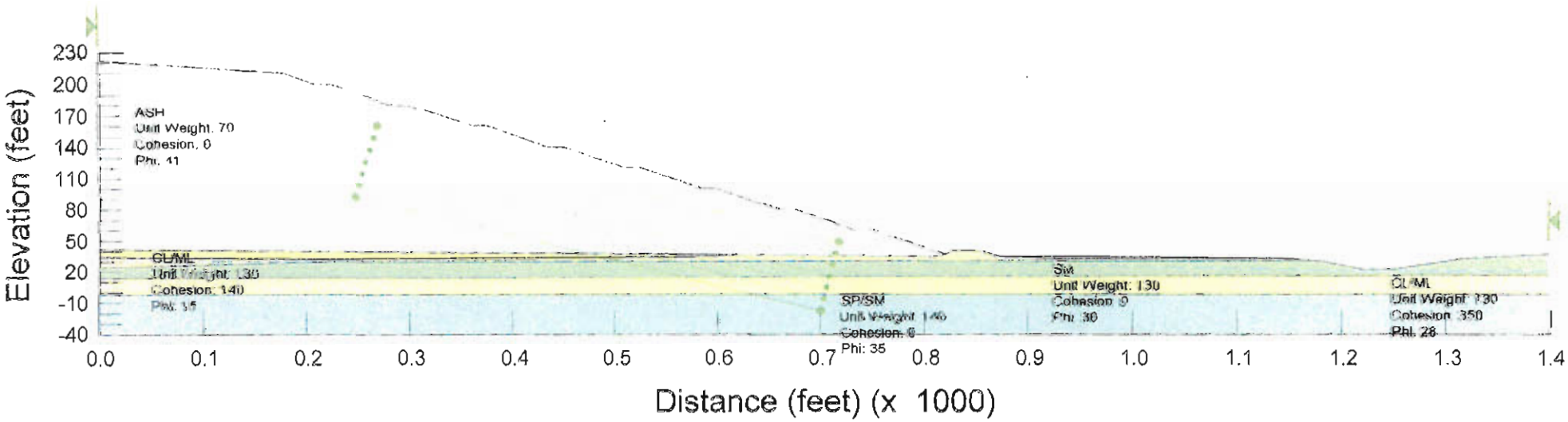

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All Soils
Soil 1
ASH
Soil Model      Mohr-Coulomb
Unit Weight     70
Cohesion        0
Phi     41
Piezometric Line #      1
Pore-Air Pressure       0

Soil 2
CL/ML
Soil Model      Mohr-Coulomb
Unit Weight     130
Cohesion        140
Phi     15
Piezometric Line #      1
Pore-Air Pressure       0

Soil 3
CL/ML
Soil Model      Mohr-Coulomb
Unit Weight     130
Cohesion        350
Phi     28
Piezometric Line #      1
Pore-Air Pressure       0

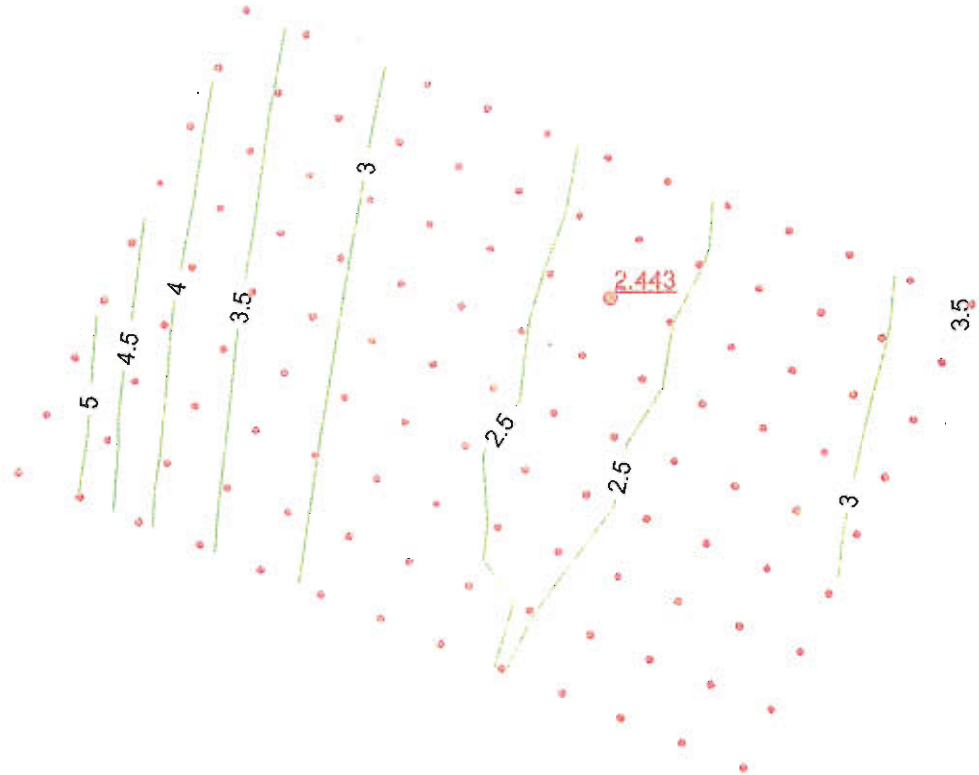
Soil 4
SM
Soil Model      Mohr-Coulomb
Unit Weight     130
Cohesion        0
Phi     30
Piezometric Line #      1
Pore-Air Pressure       0

Soil 5
CL/ML
Soil Model      Mohr-Coulomb
Unit Weight     130
Cohesion        350
```

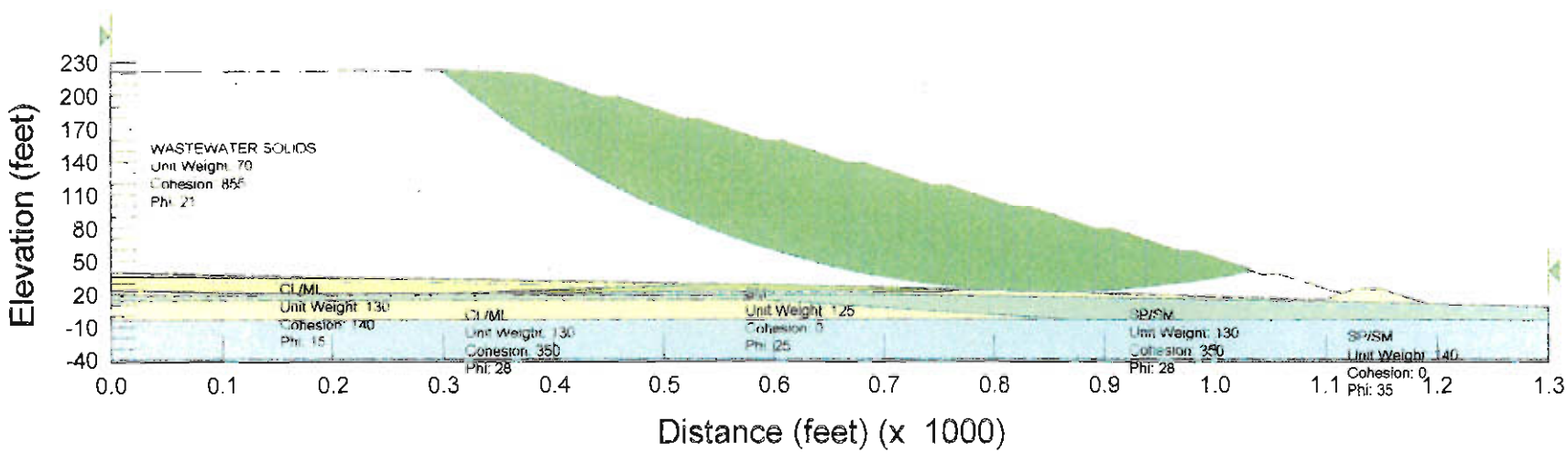
```
Phi      28
Piezometric Line #       1
Pore-Air Pressure        0

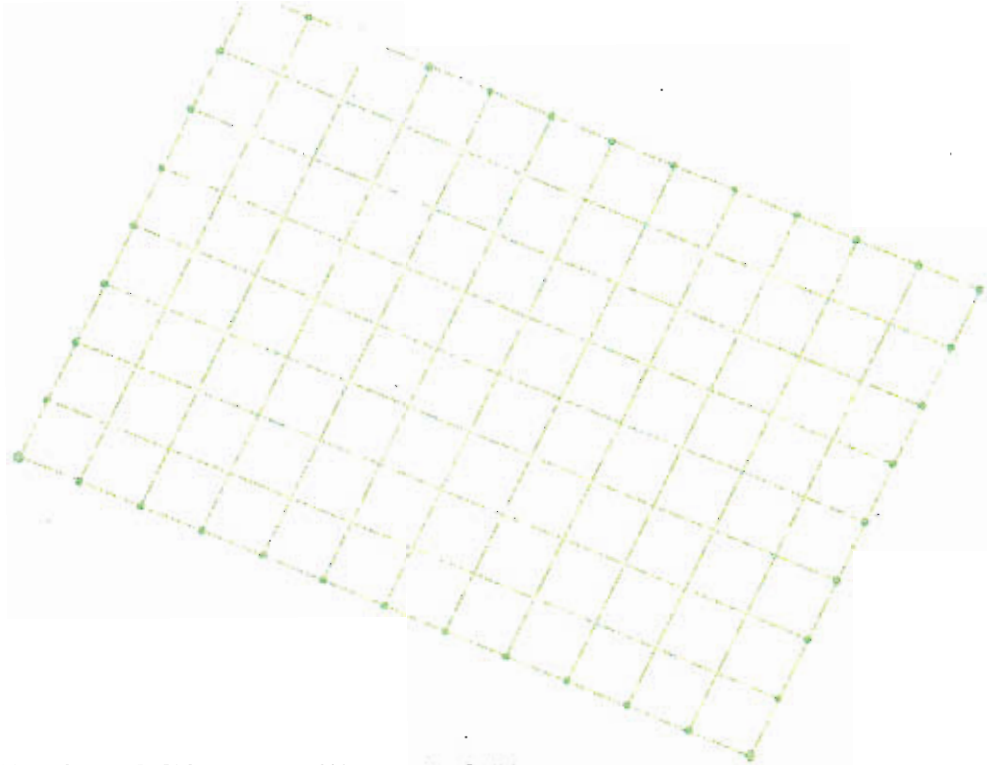
Soil 6
SP/SM
Soil Model       Mohr-Coulomb
Unit Weight      140
Cohesion         0
Phi      35
Piezometric Line #       1
Pore-Air Pressure        0

Soil 7
Bedrock
Soil Model       Bedrock
Piezometric Line #       0
Pore-Air Pressure        0
```

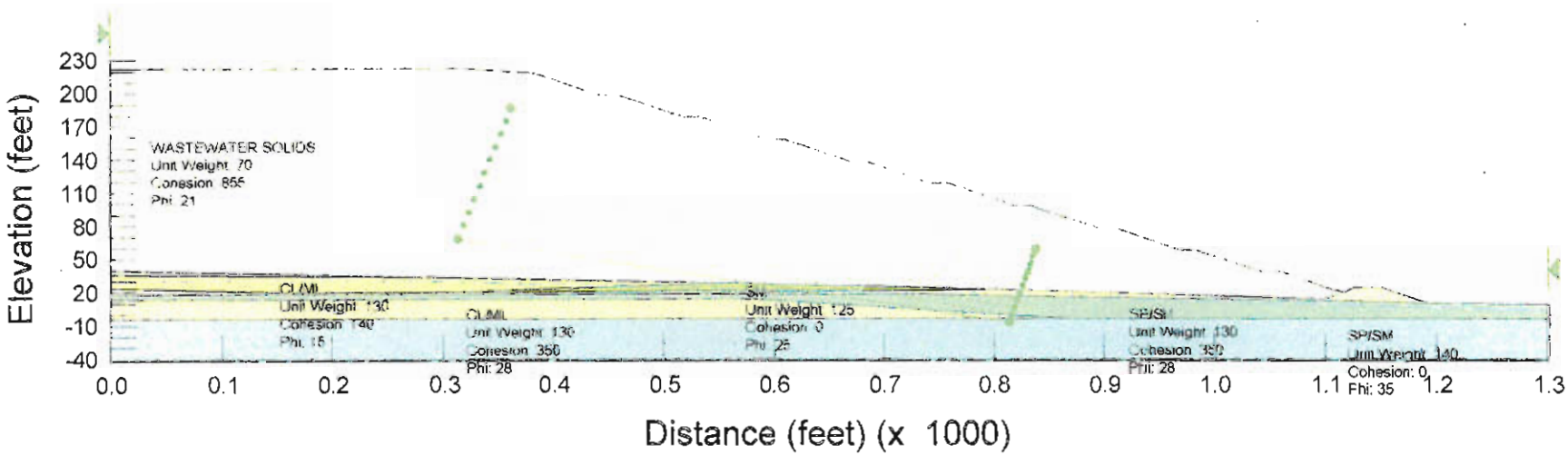


Description: Weyerhaeuser Landfill No. 3/West C-C'/De-watered Wastewater Solids
Comments: Consolidated Undrained/3H:1V sideslopes w/ 15' benches
File Name: WPCC_W_S.slp
Last Saved Date: 01/15/2002
Last Saved Time: 2:33:51 PM
Analysis Method: Bishop





Description: Weyerhaeuser Landfill No. 3/West C-C'/De-watered Wastewater Solids
Comments: Consolidated Undrained/3H:1V sideslopes w/ 15' benches
File Name: WPCC_W_S.slp
Last Saved Date: 01/15/2002
Last Saved Time: 2:33:51 PM
Analysis Method: Bishop (with Ordinary & Janbu)



```
All Soils
Soil 1
WASTEWATER SOLIDS
Soil Model      Mohr-Coulomb
Unit Weight     70
Cohesion        855
Phi     21
Piezometric Line #      1
Pore-Air Pressure       0

Soil 2
SP/SM
Soil Model      Mohr-Coulomb
Unit Weight     115
Cohesion        0
Phi     25
Piezometric Line #      1
Pore-Air Pressure       0

Soil 3
CL/ML
Soil Model      Mohr-Coulomb
Unit Weight     130
Cohesion        140
Phi     15
Piezometric Line #      1
Pore-Air Pressure       0

Soil 4
SM
Soil Model      Mohr-Coulomb
Unit Weight     125
Cohesion        0
Phi     25
Piezometric Line #      1
Pore-Air Pressure       0

Soil 5
CL/ML
Soil Model      Mohr-Coulomb
Unit Weight     130
Cohesion        350
```

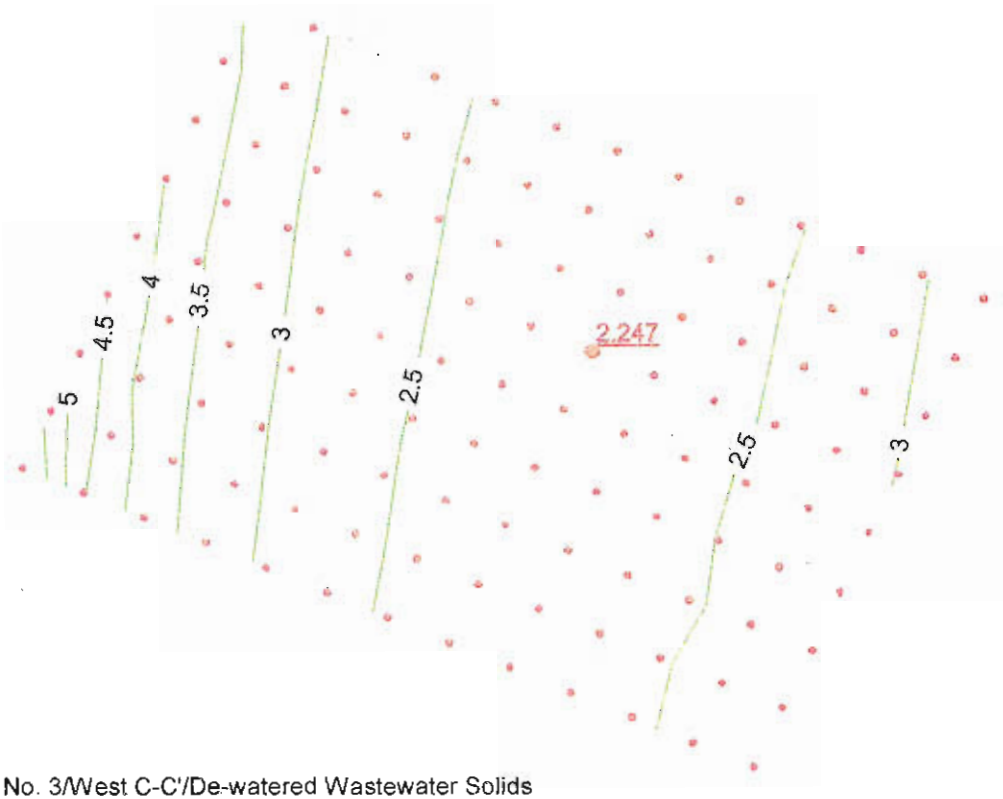
```
Phi      28
Piezometric Line #       1
Pore-Air Pressure        0

Soil 6
SP/SM
Soil Model       Mohr-Coulomb
Unit Weight      130
Cohesion         350
Phi      28
Piezometric Line #       1
Pore-Air Pressure        0

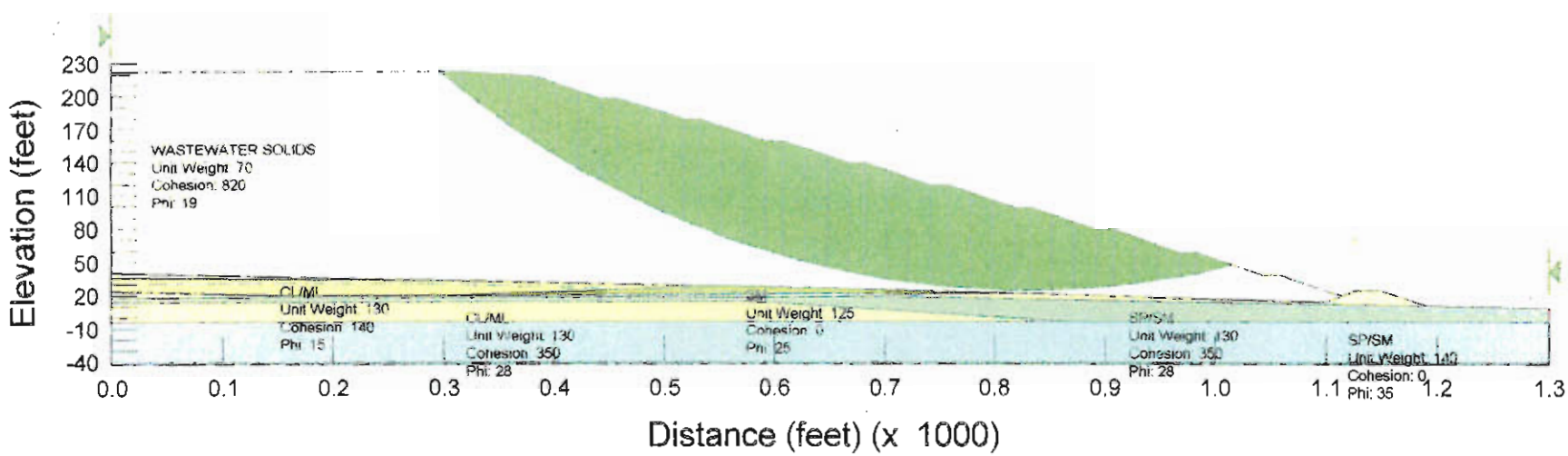
Soil 7
CL/ML
Soil Model       Mohr-Coulomb
Unit Weight      130
Cohesion         350
Phi      28
Piezometric Line #       1
Pore-Air Pressure        0

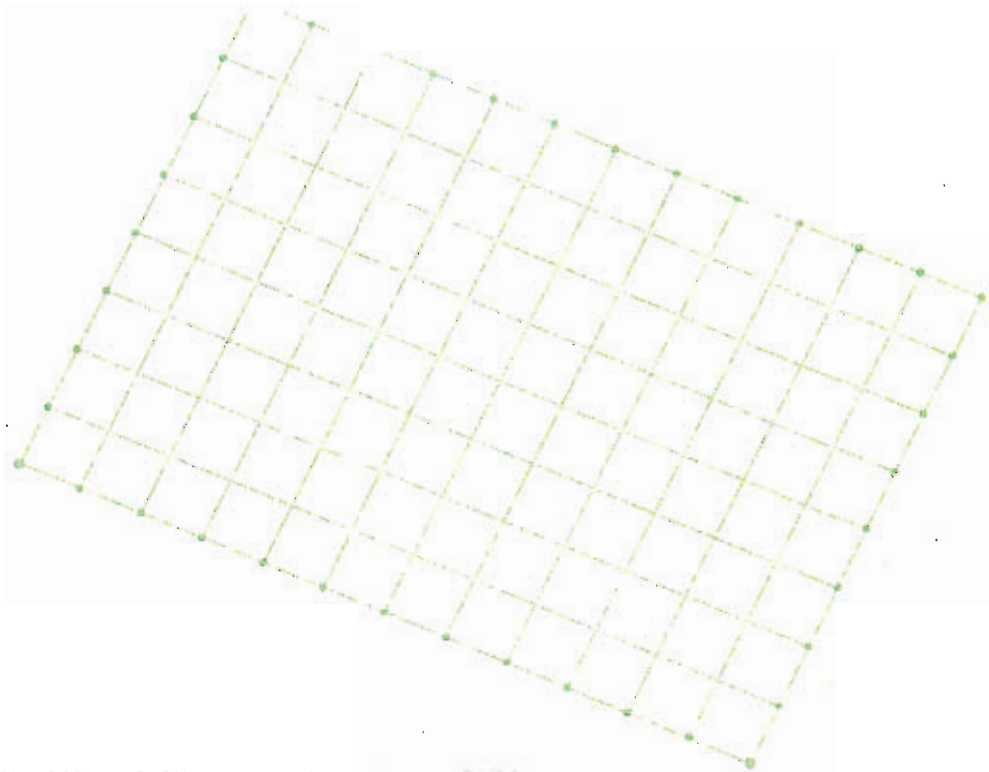
Soil 8
SP/SM
Soil Model       Mohr-Coulomb
Unit Weight      140
Cohesion         0
Phi      35
Piezometric Line #       1
Pore-Air Pressure        0

Soil 9
Bedrock
Soil Model       Bedrock
Piezometric Line #       0
Pore-Air Pressure        0
```

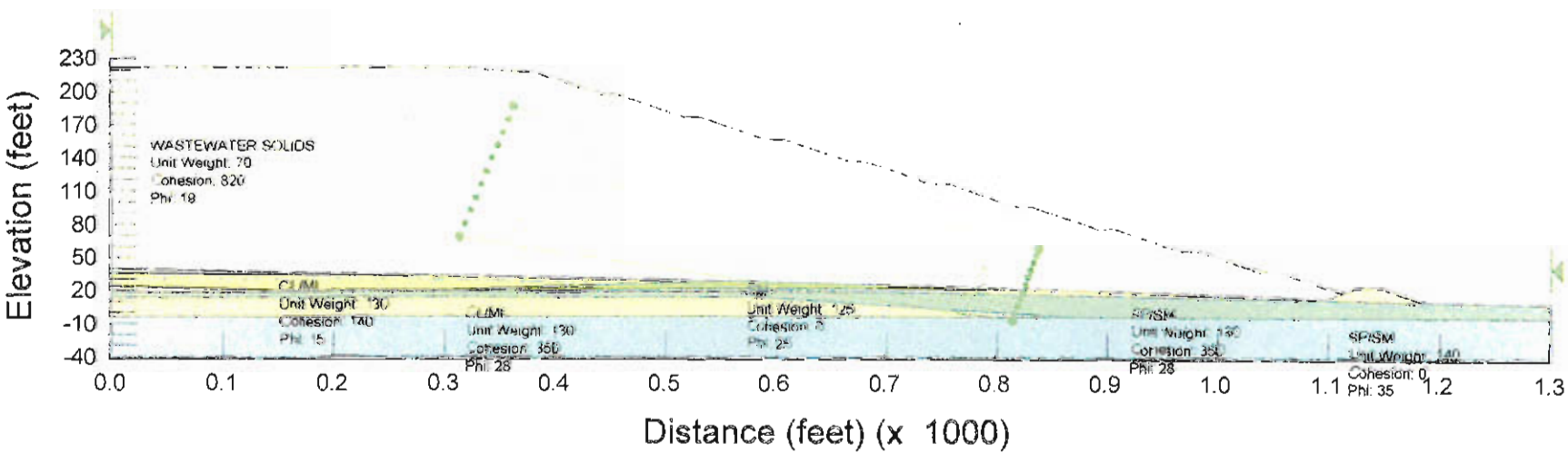


Description: Weyerhaeuser Landfill No. 3/West C-C'/De-watered Wastewater Solids
Comments: Consolidated Drained/3H:1V sideslopes w/ 15' benches
File Name: WPCC_W_S1.slp
Last Saved Date: 01/15/2002
Last Saved Time: 2:36:48 PM
Analysis Method: Bishop





Description: Weyerhaeuser Landfill No. 3/West C-C'/De-watered Wastewater Solids
Comments: Consolidated Drained/3H:1V sideslopes w/ 15' benches
File Name: WPCC_W_S1.slp
Last Saved Date: 01/15/2002
Last Saved Time: 2:36:48 PM
Analysis Method: Bishop (with Ordinary & Janbu)



```
All Soils
Soil 1
WASTEWATER SOLIDS
Soil Model       Mohr-Coulomb
Unit Weight      70
Cohesion         820
Phi      19
Piezometric Line #       1
Pore-Air Pressure        0

Soil 2
SP/SM
Soil Model       Mohr-Coulomb
Unit Weight      115
Cohesion         0
Phi      25
Piezometric Line #       1
Pore-Air Pressure        0

Soil 3
CL/ML
Soil Model       Mohr-Coulomb
Unit Weight      130
Cohesion         140
Phi      15
Piezometric Line #       1
Pore-Air Pressure        0

Soil 4
SM
Soil Model       Mohr-Coulomb
Unit Weight      125
Cohesion         0
Phi      25
Piezometric Line #       1
Pore-Air Pressure        0

Soil 5
CL/ML
Soil Model       Mohr-Coulomb
Unit Weight      130
Cohesion         350
```

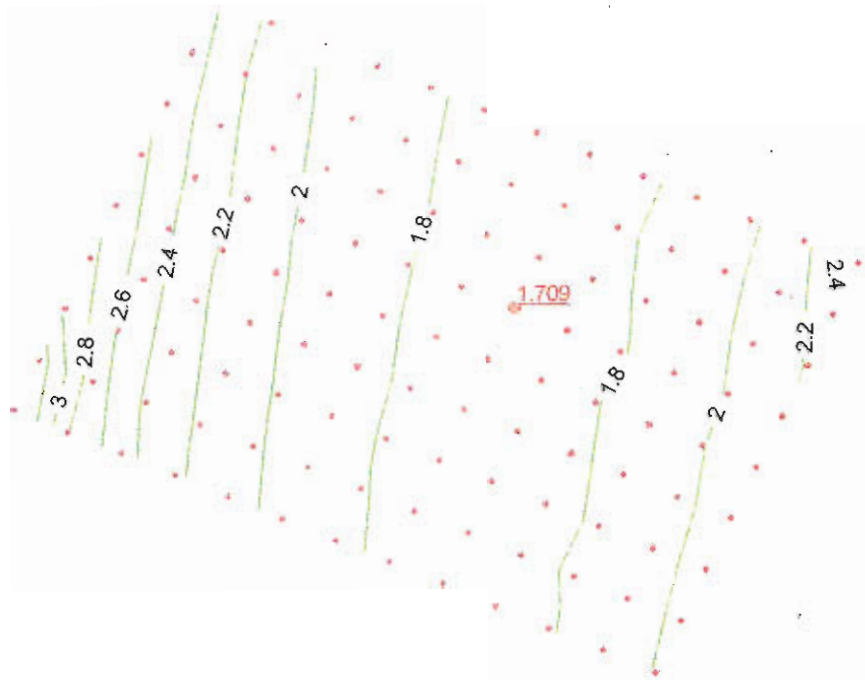
```
Phi      28
Piezometric Line #       1
Pore-Air Pressure        0

Soil 6
SP/SM
Soil Model       Mohr-Coulomb
Unit Weight      130
Cohesion         350
Phi      28
Piezometric Line #       1
Pore-Air Pressure        0

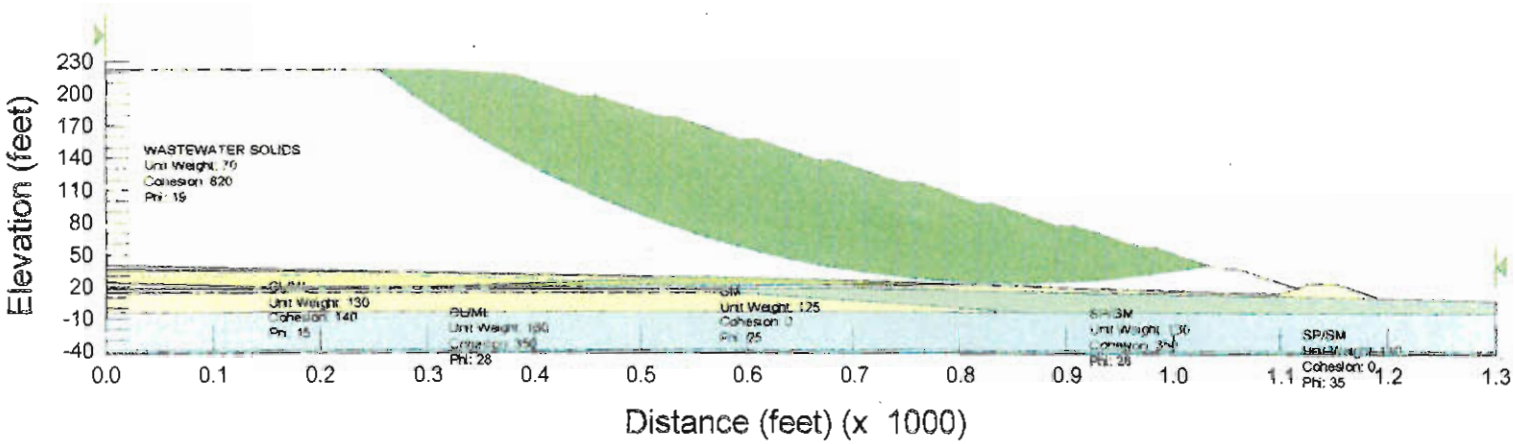
Soil 7
CL/ML
Soil Model       Mohr-Coulomb
Unit Weight      130
Cohesion         350
Phi      28
Piezometric Line #       1
Pore-Air Pressure        0

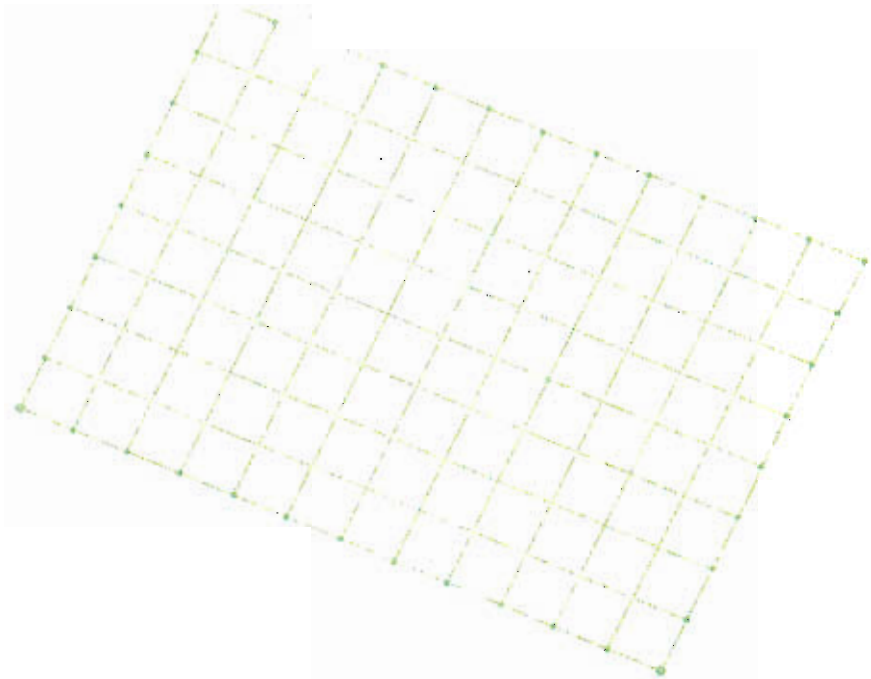
Soil 8
SP/SM
Soil Model       Mohr-Coulomb
Unit Weight      140
Cohesion         0
Phi      35
Piezometric Line #       1
Pore-Air Pressure        0

Soil 9
Bedrock
Soil Model       Bedrock
Piezometric Line #       0
Pore-Air Pressure        0
```

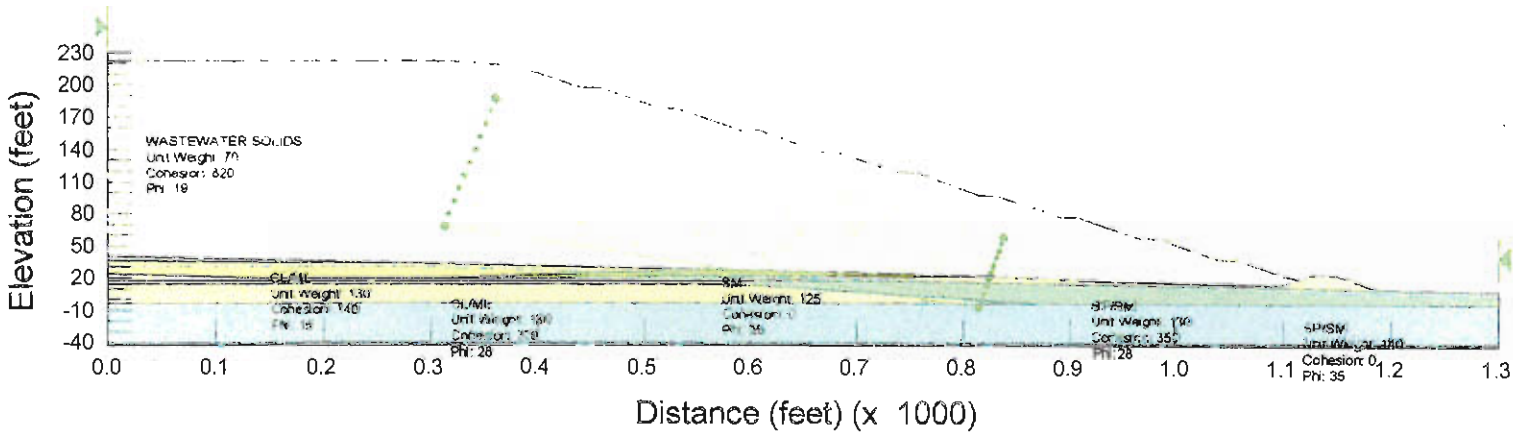


Description: Weyerhaeuser Landfill No. 3/West C-C'/De-watered Wastewater Solids
Comments: Consolidated Drained --Seismic /3H:1V sideslopes w/ 15' benches
File Name: WPCC_W_S2.slp
Last Saved Date: 01/15/2002
Last Saved Time: 2:48:32 PM
Analysis Method: Bishop
Seismic Coefficient: Horizontal and Vertical





Weyerhaeuser Landfill No. 3/West C-C'/De-watered Wastewater Solids
Consolidated Drained --Seismic /3H:1V sideslopes w/ 15' benches
File Name: WPCC_W_S2.slp
Last Saved Date: 01/15/2002
Last Saved Time: 2:48:32 PM
Bishop (with Ordinary & Janbu)
Seismic Coefficient: Horizontal and Vertical



```
All Soils
Soil 1
WASTEWATER SOLIDS
Soil Model      Mohr-Coulomb
Unit Weight     70
Cohesion        820
Phi     19
Piezometric Line #      1
Pore-Air Pressure       0

Soil 2
SP/SM
Soil Model      Mohr-Coulomb
Unit Weight     115
Cohesion        0
Phi     25
Piezometric Line #      1
Pore-Air Pressure       0

Soil 3
CL/ML
Soil Model      Mohr-Coulomb
Unit Weight     130
Cohesion        140
Phi     15
Piezometric Line #      1
Pore-Air Pressure       0

Soil 4
SM
Soil Model      Mohr-Coulomb
Unit Weight     125
Cohesion        0
Phi     25
Piezometric Line #      1
Pore-Air Pressure       0

Soil 5
CL/ML
Soil Model      Mohr-Coulomb
Unit Weight     130
Cohesion        350
```

```
Phi      28
Piezometric Line #       1
Pore-Air Pressure        0

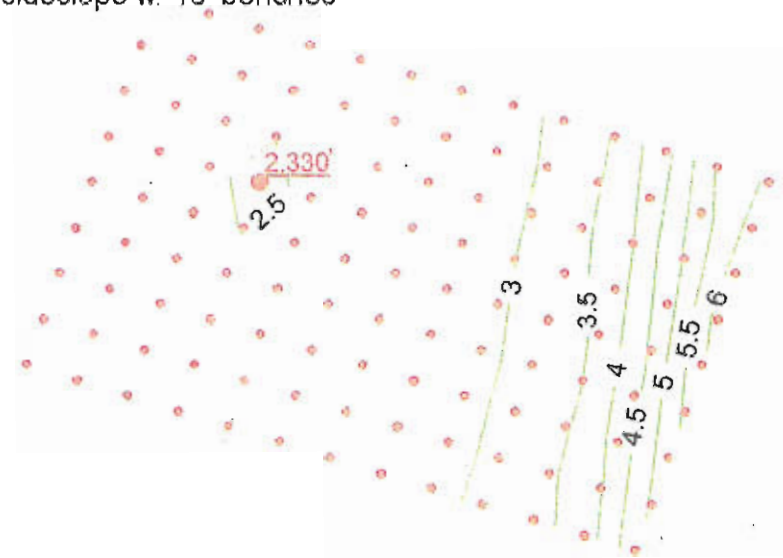
Soil 6
SP/SM
Soil Model       Mohr-Coulomb
Unit Weight      130
Cohesion         350
Phi      28
Piezometric Line #       1
Pore-Air Pressure        0

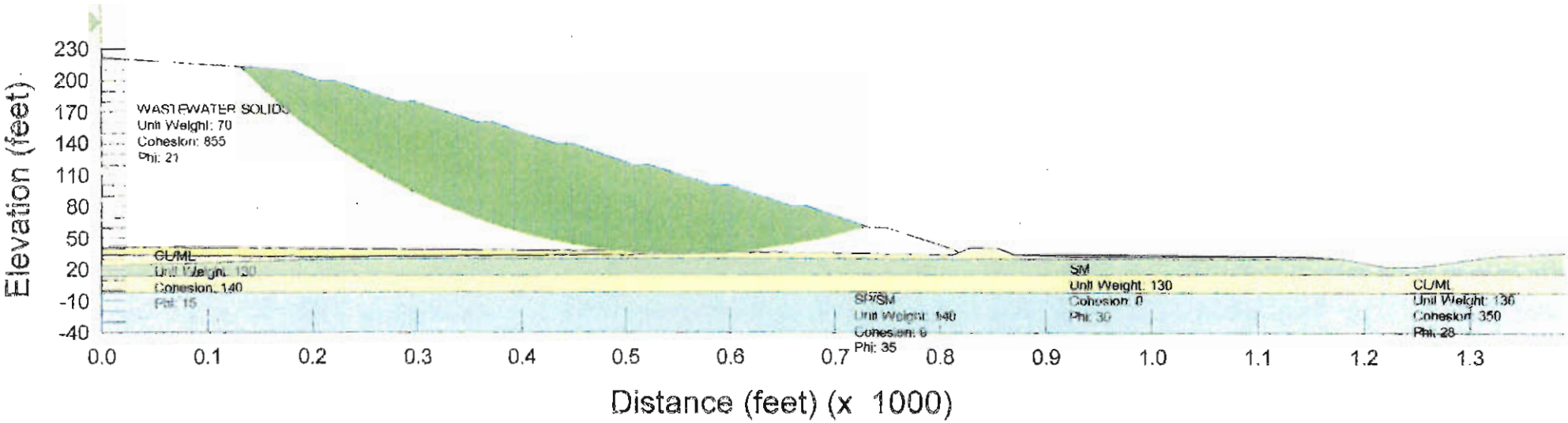
Soil 7
CL/ML
Soil Model       Mohr-Coulomb
Unit Weight      130
Cohesion         350
Phi      28
Piezometric Line #       1
Pore-Air Pressure        0

Soil 8
SP/SM
Soil Model       Mohr-Coulomb
Unit Weight      140
Cohesion         0
Phi      35
Piezometric Line #       1
Pore-Air Pressure        0

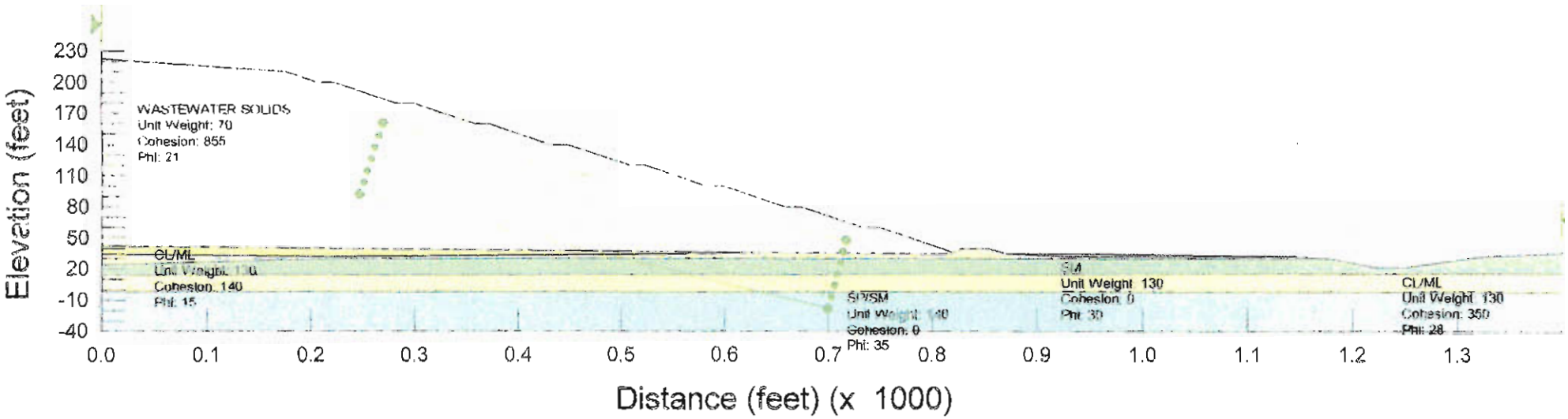
Soil 9
Bedrock
Soil Model       Bedrock
Piezometric Line #       0
Pore-Air Pressure        0
```

Weyerhaeuser Landfill No. 3/ East C-C'/De-watered Wastewater Solids
Consolidated Undrained/ 3H:1V sideslope w/ 15' benches
File Name: WPCC_E_S.slp
Last Saved Date: 01/11/2002
Last Saved Time: 4:04:00 PM
Bishop





Weyerhaeuser Landfill No. 3/ East C-C'/De-watered Wastewater Solids
Consolidated Undrained/ 3H:1V sideslope w/ 15' benches
File Name: WPCC_E_S.slp
Last Saved Date: 01/11/2002
Last Saved Time: 4:04:00 PM
Bishop (with Ordinary & Janbu)



All Soils
Soil 1
WASTEWATER SOLIDS
Soil Model Mohr-Coulomb
Unit Weight 70
Cohesion 855
Phi 21
Piezometric Line # 1
Pore-Air Pressure 0

Soil 2
CL/ML
Soil Model Mohr-Coulomb
Unit Weight 130
Cohesion 140
Phi 15
Piezometric Line # 1
Pore-Air Pressure 0

Soil 3
CL/ML
Soil Model Mohr-Coulomb
Unit Weight 130
Cohesion 350
Phi 28
Piezometric Line # 1
Pore-Air Pressure 0

Soil 4
SM
Soil Model Mohr-Coulomb
Unit Weight 130
Cohesion 0
Phi 30
Piezometric Line # 1
Pore-Air Pressure 0

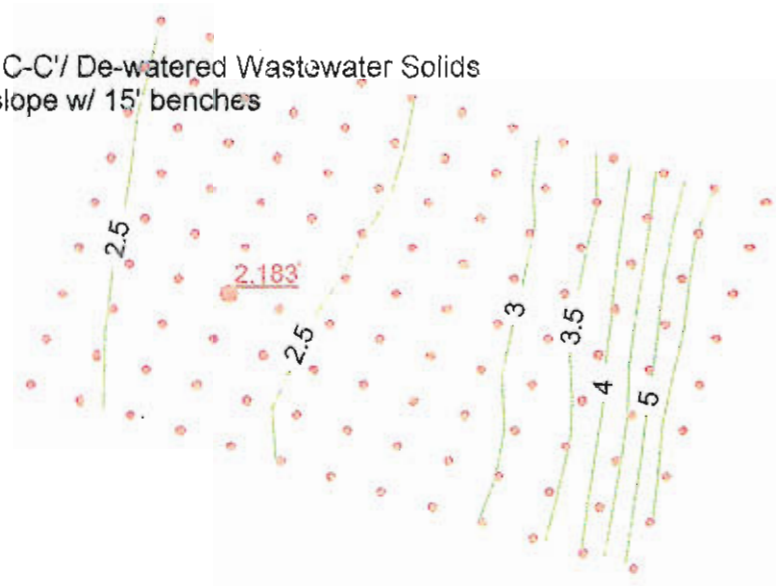
Soil 5
CL/ML
Soil Model Mohr-Coulomb
Unit Weight 130
Cohesion 350

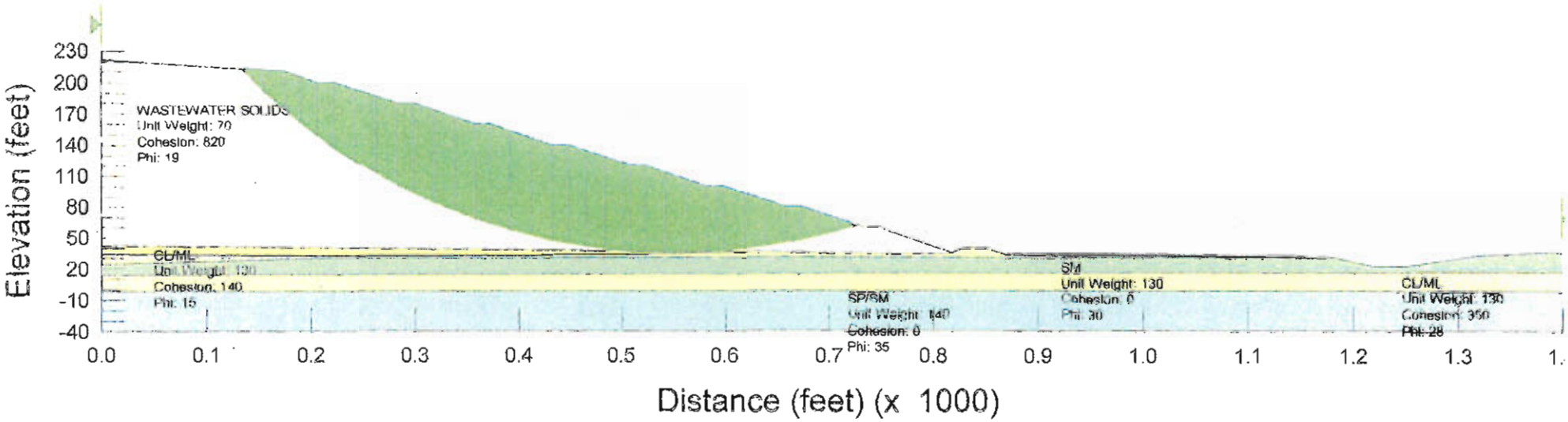
```
Phi      28
Piezometric Line #       1
Pore-Air Pressure        0

Soil 6
SP/SM
Soil Model       Mohr-Coulomb
Unit Weight      140
Cohesion         0
Phi      35
Piezometric Line #       1
Pore-Air Pressure        0

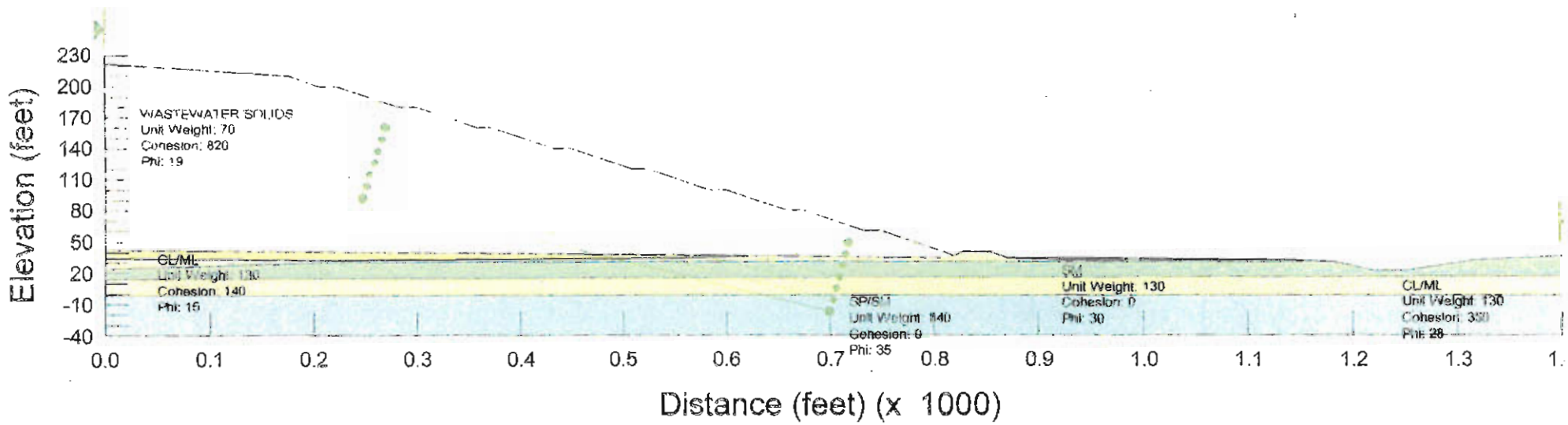
Soil 7
Bedrock
Soil Model       Bedrock
Piezometric Line #       0
Pore-Air Pressure        0
```

Weyerhaeuser Landfill No. 3/ East C-C'/ De-watered Wastewater Solids
Consolidated Drained/ 3H:1V sideslope w/ 15' benches
File Name: WPCC_E_S1.slp
Last Saved Date: 01/11/2002
Last Saved Time: 4:06:14 PM
Bishop





Weyerhaeuser Landfill No. 3/ East C-C'/ De-watered Wastewater Solids
Consolidated Drained/ 3H:1V sideslope w/ 15' benches
File Name: WPCC_E_S1.slp
Last Saved Date: 01/11/2002
Last Saved Time: 4:06:14 PM
Bishop (with Ordinary & Janbu)



All Soils
Soil 1
WASTEWATER SOLIDS
Soil Model Mohr-Coulomb
Unit Weight 70
Cohesion 820
Phi 19
Piezometric Line # 1
Pore-Air Pressure 0

Soil 2
CL/ML
Soil Model Mohr-Coulomb
Unit Weight 130
Cohesion 140
Phi 15
Piezometric Line # 1
Pore-Air Pressure 0

Soil 3
CL/ML
Soil Model Mohr-Coulomb
Unit Weight 130
Cohesion 350
Phi 28
Piezometric Line # 1
Pore-Air Pressure 0

Soil 4
SM
Soil Model Mohr-Coulomb
Unit Weight 130
Cohesion 0
Phi 30
Piezometric Line # 1
Pore-Air Pressure 0

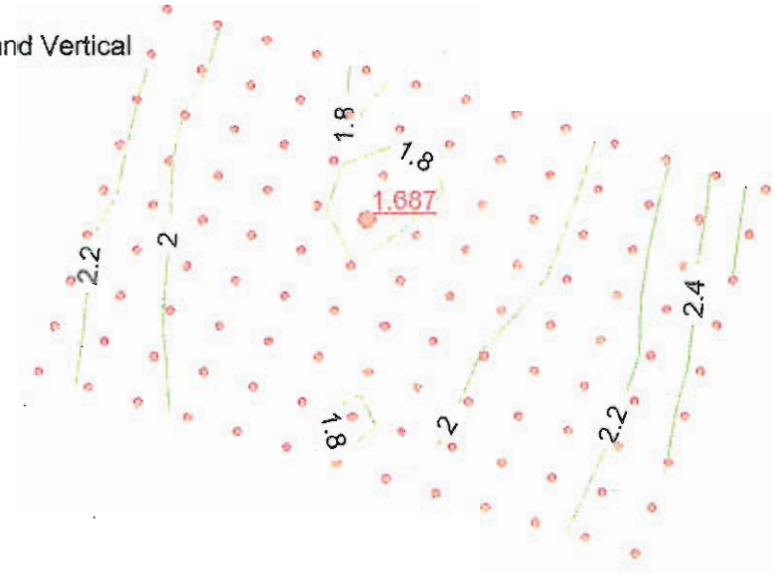
Soil 5
CL/ML
Soil Model Mohr-Coulomb
Unit Weight 130
Cohesion 350

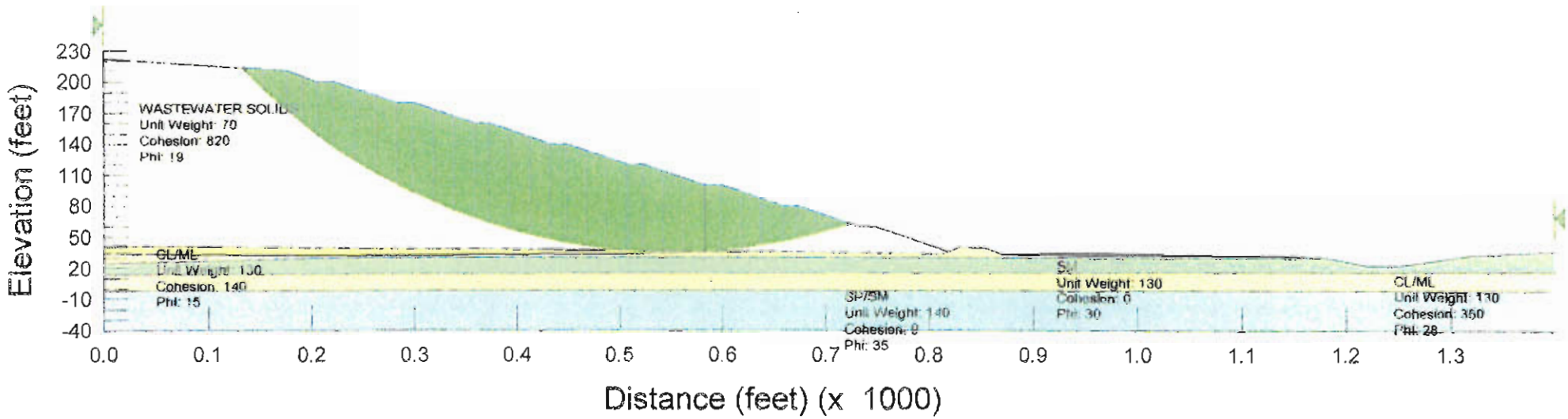
```
Phi      28
Piezometric Line #       1
Pore-Air Pressure        0

Soil 6
SP/SM
Soil Model       Mohr-Coulomb
Unit Weight      140
Cohesion         0
Phi      35
Piezometric Line #       1
Pore-Air Pressure        0

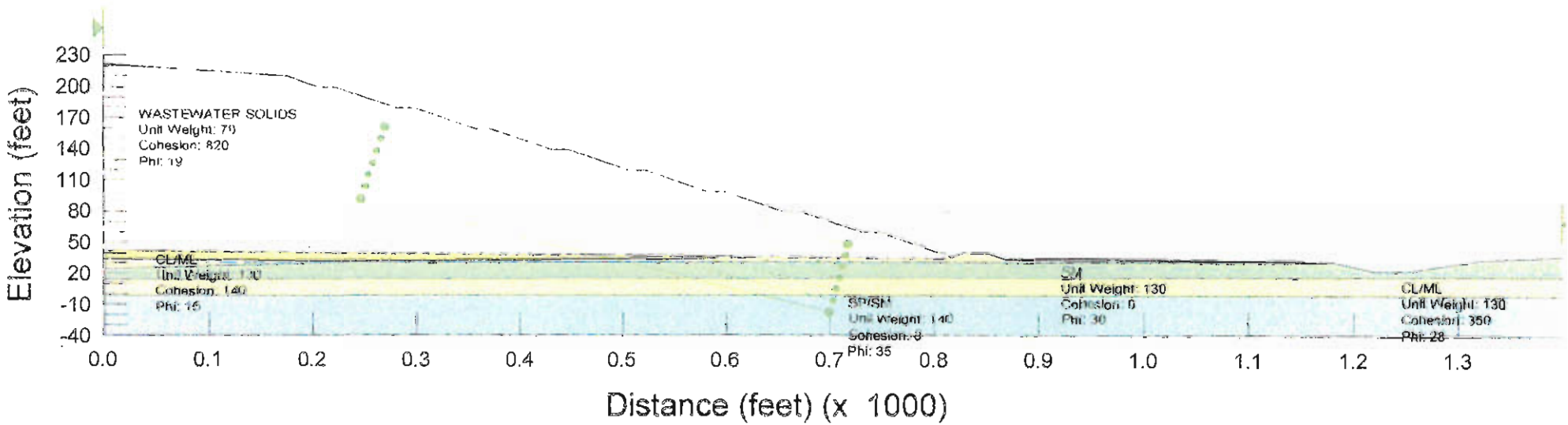
Soil 7
Bedrock
Soil Model       Bedrock
Piezometric Line #       0
Pore-Air Pressure        0
```

Description: Weyerhaeuser Landfill No. 3/ East C-C'/ De-watered Wastewater Solids
Comments: Consolidated Drained--Seismic/ 3H:1V sideslope w/ 15' benches
File Name: WPCC_E_S2.slp
Last Saved Date: 01/14/2002
Last Saved Time: 3:30:13 PM
Analysis Method: Bishop
Seismic Coefficient: Horizontal and Vertical





Description: Weyerhaeuser Landfill No. 3/ East C-C/ De-watered Wastewater Solids
Comments: Consolidated Drained--Seismic/ 3H:1V sideslope w/ 15' benches
File Name: WPCC_E_S2.slp
Last Saved Date: 01/14/2002
Last Saved Time: 4:01:56 PM
Analysis Method: Bishop (with Ordinary & Janbu)
Seismic Coefficient: Horizontal and Vertical



```
All Soils
Soil 1
WASTEWATER SOLIDS
Soil Model      Mohr-Coulomb
Unit Weight     70
Cohesion        820
Phi     19
Piezometric Line #      1
Pore-Air Pressure       0

Soil 2
CL/ML
Soil Model      Mohr-Coulomb
Unit Weight     130
Cohesion        140
Phi     15
Piezometric Line #      1
Pore-Air Pressure       0

Soil 3
CL/ML
Soil Model      Mohr-Coulomb
Unit Weight     130
Cohesion        350
Phi     28
Piezometric Line #      1
Pore-Air Pressure       0

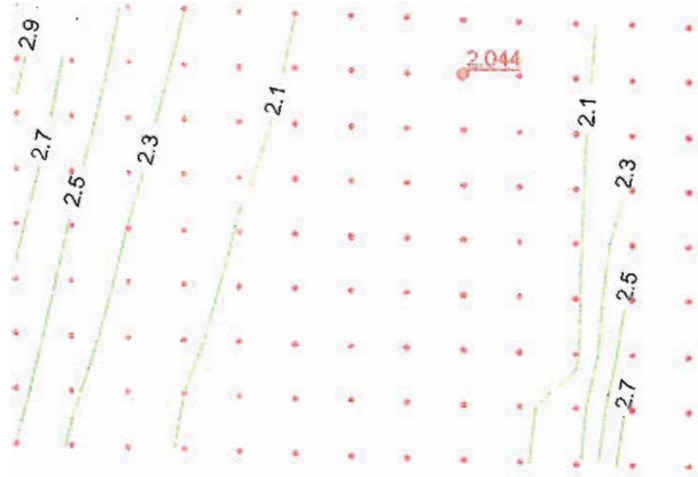
Soil 4
SM
Soil Model      Mohr-Coulomb
Unit Weight     130
Cohesion        0
Phi     30
Piezometric Line #      1
Pore-Air Pressure       0

Soil 5
CL/ML
Soil Model      Mohr-Coulomb
Unit Weight     130
Cohesion        350
```

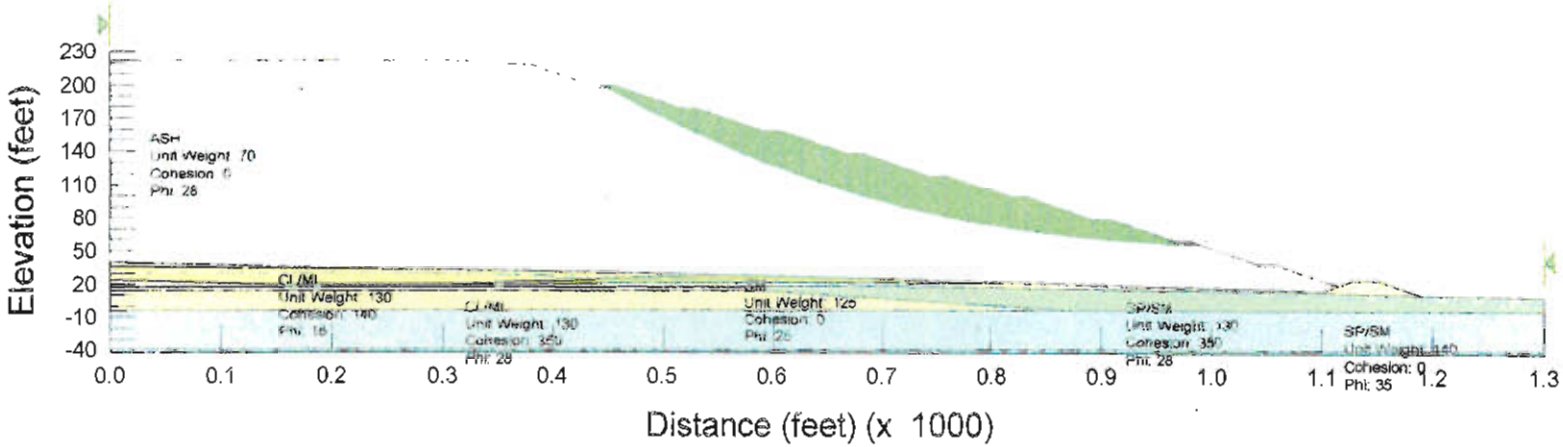
```
Phi      28
Piezometric Line #       1
Pore-Air Pressure        0

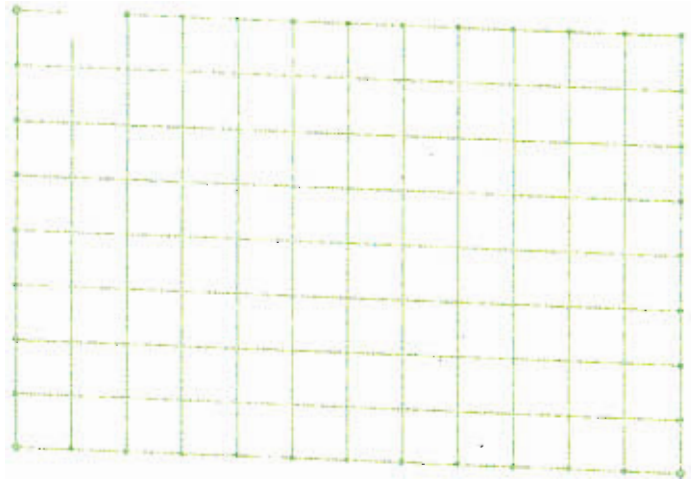
Soil 6
SP/SM
Soil Model       Mohr-Coulomb
Unit Weight      140
Cohesion         0
Phi      35
Piezometric Line #       1
Pore-Air Pressure        0

Soil 7
Bedrock
Soil Model       Bedrock
Piezometric Line #       0
Pore-Air Pressure        0
```

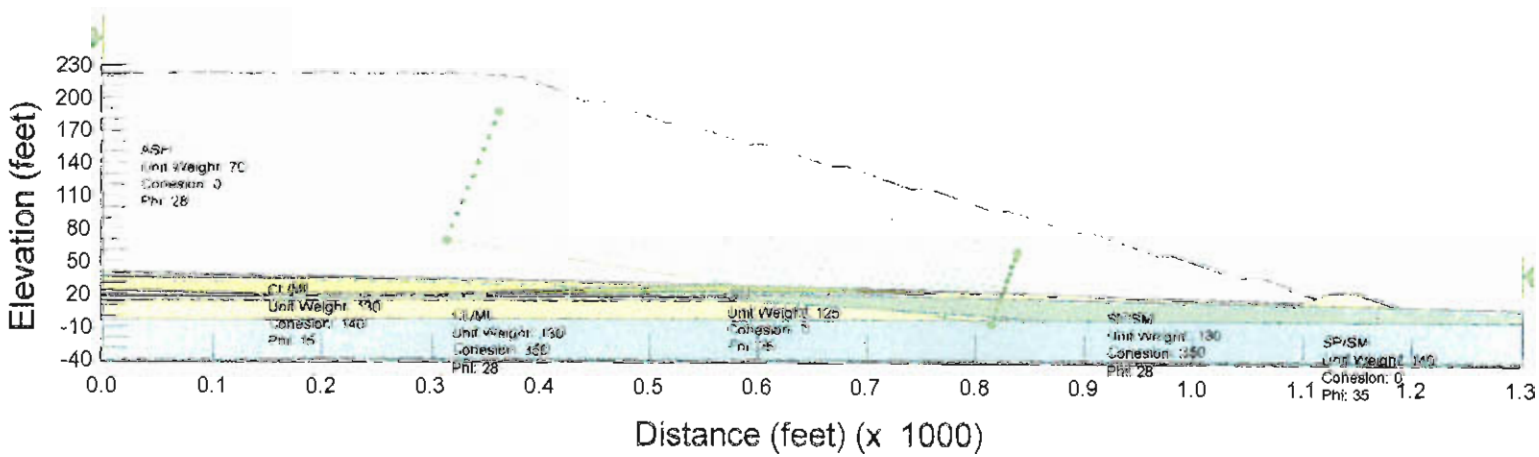


Description: Weyerhaeuser Landfill No. 3/West C-C'/Ash
Comments: Consolidated Undrained/3H:1V sideslopes w/ 15' benches
File Name: WPCC_W_A.slp
Last Saved Date: 01/15/2002
Last Saved Time: 2:04:24 PM
Analysis Method: Bishop





Description: Weyerhaeuser Landfill No. 3/West C-C'/Ash
Comments: Consolidated Undrained/3H:1V sideslopes w/ 15' benches
File Name: WPCC_W_A.slp
Last Saved Date: 01/15/2002
Last Saved Time: 2:02:07 PM
Analysis Method: Bishop (with Ordinary & Janbu)



All Soils
Soil 1
ASH
Soil Model Mohr-Coulomb
Unit Weight 70
Cohesion 0
Phi 28
Piezometric Line # 1
Pore-Air Pressure 0

Soil 2
SP/SM
Soil Model Mohr-Coulomb
Unit Weight 115
Cohesion 0
Phi 25
Piezometric Line # 1
Pore-Air Pressure 0

Soil 3
CL/ML
Soil Model Mohr-Coulomb
Unit Weight 130
Cohesion 140
Phi 15
Piezometric Line # 1
Pore-Air Pressure 0

Soil 4
SM
Soil Model Mohr-Coulomb
Unit Weight 125
Cohesion 0
Phi 25
Piezometric Line # 1
Pore-Air Pressure 0

Soil 5
CL/ML
Soil Model Mohr-Coulomb
Unit Weight 130
Cohesion 350

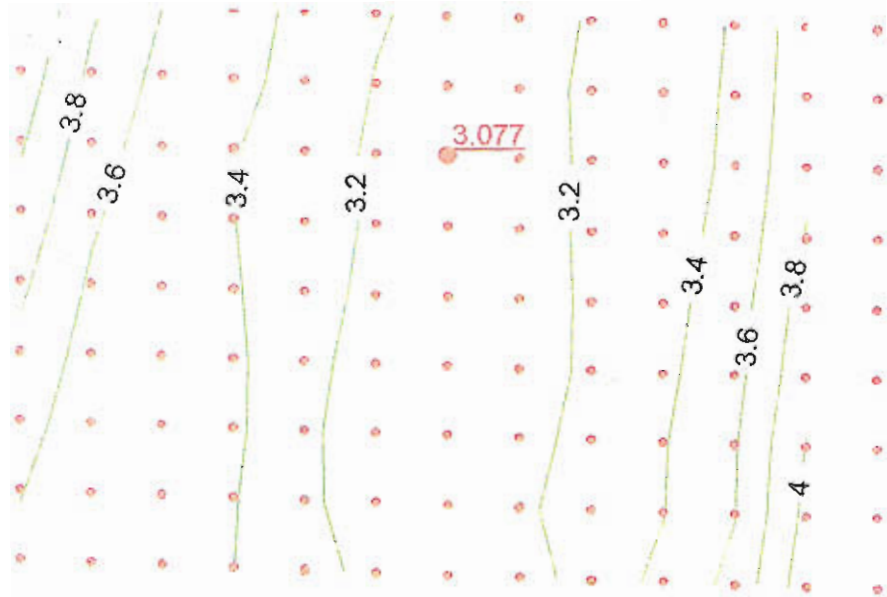
```
Phi      28
Piezometric Line #       1
Pore-Air Pressure        0

Soil 6
SP/SM
Soil Model       Mohr-Coulomb
Unit Weight      130
Cohesion         350
Phi      28
Piezometric Line #       1
Pore-Air Pressure        0

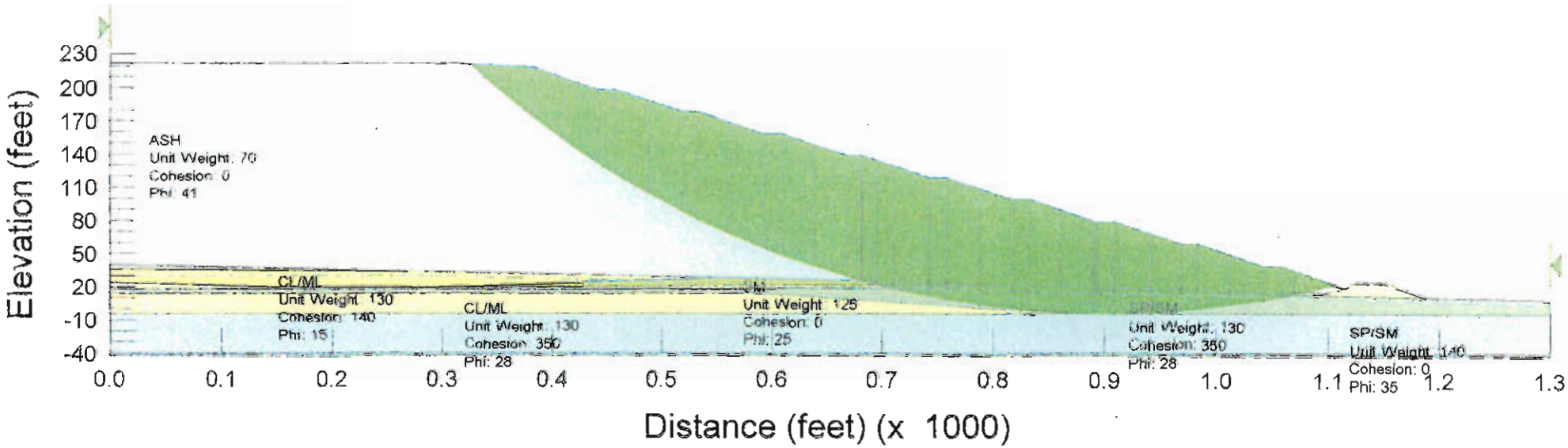
Soil 7
CL/ML
Soil Model       Mohr-Coulomb
Unit Weight      130
Cohesion         350
Phi      28
Piezometric Line #       1
Pore-Air Pressure        0

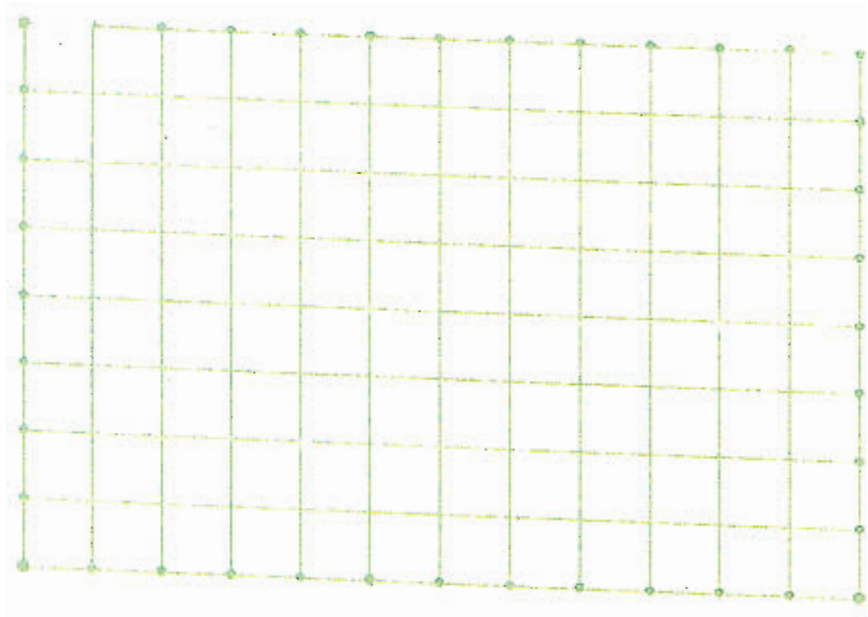
Soil 8
SP/SM
Soil Model       Mohr-Coulomb
Unit Weight      140
Cohesion         0
Phi      35
Piezometric Line #       1
Pore-Air Pressure        0

Soil 9
Bedrock
Soil Model       Bedrock
Piezometric Line #       0
Pore-Air Pressure        0
```



Description: Weyerhaeuser Landfill No. 3/West C-C'/Ash
Comments: Consolidated Drained/3H:1V sideslopes w/ 15' benches
File Name: WPCC_W_A1.slp
Last Saved Date: 01/15/2002
Last Saved Time: 2:13:17 PM
Analysis Method: Bishop





Description: Weyerhaeuser Landfill No. 3/West C-C'/Ash
Comments: Consolidated Drained/3H:1V sideslopes w/ 15' benches
File Name: WPCC_W_A1.slp
Last Saved Date: 01/15/2002
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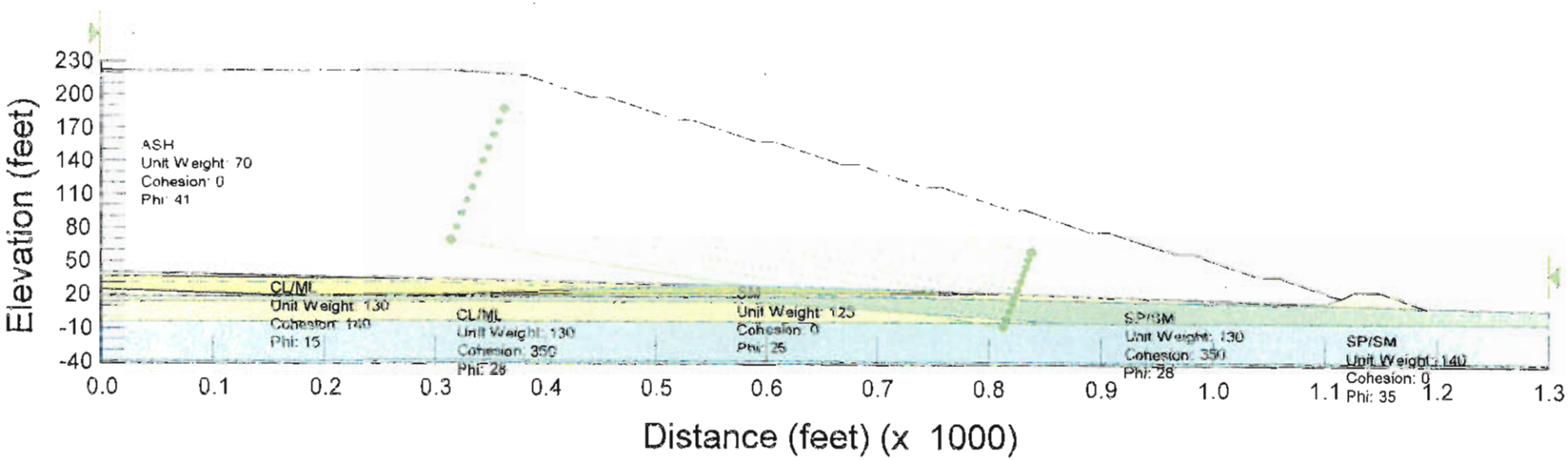
Analysis Method: Bishop (with Ordinary & Janbu)



All Soils
Soil 1
ASH
Soil Model Mohr-Coulomb
Unit Weight 70
Cohesion 0
Phi 41
Piezometric Line # 1
Pore-Air Pressure 0

Soil 2
SP/SM
Soil Model Mohr-Coulomb
Unit Weight 115
Cohesion 0
Phi 25
Piezometric Line # 1
Pore-Air Pressure 0

Soil 3
CL/ML
Soil Model Mohr-Coulomb
Unit Weight 130
Cohesion 140
Phi 15
Piezometric Line # 1
Pore-Air Pressure 0

Soil 4
SM
Soil Model Mohr-Coulomb
Unit Weight 125
Cohesion 0
Phi 25
Piezometric Line # 1
Pore-Air Pressure 0

Soil 5
CL/ML
Soil Model Mohr-Coulomb
Unit Weight 130
Cohesion 350

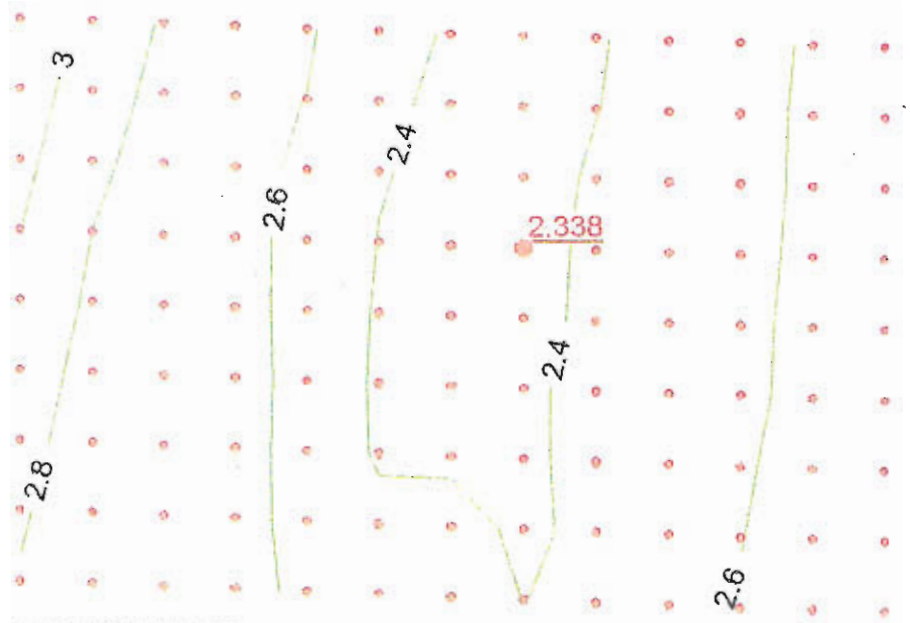
Phi 28
Piezometric Line # 1
Pore-Air Pressure 0

Soil 6
SP/SM
Soil Model Mohr-Coulomb
Unit Weight 130
Cohesion 350
Phi 28
Piezometric Line # 1
Pore-Air Pressure 0

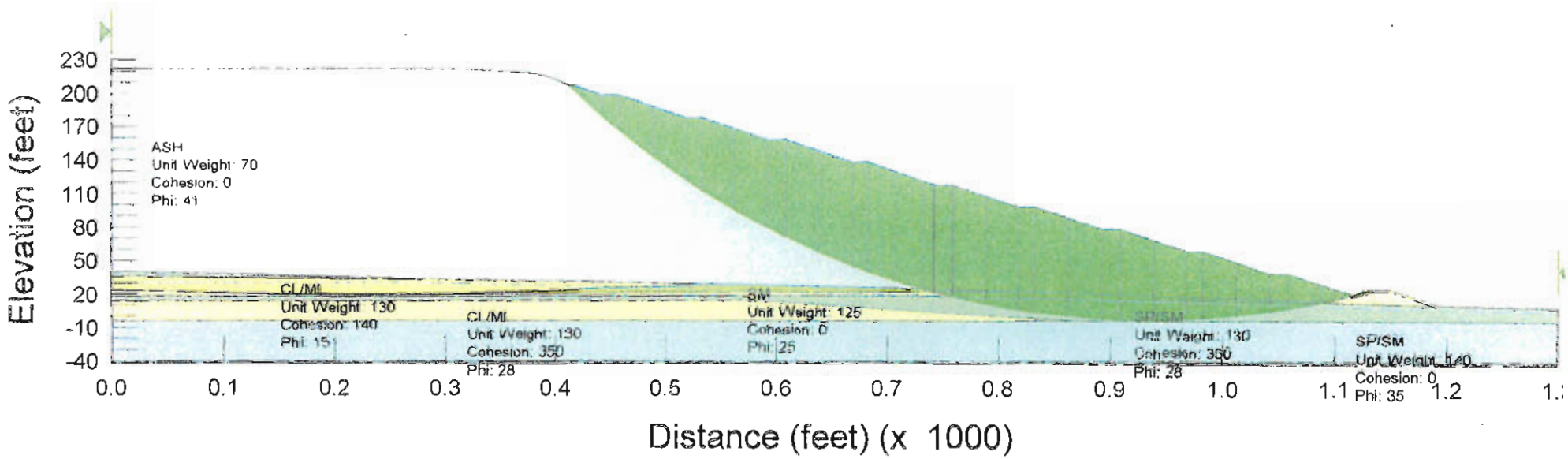
Soil 7
CL/ML
Soil Model Mohr-Coulomb
Unit Weight 130
Cohesion 350
Phi 28
Piezometric Line # 1
Pore-Air Pressure 0

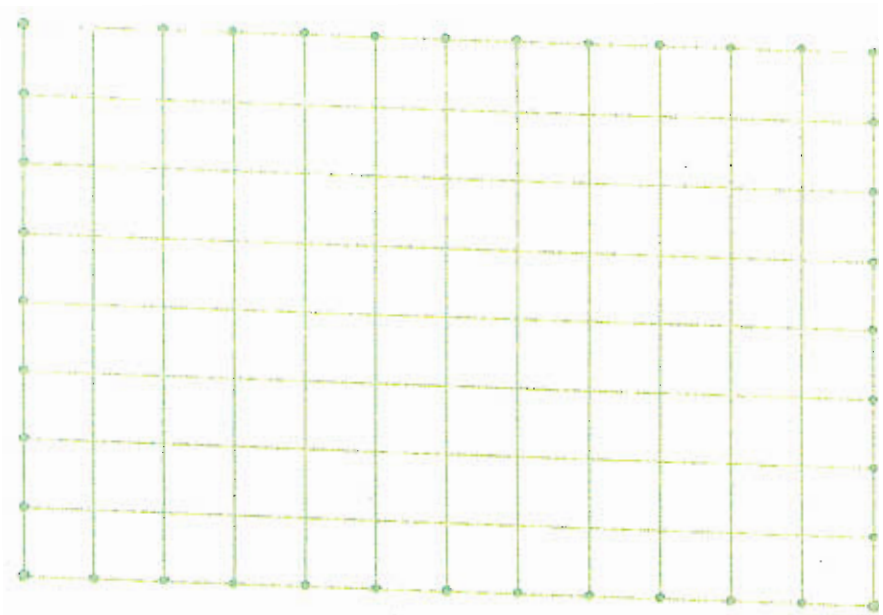
Soil 8
SP/SM
Soil Model Mohr-Coulomb
Unit Weight 140
Cohesion 0
Phi 35
Piezometric Line # 1
Pore-Air Pressure 0

Soil 9
Bedrock
Soil Model Bedrock
Piezometric Line # 0
Pore-Air Pressure 0

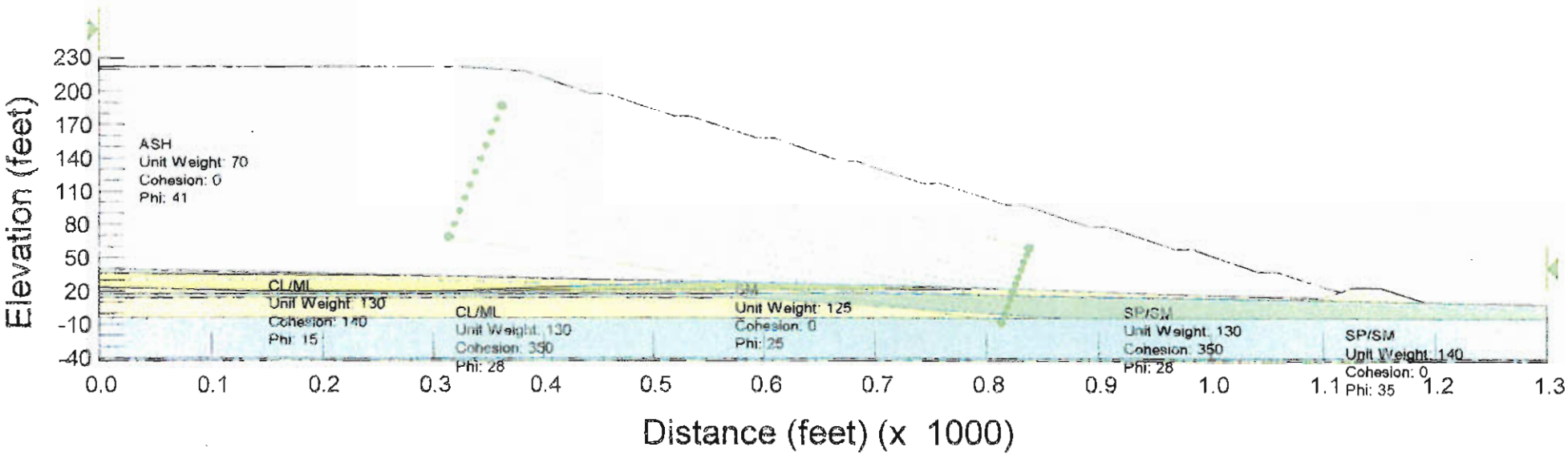


Description: Weyerhaeuser Landfill No. 3/West C-C'/Ash
Comments: Consolidated Drained -- Seismic /3H:1V sideslopes w/ 15' benches
File Name: WPCC_W_A2.slp
Last Saved Date: 01/15/2002
Last Saved Time: 2:22:48 PM
Analysis Method: Bishop
Seismic Coefficient: Horizontal and Vertical





Weyerhaeuser Landfill No. 3/West C-C'/Ash
Consolidated Drained -- Seismic /3H:1V sideslopes w/ 15' benches
File Name: WPCC_W_A2.slp
Last Saved Date: 01/15/2002
Last Saved Time: 2:22:27 PM
Bishop (with Ordinary & Janbu)
Seismic Coefficient: Horizontal and Vertical



```
All Soils
Soil 1
ASH
Soil Model      Mohr-Coulomb
Unit Weight     70
Cohesion        0
Phi     41
Piezometric Line #      1
Pore-Air Pressure       0

Soil 2
SP/SM
Soil Model      Mohr-Coulomb
Unit Weight     115
Cohesion        0
Phi     25
Piezometric Line #      1
Pore-Air Pressure       0

Soil 3
CL/ML
Soil Model      Mohr-Coulomb
Unit Weight     130
Cohesion        140
Phi     15
Piezometric Line #      1
Pore-Air Pressure       0

Soil 4
SM
Soil Model      Mohr-Coulomb
Unit Weight     125
Cohesion        0
Phi     25
Piezometric Line #      1
Pore-Air Pressure       0

Soil 5
CL/ML
Soil Model      Mohr-Coulomb
Unit Weight     130
Cohesion        350
```

```
Phi      28
Piezometric Line #       1
Pore-Air Pressure        0

Soil 6
SP/SM
Soil Model       Mohr-Coulomb
Unit Weight      130
Cohesion         350
Phi      28
Piezometric Line #       1
Pore-Air Pressure        0

Soil 7
CL/ML
Soil Model       Mohr-Coulomb
Unit Weight      130
Cohesion         350
Phi      28
Piezometric Line #       1
Pore-Air Pressure        0

Soil 8
SP/SM
Soil Model       Mohr-Coulomb
Unit Weight      140
Cohesion         0
Phi      35
Piezometric Line #       1
Pore-Air Pressure        0

Soil 9
Bedrock
Soil Model       Bedrock
Piezometric Line #       0
Pore-Air Pressure        0
```

Attachment E3
Interface Friction Analysis

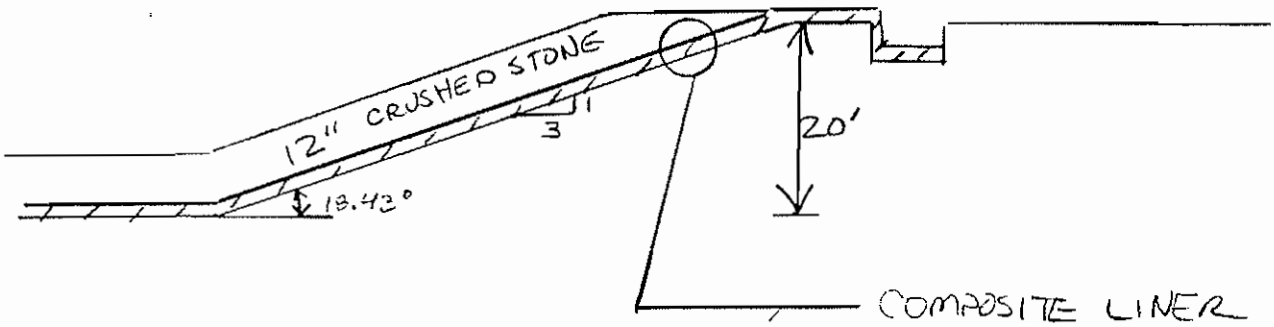
DESIGN SHEET

SHEET 1 OF

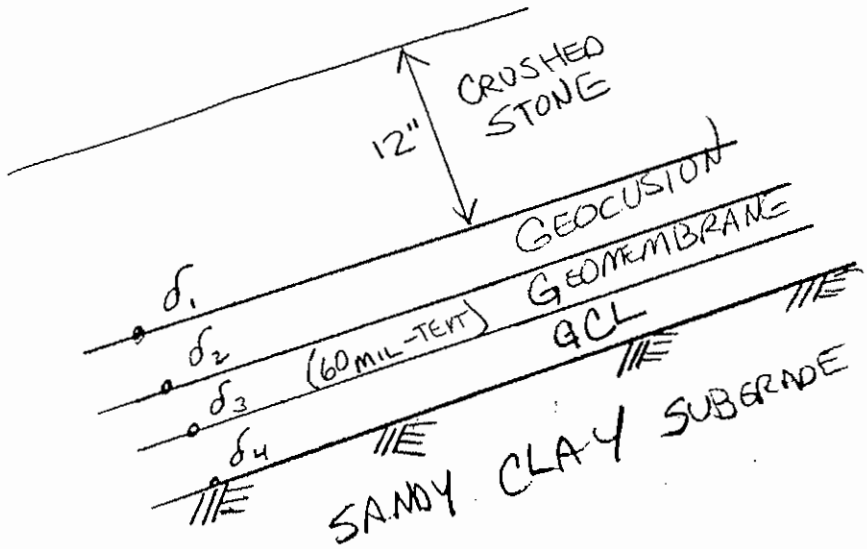
RMT® 100 Verdae Boulevard P.O. Box 16778 Greenville, SC 29607-3825 Phone: 864-281-0030 FAX: 864-281-0288

PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER PLYMOUTH	SYK	9/3/99	[illegible]	9/14/99	05101.01

INTERFACE FRICTION ANALYSES, SIDE SLOPE AGGREGATE & DOZER SUPPORT ANALYSES + ANCHOR TRENCH DESIGN



NOTE: 6 INCH SAND & 12 INCH SELECT ASH LAYER WILL BE PLACED JUST PRIOR TO WASTE PLACEMENT



DESIGN SHEET

SHEET 2 OF

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

PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER-PLYMOUTH	SYK	9/3/99	EWD	9/14/99	05101.01

DESIGN PARAMETERS TO BE USED IN ANALYSIS:

Ref #	Interface Description	Interface Friction Angle	SOURCE
δ_0	SOIL : GEOCUSHION	23°	ASSUMED VALUE
δ_1	Stone : GEOCUSHION	23°	ASSUMED VALUE
δ_2	GEOCUSHION: TEXT GEOMEMBRANE	36°	*
δ_3	TEXT GEOMEMBRANE : GCL	26°	TEST RESULT
δ_4	GCL: SANDY CLAY	25°	TEST RESULT

* ASSUMED BASED ON TREVIRA TECHNICAL NOTE
** GCL GEOTEXTILE IS WOVEN.

MATERIAL SPECIFICATIONS:

$\gamma_{STONE} = 125$ PCF

GEOCUSHION = 32 oz/SY

$\gamma_{COVER\ SOIL} = 110$ PCF

GEOMEMBRANE = 0.95 gm/cm²

$\gamma_{GCL} = 0.95$ lb/SF

BULLDOZER = 22,500 lb
(18" x 88" TRACKS)

GEOMEMBRANE = 0.06 INCHES THICK.

NOTE

DESIGN PARAMETERS NEED TO BE CONFIRMED VIA INTERFACE FRICTION TESTING OF ACTUAL MATERIALS TO BE USED.

DESIGN SHEET

SHEET 3 OF

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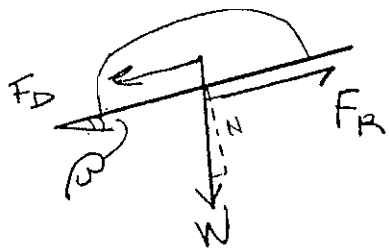
PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER PLYMOUTH	SYK	9/3/99	[illegible]	9/14/99	05101.01

CHECK INTERFACE BETWEEN STONE AND GEOCUSHION TO SEE IF SLIDING COULD BE A PROBLEM.



$\sin\beta = \frac{F_D}{W}$

$\cos\beta = \frac{N}{W}$

$F_R = N \tan\delta$

$T_R = F_D(FS) - F_R$

$0 = F_D(FS) - F_R$

$F_R = F_D(FS)$

$\cancel{W_T} \cos\beta \tan\delta = \cancel{W_T}(\sin\beta)(FS)$

$FS = \cos\beta \tan\delta / \sin\beta$

$F_D = W_T \sin\beta$

$F_R = W_T \cos\beta \tan\delta$

LET: $T_R = 0$

$\beta = 18.43°$

$\delta = 23°$

$FS = \cos 18.43° \tan 23° / \sin 18.43°$

$FS = 1.27 \gg 1.0$. STONE SHOULD NOT SLIDE ALONG THE GEOCUSHION : STONE INTERFACE

DESIGN SHEET

SHEET 4 OF

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PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
W EYERHAEUSER PLYMOUTH	SYK	9/3/99	GWD	9/14/99	05101.01

CHECK THE STRESS IN EACH LINER COMPONENT DUE TO ITS WEIGHT AND THE LOADING CONDITIONS ABOVE IT VERSES ITS LOWEST YEILD TENSION TO SEE THAT ITS NOT OVERSTRESSED.

$$T_R \leq T_{YEILD} \text{ OR } T_{ULT}$$

WHERE: T_R = NET DRIVING FORCE = $F_D - F_F$

WEIGHT OF EACH COMPONENT PER 1-FOOT WIDTH OF THE SECTION SHOWN ON SHEET 1

GEOCUSHION:

$$W_{T_{CUSH}} = \left[\frac{32\text{ oz}}{\text{SQ. YD.}} \cdot \frac{1\text{ lb}}{16\text{ oz}} \cdot \frac{1\text{ SQ. YD}}{9\text{ SQ FT}}\right]\left[\frac{20\text{ ft}}{\cos 18.43^\circ}\right]\left[1\text{ ft width}\right]$$

$$W_{T_{CUSH}} = 14.06 \text{ lbs.}$$

GEOMEMBRANE:

$$W_{T_{FML}} = \left[\frac{0.95\text{ gm}}{\text{cm}^3} \cdot \frac{1\text{ lb}}{454\text{ gm}} \cdot \frac{(2.54\text{ cm})^3}{(1\text{ in})^3} \cdot 0.06\text{ in} \cdot \frac{144\text{ in}^2}{1\text{ ft}^2}\right]\left[\frac{20\text{ ft}}{\cos 18.43^\circ}\right]\left[1\text{ ft width}\right]$$

$$W_{T_{FML}} = 18.74 \text{ lbs.}$$

STONE:

$$W_{T_{STONE}} = \left[125\text{ pcf} \cdot 1\text{ ft} \cdot \frac{20\text{ ft}}{\cos 18.43^\circ}\right]\left[1\text{ ft width}\right]$$

$$W_{T_{STONE}} = 7907.74 \text{ lb}$$

DESIGN SHEET

SHEET 5 OF

RMT®
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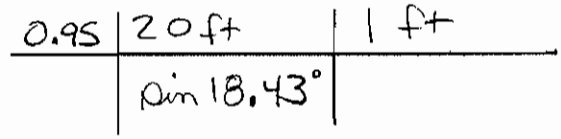
PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER PLYMOUTH	DYK	9/3/99	Eub	9/14/99	0501.01

GEOSYNTHETIC CLAY LINER (GCL)

$\gamma_{GCL} = 0.95 \text{ lb/ft}^2$

$W_{T_{GCL}} =$



$W_{T_{GCL}} = 60.10 \text{ lbs}$

DESIGN SHEET

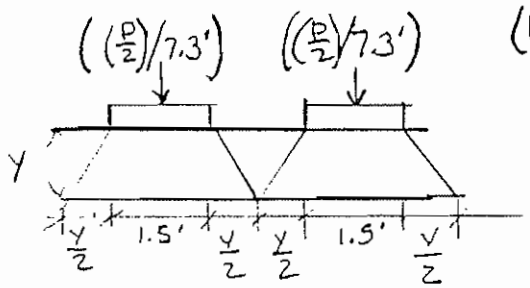
RMT
100 Verdae Boulevard P.O. Box 16778 Greenville, SC 29607-3825 Phone: 864-281-0030 FAX: 864-281-0286

PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER PLYMOUTH	AYK	9/3/99	BWD	9/14/99	05101.01

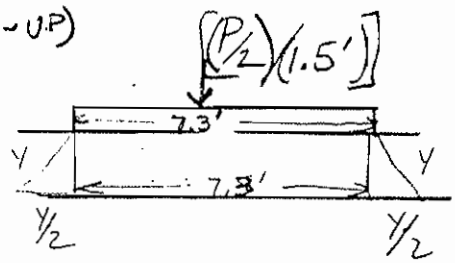
BULLDOZER DH 4 SERIES II (STRAIGHT BLADE)

TOTAL WT = 22,500 lb = P
BLADE CAPACITY = 2.5 cy = 67 ft³
TRACK WIDTH = 1.5 ft BLADE HT = 38 in =
TRACK LENGTH = 7.3 ft BLADE WIDTH = 8' 6"

(S ~ SIDE WAYS)



(U ~ UP)

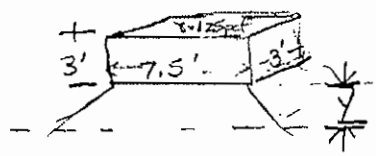


DETERMINE THE MAXIMUM TEMPORARY WEIGHT OF THE BULL DOZER IMPOSED ON THE LINER

$$W_{BD\,(S)} = \left[\left(\frac{P}{2}\right)/(7.3')\right]2 = 3082.19/1\text{ft WIDTH}$$

$$W_{BD\,(U)} = \left(\frac{P}{2}\right)/(1.5') = 7500.00/\text{ft WIDTH}$$

TEMPORARY STOCKPILE : (ASSUMED SIZE OF STOCKPILE MOVED BY DOZER)



$$W_{TSP\,(U)} = \frac{(3')(3')(7.5')(125\text{pcf})}{7.5\text{ft}} = 1125\#/1\text{ft width}$$

$$W_{TSP\,(S)} = \frac{(3')(3')(7.5')(125\text{pcf})}{3'\text{ width}} = 2813\ \frac{\text{lb}}{\text{ft width}}$$

DESIGN SHEET

SHEET 7 OF

RMT®
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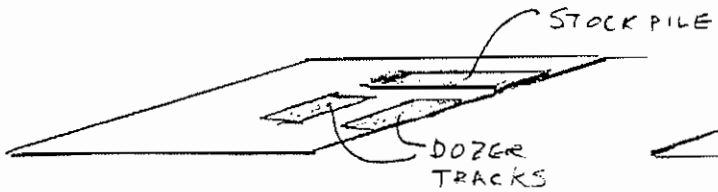
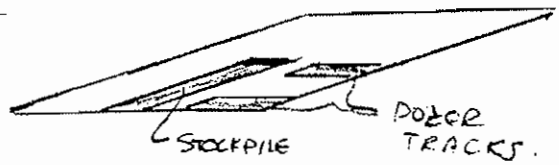
PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER - PLYMOUTH	SYK	9/13/99	EWD	9/14/99	25101.01

TEMPORARY LOADING SENARIOS.

UP (U)



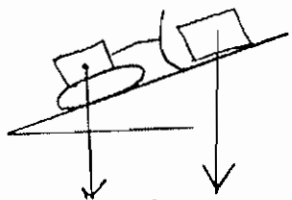
SIDEWAYS (S)



MAXIMUM TEMPORARY WEIGHT ON 1-FOOT WIDE SECTION

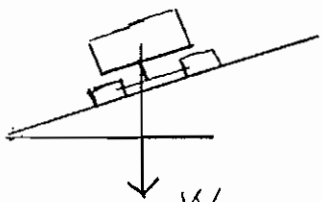
W_{TEMP} (U) = 7500# + 1125# = 8625# W_{TEMP} (S) = 3082 #

UP



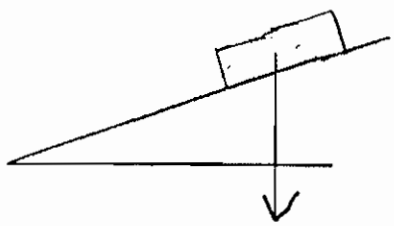
W_{DOZER} / 1 ft WIDTH + $W_{STOCKPILE}$ / 1 ft WIDTH

SIDEWAYS



W_{DOZER} / 1 ft WIDTH

OR



$W_{STOCKPILE}$ / 1 FT WIDTH

DESIGN SHEET

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

PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER PLYMOUTH	SYK	9/3/99	EWS	1/14/99	05101.01

COMPONENT	COMPONENT WT. / 1-FT. WIDTH (lbs)	W_T CUMMULATIVE NET WT. / 1-FT. WIDTH (lbs)	δ (degree)	F_D ($W_T \sin\beta$)	F_R ($W_T \cos\beta \cdot \tan\delta$)	T_R $\frac{(F_D - F_R)}{FS}$	T_Y	COMPONENT
TEMP. STOCKPILE	1125	↓	-	↓	↓	↓	↓	↓
BULLDOZER	7500	↓	-	↓	↓	↓	↓	↓
STONE	7908	↓	23°	↓	↓	↓	↓	↓
GEOCUSHION	14	16,547	36°	5,231	11,405	-6174* / 2.18	100	GEOCUSHION
GEOMEMBRANE (G)	19	16,566	26°	5237	7,665	-2428* / 1.46	1800	GEOMEMBRAN
GCL	60	16,626	25°	5256	7355	-2099* / 1.40	420	GCL
SANDY CLAY	—							

*NO TENSILE STRESS IN GEOSYNTHETIC COMPONENTS, COMPONENTS HELD ON SLOPE VIA FRICTION FORCES

$F_D = W_T \sin\beta$

$F_R = W_T \cos\beta \tan\delta$

where: $\beta = 18.43°$

T_Y = Tensile Yeild Strength of Component (from mfr's specifications)

T_R = Tensile Force Required in Component

$T_R = F_D - F_R$

DESIGN SHEET

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

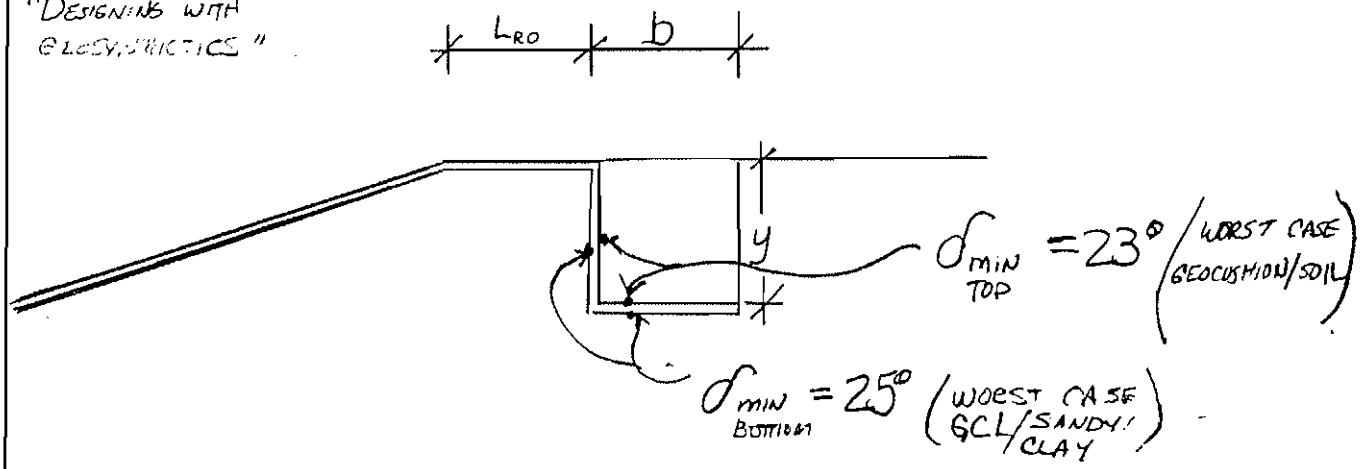
PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER - PLYMOUTH	SYK	9/17/99	CWJ	9/19/99	05101.01

DESIGN ANCHOR TENCH TO RESIST $T_{ALLOWABLE}$ OF THE GEOCUSHION: $T_{ALL} = (T_y / FS) = (100\ lbs / 1.3)$

$T_{ALL} = 77\ lbs$

ASSUME ALL GEOSYNTHETIC LAYERS GO INTO THE SAME ANCHOR TRENCH.
AND USE $\delta_o = 23°$ (GEOCUSHION TO SOIL) AS TOP FRICTION ANGLE
AND USE $\delta_y = 25°$ (GCL TO CLAYEY SAND) AS BOTTOM FRICTION ANGLE

KOERNER (1990)
"DESIGNING WITH GEOSYNTHETICS"



$$T_R = F_{U_{LRO}} + F_{L_{LRO}} + F_{U_{ATS}} + F_{L_{ATS}} + F_{U_{ATB}} + F_{L_{ATB}}$$

$$F_{U_{LRO}} = [d_c \gamma_{cs} L_{RO} \tan \delta_u]$$ ~ assumed negligible

$$F_{L_{LRO}} = [d_c \gamma_{cs} L_{RO} \tan \delta_L]$$

$$F_{ATS} = y K_o \gamma_{cs} (d_c + 0.5y) \tan \delta_{G/S}$$

$$F_{ATB} = (d_c \gamma_{cs} + y \gamma_c)\, b \tan \delta_{G/S}$$

DESIGN SHEET

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

PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER - PLYMOUTH	SYK	9/7/99	CWD	9/14/99	05101.01

where:

T_R = required tensile strength $= T_{ALL}$
$F_{U_{LRO}}$ = horizontal tension force above geosynthetic, along runout length
$F_{L_{LRO}}$ = " " " below " " " "
F_{ATS} = frictional force along side of anchor trench
F_{ATB} = " " " bottom " " "
$\delta_{G/S}$ = interface friction angle between soil & geosynthetic
b = width of anchor trench
y = depth of anchor trench
L_{RO} = runout length (3 ft min)
d_c = depth of cover soil
δ = interface friction angle
K_0 = lateral earth pressure coefficient $\cong (1 - \sin\phi)$
ϕ = angle of shear resistance of backfill

The following parameters are used in this analysis

$T_R = 77$ lbs/1-ft width
$\gamma_{CS} = 110$ pcf
$\delta_u = 23°$
$\delta_L = 25°$

$\phi = 30°$
$K_0 = (1 - \sin 30°) = 0.5$
$L_{RO} = 3$ ft

$d_c = 0$, since cover soil on top of anchor trench and dike will not likely be placed immediately after geomembrane installation (because of QA/QC reqmts), thus, it is not considered in determining the anchor trench pull out resistance.

DESIGN SHEET

SHEET 11 OF

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WEYERHAEUSER - PLYMOUTH	JYK		CWB	9/14/99	05101.01

$$T_R = \cancel{F_{U_{LRO}}}^{0} + \cancel{F_{L_{LRO}}}^{0} + F_{U_{ATS}} + F_{L_{ATS}} + F_{U_{ATB}} + F_{L_{ATC}}$$

$$T_R = y K_o \gamma_{cs} (0.5y)[\tan\delta_u + \tan\delta_L] + y\gamma_{cs} b(\tan\delta_u + \tan\delta_L)$$

$$77 = y(0.5)(110)(0.5)(y)[\tan 23^\circ + \tan 25^\circ] + y(110)(b)(\tan 23^\circ + \tan 25^\circ)$$

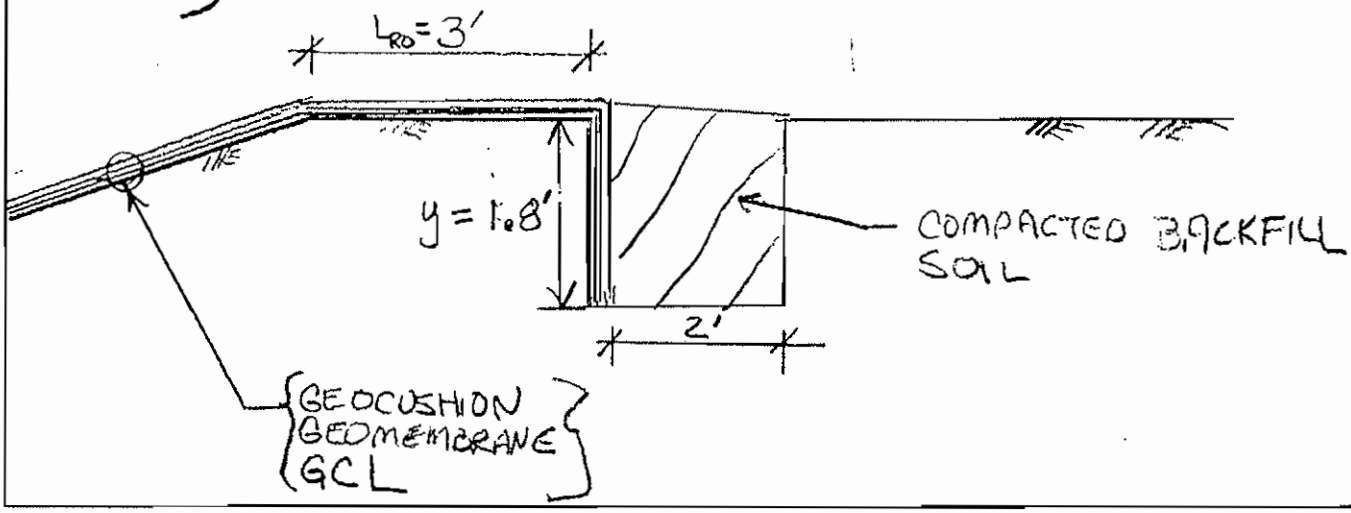
$$77 = y^2(24.5) + y(98.0)(b)$$

$$b = \frac{77 - (24.5)y^2}{y(98.0)}$$

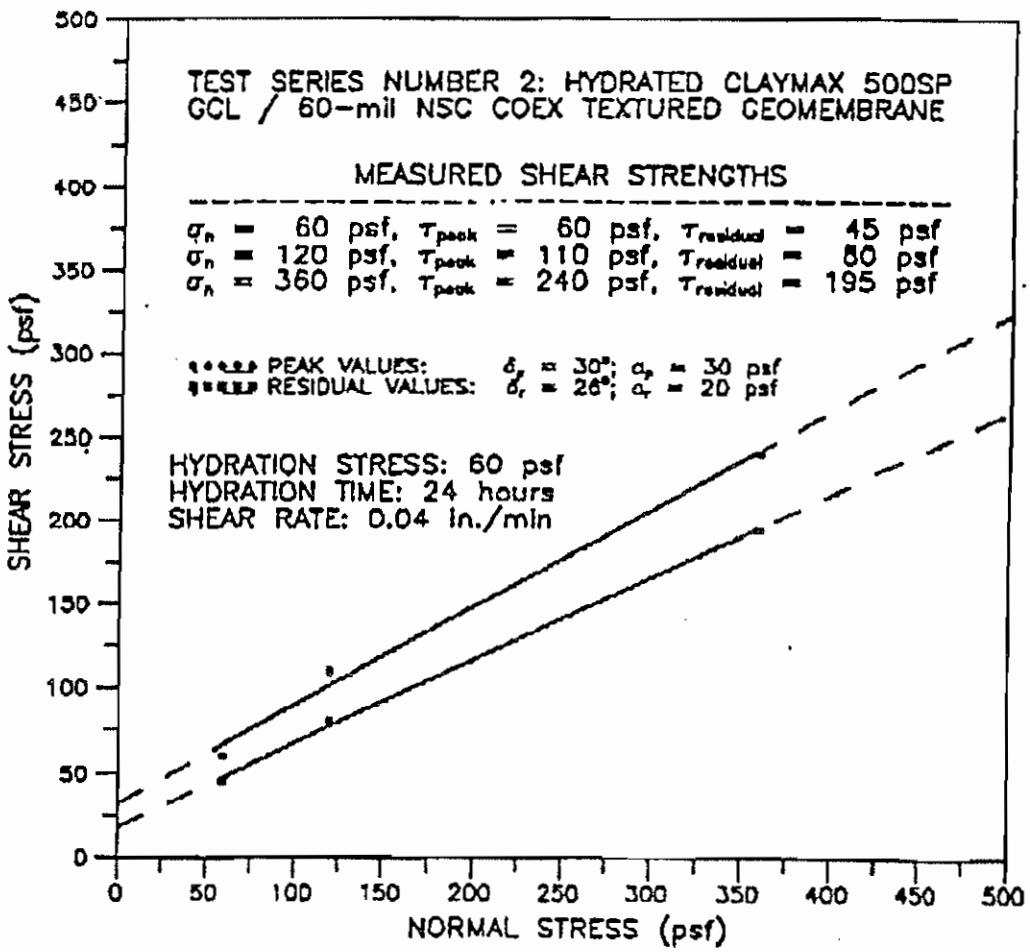
let "y" equal (feet)	solve for "b" (feet)
0.5'	1.44'
1.0'	0.54'
0.67	1.00'

ASSUME WIDTH OF ANCHOR TRENCH IS NEGLIGIBLE (b = 0) — THE GEOSYNTHETICS ARE INSTALLED ONLY ALONG THE SIDEWALL OF THE ANCHOR TRENCH

$$y = (77/24.5)^{1/2} = 1.77 \text{ ft} \simeq 22 \text{ INCHES}.$$



RMT, INC.
INTERFACE DIRECT SHEAR TESTING



NOTE: The reported value of adhesion may not be the true adhesion of the interface, and caution should be exercised in using this adhesion value for applications involving normal stresses outside the range of stresses covered by the test.

DATE TESTED: 7 JULY 1993

GEOSYNTEC CONSULTANTS
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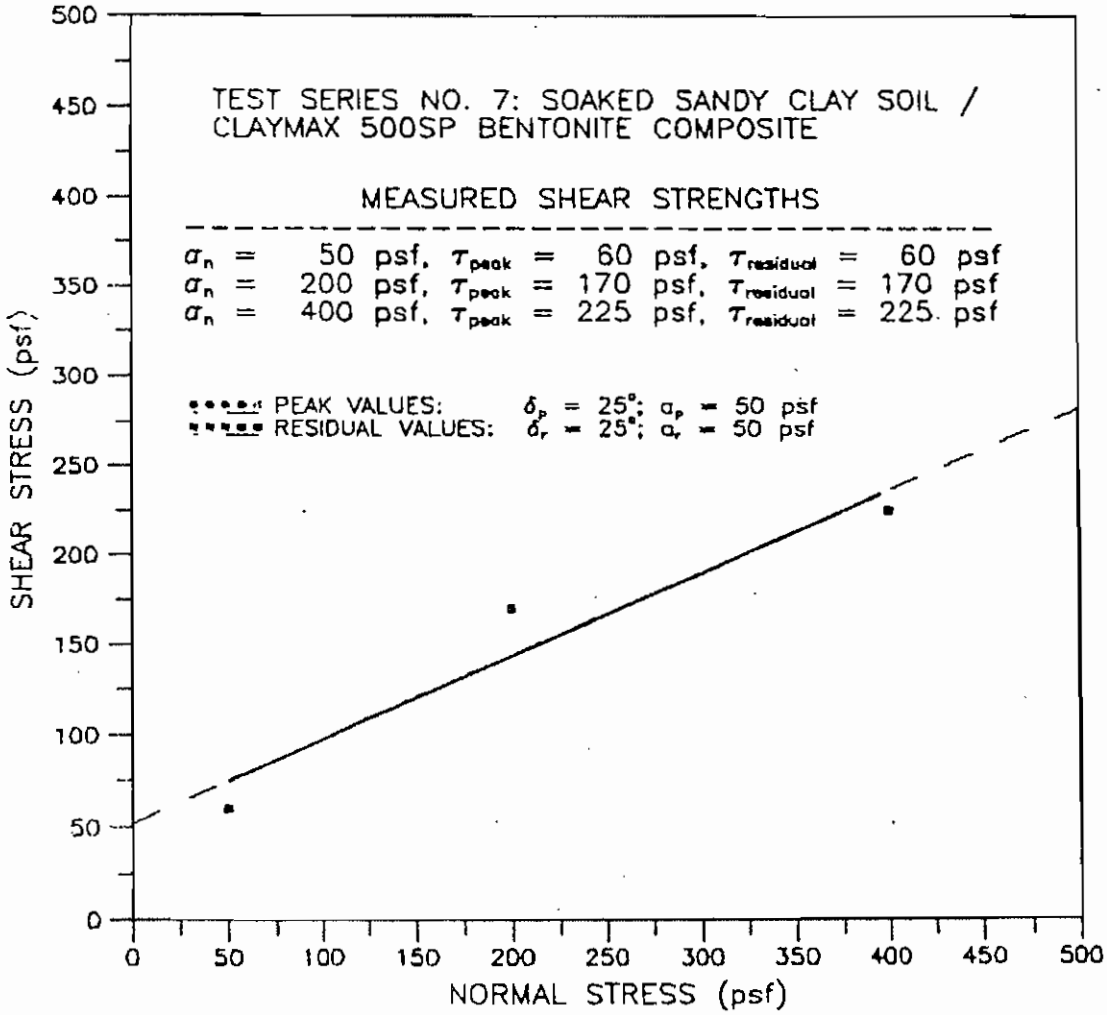
FIGURE NO.	A-4
PROJECT NO.	GL3410
DOCUMENT NO.	
PAGE NO.	

JAMES CLEM CORPORATION
INTERFACE DIRECT SHEAR TESTING



NOTE: The reported value of adhesion may not be the true adhesion of the interface, and caution should be exercised in using this adhesion value for applications involving normal stresses outside the range of stresses covered by the test.

DATE TESTED: NOVEMBER 1992

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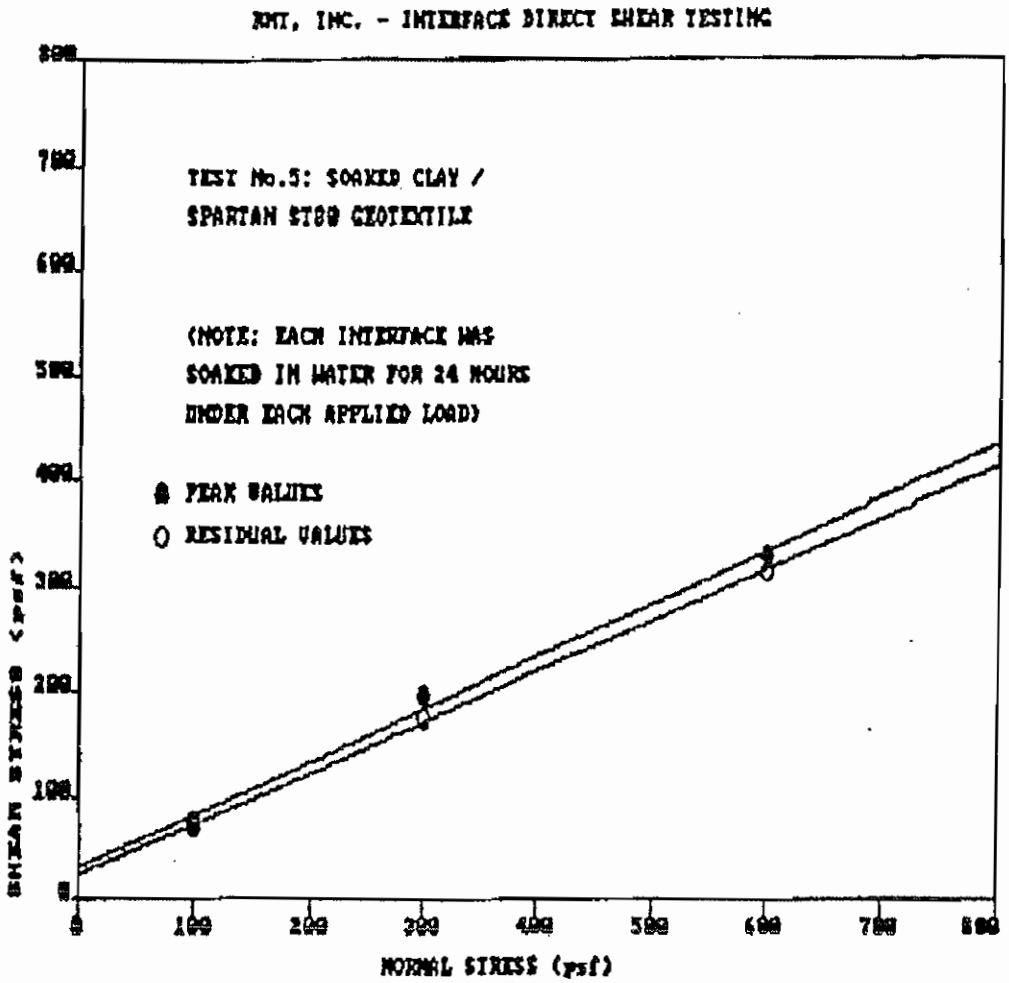
FIGURE NO.	B-13
PROJECT NO.	GL3160
DOCUMENT NO.	GEL92211
PAGE NO.	



THE REGRESSION POLYNOMIAL OF LINE 7 - PEAK VALUES

(3.158E+01) + (5.053E-01)*X
THE VARIANCE - 7.105E+01

a = 30 PSF δ = 27°

THE REGRESSION POLYNOMIAL OF LINE 8 - RESIDUAL VALUES

(2.395E+01) + (4.882E-01)*X
THE VARIANCE - 1.075E+01

a = 25 PSF δ = 26°

TREVIRA® SPUNBOND

TECH NOTE

Hoechst Celanese Corporation
P.O. Box 5650 Spartanburg, SC 29304-5650

Soil/Geosynthetic Interface Friction By Direct Shear

Test Procedure: The coefficient of friction between a geosynthetic and soil (see Table 1) or between ar combination of geosynthetics selected by the user is determined by placing the geosynthetic and one o more contact surfaces within a 12" x 12" direct shear box. A constant, normal compressive stress is applied to the specimen and a tangential (shear) force is applied to the apparatus so that one section o the box moves in relation to the other section. The shear force is recorded as a function of the deflectio of the moving section of the shear box. The test is performed for a minimum of three different, normal stresses selected by the user (100, 200, and 250 psf were used here) to model appropriate field conditions. The peak (or residual) shear stresses recorded are plotted against the applied, normal compressive stresses used for testing. The test data generally forms a straight line whose slope is the coefficient of friction, μ, between the two materials where the shearing occurred. The y-intercept of the plot is the adhesion, a. The equivalent friction angle, δ, is calculated as: $\delta = \tan(\mu)$.

Related Test: Interlock Friction by Pullout is a related test used primarily with geogrids. Generally, for geotextiles, the direct shear test provides more conservative (lower) results than the pullout test.

Results of Tests Performed by Georgia Institute of Technology

SLIDING SURFACE	μ	δ (deg.)	a (psf)
Ottowa Sand/TREVIRA® 011/140	0.51	27	68
Ottowa Sand/Trevira 011/550	0.68	34	21
Glatial Till/Trevira 011/140	0.76	37	32
Glatial Till/Trevira 011/550	0.75	37	10
Gulf Coast Clay/Trevira 011/140	0.98	43	62
Gulf Coast Clay/Trevira 011/550	1.26	52	45
MDPE Geonet*/Trevira 011/140	0.46	25	29
HDPE Geonet*/Trevira 011/140	0.32	18	39
HDPE Geomembrane/Trevira 011/550	0.17	10	0
Embossed HDPE Geomembrane/Trevira 011/550	0.72	36	18
Trevira®011/550 / Trevira®011/550**	0.33	18	13
Typar 3401/Typar 3401**	0.19	11	44
Mirafi 600X/Mirafi 600X**	0.29	16	60

* Avg. of 3 different confining soils. ** Glatial Till used as confining soil.

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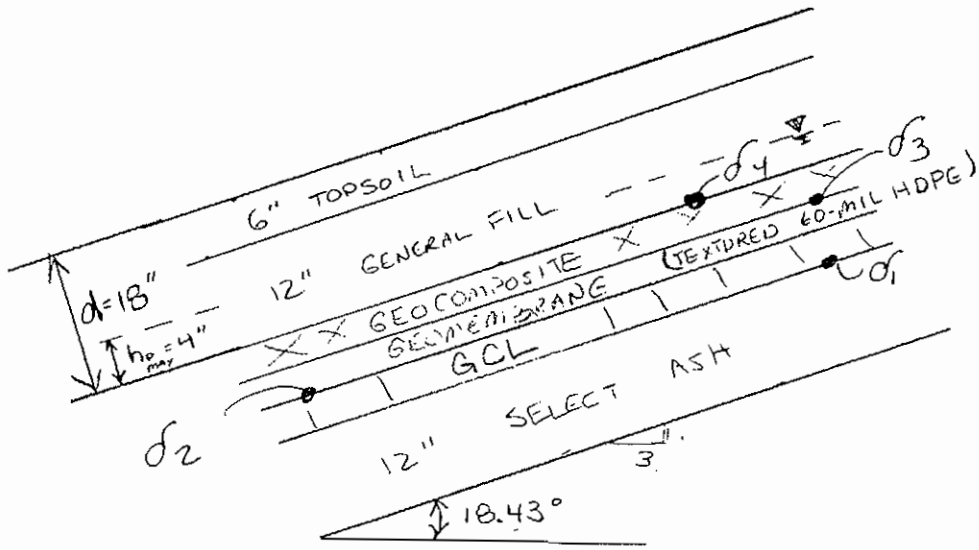
INTERFACE FRICTION ANALYSIS OF PROPOSED CAP



INTERFACE COMPONENT	INTERFACE FRICTION	SOURCE
SELECT ASH (GRANULAR) / GCL	$\delta_1 = 33°$	*
GCL / TEXTURED GEOMEMBRANE	$\delta_2 = 26°$	TEST RESULT
TEXTURED GEOMEMBRANE / GEOCOMPOSITE	$\delta_3 = 36°$	*
GEOCOMPOSITE / GENERAL FILL (SANDY)	$\delta_4 = 34°$	*

* ESTIMATED BASED ON LITERATURE

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WEYERHAEUSER - PLYMOUTH	SYK	6/23/99	RKN	7/8/99	05101.01

GENERAL EQUATION:

$$FS_{MIN} = \frac{\tan \phi_{min}}{\tan \beta}\left[1 - \left(\frac{\gamma_w h_p}{\gamma \cdot d}\right)\cdot\left(\frac{1}{\cos^2 \beta}\right)\right]$$

where: $\gamma_w = 62.4$ pcf
$d = 1.5$ ft
$\phi_{min} = 26°$
$\beta = 18.43°$ (3H:1V SIDE SLOPE

FS = factor of safety

assume: $h_p \leq 4$ inches
$\gamma = 110$ pcf

$$FS_{MIN} = \frac{\tan 26°}{\tan 18.43°}\left[1 - \frac{(62.4)(0.333')}{(110)(1.500')}\cdot\frac{1}{\cos^2(18.43)}\right]$$

$FS_{MIN} = 1.25 \geq 1.20$ OK

Appendix F
Groundwater Flow Model for Liner Design

RMT®
Integrated Environmental Solutions

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Greenville, SC
Telephone: 864-281-0030
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GROUNDWATER FLOW MODEL FOR LINER DESIGN

WEYERHAEUSER COMPANY
PLYMOUTH, NORTH CAROLINA

PREPARED BY RMT, INC., NORTH CAROLINA

September 1999

NORTH CAROLINA PROFESSIONAL SEAL No. 17543 ENGINEER R. KENT NILSSON

R. Kent Nilsson, P.E.
Project Manager

Jon A. Freitag
Groundwater Scientist

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Certification

The hydrogeology work for the Weyerhaeuser Company, Plymouth, North Carolina, site was performed by an RMT, Inc. Consulting Hydrogeologist in support of RMT, Inc., North Carolina.

Dan O. Madison, Jr., P.G.
Consulting Hydrogeologist
RMT, Inc.

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GEOLOGIST
DAN O. MADISON, JR.
9/22/99

Table of Contents

1. Introduction 1

2. Model Setup 2
   - 2.1 Grid Layout 2
   - 2.2 Groundwater Flow Calibration 2
   - 2.3 Parameter Assignments 4
   - 2.4 Boundary Conditions 5

3. Predictive Simulations 23

List of Figures

Figure 1 Model Grip and Base Map 7
Figure 2 Model Layers 8
Figure 3 Modeled Water Level Residuals 9
Figure 4 Qualitative Calibration Evaluation 10
Figure 5 Quantitative Calibration Evaluation 11
Figure 6 Modeled Water Table Configuration 13
Figure 7 Hydraulic Conductivity Distribution (Layers 1 through 3) 14
Figure 8 Hydraulic Conductivity Distribution (Layer 4) 15
Figure 9 Hydraulic Conductivity Distribution (Layer 5) 16
Figure 10 Boundary Conditions (Layer 1) 17
Figure 11 Boundary Conditions (Layer 2) 18
Figure 12 Boundary Conditions (Layer 3) 19
Figure 13 Boundary Conditions (Layers 4 through 5) 20
Figure 14 Drainage Enhancements (Layer 1) 24
Figure 15 Drainage Enhancements (Layer 2) 25
Figure 16 Drawdown Resulting from Drainage Enhancements 26
Figure 17 Predictive Water Table Configuration with Drainage Enhancements 27
Figure 18 Modeled Water Table Configuration with Drainage Enchancements 28

List of Tables

Table 1 Summary of Observed and Calculated Hydraulic Head....12
Table 2 Summary of General Head Boundary Conditions....21
Table 3 Summary of River Boundary Conditions....22
Table 4 Summary of Drain Boundary Conditions....22

Section 1
Introduction

Groundwater modeling was performed to aid in the design of proposed Landfill No. 3, at the Weyerhaeuser Company's (Weyerhaeuser's) Facility located in Plymouth, North Carolina. Drainage restoration along the southeast side of proposed Landfill No. 3 was conducted during the spring of 1999 in an attempt to lower the water table in the vicinity of the drainage ditch. Groundwater modeling was used to assess the long-term configuration of the water table resulting from the drainage restoration. Steady state simulations were run since the rate of change was not important for this evaluation. Results from the predictive groundwater simulations were used in conjunction with historical water levels to design the liner of the proposed landfill. Using the model results for the design basis allows for a lowering of landfill base grades, while complying with applicable regulatory requirements. Optimized base grades will increase the landfill capacity and reduce fill requirements for construction.

Groundwater modeling was conducted using MODFLOW (McDonald and Harbaugh, 1988), which is a three-dimensional finite difference numerical model. The model setup was completed using Visual MODLFOW (version 2.8), by Waterloo Hydrogeologic, which is a pre-processor and post-processor for MODFLOW.

Section 2
Model Setup

2.1 Grid Layout

The modeled area extends from Welch Creek in the west to Little Mill Creek in the north and east, and approximately 300 feet south of the proposed Landfill No. 3 footprint. The model grid encompasses an area of 5,500 feet in the X – direction and 6,000 feet in the Y – direction. Grid spacing ranges from 25 to 100 feet with 58 rows and 85 columns. A finer grid spacing (25 feet) was used in the vicinity of the drainage enhancements and increased by a factor of 1.5 to the maximum spacing (100 feet). The refined grid spacing allowed the assignment of drain nodes consistent with the dimensions of the drainage ditch and more resolution in model-calculated hydraulic heads near drainage enhancements, where steeper gradients would be imposed on the hydrogeologic system. The model grid also includes five layers, which comprise the shallow, unconfined aquifer, with uniform layer thicknesses ranging from 10 to 15 feet and a total thickness of 65 feet. The layout of the model grid in map view is illustrated in Figure 1. A cross-sectional schematic of the model grid layers is illustrated in Figure 2.

2.2 Groundwater Flow Calibration

Following the initial assignment of hydraulic parameters and boundary conditions, numerous simulations were run during the calibration process. Hydraulic conductivity values, zonation, and boundary conditions were adjusted iteratively until model calibration was achieved. The types of boundary condition assignments, and specific parameters within a given boundary condition were also changed during the calibration process. The final calibrated groundwater model demonstrated a good match between modeled and observed hydraulic heads for water level measurements taken in April 1993. The April 1993 water level data were used for the model calibration, because it represents the highest water levels measured at the site to date. The resulting calibrated model will therefore be conservative with respect to the water level elevations.

Model calibration was performed with the assistance of WinPEST, an automated parameter estimation package. WinPEST, developed by Watermark Numerical Computing, was run within Visual MODFLOW to optimize parameter values using nonlinear parameter estimation techniques. Groundwater flow models are inherently nonlinear problems due to the heterogeneity and anisotropy of most hydrogeologic systems. Parameter estimation for

nonlinear problems is performed by linearizing the relationship between model parameters and model-generated observations. The problem is linearized by calculating derivatives of all observations with respect to all of the model parameters. The linearized problem is then solved for better parameter set by running the model again, while reducing the difference between model-calculated observations and field-measured observations.

WinPEST was used to optimize the hydraulic conductivity values for each of the zones defined in the model layers. Aquifer recharge resulting from the direct infiltration of precipitation is generally more homogeneous than hydraulic conductivity values, and is easier to estimate based on precipitation data. Therefore, WinPEST was not used to optimize recharge estimates. No constraints were placed on the range of hydraulic conductivity values generated by WinPEST during optimization runs. This approach provided an indication of how reasonable the assignment of parameter zonations and boundary conditions were. If an optimization run resulted in hydraulic conductivity values beyond the expected range of a given material, the boundary conditions and parameter zonations were reevaluated. WinPEST allowed model calibration to be completed more efficiently and with greater accuracy than most likely could have been achieved manually.

The difference between observed hydraulic heads and model-generated hydraulic heads, residuals, range from 0.65 feet to 2.52 feet. The maximum and minimum residuals are 10 percent and 2.5 percent, respectively, of the range of water levels measured at the site in April 1993. This indicates that the variability between the response of the modeled hydrogeologic system and the actual hydrogeologic system is relatively small. Table 1 summarizes the calculated and observed hydraulic heads, and the residuals for each of the 13 monitoring wells, which had water levels measured during April 1993. The distribution of residuals is illustrated in Figure 3. The areas with the largest residuals are centered around LF0-04 and MW-5, which are both in the vicinity of large hydraulic gradients. These two areas are also outside of the landfill footprint, where precise modeled water levels are not as important. Figure 4 illustrates contours of model-calculated hydraulic heads and observed hydraulic heads from April 1993, at the locations of existing monitoring wells used in the model calibration. The two sets of contours overlay each other very closely. The similarity between the two sets of contours indicates, qualitatively, that the calibrated model produces a hydraulic head distribution similar to the observed hydraulic head distribution.

The model calibration was also evaluated quantitatively. Figure 5 illustrates a scatter plot of model-calculated hydraulic heads and observed heads. A linear trendline was fit to the hydraulic head data with a correlation coefficient of 0.98. The fit of the trendline to the hydraulic head data is indicative of the excellent match between calculated and observed

hydraulic heads. The following three statistics were also calculated to evaluate the model calibration in a quantitative manner: 1) mean error, 2) mean absolute error, and 3) root mean squared. These statistics are defined below:

Mean Error $$ME = \frac{1}{n}\sum_{i=1}^{n}(h_o - h_c)$$

Mean Absolute Error $$MAE = \frac{1}{n}\sum_{i=1}^{n}\left|(h_o - h_c)_i\right|$$

Root Mean Squared $$RMS = \left[\frac{1}{n}\sum_{i=1}^{n}(h_o - h_c)_i^2\right]^{1/2}$$

The mean error describes the average residual (in this case, the average residual hydraulic head) throughout the model. It tends to characterize error on the low side since positive and negative residuals negate each other. The mean absolute error provides a more accurate indication of the average magnitude of error, by averaging the absolute value of each residual. The root mean squared, also known as the standard deviation, is the average of the squared differences in observed and model-calculated hydraulic heads.

The calibration statistics are summarized in Table 1. These statistics range from 0.4 percent to 6.6 percent of the observed range in water levels at the site. Each of the methods of evaluating the model calibration indicate that the current configuration of boundary conditions and hydraulic parameters result in a response from the model that closely resembles the observed groundwater flow system at the site. The modeled water table configuration from the calibrated groundwater model is illustrated in Figure 6. This configuration is based on model-calculated hydraulic heads at each node throughout the modeled area.

2.3 Parameter Assignments

Hydraulic parameters were assigned to the active cells within the modeled area. The hydraulic parameters include hydraulic conductivity zones, which varied between each layer and within individual layers. Initial assignments were made based on hydraulic conductivity estimates from single well response tests and the general configuration of the water table surface as mapped in April 1993. Hydraulic conductivity values and zonation were changed during the calibration process until a good match between modeled and observed hydraulic heads was achieved. The final hydraulic conductivity zonation and associated hydraulic conductivity values for each layer are illustrated in Figures 7, 8, and 9.

2.4 Boundary Conditions

Six types of boundary conditions were used in the setup of the groundwater flow model: 1) no flow, 2) general head, 3) constant head, 4) rivers 5) drains, and 6) recharge. These boundary conditions were used to simulate a range of hydrogeologic conditions, such as surface water/groundwater interactions, regional groundwater flow, and groundwater streamlines. The boundary condition assignments are illustrated in Figures 10, 11, 12, and 13.

General head boundary conditions were used to simulate regional groundwater flow into and out of the modeled area. General head boundary conditions were used along the southern boundary to simulate regional groundwater flow into the site, and along the east boundary to simulate groundwater flow out of the modeled area. Groundwater underflow beneath the two creeks was also represented using a general head boundary condition. The conductance values assigned to general head boundary nodes range from 42 to 500 ft^2/day. Values assigned to the general head boundaries are summarized in Table 2.

Constant head boundary conditions were used to simulate regional groundwater flow into the modeled area along the southeastern corner of the model. The use of a constant head boundary condition also provides the model a reference elevation for the calculation of hydraulic heads for steady state simulations. The exclusive use of general head boundary conditions in steady state simulations may result in a non-unique solution because both the groundwater flow equations and boundary conditions would be written as differences in hydraulic heads. Constant head boundary assignments ranged from 35 feet to 27.5 feet.

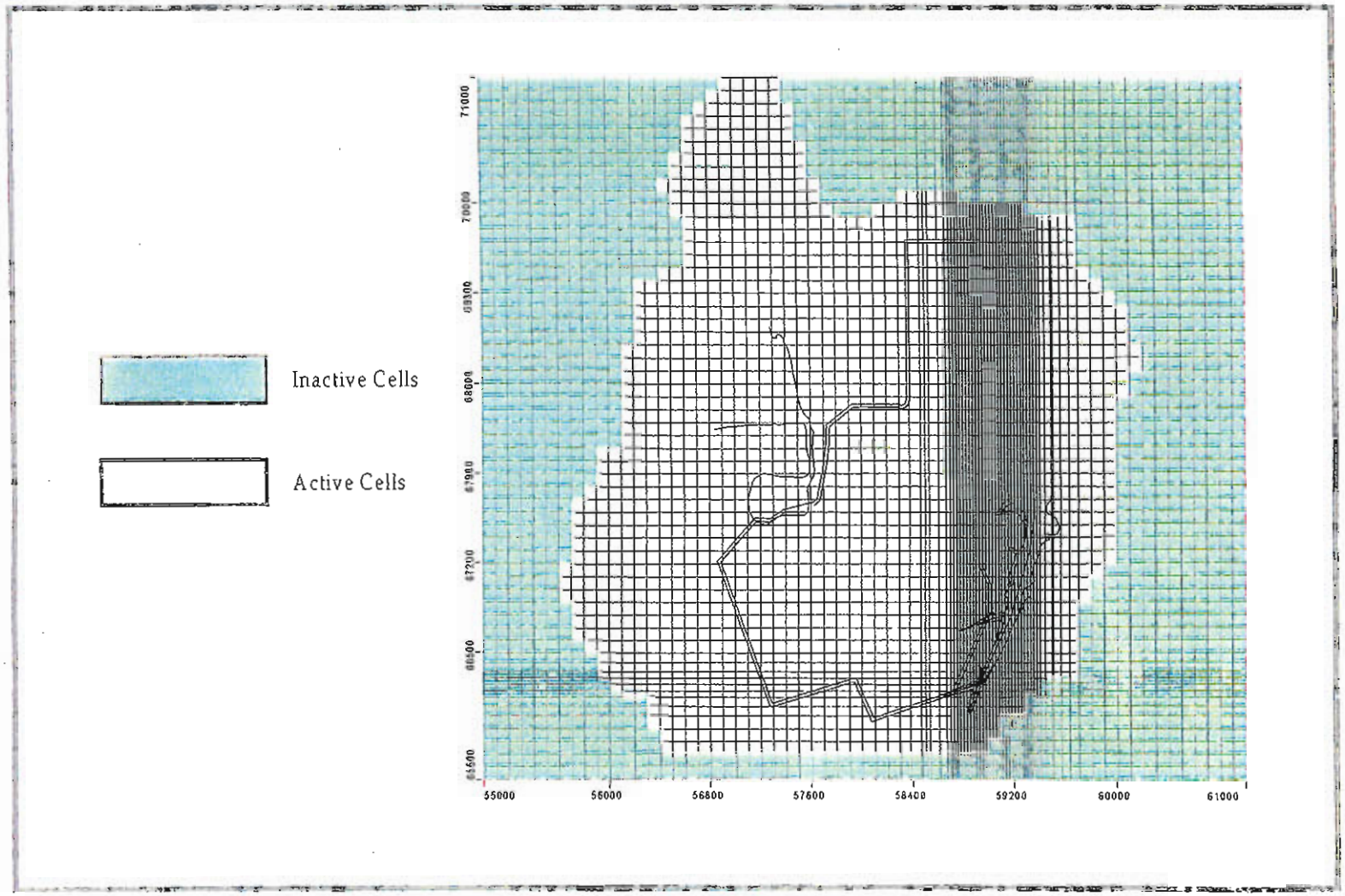
River boundary conditions were used to represent groundwater interactions with Welch Creek, which borders the site to the west, and Little Mill Creek, which borders the site to the north and northeast. Both of these creeks appear to be discharge points for groundwater based on groundwater elevations near the creeks that are greater than the adjacent creek stage. Values assigned to the river stage at nodes representing Welch creek ranged from 4 feet in the southwest to 2 feet at the confluence with Little Mill Creek. Values assigned to the river stage at nodes representing Little Mill Creek ranged from 5 feet in the east to 2 feet at the confluence with Welch Creek. The creek stage assignments were based on staff gauge measurements and supplemented with the water table configuration as mapped in April 1993. The creek sediment thickness was assumed to be a uniform 2 feet along the entire length of each creek, and the conductance at each node ranged from 125 to 342 ft^2/day. Values assigned to river nodes are summarized in Table 3.

Drain boundary conditions were used to represent groundwater discharge into low-lying areas and ditches where seepage faces would be expected based on the water table configuration at the site. Drain nodes were incorporated into the model in Layer 1 and Layer 2 in the north central part of the modeled area, where an elongated depression is observed in the water table configuration as mapped in April 1993. The topography in this portion of the site indicates a ditch or low-lying area where groundwater most likely discharges during periods of elevated groundwater levels. Drain conductances were uniformly assigned a value of 1,000 ft^2/day. Values for drain elevation and conductance assignments are summarized in Table 4.

No flow boundary conditions were used to represent groundwater streamlines and impermeable contacts. Streamlines run parallel to the direction of groundwater flow, and by definition are oriented perpendicular to equipotential lines. Streamlines therefore represent no flow boundaries, which were assigned along relatively short sections of the perimeter of the modeled area in the southeast and southwest, based on the water table configuration. The base of Layer 5 is also a no flow boundary, representing the contact with a clay unit situated beneath the materials comprising the water table aquifer.

A recharge boundary condition was used to represent the infiltration of precipitation at the site. Recharge enters the modeled area through the highest active cells, which are typically in Layer 1. Recharge was uniformly assigned as 7.5 inches per year over the entire modeled area. The 7.5 inches per year represent precipitation to the modeled area, which infiltrates down to the water table. The recharge to the site is lower than the total precipitation due to runoff and evapotranspiration.

Figure 1
Weyerhaeuser - Plymouth, NC



Model Grid and Base Map

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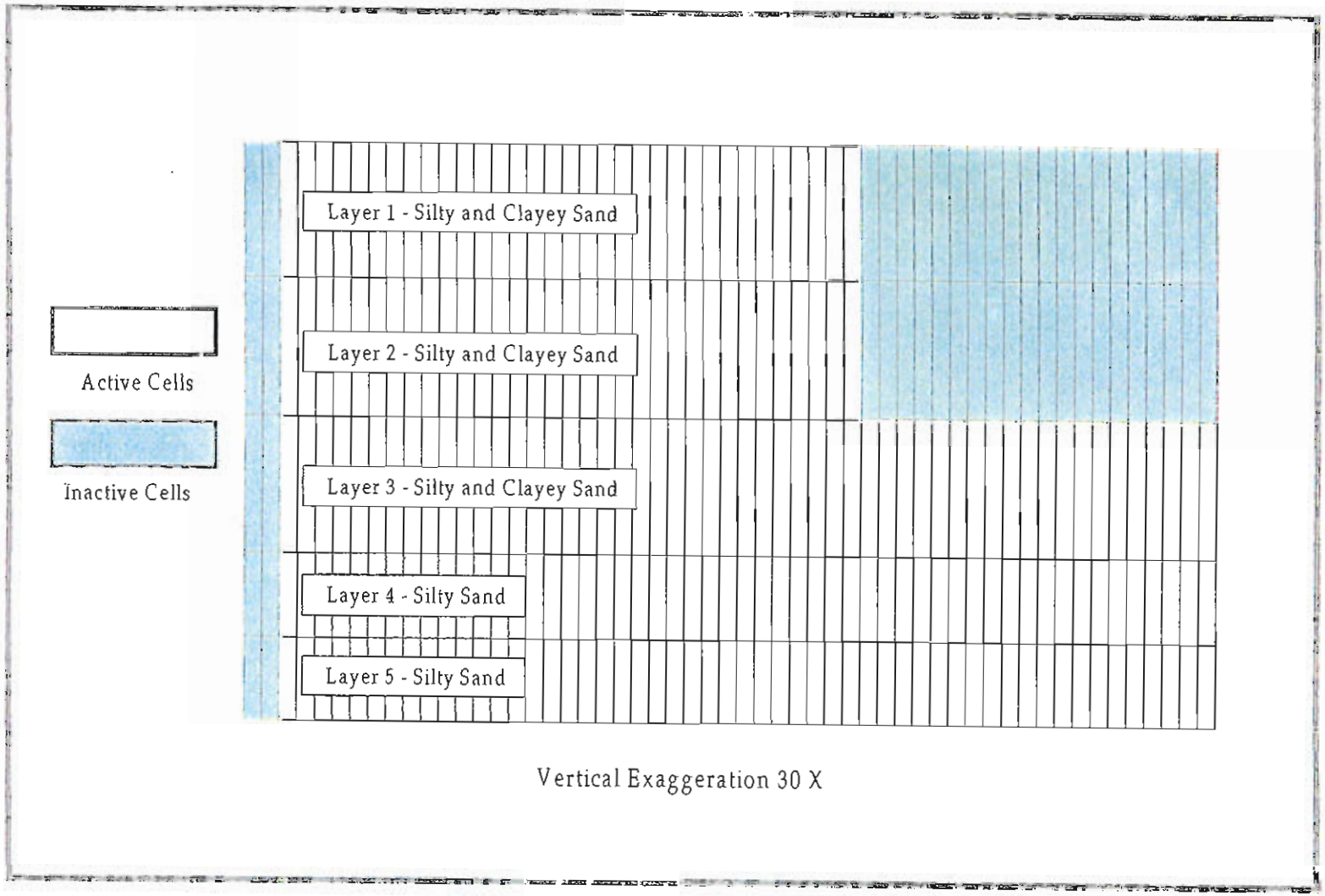
Figure 2
Weyerhaeuser - Plymouth, NC



Model Layers

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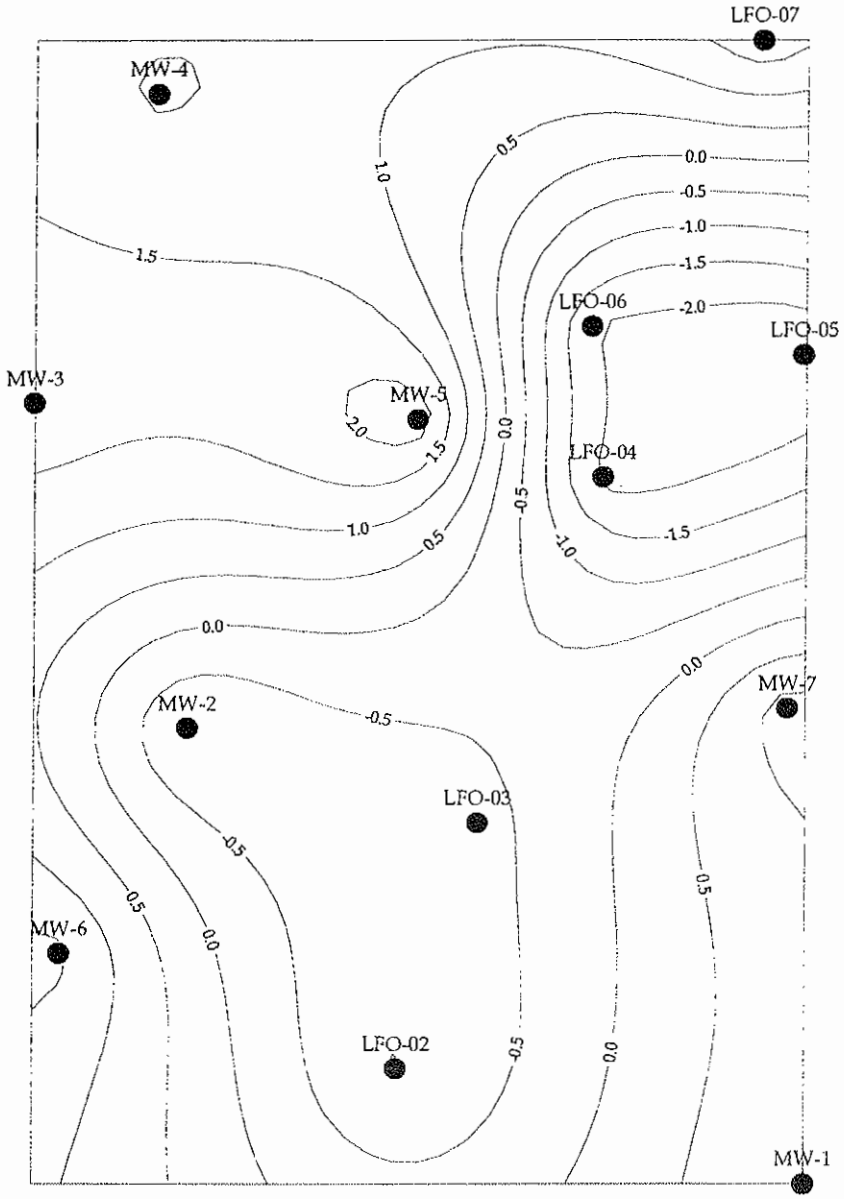
Figure 3
Weyerhaeuser - Plymouth, North Carolina



Modeled Water Level Residuals (feet)

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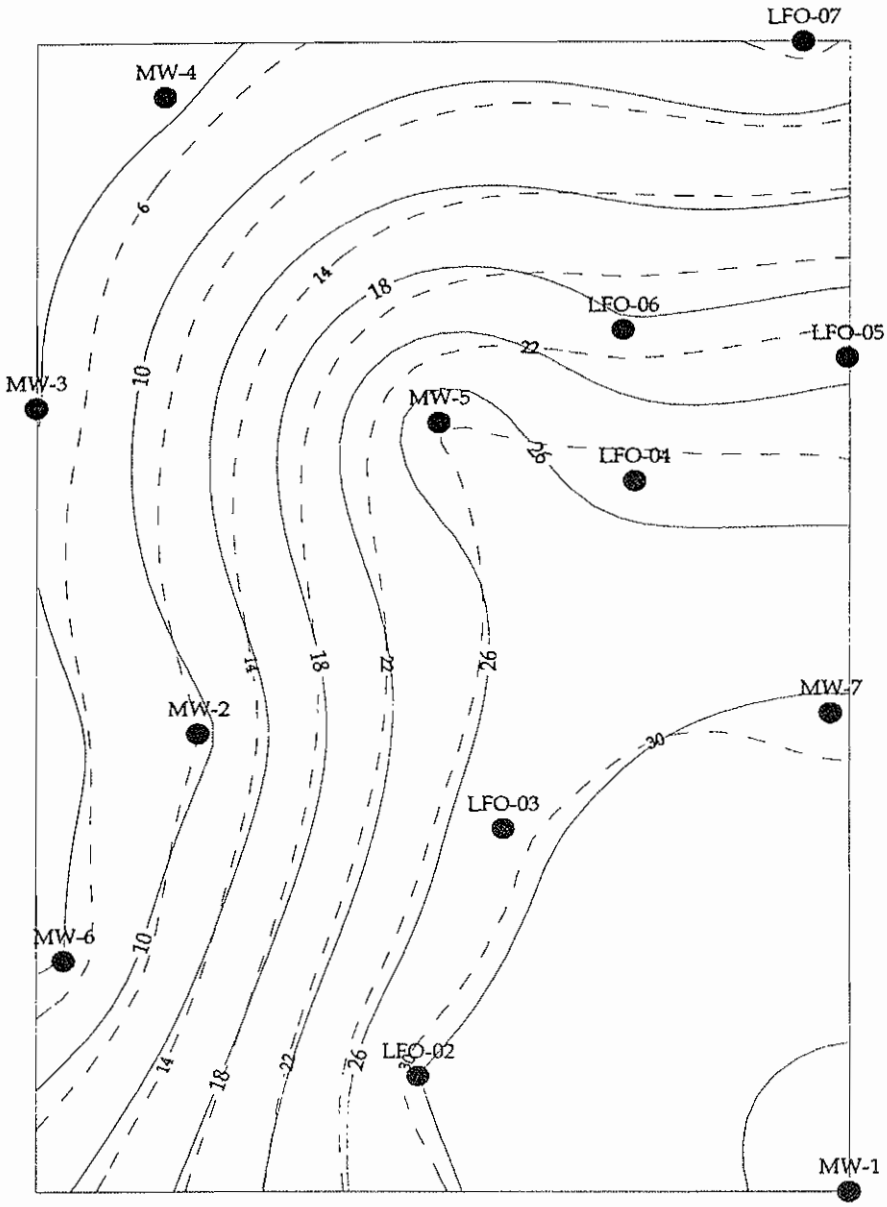
Figure 4
Weyerhaeuser - Plymouth, North Carolina



Qualitative Calibration Evaluation

Modeled Water Levels

Observed Water Levels - April 1993

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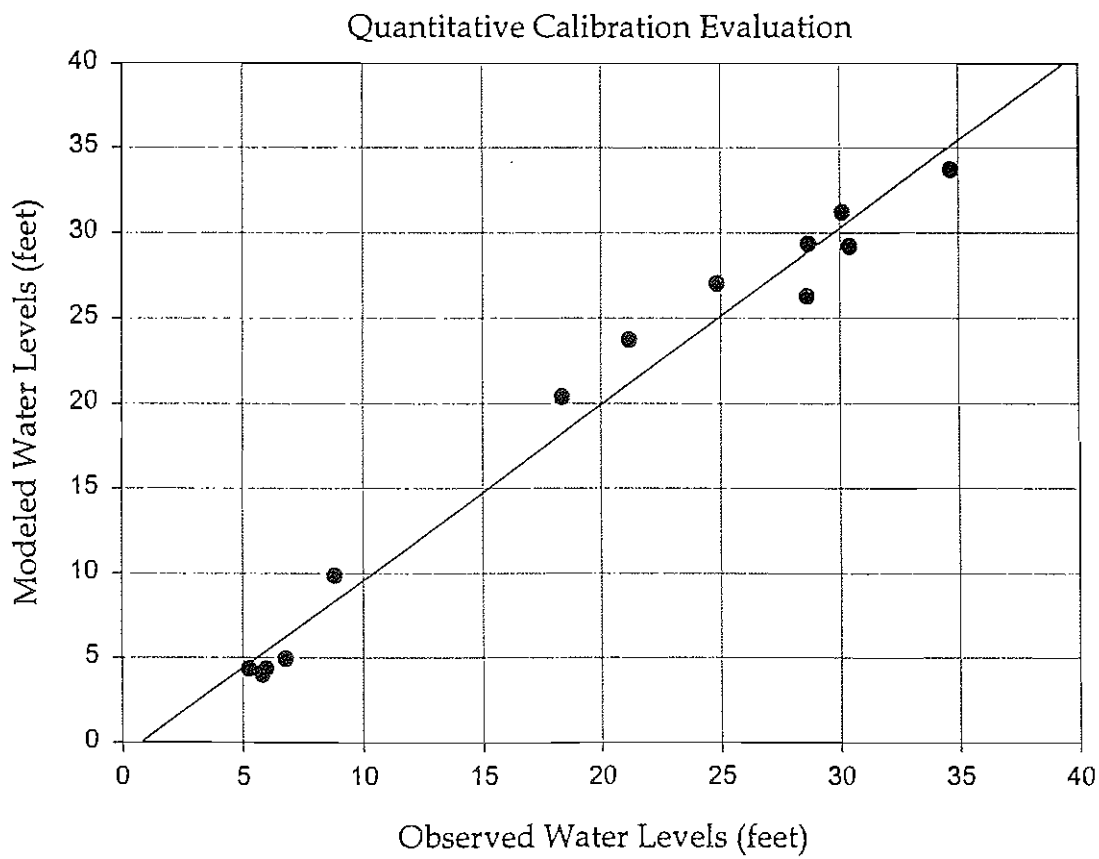
Figure 5
Weyerhaeuser - Plymouth, NC



Correlation Coefficient 0.98
Mean Error 0.11 (ft)
Mean Absolute Error 1.56 (ft)
Root Mean Squared 1.66 (ft)

RMT

G:\Data\Hydro\5101\model\doc\calbr.jnb

Table 1
Summary of Observed and Calculated Hydraulic Head

Well Number	Observed Head[1]	Calculated Head[1]	Residual[1]
LFO-2	30.1	31.15	-1.05
LFO-3	28.67	29.32	-0.65
LFO-4	24.83	26.99	-2.16
LFO-5	21.18	23.7	-2.52
LFO-6	18.35	20.35	-2
LFO-7	6.76	4.9	1.86
MW-1	34.67	33.66	1.01
MW-2	8.8	9.84	-1.04
MW-3	5.78	3.96	1.82
MW-4	5.24	4.31	0.93
MW-5	28.62	26.24	2.38
MW-6	5.94	4.32	1.62
MW-7	30.41	29.18	1.23
Minimum[1]			0.65
Maximum[1]			2.52
ME[1]			0.11
MAE[1]			1.56
RMS[1]			1.66

(1) measurement in feet

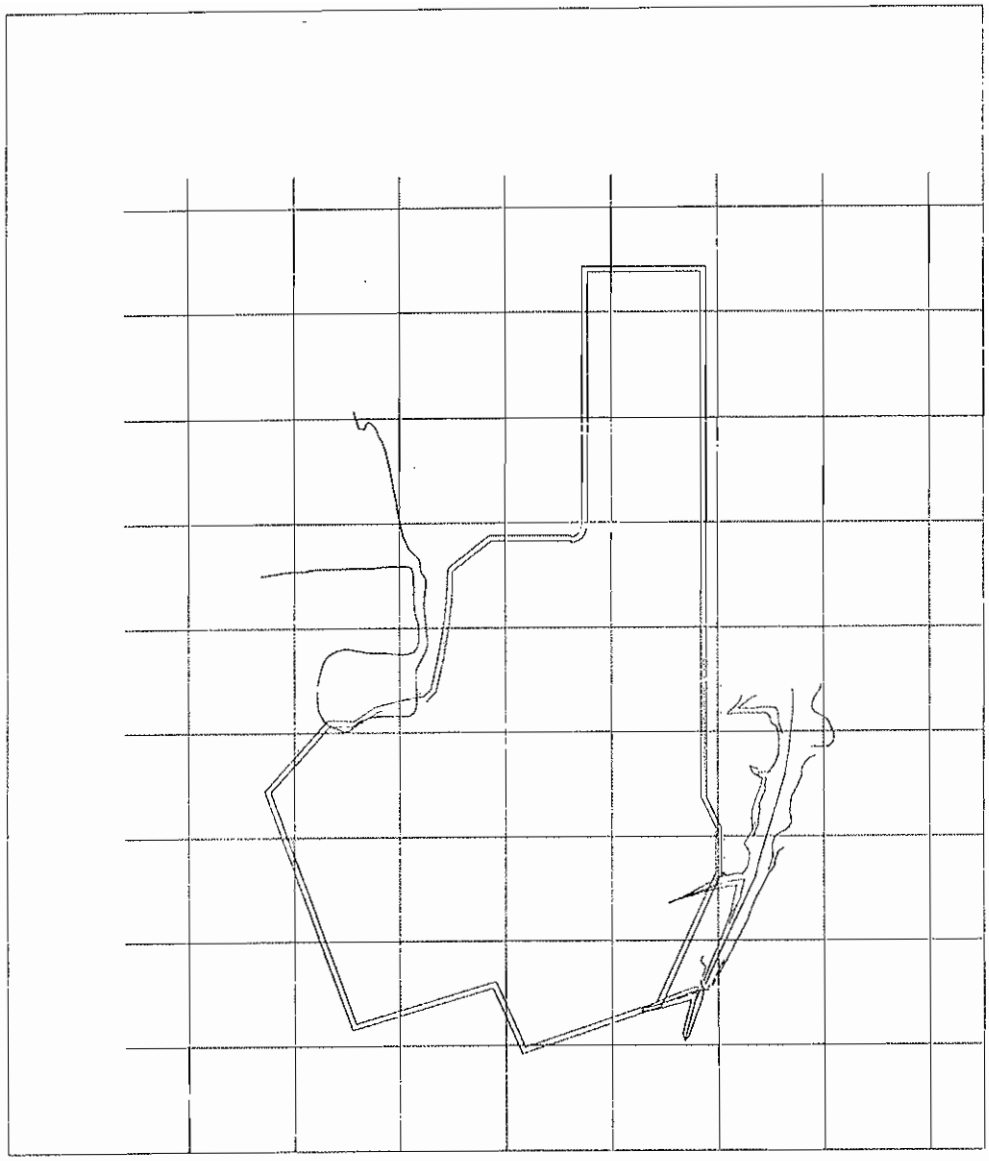
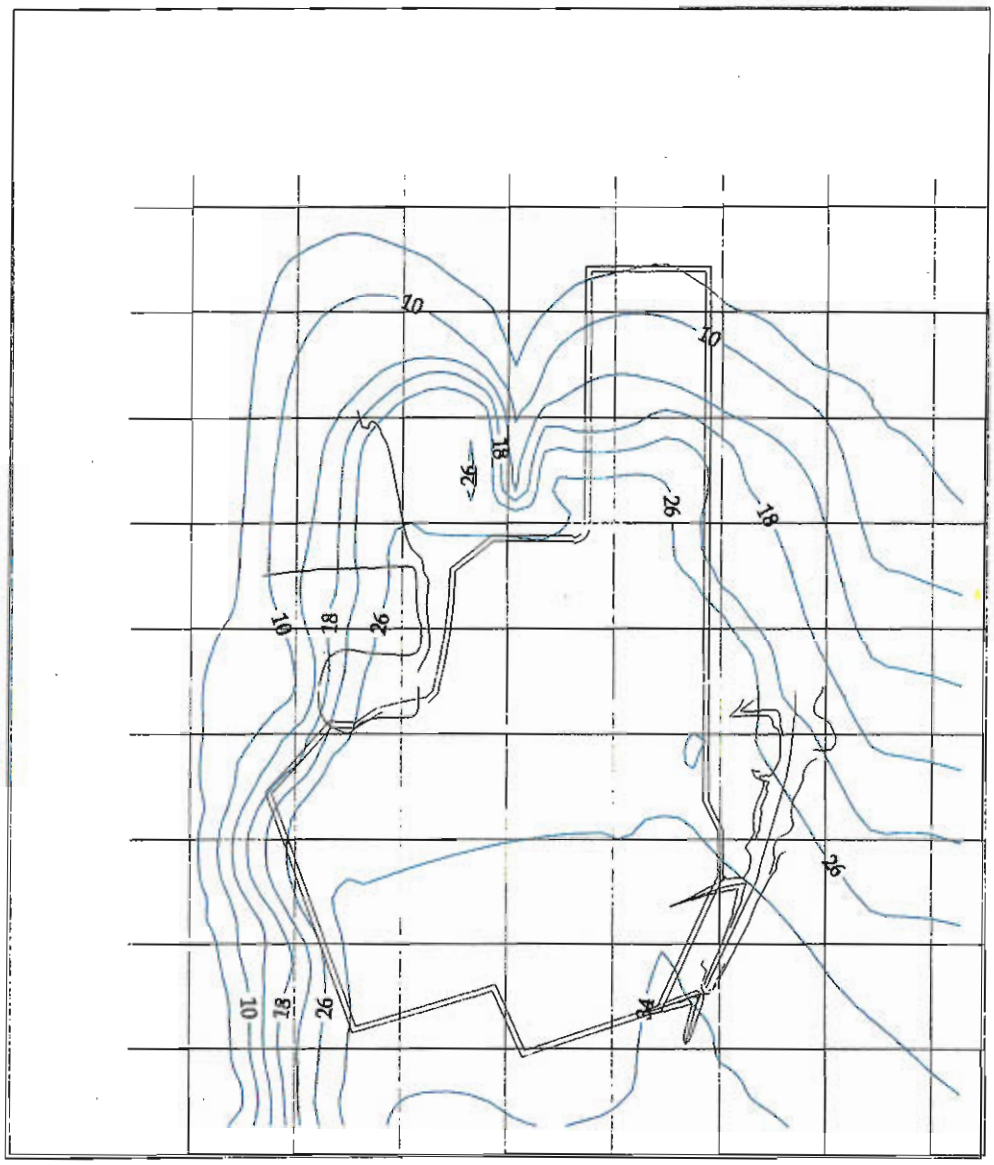


Figure 6
Weyerhaeuser - Plymouth, North Carolina



Modeled Water Table Configuration April 1993

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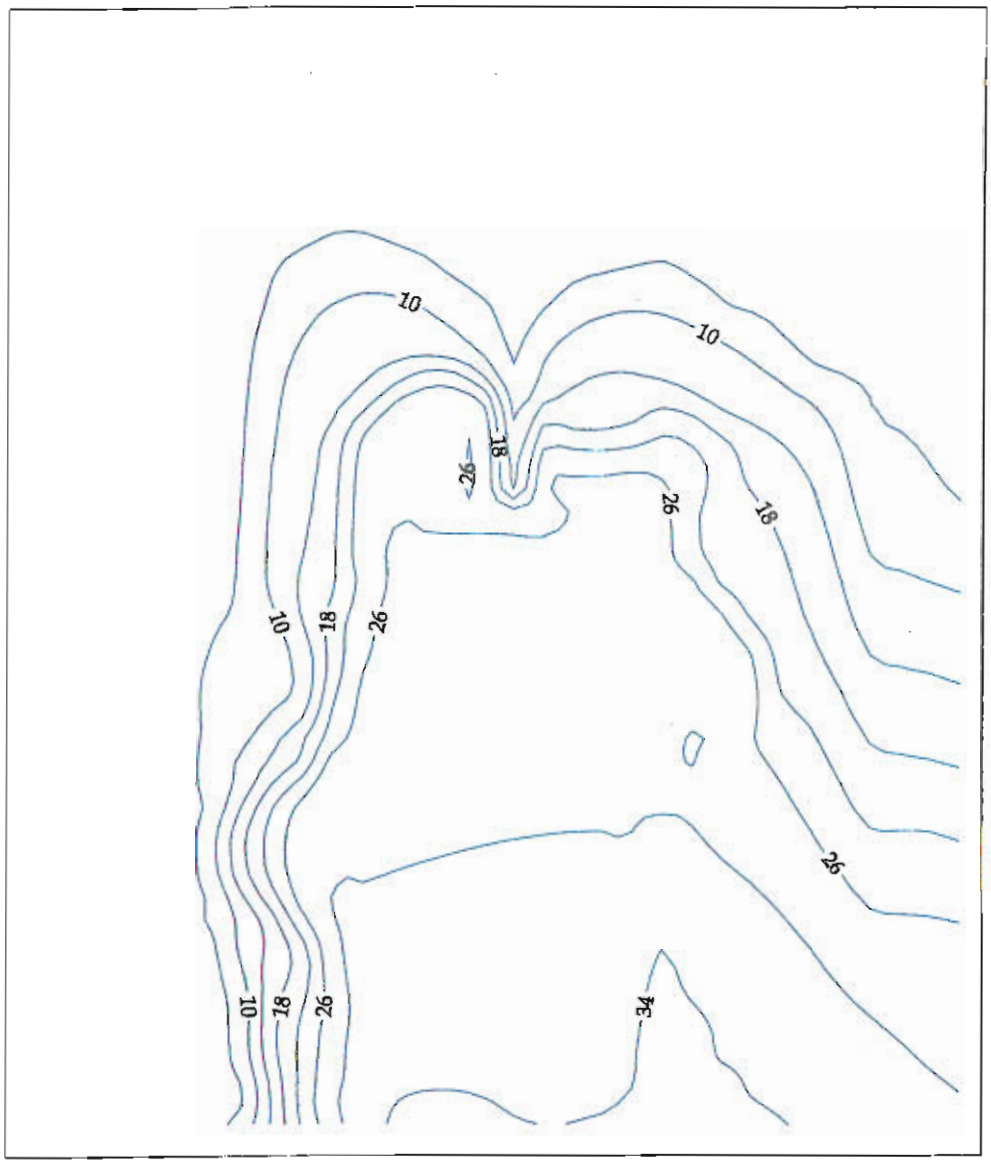
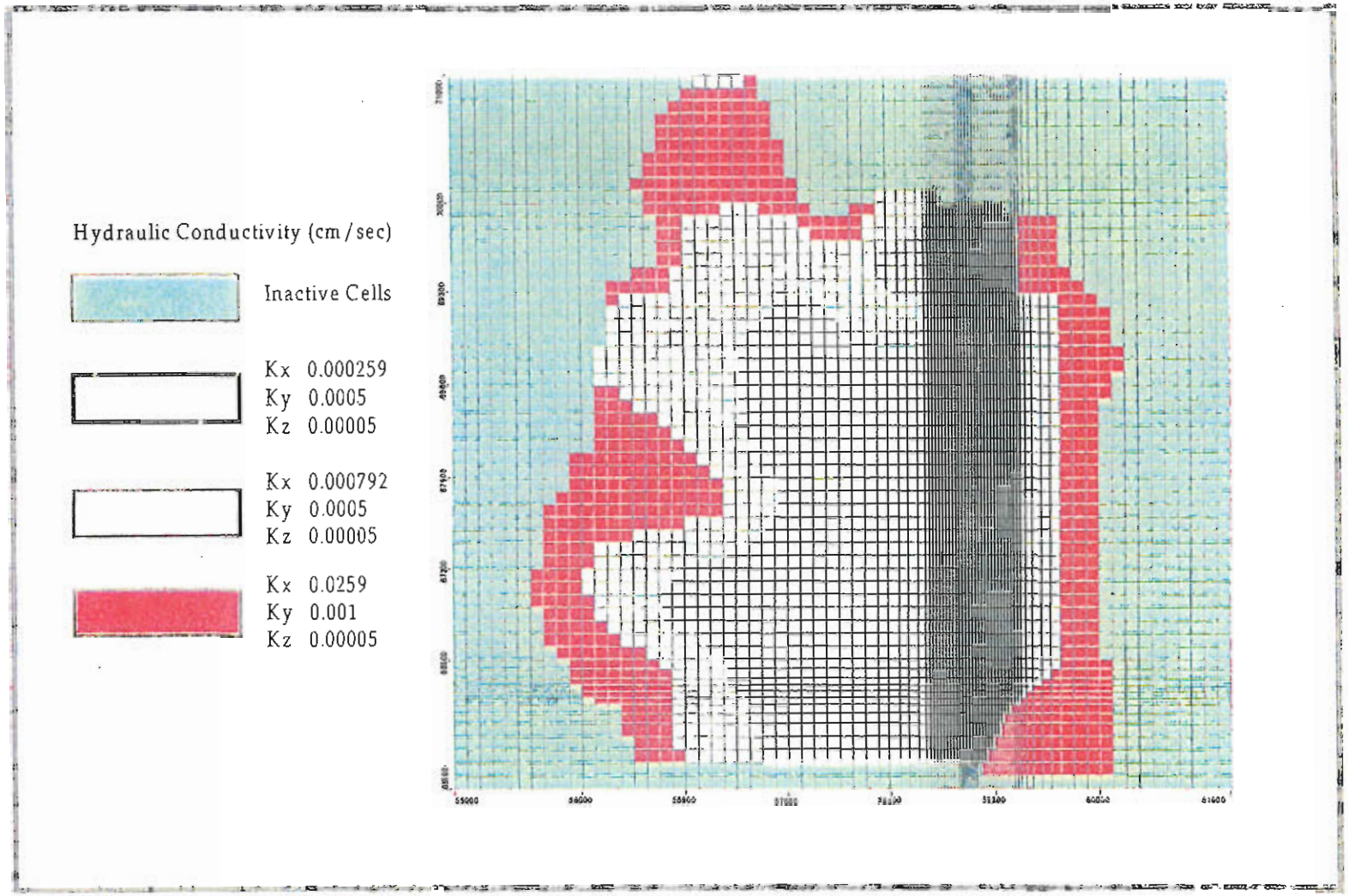
Figure 6
Weyerhaeuser - Plymouth, North Carolina



Modeled Water Table Configuration April 1993

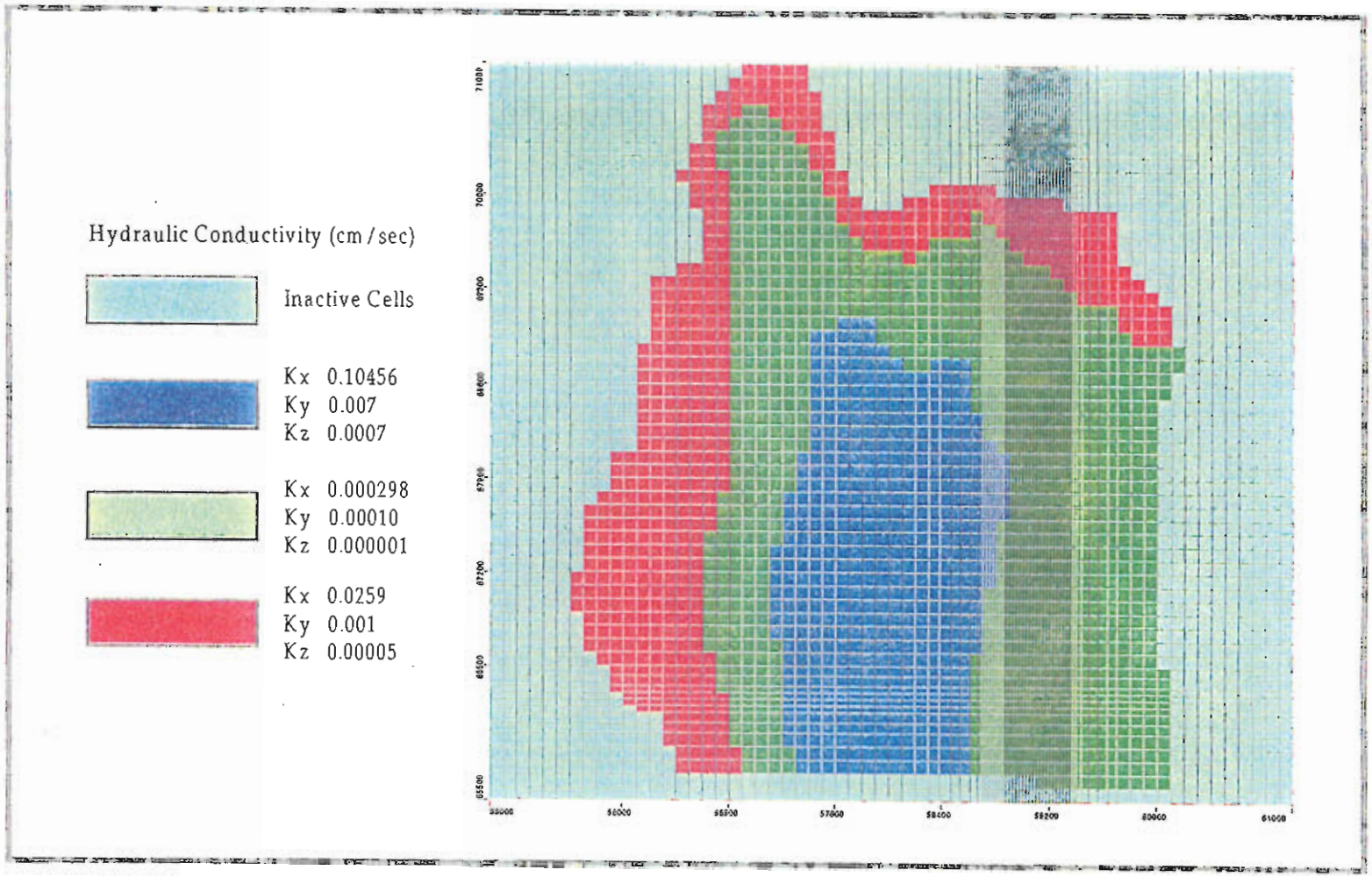
Figure 7
Weyerhaeuser - Plymouth, NC



Hydraulic Conductivity Distribution
Layers 1to 3 (Silty and Clayey Sand)

G:data:hydro:5101:model:dcc:hdrcon3a.srf

Figure 8
Weyerhaeuser - Plymouth, NC

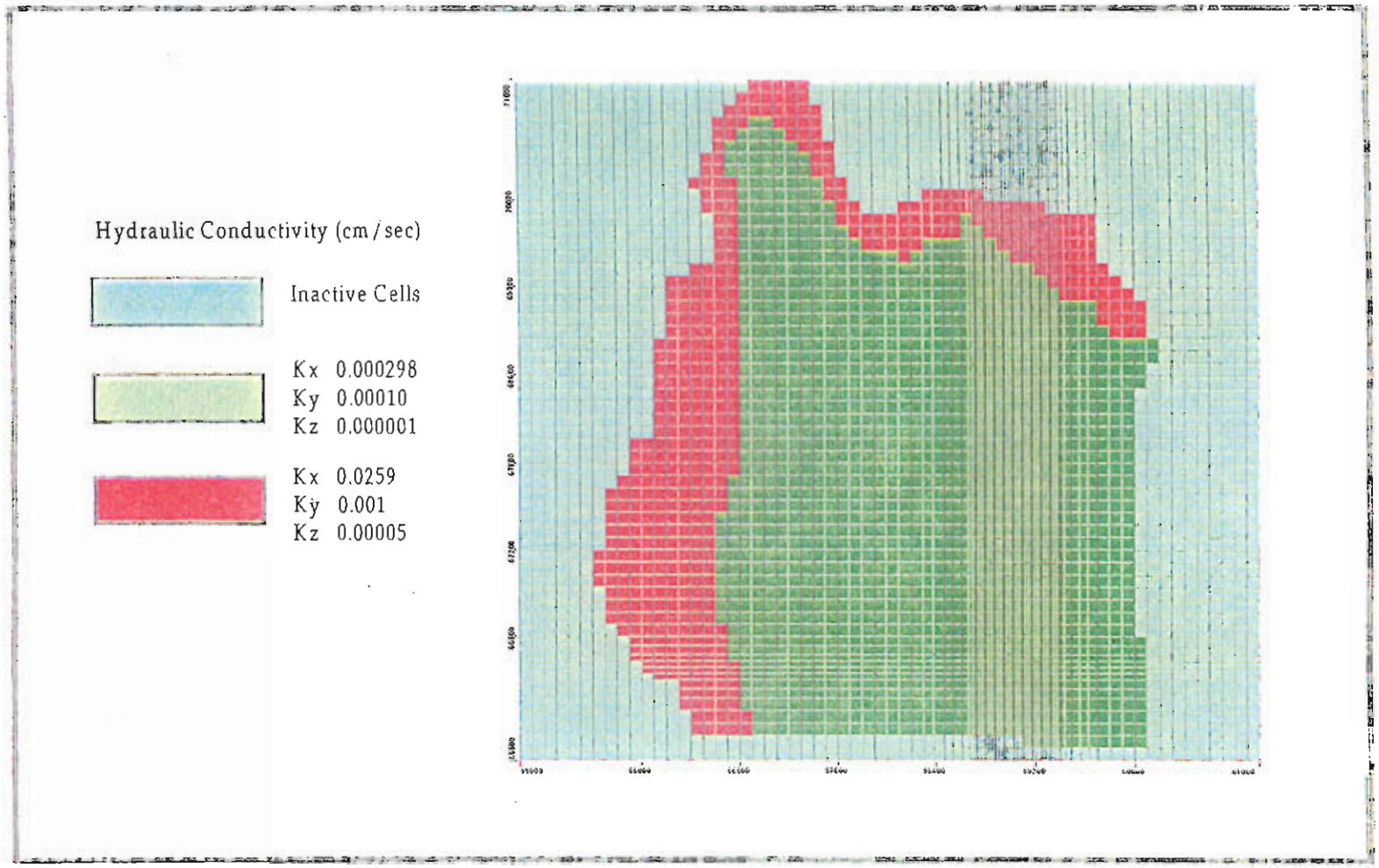


Hydraulic Conductivity Distribution
Layer 4 (Silty Sand)

RMT

G:data:hydro:5101:model:doc:kdrcon4.srf

Figure 9
Weyerhaeuser - Plymouth, NC

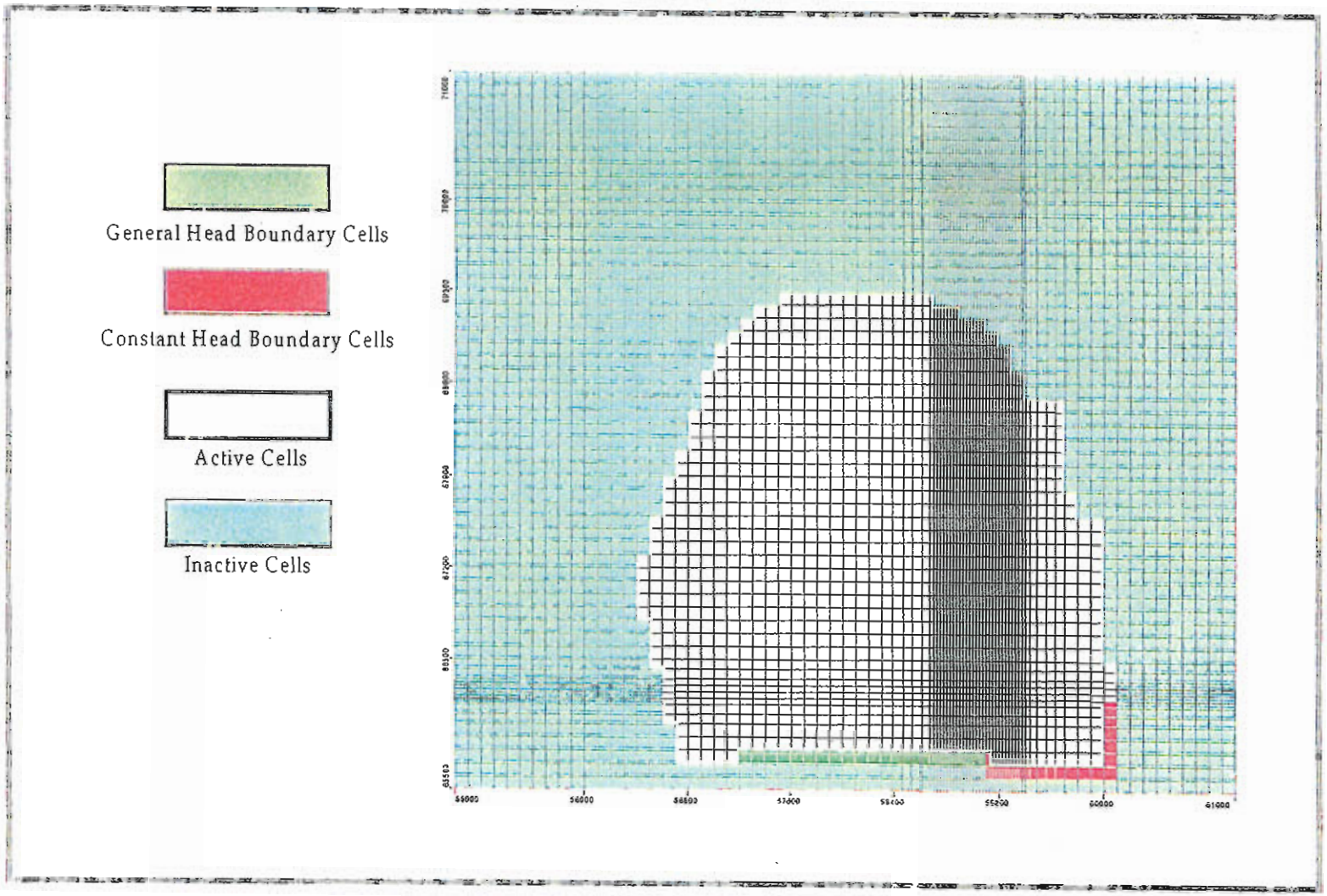


Hydraulic Conductivity Distribution
Layer 5 (Silty Sand)

RMT

G:data:hydro:5101:model:doc:hdcon5.srf

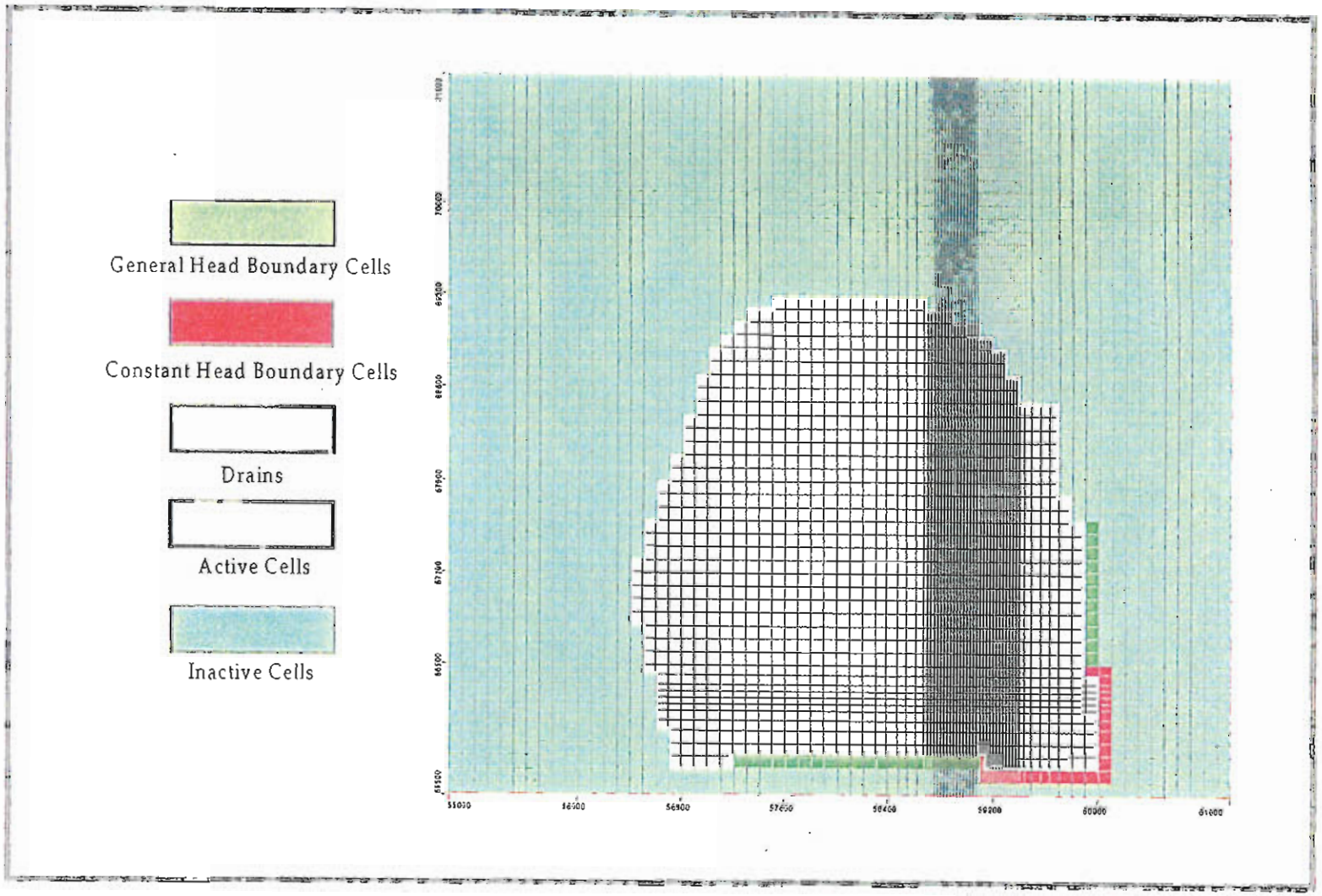
Figure 10
Weyerhaeuser - Plymouth, NC



Boundary Conditions
Layer 1

G:data:hydro:5101:model:doc:bdry1.srf

Figure 11
Weyerhaeuser - Plymouth, NC

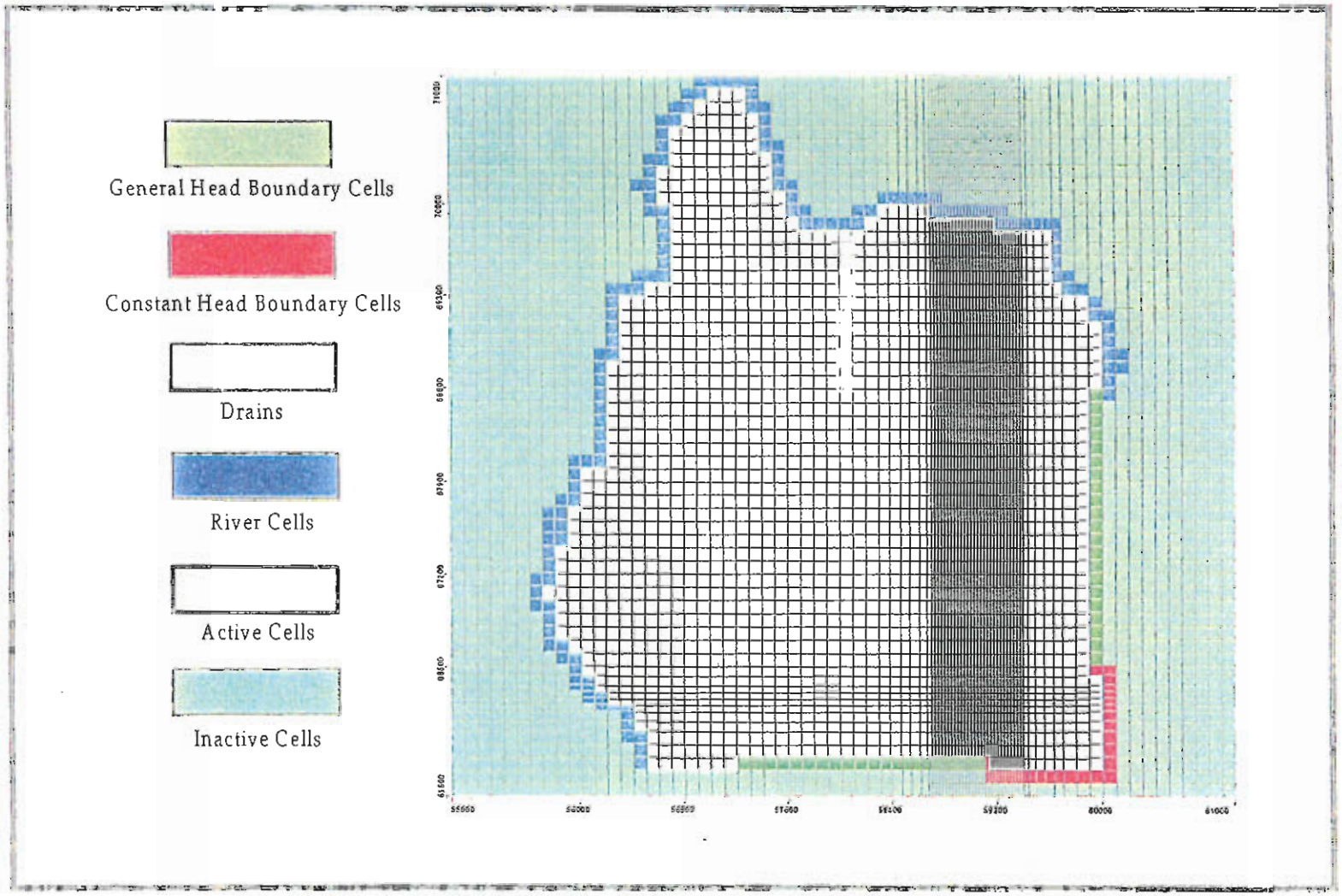


Boundary Conditions
Layer 2

RMT

G:\data\hydro\5101\model\doc\bdry2.scf

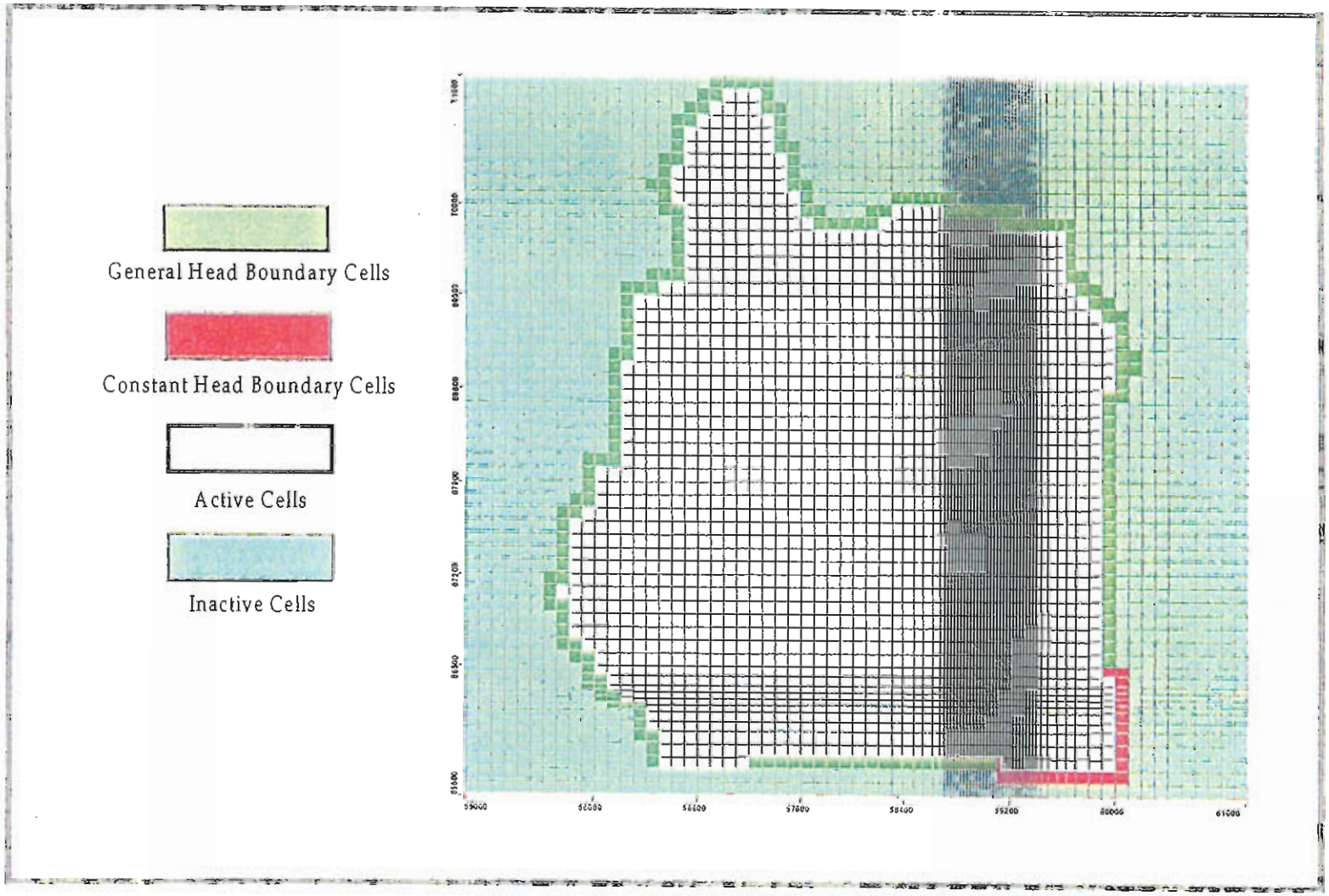
Figure 12
Weyerhaeuser - Plymouth, NC



Boundary Conditions
Layer 3

G:data:hydro:5101:model:doc:bdry3.srf

Figure 13
Weyerhaeuser - Plymouth, NC



Boundary Conditions
Layers 4 and 5

RMT

G:data:hydro:5101:model:doc:bdrv5.srf

Table 2
Summary of General Head Boundary Conditions

Layer #	Description of Area	General Head feet		Conductance feet^2 per day
		Maximum	Minimum	
1	South	35	35	10
		35	35	22
		40	35	42
2	South	35	35	10
		35	35	22
		40	35	42
	East	26	16	42
3	South	35	35	10
		35	35	30
		40	35	42
	East	13	3	75
		24	24	42
		3	3	143

Table 2
Summary of General Head Boundary Conditions

Layer #	Description of Area	General Head feet		Conductance feet² per day
		Maximum	Minimum	
4	South	40	35	42
		35	35	30
		35	35	10
	East	27	15	42
		8	5	75
	Northeast	5	4	75
		3	3	115
		3	3	143
	North	4	3	75
	Northwest	3	3	134
		3	3	225
	West	3	3	500
	Southwest	3	3	500
5	South	40	35	42
		35	35	31
		35	35	10
	East	8	5	75
		7	15	42
	Northeast	5	4	75
		3	3	115
		3	3	143
	North	4	3	75
	Northwest	3	3	134
		3	3	225
	West	3	3	500
	Southwest	3	3	500

Table 3
Summary of River Boundary Conditions

Layer #	Description of Area	River Stage Elevation feet		River Bottom feet		Conductance feet^2 per day
		Maximum	Minimum	Maximum	Minimum	
3	Southwest	4	3.5	1	0.5	300
	West	3.5	3	0.5	-0.1	300
	Northwest	3	3	-0.1	-0.5	300
		3	3	-0.1	-0.2	200
		3	3	-0.4	-0.6	142
		2.5	2	-0.5	-0.1	342
		3.5	3	0.3	0	125
	North	3	4	0.4	1	125
	Northeast	5	4	2	1	125
		4	4	0.9	0.8	200

Table 4
Summary of Drain Boundary Conditions

Layer #	Description of Area	Drain Elevation feet		Conductance feet^2 per day
		Maximum	Minimum	
2	North	18	18	1000
3	North	10	2	1000

Section 3
Predictive Simulations

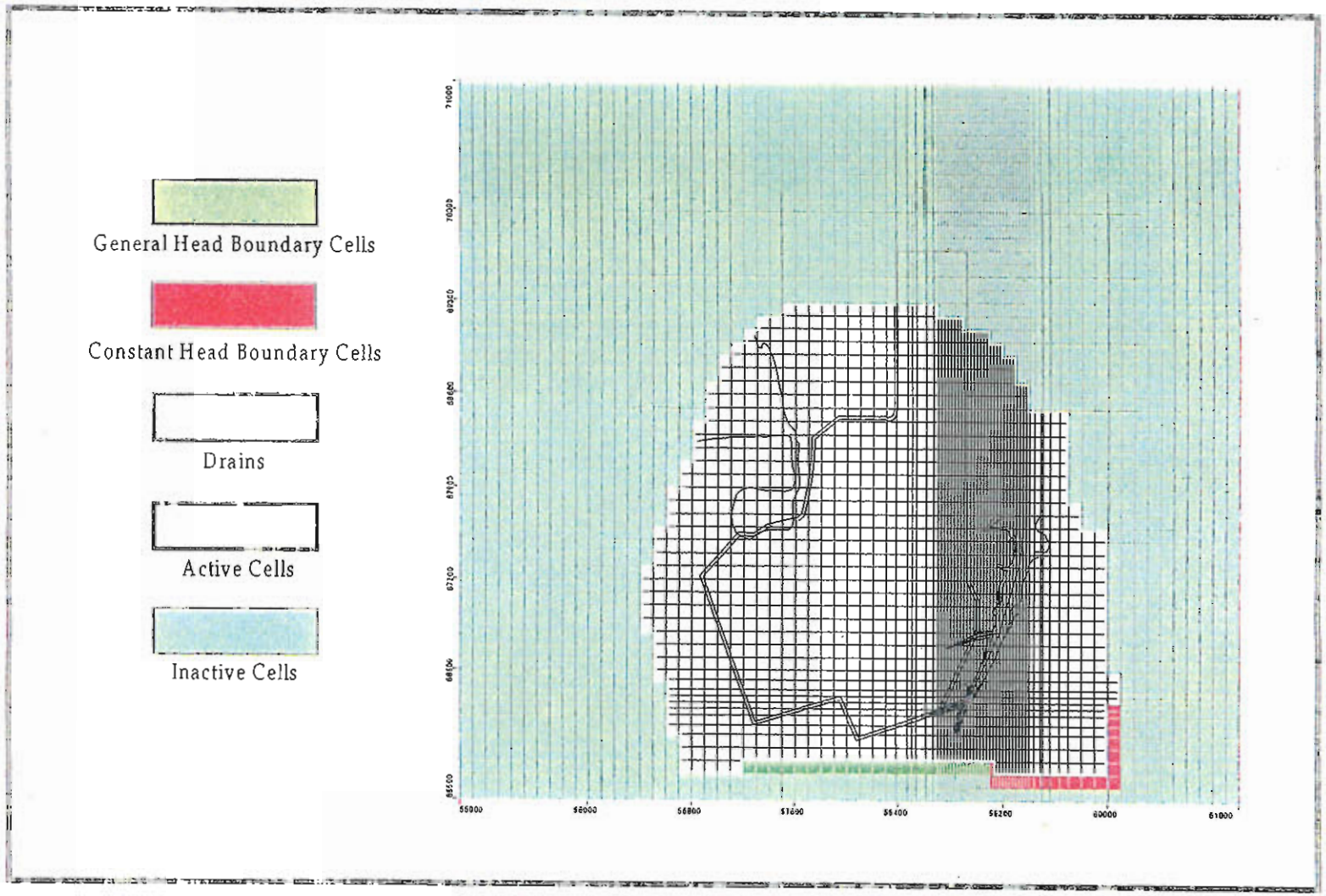
Following the calibration step in the modeling process, modifications to the model setup were made to reflect future site conditions. Future site conditions in the vicinity of proposed Landfill No. 3 consist of drainage restoration along the southeast side of the proposed landfill.

The drainage restoration conducted in the spring of 1999 was represented in the model using drain boundary conditions. This type of boundary allows groundwater to be removed from the model when water levels in the adjacent model cells are greater than the drain bottom elevation. This boundary condition assignment does not allow water to move from drain cells back into adjacent model cells under any circumstance. The drain bottom elevations assigned in the model range from 34 feet to 22 feet, based on the actual construction details of the drainage ditch. The conductance values assigned to the drain cells range from 35 ft^2/day to 142 ft^2/day depending on the size of the given cell. The drain conductance was assigned based on the following assumptions: 1) groundwater enters the ditch over a 10-foot wide surface area across the ditch; 2) the thickness of drain materials is a uniform 2 feet over the length of the ditch; and 3) the hydraulic conductivity of drain materials is 1×10^{-4} cm/sec. The drain boundary conditions for Layer 1 and Layer 2 are illustrated in Figures 14 and 15.

The results from the predictive groundwater simulations demonstrate that the long-term water table configuration will be lowered up to 6 feet in the immediate vicinity of the drainage enhancements. The long-term configuration of the water table will also exhibit a 0.5-foot depression over 1,000 feet wide and over 1,900 feet long based on the groundwater modeling. The decrease in modeled water levels resulting from the drainage enhancements is illustrated in Figure 16. The modeled water table configuration, resulting from drainage enhancements, is illustrated in Figure 17. Figure 18 illustrates the modeled water table configuration before and after drainage enhancements, as a three-dimensional surface.

Based on the current model setup, the long-term water table configuration resulting from drainage restoration can be significantly lowered along the southeast side of proposed Landfill No 3. By lowering the water table, the design capacity of the landfill can be increased and fill requirements can be reduced.

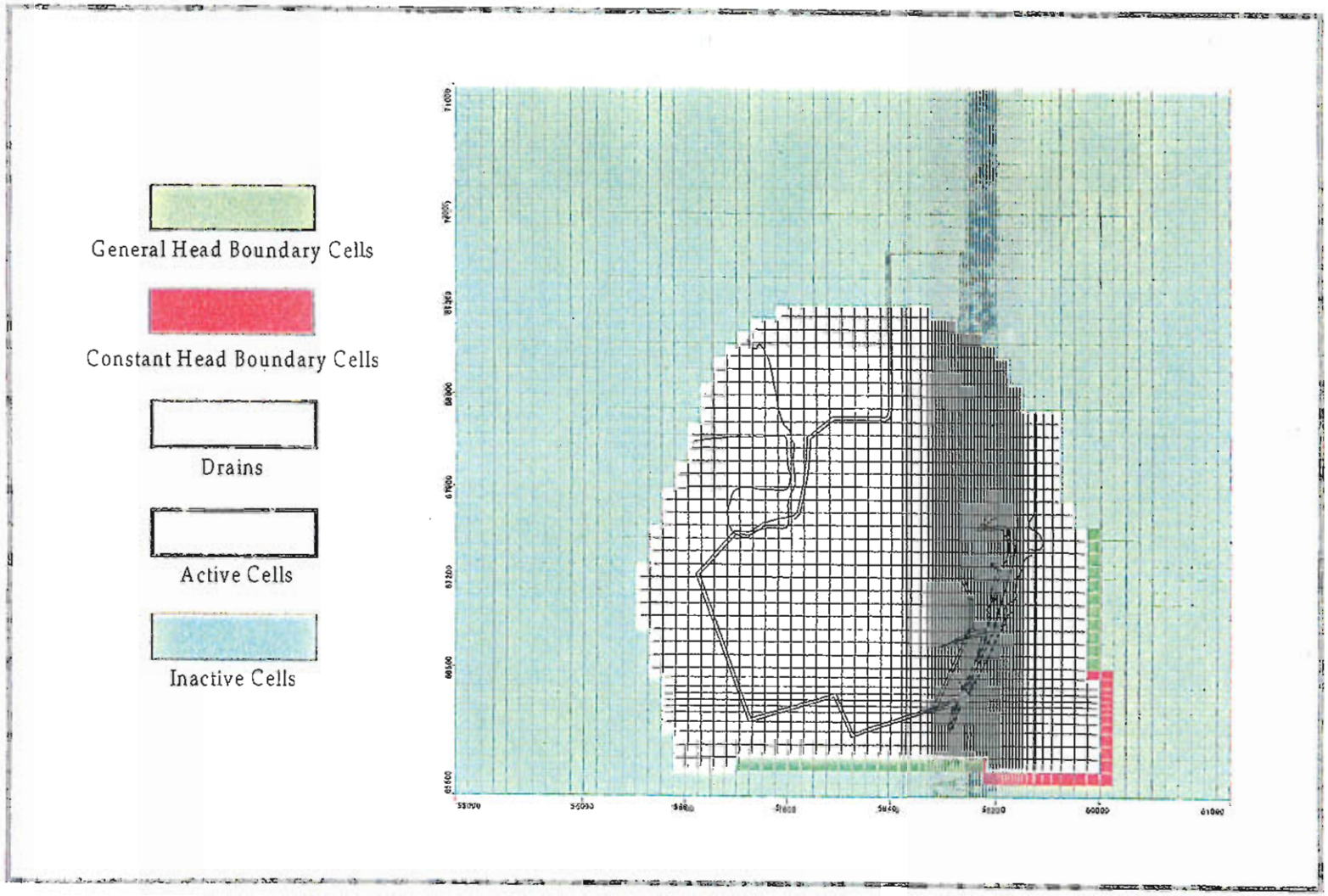
Figure 14
Weyerhaeuser - Plymouth, NC



Drainage Enhancements
Layer 1

G:data:hydro:5101:model:doc:drn1.srf

Figure 15
Weyerhaeuser - Plymouth, NC



Drainage Enhancements
Layer 2

RMT

G:data:hydro:5101:model:doc:drn2.srf

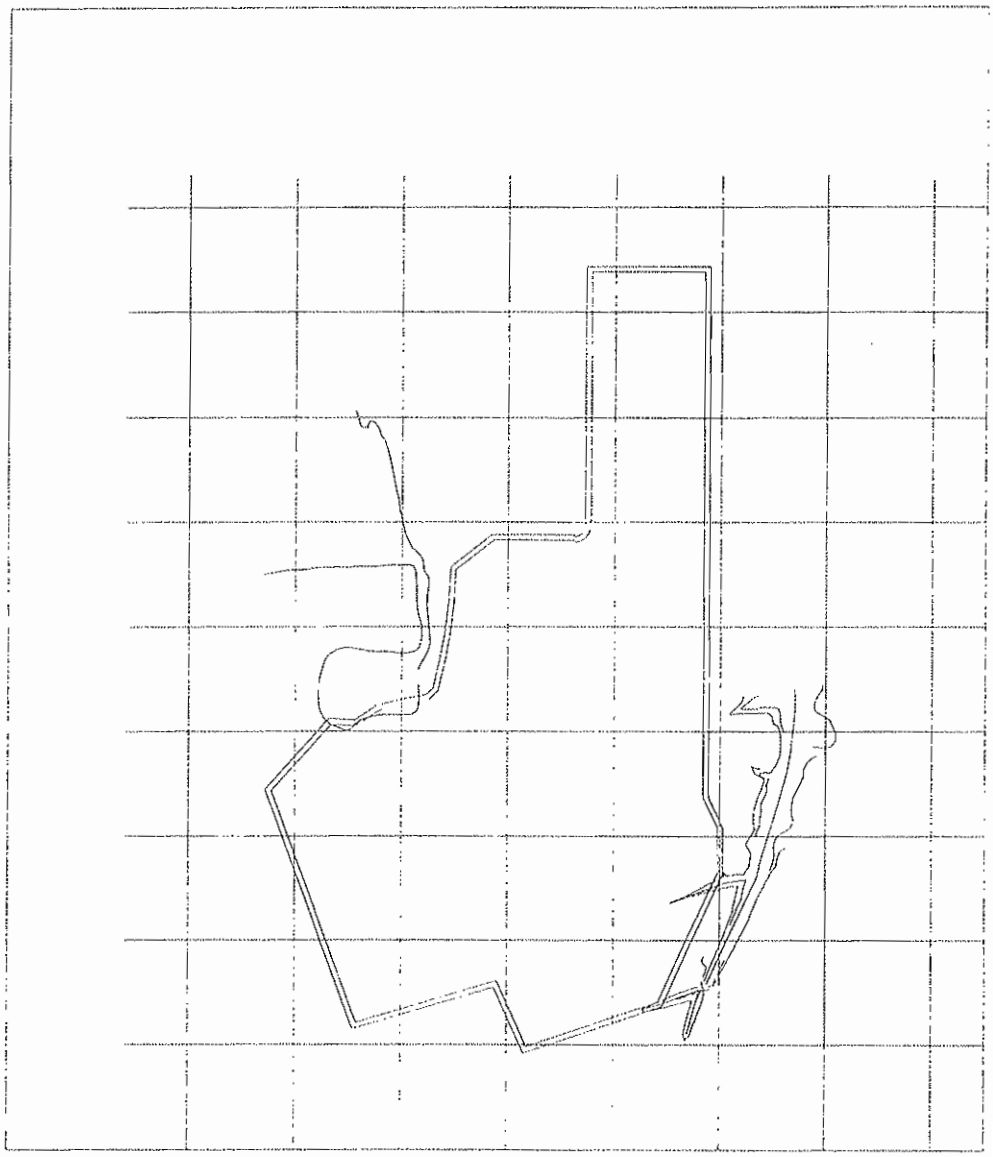
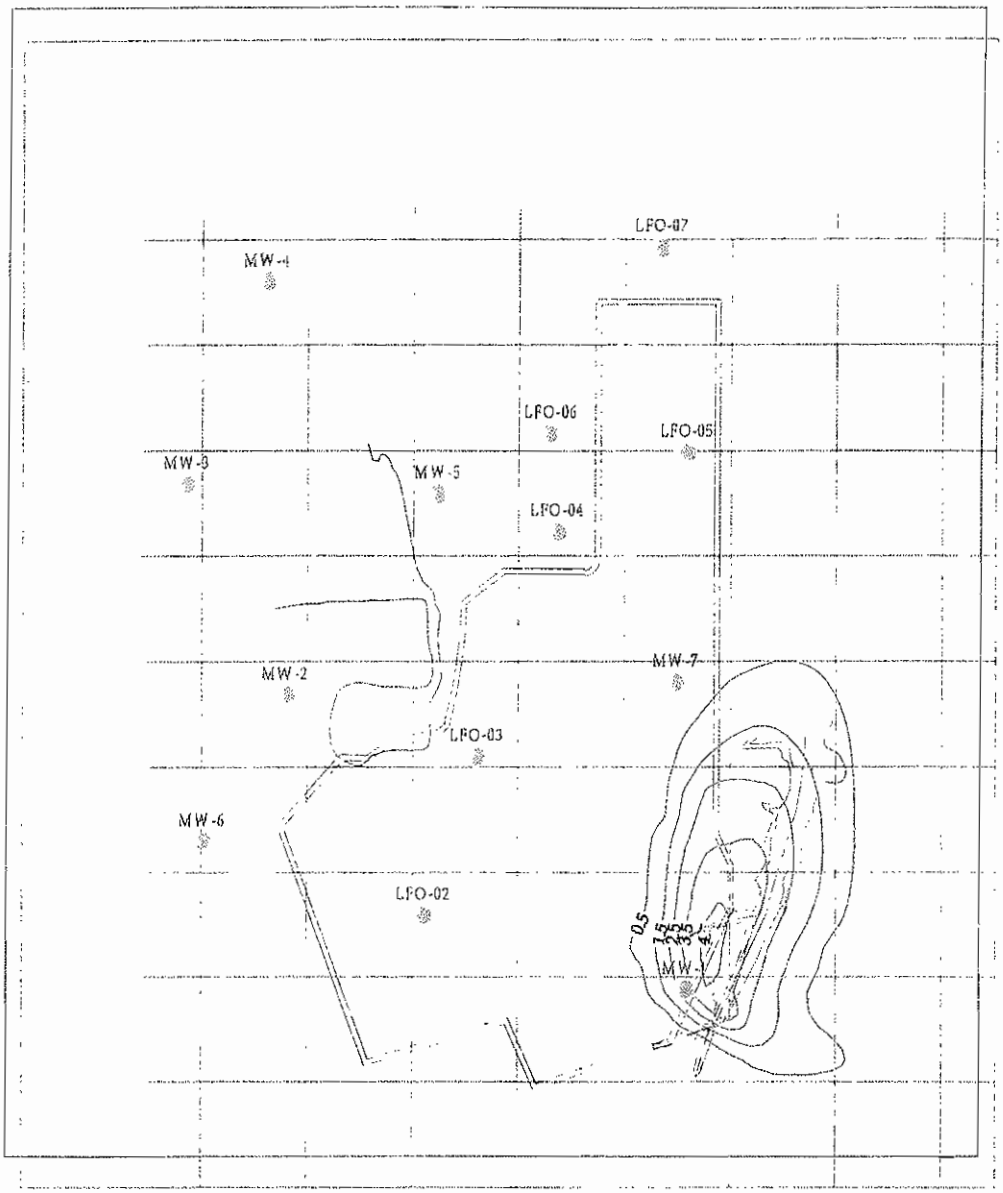


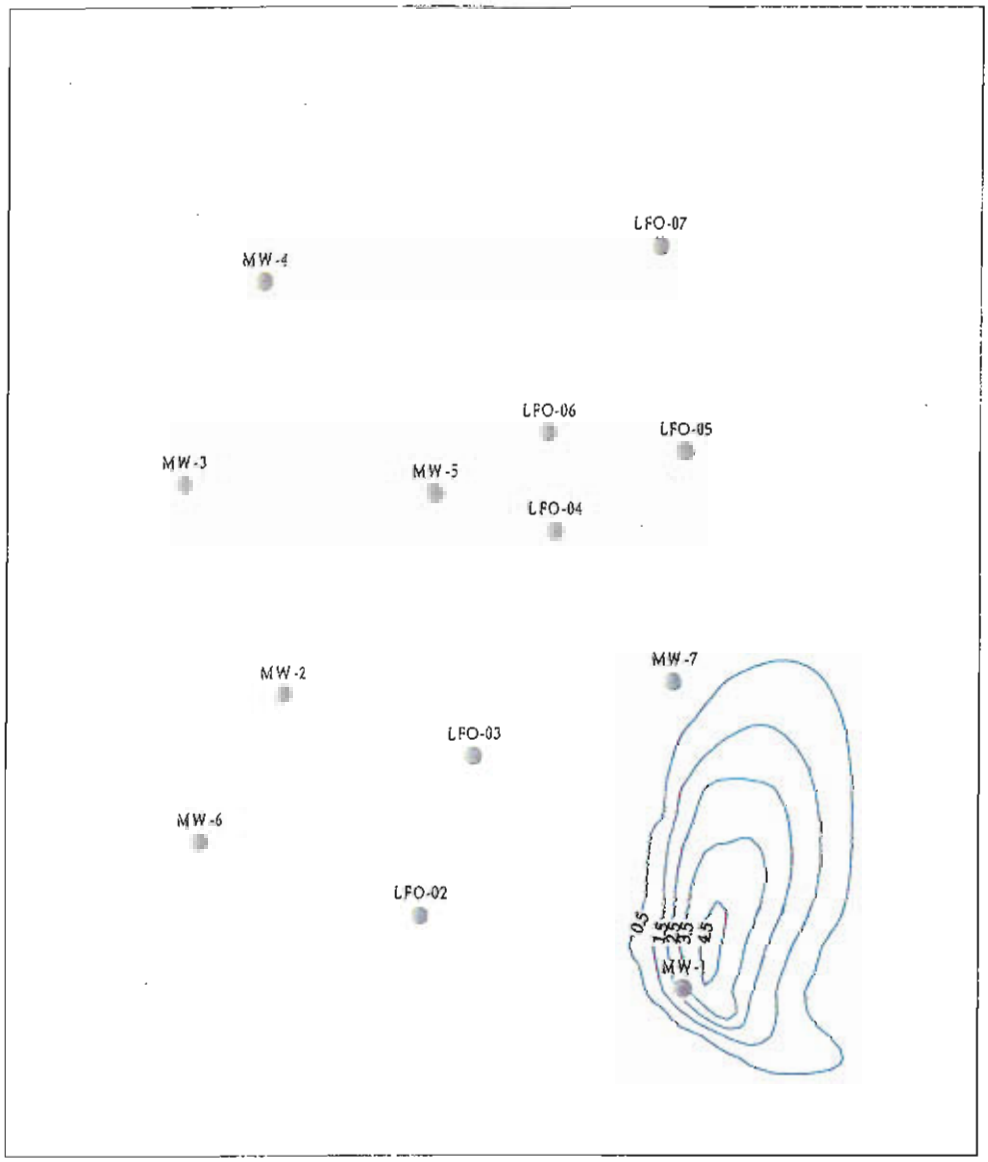
Figure 16
Weyerhaeuser - Plymouth, North Carolina



Drawdown Resulting From Drainage Enhancements

G:data:hydro5101:model:doc:drwdn.srf

Figure 16
Weyerhaeuser - Plymouth, North Carolina



Drawdown Resulting From Drainage Enhancements

G:data:hydro:5101:model:doc:drwdn.acf

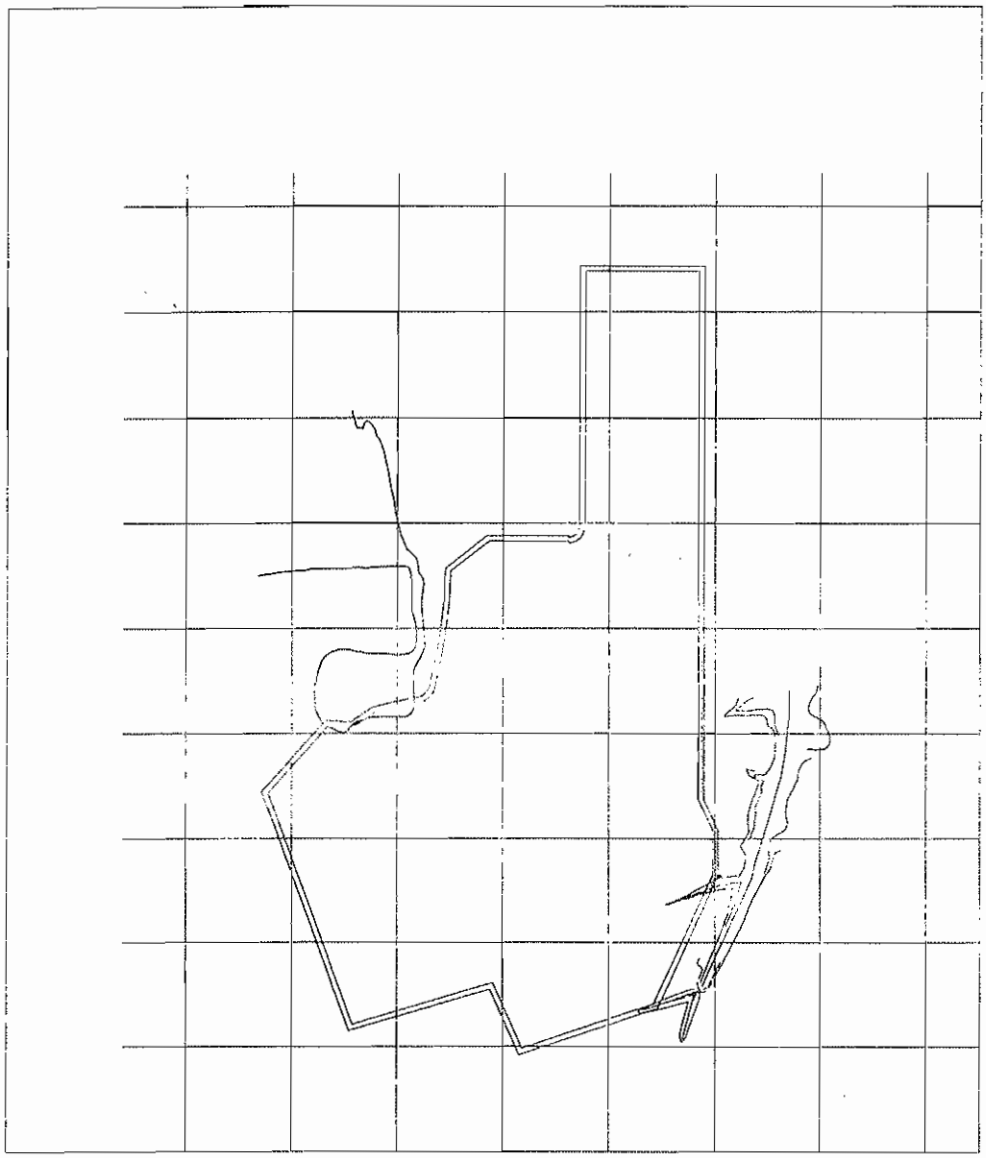
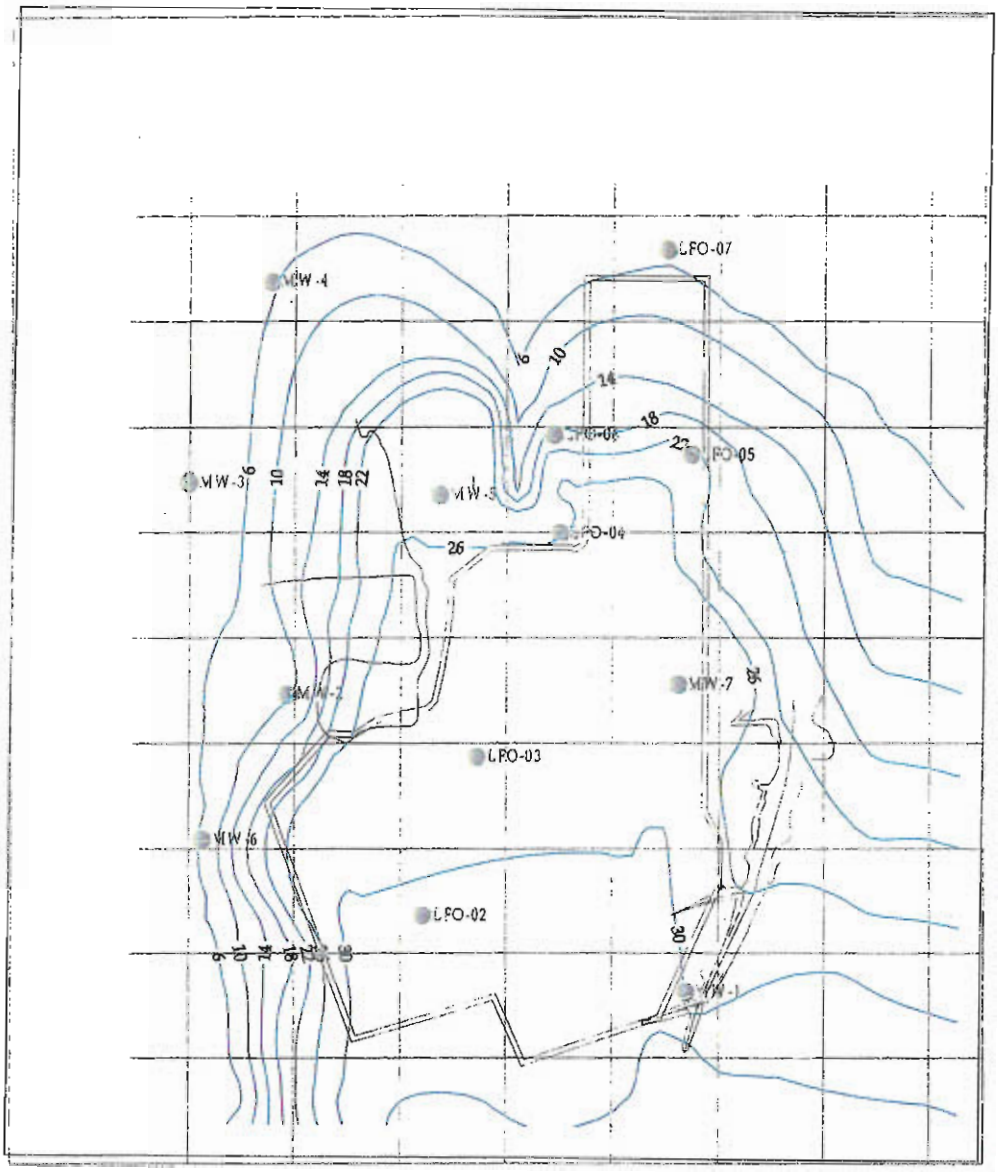


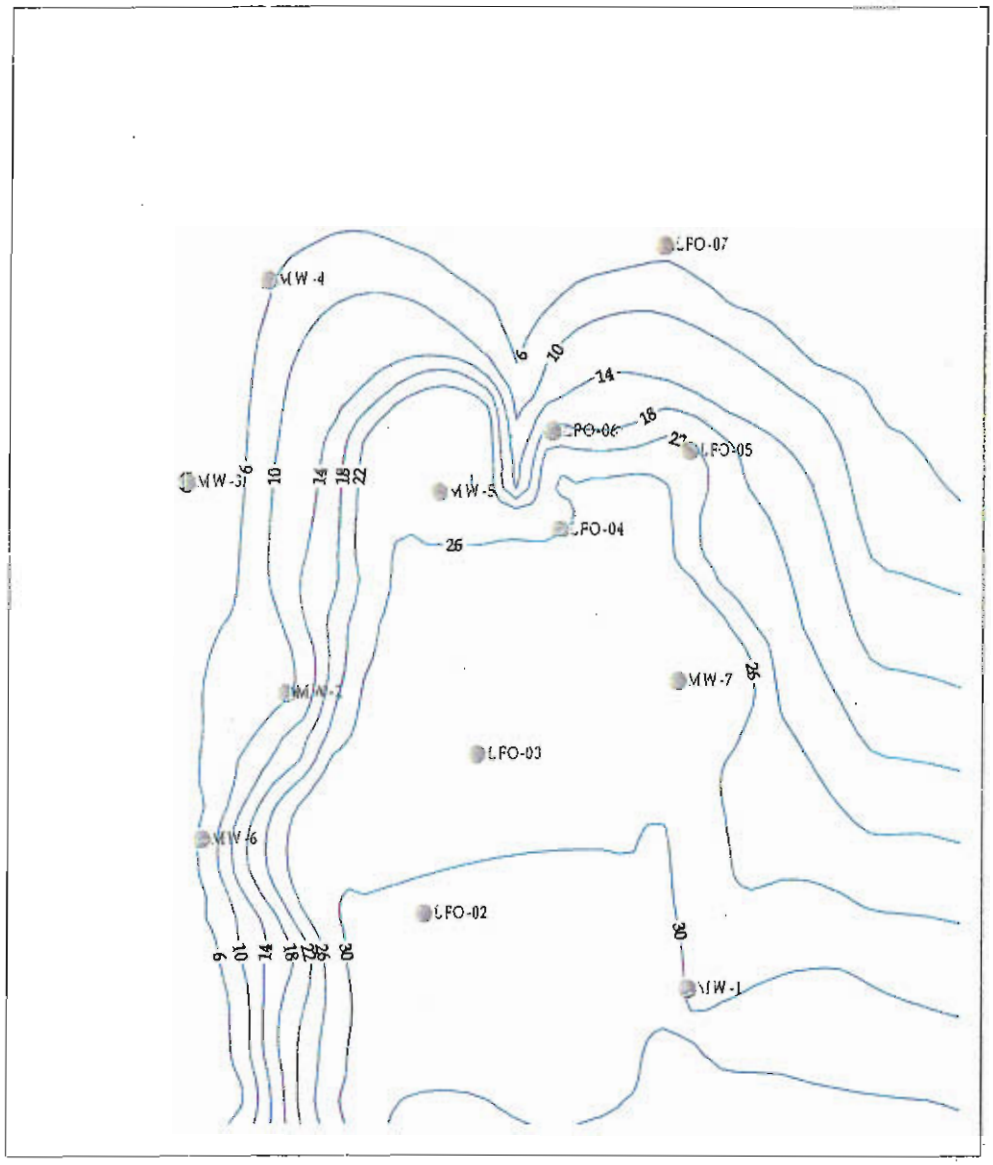
Figure 17
Weyerhaeuser - Plymouth, North Carolina



Predictive Water Table Configuration With Drainage Enhancements

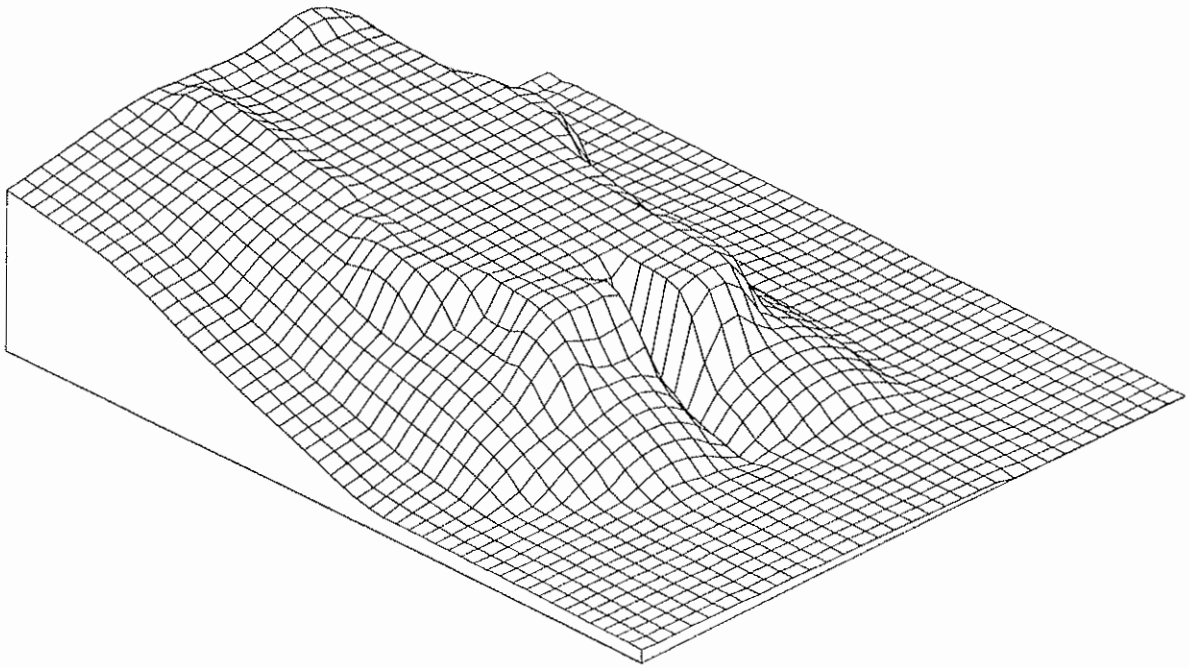
G:data:hydro:5101:model:doc:pred1m1.srf

Figure 17
Weyerhaeuser - Plymouth, North Carolina

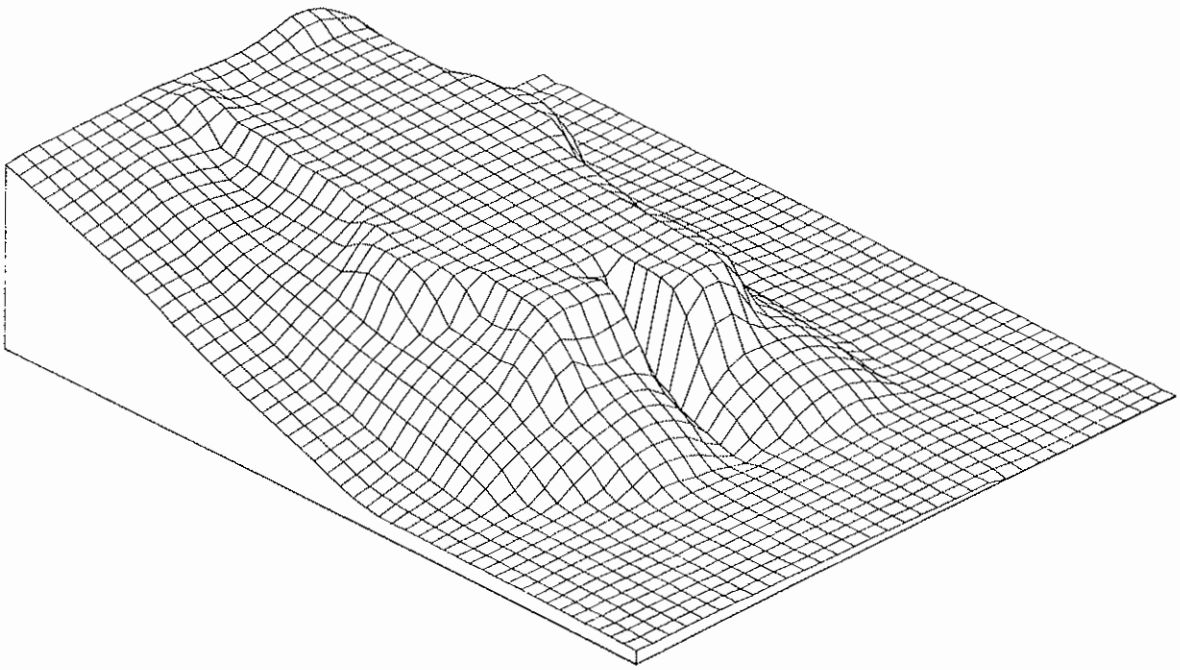


Predictive Water Table Configuration With Drainage Enhancements

Figure 18
Weyerhaeuser - Plymouth, North Carolina

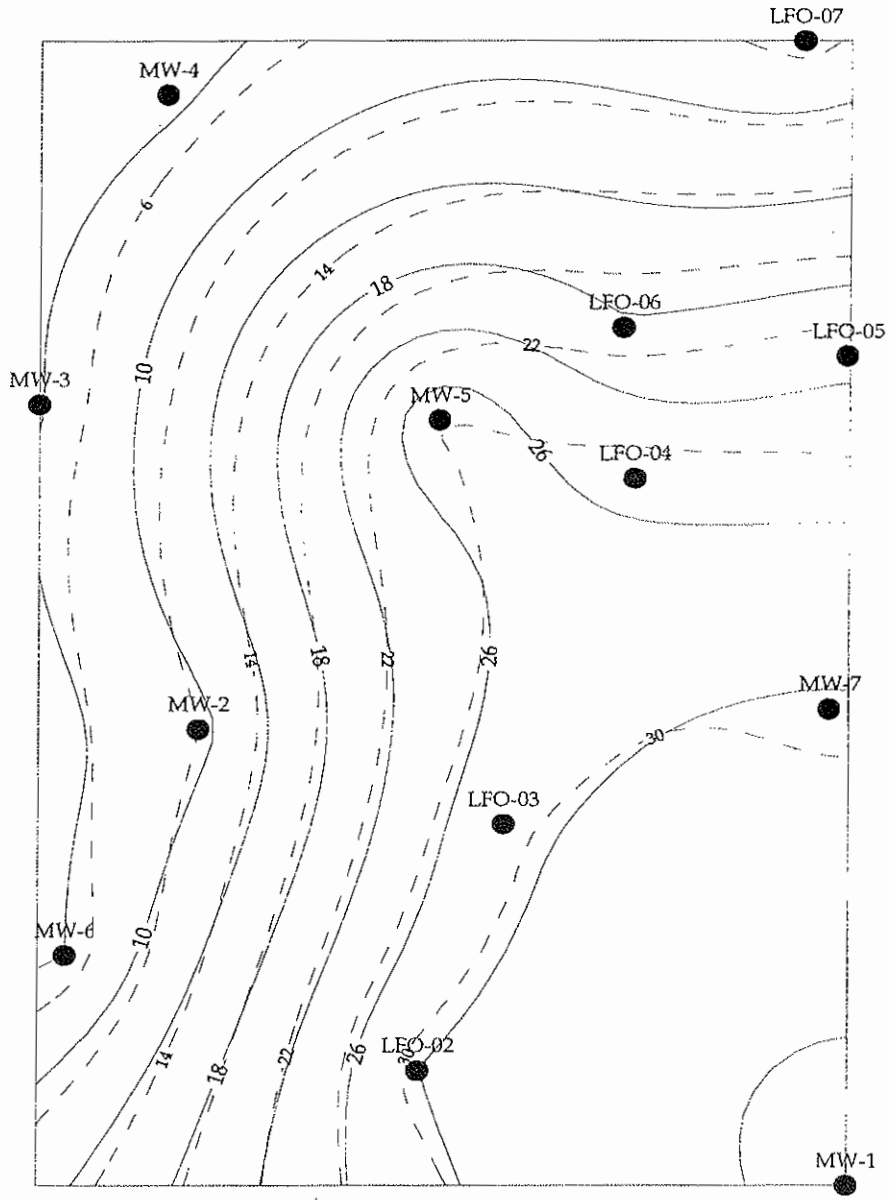


Modeled Water Table Configuration



Modeled Water Table Configuration With Drainage Enhancements)

Figure 4
Weyerhaeuser - Plymouth, North Carolina



Qualitative Calibration Evaluation

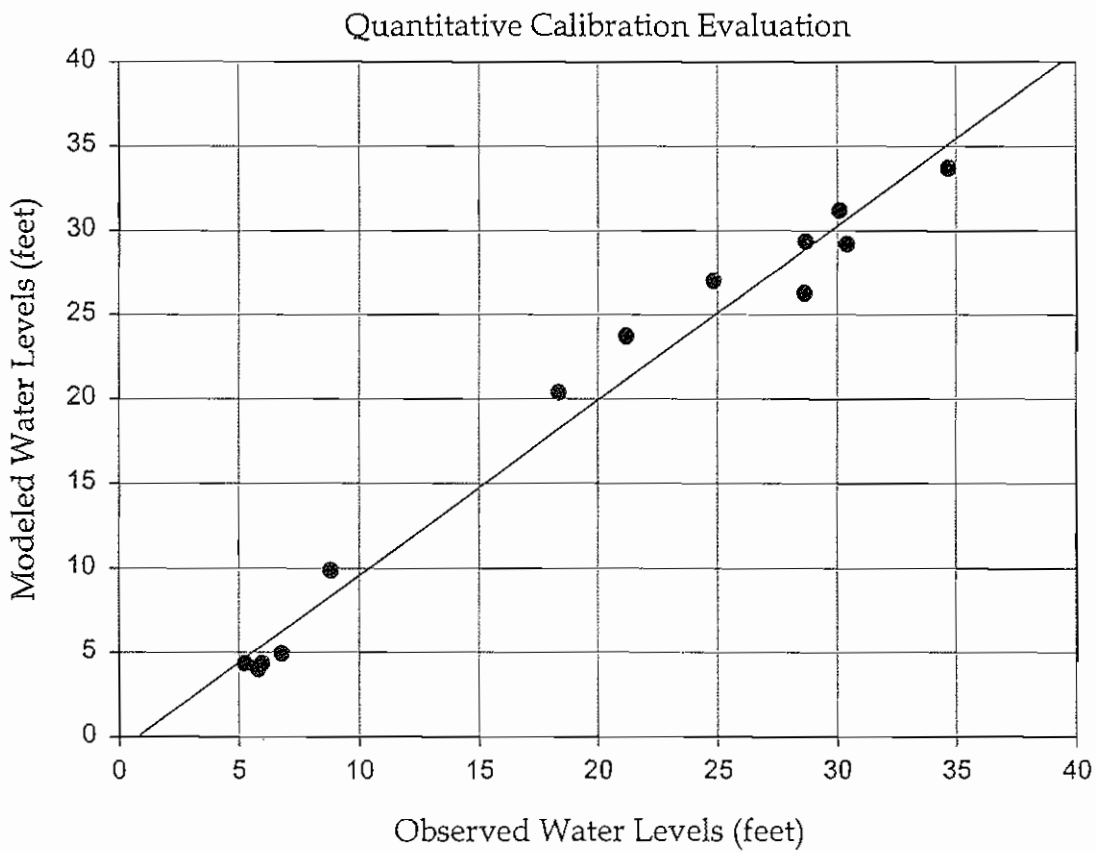
Modeled Water Levels

Observed Water Levels - April 1993

RMT

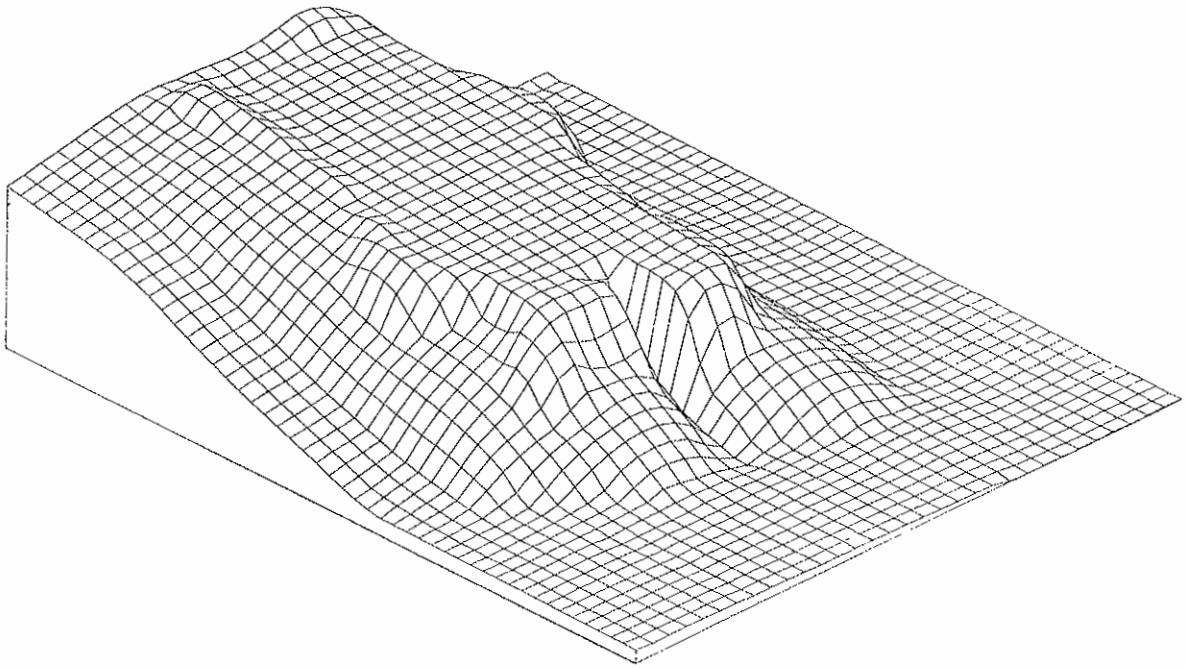
G:data:hydro:5101:model:doc:comp.srf

Figure 5
Weyerhaeuser - Plymouth, NC

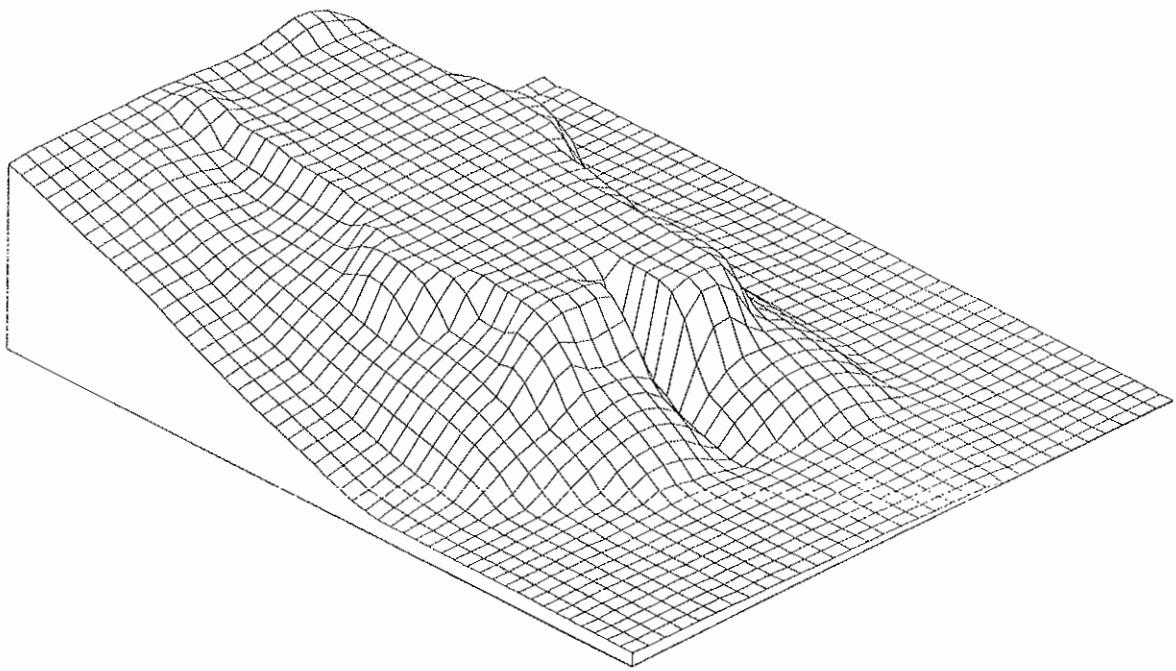


Correlation Coefficient 0.98
Mean Error 0.11 (ft)
Mean Absolute Error 1.56 (ft)
Root Mean Squared 1.66 (ft)

Figure 18
Weyerhaeuser - Plymouth, North Carolina



Modeled Water Table Configuration



Modeled Water Table Configuration With Drainage Enhancements)

Appendix G
Water and Mass Balance Calculations

Attachment G1	**Landfill Cover and Liner Design Evaluation**
Attachment G2	**HELP Model Data**
Attachment G3	**Projected Leachate Generation Rates**
Attachment G4	**Mass Balance Calculations for Liner Design of Landfill No. 3 Technical Memorandum dated September 27, 1999 (including Responses to NC DENR letter dated April 29, 1999)**

Attachment G1
Landfill Cover and Liner Design Evaluation

Landfill Cover and Liner Design Evaluation

Introduction

The purpose of this report is to evaluate the cover and liner design in combination with site-specific climatological information to estimate the following average annual quantities:

- Precipitation
- Runoff
- Evapotranspiration
- Percolation
- Lateral drainage
- Head on the liner
- Percolation through the liner

Methods

To evaluate the design, the HELP model was used. The HELP model was developed by the United States Army Engineer Waterways Experiment Station in Vicksburg, Mississippi (Schroeder, *et al.*, 1989, Volume 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.

The HELP model contains a number of inherent assumptions, which need to be considered when interpreting the calculated values for runoff, drainage, and infiltration for a landfill design. These include the following:

1. Four types of layers can be used: a vertical percolation layer, a lateral drainage layer, a barrier soil layer, and a barrier soil with a geomembrane layer.
2. The top layer may not be a geomembrane liner.
3. Lateral drainage is not permitted from a vertical percolation layer. The maximum drainage slope is 10 percent.
4. The profile can contain no more than a total of five barrier soil liners and geomembrane liners.
5. Both vertical and lateral drainage are permitted from a lateral drainage layer.

6. The top layer of the cover cannot be a barrier soil (compacted clay).
7. A barrier soil layer may not be placed adjacent to another barrier soil layer, and a geomembrane may not be placed adjacent to another geomembrane.
8. A geomembrane may not be placed directly between two barrier soil liners, and a barrier soil liner may not be placed directly between two geomembranes.
9. When a barrier soil layer or geomembrane liner is not placed directly below the lowest drainage layer, all drainage layers below the lowest liner are treated as vertical percolation layers. Thus, no lateral drainage is computed for the bottom section of the landfill.
10. Only a barrier soil or another lateral drainage layer may be placed directly below a lateral drainage layer.
11. Cover runoff is computed by using the Soil Conservation Service Runoff Curve Number method. Unless this number is manually input, the model does not consider surface slope and roughness of infiltration into the computation.
12. Percolation is modeled using Darcy's Law for saturated flow. Lateral drainage is modeled using a linearized Boussinesq equation. Evapotranspiration is modeled using a modification of the Penman method (Schroeder *et al.*, 1981).

Climatologic data can be entered using one of the following three options:

- A default precipitation option
- A manual precipitation option
- A synthetic precipitation option, with a user input option

The program can generate a synthetic daily precipitation and temperature record for 1 to 20 years for any of 139 cities. The synthetic precipitation and temperature data will have approximately the same statistical characteristics as the historical data at the selected location. For this analysis, historical data for Norfolk, Virginia, were combined with 29 years (1951 to 1980) of monthly mean precipitation and temperatures for Plymouth, North Carolina, using the synthetic option with user input override to generate data. Norfolk, Virginia, is also in a coastal plain and has a climate similar to Plymouth, North Carolina.

Daily solar radiation data were also generated based on historical data from Norfolk, Virginia, and the latitude for Plymouth, North Carolina. The climatological data for Plymouth, North Carolina, is attached.

The user must enter a maximum value of leaf area index for the vegetative cover. Leaf area index is defined as the dimensionless ratio of the leaf area of actively transpiring vegetation to the nominal surface area of the land on which the vegetation is growing. For this analysis, a

maximum leaf area index of zero was used for the open landfill analysis and a maximum leaf area index of two was used for post-closure. Two is a typical value provided by the program for a fair stand of grass in the Norfolk, Virginia, area.

The closed facility will consist of nine distinct layers:

1. Vegetative layer
2. Geocomposite drainage layer
3. Textured 40-mil VFPE geomembrane
4. GCL
5. Waste material
6. Graded granular filter (6 inches of sand)
7. Lateral drainage layer (12 inches of crushed stone overlying a Geocushion™)
8. Textured 60-mil HDPE geomembrane
9. GCL

The open facility will consist of five distinct layers:

1. Waste material
2. Graded granular filter (6 inches of sand)
3. Lateral drainage layer (12 inches of crushed stone overlying a Geocushion™)
4. Textured 60-mil HDPE geomembrane
5. GCL

The user must also specify an evaporative zone depth. This is the maximum depth from which water may be removed from the soil by evapotranspiration. Where surface vegetation is present (post-closure conditions), the evaporative depth should at least equal the expected average depth of root penetration. Although an evaporative depth of 22 inches is recommended for a fair stand of grass in the Norfolk area, the evaporative depth was limited to 18 inches since the depth to the top of the barrier layer is 18 inches. Where surface vegetation is not present (open landfill), the evaporative depth of 8 to 18 inches is recommended for silt size soil. Therefore, an evaporative depth of 13 inches was used for the open landfill conditions.

The program allows the characteristics of each layer in the design to be entered in one of two ways. The user can choose to select default characteristic values by assigning a soil texture class number to each layer. When this method is chosen, the program provides values for each layer for porosity, wilting point, field capacity, and hydraulic conductivity. Default characteristic

values were used for the various cap and liner components since no testing was performed to determine the specific values. See Table 4 from the HELP Model User's Guide for specific Default Soil, Waste, and Geosynthetic Characteristic values. The following characteristic numbers were selected to represent various components of the liner and cap.

COMPONENT	HELP DEFAULT CHARACTERISTIC #
Vegetative layer	4
Geocomposite drainage layer	20
Geomembrane	35
GCL	17
Graded granular filter (sand)	2
Lateral drainage layer (crushed stone)	21

"Soil" characteristic data for the waste was entered manually when a waste layer was considered. The porosity, hydraulic conductivity, and initial moisture content were based on RMT test data, and the wilting point and field capacity were estimated.

The geomembrane was modeled with 8 pinholes per acre of installation defects and 1 pinhole per acre of manufacturing defects per NC DENR recommendations per correspondence dated April 29, 1999 (Appendix F). The open landfill was modeled for the maximum percolation/leakage rate through the liner by not allowing for any runoff. This is a conservative assumption, since the waste material will be sloped to drain according to the recommendations of the operation plan. The open landfill was modeled with 2 feet, 4 feet, 41 feet, 81 feet, and 181 feet of waste. The cap of the closed landfill with vegetative cover over 181 feet of waste was modeled along the side and on top of the landfill.

The majority of the waste will consist of relatively dry ash. Based on Weyerhaeuser's experience with this material at their existing facility, significant pore water release is not anticipated. Therefore, it was not included in the projected leachate generation rates. Temporary stormwater controls recommended in the operating plan will also limit the quantity of leachate generated.

Conclusions

The HELP model evaluation indicates that the cover and liner design in combination with site-specific climatological data will produce the following quantities for the top and side of the landfill.

Average Annual Totals of Closed Landfill in Inches per Acre

DESCRIPTION	TOP OF LANDFILL	SIDE OF LANDFILL
Precipitation	52.35	52.35
Runoff	0.189	0.189
Evapotranspiration	7.205	7.668
Lateral drainage through the geonet	44.955	44.491
Percolation through the cover	0	0
Lateral drainage through the granular drainage layer	0	0
Percolation through the liner	0	0

The HELP model evaluation indicates that the liner design in combination with site-specific climatological data will produce the following quantities for various waste thickness.

Average Annual Totals of Open Landfill in Inches per Acre

DESCRIPTION	2' WASTE	4' WASTE	41'WASTE	81' WASTE	181' WASTE
Precipitation	52.35	52.35	52.35	52.35	52.35
Runoff	0	0	0	0	0
Evapotranspiration	31.46	31.46	31.46	31.46	31.46
Lateral drainage through the granular drainage layer	20.58	20.60	20.32	19.34	16.75
Percolation through the liner	0.00006	0.00005	0.00005	0.00004	0.00003

Attachment G2
HELP Model Data

The following parameters were input in to the HELP model for the Open Landfill condition with only two feet of waste in the landfill:

Description	Parameter Used:
AREA OF LANDFILL	1 acre
LANDFILL CONDITION	open
PERCENTAGE OF AREA WHERE RUNOFF IS POSSIBLE	0 percent (conservative assumption)
EVAPORATIVE ZONE DEPTH	13 inches (recommended by HELP for silt size particles without vegetation)
MAXIMUM LEAF AREA INDEX FOR VEGETATIVE COVER	0 (bare ground)
START OF GROWING SEASON (JULIAN DATE)	94 (user input for Plymouth, NC)
END OF GROWING SEASON (JULIAN DATE)	311 (user input for Plymouth, NC)
NUMBER OF YEARS FOR SYNTHETIC DATA GENERATION	20 years
PRECIPITATION INPUT	Synthetic---data entered manually for Plymouth, North Carolina
TEMPERATURE INPUT	Synthetic---data entered manually for Plymouth, North Carolina
SOLAR RADIATION INPUT	Synthetic---data entered manually for Plymouth, North Carolina
NEAREST CITY FOR DEFAULT INPUT	Norfolk, VA
DEPTH OF WASTE	2 feet (minimum thickness of waste placed – conservative assumption)
LEACHATE COLLECTION SYSTEM (LCS) BELOW WASTE	6 inches of sand 12 inches of crushed stone
FIRST LAYER OF COMPOSITE LINER	60-mil high density polyethylene (HDPE)
SECOND LAYER OF COMPOSITE LINER	geosynthetic clay liner (GCL)
SCS RUNOFF CURVE NUMBER	93 (newly graded area)

The following soil parameter data was input for this HELP model for the Open Landfill condition.

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	---	0.7630	0.2440	0.1360	0.2365	1.0E-05	---	---	---	---	---
WASTE	12	---	0.7630	0.2440	0.1360	0.6648	1.0E-05	---	---	---	---	---
LCS	6	2	0.4370	0.0620	0.0240	0.1752	5.8E-03	---	---	---	---	---
LCS	12	21	0.3970	0.0320	0.0130	0.0569	3.0E-01	2	100	---	---	---
FML	0.06	35	0	0	0	0	2.0E-13	---	---	1	8	3 – good
GCL	0.24	17	0.7500	0.7470	0.4000	0.7500	3.0E-09	---	---	---	---	---

This HELP model resulted in an average annual percolation or leakage rate through the bottom of the landfill of 0.205 cubic feet /acre/year. This was used in the mass balance calculations for the liner design.

CLIMATOGRAPHY OF THE UNITED STATES NO. 20

PLYMOUTH, NC

CLIMATOLOGICAL SUMMARY

PERIOD: 1951-80
ELEVATION: 21 FT

	TEMPERATURE (F) MEANS			EXTREMES						MEAN NUMBER OF DAYS				DEGREE DAYS		PRECIPITATION TOTALS (INCHES)						SNOW			MEAN NUMBER OF DAYS		
										MAX		MIN															
	* DAILY MAXIMUM	* DAILY MINIMUM	* MONTHLY	RECORD HIGHEST	YEAR	DAY	RECORD LOWEST	YEAR	DAY	90 AND ABOVE	32 AND BELOW	32 AND BELOW	0 AND BELOW	* HEATING BASE 65	* COOLING BASE 65	# MEAN	* GREATEST MONTHLY	YEAR	GREATEST DAILY	YEAR	DAY	MEAN	MAXIMUM MONTHLY	YEAR	.10 OR MORE	.50 OR MORE	1.00 OR MORE
JAN	53.5	30.7	42.1	80+	52	27	1+	62	13	0	1	18	0	710	0	4.17	9.02	60	5.10	60	31	1.6	7.5	65	7	3	1
FEB	55.7	32.1	43.9	84+	62	28	4+	79	10	0	0	10	0	591	0	3.98	6.80	61	2.36	71	23	1.9	11.5	80	7	3	1
MAR	63.3	38.5	50.9	89+	74	8	16+	80	4	0	0	10	0	445	8	4.18	6.63	80	2.45	68	13	1.1	15.0	80	7	3	1
APR	73.9	46.6	60.3	95+	60	26	25+	73	12	1	0	2	0	156	15	3.14	5.60	59	2.86	75	15	.0	.0		6	2	1
MAY	80.2	55.2	67.7	95+	64	20	31+	54	11	3	0	0	0	34	118	4.66	11.12	66	4.05	77	24	.0	.0		8	3	1
JUN	86.1	62.5	74.3	102+	54	27	42+	65	5	10	0	0	0	0	279	4.53	13.07	62	4.17	62	30	.0	.0		7	3	1
JUL	89.1	66.9	78.0	102+	52	22	47+	72	8	15	0	0	0	0	403	6.30	14.95	65	4.22	65	05	.0	.0		9	4	2
AUG	88.2	66.4	77.3	100+	80	6	39	65	31	13	0	0	0	0	381	5.85	13.42	55	5.04	55	12	.0	0		7	4	2
SEP	83.2	60.8	72.0	98+	80	7	36	51	30	5	0	0	0	7	217	4.62	11.97	55	5.20	55	19	.0	0		6	3	1
OCT	73.6	49.4	61.5	95	54	6	21+	62	26	0	0	2	0	147	39	3.95	11.52	71	4.20	64	05	.0	0		5	2	1
NOV	65.0	39.7	52.4	87+	74	3	14	51	21	0	0	8	0	378	0	3.10	6.64	77	4.17	62	05	.0	0	62	5	2	1
DEC	56.5	32.7	44.6	82+	78	9	5+	58	16	0	0	17	0	632	0	3.32	7.81	73	3.12	64	27	.6	12.0	58	6	3	1
YEAR	72.4	48.5	60.4	102	JUL 52	22	1	JAN 62	13	47	1	73	0	3100	1460	51.20	14.95	JUL 65	5.20	SEP 55	19	5.2	15.0	MAR 80	80	35	14

*FROM 1951-80 NORMALS

ESTIMATED VALUE BASED ON DATA FROM SURROUNDING STATIONS

+ ALSO ON EARLIER DATES.

DEGREE DAYS TO SELECTED BASE TEMPERATURES (F)

BASE	HEATING DEGREE DAYS												
BELOW	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
65	710	591	445	156	34	0	0	0	7	147	378	632	3100
60	562	459	305	61	6	0	0	0	0	64	240	486	2183
57	475	381	232	25	0	0	0	0	0	29	167	400	1709
55	419	332	190	12	0	0	0	0	0	17	127	345	1442
50	290	222	107	0	0	0	0	0	0	0	51	226	896

BASE	COOLING DEGREE DAYS												
ABOVE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
55	19	21	63	171	394	579	713	691	510	218	49	23	3451
57	13	14	43	124	332	519	651	629	450	169	29	15	2988
60	7	8	23	70	244	429	558	536	360	110	12	8	2365
65	0	0	8	15	118	279	403	381	217	39	0	0	1460
70	0	0	0	0	38	145	248	226	100	9	0	0	766

DERIVED FROM THE 1951-80 MONTHLY NORMALS

PROBABILITY THAT THE MONTHLY PRECIPITATION WILL BE EQUAL TO OR LESS THAN THE INDICATED PRECIPITATION AMOUNT

MONTHLY PRECIPITATION (INCHES)

PROBABILITY LEVELS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
.05	1.40	1.56	1.99	1.25	1.26	1.29	2.04	1.07	1.19	.50	.69	1.12
.10	1.80	1.92	2.35	1.54	1.70	1.72	2.64	1.59	1.63	.78	.98	1.43
.20	2.37	2.45	2.84	1.95	2.38	2.37	3.52	2.45	2.30	1.26	1.43	1.89
.30	2.86	2.89	3.25	2.29	2.97	2.94	4.27	3.24	2.89	1.73	1.84	2.28
.40	3.33	3.30	3.62	2.62	3.55	3.49	5.00	4.05	3.47	2.21	2.25	2.65
.50	3.82	3.72	3.99	2.94	4.15	4.06	5.75	4.93	4.09	2.74	2.68	3.04
.60	4.35	4.17	4.39	3.29	4.82	4.70	6.57	5.92	4.77	3.35	3.17	3.46
.70	4.97	4.70	4.84	3.70	5.62	5.45	7.53	7.13	5.58	4.09	3.76	3.95
.80	5.76	5.36	5.41	4.22	6.66	6.43	8.76	8.73	6.64	5.09	4.53	4.58
.90	7.00	6.39	6.26	5.01	8.28	7.96	10.68	11.31	8.31	6.73	5.75	5.56
.95	8.13	7.32	7.03	5.73	9.81	9.38	12.46	13.77	9.87	8.29	6.90	6.46

THESE VALUES WERE DETERMINED FROM THE INCOMPLETE GAMMA DISTRIBUTION.

316853 PLYMOUTH, NC

DEG MIN DEG MIN
LAT: 35 52N LONG: 76 39W

PERIOD: 1951-80

FREEZE DATA

PROBABILITY OF LATER DATE IN SPRING (THRU JULY 31) THAN INDICATED(*)

TEMP (F)	.90	.80	.70	.60	.50	.40	.30	.20	.10
	SPRING FREEZE DATES (MO/DAY)								
36	4/11	4/17	4/21	4/24	4/28	5/01	5/05	5/09	5/15
32	3/30	4/04	4/08	4/11	4/14	4/17	4/20	4/24	4/29
28	3/12	3/18	3/22	3/26	3/29	4/01	4/05	4/09	4/14
24	2/17	2/24	3/01	3/06	3/10	3/14	3/19	3/24	3/31
20	1/27	2/03	2/09	2/13	2/17	2/21	2/26	3/03	3/10
16	12/26	1/10	1/19	1/25	1/31	2/06	2/12	2/19	2/28

PROBABILITY OF EARLIER DATE IN FALL (BEGINNING AUG 1) THAN INDICATED(*)

TEMP (F)	.10	.20	.30	.40	.50	.60	.70	.80	.90
	FALL FREEZE DATES (MO/DAY)								
36	10/04	10/09	10/12	10/15	10/17	10/20	10/22	10/25	10/30
32	10/11	10/16	10/19	10/22	10/25	10/28	10/31	11/03	11/08
28	10/24	10/29	11/02	11/06	11/09	11/12	11/15	11/19	11/24
24	10/30	11/05	11/09	11/13	11/17	11/20	11/24	11/29	12/05
20	11/17	11/23	11/28	12/01	12/05	12/08	12/12	12/17	12/23
16	12/01	12/10	12/17	12/23	12/29	1/03	1/10	1/18	2/02

PROBABILITY OF LONGER THAN INDICATED FREEZE FREE PERIOD (DAYS)

TEMP (F)	.10	.20	.30	.40	.50	.60	.70	.80	.90
	FREEZE FREE PERIOD								
36	193	186	180	176	172	167	163	157	150
32	212	206	201	197	193	189	185	180	174
28	245	241	234	229	224	219	214	208	199
24	280	270	263	257	251	245	239	232	222
20	318	309	302	296	290	284	278	271	261
16	>365	>365	349	336	328	320	313	305	294

(*)PROBABILITY OF OBSERVING A TEMPERATURE AS COLD, OR COLDER, LATER IN THE SPRING OR EARLIER IN THE FALL THAN THE INDICATED DATE. 0/00 INDICATES THAT THE PROBABILITY OF OCCURRENCE OF THRESHOLD TEMPERATURE IS LESS THAN INDICATED PROBABILITY.

GROWING DEGREE UNITS TO SELECTED BASE TEMPERATURES (F)

BASE		GROWING DEGREE UNITS												
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
40	M	167	179	358	614	867	1036	1187	1165	968	677	385	208	7811
	S	167	346	704	1318	2185	3221	4408	5573	6541	7218	7603	7811	
45	M	93	102	231	465	712	886	1032	1010	818	523	256	120	6248
	S	93	195	426	891	1603	2489	3521	4531	5349	5872	6128	6248	
50	M	45	51	134	324	557	736	877	855	668	374	150	62	4833
	S	45	96	230	554	1111	1847	2724	3579	4247	4621	4771	4833	
55	M	18	21	68	204	404	586	722	700	518	239	75	26	3581
	S	18	39	107	311	715	1301	2023	2723	3241	3480	3555	3581	
60	M	5	7	28	112	260	436	567	545	369	129	31	8	2497
	S	5	12	40	152	412	848	1415	1960	2329	2458	2489	2497	

M = MONTHLY DATA S = SUM OF MONTHLY DATA

		GROWING DEGREE UNITS FOR CORN												
CORN	M	113	121	232	401	569	700	817	803	655	435	250	138	5234
	S	113	234	466	867	1436	2136	2953	3756	4411	4846	5096	5234	

NOTE: FOR CORN THE BASE IS 50, AND THE DEGREE UNITS ARE ADJUSTED FOR TEMPERATURES BELOW 50 AND ABOVE 86

OTHER CLIMATOLOGICAL DATA ARE AVAILABLE IN A VARIETY OF SUMMARIES AND FORMATS, SUCH AS THE CLIMATOGRAPHY OF THE UNITED STATES: NO. 60 - CLIMATE OF STATES: NO. 81 - MONTHLY NORMALS (AND SUPPLEMENTS: ANNUAL DEGREE DAYS TO SELECTED BASES DERIVED FROM THE 1951-80 NORMALS; AND MONTHLY PRECIPITATION PROBABILITIES, SELECTED PROBABILITY LEVELS DERIVED FROM THE 1951-80 NORMALS); NO. 84 - DAILY NORMALS; NO. 85 - DIVISIONAL NORMALS. A VARIETY OF DATA IS AVAILABLE EITHER ON MAGNETIC TAPE, MICROFICHE, OR PAPER COPY.

TO OBTAIN INFORMATION ABOUT CLIMATOLOGICAL DATA AND RELATED PUBLICATIONS, CONTACT:

DIRECTOR
NATIONAL CLIMATIC DATA CENTER
FEDERAL BUILDING
ASHEVILLE, NC 28801-2696
(OR TELEPHONE: (704) 259-0682)

DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL ENVIRONMENTAL SATELLITE, DATA, AND INFORMATION SERVICE
NATIONAL CLIMATIC DATA CENTER
ASHEVILLE, NC

USCOMM-NOAA-ASHEVILLE, NC 7/84/200

FROM HELP MODEL USER'S GUIDE (V.3)

TABLE 4. DEFAULT SOIL, WASTE, AND GEOSYNTHETIC CHARACTERISTICS

Classification			Total Porosity	Field Capacity	Wilting Point	Saturated Hydraulic Conductivity
HELP	USDA	USCS	vol/vol	vol/vol	vol/vol	cm/sec
1	CoS	SP	0.417	0.045	0.018	1.0×10^{-2}
2	S	SW	0.437	0.062	0.024	5.8×10^{-3}
3	FS	SW	0.457	0.083	0.033	3.1×10^{-3}
4	LS	SM	0.437	0.105	0.047	1.7×10^{-3}
5	LFS	SM	0.457	0.131	0.058	1.0×10^{-3}
6	SL	SM	0.453	0.190	0.085	7.2×10^{-4}
7	FSL	SM	0.473	0.222	0.104	5.2×10^{-4}
8	L	ML	0.463	0.232	0.116	3.7×10^{-4}
9	SiL	ML	0.501	0.284	0.135	1.9×10^{-4}
10	SCL	SC	0.398	0.244	0.136	1.2×10^{-4}
11	CL	CL	0.464	0.310	0.187	6.4×10^{-5}
12	SiCL	CL	0.471	0.342	0.210	4.2×10^{-5}
13	SC	SC	0.430	0.321	0.221	3.3×10^{-5}
14	SiC	CH	0.479	0.371	0.251	2.5×10^{-5}
15	C	CH	0.475	0.378	0.265	1.7×10^{-5}
16	Barrier Soil		0.427	0.418	0.367	1.0×10^{-7}
17	Bentonite Mat (0.6 cm)		0.750	0.747	0.400	3.0×10^{-9}
18	Municipal Waste (900 lb/yd^3 or 312 kg/m^3)		0.671	0.292	0.077	1.0×10^{-3}
19	Municipal Waste (channeling and dead zones)		0.168	0.073	0.019	1.0×10^{-3}
20	Drainage Net (0.5 cm)		0.850	0.010	0.005	$1.0 \times 10^{+1}$
21	Gravel		0.397	0.032	0.013	3.0×10^{-1}
22	L*	ML	0.419	0.307	0.180	1.9×10^{-5}
23	SiL*	ML	0.461	0.360	0.203	9.0×10^{-6}
24	SCL*	SC	0.365	0.305	0.202	2.7×10^{-6}
25	CL*	CL	0.437	0.373	0.266	3.6×10^{-6}
26	SiCL*	CL	0.445	0.393	0.277	1.9×10^{-6}
27	SC*	SC	0.400	0.366	0.288	7.8×10^{-7}
28	SiC*	CH	0.452	0.411	0.311	1.2×10^{-6}
29	C*	CH	0.451	0.419	0.332	6.8×10^{-7}
30	Coal-Burning Electric Plant Fly Ash*		0.541	0.187	0.047	5.0×10^{-5}
31	Coal-Burning Electric Plant Bottom Ash*		0.578	0.076	0.025	4.1×10^{-3}
32	Municipal Incinerator Fly Ash*		0.450	0.116	0.049	1.0×10^{-2}
33	Fine Copper Slag*		0.375	0.055	0.020	4.1×10^{-2}
34	Drainage Net (0.6 cm)		0.850	0.010	0.005	$3.3 \times 10^{+1}$

* Moderately Compacted

(Continued)

FROM HELP MODEL USER'S GUIDE (V.3)

TABLE 4 (continued). DEFAULT SOIL, WASTE, AND GEOSYNTHETIC CHARACTERISTICS

Classification		Total Porosity	Field Capacity	Wilting Point	Saturated Hydraulic Conductivity
HELP	Geomembrane Material	vol/vol	vol/vol	vol/vol	cm/sec
35	High Density Polyethylene (HDPE)				2.0×10^{-13}
36	Low Density Polyethylene (LDPE)				4.0×10^{-13}
37	Polyvinyl Chloride (PVC)				2.0×10^{-11}
38	Butyl Rubber				1.0×10^{-12}
39	Chlorinated Polyethylene (CPE)				4.0×10^{-12}
40	Hypalon or Chlorosulfonated Polyethylene (CSPE)				3.0×10^{-12}
41	Ethylene-Propylene Diene Monomer (EPDM)				2.0×10^{-12}
42	Neoprene				3.0×10^{-12}

(concluded)

user-defined soil option accepts non-default soil characteristics for layers assigned soil type numbers greater than 42. This is especially convenient for specifying characteristics of waste layers. User-specified soil characteristics can be assigned any soil type number greater than 42.

When a default soil type is used to describe the top soil layer, the program adjusts the saturated hydraulic conductivities of the soils in the top half of the evaporative zone for the effects of root channels. The saturated hydraulic conductivity value is multiplied by an empirical factor that is computed as a function of the user-specified maximum leaf area index. Example values of this factor are 1.0 for a maximum LAI of 0 (bare ground), 1.8 for a maximum LAI of 1 (poor stand of grass), 3.0 for a maximum LAI of 2 (fair stand of grass), 4.2 for a maximum LAI of 3.3 (good stand of grass) and 5.0 for a maximum LAI of 5 (excellent stand of grass).

The manual option requires values for porosity, field capacity, wilting point, and saturated hydraulic conductivity. These and related soil properties are defined below.

Soil Water Storage (Volumetric Content): the ratio of the volume of water in a soil to the total volume occupied by the soil, water and voids.

Total Porosity: the soil water storage/volumetric content at saturation (fraction of total volume).

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


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:  13:59     DATE:   8/31/1999


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

     TITLE:  WEYERHAEUSER PLYMOUTH/OPEN LANDFILL/ 2' OF WASTE

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


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


                                  LAYER  1
                                  --------
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```
          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =      12.00   INCHES
POROSITY                     =       0.7630 VOL/VOL
FIELD CAPACITY               =       0.2440 VOL/VOL
WILTING POINT                =       0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT   =       0.2365 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                     =       0.7630 VOL/VOL
FIELD CAPACITY               =       0.2440 VOL/VOL
WILTING POINT                =       0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT   =       0.6648 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-05 CM/SEC


                         LAYER  3
                         --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   2
THICKNESS                    =       6.00   INCHES
POROSITY                     =       0.4370 VOL/VOL
FIELD CAPACITY               =       0.0620 VOL/VOL
WILTING POINT                =       0.0240 VOL/VOL
INITIAL SOIL WATER CONTENT   =       0.1752 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.579999993000E-02 CM/SEC


                         LAYER  4
                         --------
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              TYPE 2 - LATERAL DRAINAGE LAYER
                MATERIAL TEXTURE NUMBER  21
THICKNESS                    =      12.00   INCHES
POROSITY                     =       0.3970 VOL/VOL
FIELD CAPACITY               =       0.0320 VOL/VOL
WILTING POINT                =       0.0130 VOL/VOL
INITIAL SOIL WATER CONTENT   =       0.0569 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.300000012000      CM/SEC
SLOPE                        =       2.00   PERCENT
DRAINAGE LENGTH              =     100.0    FEET


                         LAYER  5
                         --------

              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     =       8.00   HOLES/ACRE
FML PLACEMENT QUALITY        =  3 - GOOD


                         LAYER  6
                         --------

              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	=	93.00	
FRACTION OF AREA ALLOWING RUNOFF	=	0.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	13.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.377	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	9.919	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.768	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	12.730	INCHES
TOTAL INITIAL WATER	=	12.730	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
PLYMOUTH 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	=	7.60	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	68.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	68.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	77.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	73.00	%

NOTE: PRECIPITATION DATA WAS ~~SYNTHETICALLY GENERATED USING~~ ENTERED MANUALLY FOR
~~COEFFICIENTS FOR NORFOLK VIRGINIA~~
PLYMOUTH, NORTH CAROLINA.

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC

4.17	3.98	4.18	3.14	4.66	4.53
6.30	5.85	4.62	3.35	3.10	3.32

NOTE: TEMPERATURE DATA WAS ~~SYNTHETICALLY GENERATED USING~~ ENTERED MANUALLY FOR PLYMOUTH, NC
~~COEFFICIENTS FOR NORFOLK VIRGINIA~~

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~~ ENTERED MANUALLY FOR PLYMOUTH, NC
~~COEFFICIENTS FOR NORFOLK VIRGINIA~~

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	3.42	3.66	4.52	2.76	4.19	5.02
	7.36	7.52	4.98	2.34	2.74	3.83
STD. DEVIATIONS	2.25	1.38	1.86	1.27	1.84	2.52
	3.32	3.06	2.72	1.33	1.43	1.73

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	1.524	1.735	2.900	2.393	3.289	3.705
	4.082	4.017	3.073	1.822	1.496	1.414
STD. DEVIATIONS	0.400	0.453	0.816	0.997	1.148	1.523
	1.469	1.234	1.146	0.790	0.527	0.219

LATERAL DRAINAGE COLLECTED FROM LAYER 4

TOTALS	1.9900	1.4995	2.0321	1.4353	1.0149	1.073
	1.4650	2.4987	3.2323	1.9762	1.0446	1.321
STD. DEVIATIONS	1.4579	1.0815	1.3261	1.0699	1.0681	1.232
	1.6159	1.8524	2.1318	1.3740	0.9967	1.178

PERCOLATION/LEAKAGE THROUGH LAYER 6

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ACROSS LAYER 6

AVERAGES	0.2698	0.2133	0.2773	0.1768	0.1306	0.142
	0.2005	0.3830	0.5351	0.2671	0.1297	0.171

STD. DEVIATIONS	0.2762	0.2084	0.2420	0.2010	0.1863	0.2186
	0.2957	0.3485	0.4516	0.2634	0.1781	0.1943

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

	INCHES		CU. FEET	PERCENT
PRECIPITATION	52.35	(8.675)	190032.3	100.00
RUNOFF	0.000	(0.0000)	0.00	0.000
EVAPOTRANSPIRATION	31.452	(7.4949)	114170.05	60.079
LATERAL DRAINAGE COLLECTED FROM LAYER 4	20.58297	(8.48051)	74716.164	39.31761
PERCOLATION/LEAKAGE THROUGH FROM LAYER 6	0.00006	(0.00003)	0.205	0.00011
AVERAGE HEAD ACROSS TOP OF LAYER 6	0.241	(0.130)		
CHANGE IN WATER STORAGE	0.316	(2.0589)	1145.92	0.603

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	5.73	20799.900

RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 4	0.34003	1234.31641
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000002	0.00557
AVERAGE HEAD ACROSS LAYER 6	2.090	
SNOW WATER	2.95	10713.2930

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.7440
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1360

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FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	8.5252	0.7104
2	8.8920	0.7410
3	0.9547	0.1591
4	0.4917	0.0410
5	0.0000	0.0000
6	0.1800	0.7500
SNOW WATER	0.000	

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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:  14: 6     DATE:   8/31/1999


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     TITLE:  WEYERHAEUSER PLYMOUTH/OPEN LANDFILL/4' OF 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
                                  --------
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```
          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                      =      36.00   INCHES
POROSITY                       =       0.7630 VOL/VOL
FIELD CAPACITY                 =       0.2440 VOL/VOL
WILTING POINT                  =       0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT     =       0.5355 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                       =       0.7630 VOL/VOL
FIELD CAPACITY                 =       0.2440 VOL/VOL
WILTING POINT                  =       0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT     =       0.6301 VOL/VOL
EFFECTIVE SAT. HYD. COND.      =  0.999999975000E-05 CM/SEC


                         LAYER  3
                         --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   2
THICKNESS                      =       6.00   INCHES
POROSITY                       =       0.4370 VOL/VOL
FIELD CAPACITY                 =       0.0620 VOL/VOL
WILTING POINT                  =       0.0240 VOL/VOL
INITIAL SOIL WATER CONTENT     =       0.1365 VOL/VOL
EFFECTIVE SAT. HYD. COND.      =  0.579999993000E-02 CM/SEC


                         LAYER  4
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              TYPE 2 - LATERAL DRAINAGE LAYER
                MATERIAL TEXTURE NUMBER  21
THICKNESS                    =      12.00   INCHES
POROSITY                     =       0.3970 VOL/VOL
FIELD CAPACITY               =       0.0320 VOL/VOL
WILTING POINT                =       0.0130 VOL/VOL
INITIAL SOIL WATER CONTENT   =       0.0350 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.300000012000     CM/SEC
SLOPE                        =       2.00   PERCENT
DRAINAGE LENGTH              =     100.0    FEET


                         LAYER  5
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              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     =       8.00   HOLES/ACRE
FML PLACEMENT QUALITY        =  3 - GOOD


                         LAYER  6
                         --------

               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
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GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

SCS RUNOFF CURVE NUMBER	=	93.00	
FRACTION OF AREA ALLOWING RUNOFF	=	0.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	13.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.381	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	9.919	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.768	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	28.258	INCHES
TOTAL INITIAL WATER	=	28.258	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
PLYMOUTH 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	=	7.60	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	68.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	68.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	77.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	73.00	%

NOTE: PRECIPITATION DATA WAS ~~SYNTHETICALLY GENERATED USING~~ ENTERED MANUALLY FOR PLYMOUTH, NC
~~COEFFICIENTS FOR NORFOLK VIRGINIA~~

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC

4.17	3.98	4.18	3.14	4.66	4.53
6.30	5.85	4.62	3.35	3.10	3.32

NOTE: TEMPERATURE DATA WAS ~~SYNTHETICALLY GENERATED USING~~ ENTERED MANUALLY FOR PLYMOUTH, NC
~~COEFFICIENTS FOR NORFOLK VIRGINIA~~

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~~ ENTERED MANUALLY FOR PLYMOUTH, NC
~~COEFFICIENTS FOR NORFOLK VIRGINIA~~

STATION LATITUDE = 35.87 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

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	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.42	3.66	4.52	2.76	4.19	5.02
	7.36	7.52	4.98	2.34	2.74	3.83
STD. DEVIATIONS	2.25	1.38	1.86	1.27	1.84	2.52
	3.32	3.06	2.72	1.33	1.43	1.73

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	1.524	1.735	2.900	2.393	3.289	3.705
	4.086	4.018	3.073	1.822	1.496	1.414
STD. DEVIATIONS	0.400	0.453	0.816	0.997	1.148	1.523
	1.467	1.235	1.146	0.790	0.527	0.219

LATERAL DRAINAGE COLLECTED FROM LAYER 4

TOTALS	1.5563	1.7100	1.7480	1.7941	1.3667	1.157
	1.2367	2.0033	2.7946	2.4613	1.5585	1.216
STD. DEVIATIONS	1.1595	1.3770	1.2021	1.0082	0.9564	1.099
	1.2375	1.7636	1.8165	1.1383	1.0231	0.861

PERCOLATION/LEAKAGE THROUGH LAYER 6

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ACROSS LAYER 6

AVERAGES	0.1908	0.2452	0.2226	0.2203	0.1520	0.143
	0.1556	0.2883	0.4482	0.3246	0.1858	0.137

STD. DEVIATIONS	0.1871	0.2880	0.2179	0.1688	0.1794	0.1933
	0.2235	0.3254	0.3654	0.2102	0.1949	0.1424

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

	INCHES		CU. FEET	PERCENT
PRECIPITATION	52.35	(8.675)	190032.3	100.00
RUNOFF	0.000	(0.0000)	0.00	0.000
EVAPOTRANSPIRATION	31.456	(7.4940)	114184.73	60.087
LATERAL DRAINAGE COLLECTED FROM LAYER 4	20.60348	(8.54843)	74790.641	39.35680
PERCOLATION/LEAKAGE THROUGH FROM LAYER 6	0.00005	(0.00003)	0.187	0.00010
AVERAGE HEAD ACROSS TOP OF LAYER 6	0.226	(0.129)		
CHANGE IN WATER STORAGE	0.291	(2.3999)	1056.76	0.556

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	5.73	20799.900

RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 4	0.33544	1217.64282
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000002	0.00547
AVERAGE HEAD ACROSS LAYER 6	2.060	
SNOW WATER	2.95	10713.2930

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.7440
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1360

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FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	25.3259	0.7035
2	7.3368	0.6114
3	0.8312	0.1385
4	0.4065	0.0339
5	0.0000	0.0000
6	0.1800	0.7500
SNOW WATER	0.000	

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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:  14:10     DATE:   8/31/1999


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     TITLE:  WEYERHAEUSER PLYMOUTH/OPEN LANDFILL/41' OF 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
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```
          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER    0
THICKNESS                      =    240.00   INCHES
POROSITY                       =      0.7630 VOL/VOL
FIELD CAPACITY                 =      0.2440 VOL/VOL
WILTING POINT                  =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT     =      0.2893 VOL/VOL
EFFECTIVE SAT. HYD. COND.      =  0.999999975000E-05 CM/SEC


                         LAYER  2
                         --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER    0
THICKNESS                      =    240.00   INCHES
POROSITY                       =      0.7630 VOL/VOL
FIELD CAPACITY                 =      0.2440 VOL/VOL
WILTING POINT                  =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT     =      0.2792 VOL/VOL
EFFECTIVE SAT. HYD. COND.      =  0.999999975000E-05 CM/SEC


                         LAYER  3
                         --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER    0
THICKNESS                      =     12.00   INCHES
POROSITY                       =      0.7630 VOL/VOL
FIELD CAPACITY                 =      0.2440 VOL/VOL
WILTING POINT                  =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT     =      0.2588 VOL/VOL
EFFECTIVE SAT. HYD. COND.      =  0.999999975000E-05 CM/SEC


                         LAYER  4
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              TYPE 2 - LATERAL DRAINAGE LAYER
                MATERIAL TEXTURE NUMBER   2
THICKNESS                    =      6.00    INCHES
POROSITY                     =      0.4370 VOL/VOL
FIELD CAPACITY               =      0.0620 VOL/VOL
WILTING POINT                =      0.0240 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0681 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.579999993000E-02 CM/SEC


                         LAYER  5
                         --------

              TYPE 2 - LATERAL DRAINAGE LAYER
                MATERIAL TEXTURE NUMBER  21
THICKNESS                    =     12.00    INCHES
POROSITY                     =      0.3970 VOL/VOL
FIELD CAPACITY               =      0.0320 VOL/VOL
WILTING POINT                =      0.0130 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0320 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.300000012000      CM/SEC
SLOPE                        =      2.00    PERCENT
DRAINAGE LENGTH              =    100.0     FEET


                         LAYER  6
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              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     =      8.00    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	=	93.00	
FRACTION OF AREA ALLOWING RUNOFF	=	0.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	13.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.381	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	9.919	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.768	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	140.520	INCHES
TOTAL INITIAL WATER	=	140.520	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
PLYMOUTH 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 = 7.60 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY = 68.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY = 68.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 77.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 73.00 %

NOTE: PRECIPITATION DATA WAS ~~SYNTHETICALLY GENERATED USING~~ ENTERED MANUALLY FOR PLYMOUTH, NC
~~COEFFICIENTS FOR NORFOLK VIRGINIA~~

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
4.17	3.98	4.18	3.14	4.66	4.53
6.30	5.85	4.62	3.35	3.10	3.32

NOTE: TEMPERATURE DATA WAS ~~SYNTHETICALLY GENERATED USING~~ ENTERED MANUALLY FOR PLYMOUTH, NC
~~COEFFICIENTS FOR NORFOLK VIRGINIA~~

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~~ ENTERED MANUALLY FOR PLYMOUTH, NC
~~COEFFICIENTS FOR NORFOLK VIRGINIA~~

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	3.42	3.66	4.52	2.76	4.19	5.02
	7.36	7.52	4.98	2.34	2.74	3.83
STD. DEVIATIONS	2.25	1.38	1.86	1.27	1.84	2.52
	3.32	3.06	2.72	1.33	1.43	1.73
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	1.524	1.735	2.900	2.393	3.289	3.705
	4.086	4.018	3.073	1.822	1.496	1.414
STD. DEVIATIONS	0.400	0.453	0.816	0.997	1.148	1.523
	1.467	1.235	1.146	0.790	0.527	0.219
LATERAL DRAINAGE COLLECTED FROM LAYER 5						
TOTALS	1.3971	1.5389	1.5706	1.7087	1.6269	1.350
	1.2553	1.5588	2.1736	2.6892	1.9764	1.473
STD. DEVIATIONS	1.1688	1.2378	1.0128	1.0726	1.1609	0.805
	0.8635	1.5634	1.4320	1.6663	1.1787	0.809
PERCOLATION/LEAKAGE THROUGH LAYER 7						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.000

0.0000	0.0000	0.0000	0.0000	0.0000	0.000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ACROSS LAYER 7

AVERAGES	0.1647	0.2138	0.1831	0.2126	0.1865	0.152
	0.1423	0.2126	0.3164	0.3798	0.2422	0.160
STD. DEVIATIONS	0.1998	0.2433	0.1594	0.1746	0.2122	0.141
	0.1374	0.2930	0.2679	0.3129	0.2276	0.139

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

	INCHES		CU. FEET	PERCENT
PRECIPITATION	52.35	(8.675)	190032.3	100.00
RUNOFF	0.000	(0.0000)	0.00	0.000
EVAPOTRANSPIRATION	31.456	(7.4940)	114184.73	60.087
LATERAL DRAINAGE COLLECTED FROM LAYER 5	20.31914	(8.65141)	73758.461	38.81364
PERCOLATION/LEAKAGE THROUGH FROM LAYER 7	0.00005	(0.00003)	0.174	0.0000
AVERAGE HEAD ACROSS TOP OF LAYER 7	0.214	(0.125)		

CHANGE IN WATER STORAGE	0.575	(3.0661)	2088.95	1.099

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	5.73	20799.900
RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 5	0.30308	1100.16296
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000001	0.00475
AVERAGE HEAD ACROSS LAYER 7	1.842	
SNOW WATER	2.95	10713.2930

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.7440
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1360

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****

FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	75.4760	0.3145
2	67.4821	0.2812

3	7.6089	0.6341
4	0.8784	0.1464
5	0.4043	0.0337
6	0.0000	0.0000
7	0.1800	0.7500
SNOW WATER	0.000	

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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:  14:20     DATE:   8/31/1999


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     TITLE:  WEYERHAEUSER PLYMOUTH/OPEN LANDFILL/81' OF 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                    =    240.00   INCHES
POROSITY                     =      0.7630 VOL/VOL
FIELD CAPACITY               =      0.2440 VOL/VOL
WILTING POINT                =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2893 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-05 CM/SEC


                        LAYER  2
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =    240.00   INCHES
POROSITY                     =      0.7630 VOL/VOL
FIELD CAPACITY               =      0.2440 VOL/VOL
WILTING POINT                =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2792 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-05 CM/SEC


                        LAYER  3
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =    240.00   INCHES
POROSITY                     =      0.7630 VOL/VOL
FIELD CAPACITY               =      0.2440 VOL/VOL
WILTING POINT                =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2447 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-05 CM/SEC


                        LAYER  4
                        --------
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```
          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =    240.00   INCHES
POROSITY                     =      0.7630 VOL/VOL
FIELD CAPACITY               =      0.2440 VOL/VOL
WILTING POINT                =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2440 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-05 CM/SEC


                        LAYER  5
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =     12.00   INCHES
POROSITY                     =      0.7630 VOL/VOL
FIELD CAPACITY               =      0.2440 VOL/VOL
WILTING POINT                =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2440 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-05 CM/SEC


                        LAYER  6
                        --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   2
THICKNESS                    =      6.00   INCHES
POROSITY                     =      0.4370 VOL/VOL
FIELD CAPACITY               =      0.0620 VOL/VOL
WILTING POINT                =      0.0240 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0681 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.579999993000E-02 CM/SEC


                        LAYER  7
                        --------

            TYPE 2 - LATERAL DRAINAGE LAYER
```

```
                MATERIAL TEXTURE NUMBER  21
THICKNESS                    =      12.00    INCHES
POROSITY                     =       0.3970 VOL/VOL
FIELD CAPACITY               =       0.0320 VOL/VOL
WILTING POINT                =       0.0130 VOL/VOL
INITIAL SOIL WATER CONTENT   =       0.0320 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.300000012000      CM/SEC
SLOPE                        =       2.00    PERCENT
DRAINAGE LENGTH              =     100.0     FEET


                         LAYER  8
                         --------

              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     =       8.00    HOLES/ACRE
FML PLACEMENT QUALITY        =  3 - GOOD


                         LAYER  9
                         --------

               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	=	93.00	
FRACTION OF AREA ALLOWING RUNOFF	=	0.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	13.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.381	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	9.919	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.768	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	257.640	INCHES
TOTAL INITIAL WATER	=	257.640	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
PLYMOUTH 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	=	7.60	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	68.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	68.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	77.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	73.00	%

NOTE: PRECIPITATION DATA WAS ~~SYNTHETICALLY GENERATED USING~~ ENTERED MANUALLY FOR PLYMOUTH, NC
~~COEFFICIENTS FOR~~ ~~NORFOLK~~ ~~VIRGINIA~~

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
---	---	---	---	---	---

4.17	3.98	4.18	3.14	4.66	4.53
6.30	5.85	4.62	3.35	3.10	3.32

NOTE: TEMPERATURE DATA WAS ~~SYNTHETICALLY GENERATED USING COEFFICIENTS FOR NORFOLK VIRGINIA~~ ENTERED MANUALLY FOR PLYMOUTH, NC

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 NORFOLK VIRGINIA~~ ENTERED MANUALLY FOR PLYMOUTH, NC

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	3.42	3.66	4.52	2.76	4.19	5.02
	7.36	7.52	4.98	2.34	2.74	3.83
STD. DEVIATIONS	2.25	1.38	1.86	1.27	1.84	2.52
	3.32	3.06	2.72	1.33	1.43	1.73

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	1.524	1.735	2.900	2.393	3.289	3.705
	4.086	4.018	3.073	1.822	1.496	1.414
STD. DEVIATIONS	0.400	0.453	0.816	0.997	1.148	1.523
	1.467	1.235	1.146	0.790	0.527	0.219

LATERAL DRAINAGE COLLECTED FROM LAYER 7

TOTALS	1.4779	1.2299	1.5294	1.5159	1.7074	1.485
	1.4152	1.4107	1.5452	1.9497	2.2066	1.865
STD. DEVIATIONS	0.9542	0.9421	1.2954	0.9357	1.0558	0.965
	0.9056	0.9163	1.4419	1.4549	1.2406	1.122

PERCOLATION/LEAKAGE THROUGH LAYER 9

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ACROSS LAYER 9

AVERAGES	0.1592	0.1540	0.1837	0.1766	0.1970	0.168
	0.1541	0.1594	0.2064	0.2683	0.2919	0.213
STD. DEVIATIONS	0.1449	0.1707	0.2227	0.1499	0.1654	0.158

0.1477 0.1473 0.2747 0.2590 0.2083 0.1836

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

	INCHES		CU. FEET	PERCENT
PRECIPITATION	52.35	(8.675)	190032.3	100.00
RUNOFF	0.000	(0.0000)	0.00	0.000
EVAPOTRANSPIRATION	31.456	(7.4940)	114184.73	60.087
LATERAL DRAINAGE COLLECTED FROM LAYER 7	19.33913	(9.32229)	70201.039	36.94163
PERCOLATION/LEAKAGE THROUGH FROM LAYER 9	0.00004	(0.00003)	0.157	0.0000
AVERAGE HEAD ACROSS TOP OF LAYER 9	0.194	(0.125)		
CHANGE IN WATER STORAGE	1.555	(5.9108)	5646.42	2.971

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	5.73	20799.900

RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 7	0.27602	1001.95624
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.000001	0.00416
AVERAGE HEAD ACROSS LAYER 9	1.654	
SNOW WATER	2.95	10713.2930

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.7440
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1360

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FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	75.4760	0.3145
2	67.4821	0.2812
3	67.9560	0.2832
4	68.3228	0.2847
5	7.9246	0.6604
6	0.9579	0.1597
7	0.4506	0.0376
8	0.0000	0.0000
9	0.1800	0.7500
SNOW WATER	0.000	

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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:  14:25     DATE:   8/31/1999


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

     TITLE:  WEYERHAEUSER PLYMOUTH/OPEN LANDFILL/181' OF 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                    =    240.00   INCHES
POROSITY                     =      0.7630 VOL/VOL
FIELD CAPACITY               =      0.2440 VOL/VOL
WILTING POINT                =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2893 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-05 CM/SEC


                        LAYER  2
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =    240.00   INCHES
POROSITY                     =      0.7630 VOL/VOL
FIELD CAPACITY               =      0.2440 VOL/VOL
WILTING POINT                =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2792 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-05 CM/SEC


                        LAYER  3
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =    240.00   INCHES
POROSITY                     =      0.7630 VOL/VOL
FIELD CAPACITY               =      0.2440 VOL/VOL
WILTING POINT                =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2447 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-05 CM/SEC


                        LAYER  4
                        --------
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```
          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =    240.00   INCHES
POROSITY                     =      0.7630 VOL/VOL
FIELD CAPACITY               =      0.2440 VOL/VOL
WILTING POINT                =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2440 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-05 CM/SEC


                        LAYER  5
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =    240.00   INCHES
POROSITY                     =      0.7630 VOL/VOL
FIELD CAPACITY               =      0.2440 VOL/VOL
WILTING POINT                =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2440 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-05 CM/SEC


                        LAYER  6
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =    240.00   INCHES
POROSITY                     =      0.7630 VOL/VOL
FIELD CAPACITY               =      0.2440 VOL/VOL
WILTING POINT                =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2440 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-05 CM/SEC


                        LAYER  7
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
```

```
                MATERIAL TEXTURE NUMBER   0
THICKNESS                    =    240.00   INCHES
POROSITY                     =      0.7630 VOL/VOL
FIELD CAPACITY               =      0.2440 VOL/VOL
WILTING POINT                =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2440 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-05 CM/SEC


                         LAYER  8
                         --------

            TYPE 1 - VERTICAL PERCOLATION LAYER
                MATERIAL TEXTURE NUMBER   0
THICKNESS                    =    240.00   INCHES
POROSITY                     =      0.7630 VOL/VOL
FIELD CAPACITY               =      0.2440 VOL/VOL
WILTING POINT                =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2440 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-05 CM/SEC


                         LAYER  9
                         --------

            TYPE 1 - VERTICAL PERCOLATION LAYER
                MATERIAL TEXTURE NUMBER   0
THICKNESS                    =    240.00   INCHES
POROSITY                     =      0.7630 VOL/VOL
FIELD CAPACITY               =      0.2440 VOL/VOL
WILTING POINT                =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2440 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-05 CM/SEC


                         LAYER 10
                         --------

            TYPE 1 - VERTICAL PERCOLATION LAYER
                MATERIAL TEXTURE NUMBER   0
```

```
THICKNESS                      =      12.00    INCHES
POROSITY                       =       0.7630 VOL/VOL
FIELD CAPACITY                 =       0.2440 VOL/VOL
WILTING POINT                  =       0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT     =       0.2440 VOL/VOL
EFFECTIVE SAT. HYD. COND.      =  0.999999975000E-05 CM/SEC
```

LAYER 11

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 2

```
THICKNESS                      =       6.00    INCHES
POROSITY                       =       0.4370 VOL/VOL
FIELD CAPACITY                 =       0.0620 VOL/VOL
WILTING POINT                  =       0.0240 VOL/VOL
INITIAL SOIL WATER CONTENT     =       0.0681 VOL/VOL
EFFECTIVE SAT. HYD. COND.      =  0.579999993000E-02 CM/SEC
```

LAYER 12

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 21

```
THICKNESS                      =      12.00    INCHES
POROSITY                       =       0.3970 VOL/VOL
FIELD CAPACITY                 =       0.0320 VOL/VOL
WILTING POINT                  =       0.0130 VOL/VOL
INITIAL SOIL WATER CONTENT     =       0.0320 VOL/VOL
EFFECTIVE SAT. HYD. COND.      =  0.300000012000      CM/SEC
SLOPE                          =       2.00    PERCENT
DRAINAGE LENGTH                =     100.0     FEET
```

LAYER 13

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     =      8.00   HOLES/ACRE
FML PLACEMENT QUALITY        =  3 - GOOD


                         LAYER 14
                         --------

                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              =     93.00
FRACTION OF AREA ALLOWING RUNOFF     =      0.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE   =      1.000  ACRES
EVAPORATIVE ZONE DEPTH               =     13.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE    =      3.381  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE   =      9.919  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE   =      1.768  INCHES
INITIAL SNOW WATER                   =      0.000  INCHES
INITIAL WATER IN LAYER MATERIALS     =    550.441  INCHES
TOTAL INITIAL WATER                  =    550.441  INCHES
TOTAL SUBSURFACE INFLOW              =      0.00   INCHES/YEAR
```

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
PLYMOUTH 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	=	7.60 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	68.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	68.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	77.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	73.00 %

NOTE: PRECIPITATION DATA WAS ENTERED MANUALLY FOR PLYMOUTH, NC ~~SYNTHETICALLY GENERATED USING COEFFICIENTS FOR NORFOLK VIRGINIA~~

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
4.17	3.98	4.18	3.14	4.66	4.53
6.30	5.85	4.62	3.35	3.10	3.32

NOTE: TEMPERATURE DATA WAS ENTERED MANUALLY FOR PLYMOUTH, NC ~~SYNTHETICALLY GENERATED USING COEFFICIENTS FOR NORFOLK VIRGINIA~~

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 NORFOLK VIRGINIA~~ ENTERED MANUALLY FOR PLYMOUTH, NC

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	3.42	3.66	4.52	2.76	4.19	5.02
	7.36	7.52	4.98	2.34	2.74	3.83
STD. DEVIATIONS	2.25	1.38	1.86	1.27	1.84	2.52
	3.32	3.06	2.72	1.33	1.43	1.73
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	1.524	1.735	2.900	2.393	3.289	3.705
	4.086	4.018	3.073	1.822	1.496	1.414
STD. DEVIATIONS	0.400	0.453	0.816	0.997	1.148	1.523
	1.467	1.235	1.146	0.790	0.527	0.219

LATERAL DRAINAGE COLLECTED FROM LAYER 12

TOTALS	1.7017	1.4120	1.6408	1.4801	1.3286	1.2745
	1.4249	1.4385	1.2290	1.2499	1.2079	1.3667
STD. DEVIATIONS	1.4169	0.9258	1.1231	1.1309	0.9283	0.9255
	0.9690	1.0712	0.8641	0.8859	1.1027	0.8894

PERCOLATION/LEAKAGE THROUGH LAYER 14

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 14

AVERAGES	0.2094	0.1725	0.1827	0.1726	0.1415	0.1420
	0.1579	0.1595	0.1325	0.1315	0.1406	0.1519
STD. DEVIATIONS	0.2294	0.1382	0.1694	0.1915	0.1340	0.1372
	0.1343	0.1548	0.1221	0.1336	0.2017	0.1268

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

	INCHES		CU. FEET	PERCENT
PRECIPITATION	52.35	(8.675)	190032.3	100.00

RUNOFF	0.000	(0.0000)	0.00	0.000
EVAPOTRANSPIRATION	31.456	(7.4940)	114184.73	60.087
LATERAL DRAINAGE COLLECTED FROM LAYER 12	16.75467	(9.75302)	60819.434	32.00478
PERCOLATION/LEAKAGE THROUGH FROM LAYER 14	0.00003	(0.00003)	0.127	0.0000
AVERAGE HEAD ACROSS TOP OF LAYER 14	0.158	(0.116)		
CHANGE IN WATER STORAGE	4.140	(12.2103)	15028.01	7.908

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	5.73	20799.900
RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 12	0.25326	919.34296
PERCOLATION/LEAKAGE THROUGH LAYER 14	0.000001	0.00367
AVERAGE HEAD ACROSS LAYER 14	1.491	
SNOW WATER	2.95	10713.2930

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.7440
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1360

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FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	75.4760	0.3145
2	67.4821	0.2812
3	67.9560	0.2832
4	68.3228	0.2847
5	68.6051	0.2859
6	68.7845	0.2866
7	68.9655	0.2874
8	69.0845	0.2879
9	69.0887	0.2879
10	7.9410	0.6617
11	0.9198	0.1533
12	0.4336	0.0361
13	0.0000	0.0000
14	0.1800	0.7500
SNOW WATER	0.000	

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


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:  14:50     DATE:   8/31/1999


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

     TITLE:  WEYERHAEUSER PLYMOUTH/POST CLOSURE/SIDE OF THE LANDFILL

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


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


                                  LAYER  1
                                  --------
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                TYPE 1 - VERTICAL PERCOLATION LAYER
                    MATERIAL TEXTURE NUMBER   4
  THICKNESS                    =      18.00   INCHES
  POROSITY                     =       0.4370 VOL/VOL
  FIELD CAPACITY               =       0.1050 VOL/VOL
  WILTING POINT                =       0.0470 VOL/VOL
  INITIAL SOIL WATER CONTENT   =       0.0468 VOL/VOL
  EFFECTIVE SAT. HYD. COND.    =  0.170000002000E-02 CM/SEC
NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
         FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                          LAYER  2
                          --------

                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                        =      33.30   PERCENT
  DRAINAGE LENGTH              =      60.0    FEET


                          LAYER  3
                          --------

                TYPE 4 - FLEXIBLE MEMBRANE LINER
                    MATERIAL TEXTURE NUMBER  35
  THICKNESS                    =       0.04   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     =       8.00   HOLES/ACRE
  FML PLACEMENT QUALITY        =  3 - GOOD
```

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                    LAYER  4
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            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


                    LAYER  5
                    --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =    240.00   INCHES
POROSITY                     =      0.7630 VOL/VOL
FIELD CAPACITY               =      0.2440 VOL/VOL
WILTING POINT                =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2440 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-05 CM/SEC


                    LAYER  6
                    --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =    240.00   INCHES
POROSITY                     =      0.7630 VOL/VOL
FIELD CAPACITY               =      0.2440 VOL/VOL
WILTING POINT                =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2440 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-05 CM/SEC
```

```
                    LAYER  7
                    --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                      =    240.00   INCHES
POROSITY                       =      0.7630 VOL/VOL
FIELD CAPACITY                 =      0.2440 VOL/VOL
WILTING POINT                  =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT     =      0.2440 VOL/VOL
EFFECTIVE SAT. HYD. COND.      =  0.999999975000E-05 CM/SEC


                    LAYER  8
                    --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                      =    240.00   INCHES
POROSITY                       =      0.7630 VOL/VOL
FIELD CAPACITY                 =      0.2440 VOL/VOL
WILTING POINT                  =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT     =      0.2440 VOL/VOL
EFFECTIVE SAT. HYD. COND.      =  0.999999975000E-05 CM/SEC


                    LAYER  9
                    --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                      =    240.00   INCHES
POROSITY                       =      0.7630 VOL/VOL
FIELD CAPACITY                 =      0.2440 VOL/VOL
WILTING POINT                  =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT     =      0.2440 VOL/VOL
EFFECTIVE SAT. HYD. COND.      =  0.999999975000E-05 CM/SEC
```

```
                    LAYER 10
                    --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                     =    240.00   INCHES
POROSITY                      =      0.7630 VOL/VOL
FIELD CAPACITY                =      0.2440 VOL/VOL
WILTING POINT                 =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT    =      0.2440 VOL/VOL
EFFECTIVE SAT. HYD. COND.     =  0.999999975000E-05 CM/SEC


                    LAYER 11
                    --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                     =    240.00   INCHES
POROSITY                      =      0.7630 VOL/VOL
FIELD CAPACITY                =      0.2440 VOL/VOL
WILTING POINT                 =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT    =      0.2440 VOL/VOL
EFFECTIVE SAT. HYD. COND.     =  0.999999975000E-05 CM/SEC


                    LAYER 12
                    --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                     =    240.00   INCHES
POROSITY                      =      0.7630 VOL/VOL
FIELD CAPACITY                =      0.2440 VOL/VOL
WILTING POINT                 =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT    =      0.2440 VOL/VOL
EFFECTIVE SAT. HYD. COND.     =  0.999999975000E-05 CM/SEC
```

```
                    LAYER 13
                    --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =    240.00   INCHES
POROSITY                     =      0.7630 VOL/VOL
FIELD CAPACITY               =      0.2440 VOL/VOL
WILTING POINT                =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2440 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-05 CM/SEC


                    LAYER 14
                    --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =     12.00   INCHES
POROSITY                     =      0.7630 VOL/VOL
FIELD CAPACITY               =      0.2440 VOL/VOL
WILTING POINT                =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2440 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-05 CM/SEC


                    LAYER 15
                    --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   2
THICKNESS                    =      6.00   INCHES
POROSITY                     =      0.4370 VOL/VOL
FIELD CAPACITY               =      0.0620 VOL/VOL
WILTING POINT                =      0.0240 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0620 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.579999993000E-02 CM/SEC
```

```
                    LAYER 16
                    --------

          TYPE 2 - LATERAL DRAINAGE LAYER
            MATERIAL TEXTURE NUMBER  21
THICKNESS                    =      12.00   INCHES
POROSITY                     =       0.3970 VOL/VOL
FIELD CAPACITY               =       0.0320 VOL/VOL
WILTING POINT                =       0.0130 VOL/VOL
INITIAL SOIL WATER CONTENT   =       0.0320 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.300000012000     CM/SEC
SLOPE                        =       2.00   PERCENT
DRAINAGE LENGTH              =     100.0    FEET


                    LAYER 17
                    --------

          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     =       8.00   HOLES/ACRE
FML PLACEMENT QUALITY        =  3 - GOOD


                    LAYER 18
                    --------

          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	=	69.00	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	18.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	0.843	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	7.866	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.846	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	531.929	INCHES
TOTAL INITIAL WATER	=	531.929	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
PLYMOUTH NORTH CAROLINA

MAXIMUM LEAF AREA INDEX	=	2.00	
START OF GROWING SEASON (JULIAN DATE)	=	94	
END OF GROWING SEASON (JULIAN DATE)	=	311	
AVERAGE ANNUAL WIND SPEED	=	7.60	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	68.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	68.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	77.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	73.00	%

NOTE: PRECIPITATION DATA WAS ENTERED MANUALLY FOR PLYMOUTH, NC ~~SYNTHETICALLY GENERATED USING COEFFICIENTS FOR NORFOLK VIRGINIA~~

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
4.17	3.98	4.18	3.14	4.66	4.53
6.30	5.85	4.62	3.35	3.10	3.32

NOTE: TEMPERATURE DATA WAS ENTERED MANUALLY FOR PLYMOUTH, NC ~~SYNTHETICALLY GENERATED USING COEFFICIENTS FOR NORFOLK VIRGINIA~~

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 ENTERED MANUALLY FOR PLYMOUTH, NC ~~SYNTHETICALLY GENERATED USING COEFFICIENTS FOR NORFOLK VIRGINIA~~

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	3.42	3.66	4.52	2.76	4.19	5.02
	7.36	7.52	4.98	2.34	2.74	3.83

STD. DEVIATIONS	2.25	1.38	1.86	1.27	1.84	2.52
	3.32	3.06	2.72	1.33	1.43	1.73

RUNOFF

TOTALS	0.000	0.002	0.003	0.000	0.003	0.000
	0.055	0.084	0.040	0.001	0.000	0.000
STD. DEVIATIONS	0.000	0.007	0.009	0.000	0.013	0.002
	0.167	0.154	0.080	0.004	0.001	0.000

EVAPOTRANSPIRATION

TOTALS	0.393	0.412	0.821	0.387	0.575	0.691
	1.110	1.335	0.912	0.423	0.249	0.362
STD. DEVIATIONS	0.260	0.183	0.656	0.257	0.323	0.395
	0.962	0.855	0.730	0.450	0.165	0.156

LATERAL DRAINAGE COLLECTED FROM LAYER 2

TOTALS	3.0284	3.0635	3.8824	2.3827	3.6157	4.346
	5.9440	6.0005	4.1852	2.1082	2.4821	3.452
STD. DEVIATIONS	2.0589	1.3199	1.7201	1.0839	1.6026	2.153
	2.3809	2.3571	2.1724	1.1517	1.2810	1.614

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.000

LATERAL DRAINAGE COLLECTED FROM LAYER 16

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.000

PERCOLATION/LEAKAGE THROUGH LAYER 18

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.000(
	0.0000	0.0000	0.0000	0.0000	0.0000	0.000(
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.000(
	0.0000	0.0000	0.0000	0.0000	0.0000	0.000(

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ACROSS LAYER 4

AVERAGES	0.0004	0.0005	0.0005	0.0004	0.0005	0.000'
	0.0008	0.0009	0.0006	0.0003	0.0004	0.000!
STD. DEVIATIONS	0.0003	0.0002	0.0002	0.0002	0.0002	0.000:
	0.0004	0.0004	0.0003	0.0002	0.0002	0.000:

DAILY AVERAGE HEAD ACROSS LAYER 18

AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.000'
	0.0000	0.0000	0.0000	0.0000	0.0000	0.000'
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.000

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

	INCHES		CU. FEET	PERCENT
PRECIPITATION	52.35	(8.675)	190032.3	100.00
RUNOFF	0.189	(0.2603)	685.86	0.361

EVAPOTRANSPIRATION	7.668	(2.0260)	27836.03	14.648
LATERAL DRAINAGE COLLECTED FROM LAYER 2	44.49126	(7.11093)	161503.266	84.98726
PERCOLATION/LEAKAGE THROUGH FROM LAYER 4	0.00000	(0.00000)	0.002	0.0000
AVERAGE HEAD ACROSS TOP OF LAYER 4	0.001	(0.000)		
LATERAL DRAINAGE COLLECTED FROM LAYER 16	0.00000	(0.00000)	0.000	0.00000
PERCOLATION/LEAKAGE THROUGH FROM LAYER 18	0.00000	(0.00000)	0.002	0.0000
AVERAGE HEAD ACROSS TOP OF LAYER 18	0.000	(0.000)		
CHANGE IN WATER STORAGE	0.002	(0.0593)	7.15	0.004

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	5.73	20799.900
RUNOFF	0.720	2612.8420
DRAINAGE COLLECTED FROM LAYER 2	3.36662	12220.84770
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000000	0.00005
AVERAGE HEAD ACROSS LAYER 4	0.017	
DRAINAGE COLLECTED FROM LAYER 16	0.00000	0.00001

PERCOLATION/LEAKAGE THROUGH LAYER 18	0.000000	0.00002
AVERAGE HEAD ACROSS LAYER 18	0.000	
SNOW WATER	2.95	10713.2930

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.2745
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0411

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FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	0.8826	0.0490
2	0.0020	0.0100
3	0.0000	0.0000
4	0.1800	0.7500
5	58.5600	0.2440
6	58.5600	0.2440
7	58.5600	0.2440
8	58.5600	0.2440
9	58.5600	0.2440
10	58.5600	0.2440
11	58.5600	0.2440

12	58.5600	0.2440
13	58.5600	0.2440
14	2.9280	0.2440
15	0.3720	0.0620
16	0.3840	0.0320
17	0.0000	0.0000
18	0.1800	0.7500
SNOW WATER	0.000	

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


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:  14:38     DATE:   8/31/1999


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

     TITLE:  WEYERHAEUSER PLYMOUTH/POST CLOSURE/ TOP OF THE LANDFILL

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


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


                                  LAYER  1
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                TYPE 1 - VERTICAL PERCOLATION LAYER
                    MATERIAL TEXTURE NUMBER   4
  THICKNESS                    =      18.00   INCHES
  POROSITY                     =       0.4370 VOL/VOL
  FIELD CAPACITY               =       0.1050 VOL/VOL
  WILTING POINT                =       0.0470 VOL/VOL
  INITIAL SOIL WATER CONTENT   =       0.0468 VOL/VOL
  EFFECTIVE SAT. HYD. COND.    =  0.170000002000E-02 CM/SEC
NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
         FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                          LAYER  2
                          --------

                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                        =       5.00   PERCENT
  DRAINAGE LENGTH              =     150.0    FEET


                          LAYER  3
                          --------

                TYPE 4 - FLEXIBLE MEMBRANE LINER
                    MATERIAL TEXTURE NUMBER  35
  THICKNESS                    =       0.04   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     =       8.00   HOLES/ACRE
  FML PLACEMENT QUALITY        =  3 - GOOD
```

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                    LAYER  4
                    --------

            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


                    LAYER  5
                    --------

         TYPE 1 - VERTICAL PERCOLATION LAYER
             MATERIAL TEXTURE NUMBER   0
THICKNESS                    =    240.00    INCHES
POROSITY                     =      0.7630 VOL/VOL
FIELD CAPACITY               =      0.2440 VOL/VOL
WILTING POINT                =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2440 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-05 CM/SEC


                    LAYER  6
                    --------

         TYPE 1 - VERTICAL PERCOLATION LAYER
             MATERIAL TEXTURE NUMBER   0
THICKNESS                    =    240.00    INCHES
POROSITY                     =      0.7630 VOL/VOL
FIELD CAPACITY               =      0.2440 VOL/VOL
WILTING POINT                =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2440 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-05 CM/SEC
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                    LAYER  7
                    --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                      =    240.00   INCHES
POROSITY                       =      0.7630 VOL/VOL
FIELD CAPACITY                 =      0.2440 VOL/VOL
WILTING POINT                  =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT     =      0.2440 VOL/VOL
EFFECTIVE SAT. HYD. COND.      =  0.999999975000E-05 CM/SEC


                    LAYER  8
                    --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                      =    240.00   INCHES
POROSITY                       =      0.7630 VOL/VOL
FIELD CAPACITY                 =      0.2440 VOL/VOL
WILTING POINT                  =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT     =      0.2440 VOL/VOL
EFFECTIVE SAT. HYD. COND.      =  0.999999975000E-05 CM/SEC


                    LAYER  9
                    --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                      =    240.00   INCHES
POROSITY                       =      0.7630 VOL/VOL
FIELD CAPACITY                 =      0.2440 VOL/VOL
WILTING POINT                  =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT     =      0.2440 VOL/VOL
EFFECTIVE SAT. HYD. COND.      =  0.999999975000E-05 CM/SEC
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                    LAYER 10
                    --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =    240.00   INCHES
POROSITY                     =      0.7630 VOL/VOL
FIELD CAPACITY               =      0.2440 VOL/VOL
WILTING POINT                =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2440 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-05 CM/SEC


                    LAYER 11
                    --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =    240.00   INCHES
POROSITY                     =      0.7630 VOL/VOL
FIELD CAPACITY               =      0.2440 VOL/VOL
WILTING POINT                =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2440 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-05 CM/SEC


                    LAYER 12
                    --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =    240.00   INCHES
POROSITY                     =      0.7630 VOL/VOL
FIELD CAPACITY               =      0.2440 VOL/VOL
WILTING POINT                =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2440 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-05 CM/SEC
```

```
                    LAYER 13
                    --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =    240.00   INCHES
POROSITY                     =      0.7630 VOL/VOL
FIELD CAPACITY               =      0.2440 VOL/VOL
WILTING POINT                =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2440 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-05 CM/SEC


                    LAYER 14
                    --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =     12.00   INCHES
POROSITY                     =      0.7630 VOL/VOL
FIELD CAPACITY               =      0.2440 VOL/VOL
WILTING POINT                =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2440 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-05 CM/SEC


                    LAYER 15
                    --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   2
THICKNESS                    =      6.00   INCHES
POROSITY                     =      0.4370 VOL/VOL
FIELD CAPACITY               =      0.0620 VOL/VOL
WILTING POINT                =      0.0240 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0620 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.579999993000E-02 CM/SEC
```

LAYER 16

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 21

THICKNESS	=	12.00	INCHES
POROSITY	=	0.3970	VOL/VOL
FIELD CAPACITY	=	0.0320	VOL/VOL
WILTING POINT	=	0.0130	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0320	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000012000	CM/SEC
SLOPE	=	2.00	PERCENT
DRAINAGE LENGTH	=	100.0	FEET

LAYER 17

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	=	8.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

LAYER 18

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	=	69.00	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	18.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	0.843	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	7.866	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.846	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	531.929	INCHES
TOTAL INITIAL WATER	=	531.929	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
PLYMOUTH NORTH CAROLINA

MAXIMUM LEAF AREA INDEX	=	2.00	
START OF GROWING SEASON (JULIAN DATE)	=	94	
END OF GROWING SEASON (JULIAN DATE)	=	311	
AVERAGE ANNUAL WIND SPEED	=	7.60	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	68.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	68.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	77.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	73.00	%

NOTE: PRECIPITATION DATA WAS ~~SYNTHETICALLY GENERATED USING~~ ENTERED MANUALLY FOR PLYMOUTH, NC
~~COEFFICIENTS FOR NORFOLK VIRGINIA~~

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
4.17	3.98	4.18	3.14	4.66	4.53
6.30	5.85	4.62	3.35	3.10	3.32

NOTE: TEMPERATURE DATA WAS ~~SYNTHETICALLY GENERATED USING~~ ENTERED MANUALLY FOR PLYMOUTH, NC
~~COEFFICIENTS FOR NORFOLK VIRGINIA~~

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~~ ENTERED MANUALLY FOR PLYMOUTH, NC
~~COEFFICIENTS FOR NORFOLK VIRGINIA~~

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	3.42	3.66	4.52	2.76	4.19	5.02
	7.36	7.52	4.98	2.34	2.74	3.83

STD. DEVIATIONS	2.25	1.38	1.86	1.27	1.84	2.52
	3.32	3.06	2.72	1.33	1.43	1.73

RUNOFF

TOTALS	0.000	0.002	0.002	0.000	0.003	0.000
	0.056	0.084	0.040	0.001	0.000	0.000
STD. DEVIATIONS	0.000	0.005	0.007	0.000	0.013	0.001
	0.168	0.154	0.080	0.004	0.001	0.000

EVAPOTRANSPIRATION

TOTALS	0.390	0.407	0.597	0.406	0.604	0.680
	1.135	1.151	0.856	0.409	0.236	0.334
STD. DEVIATIONS	0.246	0.181	0.250	0.291	0.337	0.420
	1.011	0.781	0.736	0.377	0.142	0.156

LATERAL DRAINAGE COLLECTED FROM LAYER 2

TOTALS	3.0264	3.1898	4.0023	2.3504	3.5929	4.355
	5.9262	6.1887	4.2237	2.1278	2.4988	3.472
STD. DEVIATIONS	2.0555	1.2760	1.7310	0.9970	1.5845	2.139
	2.1998	2.3376	2.2198	1.1525	1.3123	1.624

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.000

LATERAL DRAINAGE COLLECTED FROM LAYER 16

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.000

PERCOLATION/LEAKAGE THROUGH LAYER 18

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	0.0052	0.0060	0.0068	0.0042	0.0061	0.007
	0.0103	0.0123	0.0088	0.0036	0.0044	0.005
STD. DEVIATIONS	0.0035	0.0024	0.0030	0.0018	0.0027	0.003
	0.0042	0.0084	0.0072	0.0020	0.0023	0.002

DAILY AVERAGE HEAD ACROSS LAYER 18

AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.000

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

	INCHES		CU. FEET	PERCENT
PRECIPITATION	52.35	(8.675)	190032.3	100.00
RUNOFF	0.189	(0.2608)	684.79	0.360

EVAPOTRANSPIRATION	7.205	(2.2178)	26152.52	13.762
LATERAL DRAINAGE COLLECTED FROM LAYER 2	44.95533	(7.21510)	163187.844	85.87373
PERCOLATION/LEAKAGE THROUGH FROM LAYER 4	0.00000	(0.00000)	0.009	0.0000
AVERAGE HEAD ACROSS TOP OF LAYER 4	0.007	(0.001)		
LATERAL DRAINAGE COLLECTED FROM LAYER 16	0.00000	(0.00000)	0.005	0.00000
PERCOLATION/LEAKAGE THROUGH FROM LAYER 18	0.00000	(0.00000)	0.004	0.0000
AVERAGE HEAD ACROSS TOP OF LAYER 18	0.000	(0.000)		
CHANGE IN WATER STORAGE	0.002	(0.0682)	7.17	0.004

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	5.73	20799.900
RUNOFF	0.720	2612.8420
DRAINAGE COLLECTED FROM LAYER 2	3.22145	11693.86330
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000001	0.00206
AVERAGE HEAD ACROSS LAYER 4	0.680	
DRAINAGE COLLECTED FROM LAYER 16	0.00000	0.00149

PERCOLATION/LEAKAGE THROUGH LAYER 18	0.000000	0.00002
AVERAGE HEAD ACROSS LAYER 18	0.000	
SNOW WATER	2.95	10713.2930

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.2745
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0389

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FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	0.8827	0.0490
2	0.0020	0.0100
3	0.0000	0.0000
4	0.1800	0.7500
5	58.5600	0.2440
6	58.5600	0.2440
7	58.5600	0.2440
8	58.5600	0.2440
9	58.5600	0.2440
10	58.5600	0.2440
11	58.5600	0.2440

12	58.5600	0.2440
13	58.5600	0.2440
14	2.9280	0.2440
15	0.3720	0.0620
16	0.3840	0.0320
17	0.0000	0.0000
18	0.1800	0.7500
SNOW WATER	0.000	

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Attachment G3
Projected Leachate Generation Rates

AVERAGE DAILY PROJECTED LEACHATE GENERATION VOLUMES 9/9/99
WEYERHAEUSER NO. 3 LANDFILL, PLYMOUTH, NORTH CAROLINA RMT JOB NO. 5101.01

PHASE	AREA (acres)	AVERAGE HEIGHT WHEN FULL (ft.)	VOLUME/ACRE FULL LANDFILL (gpd/ac)	VOLUME /ACRE OPEN LANDFILL (gpd/ac)	VOLUME/PHASE FULL LANDFILL (gpd/phase)	VOLUME /PHASE OPEN LANDFILL (gpd/phase)	TOTAL VOLUME/ PHASE OF LANDFILL (gpd/phase)
1	14.36	41	1,512	1,531	21,712	21,985	43,927
2	14.51	41	1,512	1,531	21,939	22,215	30,620
3	5.67	81	1,439	1,531	8,159	8,681	17,070
4	5.82	111	1,381	1,531	8,037	8,910	16,688
5	5.65	131	1,343	1,531	7,588	8,650	15,917
6	5.44	161	1,207	1,531	6,566	8,329	14,895
7	5.44	181	1,246	1,531	6,778	8,329	14,724
8	5.19	161	1,207	1,531	6,264	7,946	13,246
9	4.56	121	1,362	1,531	6,211	6,981	14,631
10	5.5	111	1,381	1,531	7,596	8,421	15,419
11	5.11	81	1,439	1,531	7,353	7,823	11,319
12	2.59	81	1,439	1,531	3,727	3,965	7,524
13	2.48	81	1,439	1,531	3,569	3,797	7,350
14	2.47	81	1,439	1,531	3,554	3,782	7,259
15	2.42	81	1,439	1,531	3,482	3,705	7,141
16	2.39	81	1,439	1,531	3,439	3,659	7,006
17	2.33	81	1,439	1,531	3,353	3,567	7,732
18	2.86	41	1,512	1,531	4,324	4,379	4,324

NOTES: *Leachate generation rates are estimated based on HELP model results. If the landfill final design, construction, phasing, or operation is different than the parameters used to develop these projections, the leachate generation rate projections could be significantly affected.*

The "TOTAL" volume of leachate generated under a particular phase is the sum of the volumes from the previous phase---POST-CLOSURE; the referenced phase—FULL; and the subsequent phase---OPEN.

The "OPEN" status assumes 2 feet of waste is covering the bottom of the landfill phase.

The "FULL" status assumes the referenced phase is full of waste. The volume of leachate is based on an estimated average thickness of waste in each phase, just prior to closure.

The "POST-CLOSURE" status assumes the waste in the referenced phase has been capped. The leachate generation rates during post-closure were assumed negligible for these calculations, when compared to the leachate generation rates of the open and full landfill phase.

EXAMPLE: *Determine the "average" daily leachate generated during Phase 2, just prior to capping Phase 2. Note that at that time Phase 3 would be open and operating.*

Phase 1	closed	-	(gpd/phase)
Phase 2	full	21,939	(gpd/phase)
Phase 3	open	8,681	(gpd/phase)
	TOTAL	30,620	(gpd/phase)

PEAK DAILY PROJECTED LEACHATE GENERATION VOLUMES 9/9/99
WEYERHAEUSER NO. 3 LANDFILL, PLYMOUTH, NORTH CAROLINA RMT JOB NO. 5101.01

PHASE	AREA (acres)	AVERAGE HEIGHT WHEN FULL (ft.)	VOLUME/ACRE FULL LANDFILL (gpd/ac)	VOLUME /ACRE OPEN LANDFILL (gpd/ac)	VOLUME/PHASE FULL LANDFILL (gpd/phase)	VOLUME /PHASE OPEN LANDFILL (gpd/phase)	TOTAL VOLUME/ PHASE OF LANDFILL (gpd/phase)
1	14.36	41	8,235	9,238	118,255	132,658	252,298
2	14.51	41	8,235	9,238	119,490	134,043	171,869
3	5.67	81	7,495	9,238	42,497	52,379	96,262
4	5.82	111	7,679	9,238	44,692	53,765	96,886
5	5.65	131	7,189	9,238	40,618	52,195	90,873
6	5.44	161	7,005	9,238	38,107	50,255	88,362
7	5.44	181	6,882	9,238	37,438	50,255	85,383
8	5.19	161	7,005	9,238	36,356	47,945	78,481
9	4.56	121	7,434	9,238	33,899	42,125	84,708
10	5.5	111	7,679	9,238	42,235	50,809	89,441
11	5.11	81	7,495	9,238	38,299	47,206	62,226
12	2.59	81	7,495	9,238	19,412	23,926	42,322
13	2.48	81	7,495	9,238	18,588	22,910	41,405
14	2.47	81	7,495	9,238	18,513	22,818	40,869
15	2.42	81	7,495	9,238	18,138	22,356	40,217
16	2.39	81	7,495	9,238	17,913	22,079	39,438
17	2.33	81	7,495	9,238	17,463	21,525	43,884
18	2.86	41	8,235	9,238	23,552	26,421	23,552

NOTES: *Leachate generation rates are estimated based on HELP model results. If the landfill final design, construction, phasing, or operation is different than the parameters used to develop these projections, the leachate generation rate projections could be significantly affected.*

The "TOTAL" volume of leachate generated under a particular phase is the sum of the volumes from the previous phase---POST-CLOSURE; the referenced phase---FULL; and the subsequent phase---OPEN.

The "OPEN" status assumes 2 feet of waste is covering the bottom of the landfill phase.

The "FULL" status assumes the referenced phase is full of waste. The volume of leachate is based on an estimated average thickness of waste in each phase, just prior to closure.

The "POST-CLOSURE" status assumes the waste in the referenced phase has been capped. The leachate generation rates during post-closure were assumed negligible for these calculations, when compared to the leachate generation rates of the open and full landfill phase.

EXAMPLE: *Determine the "peak" daily leachate generated during Phase 2, just prior to capping Phase 2. Note that at that time Phase 3 would be open and operating.*

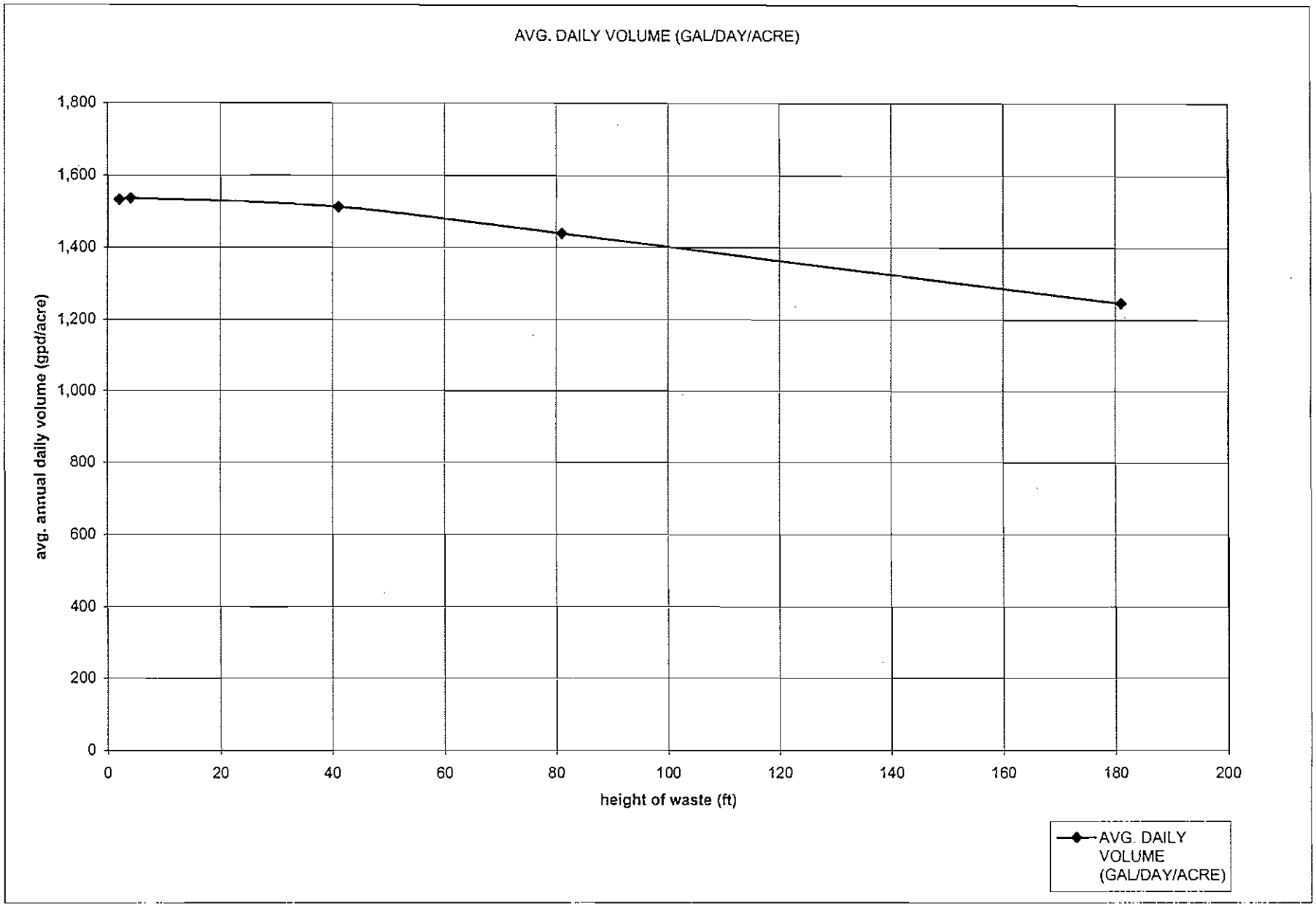
Phase 1	closed	-	(gpd/phase)
Phase 2	full	119,490	(gpd/phase)
Phase 3	open	52,379	(gpd/phase)
	TOTAL	171,869	(gpd/phase)

Weyerhaeuser Plymouth
Help Model Results

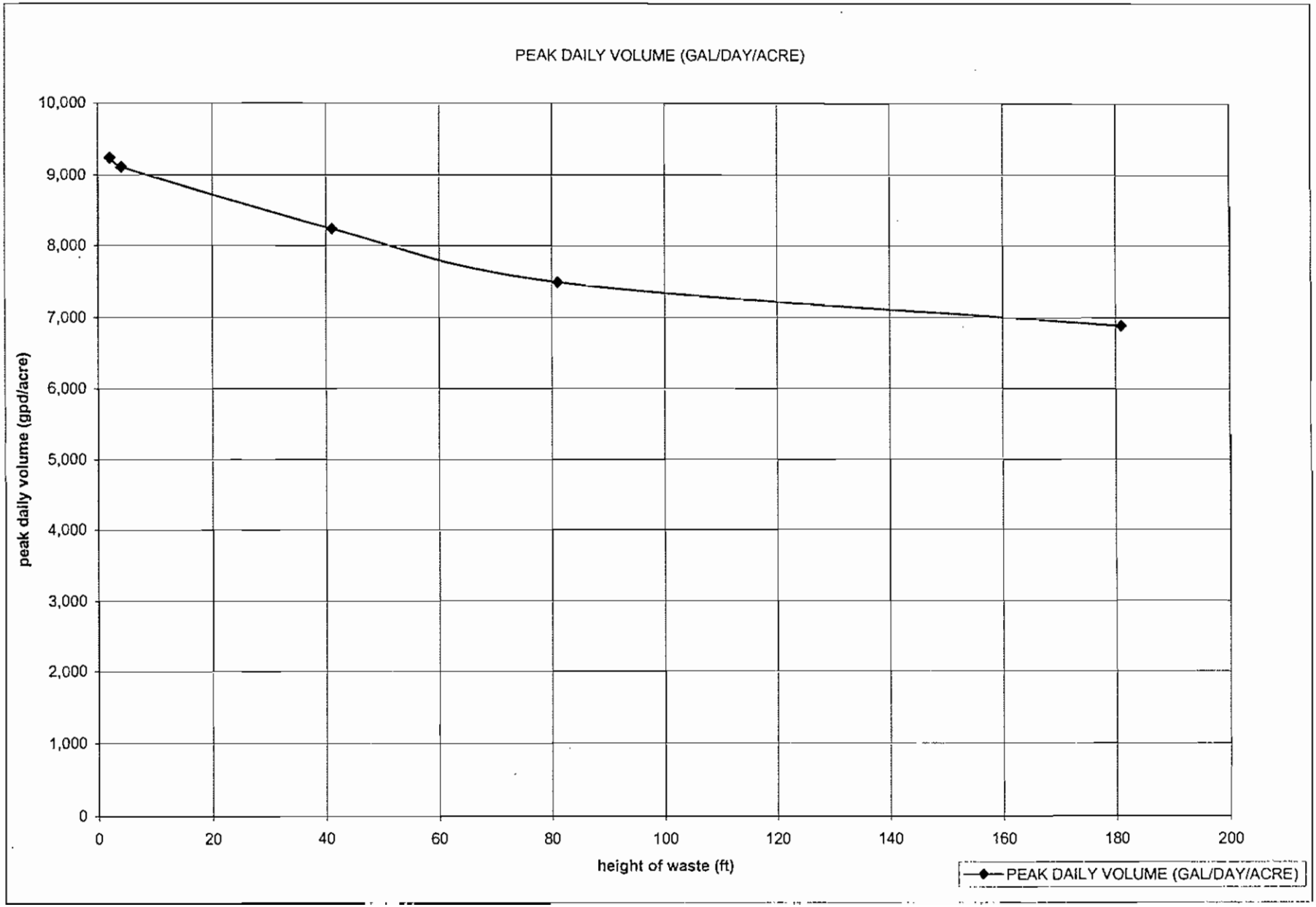
9/8/99

	OPEN LANDFILL:					CLOSED LANDFILL:	
Leachate Collection	waste height (feet)					waste height (feet)	
HT. OF WASTE (FT)	2	4	41	81	181	181	181
AVG. ANNUAL VOL.(CF/AC)	74,717	74,891	73,759	70,202	60,820	0.005	0.000
AVG. DAILY VOLUME (GAL/DAY/ACRE)	1,531	1,535	1,512	1,439	1,246	0.000	0.000
PEAK DAILY VOL. (CF/AC)	1,235	1,218	1,101	1,002	920	0.00150	0.00002
PEAK DAILY VOLUME (GAL/DAY/ACRE)	9,238	9,111	8,235	7,495	6,882	0.01122	0.00015

HELP MO_ _ RESULTS
CHART 1



HELP MODEL RESULTS
CHART 2



Attachment G4
Mass Balance Calculations for Liner Design of Landfill No. 3
Technical Memorandum dated September 27, 1999
(including Responses to NC DENR letter dated April 29, 1999)

Technical Memorandum

Date: September 27, 1999

To: Mr. 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 3.32 feet of aquifer thickness once the leachate percolated to groundwater. This volumetric rate suggests that the leachate concentration must be three 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, would 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 (VOCs) 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 14.37 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 for a single composite liner design. 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 8 holes per acre. This HELP model resulted in an average annual percolation or leakage rate through the bottom of the landfill of 0.208 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 as "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. Four shallow groundwater monitoring wells, OW-4, OW-5, OW-6, and OW-7, are located in the vicinity of the Phase 1 landfill. Boring logs and well construction diagrams for these four 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, OW-5, OW-6, 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 through OW-7 were calculated from *in-situ* hydraulic conductivity tests using the Bouwer-Rice (1976) solution. The geometric mean of these estimates is 2.44×10^{-4} 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 33 percent of the calculated mixing zone thickness. The width of the mixing zone is 535 feet, which is the maximum width of the Phase 1 landfill. The resulting cross sectional area, perpendicular to groundwater flow is 1,771 ft^2. Groundwater migrating into the mixing zone is assumed to be unaffected.

Estimating the mixing zone thickness involved two steps:

1. Calculating the dispersion coefficient, and
2. Calculating the variance in constituent concentrations following migration beneath the Phase 1 footprint.

The dispersion coefficient was calculated using the average linear groundwater velocity and a dispersivity estimate. Dispersivity was assigned conservatively, using a discrete estimate for silty sand, rather than using an effective estimate. The difference in these two estimates is that an effective estimate is larger because it accounts for larger scale heterogeneities in aquifer material that cause greater variation in groundwater velocities on a pore scale. Discrete estimates are smaller, only accounting for variations in groundwater velocities within one material type, which results in less spreading of constituent mass. By using discrete estimates, the degree of spreading is smaller, resulting in a smaller mixing zone. The vertical dispersivity

estimate used was 0.005 feet (Garabedian *et al.*, 1991 and LeBlanc *et al.*, 1991). Effective estimates can be on the order of single feet in calibrated transport models. The average linear groundwater velocity calculation is discussed above.

The variance in constituent concentrations as a function of transport distance generally exhibits a normal distribution, allowing the dispersion coefficient to be related to the variance. A standard deviation can be calculated from the variance, which in turn can be used to estimate the mixing zone thickness. A variance (in the vertical direction) of 11 feet was calculated at 26,894 days. This is the number of days for the center of mass to migrate the length of the Phase 1 footprint (1,100 feet) based on the average linear groundwater velocity. A standard deviation of 3.32 feet was calculated from the variance. Because three standard deviations will encompass more than 99 percent of the constituents with a normal distribution, the mixing zone thickness would be 9.96 feet. The actual mixing zone thickness used in the mass balance calculations was 3.32 feet, which is 33 percent of the estimated mixing zone thickness. The 3.32 feet was chosen for the mixing zone thickness, so that mass balance calculations would be conservative, only accounting for the mixing zone thickness containing 68 percent of constituent mass. Mixing zone thickness calculations are presented in Attachment 14.

Mass Balance Calculations

Parameters used in the mass balance calculations were based on available data or assigned conservatively if no data were available. Parameters include constituent leachate concentrations, hydraulic conductivity, hydraulic gradient, landfill liner leakage rate, mixing zone thickness, and geometry of the Phase 1 footprint. Constituent leachate concentrations were assigned based on the results of waste stream TCLP tests. Hydraulic conductivity was assigned based on the geometric mean of hydraulic conductivity estimates for OW-4 through OW-7, calculated using the Bouwer and Rice (1976) solution for unconfined *in-situ* hydraulic conductivity tests. The hydraulic gradient was measured from the water table configuration, as mapped in April 1993, along the primary axis of flow, in the area of the Phase 1 footprint. The landfill liner leakage rate was based on the results of HELP model simulations. The mixing zone thickness was assigned as 3.32 feet, which is 33 percent of the calculated mixing zone thickness after 1,100 feet of migration (approximate length of the Phase 1 footprint). The supporting calculations for the mixing zone thickness are provided as Attachment 13. The geometry of the landfill footprint is based on the design as depicted in Attachment 2.

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 the upper 3.32 feet of the aquifer, the resulting manganese concentration in groundwater would be 7.58×10^{-3} 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 that the leachate concentration must be approximately three 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 99 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.

The results of the mass balance calculations indicate a single composite liner with "good" quality control will be protective of groundwater. The leakage rate through the single composite liner increased to 4.71×10^{-6} feet per year from 1.38×10^{-7} feet per year with a dual composite liner design (See RMT Letter Report, January 1999). The increased leakage rate resulted in an increase in the volumetric flux through the liner; however, the volumetric flux through the single composite liner remained small in comparison to the volumetric flux of groundwater through the mixing zone. The volumetric flux through the mixing zone is four orders of magnitude larger than the volumetric flux through the single composite liner. The constituent concentration to NCAC 2L ratio protective of groundwater decreased from 2.19×10^{4} to 1.98×10^{3}, resulting from the change in liner design. Mass balance calculations from the dual composite liner design are included in Attachment 13 for comparison with the calculations with the single composite liner.

RMT's Response to NC DENR Comments Dated April 29, 1999

NC DENR Comment

There appears to be an error on page 2 for the unit between the geocomposite drainage layer and the geosynthetic clay liner.

RMT Response

The proposed liner system has since been changed from a double composite liner to a single composite liner. Therefore, the leak detection layer geocomposite, the secondary geomembrane liner and secondary GCL liner have been omitted from the design. The HELP model and mass balance calculations have been revised accordingly.

NC DENR Comment

Please expand on the comment in the cover letter to Cheryl Marks dated January 21, 1999, that the primary liner was considered a single liner.

RMT Response

The HELP model can only analyze landfill models with up to five barrier layers. Since the originally proposed landfill design included a double composite liner and single composite cap (a total of six barrier layers), the primary GCL liner was omitted in the original HELP model. This provided more conservative results. Since then, the landfill design and HELP model have been revised. See the previous comment. The new cover letter was revised accordingly.

NC DENR Comment

Typically 8 holes per acre is the minimum input parameter required when using the HELP model for the installed liner.

RMT Response

The HELP model was revised using 8 holes per acre for the installed liner, per NC DENR recommendation.

NC DENR Comment

Why was two feet of waste chosen for the HELP model input parameter?

RMT Response

The design requires that no less than 1 foot of select ash waste be placed over the sand filter layer of the leachate collection system. The select ash will be placed immediately following placement of the sand. Since the waste will typically be place in 2-foot to 3-foot thick lifts, 2 feet of waste was selected as a conservative thickness for the HELP model input parameter.

NC DENR Comment

How was evaporative zone depth of 22 inches chosen?

RMT Response

This was revised to 13 inches for the open landfill and 18 inches for the closed landfill. Although 22 inches was recommended for an evaporative zone for the closed landfill, in this geographical location, the depth was limited to 18 inches since the vegetation layer itself is only 18 inches thick over the geomembrane barrier. For the open landfill condition, our modeling assumed the ash layer in the upper level of the waste would be generally silt size particles. The HELP model for silt size soil recommended an evaporative zone depth of 8 to 18 inches; therefore, an average value of 13 inches was used for the waste material in the open landfill analysis.

NC DENR Comment

Is the leakage rate near steady state?

RMT Response

Yes. An average annual rate over a period of 20 years was used.

NC DENR Comment

The HELP model requires climatological data to generate the leakage/percolation values. It appears evapotranspiriation and weather data were obtained from Raleigh, North Carolina. Raleigh is in the Piedmont Physiographic Province while Plymouth is in the Coastal Plain Physiographic Province. Norfolk, Virginia is also in a coastal plain and has a climate similar to Plymouth. Use a location that provides as close a match as possible.

RMT Response

The HELP model analysis has been revised using a Coastal Plain Physiographic Province. The geographic location of Norfolk, Virginia was input in setting up data for the program, since Plymouth, North Carolina was not a selection under the synthetic generation of data. However, precipitation data, temperature data, and the latitude for Plymouth, North Carolina were entered manually, where we were allowed to override data for Norfolk, Virginia.

NC DENR Comment

The raw historical groundwater levels in Attachment 9 have several headings. Does the MP elevation indicate the monitoring point? If so, why does the monitoring point change? Does D in the depth to water mean the piezometer was dry at the time of reading? Are some of the columns reversed between Depth to Water and Water Elevation?

RMT Response

The MP Elevation indicates the elevation of the measuring point (typically the top of the casing). Some of the measuring point elevations for a given station did change, but have been corrected. The "D" previously used to denote dry wells has been changed to "Dry." Some of the Depth to Water and the corresponding Water Elevations were reversed, but have been corrected.

NC DENR Comment

The two aquifer units are reported to be separated by an aquitard. The cross-sections and boring logs support the north-south component of the silty-clay unit however, the boring logs provided do not have enough depth to validate the east-west component. Provide the boring logs and test pits.

RMT Response

Boring logs with additional depth in the east – west component have been included.

NC DENR Comment

Only OW-4 is located in the vicinity of the Phase 1 landfill. OW-7 is over 1200 feet from the cell footprint shown on the Data Point Location Map. Was OW-7 intended to be MW-7?

RMT Response

Monitoring well OW-7 is located approximately 130 feet north of the north end of the Phase 1 footprint. This monitoring well was intended to be used in various calculations.

NC DENR Comment

Are groundwater contours on Attachment 2 from a single day reading event? A drainage feature was restored on the eastern boundary of the site. Has there been any notable change in the groundwater table? Will it affect any portion of Phase 1?

RMT Response

The groundwater elevations used to map the water table configuration illustrated in Attachment 2 were all measured on the same day (April 2, 1993). Groundwater elevations in the vicinity of the drainage restoration have decreased since the time of the restoration. There has not been sufficient time to assess if the decrease is a result of the drainage restoration or seasonal fluctuations. Results of numerical groundwater modeling indicate the drainage restoration will have a significant effect on the water table configuration. Water levels in the vicinity of the drainage restoration are expected to decrease up to 5 feet, with a 0.5 foot decrease extending up to 500 feet into the landfill footprint. The drainage restoration is not expected to affect water levels as far north as the Phase 1 footprint.

NC DENR Comment

A mixing thickness of 10 percent of the aquifer saturated thickness was chosen. What criteria was used to determine the 10 percent assignment?

RMT Response

The only criteria used in the original assignment was a conservative approach. A new assignment has been made of 3.32 feet. This is based on a calculated mixing zone thickness of 9.96 feet. Thirty-three percent of the calculated mixing zone thickness was used to maintain the conservative approach. The 33 percent of the mixing zone thickness is one standard deviation, which would encompass 68 percent of the constituent mass.

NC DENR Comment

Provide the formula used to calculate the hydraulic conductivity.

RMT Response

Hydraulic conductivity estimates were calculated using the Bouwer and Rice (1976) solution. A detailed discussion of this solution is readily available in the literature or a standard textbook on Well Hydraulics.

Attachments:

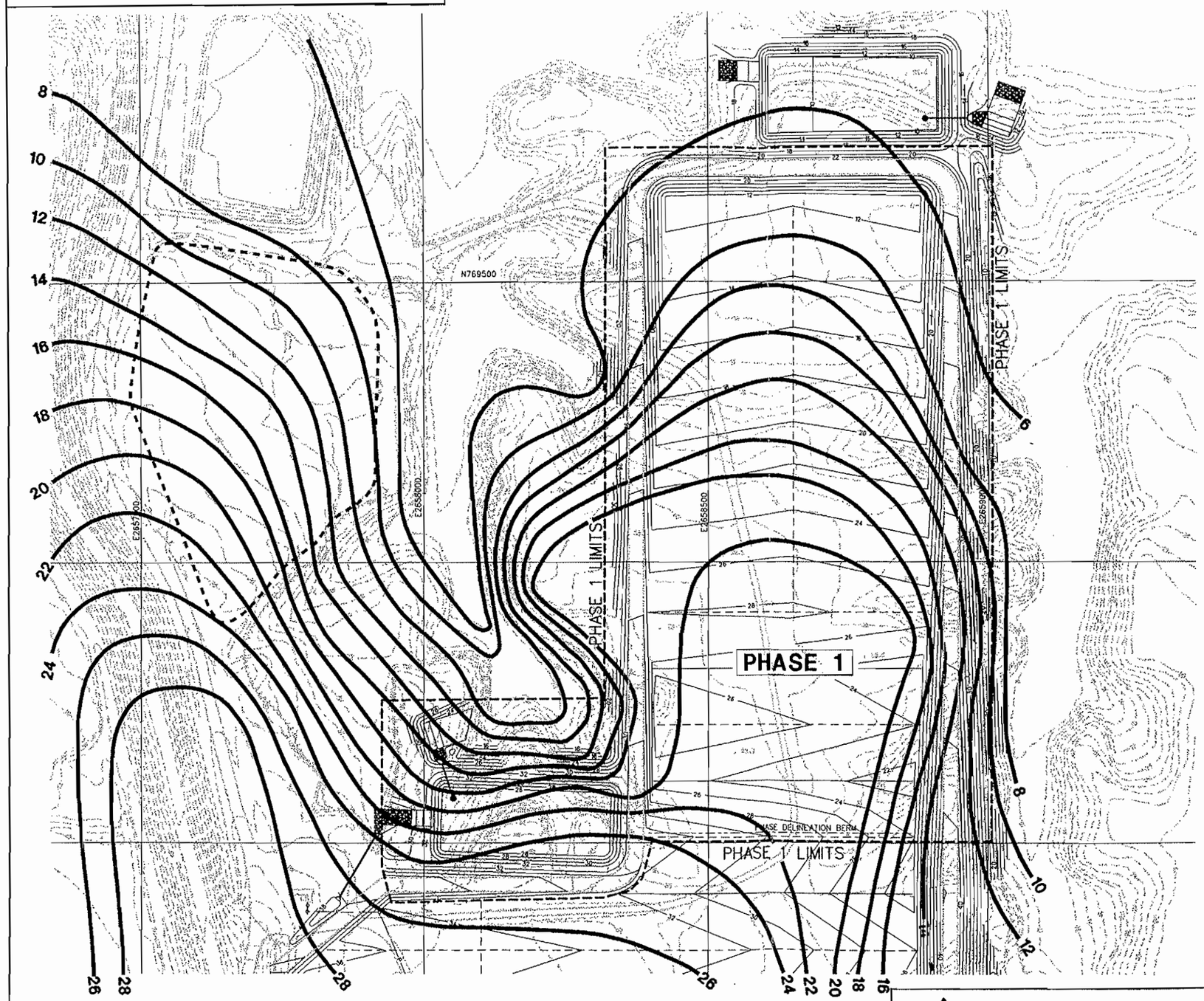
1 Table 1 - Summary of TCLP Laboratory Analyses
2 New Landfill - Phase 1
3 Table 2 - HELP Model Input Parameters
4 Table 3 - HELP Model Barrier and Drainage Layer Parameters
5 HELP Model Data
6 Data Point Location Map
7 Geologic Cross Sections - Sheet 1
8 Geologic Cross Sections - Sheet 2
9 Groundwater Elevation Data
10 Boring Logs
11 Well Construction Diagrams
12 Hydraulic Conductivity Test Results
13 Mass Balance and Mixing Zone Calculations
14 NC DENR Letter Dated April 29, 1999

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.

j:\cad\civil\weyerhae\5101001c\north.exp
dmc 9-10-99



Weyerhaeuser

PLYMOUTH, NORTH CAROLINA

N

LEGEND

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

NEW LANDFILL
PHASE 1
FIGURE 11599

Weyerhaeuser

RMT

Drawn By: D.M.C.	
Approved By: R.K.N.	
Date: 9-10-99	
Proj. No.: 5101.01	

\cad\civil\weyerhae\510101c\ datapnt.map
jb 4-10-00

NOTES:

1. REFER TO DRAWING NO. 510101-C01 FOR STANDARD LEGEND, ABBREVIATIONS AND GENERAL NOTES.

0 200' 400' 600' 800'
SCALE: 1" = 200'

NOT FOR CONSTRUCTION

NOTE: THESE PLANS ARE ACCOMPANIED BY A CONSTRUCTION PLAN APPLICATION OF THE THE SAME TITLE. THESE DOCUMENTS ARE INTERRELATED AND ARE INTENDED TO BE USED AND REVIEWED TOGETHER. THESE DOCUMENTS ARE INTENDED FOR REGULATORY PURPOSES ONLY.

DATE		BY	CK.	APVD.	NO.	DATE	BY	CK.	APVD.	NO.	DATE	BY	CK.	APVD.
4-10-00	ADDED B-201 AND B-202	DMC	DOM	RKN										
3-7-00	ISSUED FOR REGULATORY REVIEW	DMC	DOM	RKN										
3-3-00	ISSUED FOR REGULATORY REVIEW	DMC	DOM	RKN										
9-24-99	ISSUED FOR REGULATORY APPROVAL	DMC	EWT	RKN										
7-9-99	ISSUED FOR CLIENT REVIEW	DMC	EWT	RKN										

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL No. 17540 R. KENT NILSSON 4/10/00

Weyerhaeuser
PLYMOUTH, NORTH CAROLINA

PROJECT MGR:	RKN
DESIGNED BY:	DMC/SYK/EWT
DRAWN BY:	DMC
CHECKED BY:	SYK
APPROVED BY:	
APPROVED BY:	
APPROVED BY:	
DATE:	SEPTEMBER, 1999
JOB NO:	5101.01

RMT
RMT North Carolina, Inc.

CONSTRUCTION PLAN APPLICATION - LANDFILL No. 3
DATA POINT LOCATION MAP

SCALE		DRAWING NO.	REV.
AS SHOWN		510101-C02	E

NOT FOR CONSTRUCTION

Table 2
HELP Model Input Parameters

DESCRIPTION	PARAMETERS USED
Area of Landfill	1 acre
Landfill Condition	Open
Percentage of Area where Runoff is Possible	0 percent
Evaporative Zone Depth	13 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	User Input Data for Plymouth, NC
Temperature Input	User Input Data for Plymouth, NC
Solar Radiation Input	User Input Data for Plymouth, NC
Nearest City for Default Input	Norfolk, Virginia
Depth of Waste	2 feet
Leachate Collection System (LCS) Below Waste	18 inches of graded granular filter (6 inches sand and 12 inches crushed stone)
First Layer of Composite Liner	60-mil high density polyethylene (HDPE)
Second Layer of Composite Liner	Geosynthetic clay liner (GCL)
SCS Runoff Curve Number	93

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 (sand)	6	2	0.437	0.062	0.024	0.1752	5.8E-03	2	100	—	—	—
LCS (crushed stone)	12	21	0.3970	0.0320	0.0130	0.0322	3.0E-01	2	100	1	8	3–good
FML	0.06	35	0	0	0	0	2.0E-13	—	—	1	8	3–good
GCL	0.24	17	0.7500	0.7470	0.4000	0.7500	3.0E-09	—	—	—	—	—

LCS - leachate collection system
FML - flexible membrane liner (geomembrane)
GCL - geosynthetic clay liner

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              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              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


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:  13:59     DATE:   8/31/1999


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

     TITLE:  WEYERHAEUSER PLYMOUTH/OPEN LANDFILL/ 2' OF WASTE

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


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


                                  LAYER  1
                                  --------
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```
          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER    0
THICKNESS                      =      12.00    INCHES
POROSITY                       =       0.7630 VOL/VOL
FIELD CAPACITY                 =       0.2440 VOL/VOL
WILTING POINT                  =       0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT     =       0.2365 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                       =       0.7630 VOL/VOL
FIELD CAPACITY                 =       0.2440 VOL/VOL
WILTING POINT                  =       0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT     =       0.6648 VOL/VOL
EFFECTIVE SAT. HYD. COND.      =  0.999999975000E-05 CM/SEC


                         LAYER  3
                         --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER    2
THICKNESS                      =       6.00    INCHES
POROSITY                       =       0.4370 VOL/VOL
FIELD CAPACITY                 =       0.0620 VOL/VOL
WILTING POINT                  =       0.0240 VOL/VOL
INITIAL SOIL WATER CONTENT     =       0.1752 VOL/VOL
EFFECTIVE SAT. HYD. COND.      =  0.579999993000E-02 CM/SEC


                         LAYER  4
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                TYPE 2 - LATERAL DRAINAGE LAYER
                  MATERIAL TEXTURE NUMBER  21
THICKNESS                    =      12.00    INCHES
POROSITY                     =       0.3970 VOL/VOL
FIELD CAPACITY               =       0.0320 VOL/VOL
WILTING POINT                =       0.0130 VOL/VOL
INITIAL SOIL WATER CONTENT   =       0.0569 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.300000012000      CM/SEC
SLOPE                        =       2.00    PERCENT
DRAINAGE LENGTH              =     100.0     FEET


                          LAYER  5
                          --------

                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     =       8.00    HOLES/ACRE
FML PLACEMENT QUALITY        =  3 - GOOD


                          LAYER  6
                          --------

                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	=	93.00	
FRACTION OF AREA ALLOWING RUNOFF	=	0.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	13.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.377	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	9.919	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.768	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	12.730	INCHES
TOTAL INITIAL WATER	=	12.730	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
PLYMOUTH 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	=	7.60	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	68.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	68.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	77.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	73.00	%

NOTE: PRECIPITATION DATA WAS ENTERED MANUALLY FOR ~~SYNTHETICALLY GENERATED USING COEFFICIENTS FOR NORFOLK VIRGINIA~~
PLYMOUTH, NORTH CAROLINA.

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC

4.17	3.98	4.18	3.14	4.66	4.53
6.30	5.85	4.62	3.35	3.10	3.32

NOTE: TEMPERATURE DATA WAS ~~SYNTHETICALLY GENERATED USING COEFFICIENTS FOR NORFOLK VIRGINIA~~ ENTERED MANUALLY FOR PLYMOUTH, NC

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 NORFOLK VIRGINIA~~ ENTERED MANUALLY FOR PLYMOUTH, NC

STATION LATITUDE = 35.87 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

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	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.42	3.66	4.52	2.76	4.19	5.02
	7.36	7.52	4.98	2.34	2.74	3.83
STD. DEVIATIONS	2.25	1.38	1.86	1.27	1.84	2.52
	3.32	3.06	2.72	1.33	1.43	1.73

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	1.524	1.735	2.900	2.393	3.289	3.705
	4.082	4.017	3.073	1.822	1.496	1.414
STD. DEVIATIONS	0.400	0.453	0.816	0.997	1.148	1.523
	1.469	1.234	1.146	0.790	0.527	0.219

LATERAL DRAINAGE COLLECTED FROM LAYER 4

TOTALS	1.9900	1.4995	2.0321	1.4353	1.0149	1.0733
	1.4650	2.4987	3.2323	1.9762	1.0446	1.3210
STD. DEVIATIONS	1.4579	1.0815	1.3261	1.0699	1.0681	1.2320
	1.6159	1.8524	2.1318	1.3740	0.9967	1.1788

PERCOLATION/LEAKAGE THROUGH LAYER 6

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 6

AVERAGES	0.2698	0.2133	0.2773	0.1768	0.1306	0.1421
	0.2005	0.3830	0.5351	0.2671	0.1297	0.1714

STD. DEVIATIONS	0.2762	0.2084	0.2420	0.2010	0.1863	0.218
	0.2957	0.3485	0.4516	0.2634	0.1781	0.194

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

	INCHES		CU. FEET	PERCENT
PRECIPITATION	52.35	(8.675)	190032.3	100.00
RUNOFF	0.000	(0.0000)	0.00	0.000
EVAPOTRANSPIRATION	31.452	(7.4949)	114170.05	60.079
LATERAL DRAINAGE COLLECTED FROM LAYER 4	20.58297	(8.48051)	74716.164	39.31761
PERCOLATION/LEAKAGE THROUGH FROM LAYER 6	0.00006	(0.00003)	0.205	0.00011
AVERAGE HEAD ACROSS TOP OF LAYER 6	0.241	(0.130)		
CHANGE IN WATER STORAGE	0.316	(2.0589)	1145.92	0.603

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	5.73	20799.900

RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 4	0.34003	1234.31641
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000002	0.00557
AVERAGE HEAD ACROSS LAYER 6	2.090	
SNOW WATER	2.95	10713.2930

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.7440
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1360

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FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	8.5252	0.7104
2	8.8920	0.7410
3	0.9547	0.1591
4	0.4917	0.0410
5	0.0000	0.0000
6	0.1800	0.7500
SNOW WATER	0.000	

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Ground Water Elevation Data
Weyerhaeuser Landfill
Plymouth, North Carolina

Well Number	*Date*	*Measuring Point Elevation(1)*	*Depth to Water (2)*	*Water Elevation(1)*	*Comment*
LF-01	8/16/89	37.59	4	33.59	
LF-01	8/16/90	37.59	7.91	29.68	
LF-01	11/20/90	37.59	11.42	26.17	
LF-01	12/14/90	37.59	8.88	28.71	
LF-01	1/14/91	37.59	8.17	29.42	
LF-01	2/14/91	37.59	6.21	31.38	
LF-01	3/20/91	37.59	5.42	32.17	
LF-01	4/2/93	37.59	2.92	34.67	
LF-01	6/4/93	37.59	6.21	31.38	
LF-01	8/17/93	37.59	8.29	29.3	
LF-01	9/20/93	37.59	8.88	28.71	
LF-01	10/14/93	37.59	9.25	28.34	
LF-01	11/29/93	37.59	9	28.59	
LF-01	12/22/93	37.59	8.27	29.32	
LF-01	1/10/94	37.59	8.12	29.47	
LF-01	2/22/94	37.59	5.53	32.06	
LF-01	5/23/94	37.59	7.05	30.54	
LF-01	6/21/94	37.59	7.96	29.63	
LF-01	7/27/94	37.59	9	28.59	
LF-01	10/20/94	37.59	7.95	29.62	
LF-01	2/28/95	37.59	4.92	32.65	
LF-01	4/20/95	37.59	6.76	30.83	
LF-01	1/26/96	37.59	7.05	30.54	
LF-01	10/7/96	37.59	5.9	31.69	
LF-01	11/5/96	37.59	4.65	32.94	
LF-01	12/4/96	37.59	5.96	31.63	
LF-01	1/8/97	37.59	4.25	33.34	

(1) Relative to mean sea level

(2) Feet below top of casing

Well Number	Date	Measuring Point Elevation(1)	Depth to Water (2)	Water Elevation(1)	Comment
LF-01	2/5/97	37.59	4.38	33.21	
LF-01	3/6/97	37.59	4.31	33.28	
LF-01	4/4/97	37.59	4.71	32.88	
LF-01	5/9/97	37.59	5.21	32.38	
LF-01	6/5/97	37.59	6.54	31.05	
LF-01	7/8/97	37.59	8.1	29.49	
LF-01	8/5/97	37.59	8.28	29.31	
LF-01	9/9/97	37.59	9.07	28.52	
LF-01	10/7/97	37.59	8.93	28.66	
LF-01	11/4/97	37.59	8.83	28.76	
LF-01	12/10/97	37.59	8.05	29.54	
LF-01	4/17/98	37.59	4.38	33.21	
LF-01A	11/20/90	37.62	31.54	6.08	
LF-01A	12/14/90	37.62	28.5	9.12	
LF-01A	1/14/91	37.62	28.42	9.2	
LF-01A	2/14/91	37.62	28	9.62	
LF-01A	3/20/91	37.62	27.67	9.95	
LF-01A	4/2/93	37.62	23.79	13.83	
LF-01A	6/4/93	37.62	25.54	12.08	
LF-01A	8/17/93	37.62	27.54	10.08	
LF-01A	9/20/93	37.62	28.25	9.37	
LF-01A	10/14/93	37.62	28.5	9.12	
LF-01A	11/29/93	37.62	28.45	9.17	
LF-01A	12/22/93	37.62	28.33	9.29	
LF-01A	1/10/94	37.62	28.69	8.93	
LF-01A	2/22/94	37.62	27.8	9.82	
LF-01A	5/23/94	37.62	27.3	10.32	
LF-01A	6/21/94	37.62	27.93	9.69	
LF-01A	7/27/94	37.62	28.57	9.05	
LF-01A	10/20/94	37.62	28.72	8.86	
LF-01A	2/28/95	37.62	27.26	10.36	

(1) Relative to mean sea level

(2) Feet below top of casing

Well Number	Date	Measuring Point Elevation(1)	Depth to Water (2)	Water Elevation(1)	Comment
LF-01A	4/20/95	37.62	27.15	10.47	
LF-01A	1/26/96	37.62	28.1	9.52	
LF-01A	10/7/96	37.62	26.55	11.07	
LF-01A	11/5/96	37.62	26.06	11.56	
LF-01A	12/4/96	37.62	26.47	11.15	
LF-01A	1/8/97	37.62	26.13	11.49	
LF-01A	2/5/97	37.62	25.9	11.72	
LF-01A	3/6/97	37.62	25.91	11.71	
LF-01A	4/4/97	37.62	25.9	11.72	
LF-01A	5/9/97	37.62	26.08	11.54	
LF-01A	6/5/97	37.62	26.74	10.88	
LF-01A	7/8/97	37.62	27.58	10.04	
LF-01A	8/5/97	37.62	27.99	9.63	
LF-01A	9/9/97	37.62	28.46	9.16	
LF-01A	10/7/97	37.62	28.55	9.07	
LF-01A	11/4/97	37.62	28.74	8.88	
LF-01A	12/10/97	37.62	28.32	9.3	
LF-01A	4/17/98	37.62	25.04	12.58	
LF-02	8/16/89	27.68	20.33	7.35	
LF-02	8/16/90	27.68	21.79	5.89	
LF-02	11/20/90	27.68	21.58	6.1	
LF-02	12/14/90	27.68	21.71	5.97	
LF-02	1/14/91	27.68	21.5	6.18	
LF-02	2/14/91	27.68	21.21	6.47	
LF-02	3/20/91	27.68	21.13	6.55	
LF-02	4/2/93	27.68	18.88	8.8	
LF-02	6/4/93	27.68	20.12	7.56	
LF-02	8/17/93	27.68	21.46	6.22	
LF-02	9/20/93	27.68	21.79	5.89	
LF-02	10/14/93	27.68	21.83	5.85	
LF-02	11/29/93	27.68	21.66	6.02	

(1) Relative to mean sea level

(2) Feet below top of casing

Well Number	Date	Measuring Point Elevation(1)	Depth to Water (2)	Water Elevation(1)	Comment
LF-02	1/10/94	27.68	22.04	5.64	
LF-02	2/22/94	27.68	21.35	6.33	
LF-02	5/23/94	27.68	21.62	6.06	
LF-02	6/21/94	27.68	22	5.68	
LF-02	7/27/94	27.68	22.49	5.19	
LF-02	10/20/94	27.68	22.39	5.15	
LF-02	2/28/95	27.68	21.08	6.6	
LF-02	4/20/95	27.68	21.59	6.09	
LF-02	1/26/96	27.68	21.84	5.84	
LF-02	10/7/96	27.68	20.94	6.74	
LF-02	11/5/96	27.68	20.73	6.95	
LF-02	12/4/96	27.68	21	6.68	
LF-02	1/8/97	27.68	19.69	7.99	
LF-02	2/5/97	27.68	20.61	7.07	
LF-02	3/6/97	27.68	20.57	7.11	
LF-02	4/4/97	27.68	20.51	7.17	
LF-02	5/9/97	27.68	20.59	7.09	
LF-02	6/5/97	27.68	21.13	6.55	
LF-02	7/8/97	27.68	21.73	5.95	
LF-02	8/5/97	27.68	21.98	5.7	
LF-02	9/9/97	27.68	22.22	5.46	
LF-02	10/7/97	27.68	22.08	5.6	
LF-02	11/4/97	27.68	22.08	5.6	
LF-02	12/10/97	27.68	21.8	5.88	
LF-02	4/17/98	27.68	19.89	7.79	
LF-03	8/16/89	10.7	5.92	4.78	
LF-03	8/16/90	10.7	6.12	4.58	
LF-03	11/20/90	10.7	6.12	4.58	
LF-03	12/14/90	10.7	6.21	4.49	
LF-03	1/14/91	10.7	5.92	4.78	
LF-03	2/14/91	10.7	5.96	4.74	

(1) Relative to mean sea level

(2) Feet below top of casing

Well Number	Date	Measuring Point Elevation(1)	Depth to Water (2)	Water Elevation(1)	Comment
LF-03	3/20/91	10.7	5.83	4.87	
LF-03	4/2/93	10.7	5.78	4.92	
LF-03	6/4/93	10.7	5.79	4.91	
LF-03	8/17/93	10.7	6.29	4.41	
LF-03	9/20/93	10.7	6.33	4.37	
LF-03	10/14/93	10.7	6.38	4.32	
LF-03	11/29/93	10.7	6.17	4.53	
LF-03	1/10/94	10.7	6.5	4.2	
LF-03	2/22/94	10.7	6.4	4.3	
LF-03	5/23/94	10.7	6.75	3.95	
LF-03	6/21/94	10.7	6.9	3.8	
LF-03	7/27/94	10.7	7.12	3.58	
LF-03	10/20/94	10.7	6.95	3.62	
LF-03	2/28/95	10.7	6.32	4.38	
LF-03	4/20/95	10.7	6.51	4.19	
LF-03	10/7/96	10.7	6.2	4.5	
LF-03	11/5/96	10.7	6.12	4.58	
LF-03	12/4/96	10.7	6.22	4.48	
LF-03	1/8/97	10.7	6.04	4.66	
LF-03	2/5/97	10.7	6.02	4.68	
LF-03	3/6/97	10.7	5.96	4.74	
LF-03	4/4/97	10.7	5.99	4.71	
LF-03	5/9/97	10.7	6.03	4.67	
LF-03	6/5/97	10.7	6.34	4.36	
LF-03	7/8/97	10.7	6.71	3.99	
LF-03	8/5/97	10.7	6.76	3.94	
LF-03	9/9/97	10.7	6.92	3.78	
LF-03	10/7/97	10.7	6.9	3.8	
LF-03	11/4/97	10.7	6.7	4	
LF-03	12/10/97	10.7	6.48	4.22	
LF-03	4/17/98	10.7	5.75	4.95	

(1) Relative to mean sea level

(2) Feet below top of casing

Well Number	Date	Measuring Point Elevation(1)	Depth to Water (2)	Water Elevation(1)	Comment
LF-04	8/16/89	12.09	7.79	4.3	
LF-04	8/16/90	12.09	8.75	3.34	
LF-04	11/20/90	12.09	8.13	3.96	
LF-04	12/14/90	12.09	8.17	3.92	
LF-04	1/14/91	12.09	7.75	4.34	
LF-04	2/14/91	12.09	7.5	4.59	
LF-04	3/20/91	12.09	7.33	4.76	
LF-04	4/2/93	12.09	6.85	5.24	
LF-04	6/4/93	12.09	7.46	4.63	
LF-04	8/17/93	12.09	8.15	3.94	
LF-04	9/20/93	12.09	8.29	3.8	
LF-04	10/14/93	12.09	8.5	3.59	
LF-04	11/29/93	12.09	8.08	4.01	
LF-04	1/10/94	12.09	8.38	3.71	
LF-04	2/22/94	12.09	8.05	4.04	
LF-04	5/23/94	12.09	8.71	3.38	
LF-04	6/21/94	12.09	8.71	3.38	
LF-04	7/27/94	12.09	8.99	3.1	
LF-04	10/20/94	12.09	8.72	3.18	
LF-04	2/28/95	12.09	7.96	4.13	
LF-04	4/20/95	12.09	8.43	3.66	
LF-04	1/26/96	12.09	8.24	3.85	
LF-04	10/7/96	12.09	7.79	4.3	
LF-04	11/5/96	12.09	7.85	4.24	
LF-04	12/4/96	12.09	7.85	4.24	
LF-04	1/8/97	12.09	7.73	4.36	
LF-04	2/5/97	12.09	7.74	4.35	
LF-04	3/6/97	12.09	7.65	4.44	
LF-04	4/4/97	12.09	7.68	4.41	
LF-04	5/9/97	12.09	7.68	4.41	
LF-04	6/5/97	12.09	8.07	4.02	

(1) Relative to mean sea level

(2) Feet below top of casing

Well Number	Date	Measuring Point Elevation(1)	Depth to Water (2)	Water Elevation(1)	Comment
LF-04	7/8/97	12.09	8.44	3.65	
LF-04	8/5/97	12.09	8.55	3.54	
LF-04	9/9/97	12.09	8.71	3.38	
LF-04	10/7/97	12.09	8.57	3.52	
LF-04	11/4/97	12.09	8.42	3.67	
LF-04	12/10/97	12.09	8.2	3.89	
LF-04	4/17/98	12.09	7.41	4.68	
LF-05	8/16/89	39.16	12.17	26.99	
LF-05	8/16/90	39.16	13.2	25.96	
LF-05	11/20/90	39.16	13.46	25.7	
LF-05	12/14/90	39.16	13.67	25.49	
LF-05	1/14/91	39.16	13.33	25.83	
LF-05	2/14/91	39.16	13.25	25.91	
LF-05	3/20/91	39.16	14.25	24.91	
LF-05	4/2/93	39.16	10.54	28.62	
LF-05	6/4/93	39.16	11.46	27.7	
LF-05	8/17/93	39.16	12.67	26.49	
LF-05	9/20/93	39.16	13.17	25.99	
LF-05	10/14/93	39.16	13.33	25.83	
LF-05	11/29/93	39.16	13.42	25.74	
LF-05	1/10/94	39.16	14.11	25.05	
LF-05	2/22/94	39.16	13.12	26.04	
LF-05	5/23/94	39.16	13.41	25.75	
LF-05	6/21/94	39.16	13.72	25.44	
LF-05	7/27/94	39.16	14.15	25.01	
LF-05	10/20/94	39.16	14.04	25.1	
LF-05	2/28/95	39.16	13.44	25.7	
LF-05	4/20/95	39.16	13.03	26.13	
LF-05	1/26/96	39.16	13.75	25.41	
LF-05	10/7/96	39.16	12.85	26.31	
LF-05	11/5/96	39.16	12.65	26.51	

(1) Relative to mean sea level

(2) Feet below top of casing

Well Number	Date	Measuring Point Elevation(1)	Depth to Water (2)	Water Elevation(1)	Comment
LF-05	12/4/96	39.16	12.58	26.58	
LF-05	1/8/97	39.16	12.25	26.91	
LF-05	2/5/97	39.16	12.28	26.88	
LF-05	3/6/97	39.16	12.2	26.96	
LF-05	4/4/97	39.16	12.19	26.97	
LF-05	5/9/97	39.16	12.29	26.87	
LF-05	6/5/97	39.16	12.8	26.36	
LF-05	7/8/97	39.16	13.43	25.73	
LF-05	8/5/97	39.16	13.64	25.52	
LF-05	9/9/97	39.16	13.78	25.38	
LF-05	10/7/97	39.16	13.82	25.34	
LF-05	11/4/97	39.16	13.74	25.42	
LF-05	12/10/97	39.16	13.42	25.74	
LF-05	4/17/98	39.16	12.23	26.93	
LF-06	8/16/89	14.02	10	4.02	
LF-06	8/16/90	14.02	11.5	2.52	
LF-06	11/20/90	14.02	10.58	3.44	
LF-06	12/14/90	14.02	10.58	3.44	
LF-06	1/14/91	14.02	10.17	3.85	
LF-06	2/14/91	14.02	10	4.02	
LF-06	3/20/91	14.02	10	4.02	
LF-06	4/2/93	14.02	8.08	5.94	
LF-06	6/4/93	14.02	10.21	3.81	
LF-06	8/17/93	14.02	10.94	3.08	
LF-06	9/20/93	14.02	11	3.02	
LF-06	10/14/93	14.02	10.88	3.14	
LF-06	11/29/93	14.02	10.5	3.52	
LF-06	1/10/94	14.02	10.63	3.39	
LF-06	2/22/94	14.02	10.6	3.42	
LF-06	5/23/94	14.02	11.22	2.8	
LF-06	6/21/94	14.02	11.5	2.52	

(1) Relative to mean sea level

(2) Feet below top of casing

Well Number	Date	Measuring Point Elevation(1)	Depth to Water (2)	Water Elevation(1)	Comment
LF-06	7/27/94	14.02	11.85	2.17	
LF-06	10/20/94	14.02	11.14	2.74	
LF-06	2/28/95	14.02	10.33	3.69	
LF-06	4/20/95	14.02	11.04	2.98	
LF-06	1/26/96	14.02	10.67	3.35	
LF-06	10/7/96	14.02	10.32	3.7	
LF-06	11/5/96	14.02	10.32	3.7	
LF-06	12/4/96	14.02	10.53	3.49	
LF-06	1/8/97	14.02	10.3	3.72	
LF-06	2/5/97	14.02	10.38	3.64	
LF-06	3/6/97	14.02	10.4	3.62	
LF-06	4/4/97	14.02	10.35	3.67	
LF-06	5/9/97	14.02	10.43	3.59	
LF-06	6/5/97	14.02	10.78	3.24	
LF-06	7/8/97	14.02	11.36	2.66	
LF-06	8/5/97	14.02	11.44	2.58	
LF-06	9/9/97	14.02	11.53	2.49	
LF-06	10/7/97	14.02	11.21	2.81	
LF-06	11/4/97	14.02	11.06	2.96	
LF-06	12/10/97	14.02	7.26	6.76	
LF-06	4/17/98	14.02	9.93	4.09	
LF-06A	11/20/90	14.05	10.08	3.97	
LF-06A	12/14/90	14.05	10.08	3.97	
LF-06A	1/14/91	14.05	9.83	4.22	
LF-06A	2/14/91	14.05	9.58	4.47	
LF-06A	3/20/91	14.05	9.51	4.54	
LF-06A	4/2/93	14.05	8.37	5.68	
LF-06A	6/4/93	14.05	9.54	4.51	
LF-06A	8/17/93	14.05	10.38	3.67	
LF-06A	9/20/93	14.05	10.37	3.68	
LF-06A	10/14/93	14.05	10.33	3.72	

(1) Relative to mean sea level

(2) Feet below top of casing

Well Number	Date	Measuring Point Elevation(1)	Depth to Water (2)	Water Elevation(1)	Comment
LF-06A	11/29/93	14.05	10	4.05	
LF-06A	1/10/94	14.05	10.25	3.8	
LF-06A	2/22/94	14.05	10.08	3.97	
LF-06A	5/23/94	14.05	10.55	3.5	
LF-06A	6/21/94	14.05	10.9	3.15	
LF-06A	7/27/94	14.05	11.27	2.78	
LF-06A	10/20/94	14.05	10.69	2.7	
LF-06A	2/28/95	14.05	9.78	4.27	
LF-06A	4/20/95	14.05	10.43	3.62	
LF-06A	1/26/96	14.05	10.29	3.76	
LF-06A	10/7/96	14.05	9.8	4.25	
LF-06A	11/5/96	14.05	9.73	4.32	
LF-06A	12/4/96	14.05	9.94	4.11	
LF-06A	1/8/97	14.05	9.71	4.34	
LF-06A	2/5/97	14.05	9.72	4.33	
LF-06A	3/6/97	14.05	9.73	4.32	
LF-06A	4/4/97	14.05	9.72	4.33	
LF-06A	5/9/97	14.05	9.81	4.24	
LF-06A	6/5/97	14.05	10.17	3.88	
LF-06A	7/8/97	14.05	10.77	3.28	
LF-06A	8/5/97	14.05	10.84	3.21	
LF-06A	9/9/97	14.05	10.99	3.06	
LF-06A	10/7/97	14.05	10.69	3.36	
LF-06A	11/4/97	14.05	10.57	3.48	
LF-06A	12/10/97	14.05	10.27	3.78	
LF-06A	4/17/98	14.05	9.22	4.83	
LF-07	8/16/89	36.33	6.96	29.37	
LF-07	8/16/90	36.33	10.83	25.5	
LF-07	11/20/90	36.33	11.17	25.16	
LF-07	12/14/90	36.33	11.17	25.16	
LF-07	1/14/91	36.33	10.75	25.58	

(1) Relative to mean sea level

(2) Feet below top of casing

Well Number	Date	Measuring Point Elevation(1)	Depth to Water (2)	Water Elevation(1)	Comment
LF-07	2/14/91	36.33	9.75	26.58	
LF-07	3/20/91	36.33	9.92	26.41	
LF-07	4/2/93	36.33	5.92	30.41	
LF-07	6/4/93	36.33	9.38	26.95	
LF-07	8/17/93	36.33	11.58	24.75	
LF-07	9/20/93	36.33	11.75	24.58	
LF-07	10/14/93	36.33	12.12	24.21	
LF-07	11/29/93	36.33	11.96	24.37	
LF-07	12/22/93	36.33	11.54	24.79	
LF-07	1/10/94	36.33	12.02	24.31	
LF-07	2/22/94	36.33	11.05	25.28	
LF-07	5/23/94	36.33	11.93	24.4	
LF-07	6/21/94	36.33	11.74	24.59	
LF-07	7/27/94	36.33	14.49	21.84	
LF-07	10/20/94	36.33	12.7	23.65	
LF-07	2/28/95	36.33	11.05	25.28	
LF-07	4/20/95	36.33	11.08	25.25	
LF-07	1/26/96	36.33	12.37	23.96	
LF-07	10/7/96	36.33	10.91	25.42	
LF-07	11/5/96	36.33	10	26.33	
LF-07	12/4/96	36.33	10.03	26.3	
LF-07	1/8/97	36.33	9.3	27.03	
LF-07	2/5/97	36.33	9.03	27.3	
LF-07	3/6/97	36.33	8.65	27.68	
LF-07	4/4/97	36.33	5.83	30.5	
LF-07	5/9/97	36.33	9.01	27.32	
LF-07	6/5/97	36.33	9.82	26.51	
LF-07	7/8/97	36.33	10.52	25.81	
LF-07	8/5/97	36.33	11.03	25.3	
LF-07	9/9/97	36.33	11.69	24.64	
LF-07	10/7/97	36.33	11.86	24.47	

(1) Relative to mean sea level

(2) Feet below top of casing

Well Number	Date	Measuring Point Elevation(1)	Depth to WaterP(2)	Water Elevation(1)	Comment
LF-07	11/4/97	36.33	11.77	24.56	
LF-07	12/10/97	36.33	11.86	24.47	
LF-07	4/17/98	36.33	9.43	26.9	
LF-08	11/20/90	36.19	29.71	6.48	
LF-08	12/14/90	36.19	29.46	6.73	
LF-08	1/14/91	36.19	29.67	6.52	
LF-08	2/14/91	36.19	29.33	6.86	
LF-08	3/20/91	36.19	29.25	6.94	
LF-08	4/2/93	36.19	26.83	9.36	
LF-08	6/4/93	36.19	27.88	8.31	
LF-08	8/17/93	36.19	29.25	6.94	
LF-08	9/20/93	36.19	29.67	6.52	
LF-08	10/14/93	36.19	29.83	6.36	
LF-08	11/29/93	36.19	29.69	6.5	
LF-08	12/22/93	36.19	29.54	6.65	
LF-08	1/10/94	36.19	30.07	6.12	
LF-08	2/22/94	36.19	29.5	6.69	
LF-08	5/23/94	36.19	29.43	6.76	
LF-08	6/21/94	36.19	29.44	6.75	
LF-08	7/27/94	36.19	30.25	5.94	
LF-08	10/20/94	36.19	29.81	6.31	
LF-08	2/28/95	36.19	28.82	7.37	
LF-08	4/20/95	36.19	29.03	7.16	
LF-08	1/26/96	36.19	29.66	6.53	
LF-08	10/7/96	36.19	28.55	7.64	
LF-08	11/5/96	36.19	28.29	7.9	
LF-08	12/4/96	36.19	28.5	7.69	
LF-08	1/8/97	36.19	28.26	7.93	
LF-08	2/5/97	36.19	28.07	8.12	
LF-08	3/6/97	36.19	28.08	8.11	
LF-08	4/4/97	36.19	28.02	8.17	

(1) Relative to mean sea level

(2) Feet below top of casing

Well Number	Date	Measuring Point Elevation(1)	Depth to WaterP(2)	Water Elevation(1)	Comment
LF-08	5/9/97	36.19	28.05	8.14	
LF-08	6/5/97	36.19	28.57	7.62	
LF-08	7/8/97	36.19	29.1	7.09	
LF-08	8/5/97	36.19	29.33	6.86	
LF-08	9/9/97	36.19	29.65	6.54	
LF-08	10/7/97	36.19	29.62	6.57	
LF-08	11/4/97	36.19	29.62	6.57	
LF-08	12/10/97	36.19	29.37	6.82	
LF-08	4/17/98	36.19	27.5	8.69	
LFO-01	12/14/90	36.98	29.13	7.85	
LFO-01	1/14/91	36.98	29.08	7.9	
LFO-01	2/14/91	36.98	28.75	8.23	
LFO-01	3/20/91	36.98	28.5	8.48	
LFO-01	4/2/93	36.98	25.5	11.48	
LFO-01	6/4/93	36.98	26.65	10.33	
LFO-01	8/17/93	36.98	28.33	8.65	
LFO-01	9/20/93	36.98	28.92	8.06	
LFO-01	10/14/93	36.98	29.12	7.86	
LFO-01	11/29/93	36.98	29.04	7.94	
LFO-01	12/22/93	36.98	28.94	8.04	
LFO-01	1/10/94	36.98	29.38	7.6	
LFO-01	2/22/94	36.98	28.8	8.18	
LFO-01	5/23/94	36.98	28.45	8.53	
LFO-01	6/21/94	36.98	28.45	8.53	
LFO-01	7/27/94	36.98	29.41	7.57	
LFO-01	10/20/94	36.98	29.55	7.34	
LFO-01	2/28/95	36.98	28.63	8.35	
LFO-01	4/20/95	36.98	28.31	8.67	
LFO-01	1/26/96	36.98	29.08	7.9	
LFO-01	10/7/96	36.98	28.92	8.06	
LFO-01	11/5/96	36.98	27.51	9.47	

(1) Relative to mean sea level

(2) Feet below top of casing

Well Number	Date	Measuring Point Elevation(1)	Depth to WaterP(2)	Water Elevation(1)	Comment
LFO-01	12/4/96	36.98	27.82	9.16	
LFO-01	1/8/97	36.98	27.52	9.46	
LFO-01	2/5/97	36.98	27.3	9.68	
LFO-01	3/6/97	36.98	27.31	9.67	
LFO-01	4/4/97	36.98	27.25	9.73	
LFO-01	6/5/97	36.98	27.86	9.12	
LFO-01	7/8/97	36.98	28.51	8.47	
LFO-01	8/5/97	36.98	28.82	8.16	
LFO-01	9/9/97	36.98	29.22	7.76	
LFO-01	10/7/97	36.98	29.25	7.73	
LFO-01	11/4/97	36.98	29.36	7.62	
LFO-01	12/10/97	36.98	29.04	7.94	
LFO-01	4/17/98	36.98	26.58	10.4	
LFO-02	12/14/90	33.83			Dry
LFO-02	1/14/91	33.83			Dry
LFO-02	2/14/91	33.83	11.04	22.79	
LFO-02	3/20/91	33.83	11.25	22.58	
LFO-02	4/2/93	33.83	3.73	30.1	
LFO-02	6/4/93	33.83	7.92	25.91	
LFO-02	8/17/93	33.83			Dry
LFO-02	9/20/93	33.83			Dry
LFO-02	10/14/93	33.83			Dry
LFO-02	11/29/93	33.83			Dry
LFO-02	12/22/93	33.83			Dry
LFO-02	1/10/94	33.83			Dry
LFO-02	2/22/94	33.83	13.45	20.38	
LFO-02	5/23/94	33.83	14.75	19.08	
LFO-02	6/21/94	33.83			Dry
LFO-02	7/27/94	33.83			Dry
LFO-02	10/20/94	33.83			Dry
LFO-02	2/28/95	33.83	12.23	21.6	

(1) Relative to mean sea level

(2) Feet below top of casing

Well Number	Date	Measuring Point Elevation(1)	Depth to WaterP(2)	Water Elevation(1)	Comment
LFO-02	4/20/95	33.83	14.69	19.14	
LFO-02	1/26/96	33.83	13.92	19.91	
LFO-02	10/7/96	33.83	14.3	19.53	
LFO-02	12/4/96	33.83	12.77	21.06	
LFO-02	1/8/97	33.83	11.52	22.31	
LFO-02	2/5/97	33.83	11.08	22.75	
LFO-02	3/6/97	33.83	11.28	22.55	
LFO-02	4/4/97	33.83	11.92	21.91	
LFO-02	6/5/97	33.83			Dry
LFO-02	7/8/97	33.83			Dry
LFO-02	8/5/97	33.83			Dry
LFO-02	9/9/97	33.83			Dry
LFO-02	10/7/97	33.83			Dry
LFO-02	11/4/97	33.83			Dry
LFO-02	12/10/97	33.83			Dry
LFO-03	12/14/90	45.58	20.79	24.79	
LFO-03	1/14/91	45.58	21.08	24.5	
LFO-03	2/14/91	45.58	21.25	24.33	
LFO-03	3/20/91	45.58	21.33	24.25	
LFO-03	4/2/93	45.58			Dry
LFO-03	8/17/93	45.58	19.83	25.75	
LFO-03	9/20/93	45.58	20.44	25.14	
LFO-03	10/14/93	45.58	20.75	24.83	
LFO-03	11/29/93	45.58	21.27	24.31	
LFO-03	12/22/93	45.58	21.27	24.31	
LFO-03	1/10/94	45.58	22.25	23.33	
LFO-03	2/22/94	45.58	22.37	23.21	
LFO-03	5/23/94	45.58	21.75	23.83	
LFO-03	6/21/94	45.58	21.34	24.24	
LFO-03	7/27/94	45.58	21.71	23.87	
LFO-03	10/20/94	45.58	22.5	23	

(1) Relative to mean sea level

(2) Feet below top of casing

Well Number	Date	Measuring Point Elevation(1)	Depth to WaterP(2)	Water Elevation(1)	Comment
LFO-03	2/28/95	45.58	22.74	22.84	
LFO-03	4/20/95	45.58	21.48	24.1	
LFO-03	1/26/96	45.58	20.62	24.96	
LFO-03	10/7/96	45.58	21.38	24.2	
LFO-03	12/4/96	45.58	20.56	25.02	
LFO-03	1/8/97	45.58	20.72	24.86	
LFO-03	2/5/97	45.58	20.39	25.19	
LFO-03	3/6/97	45.58	20.15	25.43	
LFO-03	4/4/97	45.58	20.14	25.44	
LFO-03	6/5/97	45.58	20.66	24.92	
LFO-03	7/8/97	45.58	20.93	24.65	
LFO-03	8/5/97	45.58	21.23	24.35	
LFO-03	9/9/97	45.58	21.61	23.97	
LFO-03	10/7/97	45.58	21.87	23.71	
LFO-03	11/4/97	45.58	22.06	23.52	
LFO-03	12/10/97	45.58	22.26	23.32	
LFO-03	4/17/98	45.58	18.91	26.67	
LFO-04	12/14/90	36.95	15	21.95	
LFO-04	1/14/91	36.95	15	21.95	
LFO-04	2/14/91	36.95	14.71	22.24	
LFO-04	3/20/91	36.95	14.67	22.28	
LFO-04	4/2/93	36.95	12.12	24.83	
LFO-04	6/4/93	36.95	13.6	23.35	
LFO-04	8/17/93	36.95	14.33	22.62	
LFO-04	9/20/93	36.95	14.67	22.28	
LFO-04	10/14/93	36.95	14.88	22.07	
LFO-04	11/29/93	36.95	14.88	22.07	
LFO-04	12/22/93	36.95	9.79	27.16	
LFO-04	1/10/94	36.95	15.25	21.7	
LFO-04	2/22/94	36.95	14.75	22.2	
LFO-04	5/23/94	36.95	14.85	22.1	

(1) Relative to mean sea level

(2) Feet below top of casing

Well Number	Date	Measuring Point Elevation(1)	Depth to WaterP(2)	Water Elevation(1)	Comment
LFO-04	6/21/94	36.95	15.14	21.81	
LFO-04	7/27/94	36.95	14.42	22.53	
LFO-04	10/20/94	36.95	15.75	21.1	
LFO-04	2/28/95	36.95	15.12	21.83	
LFO-04	4/20/95	36.95	14.96	21.99	
LFO-04	1/26/96	36.95	16.27	20.68	
LFO-04	11/5/96	36.95	14.87	22.08	
LFO-04	12/4/96	36.95	14.97	21.98	
LFO-04	1/8/97	36.95	14.74	22.21	
LFO-04	2/5/97	36.95	14.63	22.32	
LFO-04	3/6/97	36.95	14.51	22.44	
LFO-04	4/4/97	36.95	14.43	22.52	
LFO-04	6/5/97	36.95	14.68	22.27	
LFO-04	7/8/97	36.95	15.09	21.86	
LFO-04	8/5/97	36.95	15.27	21.68	
LFO-04	9/9/97	36.95	15.47	21.48	
LFO-04	10/7/97	36.95	15.48	21.47	
LFO-04	11/4/97	36.95	15.41	21.54	
LFO-04	12/10/97	36.95	5.41	31.54	
LFO-04	4/17/98	36.95	14.28	22.67	
LFO-05	12/14/90	34.1	16.5	17.6	
LFO-05	1/14/91	34.1	14.42	19.68	
LFO-05	2/14/91	34.1	13.83	20.27	
LFO-05	3/20/91	34.1			Dry
LFO-05	4/2/93	34.1	12.92	21.18	
LFO-05	6/4/93	34.1	13.9	20.2	
LFO-05	8/17/93	34.1	14.38	19.72	
LFO-05	9/20/93	34.1			Dry
LFO-05	10/14/93	34.1	14.88	19.22	
LFO-05	11/29/93	34.1	13.88	20.22	
LFO-05	12/22/93	34.1	13.6	20.5	

(1) Relative to mean sea level

(2) Feet below top of casing

Well Number	Date	Measuring Point Elevation(1)	Depth to WaterP(2)	Water Elevation(1)	Comment
LFO-05	1/10/94	34.1	14.01	20.09	
LFO-05	2/22/94	34.1	14.05	20.05	
LFO-05	5/23/94	34.1	14.8	19.3	
LFO-05	6/21/94	34.1	14.72	19.38	
LFO-05	7/27/94	34.1	15	19.1	
LFO-05	10/20/94	34.1	14.12	19.87	
LFO-05	2/28/95	34.1	13.72	20.38	
LFO-05	4/20/95	34.1	14.62	19.48	
LFO-05	1/26/96	34.1	14.3	19.8	
LFO-05	10/7/96	34.1	14.35	19.75	
LFO-05	11/5/96	34.1	14.29	19.81	
LFO-05	12/4/96	34.1	14.58	19.52	
LFO-05	1/8/97	34.1	14.26	19.84	
LFO-05	2/5/97	34.1	14.47	19.63	
LFO-05	3/6/97	34.1	14.31	19.79	
LFO-05	4/4/97	34.1	14.29	19.81	
LFO-05	6/5/97	34.1	14.3	19.8	
LFO-05	7/8/97	34.1	14.97	19.13	
LFO-05	8/5/97	34.1	15.06	19.04	
LFO-05	9/9/97	34.1	15.22	18.88	
LFO-05	10/7/97	34.1	14.89	19.21	
LFO-05	11/4/97	34.1	14.32	19.78	
LFO-05	12/10/97	34.1	14.81	19.29	
LFO-05	4/17/98	34.1	14.93	19.17	
LFO-06	1/14/90	34.27	23.75	10.52	
LFO-06	12/14/90	34.27	23.75	10.52	
LFO-06	3/20/91	34.27	20.33	13.94	
LFO-06	4/2/93	34.27	18.35	15.92	
LFO-06	6/4/93	34.27	17.67	16.6	
LFO-06	8/17/93	34.27	18.75	15.52	
LFO-06	9/20/93	34.27	19.08	15.19	

(1) Relative to mean sea level

(2) Feet below top of casing

Well Number	Date	Measuring Point Elevation(1)	Depth to WaterP(2)	Water Elevation(1)	Comment
LFO-06	10/14/93	34.27	19.29	14.98	
LFO-06	11/29/93	34.27	19.46	14.81	
LFO-06	12/22/93	34.27	19.44	14.83	
LFO-06	1/10/94	34.27	19.81	14.46	
LFO-06	2/22/94	34.27	18.83	15.44	
LFO-06	5/23/94	34.27	19.12	15.15	
LFO-06	6/21/94	34.27	19.5	14.77	
LFO-06	7/27/94	34.27	19.93	14.34	
LFO-06	10/20/94	34.27	19.55	14.54	
LFO-06	2/28/95	34.27	18.48	15.79	
LFO-06	4/20/95	34.27	18.68	15.59	
LFO-06	1/26/96	34.27	18.14	16.13	
LFO-06	10/7/96	34.27	18.08	16.19	
LFO-06	11/5/96	34.27	18.39	15.88	
LFO-06	12/4/96	34.27	19.14	15.13	
LFO-06	1/8/97	34.27	19.27	15	
LFO-06	2/5/97	34.27	19.3	14.97	
LFO-06	3/6/97	34.27	19.44	14.83	
LFO-06	4/4/97	34.27	19.23	15.04	
LFO-06	6/5/97	34.27	19.38	14.89	
LFO-06	7/8/97	34.27	20.07	14.2	
LFO-06	8/5/97	34.27	20.39	13.88	
LFO-06	9/9/97	34.27	20.58	13.69	
LFO-06	10/7/97	34.27	20.48	13.79	
LFO-06	11/4/97	34.27	20.49	13.78	
LFO-06	12/10/97	34.27	20.38	13.89	
LFO-06	4/17/98	34.27	19.98	14.29	
LFO-07	12/14/90	24.47	19.21	5.26	
LFO-07	1/14/91	24.47	19	5.47	
LFO-07	2/14/91	24.47	18.92	5.55	
LFO-07	3/20/91	24.47	18.88	5.59	

(1) Relative to mean sea level

(2) Feet below top of casing

Well Number	Date	Measuring Point Elevation(1)	Depth to WaterP(2)	Water Elevation(1)	Comment
LFO-07	4/2/93	24.47	17.71	6.76	
LFO-07	6/4/93	24.47	18.42	6.05	
LFO-07	8/17/93	24.47	18.96	5.51	
LFO-07	9/20/93	24.47	19.17	5.3	
LFO-07	10/14/93	24.47	19.29	5.18	
LFO-07	11/29/93	24.47	19.04	5.43	
LFO-07	12/22/93	24.47	19.83	4.64	
LFO-07	1/10/94	24.47	19.38	5.09	
LFO-07	2/22/94	24.47	19.2	5.27	
LFO-07	5/23/94	24.47	19.3	5.17	
LFO-07	6/21/94	24.47	19.58	4.89	
LFO-07	7/27/94	24.47	19.87	4.6	
LFO-07	10/20/94	24.47	19.69	4.66	
LFO-07	2/28/95	24.47	19.15	5.32	
LFO-07	4/20/95	24.47	19.3	5.17	
LFO-07	1/26/96	24.47	13	11.47	
LFO-07	10/7/96	24.47	19.08	5.39	
LFO-07	11/5/96	24.47	18.97	5.5	
LFO-07	12/4/96	24.47	19.02	5.45	
LFO-07	1/8/97	24.47	18.88	5.59	
LFO-07	2/5/97	24.47	18.87	5.6	
LFO-07	3/6/97	24.47	18.83	5.64	
LFO-07	4/4/97	24.47	18.8	5.67	
LFO-07	6/5/97	24.47	19.04	5.43	
LFO-07	7/8/97	24.47	19.32	5.15	
LFO-07	8/5/97	24.47	19.39	5.08	
LFO-07	9/9/97	24.47	19.58	4.89	
LFO-07	10/7/97	24.47	14.47	10	
LFO-07	11/4/97	24.47	19.35	5.12	
LFO-07	12/10/97	24.47	19.47	5	
LFO-08	5/9/97	36.63	7.33	29.3	

(1) Relative to mean sea level

(2) Feet below top of casing

Well Number	Date	Measuring Point Elevation(1)	Depth to WaterP(2)	Water Elevation(1)	Comment
LFO-08	6/5/97	36.63	9.18	27.45	
LFO-08	7/8/97	36.63	10.43	26.2	
LFO-08	8/5/97	36.63	10.8	25.83	
LFO-08	9/9/97	36.63	11.53	25.1	
LFO-08	10/7/97	36.63	11.6	25.03	
LFO-08	11/4/97	36.63	11.35	25.28	
LFO-08	12/10/97	36.63	11.05	25.58	
LFO-08	4/17/98	36.63	7.62	29.01	
LFO-09	5/9/97	33.67	3.93	29.74	
LFO-09	6/5/97	33.67	4.57	29.1	
LFO-09	7/8/97	33.67	5.82	27.85	
LFO-09	8/5/97	33.67	6.1	27.57	
LFO-09	9/9/97	33.67	7.14	26.53	
LFO-09	10/7/97	33.67	4.07	29.6	
LFO-09	11/4/97	33.67	6.46	27.21	
LFO-09	12/10/97	33.67	6.06	27.61	
LFO-09	4/17/98	33.67	3.35	30.32	
LFO-10	5/9/97	38.88	5.65	33.23	
LFO-10	6/5/97	38.88	7.1	31.78	
LFO-10	7/8/97	38.88	8.58	30.3	
LFO-10	8/5/97	38.88	8.81	30.07	
LFO-10	9/9/97	38.88	8.76	30.12	
LFO-10	10/7/97	38.88	8.32	30.56	
LFO-10	11/4/97	38.88	8.44	30.44	
LFO-10	12/10/97	38.88	7.53	31.35	
LFO-10	4/17/98	38.88	4.02	34.86	
LFO-11	5/9/97	39.52	6.74	32.78	
LFO-11	6/5/97	39.52	8.31	31.21	
LFO-11	7/8/97	39.52	10.3	29.22	
LFO-11	8/5/97	39.52	10.98	28.54	
LFO-11	9/9/97	39.52	11.41	28.11	

(1) Relative to mean sea level

(2) Feet below top of casing

Well Number	Date	Measuring Point Elevation(1)	Depth to WaterP(2)	Water Elevation(1)	Comment
LFO-11	10/7/97	39.52	11.47	28.05	
LFO-11	11/4/97	39.52	11.57	27.95	
LFO-11	12/10/97	39.52	11.08	28.44	
LFO-11	4/17/98	39.52	4.07	35.45	
LFO-12	5/9/97	39.44	7.79	31.65	
LFO-12	6/5/97	39.44	9.41	30.03	
LFO-12	7/8/97	39.44	10.8	28.64	
LFO-12	8/5/97	39.44	11.45	27.99	
LFO-12	9/9/97	39.44	12.03	27.41	
LFO-12	10/7/97	39.44	12.26	27.18	
LFO-12	11/4/97	39.44	12.54	26.9	
LFO-12	12/10/97	39.44	12.47	26.97	
LFO-12	4/17/98	39.44	5.83	33.61	
LFO-13	5/9/97	38.96	8.24	30.72	
LFO-13	6/5/97	38.96	9.51	29.45	
LFO-13	7/8/97	38.96	10.93	28.03	
LFO-13	8/5/97	38.96	11.78	27.18	
LFO-13	9/9/97	38.96	12.47	26.49	
LFO-13	10/7/97	38.96	12.64	26.32	
LFO-13	11/4/97	38.96	12.82	26.14	
LFO-13	12/10/97	38.96	12.51	26.45	
LFO-13	4/17/98	38.96	6.59	32.37	
LFO-14	5/9/97	39.89	10.57	29.32	
LFO-14	6/5/97	39.89	11.41	28.48	
LFO-14	7/8/97	39.89	12.53	27.36	
LFO-14	8/5/97	39.89	13.18	26.71	
LFO-14	9/9/97	39.89	13.77	26.12	
LFO-14	10/7/97	39.89	13.98	25.91	
LFO-14	11/4/97	39.89	14.2	25.69	
LFO-14	12/10/97	39.89	14.32	25.57	
LFO-14	4/17/98	39.89	9.21	30.68	

(1) Relative to mean sea level

(2) Feet below top of casing

Well Number	*Date*	*Measuring Point Elevation(1)*	*Depth to WaterP(2)*	*Water Elevation(1)*	*Comment*
LFO-15	5/9/97	41.61	15.25	26.36	
LFO-15	6/5/97	41.61	15.57	26.04	
LFO-15	7/8/97	41.61	16.06	25.55	
LFO-15	8/5/97	41.61	16.48	25.13	
LFO-15	9/9/97	41.61	16.97	24.64	
LFO-15	10/7/97	41.61	17.22	24.39	
LFO-15	11/4/97	41.61	17.45	24.16	
LFO-15	4/17/98	41.61	13.43	28.18	

(1) Relative to mean sea level

(2) Feet below top of casing

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. OW-1
SHEET NO. 1 OF 3
PROJECT NO. 467.42
INSTALLATION
SURFACE ELEV. 34.5
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	
1	SS	4-6-6-6	50			SILT (ML) - some very fine sand; brown. .5
						CLAY (CL) - trace fine grained sand; stiff; tan.
2	UD		0			CLAY (CL) - sandy (fine grained); silty; tan, gray, orange.
						- Increasing sand.
3	UD		100			
					5	
						6.0
4	SS	2-2-3-4	75			SILTY SAND (SM) - fine grained; trace clay; interlaminated gray and orange.
5	UD		65			- interlaminated with silty clay; micaceous; gray.
					10	
						- gray
6	SS	4-3-10-18	75			
						- more clayey
					15	
						- fine to medium grained; gray
7	SS	9-4-2-2	50			17.8
						SILTY SAND (SM) - as above, interbedded with CLAY (CL); silty; stiff; slightly micaceous; blue green and tan.
8	SS	3-4	100			SILTY CLAY (CL) - stiff; slightly micaceous; blue

GENERAL NOTES

DATE STARTED 20 APR 90
DATE COMPLETED 21 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 5-4-90/1120 DEPTH 23.85 FT. BGS

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. OW-1
SHEET NO. 2 OF 3
PROJECT NO. 467.42
INSTALLATION
SURFACE ELEV. 34.5
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	
9	UD		100			green, tan. SILT (MH) - as determined from laboratory analysis.
10	SS	33-5-6-6	85		25	Change to 5 7/8 in. bit at 21.5 ft.
11	SS	3-3-4-6	100			
					30	
12	SS	4-4-4-5	100			
13	SS	3-4-4-6	100			SILTY CLAY (CL) - as above; with trace fine grained sand.
					35	
						SILTY SAND (SM) - fine grained; gray. 37.3
14	SS	23-43-47-54	50			SILTY SAND (SM) - fine to medium grained; trace coarse grained sand; laminated; tan; trace shell fragments.
					40	

LOG OF TEST BORING

F-203 (R 01-87)

BORING NO. OW-1
SHEET NO. 3 OF 3
PROJECT NO. 467.42
INSTALLATION
SURFACE ELEV. 34.5
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	
15	SS	28-32-41-52	65		45	
						BORING TERMINATED AT 47.0 FEET
					50	
					55	
					60	
					65	

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 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	
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.
3	SS	5-4-4-7	75			SILTY SAND (SM) - fine grained; orange-brown. 4.9
					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	
7	SS	5-7-7-8	50			SILTY SAND (SM) - fine to medium grained; with white shell fragments; light gray to tan.

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

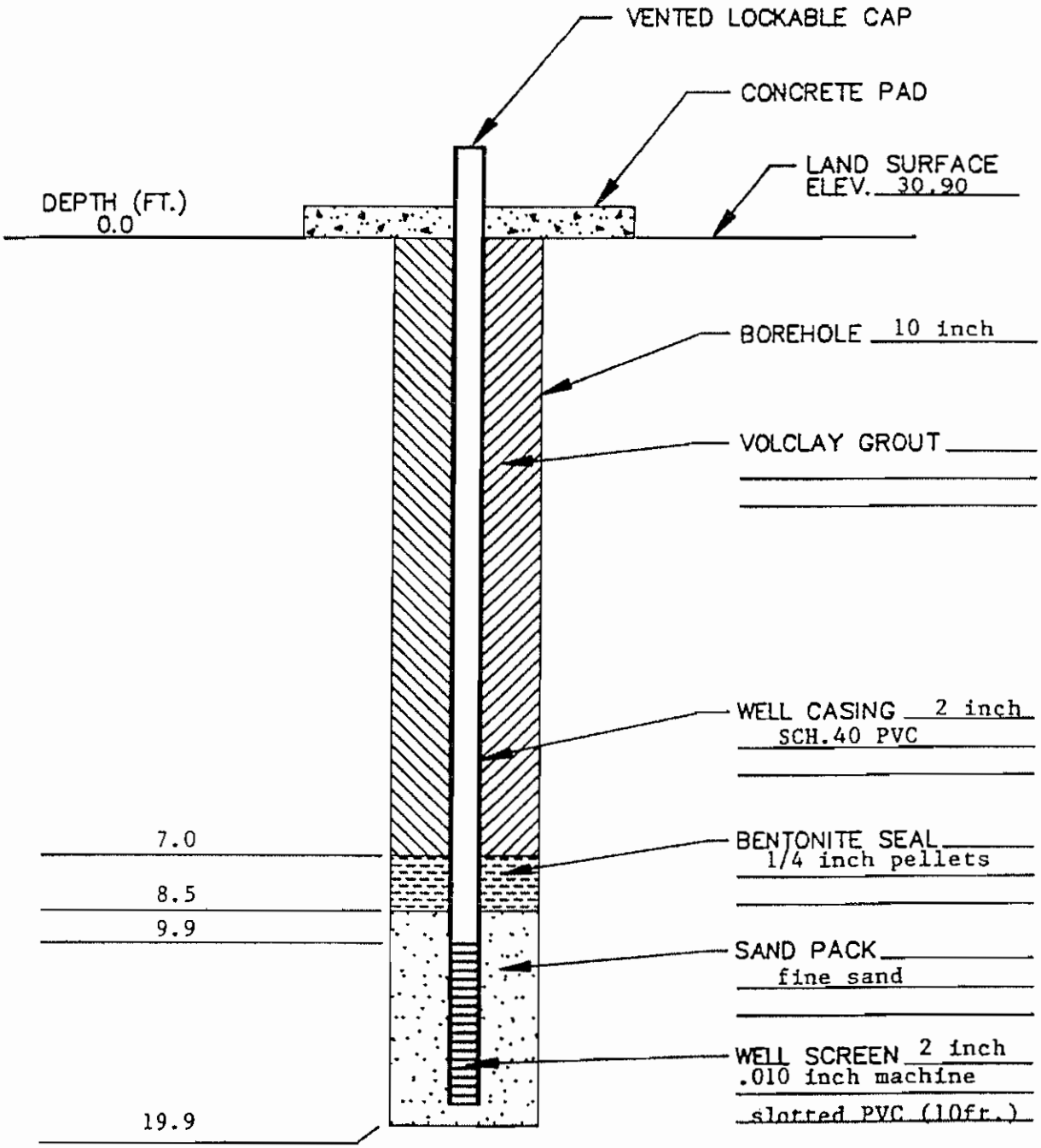
LOG OF TEST BORING

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	



OBSERVATION WELL CONSTRUCTION DIAGRAM

Not To Scale

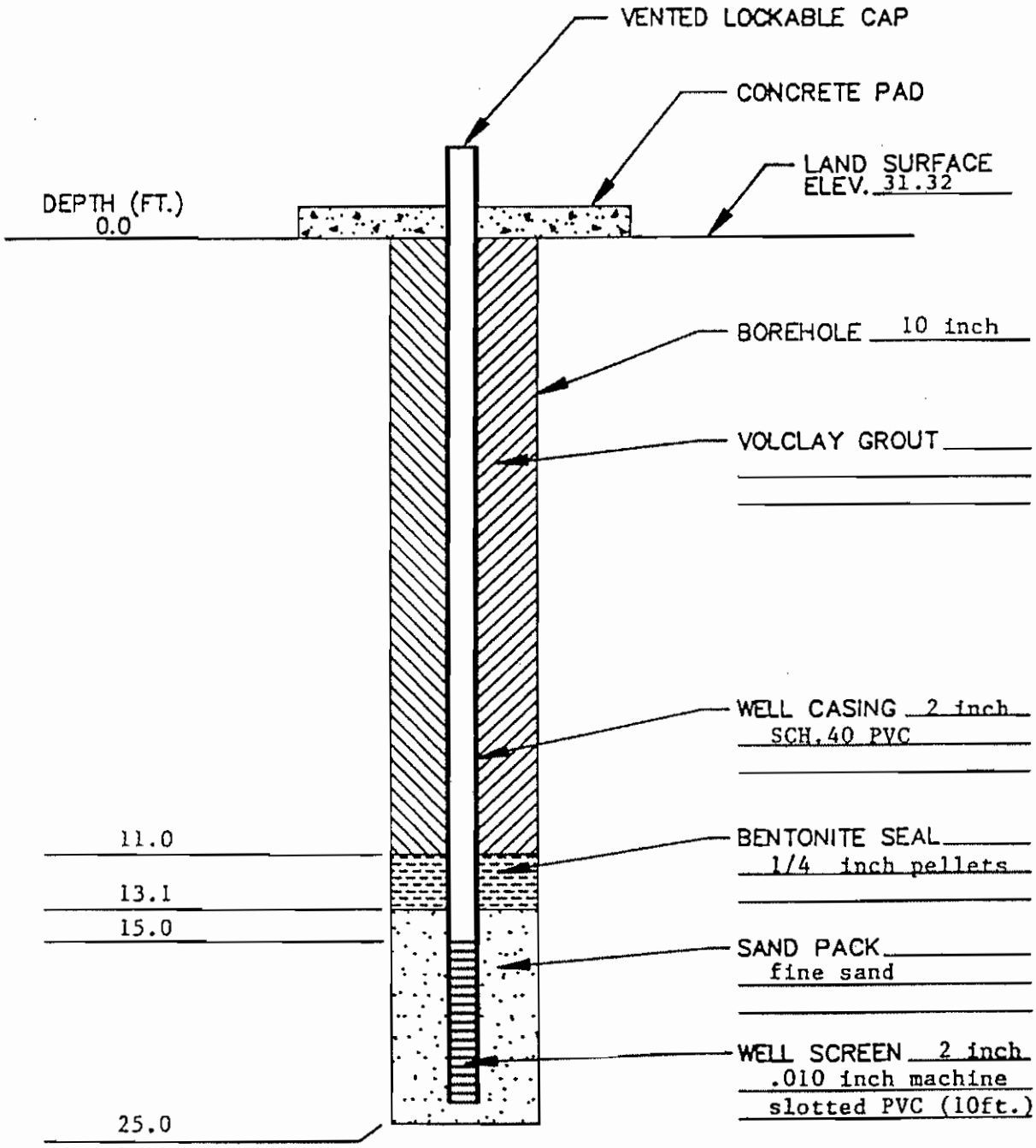
PROJECT Weyerhaeuser

PROJECT NO. 467.42

WELL NO. OW-5 DATE INSTALLED 4/24/90

DRILLING CONTRACTOR Law Engineering

RMT GEOLOGIST B. Grothaus



OBSERVATION WELL CONSTRUCTION DIAGRAM

Not To Scale

PROJECT Weyerhaeuser

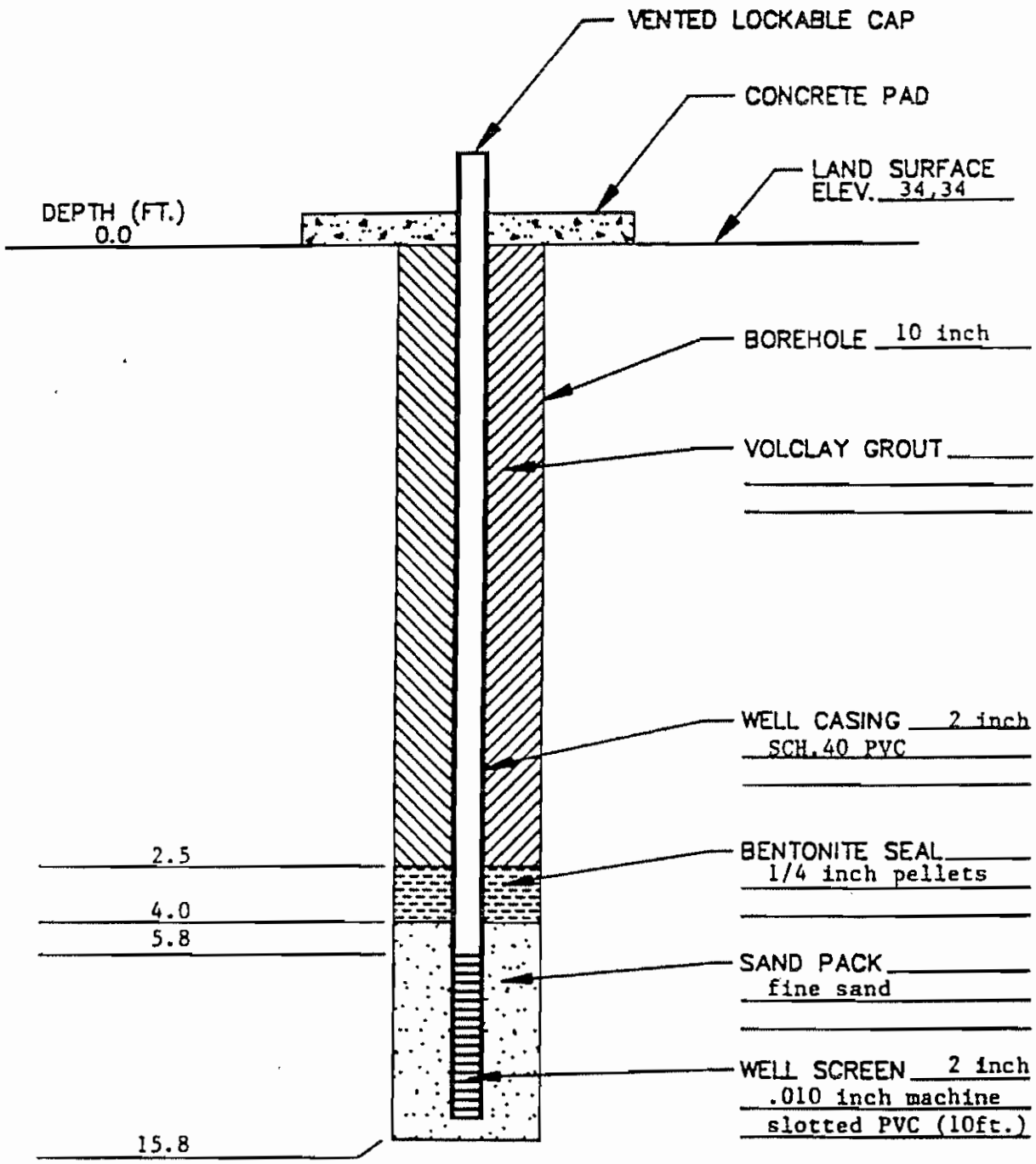
PROJECT NO. 467.42

WELL NO. OW-6 DATE INSTALLED 4/24/90

DRILLING CONTRACTOR Law Engineering

RMT GEOLOGIST B. Grothaus

RMT INC



OBSERVATION WELL CONSTRUCTION DIAGRAM

Not To Scale

PROJECT Weyerhaeuser

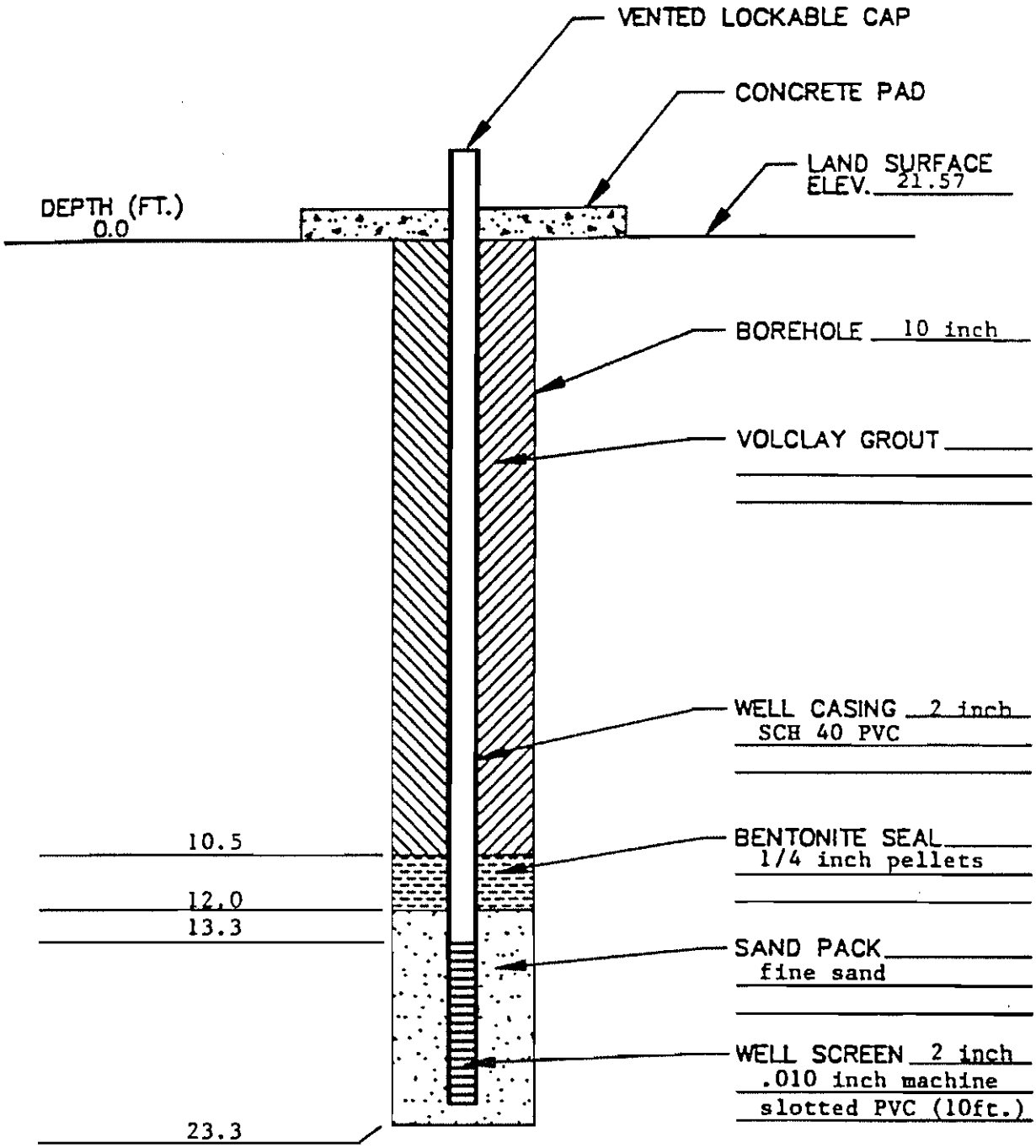
PROJECT NO. 467.42

WELL NO. OW-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.

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

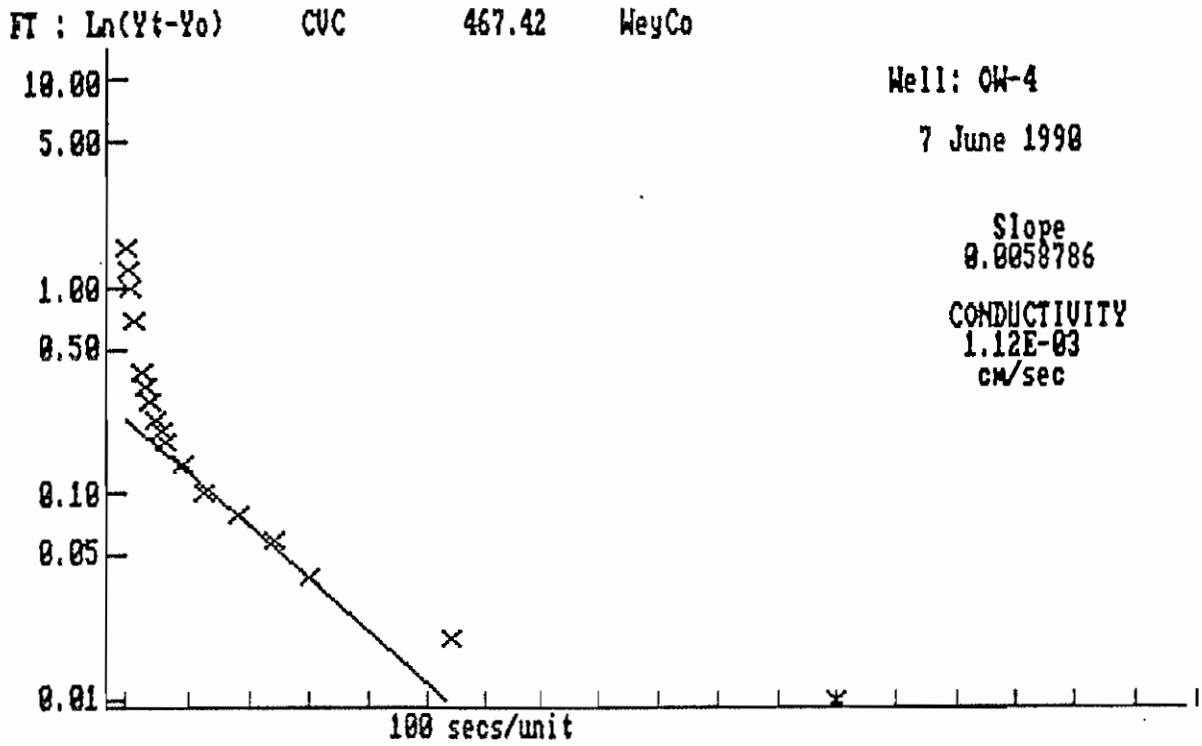
---

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
Well: OW-4
7 June 1990
Slope
0.0058786
CONDUCTIVITY
1.12E-03
cm/sec
10.00
5.00
1.00
0.50
0.10
0.05
0.01
100 secs/unit

RMT, INC.

HYDROCON - 1.01
HYDRAULIC CONDUCTIVITY
Bouwer and Rice Method

Well: OW-5

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): 4.49
L - SCREEN LENGTH (FT): 10
H - SCREEN BASE TO WATER TABLE (FT): 9.61
START TIME (H,M,S): 0,0,0

Rc - WELL RADIUS (IN): 1
D - AQUIFER THICKNESS (FT): 9.61
STATIC WATER LEVEL READING (FT): 14

Rc was corrected for response in well screen filter material to 2.598 inches

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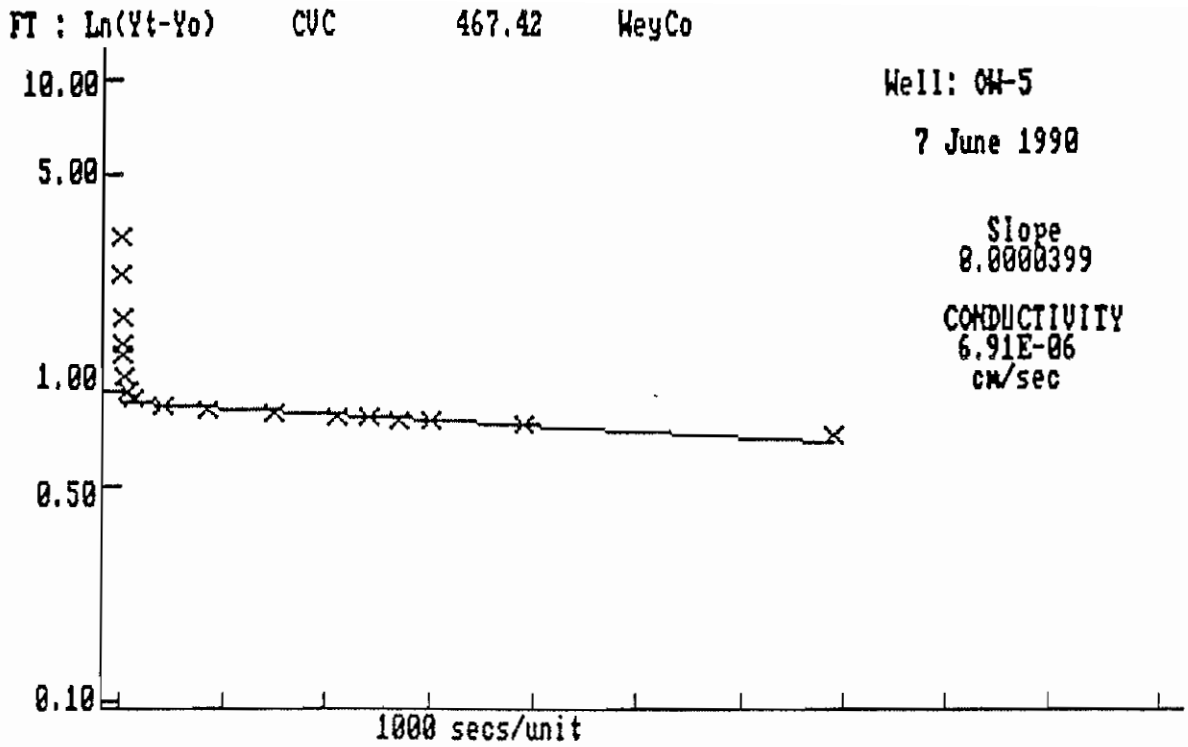
TIME (H,M,S)	DEPTH (FT)
0,0,0	17.1
0,0,6	16.36
0,0,15	15.73
0,0,21	15.44
0,0,25	15.3
0,0,35	15.12
0,1,5	15
0,2,0	14.95
0,7,0	14.9
0,14,0	14.87
0,25,0	14.85
0,35,0	14.83
0,40,0	14.82
0,45,0	14.81
0,50,0	14.8
1,5,0	14.79
1,55,0	14.73

(1/t) (ln(Yo/Yt))= 0.0000399

FULLY PENETRATING: C= 1.97

HYDRAULIC CONDUCTIVITY: 2.27E-07 ft/sec
6.91E-06 cm/sec


FT : Ln(Yt-Yo)
CVC
467.42
WeyCo
10.00
5.00
1.00
0.50
0.10
1000 secs/unit
Well: OW-5
7 June 1990
Slope
0.0000399
CONDUCTIVITY
6.91E-06
cm/sec

RMT, INC.

HYDROCON - 1.01
HYDRAULIC CONDUCTIVITY
Bouwer and Rice Method

Well: OW-6

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): 1.31
L - SCREEN LENGTH (FT): 10
H - SCREEN BASE TO WATER TABLE (FT): 1.35
START TIME (H,M,S): 0,0,0

Rc - WELL RADIUS (IN): 1
D - AQUIFER THICKNESS (FT): 6.85
STATIC WATER LEVEL READING (FT): 26.95

Rc was corrected for response in well screen filter material to 1.102 inches

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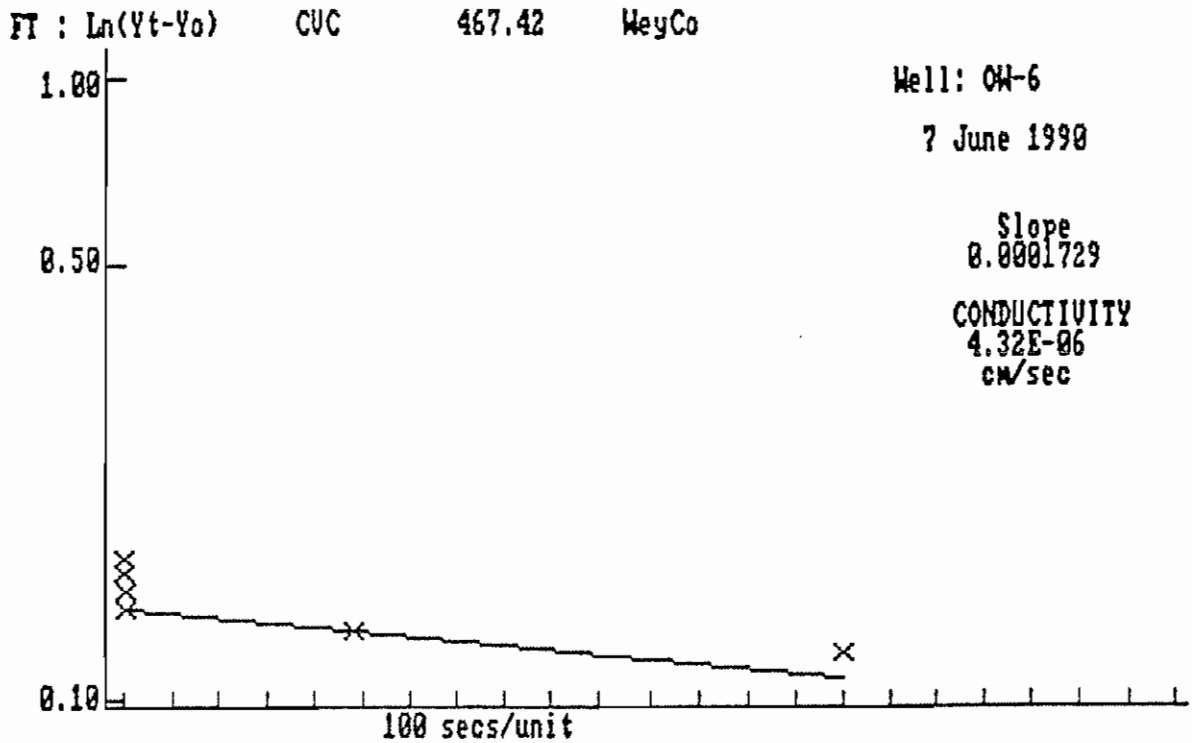
TIME (H,M,S)	DEPTH (FT)
0,0,0	27.12
0,0,1	27.11
0,0,2	27.1
0,0,3	27.09
0,8,0	27.08
0,25,0	27.07

(1/t) (ln(Yo/Yt))- 0.0001729

PARTIALLY PENETRATING: A- 4.15 B- 0.75

HYDRAULIC CONDUCTIVITY: 1.42E-07 ft/sec
4.32E-06 cm/sec


FT : Ln(Yt-Yo)
CVC
467.42
WeyCo
1.00
0.50
0.10
100 secs/unit
Well: OW-6
7 June 1990
Slope
0.0001729
CONDUCTIVITY
4.32E-06
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

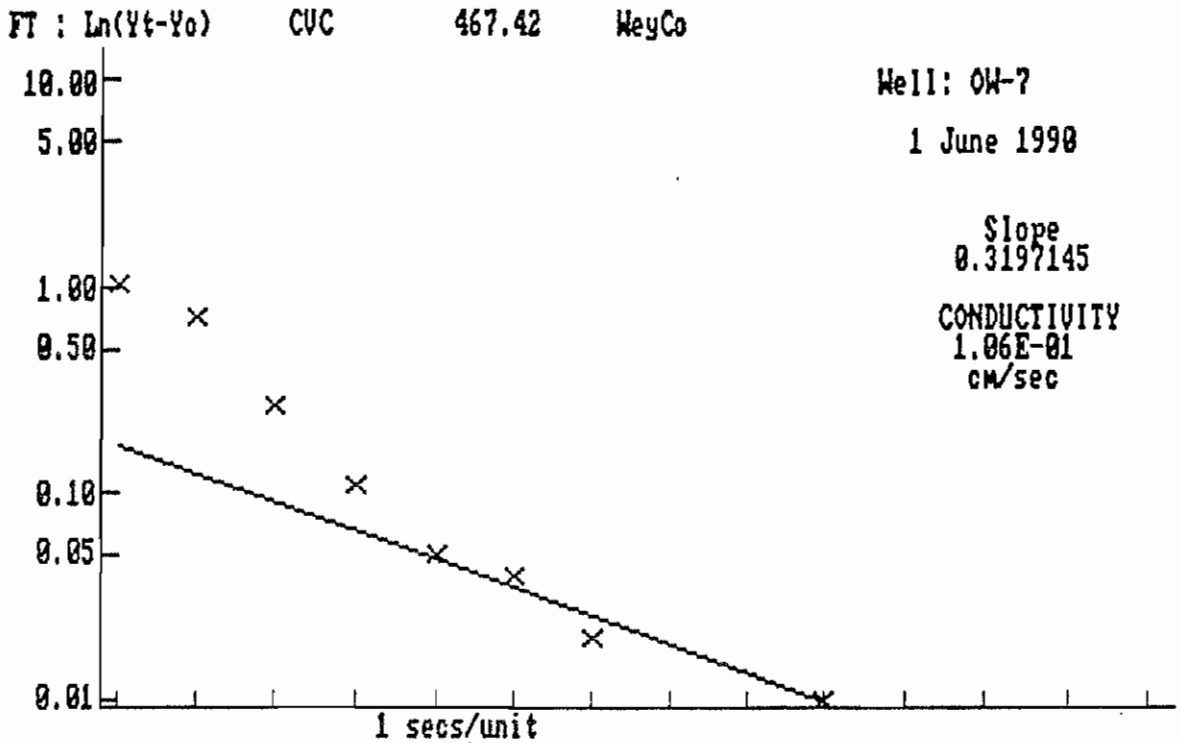
---

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
Well: OW-7
1 June 1990
Slope
0.3197145
CONDUCTIVITY
1.06E-01
cm/sec
10.00
5.00
1.00
0.50
0.10
0.05
0.01
1 secs/unit

DESIGN SHEET

Project/Proposal Name	Prepared: By:	Date:	Checked: By:	Date:	Project/Proposal No.
Weyerhaeuser	JAF	9/13/99	[illegible]	9/23/99	5101.01

The following calculations result in an estimate of the vertical thickness of constituents following migration from the up-gradient to the down-gradient end of the Phase 1 landfill. This is accomplished by using the average linear groundwater velocity in conjunction with vertical dispersivity with a normal distribution of constituents. The vertical thickness of constituents is equivalent to the aqufier thickness over which mixing would occur

Governing Equations

Average Linear Groundwater Velocity

$$\bar{v} = \frac{K \, dh/dx}{n}$$

Dispersion

$$\sigma^2 = 2Dt$$

$$D = \alpha \bar{v}$$

Parameters

v		L/t	Average linear groundwater velocity
K	2.44×10^{-4} 4.80×10^{-4}	cm/sec ft/min	Hydraulic conductivity - Geometric mean of OW-4, OW-5, OW-6, and OW-7
n	0.22	dimensionless	Porosity - Average value for silty sand
dh/dx	0.013	ft/ft	Hydraulic gradient - in the vicinity of Phase 1 - 4/93
σ^2		L	Variance - Variance of constituent concentration as a function of the distance of the center of mass
D		L^2/t	Dispersion coefficient
α	0.005	ft	Dispersivity - Aquifer property (vertical direction) Typical value for silty sand (Garabedian, et al. [1991])

Calculations

Average Linear Groundwater Velocity

$$v = \frac{4.80 \times 10^{-4} \text{ ft/min } (0.013 \text{ ft/ft})}{0.22}$$

$= 2.8 \times 10^{-5}$ ft/min; v = 0.0409 ft/day

Travel Time From End to End of Phase 1

t = x / v

x - Length of Phase 1 foot-print

$$t = \frac{1{,}100 \text{ ft}}{0.0409 \text{ ft/d}}$$

v - Average linear groundwater velocity

t = 26,894 days

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DESIGN SHEET

Project/Proposal Name	Prepared: By:	Date:	Checked: By:	Date:	Project/Proposal No.
Weyerhaeuser	JAF	9/22/99	DJK	9/23/99	5101.01

Calculations (Cont')

Variance

σ^2 = 0.005 ft x (0.0409 ft/d)x (2) x (26,894 d)

σ^2 = 11 ft^2

σ = 3.32 ft

The variance is a measure of spread (in the vertical direction) of constituents in groundwater following 1,100 feet of migration. The square root of the variance is the standard deviation. Three standard deviations will encompass 99 percent of the mass, assuming a normal distribution. Therefore three standard deviations, or 9.96 feet, would be the aquifer thickness over which constituents have spread. This aquifer thickness is equivelent to th mixing zone thickness.

DESIGN SHEET

Project/Proposal Name	Prepared: By:	Date:	Checked: By:	Date:	Project/Proposal No.
Weyerhaeuser - Plymouth	JAF	9/22/99	RJK	9/23/99	5101.01

Mass Balance Calculations: (Single Composite Liner)

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	2.44×10^{-4} 4.80×10^{-4}	cm/sec ft/min	Geometric mean of OW-4 , OW-5, OW-6 and OW-7
r	0.205 4.71×10^{-6}	ft^3/acre/yr ft/yr	HELP model output with open configuration
A_1	14.37 6.26×10^5	acres ft^2	Area of Phase 1 foot-print
A_2	1776	ft^2	Cross sectional area perpendicular to groundwater flow assuming a 3.32 foot thick mixing zone (33% of mixing thickness) with the 535 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:

$$Q_R = 4.71 \times 10^{-6}\ ft/yr\ (6.26 \times 10^5\ ft^2)$$

$$Q_R = 2.95\ ft^3/yr\ ;\ 5.61 \times 10^{-6}\ ft^3/min$$

$$Q_{GW} = 4.80 \times 10^{-4}\ ft/min\ (0.013\ ft/ft)\ (1776\ ft^2)$$

$$Q_{GW} = 0.0111\ ft^3/min$$

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DESIGN SHEET

Project/Proposal Name	Prepared: By:	Date:	Checked: By:	Date:	Project/Proposal No.
Weyerhaeuser - Plymouth	JAF	09/22/99	[illegible]	9/23/99	5101.01

Calculations: (Single Composite Liner)

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

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

Assuming upgradient groundwater is clean; Ca=0

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

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

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

$$C_P / 2L = \frac{5.61 \times 10^{-6}\ ft^3/min + 0.0111\ ft^3/min}{5.61 \times 10^{-6}\ ft^3/min}$$

$$C_P / 2L = 1.98 \times 10^3$$

The landfill leachate concentration can be 3 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

$$C_{GW} = \frac{5.61 \times 10^{-6}\ ft^3/min\ (15\ ppm)}{5.61 \times 10^{-6}\ ft^3/min + 0.0111\ ft^3/min}$$

$$C_{GW} = 7.58 \times 10^{-3}\ ppm$$

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DESIGN SHEET

Project/Proposal Name	Prepared: By:	Date:	Checked: By:	Date:	Project/Proposal No.
Weyerhaeuser - Plymouth	JAF	1/14/99	RJK.	9/23/99	5101.01

Mass Balance Calculations: (Dual Composite Liner)

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	2.44×10^{-4}	cm/sec	Geometric mean of OW-4 , OW-5, OW-6 and OW-7
	4.80×10^{-4}	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	1660	ft^2	Cross sectional area perpendicular to groundwater flow assuming a 3.32 foot thick mixing zone (33% of mixing thickness) 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:

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

$$Q_R = 0.127\ ft^3/yr\ ;\ 2.41 \times 10^{-7}\ ft^3/min$$

$$Q_{GW} = 2.44 \times 10^{-4}\ ft/min\ (0.013\ ft/ft)\ (1660\ ft^2)$$

$$Q_{GW} = 5.27 \times 10^{-3}\ ft^3/min$$

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DESIGN SHEET

Project/Proposal Name	Prepared: By:	Date:	Checked: By:	Date:	Project/Proposal No.
Weyerhaeuser - Plymouth	JAF	09/22/99	DJK	9/23/99	5101.01

Calculations: (Dual Composite)

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

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

Assuming upgradient groundwater is clean
Ca = 0

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

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

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

$$C_P / 2L = \frac{2.41 \times 10^{-7}\ ft^3/min + 5.27 \times 10^{-3}\ ft^3/min}{2.41 \times 10^{-7}\ ft^3/min}$$

$$C_P / 2L = 2.19 \times 10^4$$

The landfill leachate concentration can be 4 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

$$C_{GW} = \frac{2.41 \times 10^{-7}\ ft^3/min\ (15\ ppm)}{2.41 \times 10^{-7}\ ft^3/min + 5.27 \times 10^{-3}\ ft^3/min}$$

$$C_{GW} = 6.89 \times 10^{-4}\ ppm$$

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

NORTH CAROLINA DEPARTMENT OF
ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF WASTE MANAGEMENT

April 29, 1999

Joseph W. Kloeker, Environmental Director
Weyerhaeuser Company
P. O. Box 787
Plymouth, North Carolina 27962

Re: No., Weyerhaeuser Company.

Dear Mr. Kloeker,

A review of the alternate liner design demonstration has been completed by the Solid Waste Section for the proposed Weyerhaeuser No. 3 landfill. The submitted plan provides a mass balance demonstration to show the liner system is protective of groundwater. The model appears to be in order, however, some clarification needs to be provided. Please respond to the following comments and questions.

There appears to be an error on page 2 for the unit between the geocomposite drainage layer and the geosynthetic clay liner.

Please expand on the comment in the cover letter that the primary liner was considered a single liner.

Typically 8 holes per acre is the minimum input parameter required when using the HELP model for the installed liner.

Why was two feet of waste chosen for the HELP model input parameter? How was the evaporative zone depth of 22 inches chosen? Is the leakage rate near steady state?

The HELP model requires climatological data to generate the leakage/percolation values. It appears evapotranspiration and weather data were obtained from Raleigh, North Carolina. Raleigh is in the piedmont physiographic province while Plymouth is in the coastal plain physiographic province. Norfolk, Virginia is also in a coastal plain and has a climate similar to Plymouth. Use a location that provides as close a match as possible.

The raw historic groundwater levels in Attachment 9 have several headings. Does the MP elevation indicate the monitoring point? If so, why does the monitoring point change? Does the D in the depth to water column mean the

401 OBERLIN ROAD, SUITE 150, RALEIGH, NC 27605

piezometer was dry at the time of reading? Are some of the columns reversed between Depth to Water and Water Elevation?

The two aquifer units are reported to be separated by an aquitard. The cross-sections and boring logs support the north-south component of the silty-clay unit however, the boring logs provided do not have enough depth to validate the east-west component. Provide the boring logs and test pits.

Only OW-4 is located in the vicinity of the Phase 1 landfill. OW-7 is over 1200 feet from the cell footprint shown on the Data Point Location Map. Was OW-7 intended to be MW-7?

OW-7 is not shown on Attachment 2.

Are the groundwater contours on Attachment 2 from a single day reading event? A drainage feature was restored on the eastern boundary of the site. Has there been any notable change in the groundwater table? Will it affect any portion of Phase 1?

A mixing zone thickness of 10 percent of the aquifer saturated thickness was chosen. What criteria was used to determine the 10 percent assignment?

Provide the formula used to calculate the hydraulic conductivity.

The proposed Weyerhauser industrial landfill alternate liner demonstration provides part of the requirement for rule .0503 (2)(d)(ii)(A). Response comments for this memo may be included with the site application submittal.

If you have any questions regarding this memo, please contact me at (919) 733-0692, extension 346.

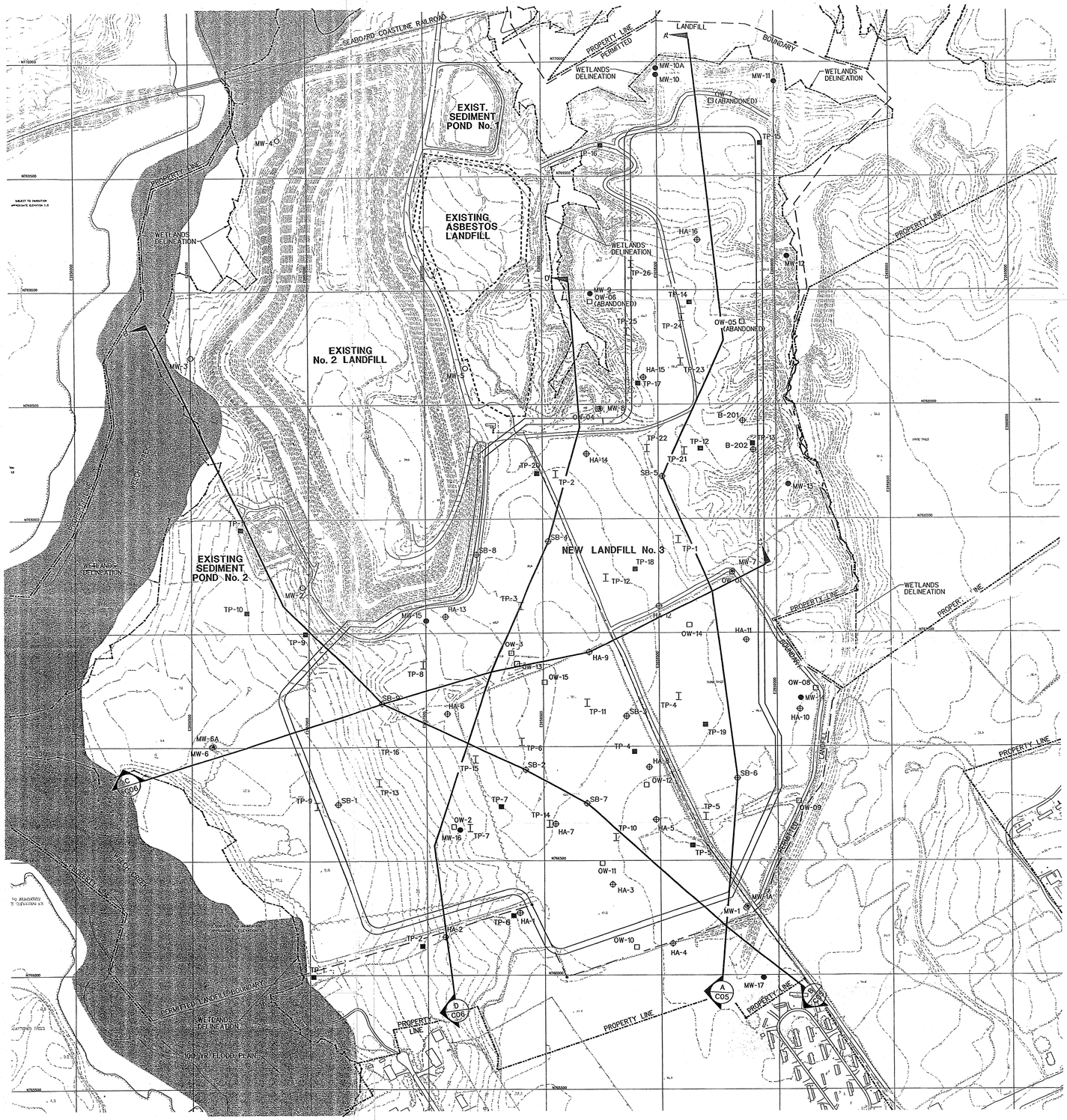
Sincerely,

Cheryl Marks

Cheryl Marks
Hydrogeologist
Solid Waste Section

cc: Sherri Coghill, Solid Waste Section
Jim Coffey, Solid Waste Section
Bobby Nelms, SWS Washington
R. Kent Nilsson, RMT Inc.

\cad\civil\weyerhae\510101c\ datapnt.map
jb 4-10-00



NOTES:

1. REFER TO DRAWING NO. 510101-C01 FOR STANDARD LEGEND, ABBREVIATIONS AND GENERAL NOTES.

0 200' 400' 600' 800'
SCALE: 1" = 200'

NOT FOR CONSTRUCTION

NOTE: THESE PLANS ARE ACCOMPANIED BY A CONSTRUCTION PLAN APPLICATION OF THE THE SAME TITLE. THESE DOCUMENTS ARE INTERRELATED AND ARE INTENDED TO BE USED AND REVIEWED TOGETHER. THESE DOCUMENTS ARE INTENDED FOR REGULATORY PURPOSES ONLY.

DATE		BY	CK.	APVD.	NO.	DATE		BY	CK.	APVD.	NO.	DATE		BY	CK.	APVD.
4-10-00	ADDED B-201 AND B-202	DMC	DOM	RKN												
3-7-00	ISSUED FOR REGULATORY REVIEW	DMC	DOM	RKN												
3-3-00	ISSUED FOR REGULATORY REVIEW	DMC	DOM	RKN												
9-24-99	ISSUED FOR REGULATORY APPROVAL	DMC	EWT	RKN												
7-9-99	ISSUED FOR CLIENT REVIEW	DMC	EWT	RKN												

NORTH CAROLINA PROFESSIONAL ENGINEER No. 17543 R. KENT NILSON 4/10/00

Weyerhaeuser
PLYMOUTH, NORTH CAROLINA

PROJECT MGR:	RKN
DESIGNED BY:	DMC/SYK/EWT
DRAWN BY:	DMC
CHECKED BY:	SYK
APPROVED BY:	
APPROVED BY:	
APPROVED BY:	
DATE:	SEPTEMBER, 1999
JOB NO:	5101.01

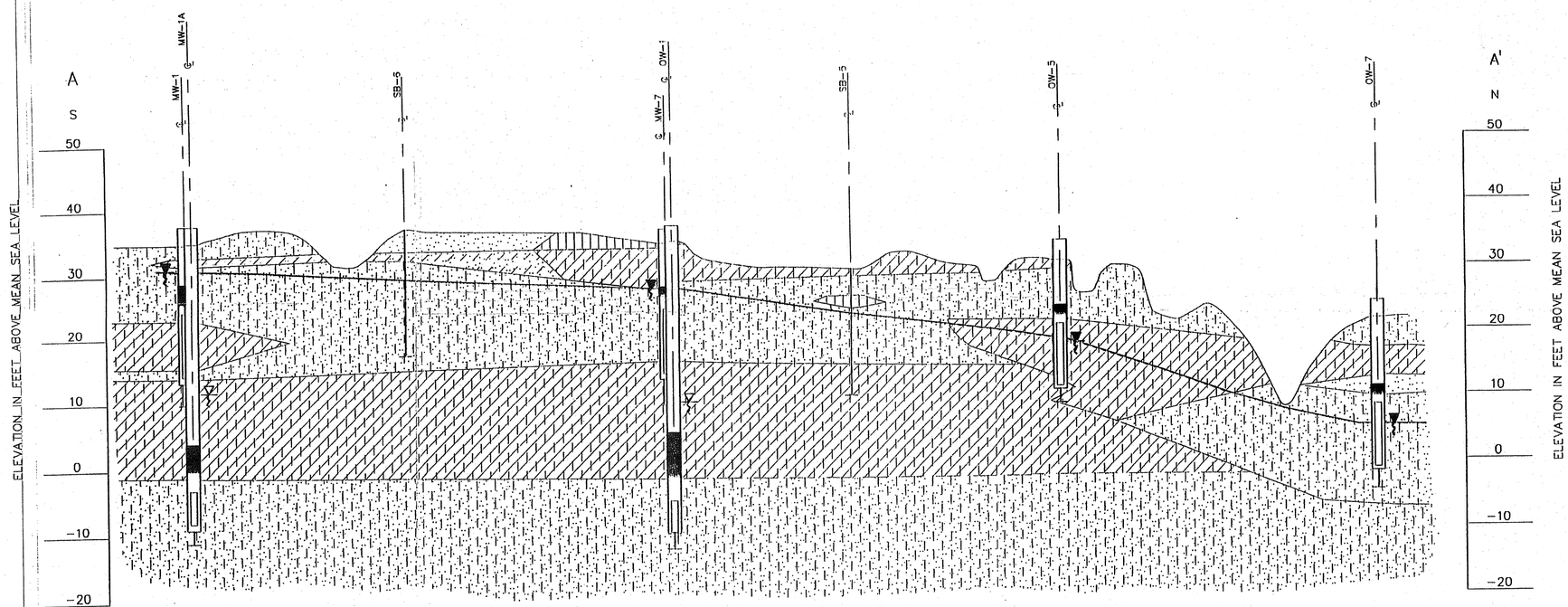
RMT
RMT North Carolina, Inc.

CONSTRUCTION PLAN APPLICATION - LANDFILL No. 3
DATA POINT LOCATION MAP

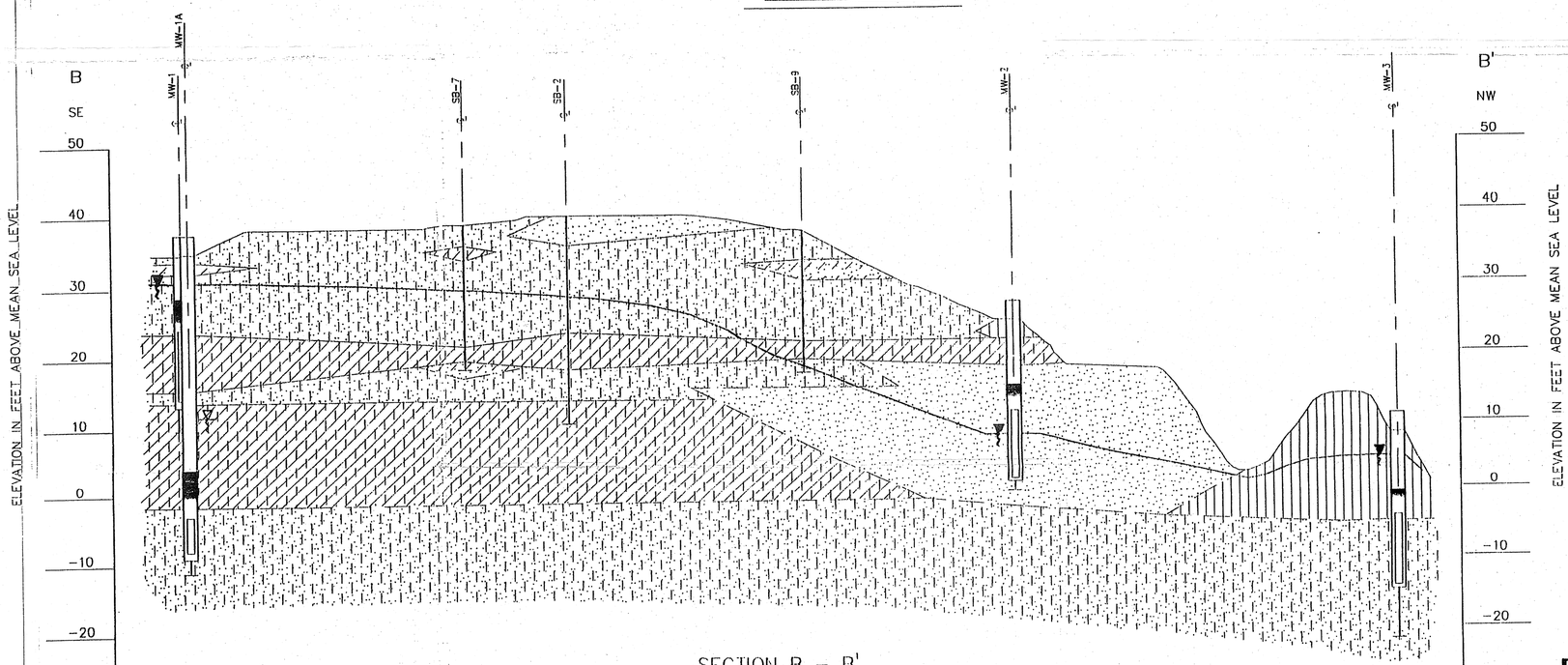
SCALE		DRAWING NO.	REV.
AS SHOWN		510101-C02	E

NOT FOR CONSTRUCTION

46742X01



SECTION A – A'



SECTION B – B'

LEGEND

- WELL SCREEN AND BENTONITE SEAL
- WATER TABLE SURFACE (JUNE, 1990)
- POTENTIOMETRIC SURFACE (JUNE, 1990)
- SILTY CLAY – SOFT TO STIFF; OCCASIONAL TRACE FINE TO MEDIUM GRAINED SAND. DEEP CLAYS ARE USUALLY MICACEOUS WITH SOME SAMPLES TESTED AS CLAYEY SILTS
- SILT – OFTEN CLAYEY; OCCASIONAL ORGANIC MATERIAL
- CLAYEY SAND – MOST FINE GRAINED; OFTEN SILTY
- SILTY SAND – MOST FINE GRAINED; OCCASIONAL CLAY WITH FRAGMENTED SHELL ZONES AND POORLY GRADED SAND ZONES
- POORLY GRADED SAND – USUALLY FINE GRAINED; OCCASIONAL THIN CLAYEY ZONES

HORIZONTAL SCALE: 1" = 200'
VERTICAL EXAGGERATION: 20X

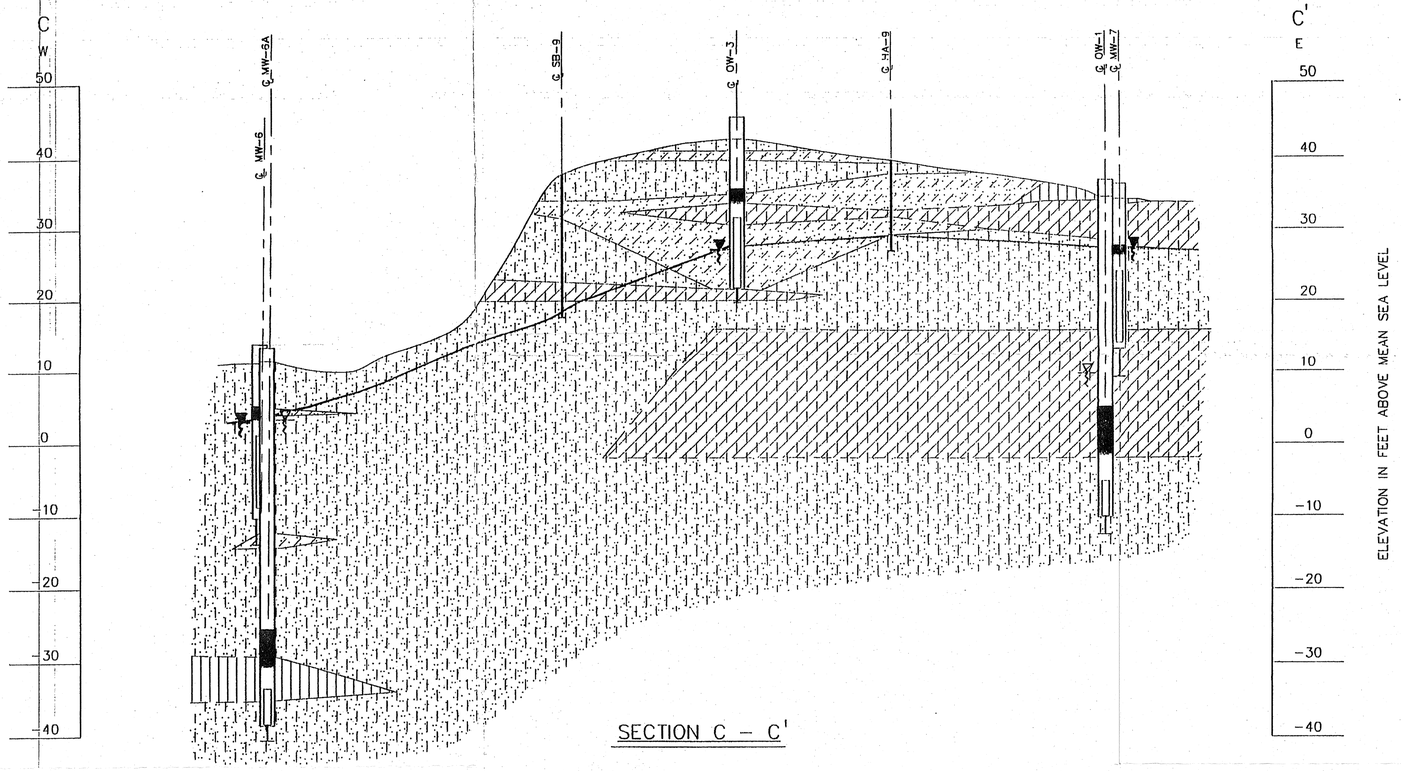
PROJECT MGR:	M.S.T.
PREPARED BY:	B.T.G.
DRAWN BY:	M.P.K.
CHECKED BY:	B.T.G.
APPROVED BY:	DEMC
APPROVED BY:	WJG
APPROVED BY:	MMT
DATE:	JULY, 1990
JOB NO:	467.42

RMT INC.
100 Verdae Boulevard
PO Box 16778
Greenville, SC 29606
(803)281-0030

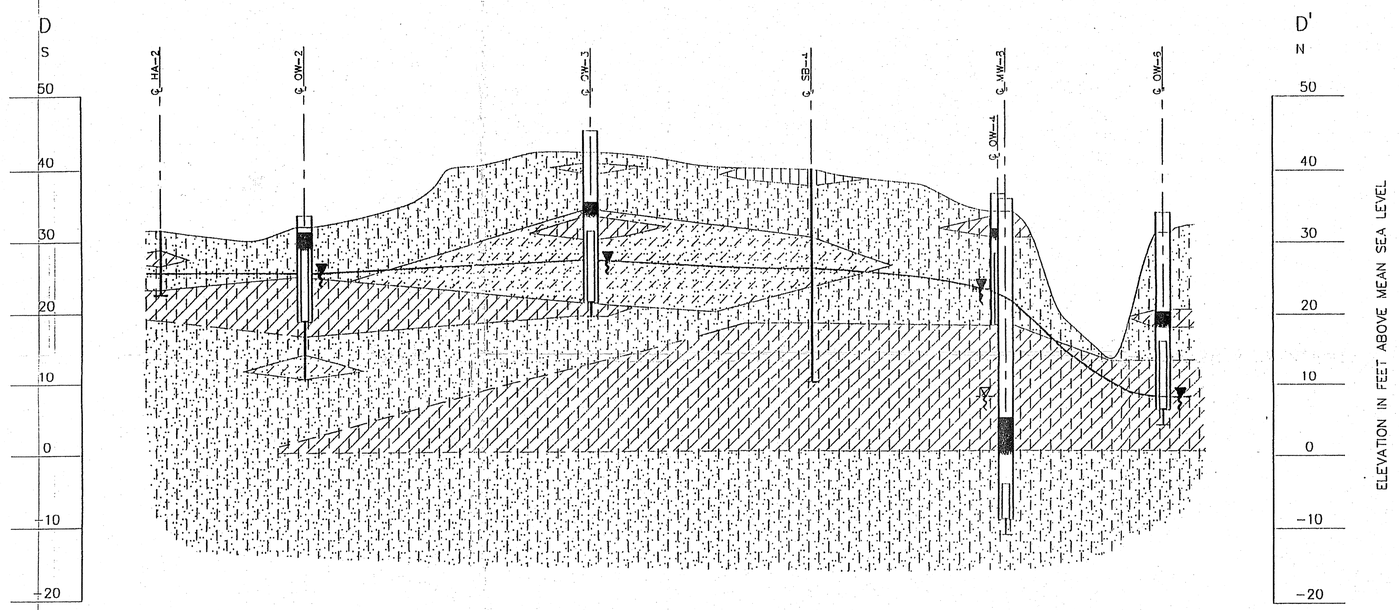
HYDROGEOLOGIC CROSS SECTIONS A–A' AND B–B'
WEYERHAEUSER PLYMOUTH, NC

SCALE	SHEET	PLAN NO.
AS SHOWN		2

46742X02



SECTION C – C'



SECTION D – D'

LEGEND

WELL SCREEN AND BENTONITE SEAL

WATER TABLE SURFACE (JUNE, 1990)

POTENTIOMETRIC SURFACE (JUNE, 1990)

SILTY CLAY – SOFT TO STIFF; OCCASIONAL TRACE FINE TO MEDIUM GRAINED SAND. DEEP CLAYS ARE USUALLY MICACEOUS WITH SOME SAMPLES TESTED AS CLAYEY SILTS

SILT – OFTEN CLAYEY; OCCASIONAL ORGANIC MATERIAL

CLAYEY SAND – MOST FINE GRAINED; OFTEN SILTY

SILTY SAND – MOST FINE GRAINED; OCCASIONAL CLAY WITH FRAGMENTED SHELL ZONES AND POORLY GRADED SAND ZONES

HORIZONTAL SCALE: 1" = 200'
VERTICAL EXAGGERATION: 20X

PROJECT MGR:	M.S.T.
PREPARED BY:	B.T.G.
DRAWN BY:	D.K.J.
CHECKED BY:	B.T.G.
APPROVED BY:	DEMC
APPROVED BY:	WJG
APPROVED BY:	WH
DATE:	JULY, 1990
JOB NO:	467.42

RMT INC.
100 Verdae Boulevard
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Greenville, SC 29606
(803)281-0030

HYDROGEOLOGIC CROSS SECTIONS C–C' AND D–D'

WEYERHAEUSER PLYMOUTH, NC

SCALE	SHEET	PLATE NO.
AS SHOWN		3

Appendix H
Leachate Line Hydraulic Calculations and Drainage Layer Equivalency Report

Attachment H1 **Leachate Line Hydraulic Calculation**

Attachment H2 **Drainage Layer Equivalency Report**

Attachment H1
Leachate Line Hydraulic Calculation

DESIGN SHEET

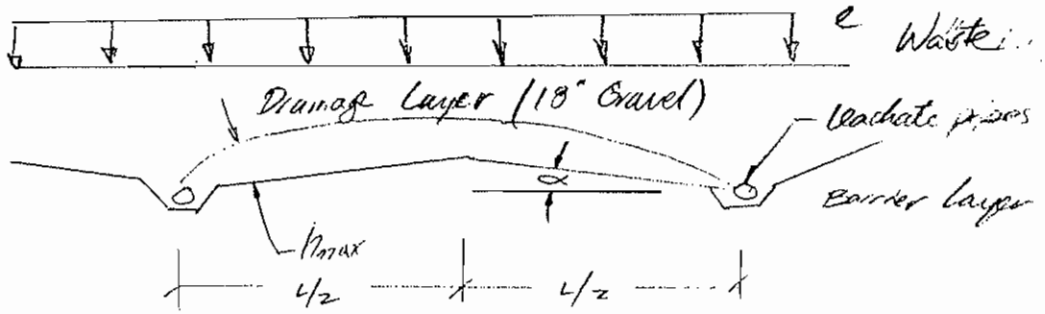
RMT INC.

SHEET 1 OF 3

1054 Claussen Road Suite 306 Augusta, GA 30907-3215 Phone: 706-737-6026 FAX: 706-737-5962

PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
Weyerhaeuser - Plymouth	BWT	9/9/99	RKN	6/10/99	5101.01

Determine minimal allowable spacing for leachate collection pipes given LF configuration. NCDENR regs require maximum head on liner not to exceed 1 foot.



① Use the following equation (Moore) to determine L/2:

$$h_{max} = (L/2)\left[\left(\tan^2\alpha + \frac{e}{K_d}\right)^{1/2} - \tan\alpha\right]$$

where, e = infiltration rate (peak monthly precip in in/day)
K_d = hydraulic conductivity of drainage layer
α = slope between leachate collection pipes.

② Determine e, infiltration rate:

Infiltration rate shall equal peak monthly precipitation = 14.95 inches

$$e = \frac{14.95 \text{ inches}}{\text{month}} \cdot \frac{1 \text{ month}}{28 \text{ days}} = 0.53 \frac{\text{in}}{\text{day}}$$

③ Determine lateral hydraulic conductivity, K_d

From HELP Model, $K_d = 0.3 \frac{\text{cm}}{\text{sec}} \cdot \frac{1 \text{ in}}{2.54 \text{ cm}} \cdot \frac{86{,}400 \text{ sec}}{1 \text{ day}} = 1.02 \times 10^4 \frac{\text{in}}{\text{day}}$

DESIGN SHEET

RMT INC.

SHEET 2 OF 3

1054 Claussen Road Suite 306 Augusta, GA 30907-3215 Phone: 706-737-6026 FAX: 706-737-5962

PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
Weyerhaeuser - Plymouth	EWT	9/9/99	DKN	6/10/99	5101.01

(4) Determine α, slope angle between crest and trough of landfill base.

$$\alpha_1 = \tan^{-1}\frac{2}{100} = 1.15^\circ \qquad \alpha_2 = \tan^{-1}\frac{1}{120} = 0.5^\circ$$

$$\alpha_3 = \tan^{-1}\frac{6}{100} = 3.43^\circ \qquad \alpha_4 = \tan^{-1}\frac{1}{240} = 0.24$$

(5) Using h_{max} = 12 inches, solve for $L/2_{max}$ using Moore equation:

$$\frac{L}{2_{max}} = \frac{h_{max}}{\left(\tan^2\alpha + \frac{e}{K_d}\right)^{1/2} - \tan\alpha}$$

$$\frac{L}{2_{max}} = \frac{12 \text{ inches}/12}{\left(\tan^2(1.15) + \frac{0.53 \text{ in/day}}{19205 \text{ in/day}}\right)^{1/2} - \tan 1.15}$$

$$\frac{L}{2_{max}} = \frac{12 \text{ inches}}{0.0201 - 0.0201}$$

@ α_1 $\quad \frac{L}{2_{max}} = 797$ ft. → use 200'

@ α_2 $\quad \frac{L}{2_{max}} = \frac{12/12}{\left(\tan^2(0.5) + \frac{0.53}{10205}\right)^{1/2} - \tan 0.5} = 386$ feet → use 200'

@ α_3 $\quad \frac{L}{2_{max}} = \frac{12/12}{\left(\tan^2(3.43) + \frac{0.53}{10205}\right)^{1/2} - \tan 3.43} = 2316$ feet → use 200'

DESIGN SHEET

RMT INC.
1054 Claussen Road Suite 306 Augusta, GA 30907-3215 Phone: 706-737-6026 FAX: 706-737-5962

PROJECT/PROPOSAL NAME	PREPARED By:	PREPARED Date:	CHECKED By:	CHECKED Date:	PROJECT/PROPOSAL NO.
Weyerhaeuser Plymouth	EMT	9/9/99			5101.01

@ α_4 $\frac{L}{2\ max} = \frac{12/12}{\left(\tan^2(0.24) + \frac{0.53}{10{,}205}\right)^{1/2} - \tan 0.24}$ = 241 feet

Lo In Phase 1, spacing is 240 feet

OK

DESIGN SHEET

Project/Proposal Name	Prepared:		Checked:		Project/Proposal No.
Weyco Plymouth	By:	Date:	By:	Date:	
	EWT	9/24/99	JA	9/24/99	5101.08

Determine leachate collection pipe size, pump and discharge pipe size, and force main size for Landfill No. 3 using the following:

1. HELP Model inputs for leachate amounts
2. Bernoulli equation for velocity, flow rate and head losses - utilizing spreadsheet
3. Flowmaster program
4. NC DEHNR regulations for landfill construction

1. Leachate amounts

From HELP Model generated by Sharon Korleski dated 5/11/99, attached spreadsheet tab entitled "HELP Results" was created. Leachate amounts for various heights of waste were calculated. To be conservative, and because waste height did not impact leachate volumes significantly, average daily flow and one peak daily flow was selected regardless of waste height. The per acre leachate volumes

Design Average Daily Flow: 1,531 gpdpac
Design Peak Daily Flow: 9,238 gpdpac

2. Leachate collection pipe size

From page 110 of NC DEHNR regs, leachate piping to have a minimal nominal diameter of 6". Check 6" pipe size for worst case flow (Phase 1) using Flowmaster program (output attached).

Using:
slope, S = 0.016 ft/ft
Mannings coefficient, n = 0.009
pipe diameter, D = 5.3 inches flowing full (using SDR 17 pipe)
Q max = 420.34 gpm > peak daily flow in any phase (e.g., Phase 1 = 94 gpm)

3. Pump, riser pipe and force main sizes

Select the above sizes based on design flow o 9,238 gpdpac. From spreadsheet tab entitled "HELP Results", flow per phase is calculated and a pump size is estimated. For the pump sizes, two scenarios are run utilizing:

a. The peak daily flow per pump
b. The "worst case flow" where pumps are run at capacity

For the force main, 4 scenarios are run based on flow from combined phases:

a. The peak daily flow from the landfill (185 gpm)
b. The "worst case flow" where Drainage Area 1 pumps are run at capacity (600 gpm)
c. The "worst case flow" where Drainage Area 2 pumps are run at capacity (400 gpm)
d. The "worst case flow" where Phase 3, 4, 5 and 6 pumps are run at capacity (320 gpm)

DESIGN SHEET

Project/Proposal Name	Prepared:		Checked:		Project/Proposal No.
Weyco Plymouth	By:	Date:	By:	Date:	
	EWT	9/24/99	JA	9/24/99	5101.08

Methodology

A. The spreadsheet tabs are linked such that flow rates are input into each of the tabs to calculate the head loss per foot utilizing Bernoulli's equation. For example, in tab "FM":

Flow rate = 185 gpm
viscosity = 1
spec. gravity = 1
spec. roughness = 5 x 10-6 for HDPE pipe
pressure drop/100 feet = 0.3010 ft for 6 inch pipe

B. Equivalent feet for each drainage area are then calculated using attached manhole detail as a "go-by". Pipe lengths are obtained from the leachate piping plan.

C. Values are summarized in a tabs entitled "Summary" and "Worst Case Summary". In both of these tabs, total equivalent feet is multiplied by head loss/100 feet to calculate the dynamic head. Static head is input based on the grading plan. Total head is then calculated by adding the dynamic and static head.

D. Using attached EPG pump curves, and worst case flow rate and head from "Worst Case Summary" Tab, a pump model is selected.

Worst Case Flow:	60	gpm @	147	feet of head
Worst Case Flow:	80	gpm @	92	feet of head

Add 10% on to head to compensate for smaller schedule 80 pipe thickness versus SDR 11

Worst Case Flow:	60	gpm @	162	feet of head
Worst Case Flow:	80	gpm @	101	feet of head

For all phases, select EPG Model WSD15-7

From pump curve sheet, WSD12-8 pump dimensions:

Length:	70.75 inches	5.9 feet
Diameter:	7.56 inches	0.6 feet
Outlet Diameter:	2 inches	0.2 feet

DESIGN SHEET

Project/Proposal Name	Prepared:		Checked:		Project/Proposal No.
Weyco Plymouth	By:	Date:	By:	Date:	
	EWT	9/24/99	JA	9/24/99	5101.08

Determine the time for Phases 1 and 2 to dewater given 25 year, 24 hour storm event and leachate collection system capacity.

q (25 yr, 24 hr) =	7	inches
Phase 1 Area =	14.36	acres
Phase 2 Area =	14.51	acres
Total Area =	28.87	acres
Volume =	733,587	cf
Volume =	5,487,229	gallons

Assume the following pump system:

Phase 1:	3	primary pumps @	60 gpm
	3	secondary pumps @	60 gpm
Phase 2:	2	primary pumps @	60 gpm
	2	secondary pumps @	60 gpm

Total System Flow =	600	gpm
Total System Flow =	864,000	gpd
Dewatering Time =	6.4	days

Weyerhaeuser Plymouth
Help Model Results and Flow Estimates
RMT Job No. 05101.01
24-Sep-99

From HELP Model:	
Design Average Daily Flow:	1,531 gpdpac
Design Peak Daily Flow:	9,238 gpdpac

Drainage Area	Phase(s)	Area (ac)	Average Daily Flow[1] (gpd)	Peak Daily Flow[2] (gpd)	Average Daily Flow[3] (gpm)	Peak Daily Flow[4] (gpm)	No. of Primary Pumps[5]	Peak Daily Flow per Pump[6] (gpm)	Selected Pump Size (gpm)	Worst Case Flow Rate[7] (gpm)	Combined Worst Case Flow Rate[8] (gpm)
1	1	14.36	21,985	132,658	15	92	3	31	60	360	600
2	2	14.51	22,215	134,043	15	93	2	47	60	240	400
3	3, 4	11.49	17,591	106,145	12	74	1	74	80	160	320
4	5, 6	11.1	16,994	102,542	12	71	1	71	80	160	320
5	7, 8	10.63	16,275	98,200	11	68	1	68	80	160	320
6	9, 10	10.01	15,325	92,472	11	64	1	64	80	160	

Phase	Total Average Flow from LF[9] (gpd)	Total Peak Flow from LF[10] (gpd)	Total Average Flow from LF[11] (gpm)	Total Peak Flow from LF[12] (gpm)
1				
	44,200	266,701	31	185
2				
	39,806	240,188	28	167
3				
	34,585	208,686	24	145
4				
	33,269	200,742	23	139
5				
	31,600	190,672	22	132
6				

1. Average Daily Flow: Area x Design Average Daily Flow
2. Peak Daily Flow: Area x Design Peak Daily Flow
3. Average Daily Flow (gpm): Typical flow rate for each phase
4. Peak Daily Flow (gpm): Design flow rate for each phase
5. No.of Primary Pumps: Number of primary pumps (not back-up) per phase
6. Peak Daily Flow per Pump (gpm): Peak Daily Flow/No. of Primary Pumps
7. Worst Case Flow Rate (gpm): Flow rate if primary and secondary pumps were running at capacity
8. Combined Worst Case Flow Rate (gpm): Flow rate if adjacent phases are being pumped from at capacity (e.g., Phase 1 worst case flow + Phase 2 worst case flow)
9. Total Average Flow from LF: Combines phases to determine the flow from the landfill; flow assumed to be the same if phase open or full.
10. Total Peak Flow from LF: Combines phases to determine the flow from the landfill; flow assumed to be the same if phase open or full.
11. Total Peak Flow from LF (gpm): Typical flow rate for force main
12. Total Peak Flow from LF (gpm): Design flow rate for force main

LIQUID PRESSURE DROP CALCULATION

Service: Weyerhaueser Plymouth Landfill Design - Force Main
Material: Smooth HDPE

INPUT Assuming Phase 1 full and Phase 2 open

Fluid Name		Water
Flow	(gallons/minute)	185
Specific Gravity		1.00
Viscosity	(centipoise)	1.00
Roughness	(feet)	0.000005

OUTPUT

	Nom Size (inches)	Pipe Schedule	Press Drop/100 equiv.ft. (psi)	(ft.water)	Velocity (ft/sec)
	0.50	80	12940.1449	29891.7346	253.79
	0.75	80	2780.8937	6423.8645	137.42
	1.00	80	786.6173	1817.0859	82.61
	1.50	80	86.6403	200.1391	33.63
	2.00	80	24.8416	57.3841	20.12
	2.50	80	10.3470	23.9016	14.02
	3.00	80	3.5411	8.1799	9.00
>>>>>	4.00	80	0.9314	2.1515	5.17
>>>>>	6.00	80	0.1303	0.3010	2.28
	8.00	80	0.0340	0.0785	1.30
	10.00	80	0.0115	0.0266	0.83
	12.00	80	0.0050	0.0116	0.58
	14.00	80	0.0032	0.0074	0.48
	16.00	40	0.0013	0.0031	0.34
	18.00	30	0.0007	0.0016	0.26
	20.00	30	0.0004	0.0010	0.21
	24.00	30	0.0002	0.0004	0.14
	30.00	20	0.0001	0.0001	0.09

LIQUID PRESSURE DROP CALCULATION

Service: Weyerhaueser Plymouth Landfill Design - Force Main
Material: Smooth HDPE

INPUT Assuming worst case flow maximizing 10 pumps
(Phase 1: 3 primary and 3 secondary @ 60 gpm)
(Phase 2: 2 primary and 2 secondary @ 100 gpm)

Fluid Name		Water
Flow	(gallons/minute)	600
Specific Gravity		1.00
Viscosity	(centipoise)	1.00
Roughness	(feet)	0.000005

OUTPUT

	Nom Size (inches)	Pipe Schedule	Press Drop/100 equiv.ft. (psi)	(ft.water)	Velocity (ft/sec)
	0.50	80	127385.3671	294260.1981	822.16
	0.75	80	26646.6249	61553.7036	445.18
	1.00	80	7355.6962	16991.6583	267.62
	1.50	80	777.8385	1796.8070	108.93
	2.00	80	218.7665	505.3507	65.19
	2.50	80	90.0794	208.0834	45.42
	3.00	80	30.4610	70.3649	29.14
	4.00	80	7.9136	18.2804	16.74
>>>>>	6.00	80	1.0911	2.5206	7.38
>>>>>	8.00	80	0.2822	0.6519	4.22
	10.00	80	0.0949	0.2192	2.68
	12.00	80	0.0412	0.0951	1.89
	14.00	80	0.0262	0.0604	1.57
	16.00	40	0.0109	0.0252	1.09
	18.00	30	0.0058	0.0133	0.84
	20.00	30	0.0035	0.0081	0.68
	24.00	30	0.0014	0.0033	0.47
	30.00	20	0.0005	0.0011	0.29

LIQUID PRESSURE DROP CALCULATION

Service: Weyerhaueser Plymouth Landfill Design - Force Main
Material: Smooth HDPE

INPUT Assuming worst case flow maximizing 10 pumps
(Phase 1: 3 primary and 3 secondary @ 60 gpm)
(Phase 2: 2 primary and 2 secondary @ 100 gpm)

Fluid Name		Water
Flow	(gallons/minute)	400
Specific Gravity		1.00
Viscosity	(centipoise)	1.00
Roughness	(feet)	0.000005

OUTPUT

	Nom Size (inches)	Pipe Schedule	Press Drop/100 equiv.ft. (psi)	(ft.water)	Velocity (ft/sec)
	0.50	80	57571.4505	132990.0508	548.11
	0.75	80	12142.2388	28048.5715	296.79
	1.00	80	3378.8921	7805.2407	178.41
	1.50	80	362.5831	837.5670	72.62
	2.00	80	102.7309	237.3085	43.46
	2.50	80	42.4901	98.1522	30.28
	3.00	80	14.4356	33.3462	19.43
	4.00	80	3.7681	8.7043	11.16
>>>>>	6.00	80	0.5224	1.2067	4.92
>>>>>	8.00	80	0.1355	0.3130	2.81
	10.00	80	0.0457	0.1055	1.79
	12.00	80	0.0199	0.0459	1.26
	14.00	80	0.0126	0.0292	1.05
	16.00	40	0.0053	0.0122	0.73
	18.00	30	0.0028	0.0065	0.56
	20.00	30	0.0017	0.0039	0.45
	24.00	30	0.0007	0.0016	0.31
	30.00	20	0.0002	0.0005	0.19

Service: Weyerhaueser Plymouth Landfill Design - Force Main
Material: Smooth HDPE

INPUT Assuming worst case flow maximizing 10 pumps
(Phase 1: 3 primary and 3 secondary @ 60 gpm)
(Phase 2: 2 primary and 2 secondary @ 100 gpm)

Fluid Name		Water
Flow	(gallons/minute)	320
Specific Gravity		1.00
Viscosity	(centipoise)	1.00
Roughness	(feet)	0.000005

OUTPUT

	Nom Size (inches)	Pipe Schedule	Press Drop/100 equiv.ft. (psi)	(ft.water)	Velocity (ft/sec)
	0.50	80	37268.9730	86091.3276	438.49
	0.75	80	7900.3337	18249.7708	237.43
	1.00	80	2208.7872	5102.2984	142.73
	1.50	80	238.9026	551.8650	58.10
	2.00	80	67.9422	156.9466	34.77
	2.50	80	28.1639	65.0585	24.22
	3.00	80	9.5905	22.1541	15.54
>>>>>	4.00	80	2.5093	5.7965	8.93
>>>>>	6.00	80	0.3488	0.8058	3.94
	8.00	80	0.0906	0.2094	2.25
	10.00	80	0.0306	0.0707	1.43
	12.00	80	0.0133	0.0308	1.01
	14.00	80	0.0085	0.0196	0.84
	16.00	40	0.0035	0.0082	0.58
	18.00	30	0.0019	0.0043	0.45
	20.00	30	0.0011	0.0026	0.36
	24.00	30	0.0005	0.0011	0.25
	30.00	20	0.0002	0.0004	0.16

LIQUID PRESSURE DROP CALCULATION

Service: Weyerhaueser Plymouth Landfill Design - Phase 1
Material: Smooth HDPE

INPUT

Fluid Name		Water
Flow	(gallons/minute)	31
Specific Gravity		1.00
Viscosity	(centipoise)	1.00
Roughness	(feet)	0.000005

OUTPUT

	Nom Size (inches)	Pipe Schedule	Press Drop/100 equiv.ft. (psi)	(ft.water)	Velocity (ft/sec)
	0.50	80	439.6996	1015.7060	42.08
	0.75	80	98.7486	228.1093	22.78
	1.00	80	28.8285	66.5939	13.70
	1.50	80	3.3168	7.6618	5.58
>>>>>	2.00	80	0.9695	2.2395	3.34
>>>>>	2.50	80	0.4086	0.9439	2.32
>>>>>	3.00	80	0.1417	0.3274	1.49
	4.00	80	0.0379	0.0874	0.86
	6.00	80	0.0054	0.0125	0.38
	8.00	80	0.0014	0.0033	0.22
	10.00	80	0.0005	0.0011	0.14
	12.00	80	0.0002	0.0005	0.10
	14.00	80	0.0001	0.0003	0.08
	16.00	40	0.0001	0.0001	0.06
	18.00	30	0.0000	0.0001	0.04
	20.00	30	0.0000	0.0000	0.03
	24.00	30	0.0000	0.0000	0.02
	30.00	20	0.0000	0.0000	0.01

Service: Weyerhaueser Plymouth Landfill Design - Phase 1
Material: Smooth HDPE

INPUT Assuming worst case flow maximizing 60 gpm pumps

Fluid Name		Water
Flow	(gallons/minute)	60
Specific Gravity		1.00
Viscosity	(centipoise)	1.00
Roughness	(feet)	0.000005

OUTPUT

	Nom Size (inches)	Pipe Schedule	Press Drop/100 equiv.ft. (psi)	(ft.water)	Velocity (ft/sec)
	0.50	80	1524.1483	3520.7826	82.22
	0.75	80	337.2434	779.0322	44.52
	1.00	80	97.4726	225.1617	26.76
	1.50	80	11.0625	25.5544	10.89
	2.00	80	3.2133	7.4227	6.52
>>>>>	2.50	80	1.3489	3.1160	4.54
>>>>>	3.00	80	0.4656	1.0755	2.91
>>>>>	4.00	80	0.1236	0.2856	1.67
	6.00	80	0.0175	0.0405	0.74
	8.00	80	0.0046	0.0107	0.42
	10.00	80	0.0016	0.0036	0.27
	12.00	80	0.0007	0.0016	0.19
	14.00	80	0.0004	0.0010	0.16
	16.00	40	0.0002	0.0004	0.11
	18.00	30	0.0001	0.0002	0.08
	20.00	30	0.0001	0.0001	0.07
	24.00	30	0.0000	0.0001	0.05
	30.00	20	0.0000	0.0000	0.03

EQUIVALENT FEET OF PIPE

Service: Weyerhaueser Plymouth - Phase 1

Segment	Pump to MH1		MH1 to Wet Well		Pump to MH2		MH2 to Wet Well		Pump to MH3		MH3 to Wet Well	
Pipe Size	3 inch		6 inch		3 inch		6 inch		3 inch		6 inch	
Fittings	Qty	Equiv.	Qty	Equiv.	Qty	Equiv.	Qty	Equiv.	Qty	Equiv.	Qty	Equiv.
90 deg Ell	1	4.4	2	30.0	1	4.4	3	45.0	1	4.4	3	45.0
Long Rad. Ell		0.0		0.0		0.0		0.0		0.0		0.0
45 deg Ell	2	5.2		0.0	2	5.2		0.0	2	5.2		0.0
TEE-Line Flow	1	2.2		0.0	1	2.2		0.0	1	2.2		0.0
TEE-Branch Flow	1	9.4		0.0	1	9.4		0.0	1	9.4		0.0
180 deg Bend		0.0		0.0		0.0		0.0		0.0		0.0
Globe Valve	1	94.0		0.0	1	94.0		0.0	1	94.0		0.0
Gate Valve	1	2.8		0.0	1	2.8		0.0	1	2.8		0.0
Sudden Expansion (6")	1	5.0		0.0	1	5.0		0.0	1	5.0		0.0
Swing Check Valve	1	27.0	1	50.5	1	27.0	1	50.5	1	27.0	1	50.5
Bell Mouth Inlet		0.0		0.0		0.0		0.0		0.0		0.0
Square Mouth Inlet		0.0		0.0		0.0		0.0		0.0		0.0
Re-Entrant Pipe		0.0		0.0		0.0		0.0		0.0		0.0
Straight Pipe	50	50.0	1800	1800.0	50	50.0	2400	2400.0	50	50.0	3500	3500.0
Total Equiv Feet		200		1880.5		200		2495.5		200		3595.5

LIQUID PRESSURE DROP CALCULATION

Service: Weyerhaueser Plymouth Landfill Design - Phase 2
Material: Smooth HDPE

INPUT

Fluid Name		Water
Flow	(gallons/minute)	47
Specific Gravity		1.00
Viscosity	(centipoise)	1.00
Roughness	(feet)	0.000005

OUTPUT

	Nom Size (inches)	Pipe Schedule	Press Drop/100 equiv.ft. (psi)	(ft.water)	Velocity (ft/sec)
	0.50	80	949.0448	2192.2935	63.78
	0.75	80	211.2448	487.9755	34.53
	1.00	80	61.3029	141.6097	20.76
	1.50	80	6.9955	16.1597	8.45
>>>>>	2.00	80	2.0370	4.7054	5.06
>>>>>	2.50	80	0.8564	1.9783	3.52
>>>>>	3.00	80	0.2961	0.6841	2.26
	4.00	80	0.0788	0.1821	1.30
	6.00	80	0.0112	0.0259	0.57
	8.00	80	0.0030	0.0068	0.33
	10.00	80	0.0010	0.0023	0.21
	12.00	80	0.0004	0.0010	0.15
	14.00	80	0.0003	0.0007	0.12
	16.00	40	0.0001	0.0003	0.08
	18.00	30	0.0001	0.0001	0.06
	20.00	30	0.0000	0.0001	0.05
	24.00	30	0.0000	0.0000	0.04
	30.00	20	0.0000	0.0000	0.02

Service: Weyerhaueser Plymouth Landfill Design - Phase 2
Material: Smooth HDPE

INPUT Assuming worst case flow maximizing 60 gpm pumps

Fluid Name		Water
Flow	(gallons/minute)	60
Specific Gravity		1.00
Viscosity	(centipoise)	1.00
Roughness	(feet)	0.000005

OUTPUT

	Nom Size (inches)	Pipe Schedule	Press Drop/100 equiv.ft. (psi)	(ft.water)	Velocity (ft/sec)
	0.50	80	1524.1483	3520.7826	82.22
	0.75	80	337.2434	779.0322	44.52
	1.00	80	97.4726	225.1617	26.76
	1.50	80	11.0625	25.5544	10.89
	2.00	80	3.2133	7.4227	6.52
>>>>>	2.50	80	1.3489	3.1160	4.54
>>>>>	3.00	80	0.4656	1.0755	2.91
>>>>>	4.00	80	0.1236	0.2856	1.67
	6.00	80	0.0175	0.0405	0.74
	8.00	80	0.0046	0.0107	0.42
	10.00	80	0.0016	0.0036	0.27
	12.00	80	0.0007	0.0016	0.19
	14.00	80	0.0004	0.0010	0.16
	16.00	40	0.0002	0.0004	0.11
	18.00	30	0.0001	0.0002	0.08
	20.00	30	0.0001	0.0001	0.07
	24.00	30	0.0000	0.0001	0.05
	30.00	20	0.0000	0.0000	0.03

Service: Weyerhaueser Plymouth - Phase 2

Segment	Pump to MH4		MH4 to Wet Well		Pump to MH5		MH5 to Wet Well	
Pipe Size	3 inch		6 inch		3 inch		6 inch	
Fittings	Qty	Equiv.	Qty	Equiv.	Qty	Equiv.	Qty	Equiv.
90 deg Ell	1	4.4	3	45.0	1	4.4	3	45.0
Long Rad. Ell		0.0		0.0		0.0		0.0
45 deg Ell	2	5.2		0.0	2	5.2		0.0
TEE-Line Flow	1	2.2		0.0	1	2.2		0.0
TEE-Branch Flow	1	9.4		0.0	1	9.4		0.0
180 deg Bend		0.0		0.0		0.0		0.0
Globe Valve	1	94.0		0.0	1	94.0		0.0
Gate Valve	1	2.8		0.0	1	2.8		0.0
Sudden Expansion (6")	1	5.0		0.0	1	5.0		0.0
Swing Check Valve	1	27.0	1	50.5	1	27.0	1	50.5
Bell Mouth Inlet		0.0		0.0		0.0		0.0
Square Mouth Inlet		0.0		0.0		0.0		0.0
Re-Entrant Pipe		0.0		0.0		0.0		0.0
Straight Pipe	90	90.0	3700	3700.0	90	90.0	4100	4100.0
Total Equiv Feet		240		3795.5		240		4195.5

LIQUID PRESSURE DROP CALCULATION

Service: Weyerhaueser Plymouth Landfill Design - Phase 3
Material: Smooth HDPE

INPUT

Fluid Name		Water
Flow	(gallons/minute)	74
Specific Gravity		1.00
Viscosity	(centipoise)	1.00
Roughness	(feet)	0.000005

OUTPUT

	Nom Size (inches)	Pipe Schedule	Press Drop/100 equiv.ft. (psi)	(ft.water)	Velocity (ft/sec)
	0.50	80	2242.4237	5179.9988	101.00
	0.75	80	493.6660	1140.3684	54.69
	1.00	80	142.1831	328.4430	32.88
	1.50	80	16.0608	37.1004	13.38
	2.00	80	4.6554	10.7540	8.01
>>>>>	2.50	80	1.9518	4.5086	5.58
>>>>>	3.00	80	0.6727	1.5539	3.58
>>>>>	4.00	80	0.1783	0.4119	2.06
	6.00	80	0.0252	0.0583	0.91
	8.00	80	0.0066	0.0153	0.52
	10.00	80	0.0023	0.0052	0.33
	12.00	80	0.0010	0.0023	0.23
	14.00	80	0.0006	0.0015	0.19
	16.00	40	0.0003	0.0006	0.13
	18.00	30	0.0001	0.0003	0.10
	20.00	30	0.0001	0.0002	0.08
	24.00	30	0.0000	0.0001	0.06
	30.00	20	0.0000	0.0000	0.04

LIQUID PRESSURE DROP CALCULATION

Service: Weyerhaueser Plymouth Landfill Design - Phase 3
Material: Smooth HDPE

INPUT Assuming worst case flow maximizing 60 gpm pumps

Fluid Name		Water
Flow	(gallons/minute)	80
Specific Gravity		1.00
Viscosity	(centipoise)	1.00
Roughness	(feet)	0.000005

OUTPUT

	Nom Size (inches)	Pipe Schedule	Press Drop/100 equiv.ft. (psi)	(ft.water)	Velocity (ft/sec)
	0.50	80	2616.1441	6043.2928	109.62
	0.75	80	574.7497	1327.6718	59.36
	1.00	80	165.2958	381.8333	35.68
	1.50	80	18.6349	43.0466	14.52
	2.00	80	5.3969	12.4669	8.69
>>>>>	2.50	80	2.2615	5.2240	6.06
>>>>>	3.00	80	0.7790	1.7995	3.89
>>>>>	4.00	80	0.2064	0.4767	2.23
	6.00	80	0.0292	0.0674	0.98
	8.00	80	0.0077	0.0177	0.56
	10.00	80	0.0026	0.0060	0.36
	12.00	80	0.0011	0.0026	0.25
	14.00	80	0.0007	0.0017	0.21
	16.00	40	0.0003	0.0007	0.15
	18.00	30	0.0002	0.0004	0.11
	20.00	30	0.0001	0.0002	0.09
	24.00	30	0.0000	0.0001	0.06
	30.00	20	0.0000	0.0000	0.04

Service: Weyerhaueser Plymouth - Phase 3

Segment	Pump to MH6		MH6 to Wet Well					
Pipe Size	3 inch		6 inch		3 inch		6 inch	
Fittings	Qty	Equiv.	Qty	Equiv.	Qty	Equiv.	Qty	Equiv.
90 deg Ell	1	4.4	3	45.0		0.0		0.0
Long Rad. Ell		0.0		0.0		0.0		0.0
45 deg Ell	2	5.2		0.0		0.0		0.0
TEE-Line Flow	1	2.2		0.0		0.0		0.0
TEE-Branch Flow	1	9.4		0.0		0.0		0.0
180 deg Bend		0.0		0.0		0.0		0.0
Globe Valve	1	94.0		0.0		0.0		0.0
Gate Valve	1	2.8		0.0		0.0		0.0
Sudden Expansion (6")	1	5.0		0.0		0.0		0.0
Swing Check Valve	1	27.0	1	50.5		0.0		0.0
Bell Mouth Inlet		0.0		0.0		0.0		0.0
Square Mouth Inlet		0.0		0.0		0.0		0.0
Re-Entrant Pipe		0.0		0.0		0.0		0.0
Straight Pipe	50	50.0	4300	4300.0		0.0		0.0
Total Equiv Feet		200		4395.5		0		0

LIQUID PRESSURE DROP CALCULATION

Service: Weyerhaueser Plymouth Landfill Design - Phase 4
Material: Smooth HDPE

INPUT

Fluid Name		Water
Flow	(gallons/minute)	71
Specific Gravity		1.00
Viscosity	(centipoise)	1.00
Roughness	(feet)	0.000005

OUTPUT

	Nom Size (inches)	Pipe Schedule	Press Drop/100 equiv.ft. (psi)	(ft.water)	Velocity (ft/sec)
	0.50	80	2101.4627	4854.3788	97.58
	0.75	80	463.0336	1069.6075	52.84
	1.00	80	133.4410	308.2488	31.76
	1.50	80	15.0856	34.8476	12.93
	2.00	80	4.3743	10.1046	7.74
>>>>>	2.50	80	1.8343	4.2373	5.39
>>>>>	3.00	80	0.6324	1.4608	3.46
>>>>>	4.00	80	0.1677	0.3874	1.99
	6.00	80	0.0237	0.0548	0.88
	8.00	80	0.0062	0.0144	0.50
	10.00	80	0.0021	0.0049	0.32
	12.00	80	0.0009	0.0022	0.22
	14.00	80	0.0006	0.0014	0.19
	16.00	40	0.0003	0.0006	0.13
	18.00	30	0.0001	0.0003	0.10
	20.00	30	0.0001	0.0002	0.08
	24.00	30	0.0000	0.0001	0.06
	30.00	20	0.0000	0.0000	0.03

Service: Weyerhaueser Plymouth Landfill Design - Phase 4
Material: Smooth HDPE

INPUT Assuming worst case flow maximizing 60 gpm pumps

Fluid Name		Water
Flow	(gallons/minute)	80
Specific Gravity		1.00
Viscosity	(centipoise)	1.00
Roughness	(feet)	0.000005

OUTPUT

	Nom Size (inches)	Pipe Schedule	Press Drop/100 equiv.ft. (psi)	(ft.water)	Velocity (ft/sec)
	0.50	80	2616.1441	6043.2928	109.62
	0.75	80	574.7497	1327.6718	59.36
	1.00	80	165.2958	381.8333	35.68
	1.50	80	18.6349	43.0466	14.52
	2.00	80	5.3969	12.4669	8.69
>>>>>	2.50	80	2.2615	5.2240	6.06
>>>>>	3.00	80	0.7790	1.7995	3.89
>>>>>	4.00	80	0.2064	0.4767	2.23
	6.00	80	0.0292	0.0674	0.98
	8.00	80	0.0077	0.0177	0.56
	10.00	80	0.0026	0.0060	0.36
	12.00	80	0.0011	0.0026	0.25
	14.00	80	0.0007	0.0017	0.21
	16.00	40	0.0003	0.0007	0.15
	18.00	30	0.0002	0.0004	0.11
	20.00	30	0.0001	0.0002	0.09
	24.00	30	0.0000	0.0001	0.06
	30.00	20	0.0000	0.0000	0.04

Service: Weyerhaueser Plymouth - Phase 4

Segment	Pump to MH7		MH7 to Wet Well					
Pipe Size	3 inch		6 inch		3 inch		4 inch	
Fittings	Qty	Equiv.	Qty	Equiv.	Qty	Equiv.	Qty	Equiv.
90 deg Ell	1	4.4	3	45.0		0.0		0.0
Long Rad. Ell		0.0		0.0		0.0		0.0
45 deg Ell	2	5.2		0.0		0.0		0.0
TEE-Line Flow	1	2.2		0.0		0.0		0.0
TEE-Branch Flow	1	9.4		0.0		0.0		0.0
180 deg Bend		0.0		0.0		0.0		0.0
Globe Valve	1	94.0		0.0		0.0		0.0
Gate Valve	1	2.8		0.0		0.0		0.0
Sudden Expansion (6")	1	5.0		0.0		0.0		0.0
Swing Check Valve	1	27.0	1	50.5		0.0		0.0
Bell Mouth Inlet		0.0		0.0		0.0		0.0
Square Mouth Inlet		0.0		0.0		0.0		0.0
Re-Entrant Pipe		0.0		0.0		0.0		0.0
Straight Pipe	50	50.0	4700	4700.0		0.0		0.0
Total Equiv Feet		200		4795.5		0		0

LIQUID PRESSURE DROP CALCULATION

Service: Weyerhaueser Plymouth Landfill Design - Phase 5
Material: Smooth HDPE

INPUT

Fluid Name		Water
Flow	(gallons/minute)	68
Specific Gravity		1.00
Viscosity	(centipoise)	1.00
Roughness	(feet)	0.000005

OUTPUT

	Nom Size (inches)	Pipe Schedule	Press Drop/100 equiv.ft. (psi)	(ft.water)	Velocity (ft/sec)
	0.50	80	1937.4461	4475.5005	93.44
	0.75	80	427.3535	987.1866	50.60
	1.00	80	123.2506	284.7089	30.42
	1.50	80	13.9476	32.2189	12.38
	2.00	80	4.0461	9.3465	7.41
>>>>>	2.50	80	1.6972	3.9204	5.16
>>>>>	3.00	80	0.5853	1.3520	3.31
>>>>>	4.00	80	0.1553	0.3586	1.90
	6.00	80	0.0220	0.0508	0.84
	8.00	80	0.0058	0.0133	0.48
	10.00	80	0.0020	0.0045	0.30
	12.00	80	0.0009	0.0020	0.22
	14.00	80	0.0006	0.0013	0.18
	16.00	40	0.0002	0.0005	0.12
	18.00	30	0.0001	0.0003	0.10
	20.00	30	0.0001	0.0002	0.08
	24.00	30	0.0000	0.0001	0.05
	30.00	20	0.0000	0.0000	0.03

Service: Weyerhaueser Plymouth Landfill Design - Phase 5
Material: Smooth HDPE

INPUT Assuming worst case flow maximizing 60 gpm pumps

Fluid Name		Water
Flow	(gallons/minute)	80
Specific Gravity		1.00
Viscosity	(centipoise)	1.00
Roughness	(feet)	0.000005

OUTPUT

	Nom Size (inches)	Pipe Schedule	Press Drop/100 equiv.ft. (psi)	(ft.water)	Velocity (ft/sec)
	0.50	80	2616.1441	6043.2928	109.62
	0.75	80	574.7497	1327.6718	59.36
	1.00	80	165.2958	381.8333	35.68
	1.50	80	18.6349	43.0466	14.52
	2.00	80	5.3969	12.4669	8.69
>>>>>	2.50	80	2.2615	5.2240	6.06
>>>>>	3.00	80	0.7790	1.7995	3.89
>>>>>	4.00	80	0.2064	0.4767	2.23
	6.00	80	0.0292	0.0674	0.98
	8.00	80	0.0077	0.0177	0.56
	10.00	80	0.0026	0.0060	0.36
	12.00	80	0.0011	0.0026	0.25
	14.00	80	0.0007	0.0017	0.21
	16.00	40	0.0003	0.0007	0.15
	18.00	30	0.0002	0.0004	0.11
	20.00	30	0.0001	0.0002	0.09
	24.00	30	0.0000	0.0001	0.06
	30.00	20	0.0000	0.0000	0.04

Service: Weyerhaueser Plymouth - Phase 5

Segment	Pump to MH8		MH8 to Wet Well					
Pipe Size	3 inch		6 inch		3 inch		4 inch	
Fittings	Qty	Equiv.	Qty	Equiv.	Qty	Equiv.	Qty	Equiv.
90 deg Ell	1	4.4	5	75.0		0.0		0.0
Long Rad. Ell		0.0		0.0		0.0		0.0
45 deg Ell	2	5.2	1	5.6		0.0		0.0
TEE-Line Flow	1	2.2		0.0		0.0		0.0
TEE-Branch Flow	1	9.4		0.0		0.0		0.0
180 deg Bend		0.0		0.0		0.0		0.0
Globe Valve	1	94.0		0.0		0.0		0.0
Gate Valve	1	2.8		0.0		0.0		0.0
Sudden Expansion (6")	1	5.0		0.0		0.0		0.0
Swing Check Valve	1	27.0	1	50.5		0.0		0.0
Bell Mouth Inlet		0.0		0.0		0.0		0.0
Square Mouth Inlet		0.0		0.0		0.0		0.0
Re-Entrant Pipe		0.0		0.0		0.0		0.0
Straight Pipe	50	50.0	5150	5150.0		0.0		0.0
Total Equiv Feet		200		5281.1		0		0

LIQUID PRESSURE DROP CALCULATION

Service: Weyerhaueser Plymouth Landfill Design - Phase 6
Material: Smooth HDPE

INPUT

Fluid Name		Water
Flow	(gallons/minute)	64
Specific Gravity		1.00
Viscosity	(centipoise)	1.00
Roughness	(feet)	0.000005

OUTPUT

	Nom Size (inches)	Pipe Schedule	Press Drop/100 equiv.ft. (psi)	(ft.water)	Velocity (ft/sec)
	0.50	80	1730.9004	3998.3799	87.99
	0.75	80	382.3595	883.2504	47.65
	1.00	80	110.3870	254.9940	28.64
	1.50	80	12.5091	28.8960	11.66
	2.00	80	3.6310	8.3877	6.98
>>>>>	2.50	80	1.5236	3.5196	4.86
>>>>>	3.00	80	0.5257	1.2143	3.12
>>>>>	4.00	80	0.1395	0.3223	1.79
	6.00	80	0.0198	0.0457	0.79
	8.00	80	0.0052	0.0120	0.45
	10.00	80	0.0018	0.0041	0.29
	12.00	80	0.0008	0.0018	0.20
	14.00	80	0.0005	0.0011	0.17
	16.00	40	0.0002	0.0005	0.12
	18.00	30	0.0001	0.0003	0.09
	20.00	30	0.0001	0.0002	0.07
	24.00	30	0.0000	0.0001	0.05
	30.00	20	0.0000	0.0000	0.03

Service: Weyerhaueser Plymouth Landfill Design - Phase 6
Material: Smooth HDPE

INPUT Assuming worst case flow maximizing 60 gpm pumps

Fluid Name		Water
Flow	(gallons/minute)	80
Specific Gravity		1.00
Viscosity	(centipoise)	1.00
Roughness	(feet)	0.000005

OUTPUT

	Nom Size (inches)	Pipe Schedule	Press Drop/100 equiv.ft. (psi)	(ft.water)	Velocity (ft/sec)
	0.50	80	2616.1441	6043.2928	109.62
	0.75	80	574.7497	1327.6718	59.36
	1.00	80	165.2958	381.8333	35.68
	1.50	80	18.6349	43.0466	14.52
	2.00	80	5.3969	12.4669	8.69
>>>>>	2.50	80	2.2615	5.2240	6.06
>>>>>	3.00	80	0.7790	1.7995	3.89
>>>>>	4.00	80	0.2064	0.4767	2.23
	6.00	80	0.0292	0.0674	0.98
	8.00	80	0.0077	0.0177	0.56
	10.00	80	0.0026	0.0060	0.36
	12.00	80	0.0011	0.0026	0.25
	14.00	80	0.0007	0.0017	0.21
	16.00	40	0.0003	0.0007	0.15
	18.00	30	0.0002	0.0004	0.11
	20.00	30	0.0001	0.0002	0.09
	24.00	30	0.0000	0.0001	0.06
	30.00	20	0.0000	0.0000	0.04

Service: Weyerhaueser Plymouth - Phase 6

Segment	Pump to MH9		MH9 to Wet Well					
Pipe Size	3 inch		6 inch		3 inch		4 inch	
Fittings	Qty	Equiv.	Qty	Equiv.	Qty	Equiv.	Qty	Equiv.
90 deg Ell	1	4.4	8	120.0		0.0		0.0
Long Rad. Ell		0.0		0.0		0.0		0.0
45 deg Ell	2	5.2	2	11.2		0.0		0.0
TEE-Line Flow	1	2.2		0.0		0.0		0.0
TEE-Branch Flow	1	9.4		0.0		0.0		0.0
180 deg Bend		0.0		0.0		0.0		0.0
Globe Valve	1	94.0		0.0		0.0		0.0
Gate Valve	1	2.8		0.0		0.0		0.0
Sudden Expansion (6")	1	5.0		0.0		0.0		0.0
Swing Check Valve	1	27.0	1	50.5		0.0		0.0
Bell Mouth Inlet		0.0		0.0		0.0		0.0
Square Mouth Inlet		0.0		0.0		0.0		0.0
Re-Entrant Pipe		0.0		0.0		0.0		0.0
Straight Pipe	70	70.0	5625	5625.0		0.0		0.0
Total Equiv Feet		220		5806.7		0		0

Weyerhaeuser Plymouth
Help Model Results and Flow Estimates - Summary
RMT Job No. 05101.01
24-Sep-99

Drainage Area	Segment	Flow Rate (gpm)	Pipe Size (inches)	Total Equivalent Feet	Head Loss/100 feet (feet)	Dynamic Head (feet)	Static Head (feet)	Total System Head (feet)
1	Pump to MH1	31	3	200	0.3274	0.7	14	14.7
1	MH1 to Wet Well	185	6	1881	0.3010	5.7	20	25.7
		Phase 1 Pump 1:		31	gpm @	40	ft of head	
1	Pump to MH2	31	3	200	0.3274	0.7	14	14.7
1	MH2 to Wet Well	185	6	2496	0.3010	7.5	25	32.5
		Phase 1 Pump 2:		31	gpm @	47	ft of head	
1	Pump to MH3	31	3	200	0.3274	0.7	18	18.7
1	MH3 to Wet Well	185	6	3596	0.3010	10.8	25	35.8
		Phase 1 Pump 3:		31	gpm @	54	ft of head	
2	Pump to MH4	47	3	240	0.6841	1.6	24	25.6
2	MH4 to Wet Well	185	6	3796	0.3010	11.4	25	36.4
		Phase 2 Pump 1:		47	gpm @	62	ft of head	
2	Pump to MH5	47	3	240	0.0068	0.0	24	24.0
2	MH5 to Wet Well	185	6	4196	0.0116	0.5	25	25.5
		Phase 2 Pump 22:		47	gpm @	50	ft of head	
3	Pump to MH6	74	3	200	1.5539	3.1	10	13.1
3	MH6 to Wet Well	185	6	4396	0.3010	13.2	25	38.2
		Phase 3 Pump 1:		74	gpm @	51	ft of head	
4	Pump to MH7	71	3	200	1.4608	2.9	10	12.9
4	MH7 to Wet Well	185	6	4796	0.3010	14.4	25	39.4
		Phase 4 Pump 1:		71	gpm @	52	ft of head	
5	Pump to MH8	68	3	200	1.3520	2.7	12	14.7
5	MH8 to Wet Well	185	6	5281.1	0.3010	15.9	25	40.9
		Phase 5 Pump 1:		68	gpm @	56	ft of head	
6	Pump to MH9	64	3	220	1.2143	2.7	14	16.7
6	MH9 to Wet Well	185	6	5807	0.3010	17.5	25	42.5
		Phase 6 Pump 1:		64	gpm @	59	ft of head	

Weyerhaeuser Plymouth
Help Model Results and Flow Estimates - Worst Case Summary
RMT Job No. 05101.01
24-Sep-99

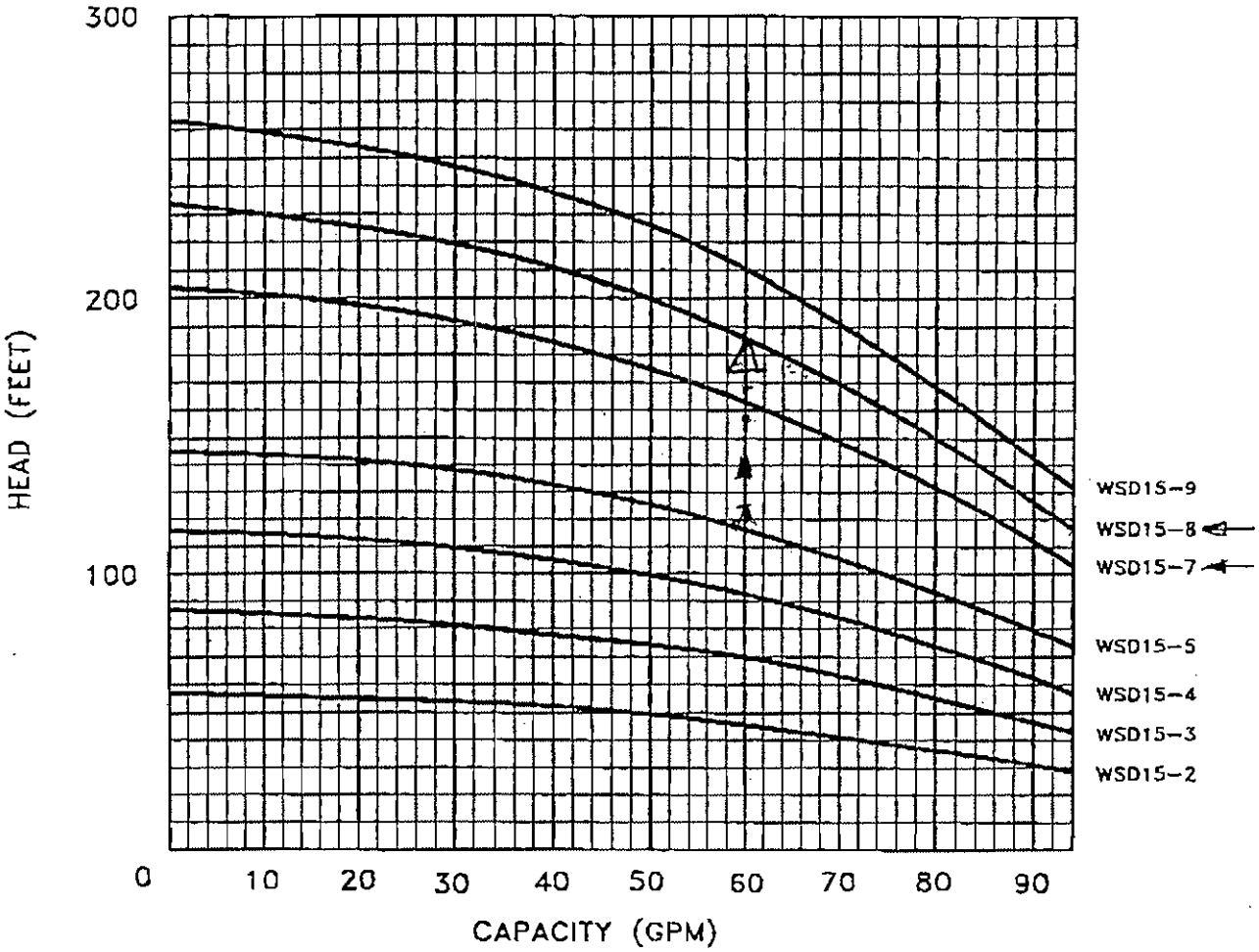
Drainage Area	Segment	Flow Rate (gpm)	Pipe Size (inches)	Total Equivalent Feet	Head Loss/100 feet (feet)	Dynamic Head (feet)	Static Head (feet)	Total System Head (feet)
1	Pump to MH1	60	3	200	1.0755	2.2	14	16.2
1	MH1 to Wet Well	600	6	1881	2.5206	47.4	20	67.4
		Phase 1 Pump 1:		60	gpm @	84	ft of head	
1	Pump to MH2	60	3	200	1.0755	2.2	14	16.2
1	MH2 to Wet Well	600	6	2496	2.5206	62.9	25	87.9
		Phase 1 Pump 2:		60	gpm @	104	ft of head	
1	Pump to MH3	60	3	200	1.0755	2.2	18	20.2
1	MH3 to Wet Well	600	6	3596	2.5206	90.6	25	115.6
		Phase 1 Pump 3:		60	gpm @	136	ft of head	
2	Pump to MH4	60	3	240	1.0755	2.6	24	26.6
2	MH4 to Wet Well	600	6	3796	2.5206	95.7	25	120.7
		Phase 2 Pump 1:		60	gpm @	147	ft of head	
2	Pump to MH5	60	3	240	1.0755	2.6	24	26.6
2	MH5 to Wet Well	600	6	4196	2.5206	105.7	25	130.7
		Phase 2 Pump 2:		60	gpm @	157	ft of head	
3	Pump to MH6	80	3	200	1.7995	3.6	10	13.6
3	MH6 to Wet Well	400	6	4396	1.2067	53.0	25	78.0
		Phase 3 Pump 1:		80	gpm @	92	ft of head	
4	Pump to MH7	80	3	200	1.7995	3.6	10	13.6
4	MH7 to Wet Well	320	6	4796	0.8058	38.6	25	63.6
		Phase 4 Pump 1:		80	gpm @	77	ft of head	
5	Pump to MH8	80	3	200	1.7995	3.6	12	15.6
5	MH8 to Wet Well	320	6	5281.1	0.8058	42.6	25	67.6
		Phase 5 Pump 1:		80	gpm @	83	ft of head	
6	Pump to MH9	80	3	220	1.7995	4.0	14	18.0
6	MH9 to Wet Well	320	6	5807	0.8058	46.8	25	71.8
		Phase 6 Pump 1:		80	gpm @	90	ft of head	

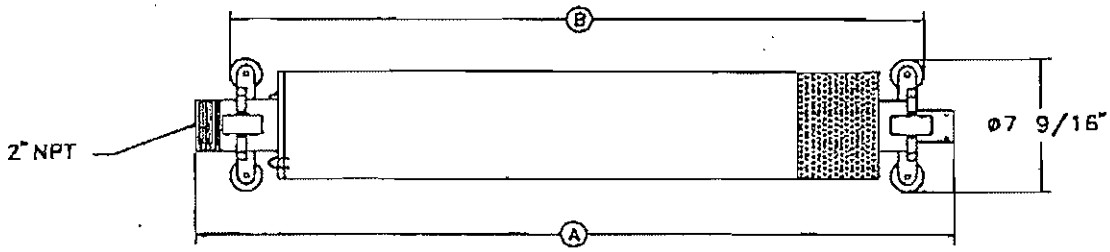
J 31

EPG COMPANIES

WSD15 SurePump™
WHEELED SUMP DRAINER

695





PUMP MODEL	SINGLE PHASE			THREE PHASE			SHIPPING WEIGHT (LBS)	
	MOTOR HP	A (in)	B (in)	MOTOR HP	A (in)	B (in)	1ø	3ø
WSD15-2	2.0	41.00	39.00	2.0	39.50	37.50	69.0	64.2
WSD15-3	2.0	43.50	41.50	2.0	42.00	40.00	72.3	67.5
WSD15-4	3.0	54.50	52.50	3.0	51.75	49.75	100.1	89.6
WSD15-5	3.0	57.00	55.00	3.0	54.25	52.25	103.5	93.0
WSD15-7	5.0	68.25	66.25	5.0	62.25	60.25	129.4	110.2
WSD15-8	5.0	70.75	68.75	5.0	64.75	62.75	132.7	113.5
WSD15-9	5.0	73.25	71.25	5.0	67.25	65.25	136.1	116.9

SEE 0577-2 FOR HIGH HEAD MODELS.

Attachment H2
Drainage Layer Equivalency Report

JLT J&L TESTING COMPANY, INC.
GEOTECHNICAL AND GEOSYNTHETICS MATERIALS TESTING AND RESEARCH

November 27, 2001
01G2731-01

Tenax Corporation
4800 East Monument Street
Baltimore, MD 21205

Attn: J.P. Kline

RE: EQUIVALENCY TEST PROGRAM TO REDUCE AASHTO No. 67 STONE THICKNESS IN A DRAINAGE LAYER

Dear Mr. Kline:

J&L Testing Company, Inc. (JLT) is pleased to submit the results of our test program to evaluate the potential replacement of six (6) inches of AASHTO No. 67 stone with a geonet drainage layer.

Purpose

The purpose of this work was to evaluate the possibility of replacing six (6) inches of a 12-inch layer of AASHTO No. 67 stone with a tri-planer geonet while still achieving equal or better flow capacity under a 15,000 psf normal load at gradients of 0.33, 0.1, 0.05 and 0.02. For this project, a standard AASHTO No. 67 stone from a local quarry was obtained. The gradation of the stone used is shown on Figure 1. For the permeability of the stone, we used 5,200 ft/day, as published in the Drainage Pavement Systems Handbook dated March 1992, FHWA-SA-92-008. This converts to 1.83 cm/sec for the purpose of our calculations.

Scope of Work

Using this permeability value for the stone, flow rates for a 12-inch layer were computed for the four gradients as shown on Figure 2. Similarly, we also computed the flow rates at these same gradients for a 6-inch layer of stone as shown on Figure 3. We then performed a transmissivity test on the tri-planer net with the configuration and results presented on Figure 4. Using the flow rate of the 6-inch layer plus the tri-planer net flow rates, we compared the flow for a 12-inch stone layer to the composite layer as shown on Figure 5. By inspection of the data and data plot, the composite performs better than 12 inches of stone alone.

It is noted, however, that this configuration placed the geotextile (12 oz/sy, Synthetic Industries 1201) between the stone and drainage net which is the typical configuration used on projects in the

northeast. We were then informed that this geotextile layer should be situated between the geonet and underlying geomembrane to serve as a cushion layer.

With these revised instructions, were re-ran the transmissivity test using the revised configuration as shown on Figure 6. Using the results presented on Figure 6, we re-computed equivalency as shown on Figure 7. Although the revised configuration yielded slightly lower flow rate properties, the data clearly shows that 6 inches of stone plus the geonet yield better flow properties than 12 inches of stone alone.

Observations

When we disassembled the configuration shown on Figure 4, we noted no adverse impregnation of stone through the geotextile. The geonet was essentially clean. Disassembly of the test configuration shown in Figure 6 revealed a few small particles of stone entrapped in the geonet but nothing of serious concern as evidenced by the flow rates. When this configuration was first tested, there was slight clouding of the water for about one minute which rapidly cleared caused by the washing of fines at the stone-geonet interface. Since there was no geotextile layer between the stone and geonet, this was clearly expected.

Conclusion

In both test configurations, the combined flow of the 6 inches of AASHTO #67 stone and triplaner geonet out performed the 12 inches of stone alone.

We appreciate the opportunity to provide our services and look forward to working with you again. Should you have any questions, comments or require additional information, please call. Thank you.

Sincerely,

J&L TESTING COMPANY, INC.

John Boschuk, Jr., P.E.
Technical Consultant

Enclosures
JB/rdo
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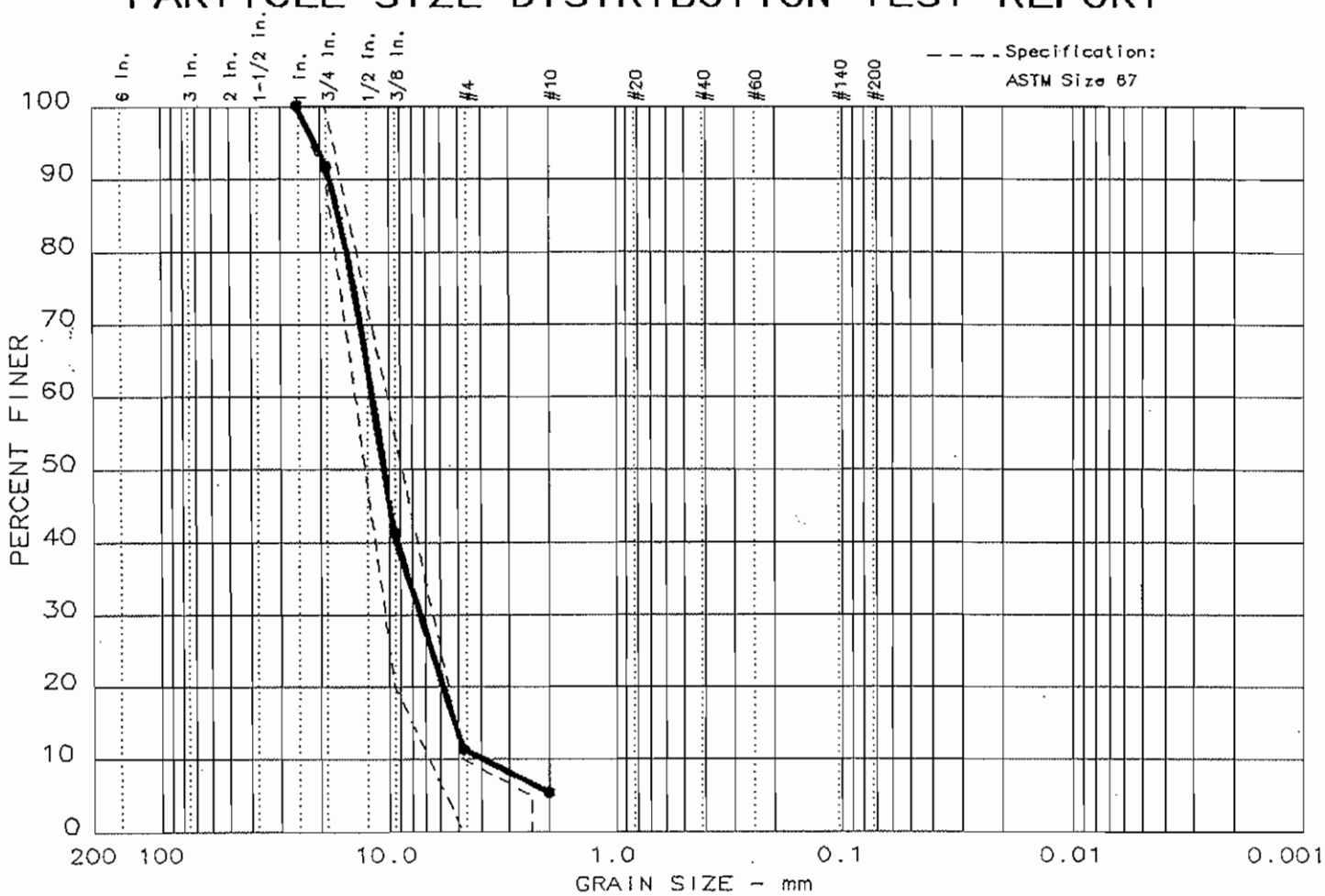
PARTICLE SIZE DISTRIBUTION TEST REPORT



	Test	%+75 mm	% GRAVEL	% SAND	% SILT	% CLAY	USCS
●	16	0.0	88.7	11.3			GP

SIEVE inches size	PERCENT FINER ●		
1	100.0		
0.75	91.6		
0.375	41.3		
	GRAIN SIZE		
D_{60}	11.87		
D_{30}	7.31		
D_{10}	3.88		
	COEFFICIENTS		
C_c	1.16		
C_u	3.1		

SIEVE number size	PERCENT FINER ●		
4	11.3		
10	5.4		

Sample information:

● #67 STONE VERIFICATION
CORPORATE RESEARCH
NORTH CAROLINA

Remarks:

ASTM C-136

J & L TESTING CO., INC.

Project No.: 01G2731
Project: TENAX CORPORATION

FIGURE 1

Date: 9/7/01

Data Sheet No. 1

DRAINAGE LAYER CALCULATIONS

12 inches of AASHTO No. 67 Stone

Permeability = 1.83 cm/sec = 2.196 ft/min (From AASHTO)

Permeability, k = Q * L / A * h * t

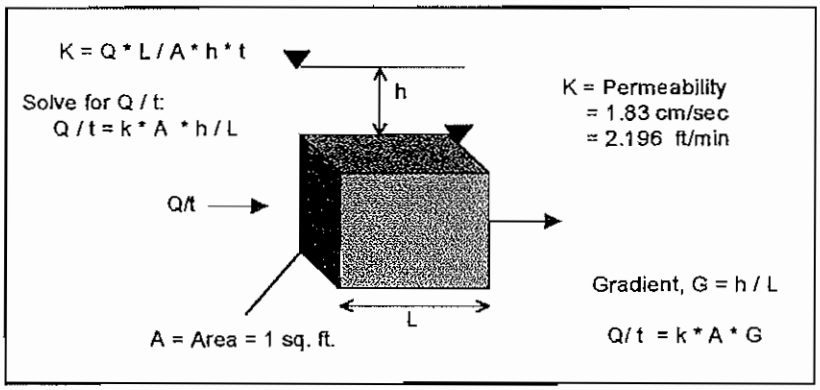
To determine flow rate, solve for Q / t :

Q / t = k * A * h / L
where: h / L = Gradient, G

Q / t = k * A * G

Q / t = k * A * G = 2.196 ft/min * 1 sq ft * G * 7.48 gal / cu ft

k =	2.196	feet/min
A =	1	sq ft
G =	0.33	
	0.01	
	0.05	
	0.02	



Gradient	Flow gal/min/ft
0.33	5.42
0.10	1.64
0.05	0.82
0.02	0.33

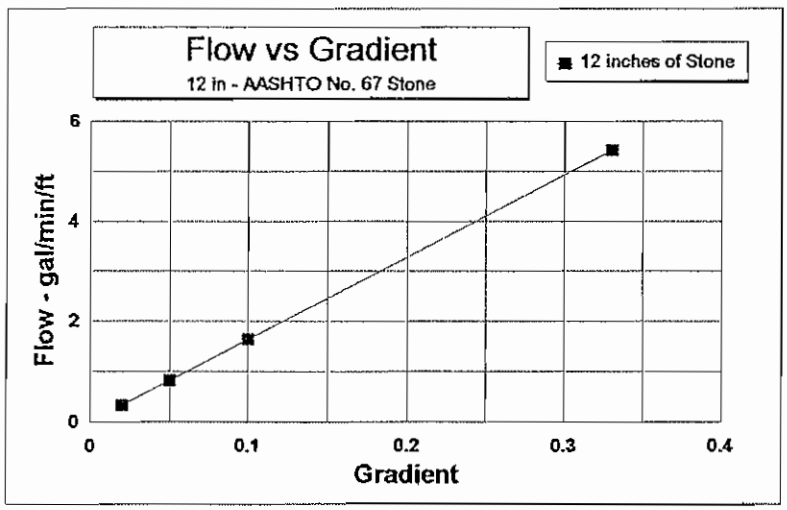


FIGURE 2

DRAINAGE LAYER CALCULATIONS

6 inches of AASHTO No. 67 Stone

Permeability = 1.83 cm/sec = 2.196 feet/min (From AASHTO)

Permeability, k = Q * L / A * h * t

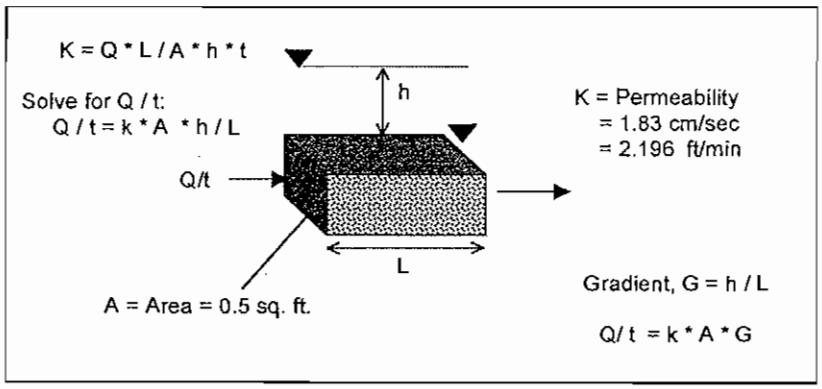
To determine flow rate, solve for Q / t :

Q / t = k * A * h / L
where: h / L = Gradient, G

Q / t = k * A * G

Q / t = k * A * G = 2.196 ft/min * 0.5 sq ft * G * 7.48 gal / cu ft

k =	2.196	feet/min
A =	0.5	sq ft
G =	0.33	
	0.01	
	0.05	
	0.02	



Gradient	Flow gal/min/ft
0.33	2.71
0.10	0.82
0.05	0.41
0.02	0.16

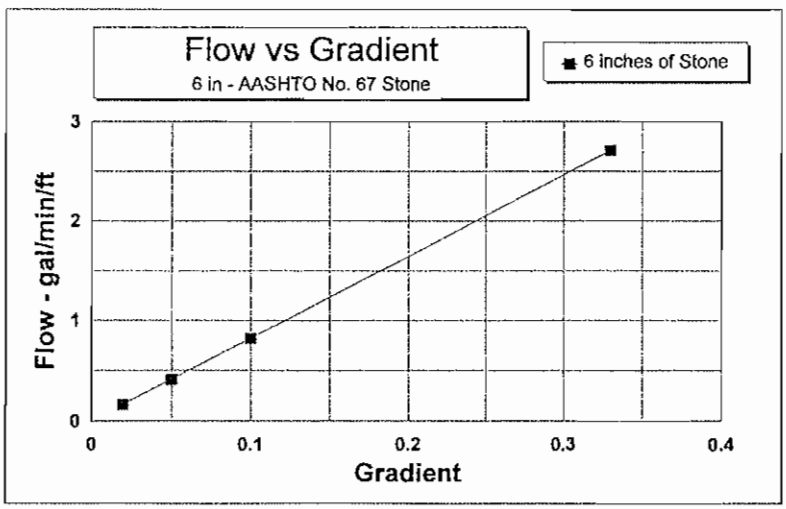


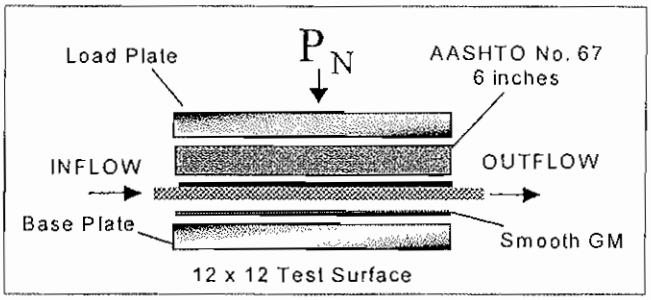
FIGURE 3

TRANSMISSIVITY TEST RESULTS
ASTM D-4716

JLT

Client:	Tenax Corporation	Job Number:	01G2731-01
Project:	Corporate	Date:	07/13/01
Material:	Geotextile covering Tri-Planar Geonet	Tested By:	MLB
Sample ID:	NC AASHTO No. 67 Stone with Triplaner Net with Fabric	Checked By:	JB

TEST CONFIGURATION



Normal Load (psf): 15,000

Test Water Temperature = 19.7
Temp. Corr. Factor = 1.0080

READING TIME	REPLICATE No.	GRADIENT	VOLUME cc	TIME secs	FLOW RATE cc/sec	TRANSMISSIVITY m2/sec	FLOW gal/min/ft
72 Hours	1	0.33	2844.00	13.42	211.92	2.12E-03	3.36
	2	0.33	2807.00	13.31	210.89	2.11E-03	3.34
	3	0.33	2776.00	13.22	209.98	2.10E-03	3.33
	Average					**2.11E-03**	**3.34**
72 Hours	1	0.10	2157.00	21.14	102.03	3.37E-03	1.62
	2	0.10	2157.00	21.11	102.18	3.38E-03	1.62
	3	0.10	2209.00	21.63	102.13	3.38E-03	1.62
	Average					**3.38E-03**	**1.62**
72 Hours	1	0.05	1780.00	30.17	59.00	3.90E-03	0.94
	2	0.05	1789.00	31.35	57.07	3.77E-03	0.90
	3	0.05	1806.00	31.84	56.72	3.75E-03	0.90
	Average					**3.81E-03**	**0.91**
72 Hours	1	0.02	1180.00	45.12	26.15	4.32E-03	0.41
	2	0.02	1193.00	45.62	26.15	4.32E-03	0.41
	3	0.02	1177.00	45.04	26.13	4.32E-03	0.41
	Average					**4.32E-03**	**0.41**

FIGURE 4

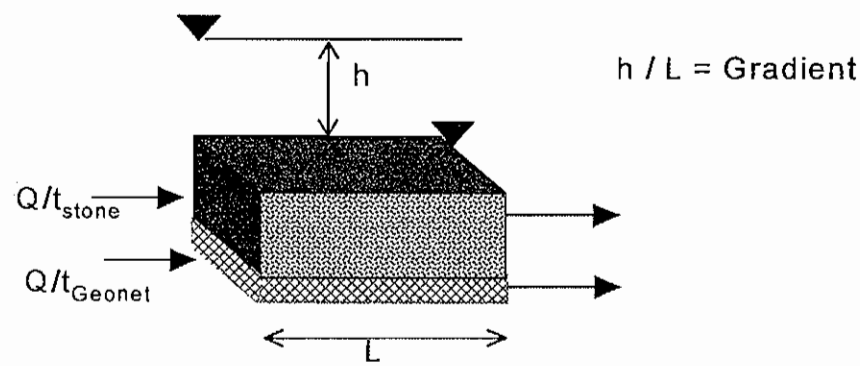
J&L Testing Company, Inc. 938 S. Central Avenue, Canonsburg, PA 15317 * Tel: (724) 746-4441 / Fax: (724) 745-4261

EQUIVALENCY COMPARISON

Does 6 inches of AASHTO No. 67 stone underlain with a geocomposite provide the same flow properties as 12 inches of AASHTO No. 67 stone?

Flow of 6 inches of stone + Geonet >/= 12 inches of stone

	Computed Flow in gal/min/ft			
Gradient	**12 in. Stone**	**6 in. Stone**	**Geonet**	**6 in. plus Geonet**
0.33	5.42	2.71	3.34	6.05
0.10	1.64	0.82	1.62	2.44
0.05	0.82	0.41	0.91	1.32
0.02	0.33	0.16	0.41	0.57



Total Flow = Stone Flow plus Drainage Net Flow

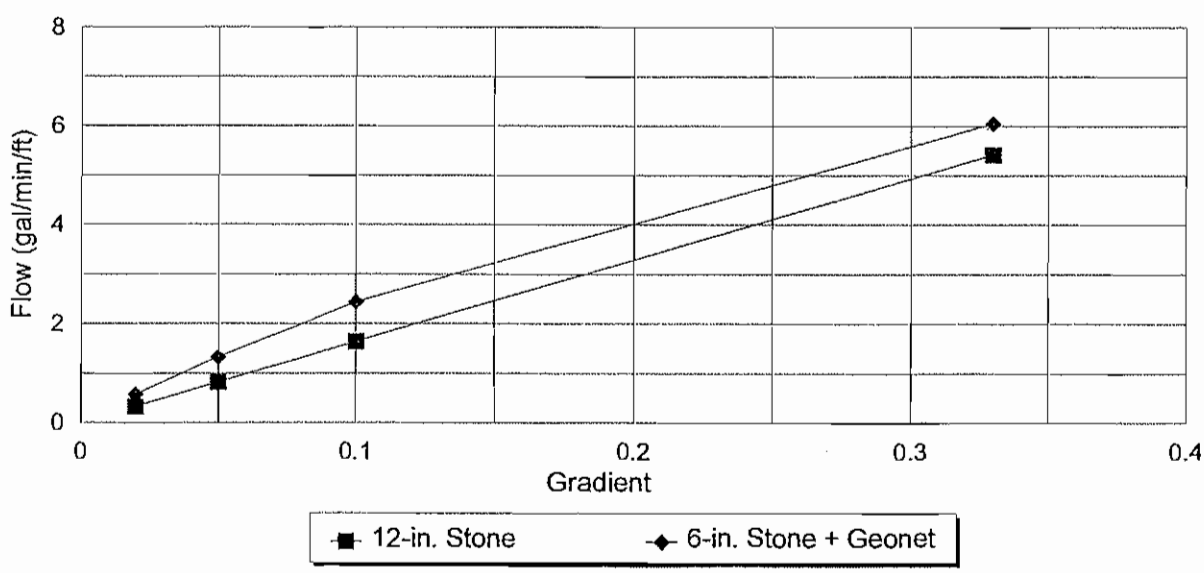


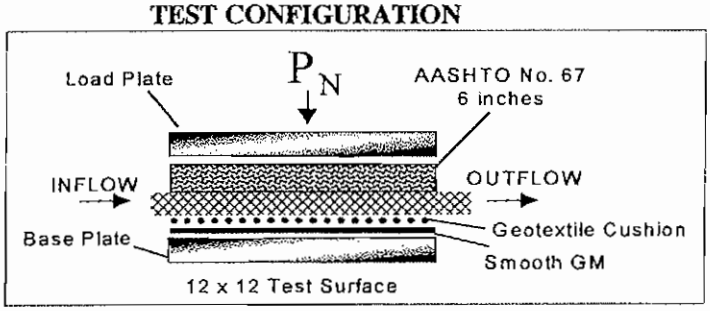
FIGURE 5

TRANSMISSIVITY TEST RESULTS
ASTM D-4716

JLT

Client:	Tenax Corporation	Job Number:	01G2731-01
Project:	Corporate	Date:	11/25/01
Material:	Tri-Planar Geonet overlying Geotextile Cushion	Tested By:	MLB
Sample ID:	NC AASHTO No. 67 Stone with Fabric and Triplaner Net	Checked By:	JB

TEST CONFIGURATION



Normal Load (psf): 15,000

Test Water Temperature = 19.8
Temp. Corr. Factor = 1.0050

READING TIME	REPLICATE No.	GRADIENT	VOLUME cc	TIME secs	FLOW RATE cc/sec	TRANSMISSIVITY m2/sec	FLOW gal/min/ft
72 Hours	1	0.33	2513.00	13.12	191.54	1.91E-03	3.05
	2	0.33	2531.00	13.24	191.16	1.91E-03	3.05
	3	0.33	2520.00	13.18	191.20	1.91E-03	3.05
	Average					**1.91E-03**	**3.05**
72 Hours	1	0.10	2002.00	20.22	99.01	3.26E-03	1.58
	2	0.10	2044.00	20.78	98.36	3.24E-03	1.57
	3	0.10	2023.00	20.45	98.92	3.26E-03	1.58
	Average					**3.26E-03**	**1.57**
72 Hours	1	0.05	1632.00	30.25	53.95	3.56E-03	0.86
	2	0.05	1688.00	31.46	53.66	3.54E-03	0.85
	3	0.05	1663.00	30.99	53.66	3.54E-03	0.85
	Average					**3.54E-03**	**0.86**
72 Hours	1	0.02	1084.00	46.34	23.39	3.86E-03	0.37
	2	0.02	1101.00	46.81	23.52	3.88E-03	0.37
	3	0.02	1093.00	46.37	23.57	3.89E-03	0.38
	Average					**3.87E-03**	**0.37**

FIGURE 6

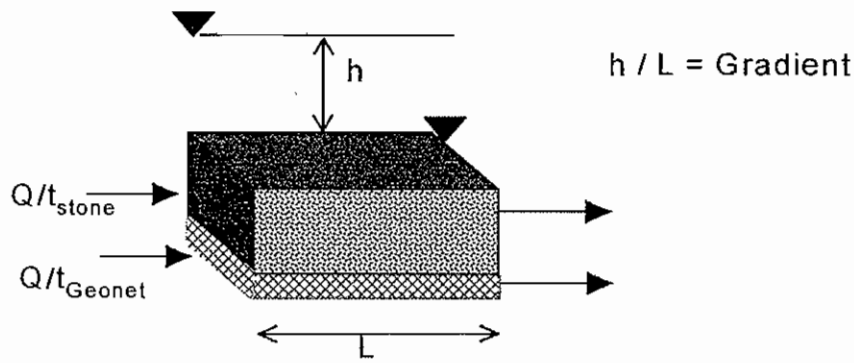
J&L Testing Company, Inc. 938 S. Central Avenue, Canonsburg, PA 15317 * Tel: (724) 746-4441 / Fax: (724) 745-4261

EQUIVALENCY COMPARISON

Does 6 inches of AASHTO No. 67 stone underlain with a triplanar geonet provide the same flow properties as 12 inches of AASHTO No. 67 stone?

Flow of 6 inches of stone + Geonet >/= 12 inches of stone

	Computed Flow in gal/min/ft			
Gradient	**12 in. Stone**	**6 in. Stone**	**Geonet**	**6 in. plus Geonet**
0.33	5.42	2.71	3.05	5.76
0.10	1.64	0.82	1.57	2.39
0.05	0.82	0.41	0.86	1.27
0.02	0.33	0.16	0.37	0.53



Total Flow = Stone Flow plus Drainage Net Flow

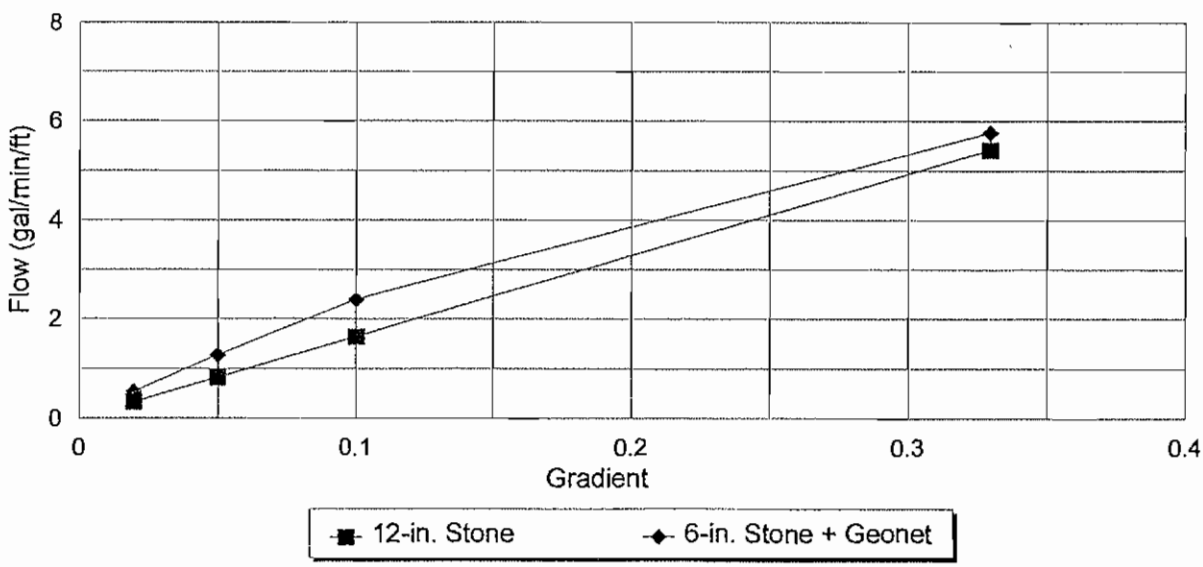


FIGURE 7

DRAINAGE LAYER CALCULATIONS

12 inches of AASHTO No. 67 Stone

Permeability = 1.83 cm/sec = 2.196 ft/min (From AASHTO)

Permeability, k = Q * L / A * h * t

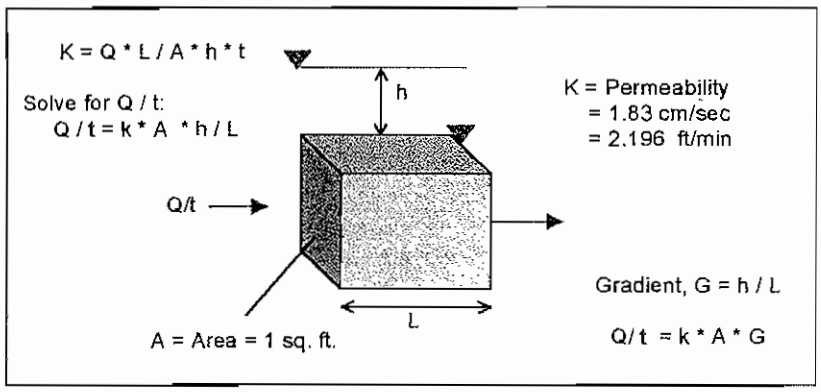
To determine flow rate, solve for Q / t :

Q / t = k * A * h / L
where: h / L = Gradient, G

Q / t = k * A * G

Q / t = k * A * G = 2.196 ft/min * 1 sq ft * G * 7.48 gal / cu ft

k =	2.196	feet/min
A =	1	sq ft
G =	0.33	
	0.01	
	0.05	
	0.02	



Gradient	Flow gal/min/ft
0.33	5.42
0.10	1.64
0.05	0.82
0.02	0.33

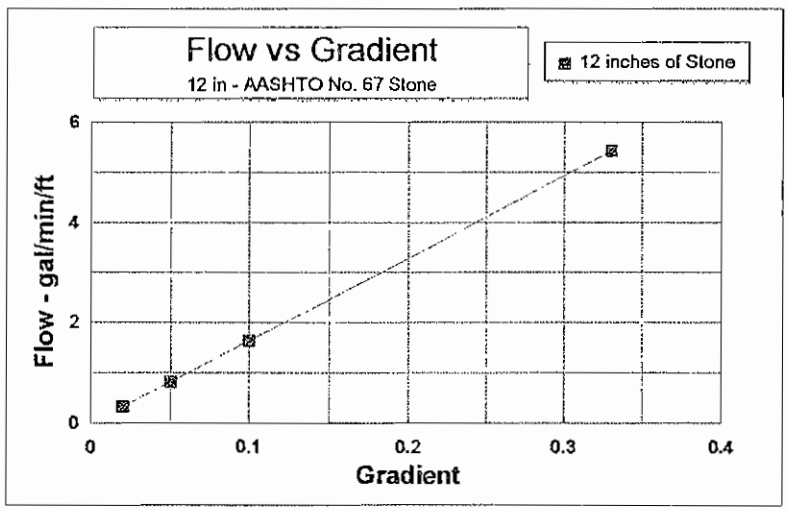


FIGURE 2

DRAINAGE LAYER CALCULATIONS

6 inches of AASHTO No. 67 Stone

Permeability = 1.83 cm/sec = 2.196 feet/min (From AASHTO)

Permeability, k = Q * L / A * h * t

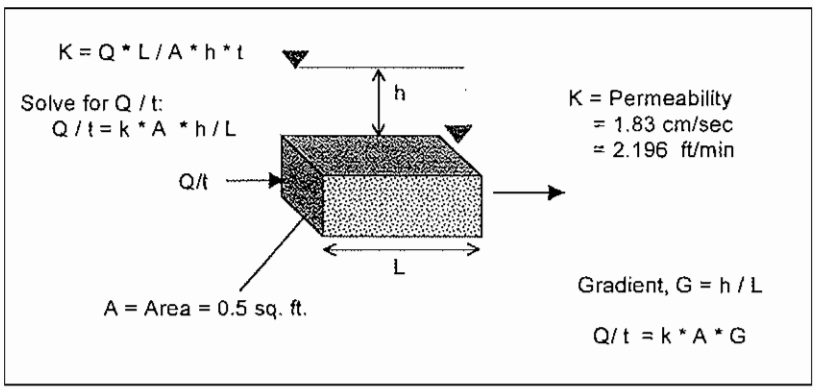
To determine flow rate, solve for Q / t :

Q / t = k * A * h / L
where: h / L = Gradient, G

Q / t = k * A * G

Q / t = k * A * G = 2.196 ft/min * 0.5 sq ft * G * 7.48 gal / cu ft

k =	2.196	feet/min
A =	0.5	sq ft
G =	0.33	
	0.01	
	0.05	
	0.02	



Gradient	Flow gal/min/ft
0.33	2.71
0.10	0.82
0.05	0.41
0.02	0.16

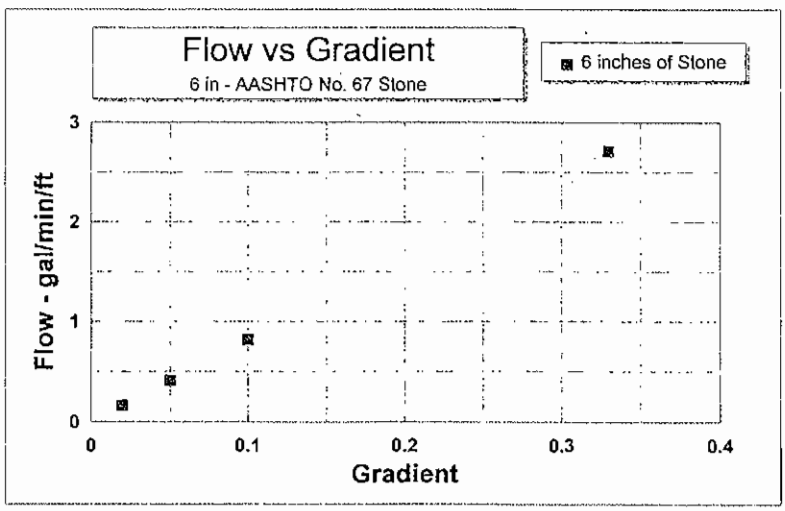


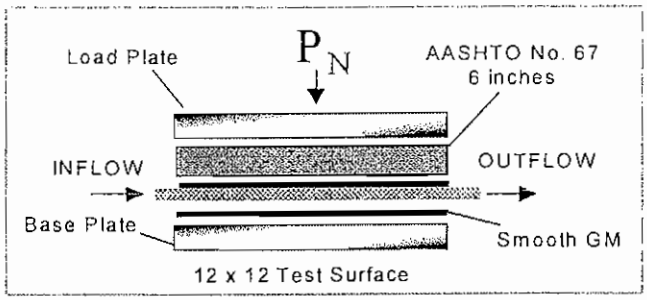
FIGURE 3

TRANSMISSIVITY TEST RESULTS
ASTM D-4716

JLT

Client:	Tenax Corporation	Job Number:	01G2731-01
Project:	Corporate	Date:	07/13/01
Material:	Geotextile covering Tri-Planar Geonet	Tested By:	MLB
Sample ID:	NC AASHTO No. 67 Stone with Triplaner Net with Fabric	Checked By:	JB

TEST CONFIGURATION



Normal Load (psf): 15,000

					Test Water Temperature =		19.7
					Temp. Corr. Factor =		1.0080
READING TIME	REPLICATE No.	GRADIENT	VOLUME cc	TIME secs	FLOW RATE cc/sec	TRANSMISSIVITY m2/sec	FLOW gal/min/ft
72 Hours	1	0.33	2844.00	13.42	211.92	2.12E-03	3.36
	2	0.33	2807.00	13.31	210.89	2.11E-03	3.34
	3	0.33	2776.00	13.22	209.98	2.10E-03	3.33
	Average					**2.11E-03**	**3.34**
72 Hours	1	0.10	2157.00	21.14	102.03	3.37E-03	1.62
	2	0.10	2157.00	21.11	102.18	3.38E-03	1.62
	3	0.10	2209.00	21.63	102.13	3.38E-03	1.62
	Average					**3.38E-03**	**1.62**
72 Hours	1	0.05	1780.00	30.17	59.00	3.90E-03	0.94
	2	0.05	1789.00	31.35	57.07	3.77E-03	0.90
	3	0.05	1806.00	31.84	56.72	3.75E-03	0.90
	Average					**3.81E-03**	**0.91**
72 Hours	1	0.02	1180.00	45.12	26.15	4.32E-03	0.41
	2	0.02	1193.00	45.62	26.15	4.32E-03	0.41
	3	0.02	1177.00	45.04	26.13	4.32E-03	0.41
	Average					**4.32E-03**	**0.41**

FIGURE 4

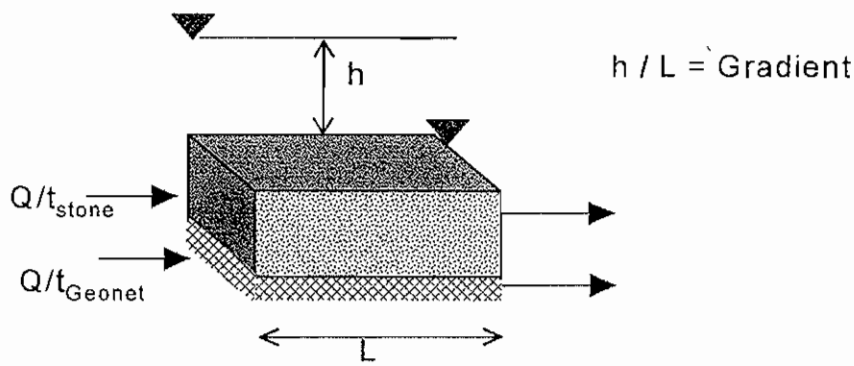
J&L Testing Company, Inc. 938 S. Central Avenue, Canonsburg, PA 15317 * Tel: (724) 746-4441 / Fax: (724) 745-4261

EQUIVALENCY COMPARISON

Does 6 inches of AASHTO No. 67 stone underlain with a geocomposite provide the same flow properties as 12 inches of AASHTO No. 67 stone?

Flow of 6 inches of stone + Geonet >/= 12 inches of stone

	Computed Flow in gal/min/ft			
Gradient	**12 in. Stone**	**6 in. Stone**	**Geonet**	**6 in. plus Geonet**
0.33	5.42	2.71	3.34	6.05
0.10	1.64	0.82	1.62	2.44
0.05	0.82	0.41	0.91	1.32
0.02	0.33	0.16	0.41	0.57



Total Flow = Stone Flow plus Drainage Net Flow

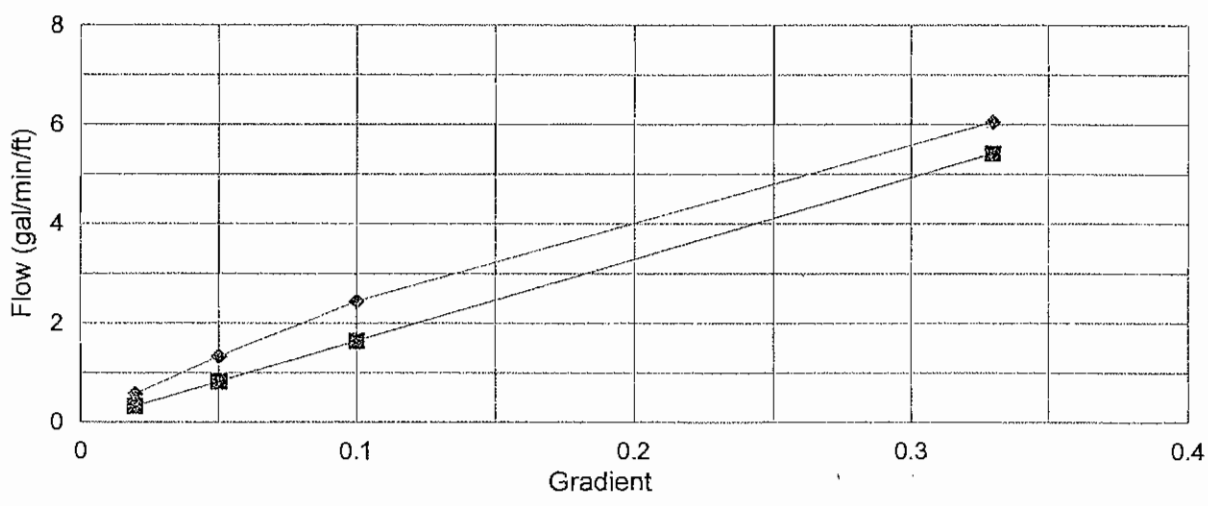


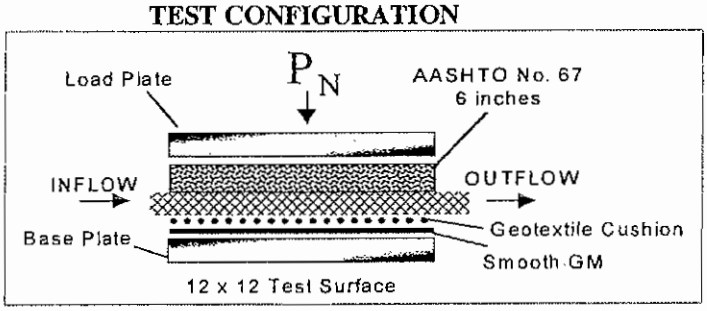
FIGURE 5

TRANSMISSIVITY TEST RESULTS
ASTM D-4716

JLT

Client:	Tenax Corporation	Job Number:	01G2731-01
Project:	Corporate	Date:	11/25/01
Material:	Tri-Planar Geonet overlying Geotextile Cushion	Tested By:	MLB
Sample ID:	NC AASHTO No. 67 Stone with Fabric and Triplaner Net	Checked By:	JB

TEST CONFIGURATION



Normal Load (psf): 15,000

Test Water Temperature = 19.8
Temp. Corr. Factor = 1.0050

READING TIME	REPLICATE No.	GRADIENT	VOLUME cc	TIME secs	FLOW RATE cc/sec	TRANSMISSIVITY m2/sec	FLOW gal/min/ft
72 Hours	1	0.33	2513.00	13.12	191.54	1.91E-03	3.05
	2	0.33	2531.00	13.24	191.16	1.91E-03	3.05
	3	0.33	2520.00	13.18	191.20	1.91E-03	3.05
	Average					**1.91E-03**	**3.05**
72 Hours	1	0.10	2002.00	20.22	99.01	3.26E-03	1.58
	2	0.10	2044.00	20.78	98.36	3.24E-03	1.57
	3	0.10	2023.00	20.45	98.92	3.26E-03	1.58
	Average					**3.26E-03**	**1.57**
72 Hours	1	0.05	1632.00	30.25	53.95	3.56E-03	0.86
	2	0.05	1688.00	31.46	53.66	3.54E-03	0.85
	3	0.05	1663.00	30.99	53.66	3.54E-03	0.85
	Average					**3.54E-03**	**0.86**
72 Hours	1	0.02	1084.00	46.34	23.39	3.86E-03	0.37
	2	0.02	1101.00	46.81	23.52	3.88E-03	0.37
	3	0.02	1093.00	46.37	23.57	3.89E-03	0.38
	Average					**3.87E-03**	**0.37**

FIGURE 6

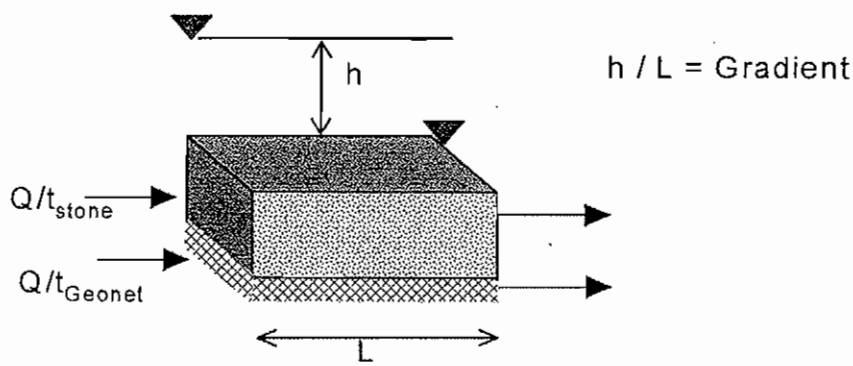
J&L Testing Company, Inc. 938 S. Central Avenue, Canonsburg, PA 15317 * Tel: (724) 746-4441 / Fax: (724) 745-4261

EQUIVALENCY COMPARISON

Does 6 inches of AASHTO No. 67 stone underlain with a triplanar geonet provide the same flow properties as 12 inches of AASHTO No. 67 stone?

Flow of 6 inches of stone + Geonet >/= 12 inches of stone

	Computed Flow in gal/min/ft			
Gradient	**12 in. Stone**	**6 in. Stone**	**Geonet**	**6 in. plus Geonet**
0.33	5.42	2.71	3.05	5.76
0.10	1.64	0.82	1.57	2.39
0.05	0.82	0.41	0.86	1.27
0.02	0.33	0.16	0.37	0.53



Total Flow = Stone Flow plus Drainage Net Flow

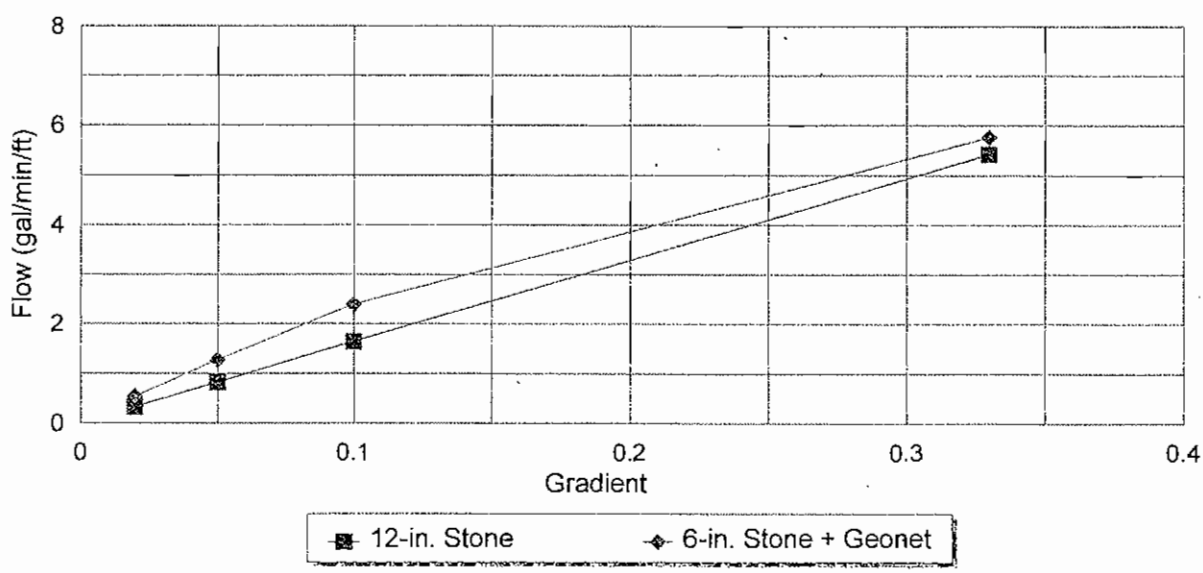


FIGURE 7

Appendix I
Pipe Strength Calculations

DESIGN SHEET

RMT INC.

SHEET 1 OF 3

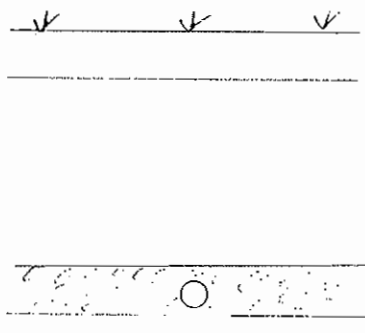
41 Perimeter Center, East Suite 399 Atlanta, GA 30346 Phone: 770-913-0280 FAX: 770-913-9353

PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
Weyerhaeuser Plymouth LF #3	DMT	5/25/99	DKN	6/11/99	5101.01

Pipe Strength Calculations for leachate system

Based on loading, determine standard dimension ratio, SDR, of leachate collection and transfer pipe.

$$SDR = \frac{O.D.}{\text{Wall Thickness}}$$



Soil/Vegetative layer (1' @ 100 pcf)

Waste layer (19.7' @ 70 pcf)

Drainage layer (1.5' @ 130 pcf)

P_s = Total Static Load on Pipe = 1(100) + 19.7(70) + 1.5(130)
= 13,385 psf
= 93.0 psi

① Design by wall crushing:

Assume SF of 2.0. $SF = 1500 / S_A$ where 1,500 = compressive yield strength (psi) of pipe

S_A = actual compressive stress (psi)

$SF = 2 = 1,500 / S_A \therefore S_A = 750$ psi

$S_A = \left(\frac{SDR-1}{2}\right) P_t$ where $P_t = P_s = 93$ psi

$\therefore SDR = \frac{2S_A}{P_t} + 1 = 2\left(\frac{750 \text{ psi}}{93 \text{ psi}}\right) + 1 = \underline{\underline{17.1}}$

DESIGN SHEET

RMT INC.
41 Perimeter Center, East Suite 399 Atlanta, GA 30346 Phone: 770-913-0280 FAX: 770-913-9353

PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
Weyerhaeuser Plymouth LF # 3	EWI	5/25/99	RKN	6/1/99	5101.01

② Design by wall buckling:

Assume $SF = 2.0$

$SF = P_{CB} / P_t$ where P_{CB} = critical buckling soil pressure at top of pipe (psi)

$SF = 2 = P_{CB} / 93.0 \quad \therefore P_{CB} = 186$ psi

$P_{CB} = 0.8\sqrt{E' \cdot P_c}$ where: E' = soil modulus in psi calculated as the ratio of vertical soil pressure to vertical soil strain at a specified density (13,900 for gravel bed)

P_c = hydrostatic critical collapse differential pressure

$$P_c = \frac{\left[\frac{P_{CB}}{0.8}\right]^2}{E'} = \frac{\left(\frac{186}{0.8}\right)^2}{13,900} = 3.89 \text{ psi}$$

$$P_c = \frac{2.32E}{(SDR)^3} \quad \therefore \quad SDR = \sqrt[3]{\frac{2.32E}{P_c}}$$

where: E = Stress & time dependent tensile modulus of elasticity for HDPE pipe. @ 750 psi & 50 yrs $E = 14,000$ psi

$$SDR = \sqrt[3]{\frac{(2.32)(14,000)}{3.89}} = \underline{\underline{20.3}}$$

DESIGN SHEET

RMT INC.

SHEET 3 OF 3

41 Perimeter Center, East Suite 399 Atlanta, GA 30346 Phone: 770-913-0280 FAX: 770-913-9353

PROJECT/PROPOSAL NAME	PREPARED By:	PREPARED Date:	CHECKED By:	CHECKED Date:	PROJECT/PROPOSAL NO.
Weyerhaeuser Plymouth	EWT	5/25	RKN	6/1/99	5101.01

(3) Design by Ring Deflection:

Assume $\varepsilon_s < \Delta Y / D$ where ε_s = vertical soil strain = P_e / E'

$$\varepsilon_s = \frac{93}{13{,}900} = 0.007$$

ΔY = vertical pipe deflection
D = pipe O.D.

$$\frac{\Delta Y}{D} = 0.0025 \text{ SDR}$$

$$\text{SDR} > \frac{\Delta Y}{D} \Big/ 0.0025 = \frac{0.007}{0.0025} = 2.8$$

$\therefore$ SDR > 2.8

(4) Conclusion

SDR of 17 satisfies all conditions.

Using 6 O.D. pipe, wall thickness = 0.35 inches

$\therefore$ Resultant pipe I.D. = 6 − 2(0.35) = 5.3 inches

Appendix J
Material Volume Calculations

DESIGN SHEET

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

PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER - LANDFILL No 3	DMC	9/22/99	[illegible]	9/23/99	5101.01

CAPACITY FOR EACH PHASE:

PHASE 1:	TOTAL	665,143 C.Y.
	CAP MAT'L (-)	31,470 C.Y.
	LEACHATE (-)	37,000 C.Y.
	NET	596,673 C.Y.
PHASE 2:	TOTAL	782,601 C.Y.
	CAP MAT'L (-)	27,840 C.Y.
	LEACHATE (-)	36,600 C.Y.
	NET	718,161 C.Y.
PHASE 3:	TOTAL	616,873 C.Y.
	CAP MAT'L (-)	6,800 C.Y.
	LEACHATE (-)	13,526 C.Y.
	NET	596,547 C.Y.
PHASE 4:	TOTAL	894,204 C.Y.
	CAP MAT'L (-)	15,270 C.Y.
	LEACHATE (-)	14,880 C.Y.
	NET	864,054 C.Y.
PHASE 5:	TOTAL	805,032 C.Y.
	CAP MAT'L (-)	8,290 C.Y.
	LEACHATE (-)	14,600 C.Y.
	NET	782,142 C.Y.
PHASE 6:	TOTAL	831,488 C.Y.
	CAP MAT'L (-)	9,030 C.Y.
	LEACHATE (-)	12,359 C.Y.
	NET	810,099 C.Y.

NOTE: LEACHATE REFERS TO THE LEACHATE COLLECTION SYSTEM; 6 IN SAND & 12 IN. STONE

DESIGN SHEET

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

PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER - LANDFILL № 3	DMC	9/22/99	[illegible]	9/22/99	5101.01

CAPACITY FOR EACH PHASE:

PHASE 7: TOTAL 777,643 C.Y.
CAP MAT'L (-) 8,750 C.Y.
LEACHATE (-) 11,642 C.Y.
NET 757,251 C.Y.

PHASE 8: TOTAL 792,100 C.Y.
CAP MAT'L (-) 7,450 C.Y.
LEACHATE (-) 11,462 C.Y.
NET 773,188 C.Y.

PHASE 9: TOTAL 637,146 C.Y.
CAP MAT'L (-) 7,450 C.Y.
LEACHATE (-) 11,426 C.Y.
NET 618,270 C.Y.

PHASE 10: TOTAL 532,169 C.Y.
CAP MAT'L (-) 20,300 C.Y.
LEACHATE (-) 13,364 C.Y.
NET 498,505 C.Y.

PHASE 11: TOTAL 619,504 C.Y.
CAP MAT'L (-) 14,900 C.Y.
LEACHATE (-) 15,970 C.Y.
NET 588,634 C.Y.

PHASE 12: TOTAL 382,170 C.Y.
CAP MAT'L (-) 8,010 C.Y.
LEACHATE (-) 6,245 C.Y.
NET 367,915 C.Y.

DESIGN SHEET

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

PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER - LANDFILL No 3	DMC	9/22/99	[illegible]	9/23/99	5101.01

CAPACITY FOR EACH PHASE:

PHASE 13:	TOTAL	446,978 C.Y.	8,783,051
	CAP MAT'L (-)	8,570 C.Y.	
	LEACHATE (-)	6,115 C.Y.	
	NET	432,293 C.Y.	
PHASE 14:	TOTAL	471,936 C.Y.	9,254,987
	CAP MAT'L (-)	8,100 C.Y.	
	LEACHATE (-)	6,022 C.Y.	
	NET	457,814 C.Y.	
PHASE 15:	TOTAL	528,105 C.Y.	9,783,092
	CAP MAT'L (-)	8,010 C.Y.	
	LEACHATE (-)	5,894 C.Y.	
	NET	514,201 C.Y.	
PHASE 16:	TOTAL	578,736 C.Y.	10,361,828
	CAP MAT'L (-)	11,360 C.Y.	
	LEACHATE (-)	5,710 C.Y.	
	NET	561,666 C.Y.	
PHASE 17:	TOTAL	376,347 C.Y.	10,738,175
	CAP MAT'L (-)	3,540 C.Y.	
	LEACHATE (-)	5,662 C.Y.	
	NET	367,145 C.Y.	
PHASE 18:	TOTAL	575,521 C.Y.	11,313,696
	CAP MAT'L (-)	40,500 C.Y.	
	LEACHATE (-)	6,929 C.Y.	
	NET	528,092 C.Y.	

DESIGN SHEET

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

PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER - LANDFILL No 3	DMC	9/22/99	[illegible]	9/28/99	6101.01

TOTALS FOR PHASE 1 THROUGH 18

1. CAPACITY (AIRSPACE) — 10,832,650 C.Y.
2. CAP MATERIAL - TOPSOIL - 82,200 C.Y.
   * GEN FILL - 179,784 C.Y.
3. LEACHATE COLLECTION LAYER — 235,406 C.Y.
4. FOOTPRINT (EDGE OF WASTE) — 98.61 ACRES

* 10% SHRINKAGE WAS USED FOR GEN. FILL IN CAP

Appendix K
Borrow Investigation

BORROW INVESTIGATION REPORT OF THE FORMER SNELL AND BEASLEY PROPERTIES

WEYERHAEUSER COMPANY
PLYMOUTH, NORTH CAROLINA

January 1999

R. Kent Nilsson, P.E.
Project Manager/Consulting Engineer

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

G:\WPGVL\S\510102A.DOC

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Table of Contents

1. Introduction 1
   - 1.1 Background 1
   - 1.2 Scope 1
   - 1.3 Qualification 1
   - 1.4 Site Conditions 2

2. Borrow Investigation 4
   - 2.1 Review of Soil Survey Data 4
   - 2.2 Subsurface Exploration 4

3. Findings and Conclusions 7
   - 3.1 Findings 7
   - 3.2 Conclusions 9

4. Recommendations 10

List of Tables

Table 1 Summary of Laboratory Test Data 6

List of Appendices

Appendix A Test Pit Locations and Logs

Appendix B Laboratory Testing Results

Section 1
Introduction

Weyerhaeuser Company (Weyerhaeuser) purchased the former Snell and Beasley Properties, South and adjacent to the site of the proposed No. 3 Landfill. The property locations are shown on Figure 1 in Section 2 of this report. Weyerhaeuser retained RMT, Inc., North Carolina (RMT), to investigate the soil on these properties for potential use as borrow material for closure of Weyerhaeuser's No. 2 Landfill and construction of Weyerhaeuser's No. 3 Landfill.

1.1 Background

In 1993, RMT developed a Construction Plan Application (CPA) for Weyerhaeuser for permiting a new landfill at the Plymouth facility. Weyerhaeuser has recently acquired some adjacent property, and RMT is redesigning the proposed landfill to increase its capacity and possibly upgrade its liner system. Two of the property acquisitions (Snell and Beasley), could result in more "on-site" borrow source material being available for landfill construction and closure. Each of these properties is approximately 40 acres.

1.2 Scope

In October 1998, RMT conducted an investigation of soils on both the Snell and Beasley Properties to determine if a suitable source of clay borrow for liner or cap construction existed on either site. The investigation was to evaluate availability, suitability, and quantity of clay.

The borrow investigation included the following tasks:

- Reviewing existing Soil Conservation Service (SCS) soil survey maps and data
- Exploring the sites by excavating test pits
- Performing laboratory testing
- Estimating order of magnitude soil quantities

This report documents RMT's findings, conclusions, and recommendations. It also includes test pit logs, laboratory data, and a data point location and soil survey map.

1.3 Qualification

The conclusions and recommendations presented in this report represent RMT's professional engineering judgment based on the information reviewed, the interpretation of field and laboratory test data, and past experience. RMT's evaluation included the extrapolation of data

that represents subsurface conditions at the locations and times sampled. Given the inherent variability of soil conditions, actual conditions in the areas not sampled may differ from predictions. Therefore, the discovery of any site or subsurface conditions that deviate from data generated during the investigation should be reported to RMT for evaluation.

This report has been prepared for the exclusive use of Weyerhaeuser and its designates for specific application to the clay borrow source for the liner of the proposed landfill and the cap of the existing landfill. If the project information is incorrect or modified, RMT should be contacted so that the recommendations outlined in Section 4 can be reviewed.

RMT's services have been performed in accordance with generally accepted engineering principles and practices. This warranty is in lieu of all other warranties either expressed or implied.

1.4 Site Conditions

The Snell Property consists of approximately 40 acres located on the west side of Ken Trowbridge Road, approximately 1,300 feet north of its intersection with Highway 64. At the time of our investigation, nearly half of the property had been cultivated as two separate cotton fields. The remainder of the site was covered with a heavy growth of mixed hardwoods and softwoods. The topography is relatively planar, generally sloping to the east at a rate of between 0.5 to 1 percent. A shallow natural drainage swale trending in a northerly direction is located in the northeast quadrant of the site. Drainage ditches 2 to 3 feet in depth were observed in and adjacent to the cotton fields. Elevations across the site range from approximately 37 feet mean sea level (msl) at the southwest corner of the west cotton field to 22 feet msl in the drainage swale.

The Beasley Property consists of approximately 37 acres located on the north side of Highway 64, approximately 1,500 feet west of its intersection with Ken Trowbridge Road. The property adjoins the Snell Property along its northeasterly side. At the time of our investigation, an abandoned retail business building occupied an area at the southwest corner of the site. Foundation remains along the Highway 64 frontage indicated the former presence of two houses on the south side. An unimproved access road, trending south to north, bisected the site. The north side of the parcel is bordered by a recently improved drainage swale. With the exception of grassed areas in the vicinity of the existing building and former residences and areas cleared in conjunction with construction of the drainage improvements on the north, the site was covered with dense underbrush or undeveloped woodland. Topographic mapping indicates that a gentle ridge extends across the site in a north-south direction. The topography is relatively planar, generally sloping to the east and to the drainage swale at the northwest at a

rate of between 0.5 to 6 percent. Elevations across the site range from approximately 41 feet msl on the top of the ridge to 24 feet msl at the southeast corner.

Although wetlands delineation was still in progress at the time of the preparation of this report, there do not appear to be wetlands on either of the two properties.

Section 2
Borrow Investigation

2.1 Review of Soil Survey Data

To assist in planning our subsurface investigation and in providing some general delineation of soil units for estimating material volumes, RMT reviewed soil survey maps and tables for Washington County prepared by the Soil Conservation Service (Soil Survey, Washington County, North Carolina, December, 1981). Our review included review of tabulated engineering data for each of the map units, including soil classifications, grain size distribution, and index properties.

2.2 Subsurface Exploration

The Beasley Property was investigated by excavating 12 test pits across the site to depths between 7 to 10 feet. The Snell Property was investigated by excavating 14 test pits across the site to depths between 8 to 12 feet. The test pits were typically spaced about 500 to 600 feet apart to provide representative areal coverage. The test pits were excavated using a tractor-mounted backhoe.

RMT's geotechnical engineer visually classified the soil from each test pit in the field and collected representative samples for laboratory testing as soil types appeared to change. Test pit logs summarizing the visual classifications are provided in Appendix A. The stratification lines shown on the test pit logs represent approximate boundaries between soil types. Actual transitions between soil types may be gradual. The approximate test pit locations are shown on Figure 1, the Soil Classification Map, SCS soil units are also shown, included in Appendix A, with some minor adjustment to the boundaries to reflect conditions encountered by our subsurface exploration.

RMT's soils laboratory performed testing on the soil samples submitted. Laboratory data are included as Appendix B. Laboratory testing consisted of Atterberg limits testing, grain size analysis, hydrometer analyses, specific gravity testing, Standard Proctor testing, falling head permeability testing, and natural moisture content determination. Atterberg limits testing and grain size analyses were used for soil classification, as well as correlating data to engineering properties such as permeability. The natural moisture content determination was also used to establish a correlation to soil behavior. The specific gravity was used to establish a Zero Air Voids curve, which is a boundary on the Proctor test curve. Data from the Standard Proctor tests were used for remolding the soil to simulate field conditions, such as densities and

moisture contents, of the liner during construction. Falling head permeability testing was performed on the remolded soil samples to determine which soil could meet the permeability requirements under the typical compaction conditions. Results of the laboratory testing are presented in Appendix B. A summary of the laboratory test data is provided in Table 1.

Table 1
Summary of Laboratory Test Data

SAMPLE	SCS SOIL UNIT	MOISTURE CONTENT %	GRAIN SIZE (%)			ATTERBERG LIMITS			CLASS	STANDARD PROCTOR		HYDRAULIC CONDUCT.
			SAND	SILT	CLAY	LL	PL	PI		O.M.C. (%)	M.D.D. (pcf)	(cm/s)
TP-2 @ 0.5'	DgA	18.7				41	22	19	CL			
TP-3 @ 0-1'	DgA	6.2	67	18	15				SM			
TP-3 @ 1-6'	DgA		64			29	21	8	SC			
TP-4 @ 8"-5'	DgA	25.3	25	24	51	58	28	30	CH	23.3	98.6	9.6×10^{-9}
TP-4 @ 10-11'	DgA	41.0	12	29	59	55	31	24	MH	25.6	94.3	1.2×10^{-8}
TP-5 @ 0.5-3'	DgA	23.0				45	22	23	CL			
TP-5 @ 7-11'	DgA	41.2				56	27	29	CL			
TP-6 @ 2-5'	DgA	19.6				46	22	24	CL			
TP-6 @ 7-8.5'	DgA	33.8				63	32	31	CH			
TP-7 @ 8-10'	DgA	27.3	16	28	56	54	27	27	CH	24.0	96.1	1.1×10^{-8}
TP-8 @ 3.5-6.5'	DgA	27.9	14	32	54				CL			
TP-8 @ 10.5-11'	DgA	30.8	21	43	36	43	23	20	CL			
TP-9 @ 1.5-6'	DgA	22.8	33	14	53	56	26	30	CH	22.7	96.6	2.9×10^{-8}
TP-9 @ 6-9'	DgA	9.5	79	7	14				SM			
TP-9 @ 9-11'	DgA	21.4	24	39	37				CL			
TP-12 @ 4.5'	At	15.9				28	16	12	CL			
TP-13 @ 2-5'	AaA	20.3	51	9	40	40	27	13	SC	17.6	107.0	6.0×10^{-8}
TP-13 @ 5'	AaA	18.0				32	18	14	SC			
TP-16 @ 2.5-5.5'	At	24.1	48	27	25				CL			
TP-18 @ 3-8'	WkB		62			33	19	14	SC			
TP-19 @ 1.5-2.5'	AaA	14.8				31	17	14	SC			
TP-21 @ 2.5-6.5'	WkB	17.0				25	19	6	CL-ML			
TP-22 @ 3-4'	CtA	16.0	70	11	19				SM			
TP-22 @ 8.5-9.5	CtA	33.8	37	23	40				CL			
TP-25 @ 2-3.5'	WkB	24.6				60	31	29	CH			
TP-25 @ 5.5'	WkB	10.6	74	4	22				SC			

Section 3
Findings and Conclusions

The findings from this borrow source investigation are presented in Subsection 3.1. The conclusions drawn from these findings are presented in Subsection 3.2.

3.1 Findings

The laboratory test results are summarized in Table 1. The following findings were based on RMT's observations and laboratory test results.

- Review of Soil Conservation Service soil maps indicates that the Snell and Beasley properties are underlain by five major soil units as follows:
    1. Altavista fine sandy loam (AaA)
    2. Augusta fine sandy loam (At)
    3. Conetoe loamy fine sand (CtA)
    4. Dogue fine sandy loam (DgA)
    5. Wickham loamy sand (WkB)

  Approximately two-thirds of the Snell Property is underlain by the same soil unit that comprises the existing borrow area adjacent to the No. 2 Landfill, DgA. It should be recognized, however, that any of the map units may include scattered areas of soils of different properties. Observations in excavating the existing borrow source and the drainage ditch south of the landfill found significant soil variability.
- Subsurface exploration indicates that both properties are generally underlain by interbedded layers of poorly-graded sands, silty sands, clayey sands, sandy clays, and clayey silts. Based on visual classifications, test pits located in the map units identified as DgA typically encountered the largest concentration of soils classified as clays (CL, CH). Other map units showed layers of clayey sands (SC) more predominately.
- The proposed borrow sites contain a surficial layer of topsoil between 0.5 and 1-foot thick.
- Groundwater or seepage was noted in Test Pits 17 and 21 at depths of 4 feet and 10 feet, respectively. Wet to saturated soils were encountered in Test Pit 19 at a depth of 6 feet, but free water or seepage was not observed.
- Soil units identified as DgA and AaA on the former Snell Property were determined to be the most likely sources of clay suitable for liner and material that will provide remolded permeabilities of less than 1×10^{-7} cm/sec.
- Soil units identified as WkB, At, and CtA also contain layers of clayey sands that, though marginal in providing permeability of 1×10^{-7} cm/sec required for a liner, should probably meet the 1×10^{-6} cm/sec specification for cap materials for the No. 2 Landfill.

- Exploration on the Snell Property encountered one or two suitable clayey soil layers (CH, CL, and SC) at each of the test pit locations. Clay soil layers varied in thickness from 1 to 6.5 feet with an average aggregate thickness of all layers in each test pit of about 5.5 feet within the total depth of exploration. Total clay soil available for borrow from the upper 11 feet of the property is estimated to be approximately 290,000 cubic yards.
- Clayey materials were encountered at all locations on the Beasley Property except at Test Pit TP-17. Typically, these materials consisted of clayey sands (SC), which varied in thickness from 2 to 6.5 feet, averaging approximately 3.5 feet thick. Total clayey soil available per borrow is estimated to be approximately 225,000 cubic yards, assuming soils are excavated to a depth of 11 feet.
- Nearly all of the samples taken from the clayey soil strata demonstrated index properties that are favorable for the construction of low permeability clay liners or caps with hydraulic conductivities of less than 1×10^{-7} cm/sec. Typical minimum criteria are as follows:
  - Liquid Limit (LL) ≥ 30
  - Plasticity Index (PI) ≥ 10
  - Percentage of fines (P200) ≥ 50 percent passing No. 200 sieve
  - Percentage of clay ≥ 20 percent
- Clay samples tested for hydraulic conductively were generally remolded at moisture contents of 2 to 3 percent above its optimum moisture content established by the Standard Proctor test. With the exception of the sample taken from TP-4 at a 10-foot depth, the moisture content of the clays tested were close to the remolding moistures. Therefore, we expect that much of the clay material can be used directly in construction without significant moisture conditioning.
- Permeability tests performed on remolded samples of soil from TP-4, TP-7, TP-9, and TP-13 ranged from 2.9×10^{-8} cm/sec to 9.5×10^{-9} cm/sec. Lower permeabilities were derived from the fat clays samples from Test Pits TP-4 and TP-7, while higher permeabilities were measured in the clayey sands from Test Pit TP-13.
- Although our wetlands delineation effort is still in progress, preliminary delineation has not identified any jurisdictional wetlands on either of the properties that would be impacted by borrowing activities.
- Approximately 250,000 cubic yards of overburden will need to be removed to expose the underlying clayey soil layers.

3.2 Conclusions

Clay soils that are suitable for liner and cap construction are found at the former Snell and Beasley Properties within 11 feet of the ground surface. Based on the data provided herein, RMT projects the quantity of suitable clay available from both sites to range between 400,000 to 500,000 cubic yards. Due to the variation in the soil stratum between widely spaced test pits, the quantity of suitable clay projected by RMT is to be considered only as an order of magnitude estimate. In general, this estimate would be considered somewhat accurate if the average clay depths found on 40 to 50 percent of the potential borrow areas equals the clay depths found in the soil samples. Additional test pits excavations should be done prior to construction to identify locations of the thickest layers of suitable clay.

Section 4
Recommendations

The following recommendations pertain to development of the proposed borrow areas on the properties shown on Figure 1. They are based on subsurface exploration data, laboratory test results, soil survey data, and RMT's past experience with similar projects.

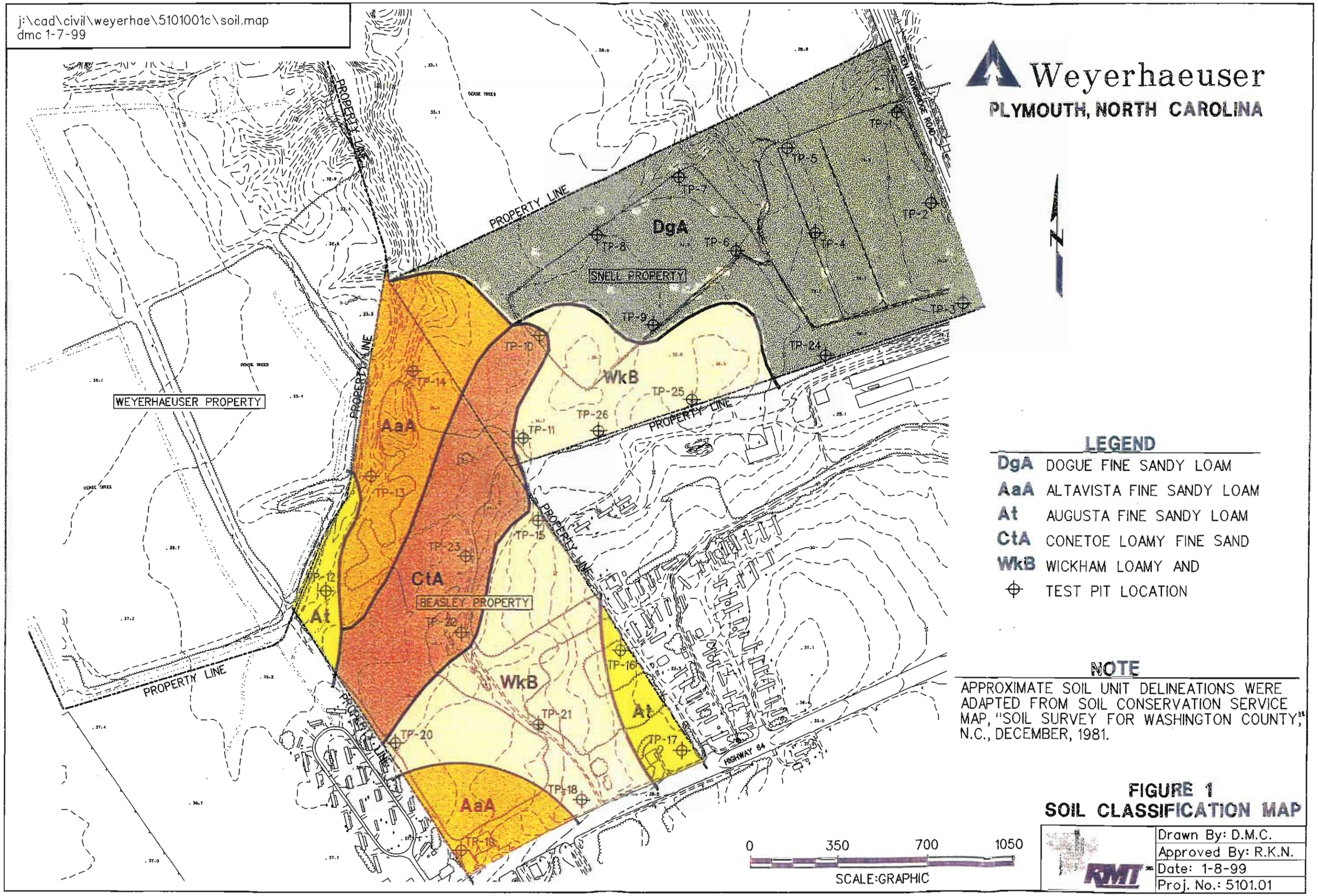
- After being cleared of timber and vegetation, the borrow areas should be thoroughly grubbed of roots. Topsoil should be stockpiled for use on the landfill cover and for revegetation of the borrow area.
- After removal of any unsuitable overburden material, the excavated clay soils should also be stockpiled on site. This will allow for more effective segregation of unsuitable soil layers as they are encountered and will facilitate a homogenization of the clayey soils.
- The select clay fill removed from the site should be free from topsoil, significant concentrations of roots, bark, organic debris, and other deleterious material.
- The select clay soil should be thoroughly blended prior to placement as liner material to incorporate the sand that was observed in the test pits as pockets and lenses within the clay. If adequate blending does not occur during excavation and loading of the soil, winnowing the clay prior to placement at the construction site might be necessary. Winnowing may also be used to decrease the moisture content in the clay, if needed.
- The clay must be placed at appropriate moisture conditions to attain the desired permeability. During liner construction, the contractor should have access to a water truck with a spray bar and a disc so that moisture content can be adjusted to achieve desired compaction results.
- During excavation of construction materials, one representative (grab) soil sample should be obtained from the borrow source for testing for every 5,000 cubic yards of clay excavated. One Atterberg limits test, one grain size analysis (sieve and hydrometer), one moisture content determination, and one moisture-density relationship using the Standard Proctor compaction should be performed on the sample. One falling head permeability test should be performed on the borrow source material remolded to 95 percent compaction at +2 percent of the optimum moisture content. A second falling head permeability test should be performed on the borrow source material remolded to 100 percent compaction at the optimum moisture content. The results from these tests will be used to confirm that clay from the borrow source will be suitable liner materials before it is transported to the project site.
- Additional soil testing may be required to establish other engineering properties of the clay as the new landfill design is finalized. This may need to include shear strength testing and liner interface friction testing.

- A borrow site development plan should be prepared which should include design measures for control of run-on/run-off, erosion control, siltation control, and reclamation of disturbed areas. North Carolina stormwater and mining permits will be required that will incorporate this information.

Appendix A
Test Pit Locations and Logs

j:\cad\civil\weyerhae\5101001c\soil.map
dmc 1-7-99

Weyerhaeuser
PLYMOUTH, NORTH CAROLINA



LEGEND

- **DgA** DOGUE FINE SANDY LOAM
- **AaA** ALTAVISTA FINE SANDY LOAM
- **At** AUGUSTA FINE SANDY LOAM
- **CtA** CONETOE LOAMY FINE SAND
- **WkB** WICKHAM LOAMY AND
- ⌖ TEST PIT LOCATION

NOTE

APPROXIMATE SOIL UNIT DELINEATIONS WERE ADAPTED FROM SOIL CONSERVATION SERVICE MAP, "SOIL SURVEY FOR WASHINGTON COUNTY, N.C., DECEMBER, 1981.

FIGURE 1
SOIL CLASSIFICATION MAP

RMT

Drawn By:	D.M.C.
Approved By:	R.K.N.
Date:	1-8-99
Proj. No.:	5101.01

RMT

LOG OF TEST PIT OR EXCAVATION

PROJECT NAME WEYERHAEUSER BORROW INVESTIGATION
LOCATION BEASLEY & SNELL PROPERTIES, PLYMOUTH, NC
CONTRACTOR B.E. SINGELTON
METHOD CASE 580K BACKHOE
LOGGED BY RKN CHECKED BY

PIT NO. TP-1
PROJECT NO. 5101.02
DATE 10-20-98
WIDTH 24 INCHES
PAGE 1 OF 1

DEPTH	MOISTURE CONTENT	P200	LL	PL	PI	VISUAL CLASSIFICATION
0.5'						TAN SILTY FINE SAND (SM): DAMP & LOOSE
1' 2' 3' 4' 5'						MOTTLED LIGHT ORANGE & GRAY SANDY CLAY (CL): DAMP & HARD, DIFFICULT DIGGING
6' 7' 8' 8.5'						LIGHT YELLOW BROWN/TAN FINE SAND (SP) WITH SILT: DAMP AND MED. DENSE
9' 10' 11'						TOTAL DEPTH - 8.5 FT. NO FREE GROUNDWATER ENCOUNTERED NO CAVING

J:/CAD/HYDRO/WEYHAUS/TP2.FIG

LOG OF TEST PIT OR EXCAVATION

PROJECT NAME WEYERHAEUSER BORROW INVESTIGATION
LOCATION BEASLEY & SNELL PROPERTIES, PLYMOUTH, NC
CONTRACTOR B.E. SINGELTON
METHOD CASE 580K BACKHOE
LOGGED BY RKN CHECKED BY

PIT NO. TP-2
PROJECT NO. 5101.02
DATE 10-20-98
WIDTH 24 INCHES
PAGE 1 OF 1

DEPTH	MOISTURE CONTENT	P200	LL	PL	PI	VISUAL CLASSIFICATION
0.5'						GRAY BROWN SILTY SAND (SM) W/SOME ROOTS AND ORGANIC MATERIAL (TOP SOIL); DAMP & LOOSE
1'	18.7		41	22	19	ORANGE BROWN SANDY CLAY (CL): MOIST AND MODERATELY DENSE
2'						
3'						
4'						
5'						
6'						
7'						
8'						MOTTLED LIGHT GRAY AND ORANGE FINE POORLY-GRADED SAND (SP) WITH SILT; MOIST AND MODERATELY DENSE
9'						
10'						
11'						TOTAL DEPTH = 10 FT. NO FREE GROUNDWATER ENCOUNTERED NO CAVING.

J:/CAD/HYDRO/WEYHAUS/TP3.FIG

LOG OF TEST PIT OR EXCAVATION

PROJECT NAME WEYERHAEUSER BORROW INVESTIGATION
LOCATION BEASLEY & SNELL PROPERTIES, PLYMOUTH, NC
CONTRACTOR B.E. SINGELTON
METHOD CASE 580K BACKHOE
LOGGED BY RKN CHECKED BY

PIT NO. TP-3
PROJECT NO. 5101.02
DATE 10-20-98
WIDTH 24 INCHES
PAGE 1 OF 1

DEPTH	MOISTURE CONTENT	P200	LL	PL	PI	VISUAL CLASSIFICATION
	6.2	33				LIGHT GRAY SILTY FINE SAND (SM): DAMP AND LOOSE (TOPSOIL)
1'						
2'		36	29	21	9	
3'						
4'						ORANGE CLAYEY FINE SAND (SC) WITH SILT: DAMP AND MODERATELY DENSE
5'						
6'						
7'						LIGHT ORANGE TO TAN FINE SAND (SP) WITH SILT: DAMP AND MODERATELY DENSE
8'						
9'						
10'						TOTAL DEPTH = 9.0 FT. NO FREE GROUNDWATER ENCOUNTERED NO CAVING
11'						

J:/CAD/HYDRO/WEYHAUS/TP4.FIG

LOG OF TEST PIT OR EXCAVATION

PROJECT NAME WEYERHAEUSER BORROW INVESTIGATION
LOCATION BEASLEY & SNELL PROPERTIES, PLYMOUTH, NC
CONTRACTOR B.E. SINGELTON
METHOD CASE 580K BACKHOE
LOGGED BY RKN CHECKED BY

PIT NO. TP-4
PROJECT NO. 5101.02
DATE 10-20-98
WIDTH 24 INCHES
PAGE 1 OF 1

DEPTH	MOISTURE CONTENT	P200	LL	PL	PI	VISUAL CLASSIFICATION
0.6'						LIGHT GRAY SILTY FINE SAND (SM) (TOPSOIL); DAMP AND LOOSE
1'	25.3	75	58	28	30	MOTTLED ORANGE TO GRAY SANDY CLAY (CH); STIFF AND MOIST
2'						
3'						
4'						
5'						
6'						MOTTLED TAN TO ORANGE FINE POORLY-GRADED SAND (SP) W/SILT; BECOMING INCREASINGLY MOIST WITH DEPTH; MODERATELY DENSE
7'						
8'						
9'						
10'						
11'	41.0	88	55	31	24	MOTTLED ORANGE AND LIGHT GRAY CLAYEY SILT (MH) WET AND STIFF
						TOTAL DEPTH - 11 FT. NO FREE GROUNDWATER ENCOUNTERED NO CAVING

J:/CAD/HYDRO/WEYHAUS/TP5.FIG

LOG OF TEST PIT OR EXCAVATION

PROJECT NAME WEYERHAEUSER BORROW INVESTIGATION
PIT NO. TP-5
LOCATION BEASLEY & SNELL PROPERTIES, PLYMOUTH, NC
PROJECT NO. 5101.02
CONTRACTOR B.E. SINGELTON
DATE 10-20-98
METHOD CASE 580K BACKHOE
WIDTH 24 INCHES
LOGGED BY RKN
CHECKED BY
PAGE 1 OF 1

DEPTH	MOISTURE CONTENT	P200	LL	PL	PI	VISUAL CLASSIFICATION
0.5'						LIGHT SILTY GRAY FINE SAND (SM) WITH ORGANIC MATERIAL (TOPSOIL) DAMP AND LOOSE
1'	23.0		45	22	23	MOTTLED ORANGE AND GRAY SANDY CLAY (CL): MOIST AND STIFF
2'						
3'						ORANGE SILTY FINE SAND (SM): MOIST AND MODERATELY DENSE
4'						
5'						
6'						
7'	41.2		56	27	29	MOTTLED ORANGE AND GRAY SANDY CLAY (CL), HEAVILY INTERBEDDED WITH FINE SAND (SP) LAYERS AND SILT LAYERS (SM): VERY MOIST AND STIFF
8'						
9'						
10'						
11'						
12'						MOTTLED ORANGE AND GRAY FINE SAND (SP)

TOTAL DEPTH = 12 FT.
NO FREE GROUNDWATER ENCOUNTERED
NO CAVING

LOG OF TEST PIT OR EXCAVATION

PROJECT NAME WEYERHAEUSER BORROW INVESTIGATION
PIT NO. TP-6
LOCATION BEASLEY & SNELL PROPERTIES, PLYMOUTH, NC
PROJECT NO. 5101.02
CONTRACTOR B.E. SINGELTON
DATE 10-20-98
METHOD CASE 580K BACKHOE
WIDTH 24 INCHES
LOGGED BY RKN
CHECKED BY
PAGE 1 OF 1

DEPTH	MOISTURE CONTENT	P200	LL	PL	PI	VISUAL CLASSIFICATION
0.5'						GRAY BROWN SILTY FINE SAND (SM) (TOPSOIL): DAMP AND LOOSE
1'						TAN SILTY FINE SAND (SM) WITH CLAY (CL) LAYERS; DAMP AND MEDIUM DENSE
2'	19.6		46	22	24	
3'						MOTTLED ORANGE AND GRAY SANDY CLAY (CL): MOIST AND HARD
4'						
5'						
6'						MOTTLED ORANGE AND GRAY CLAYEY FINE SAND (SC) MOIST AND MODERATELY DENSE
7'	33.8		63	32	31	
8'						LIGHT GRAY SLIGHTLY SANDY CLAY (CH), HIGHLY PLASTIC, MOIST AND STIFF.
8.5'						
9'						AS ABOVE BUT HIGHLY INTERBEDDED WITH SAND LAYERS
10'						
11'						MOTTLED ORANGE AND GRAY SLIGHTLY SILTY FINE TO MEDIUM SAND (SM): MOIST AND MEDIUM DENSE
						TOTAL DEPTH - 11 FT. NO FREE GROUNDWATER ENCOUNTERED NO CAVING

J:/CAD/HYDRO/WEYHAUS/TP7.FIG

LOG OF TEST PIT OR EXCAVATION

PROJECT NAME WEYERHAEUSER BORROW INVESTIGATION
LOCATION BEASLEY & SNELL PROPERTIES, PLYMOUTH, NC
CONTRACTOR B.E. SINGELTON
METHOD CASE 580K BACKHOE
LOGGED BY RKN CHECKED BY

PIT NO. TP-7
PROJECT NO. 5101.02
DATE 10-20-98
WIDTH 24 INCHES
PAGE 1 OF 1

DEPTH	MOISTURE CONTENT	P200	LL	PL	PI	VISUAL CLASSIFICATION
0.7'						LIGHT SILTY GRAY FINE SAND (SM) (TOPSOIL); MOIST AND LOOSE
1' 2' 3' 4' 5'						MOTTLED ORANGE SAND GRAY SANDY CLAY (CL); MOIST AND STIFF, GOOD PLASTICITY
6' 7'						MOTTLED ORANGE AND GRAY FINE SAND (SP); BECOMING INCREASINGLY MOIST WITH DEPTH
8' 9' 10' 11'	27.3	84	54	27	27	MOTTLED ORANGE AND GRAY SILTY CLAY (CH) WITH SAND BECOMING PREDOMINATELY GRAY WITH DEPTH; MOIST AND FIRM.
11.5'						ORANGE FINE SAND (SP); MOIST AND MEDIUM DENSE.
						TOTAL DEPTH = 11.5 FT.

NO FREE GROUNDWATER ENCOUNTERED
NO CAVING

LOG OF TEST PIT OR EXCAVATION

PROJECT NAME WEYERHAEUSER BORROW INVESTIGATION
LOCATION BEASLEY & SNELL PROPERTIES, PLYMOUTH, NC
CONTRACTOR B.E. SINGELTON
METHOD CASE 580K BACKHOE
LOGGED BY RKN CHECKED BY

PIT NO. TP-8
PROJECT NO. 5101.02
DATE 10-20-98
WIDTH 24 INCHES
PAGE 1 OF 1

DEPTH	MOISTURE CONTENT	P200	LL	PL	PI	VISUAL CLASSIFICATION
0.5'						GRAY SILTY FINE SAND (SM) (TOPSOIL); MOIST AND LOOSE
1' 2' 3' 3.5'						ORANGE SILTY SAND (SM) WITH CLAY; MOIST AND DENSE
4' 5' 6' 6.5'	27.9	86				MOTTLED GRAY AND ORANGE SILTY CLAY (CL) WITH SAND; MOIST AND FIRM
7' 8' 9' 10' 10.5						MOTTLED ORANGE AND GRAY SILTY FINE SAND (SM) WITH TRACE OF CLAY; BECOMING CLEANER WITH DEPTH
11'	30.8	79	43	28	20	MOTTLED GRAY AND ORANGE SANDY CLAY (CL); MOIST AND FIRM
						TOTAL DEPTH = 11 FT. NO FREE GROUNDWATER ENCOUNTERED NO CAVING

J:/CAD/HYDRO/WEYHAUS/TP9.FIG

LOG OF TEST PIT OR EXCAVATION

PROJECT NAME WEYERHAEUSER BORROW INVESTIGATION
LOCATION BEASLEY & SNELL PROPERTIES, PLYMOUTH, NC
CONTRACTOR B.E. SINGELTON
METHOD CASE 580K BACKHOE
LOGGED BY RKN CHECKED BY _____

PIT NO. TP-9
PROJECT NO. 5101.02
DATE 10-20-98
WIDTH 24 INCHES
PAGE 1 OF 1

DEPTH	MOISTURE CONTENT	P200	LL	PL	PI	VISUAL CLASSIFICATION
0.5'						GRAY SILTY FINE SAND (SM), (TOPSOIL): MOIST AND LOOSE
1'						ORANGE SILTY FINE (SM), WITH CLAY; MOIST AND DENSE
2'	22.8	67	56	26	30	MOTTLED ORANGE AND GRAY SILTY CLAY (CH) WITH SAND: MOIST AND HARD
3'						
4'						
5'						
6'	9.5	21				LIGHT ORANGE SILTY FINE SAND (SM): DAMP AND MODERATELY LOOSE
7'						
8'						
9'	21.4	76				MOTTLED GRAY WITH ORANGE SILTY CLAY (CL), WITH SAND AND SILT LAYERS: MOIST AND STIFF: HARD DIGGING, BECOMING HARD AT 10.5 FT.
10'						
11'						TOTAL DEPTH - 11.0 FT. NO FREE GROUNDWATER ENCOUNTERED NO CAVING

LOG OF TEST PIT OR EXCAVATION

PROJECT NAME WEYERHAEUSER BORROW INVESTIGATION
LOCATION BEASLEY & SNELL PROPERTIES, PLYMOUTH, NC
CONTRACTOR B.E. SINGELTON
METHOD CASE 580K BACKHOE
LOGGED BY RKN CHECKED BY

PIT NO. TP-10
PROJECT NO. 5101.02
DATE 10-21-98
WIDTH 24 INCHES
PAGE 1 OF 1

DEPTH	MOISTURE CONTENT	P200	LL	PL	PI	VISUAL CLASSIFICATION
1' 1.5'						DARK GRAY SILTY FINE SAND (SM); MOIST AND LOOSE
2' 3'						TAN FINE SAND (SP); MOIST AND MODERATELY DENSE
4' 5' 6' 7' 8'						ORANGE SILTY FINE SAND (SM) WITH CLAY; WITH LAYERS OF SANDY CLAY (6" MAXIMUM THICKNESS); MOIST AND MODERATELY DENSE
9' 10' 11'						TAN WITH ORANGE MOTTLING FINE SAND (SP); MOIST AND MODERATELY DENSE
						TOTAL DEPTH - 11.0 FT. NO FREE GROUNDWATER ENCOUNTERED NO CAVING

J:/CAD/HYDRO/WEYHAUS/TP11.FIG

LOG OF TEST PIT OR EXCAVATION

PROJECT NAME WEYERHAEUSER BORROW INVESTIGATION
LOCATION BEASLEY & SNELL PROPERTIES, PLYMOUTH, NC
CONTRACTOR B.E. SINGELTON
METHOD CASE 580K BACKHOE
LOGGED BY RKN CHECKED BY

PIT NO. TP-11
PROJECT NO. 5101.02
DATE 10-21-98
WIDTH 24 INCHES
PAGE 1 OF 1

DEPTH	MOISTURE CONTENT	P200	LL	PL	PI	VISUAL CLASSIFICATION
0.5'						DARK GRAY SILTY FINE (SM) WITH ROOTS AND ORGANIC MATERIAL (TOPSOIL); DAMP AND LOOSE
1'						TAN SILTY FINE SAND (SM); DAMP AND LOOSE
2'						
3'						ORANGE CLAYEY FINE SAND (SC). HARD DIGGING; DAMP AND DENSE
4'						
4.5'						
5'						AS ABOVE, WITH INCREASING CLAY CONTENT; MORE MOTTLED WITH DEPTH
6'						
7'						YELLOW TAN FINE CLEAN SAND (SP); DAMP AND DENSE
8'						
9'						MOTTLED REDDISH BROWN TO GRAY SILTY CLAY (CL); SLIGHTLY MOIST AND VERY STIFF
10'						
11'						TOTAL DEPTH - 10.0 FT. NO FREE GROUNDWATER ENCOUNTERED NO CAVING

LOG OF TEST PIT OR EXCAVATION

PROJECT NAME WEYERHAEUSER BORROW INVESTIGATION
LOCATION BEASLEY & SNELL PROPERTIES, PLYMOUTH, NC
CONTRACTOR B.E. SINGELTON
METHOD CASE 580K BACKHOE
LOGGED BY RKN CHECKED BY _____

PIT NO. TP-12
PROJECT NO. 5101.02
DATE 10-21-98
WIDTH 24 INCHES
PAGE 1 OF 1

DEPTH	MOISTURE CONTENT	P200	LL	PL	PI	VISUAL CLASSIFICATION
0.5'						GRAY SILTY FINE SAND (SM) WITH ORGANIC MATERIAL (TOPSOIL); DAMP LOOSE
1'						GRAY FINE SAND (SP); DAMP AND SLIGHTLY DAMP
2'						
3'						TAN FINE SAND (SP) WITH SOME ORANGE MOTTLING; DAMP AND MODERATELY DENSE
4'						
5'	15.9		28	16	12	
6'						MOTTLED TAN AND ORANGE CLAYEY FINE SAND (SC); MOIST AND MODERATELY DENSE
7'						
8'						
9'						MOTTLED LIGHT TAN AND ORANGE FINE SAND (SP) WITH SILT; WET AND LOOSE; CAVING TO TOP OF STRATUM
10'						
11'						TOTAL DEPTH = 10.0 FT. NO FREE GROUNDWATER ENCOUNTERED CAVING FROM 8.0 FT.

LOG OF TEST PIT OR EXCAVATION

PROJECT NAME WEYERHAEUSER BORROW INVESTIGATION
LOCATION BEASLEY & SNELL PROPERTIES, PLYMOUTH, NC
CONTRACTOR B.E. SINGELTON
METHOD CASE 580K BACKHOE
LOGGED BY RKN CHECKED BY

PIT NO. TP-13
PROJECT NO. 5101.02
DATE 10-21-98
WIDTH 24 INCHES
PAGE 1 OF 1

DEPTH	MOISTURE CONTENT	P200	LL	PL	PI	VISUAL CLASSIFICATION
1' 1.5'						DARK GRAY SILTY FINE SAND (SM), WITH HEAVY ORGANIC CONCENTRATION (FILL), DAMP AND LOOSE
2'	20.3	49	40	27	13	TAN FINE SAND (SP) WITH SOME SILT AND TRACE OF CLAY; SOME ORANGE MOTTLING (ORGINAL GROUND); DAMP AND SLIGHTLY DENSE
3' 4'						ORANGE BROWN CLAYEY FINE SAND (SC) MODERATELY DENSE AND MOIST; TRACE OF ORGANIC MATERIAL
5'	18.0		32	18	14	
6' 7' 8'						AS ABOVE; LESS CLAYEY
9' 10'						MOTTLED TAN WITH ORANGE FINE SAND (SP) WITH SILT; VERY MOIST AND SLIGHTLY DENSE; SLIGHT CAVING FROM 8.5'
11'						TOTAL DEPTH - 10.0 FT. NO FREE GROUNDWATER ENCOUNTERED

J:/CAD/HYDRO/WEYHAUS/TP14.FIG

LOG OF TEST PIT OR EXCAVATION

PROJECT NAME WEYERHAEUSER BORROW INVESTIGATION
LOCATION BEASLEY & SNELL PROPERTIES, PLYMOUTH, NC
CONTRACTOR B.E. SINGELTON
METHOD CASE 580K BACKHOE
LOGGED BY RKN CHECKED BY

PIT NO. TP-14
PROJECT NO. 5101.02
DATE 10-21-98
WIDTH 24 INCHES
PAGE 1 OF 1

DEPTH	MOISTURE CONTENT	P200	LL	PL	PI	VISUAL CLASSIFICATION
1'						ORANGE CLAYEY SAND (SC), SOME MOTTLING; DAMP AND SLIGHTLY DENSE
2'						
3'						LIGHT TO DARK ORANGE SILTY FINE SAND (SM); MOIST AND SLIGHTLY DENSE
4'						
5'						
6'						
7'						MOTTLED TAN AND ORANGE FINE SAND (SP); MOIST AND MODERATELY DENSE
8'						
9'						
9.5'						DARK GRAY FINE SAND (SP); WET AND MODERATELY DENSE
10'						
11'						TOTAL DEPTH = 10.0 FT. NO FREE GROUNDWATER ENCOUNTERED NO CAVING

J:/CAD/HYDRO/WEYHAUS/TP15.FIG

LOG OF TEST PIT OR EXCAVATION

PROJECT NAME WEYERHAEUSER BORROW INVESTIGATION
LOCATION BEASLEY & SNELL PROPERTIES, PLYMOUTH, NC
CONTRACTOR B.E. SINGELTON
METHOD CASE 580K BACKHOE
LOGGED BY RKN CHECKED BY

PIT NO. TP-15
PROJECT NO. 5101.02
DATE 10-21-98
WIDTH 24 INCHES
PAGE 1 OF 1

DEPTH	MOISTURE CONTENT	P200	LL	PL	PI	VISUAL CLASSIFICATION
0.5'						DARK GRAY SILTY BROWN FINE SAND (SM); WITH ROOTS AND ORGANIC MATERIAL (TOPSOIL); DAMP AND LOOSE
1'						TAN FINE SAND (SP) WITH SILT AND SOME ROOTS; DAMP AND LOOSE
2'						
2.5'						
3'						ORANGE BROWN CLAYEY FINE SAND (SC) GRADING TO SILTY FINE SAND (SM) WITH CLAY; MOIST AND MODERATELY DENSE
4'						
5'						GRAY BROWN CLAYEY FINE SAND (SC)
5.5'						
6'						TAN AND ORANGE CLEAN FINE SAND (SP); DAMP AND MODERATELY DENSE
7'						
8'						
9'						
10'						
11'						TOTAL DEPTH - 10.0 FT. NO FREE GROUNDWATER ENCOUNTERED NO CAVING

J:/CAD/HYDRO/WEYHAUS/TP16.FIG

LOG OF TEST PIT OR EXCAVATION

PROJECT NAME WEYERHAEUSER BORROW INVESTIGATION
LOCATION BEASLEY & SNELL PROPERTIES, PLYMOUTH, NC
CONTRACTOR B.E. SINGELTON
METHOD CASE 580K BACKHOE
LOGGED BY RKN CHECKED BY

PIT NO. TP-16
PROJECT NO. 5101.02
DATE 10-21-98
WIDTH 24 INCHES
PAGE 1 OF 1

DEPTH	MOISTURE CONTENT	P200	LL	PL	PI	VISUAL CLASSIFICATION
0.5'						DARK GRAY SILTY FINE SAND (SM), WITH ORGANIC MATERIAL (TOPSOIL) DAMP AND LOOSE
1' – 2'						LIGHT GRAY FINE SAND WITH SILT (SP); DAMP AND MODERATELY DENSE
2.5' – 3' – 4' – 5'	24.1	52				MOTTLED LIGHT BROWN AND ORANGE SANDY CLAY (CL), GRADING TO CLAYEY SAND (SC); VERY MOIST AND MODERATELY DENSE
5.5' – 6' – 7' – 8' – 9'						MOTTLED TAN WITH ORANGE FINE SAND (SP) WITH TRACE OF CLAY; MOIST AND MODERATELY DENSE
10'						LIGHT GRAY FINE SAND (SP); MOIST AND MODERATELY DENSE
11'						TOTAL DEPTH = 10.0 FT. NO FREE GROUNDWATER ENCOUNTERED NO CAVING

LOG OF TEST PIT OR EXCAVATION

PROJECT NAME WEYERHAEUSER BORROW INVESTIGATION
LOCATION BEASLEY & SNELL PROPERTIES, PLYMOUTH, NC
CONTRACTOR B.E. SINGELTON
METHOD CASE 580K BACKHOE
LOGGED BY RKN CHECKED BY

PIT NO. TP-17
PROJECT NO. 5101.02
DATE 10-21-98
WIDTH 24 INCHES
PAGE 1 OF 1

DEPTH	MOISTURE CONTENT	P200	LL	PL	PI	VISUAL CLASSIFICATION
						DARK GRAY SILTY FINE SAND (SM), WITH HIGH ORGANIC CONCENTRATION (TOP SOIL); DAMP AND LOOSE
1'						
2'						MOTTLED GRAY WITH ORANGE FINE SAND (SP): DAMP TO MOIST, BECOMING MORE MOIST WITH DEPTH, SLIGHTLY DENSE
3'						
4'						
5'						LIGHT GRAY FINE SAND (SP), WITH SILT; WET AND MODERATELY DENSE; CAVING FROM 4.0 FT.
6'						
7'						TOTAL DEPTH - 7.0 FT. SEEPING OBSERVED AT 4.0 FT. DEPTH CAVING FROM 4.0 FT.
8'						
9'						
10'						
11'						

J:/CAD/HYDRO/WEYHAUS/TP18.FIG

LOG OF TEST PIT OR EXCAVATION

PROJECT NAME WEYERHAEUSER BORROW INVESTIGATION
LOCATION BEASLEY & SNELL PROPERTIES, PLYMOUTH, NC
CONTRACTOR B.E. SINGELTON
METHOD CASE 580K BACKHOE
LOGGED BY RKN CHECKED BY

PIT NO. TP-18
PROJECT NO. 5101.02
DATE 10-21-98
WIDTH 24 INCHES
PAGE 1 OF 1

DEPTH	MOISTURE CONTENT	P200	LL	PL	PI	VISUAL CLASSIFICATION
						DARK GRAY SILTY FINE SAND (SM), (TOPSOIL): DAMP AND LOOSE
1'						
2'						GRAY BROWN TO TAN FINE SAND (SP) WITH SILT: DAMP AND MODERATELY DENSE
3'						
		38	33	19	14	
4'						ORANGE CLAYEY FINE SAND (SC) GRADING TO A SILTY FINE SAND WITH CLAY: MOIST AND MODERATELY DENSE
5'						
6'						
7'						
8'						REDDISH BROWN SILTY FINE TO MEDIUM SAND (SM): MOIST AND MODERATELY DENSE
8.5'						
9'						MOTTLED TAN AND ORANGE SILTY FINE TO MEDIUM SAND: MOIST AND MODERATELY DENSE
10'						TOTAL DEPTH - 9.0 FT. NO FREE GROUNDWATER ENCOUNTERED NO CAVING
11'						

LOG OF TEST PIT OR EXCAVATION

PROJECT NAME WEYERHAEUSER BORROW INVESTIGATION
LOCATION BEASLEY & SNELL PROPERTIES, PLYMOUTH, NC
CONTRACTOR B.E. SINGELTON
METHOD CASE 580K BACKHOE
LOGGED BY RKN CHECKED BY

PIT NO. TP-19
PROJECT NO. 5101.02
DATE 10-21-98
WIDTH 24 INCHES
PAGE 1 OF 1

DEPTH	MOISTURE CONTENT	P200	LL	PL	PI	VISUAL CLASSIFICATION
1' 1.5'						ORANGE SILTY FINE SAND (SM) WITH CONCRETE AND ASPHALT RUBBLE (FILL); DAMP AND MODERATELY DENSE
2' 2.5'	14.8		31	17	14	LIGHT ORANGE BROWN CLAYEY SAND (SC); VERY DIFFICULT DIGGING; DAMP AND DENSE (ORIGINAL GROUND)
3' 3.5'						MOTTLED ORANGE AND GRAY SILTY FINE SAND (SM); MOIST AND MODERATELY DENSE
4' 5' 6'						MOTTLED ORANGE AND GRAY SILTY FINE SAND (SM) WITH CLAY, BECOMING LESS SILTY WITH DEPTH; MOIST TO WET AND MODERATELY DENSE
7' 8' 9' 9.5'						LIGHT GRAY WITH ORANGE MOTTLING FINE SAND (SP); SLIGHTLY DENSE AND SATURATED CAVING FROM 6.0 FT. DEPTH
10'						DARK GRAY FINE SAND (SP); SATURATED AND MODERATELY DENSE
11'						TOTAL DEPTH = 10.0 FT. SOILS SATURATED FROM 6.0 FT. DEPTH, BUT NO SEEPAGE. CAVING FROM 6.0 FT. DEPTH

J:/CAD/HYDRO/WEYHAUS/TP20.FIG

LOG OF TEST PIT OR EXCAVATION

PROJECT NAME WEYERHAEUSER BORROW INVESTIGATION
LOCATION BEASLEY & SNELL PROPERTIES, PLYMOUTH, NC
CONTRACTOR B.E. SINGELTON
METHOD CASE 580K BACKHOE
LOGGED BY RKN CHECKED BY

PIT NO. TP-20
PROJECT NO. 5101.02
DATE 10-21-98
WIDTH 24 INCHES
PAGE 1 OF 1

DEPTH	MOISTURE CONTENT	P200	LL	PL	PI	VISUAL CLASSIFICATION
0.5'						DARK GRAY SILTY FINE SAND (SM) (TOP SOIL); DAMP AND LOOSE
1'						TAN FINE SAND (SP) WITH SILT; DAMP AND LOOSE
2'						
3'						ORANGE CLAYEY FINE SAND (SC); DAMP AND DENSE, SOME TREE ROOTS, HARD DIGGING
4'						
4.5'						MOTTLED GRAY AND ORANGE CLAYEY FINE SAND (SC)
5'						YELLOW-ORANGE SILTY FINE SAND (SM) GRADING TO FINE SAND WITH SILT (SM) WITH DEPTH; DAMP AND DENSE, HARD DIGGING
6'						
7'						TOTAL DEPTH = 7.0 FT. NO FREE GROUNDWATER ENCOUNTERED NO CAVING
8'						
9'						
10'						
11'						

J:/CAD/HYDRO/WEYHAUS/TP21.FIG

LOG OF TEST PIT OR EXCAVATION

PROJECT NAME WEYERHAEUSER BORROW INVESTIGATION
LOCATION BEASLEY & SNELL PROPERTIES, PLYMOUTH, NC
CONTRACTOR B.E. SINGELTON
METHOD CASE 580K BACKHOE
LOGGED BY RKN CHECKED BY

PIT NO. TP-21
PROJECT NO. 5101.02
DATE 10-21-98
WIDTH 24 INCHES
PAGE 1 OF 1

DEPTH	MOISTURE CONTENT	P200	LL	PL	PI	VISUAL CLASSIFICATION
0.5'						DARK GRAY SILYTY ASND (SM), WITH ROOTS AND ORGANIC MATERIAL (TOPSOIL); DAMP AND LOOSE
1'						TAN FINE SAND (SP) WITH SILT; MOIST AND MODERATELY DENSE
2'						
2.5'						
3'						ORANGE SANDY CLAY (CL-ML) GRADING TO CLAYEY SAND (SC); MOIST AND MODERATELY DENSE
4'						
5'						
6'						
6.5'						
7'						MOTTLED GRAY WITH ORANGE SILTY FINE SAND (SM) GRADING TO CLAYEY FINE SAND (SC) AT BOTTOM OF TEST PIT; WET AND MODERATELY DENSE
8'						
9'						
10'						
11'						TOTAL DEPTH - 10.0 FT. SEEPAGE NOTED AT BOTTOM OF EXCAVATION NO CAVING

J:/CAD/HYDRO/WEYHAUS/TP22.FIG

LOG OF TEST PIT OR EXCAVATIO

PROJECT NAME WEYERHAEUSER BORROW INVESTIGATION
LOCATION BEASLEY & SNELL PROPERTIES, PLYMOUTH, NC
CONTRACTOR B.E. SINGELTON
METHOD CASE 580K BACKHOE
LOGGED BY RKN CHECKED BY

PIT NO. TP-22
PROJECT NO. 5101.02
DATE 10-22-98
WIDTH 24 INCHES
PAGE 1 OF 1

DEPTH	MOISTURE CONTENT	P200	LL	PL	PI	VISUAL CLASSIFICATION
						DARK GRAY SILTY FINE SAND (SM) ROOTS AND ORGANIC MATERIAL (TOPSOIL); DAMP AND LOOSE
1'						
2'						TAN FINE SAND (SP); DAMP AND MODERATELY DENSE
3'						
						LIGHT ORANGE BROWN SILTY FINE SAND (SM) WITH CLAY; MOIST AND MOTERATELY DENSE
4'						
						LIGHT TAN FINE SAND (SP); DAMP AND MODERATELY DENSE
5'						
6'						YELLOW BROWN CLAYEY FINE SAND (SC); MOIST AND MODERATELY DENSE
7'						
8'						
8.5'						
9'						MOTTLED ORANGE AND GRAY SANDY CLAY (CL); VERY MOIST AND MODERATELY DENSE
9.5'						
10'						TOTAL DEPTH - 9.5 FT. NO FREE GROUNDWATER ENCOUNTERED NO CAVING
11'						

LOG OF TEST PIT OR EXCAVATION

PROJECT NAME WEYERHAEUSER BORROW INVESTIGATION
LOCATION BEASLEY & SNELL PROPERTIES, PLYMOUTH, NC
CONTRACTOR B.E. SINGELTON
METHOD CASE 580K BACKHOE
LOGGED BY RKN CHECKED BY

PIT NO. TP-23
PROJECT NO. 5101.02
DATE 10-22-98
WIDTH 24 INCHES
PAGE 1 OF 1

DEPTH	MOISTURE CONTENT	P200	LL	PL	PI	VISUAL CLASSIFICATION
						DARK GRAY SILTY FINE SAND (SM) ROOTS AND ORGANIC MATERIAL (TOP SOIL); DAMP AND LOOSE
1'						TAN FINE SAND (SP); MOIST AND MODERATELY DENSE
2'						ORANGE SILTY FINE SAND (SM) WITH CLAY, BECOMING LESS SILTY WITH DEPTH; MOIST AND MODERATELY DENSE
3'						
4'						
5'						LIGHT ORANGE FINE SAND (SP) WITH SILT; MOIST AND MODERATELY DENSE
6'						
7'						
8'						
9'						TOTAL DEPTH - 9.0 FT. NO FREE GROUNDWATER ENCOUNTERED NO CAVING
10'						
11'						

J:/CAD/HYDRO/WEYHAUS/TP24.FIG

LOG OF TEST PIT OR EXCAVATION

PROJECT NAME WEYERHAEUSER BORROW INVESTIGATION
LOCATION BEASLEY & SNELL PROPERTIES, PLYMOUTH, NC
CONTRACTOR B.E. SINGELTON
METHOD CASE 580K BACKHOE
LOGGED BY RKN CHECKED BY

PIT NO. TP-24
PROJECT NO. 5101.02
DATE 10-22-98
WIDTH 24 INCHES
PAGE 1 OF 1

DEPTH	MOISTURE CONTENT	P200	LL	PL	PI	VISUAL CLASSIFICATION
						DARK GRAY SILTY FINE SAND (SM) WITH ROOTS AND ORGANIC MATTER (TOPSOIL); DAMP AND LOOSE
1'						
2'						YELLOW BROWN SAND CLAY (CL),HARD DIGGING, INCREASED ORANGE AND GRAY MOTTLING WITH DEPTH: DAMP AND HARD
3'						
4'						
5'						
6'						AS ABOVE, BUT HIGHER SAND CONTENT: EASIER TO DIG
7'						
7.5'						MOTTLED GRAY AND ORANGE SANDY CLAY (CL): HARD DIGGING: DAMP AND VERY STIFF
8'						
9'						TOTAL DEPTH - 8.0 FT. NO FREE GROUNDWATER ENCOUNTERED NO CAVING
10'						
11'						

LOG OF TEST PIT OR EXCAVATION

PROJECT NAME WEYERHAEUSER BORROW INVESTIGATION
LOCATION BEASLEY & SNELL PROPERTIES, PLYMOUTH, NC
CONTRACTOR B.E. SINGELTON
METHOD CASE 580K BACKHOE
LOGGED BY RKN CHECKED BY

PIT NO. TP-25
PROJECT NO. 5101.02
DATE 10-22-98
WIDTH 24 INCHES
PAGE 1 OF 1

DEPTH	MOISTURE CONTENT	P200	LL	PL	PI	VISUAL CLASSIFICATION
0.5'						DARK GRAY SILTY FINE SAND (SM) (TOPSOIL); DAMP AND LOOSE
1'						TAN FINE SAND (SP); DAMP AND MODERATELY DENSE
2'	24.6		60	31	29	ORANGE FINE SANDY CLAY (CH); MOIST AND DENSE
3' 3.5'						
4'						MOTTLED ORANGE AND RED BROWN SILTY FINE SAND (SM); MOIST AND DENSE
5' 5.5'						
6'	10.6	26				ORANGE CLAYEY FINE SAND (SC); MOIST AND DENSE
7'						
8'						TOTAL DEPTH = 8.0 FT. NO FREE GROUNDWATER ENCOUNTERED NO CAVING
9'						
10'						
11'						

Appendix B
Laboratory Testing Results

RMT, Inc.

Moisture Content / Dry Density Determination

QC:

QA:

Project Name: WEYERHAEUSER

Project #: 5101.02

	Sample Location	Moisture Tare Wt. (g)	Moisture Wet Wt. + Tare (g)	Moisture Dry Wt. +Tare (g)	Moisture (%)	Sample Diameter (in)	Sample Height (in)	Density Tare Wt. (g)	Density Wet Wt. + Tare (g)	Wet Density (pcf)	Dry Density (pcf)
1	TP-2, 0.5'	84.08	215.60	194.88	18.7						
2	TP-5, 0.5-3'	83.65	322.53	277.82	23.0						
3	TP-5, 7-11'	84.35	277.64	221.22	41.2						
4	TP-6, 2-5'	83.74	292.51	258.29	19.6						
5	TP-6, 7-8.5'	83.55	270.71	223.47	33.8						
6	TP-12, 4.5'	83.12	257.40	233.45	15.9						
7	TP-13, 5'	83.86	221.86	200.79	18.0						
8	TP-19, 1.5-2.5'	83.02	300.84	272.82	14.8						
9	TP-21, 2.5-6.5'	83.52	344.70	306.76	17.0						
10	TP-25, 2-3.5'	83.87	253.72	220.24	24.6						
11	TP-8, 10.5-11'	266.27	485.31	433.76	30.8						
12	TP-16, 2.5-5.5'	278.36	698.00	616.60	24.1						
13	TP-22, 3-4'	274.51	790.70	719.60	16.0						
14	TP-22, 8.5-9.5'	267.18	661.80	562.22	33.8						
15	TP-25, 5.5'	273.53	796.00	746.10	10.6						
16	TP-3, 0-1'	276.94	619.00	599.14	6.2						
17	TP-9, 6-9'	266.58	758.20	715.70	9.5						
18	TP-9, 9-11'	267.67	925.70	809.70	21.4						
19	TP-8, 3.5-6.5'	272.97	780.20	669.50	27.9						
20											
21											
22											
23											
24											
25											
26											
27											
28											
29											
30											

RMT, Inc.

Percent Passing #200 Sieve (P200)

QC: KW

QA: JSH

Project Name: WEYERHAEUSER Project #: 5101.02

	Sample Location	Tare Wt. (g)	Dry Wt. + Tare (g)	Wash Wt. + Tare (g)	P200 (%)
1	TP-3, 1-6'	273.36	578.09	467.60	36.3
2	TP-18, 3-8'	266.34	485.36	403.00	37.6
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					

RMT, Inc.

Specific Gravity Determination

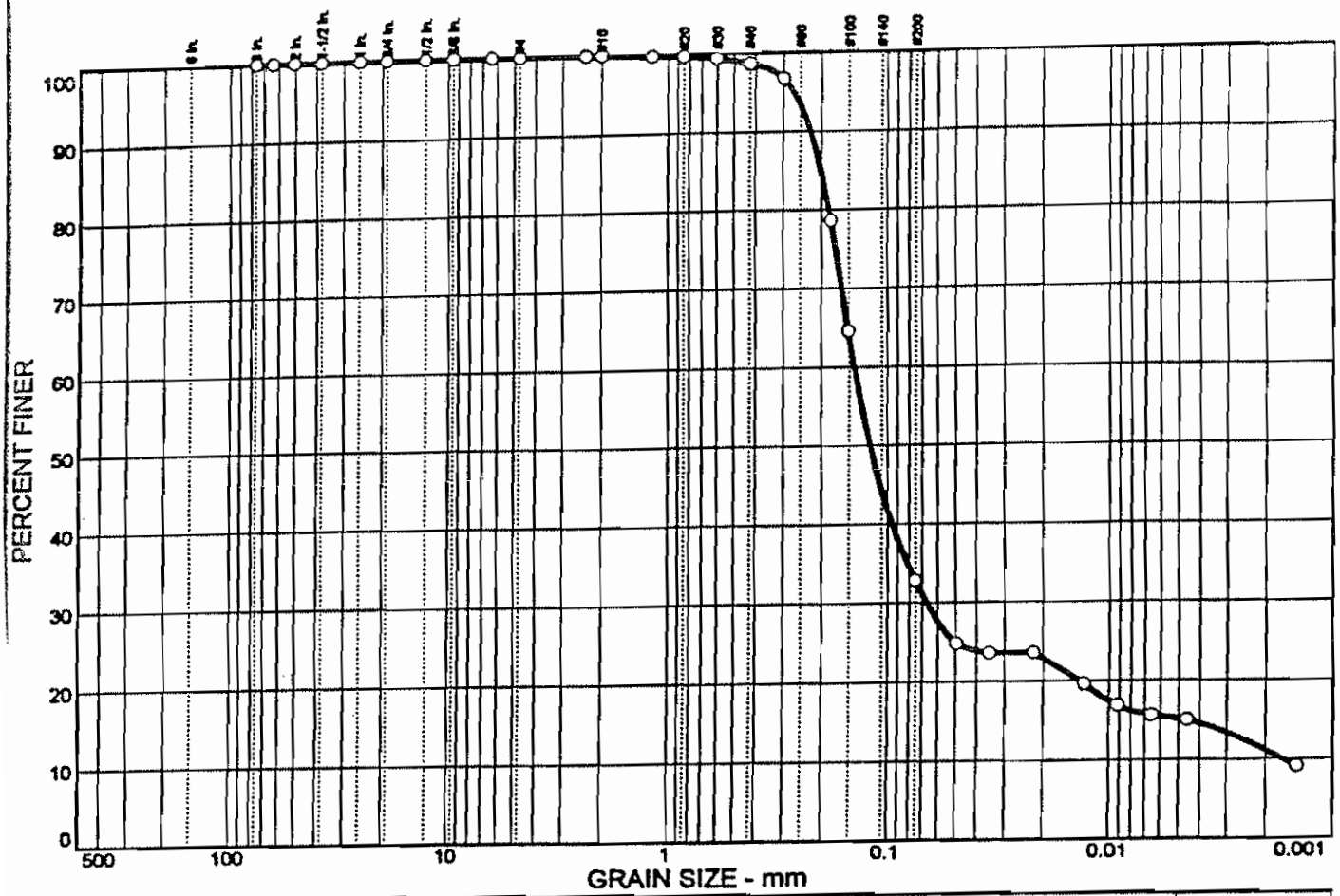
QC: dgl

QA: MH

Project Name: WEYERHAEUSER Project #: 5101

	Sample Location	Flask Vol. @ 20° C	Flask Wt. +Water	Dry Soil Wt.	Flask+Soil +Water	Temp. (c)	Specific Gravity
1	TP-4, 8"-5'	250	341.95	51.86	374.37	23.0	2.67
2	TP-4, 10-11'	250	352.65	52.70	385.51	23.0	2.65
3	TP-7, 8-10'	250	355.43	56.17	390.59	23.0	2.67
4	TP-9, 1.5-6'	250	354.02	54.95	388.40	23.0	2.67
5	TP-13, 2-5'	250	353.66	58.47	390.26	23.0	2.67
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							

GRAIN SIZE DISTRIBUTION TEST REPORT (ASTM D422)



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	67.2	17.7	15.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3.0 in.	100.0		
2.5 in.	100.0		
2.0 in.	100.0		
1.5 in.	100.0		
1.0 in.	100.0		
.75 in.	100.0		
.5 in.	100.0		
.375 in.	100.0		
.25 in.	100.0		
#4	100.0		
#8	100.0		
#10	100.0		
#16	99.8		
#20	99.7		
#30	99.4		
#40	98.7		
#50	96.8		
#80	78.6		
#100	64.6		
#200	32.8		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.200 D_{60}= 0.141 D_{50}= 0.119
D_{30}= 0.0670 D_{15}= 0.0048 D_{10}= 0.0017
C_u= 84.59 C_c= 19.19

Classification

USCS= AASHTO=

Remarks

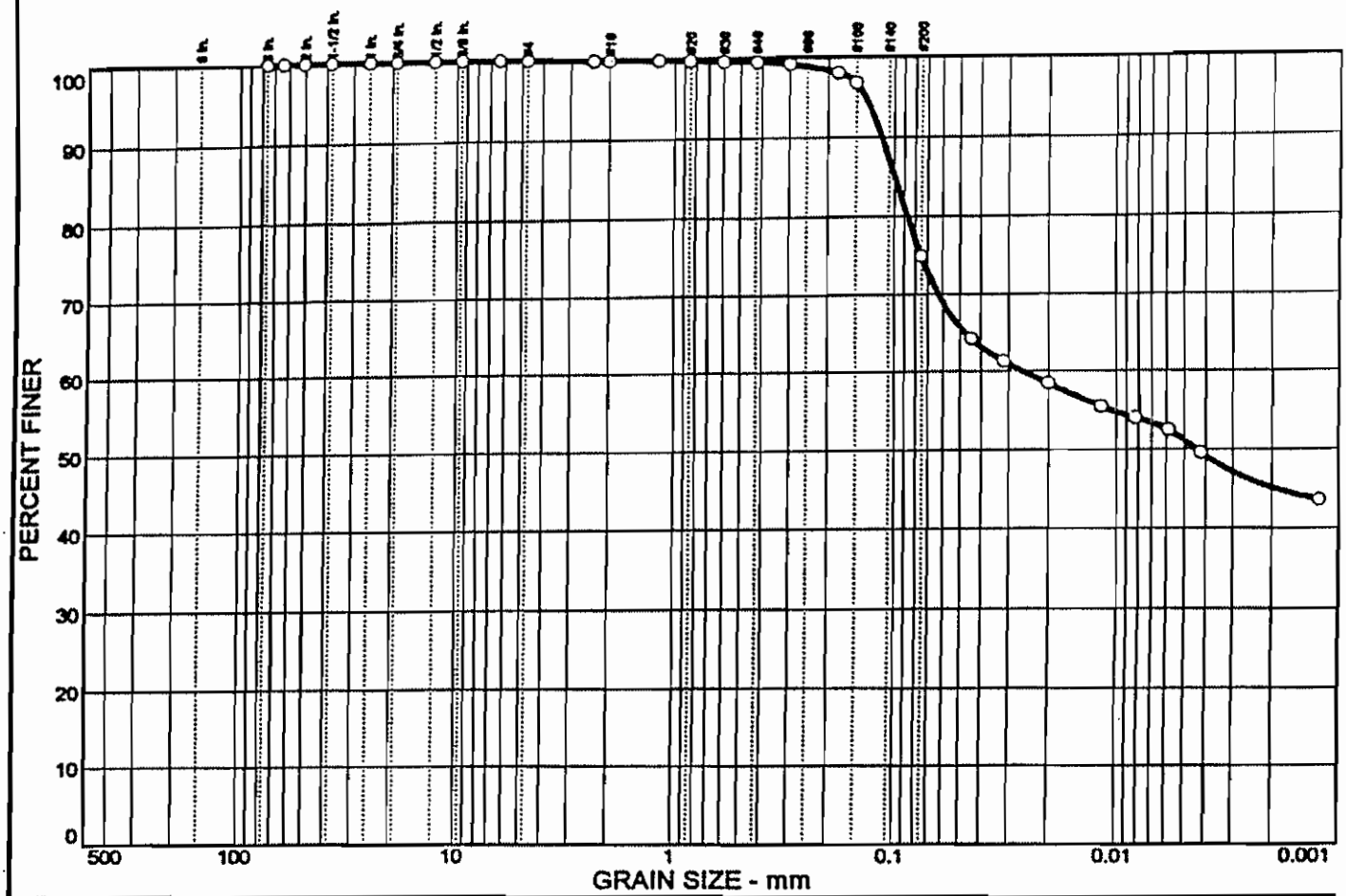
Sample No.: Source of Sample: TP-3 Date: 11/4/98
Location: Elev./Depth: 0-1'

RMT, Inc.

Client:
Project: WEYERHAEUSER
Project No: 5101.02 Figure:

✓ MH

GRAIN SIZE DISTRIBUTION TEST REPORT (ASTM D422)



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	25.0	23.8	51.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3.0 in.	100.0		
2.5 in.	100.0		
2.0 in.	100.0		
1.5 in.	100.0		
1.0 in.	100.0		
.75 in.	100.0		
.5 in.	100.0		
.375 in.	100.0		
.25 in.	100.0		
#4	100.0		
#8	99.9		
#10	99.9		
#16	99.8		
#20	99.7		
#30	99.6		
#40	99.5		
#50	99.2		
#80	98.1		
#100	96.8		
#200	75.0		

* (no specification provided)

Soil Description

Fat clay with sand

Atterberg Limits

PL= 28 LL= 58 PI= 30

Coefficients

D_{85}= 0.0992 D_{60}= 0.0259 D_{50}= 0.0044
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

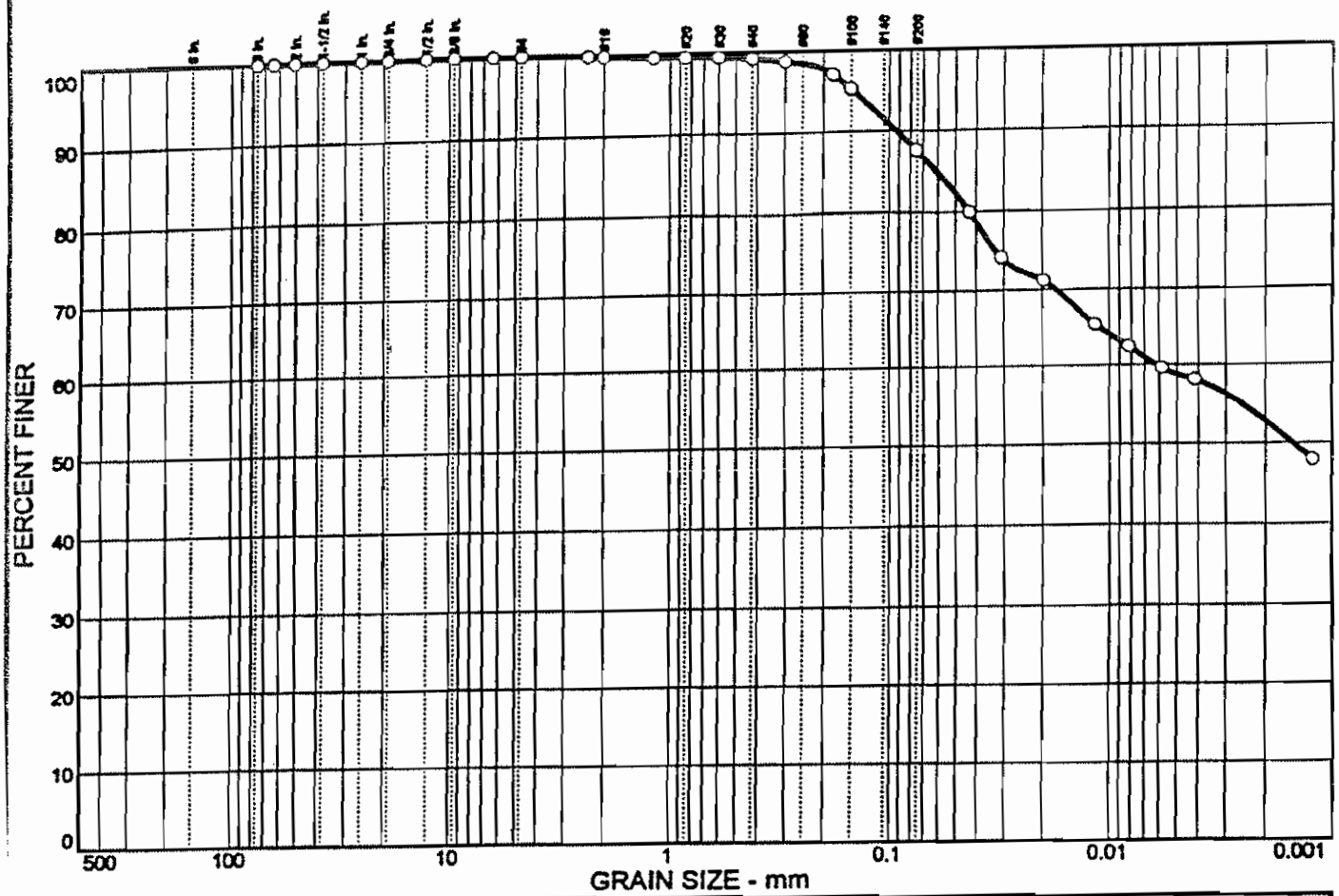
Remarks

Sample No.: **Source of Sample:** TP-4 **Date:**
Location: **Elev./Depth:** 8"-5.0'

RMT, Inc.

Client:
Project: WEYERHAEUSER
Project No: 5101.02 **Figure:**

GRAIN SIZE DISTRIBUTION TEST REPORT (ASTM D422)



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	12.4	28.8	58.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3.0 in.	100.0		
2.5 in.	100.0		
2.0 in.	100.0		
1.5 in.	100.0		
1.0 in.	100.0		
.75 in.	100.0		
.5 in.	100.0		
.375 in.	100.0		
.25 in.	100.0		
#4	100.0		
#8	99.9		
#10	99.8		
#16	99.6		
#20	99.5		
#30	99.4		
#40	99.2		
#50	98.8		
#80	97.1		
#100	95.3		
#200	87.6		

* (no specification provided)

Soil Description

Elastic silt

Atterberg Limits

PL= 31 LL= 55 PI= 24

Coefficients

D_{85}= 0.0601 D_{60}= 0.0062 D_{50}= 0.0015
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= MH AASHTO=

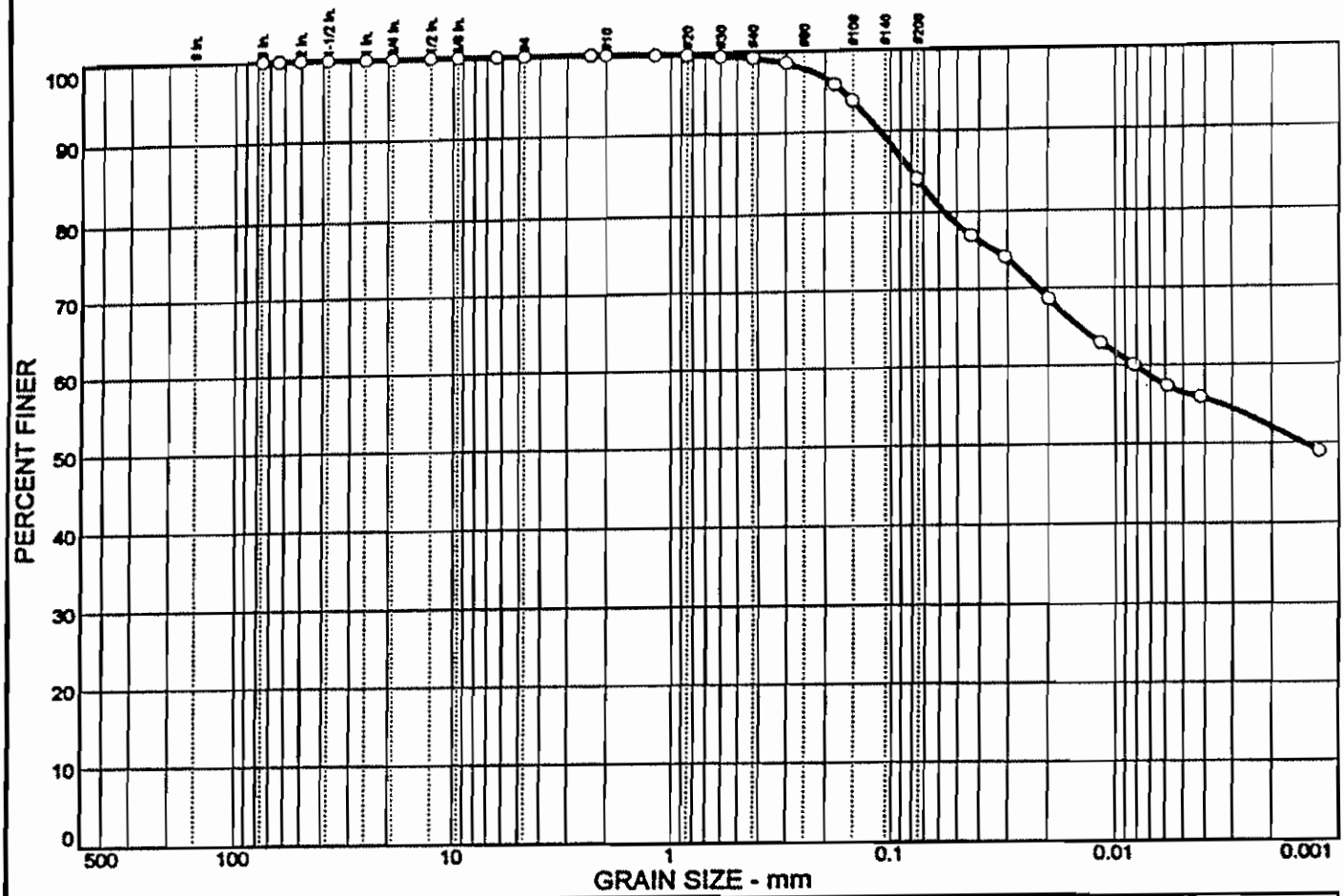
Remarks

Sample No.: **Source of Sample:** TP-4 **Date:**
Location: **Elev./Depth:** 10-11'

RMT, Inc.

Client:
Project: WEYERHAEUSER
Project No: 5101.02 **Figure:**

GRAIN SIZE DISTRIBUTION TEST REPORT (ASTM D422)



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	15.8	27.7	56.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3.0 in.	100.0		
2.5 in.	100.0		
2.0 in.	100.0		
1.5 in.	100.0		
1.0 in.	100.0		
.75 in.	100.0		
.5 in.	100.0		
.375 in.	100.0		
.25 in.	100.0		
#4	100.0		
#8	100.0		
#10	100.0		
#16	99.9		
#20	99.8		
#30	99.6		
#40	99.3		
#50	98.6		
#80	95.8		
#100	93.8		
#200	84.2		

* (no specification provided)

Soil Description

Fat clay with sand

Atterberg Limits

PL= 27 LL= 54 PI= 27

Coefficients

D_{85}= 0.0791 D_{60}= 0.0082 D_{50}= 0.0014
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

Remarks

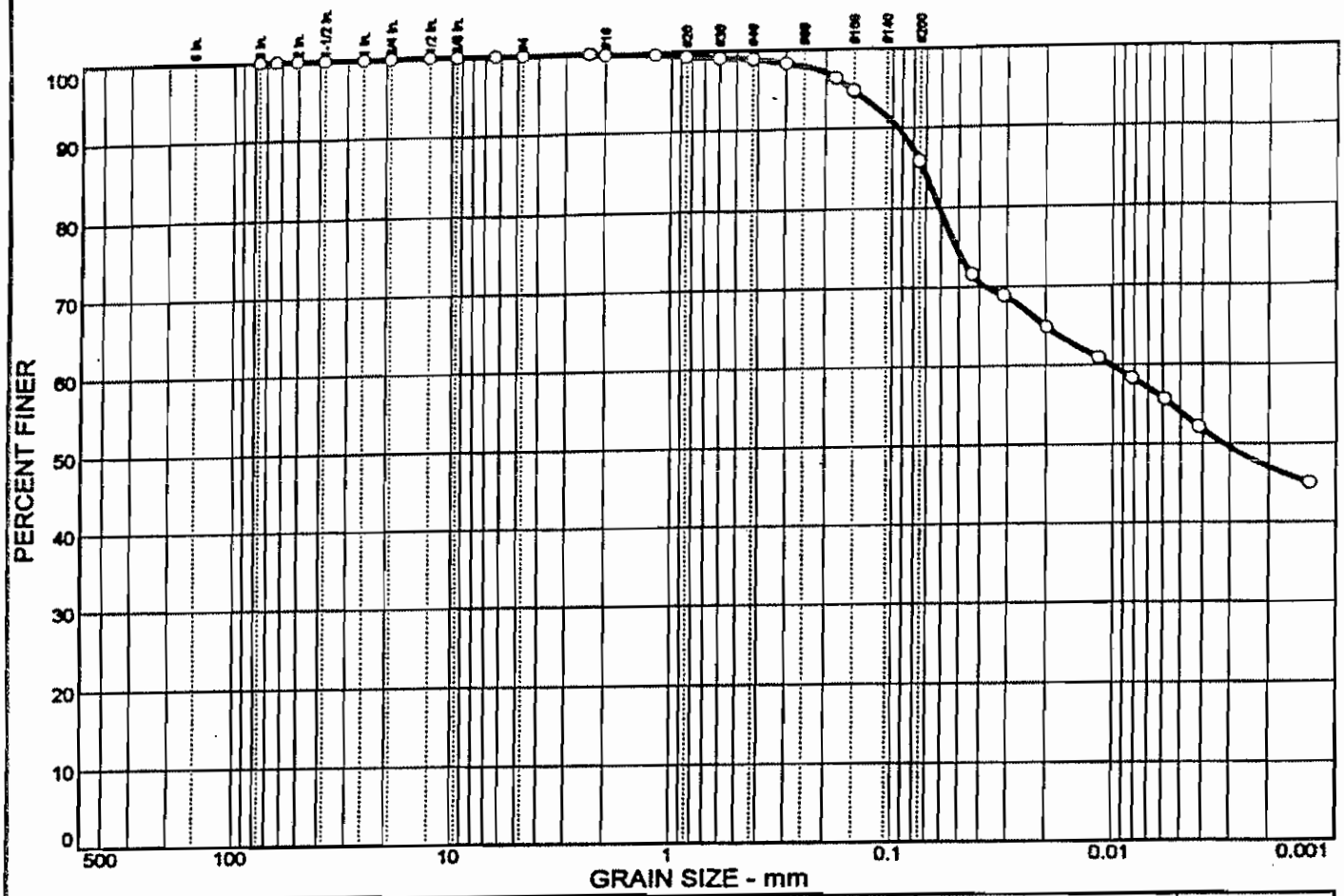
Sample No.: **Source of Sample:** TP-7 **Date:**
Location: **Elev./Depth:** 8-10'

RMT, Inc.

Client:
Project: WEYERHAEUSER
Project No: 5101.02 **Figure:**

J0911

GRAIN SIZE DISTRIBUTION TEST REPORT (ASTM D422)



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	14.2	31.7	54.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3.0 in.	100.0		
2.5 in.	100.0		
2.0 in.	100.0		
1.5 in.	100.0		
1.0 in.	100.0		
.75 in.	100.0		
.5 in.	100.0		
.375 in.	100.0		
.25 in.	100.0		
#4	100.0		
#8	100.0		
#10	99.9		
#16	99.7		
#20	99.4		
#30	99.1		
#40	98.9		
#50	98.3		
#80	96.4		
#100	94.7		
#200	85.8		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.0726 D_{60}= 0.0102 D_{50}= 0.0032
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

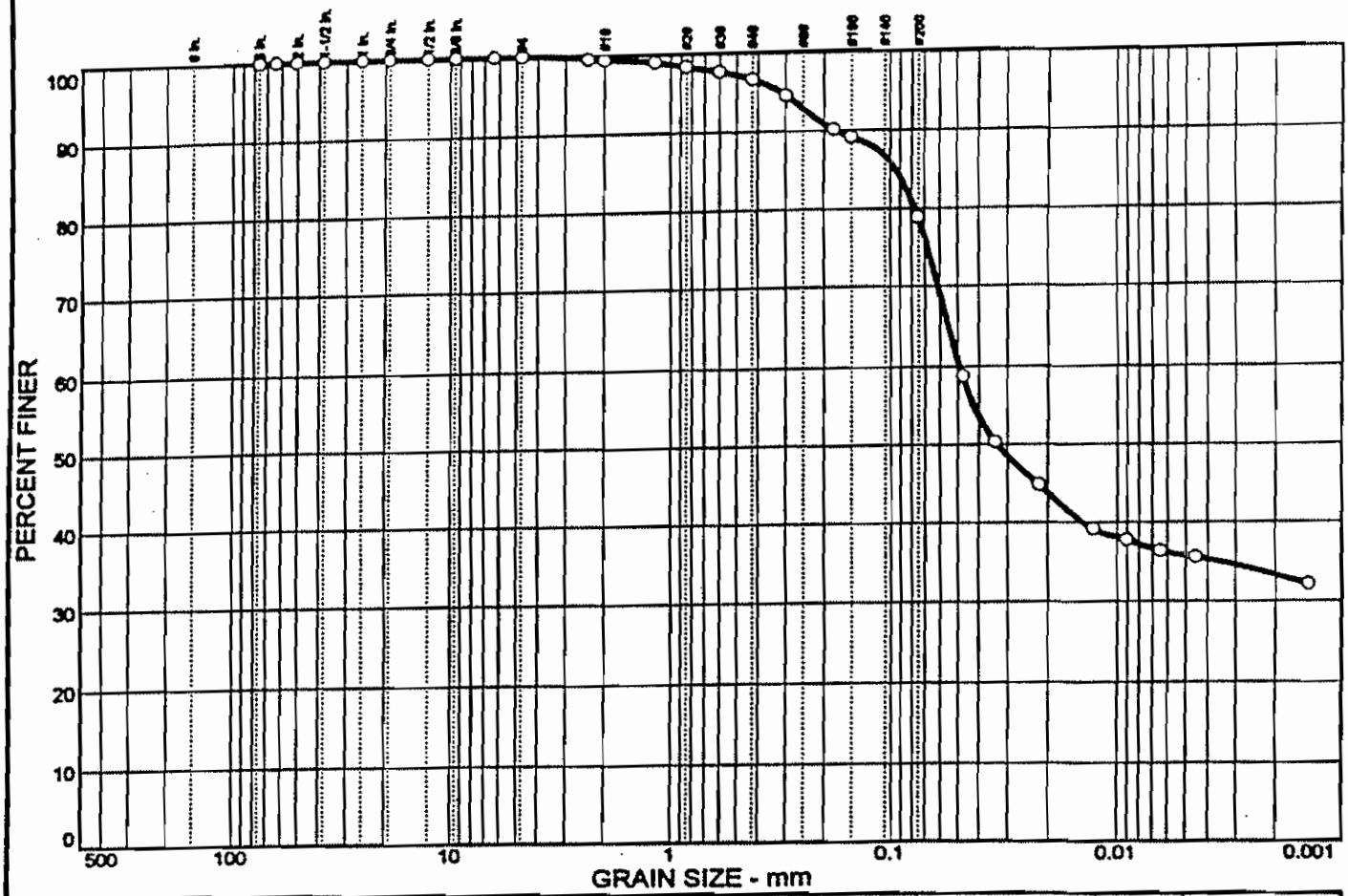
Remarks

Sample No.: **Source of Sample:** TP-8 **Date:** 11/4/98
Location: **Elev./Depth:** 3.5-6.5'

RMT, Inc.

Client:
Project: WEYERHAEUSER
Project No: 5101.02 **Figure:**

GRAIN SIZE DISTRIBUTION TEST REPORT (ASTM D422)



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	21.1	43.1	35.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3.0 in.	100.0		
2.5 in.	100.0		
2.0 in.	100.0		
1.5 in.	100.0		
1.0 in.	100.0		
.75 in.	100.0		
.5 in.	100.0		
.375 in.	100.0		
.25 in.	100.0		
#4	100.0		
#8	99.6		
#10	99.4		
#16	99.0		
#20	98.4		
#30	97.7		
#40	96.7		
#50	94.6		
#80	90.1		
#100	89.1		
#200	78.9		

* (no specification provided)

Soil Description

Lean clay with sand

Atterberg Limits

PL= 23 LL= 43 PI= 20

Coefficients

D_{85}= 0.0945 D_{60}= 0.0488 D_{50}= 0.0333
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

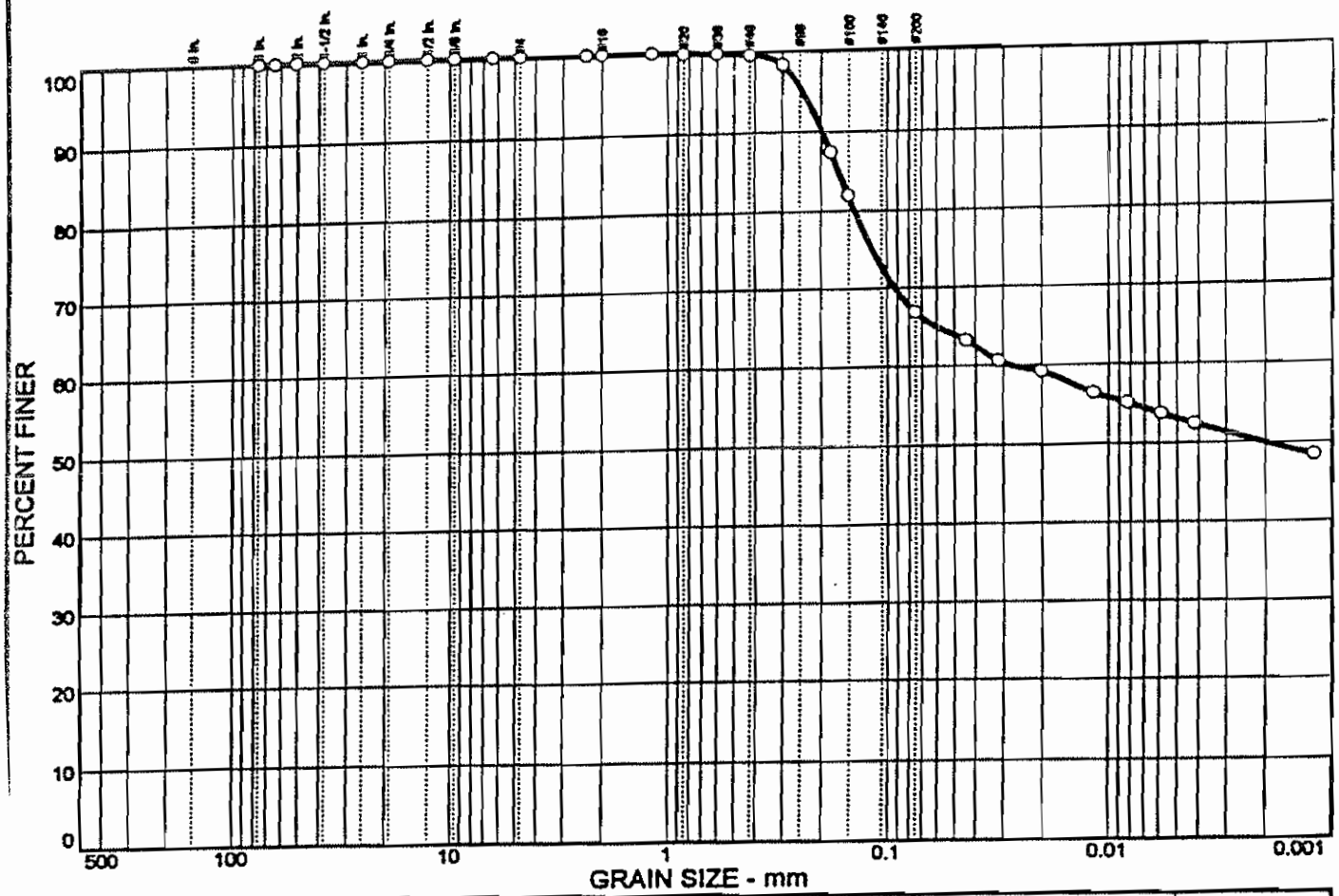
Remarks

Sample No.: **Source of Sample:** TP-8 **Date:**
Location: **Elev./Depth:** 10.5-11'

RMT, Inc.

Client:
Project: WEYERHAEUSER
Project No: 5101.02 **Figure:**

GRAIN SIZE DISTRIBUTION TEST REPORT (ASTM D422)



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	33.1	13.7	53.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3.0 in.	100.0		
2.5 in.	100.0		
2.0 in.	100.0		
1.5 in.	100.0		
1.0 in.	100.0		
.75 in.	100.0		
.5 in.	100.0		
.375 in.	100.0		
.25 in.	100.0		
#4	100.0		
#8	100.0		
#10	100.0		
#16	100.0		
#20	99.9		
#30	99.8		
#40	99.6		
#50	98.3		
#80	87.5		
#100	82.0		
#200	66.9		

* (no specification provided)

Soil Description

Sandy fat clay

Atterberg Limits

PL= 26 LL= 56 PI= 30

Coefficients

D_{85}= 0.166 D_{60}= 0.0276 D_{50}= 0.0020
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

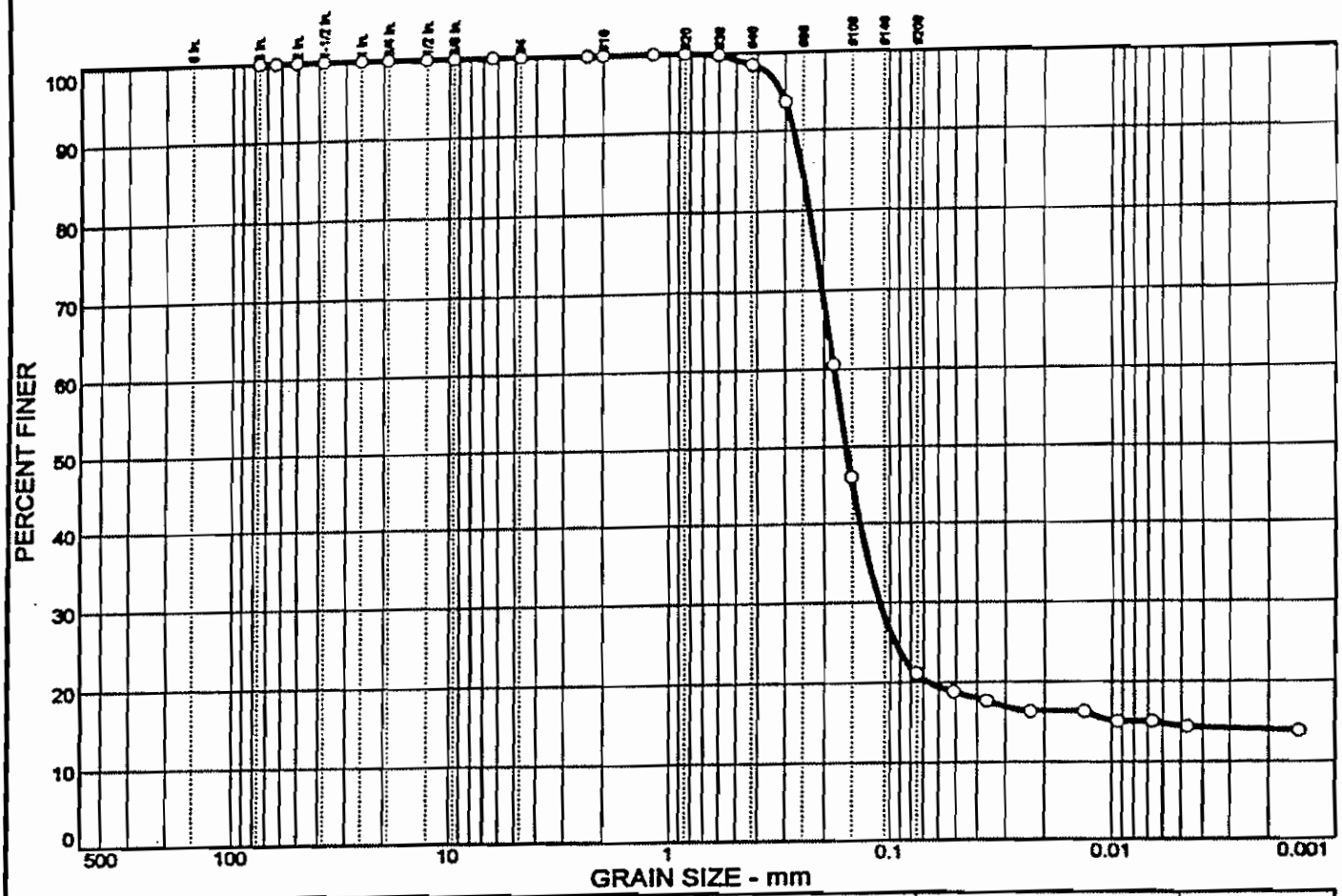
Remarks

Sample No.: Source of Sample: TP-9 Date:
Location: Elev./Depth: 1.5-6'

RMT, Inc.

Client:
Project: WEYERHAEUSER
Project No: 5101.02 Figure:

GRAIN SIZE DISTRIBUTION TEST REPORT (ASTM D422)



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	78.9	6.7	14.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3.0 in.	100.0		
2.5 in.	100.0		
2.0 in.	100.0		
1.5 in.	100.0		
1.0 in.	100.0		
.75 in.	100.0		
.5 in.	100.0		
.375 in.	100.0		
.25 in.	100.0		
#4	100.0		
#8	100.0		
#10	100.0		
#16	100.0		
#20	100.0		
#30	99.8		
#40	98.5		
#50	93.6		
#80	60.6		
#100	46.0		
#200	21.1		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.250 D_{60}= 0.179 D_{50}= 0.158
D_{30}= 0.112 D_{15}= 0.0066 D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

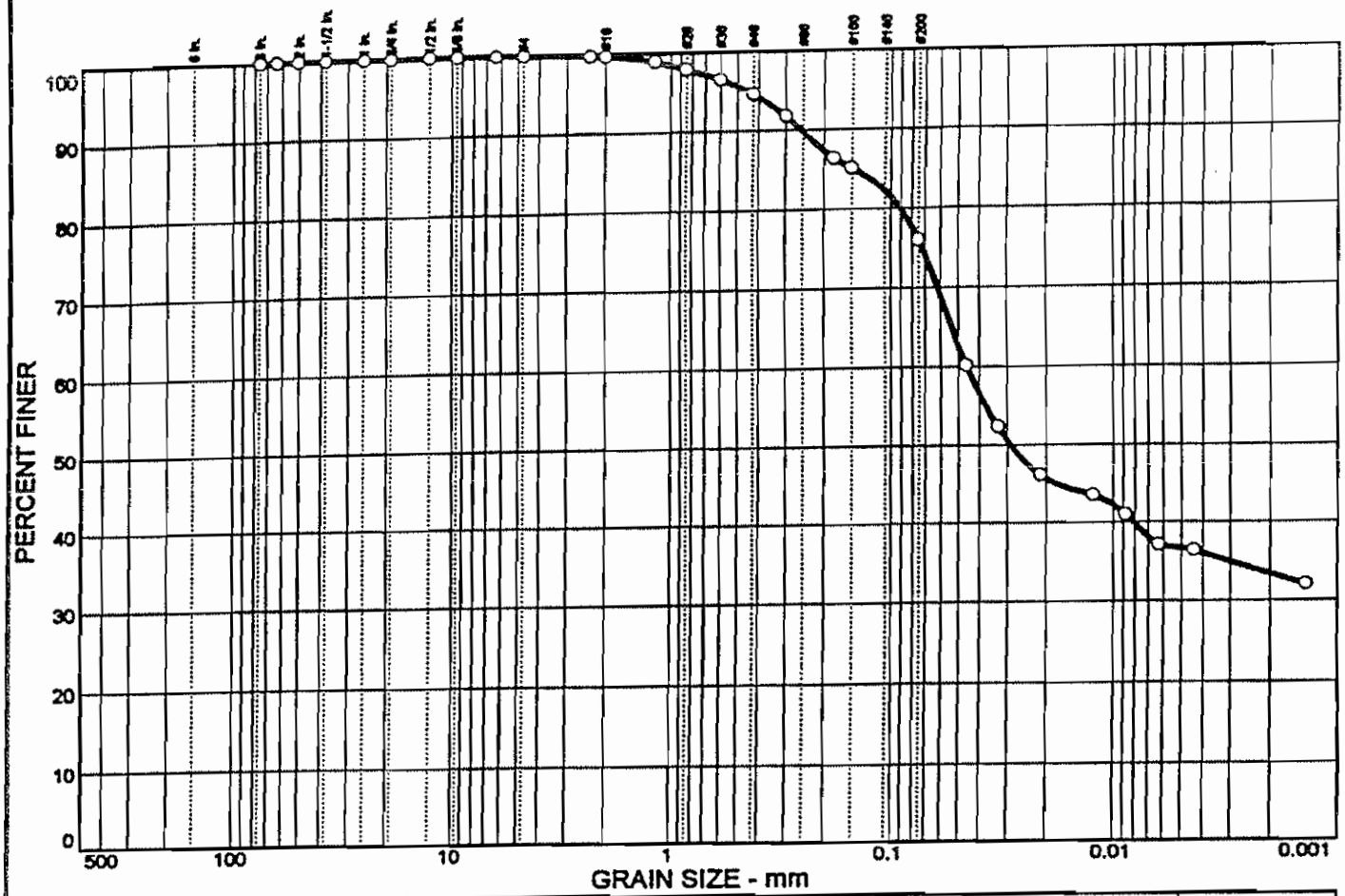
Remarks

Sample No.: **Source of Sample:** TP-9 **Date:** 11/4/98
Location: **Elev./Depth:** 6-9'

RMT, Inc.

Client:
Project: WEYERHAEUSER
Project No: 5101.02 **Figure:**

GRAIN SIZE DISTRIBUTION TEST REPORT (ASTM D422)



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	24.0	39.4	36.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3.0 in.	100.0		
2.5 in.	100.0		
2.0 in.	100.0		
1.5 in.	100.0		
1.0 in.	100.0		
.75 in.	100.0		
.5 in.	100.0		
.375 in.	100.0		
.25 in.	100.0		
#4	100.0		
#8	99.8		
#10	99.7		
#16	99.0		
#20	98.0		
#30	96.6		
#40	94.7		
#50	91.8		
#80	86.4		
#100	85.1		
#200	76.0		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.148 D_{60}= 0.0455 D_{50}= 0.0288
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

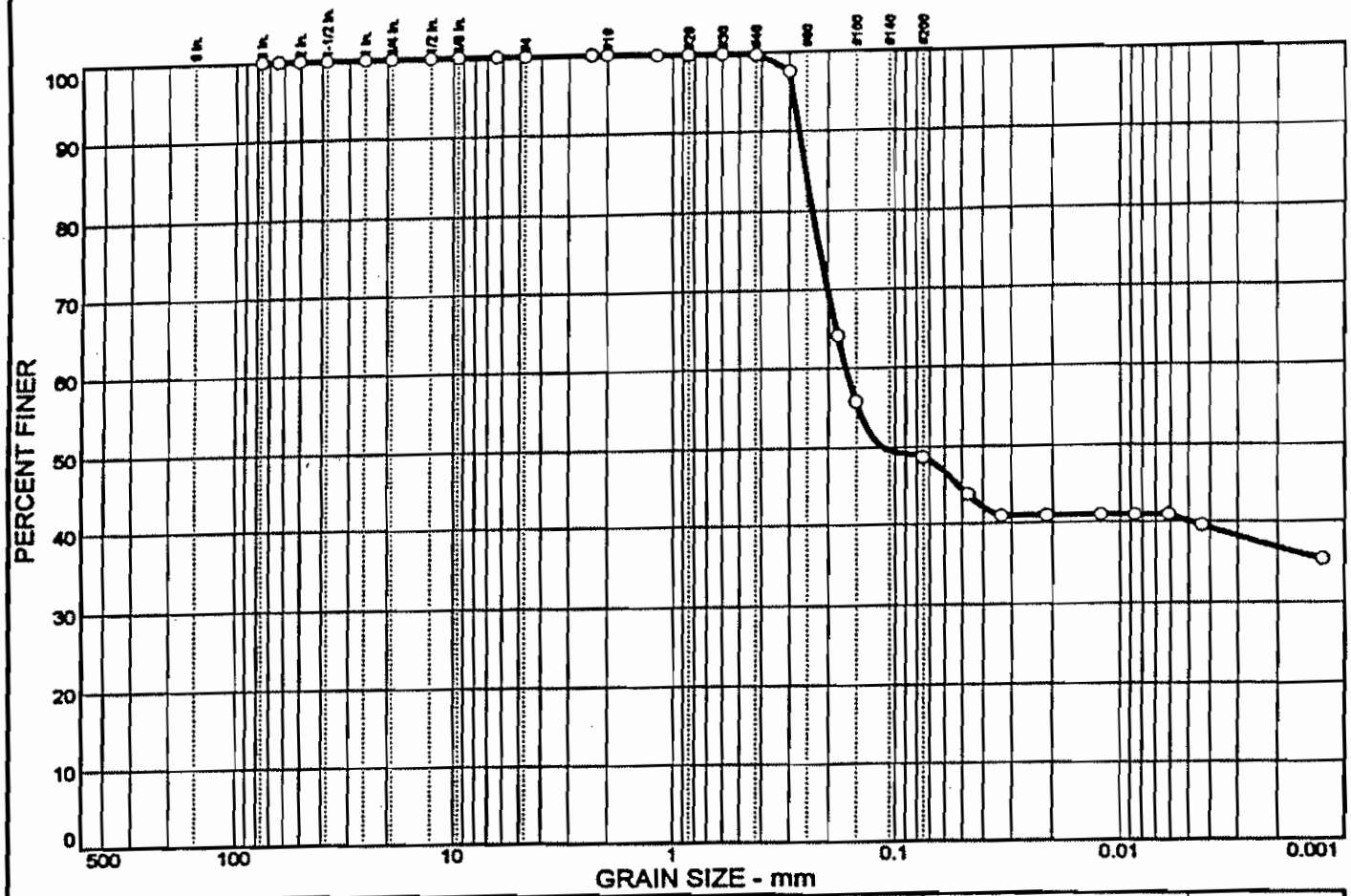
Remarks

Sample No.: **Source of Sample:** TP-9 **Date:** 11/4/98
Location: **Elev./Depth:** 9-11'

RMT, Inc.

Client:
Project: WEYERHAEUSER
Project No: 5101.02 **Figure:**

GRAIN SIZE DISTRIBUTION TEST REPORT (ASTM D422)



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	51.3	8.5	40.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3.0 in.	100.0		
2.5 in.	100.0		
2.0 in.	100.0		
1.5 in.	100.0		
1.0 in.	100.0		
.75 in.	100.0		
.5 in.	100.0		
.375 in.	100.0		
.25 in.	100.0		
#4	100.0		
#8	100.0		
#10	100.0		
#16	99.9		
#20	99.9		
#30	99.9		
#40	99.7		
#50	97.5		
#80	64.1		
#100	55.8		
#200	48.7		

* (no specification provided)

Soil Description

Clayey sand

Atterberg Limits

PL= 21 LL= 40 PI= 19

Coefficients

D_{85}= 0.251 D_{60}= 0.166 D_{50}= 0.112
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SC AASHTO=

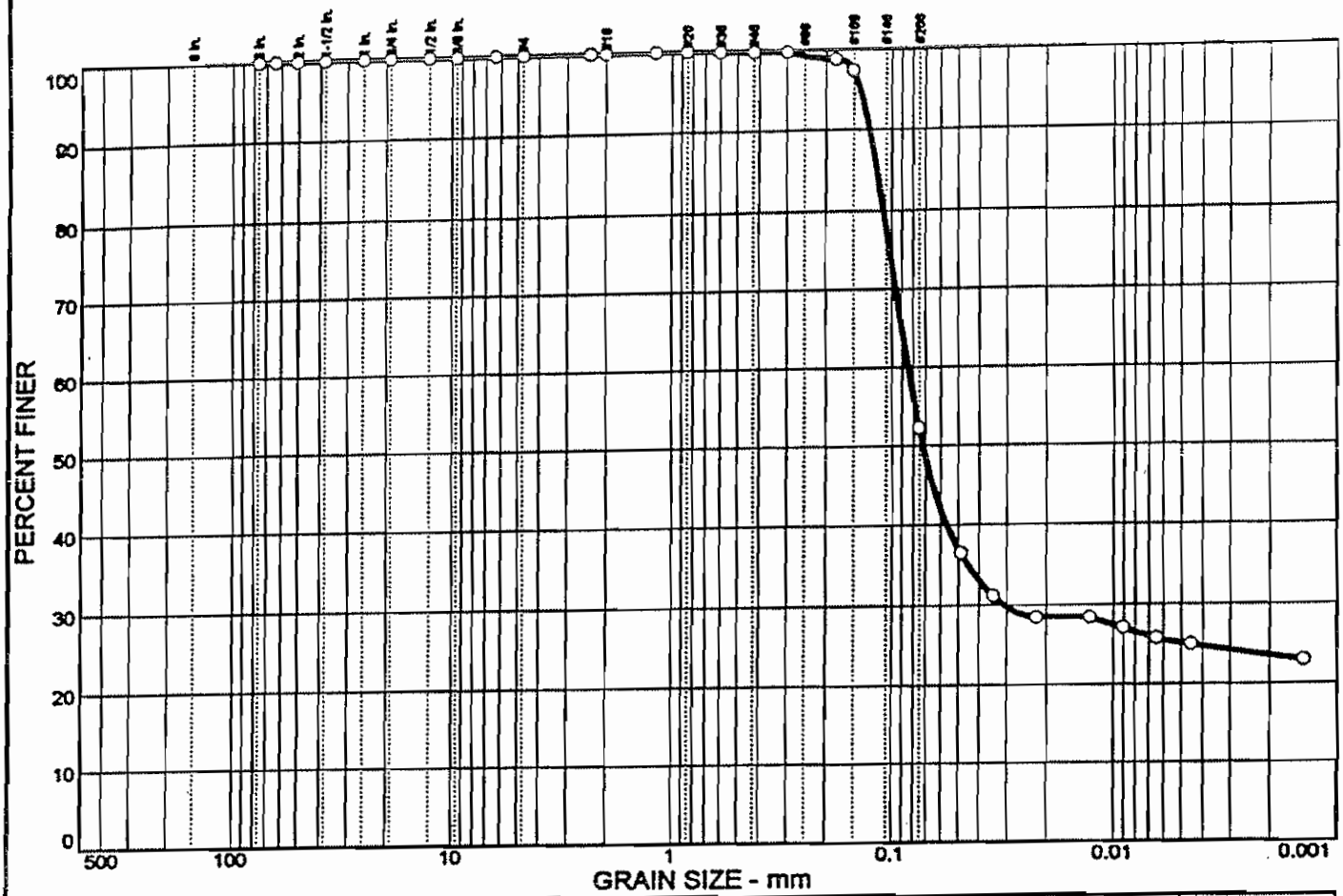
Remarks

Sample No.: **Source of Sample:** TP-13 **Date:**
Location: **Elev./Depth:** 2-5'

RMT, Inc.

Client:
Project: WEYERHAEUSER
Project No: 5101.02 **Figure:**

GRAIN SIZE DISTRIBUTION TEST REPORT (ASTM D422)



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	47.7	27.2	25.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3.0 in.	100.0		
2.5 in.	100.0		
2.0 in.	100.0		
1.5 in.	100.0		
1.0 in.	100.0		
.75 in.	100.0		
.5 in.	100.0		
.375 in.	100.0		
.25 in.	100.0		
#4	100.0		
#8	100.0		
#10	100.0		
#16	100.0		
#20	100.0		
#30	99.9		
#40	99.9		
#50	99.8		
#80	98.8		
#100	97.4		
#200	52.3		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.117 D_{60}= 0.0841 D_{50}= 0.0720
D_{30}= 0.0311 D_{15}= D_{10}=
C_u= C_c=

Classification

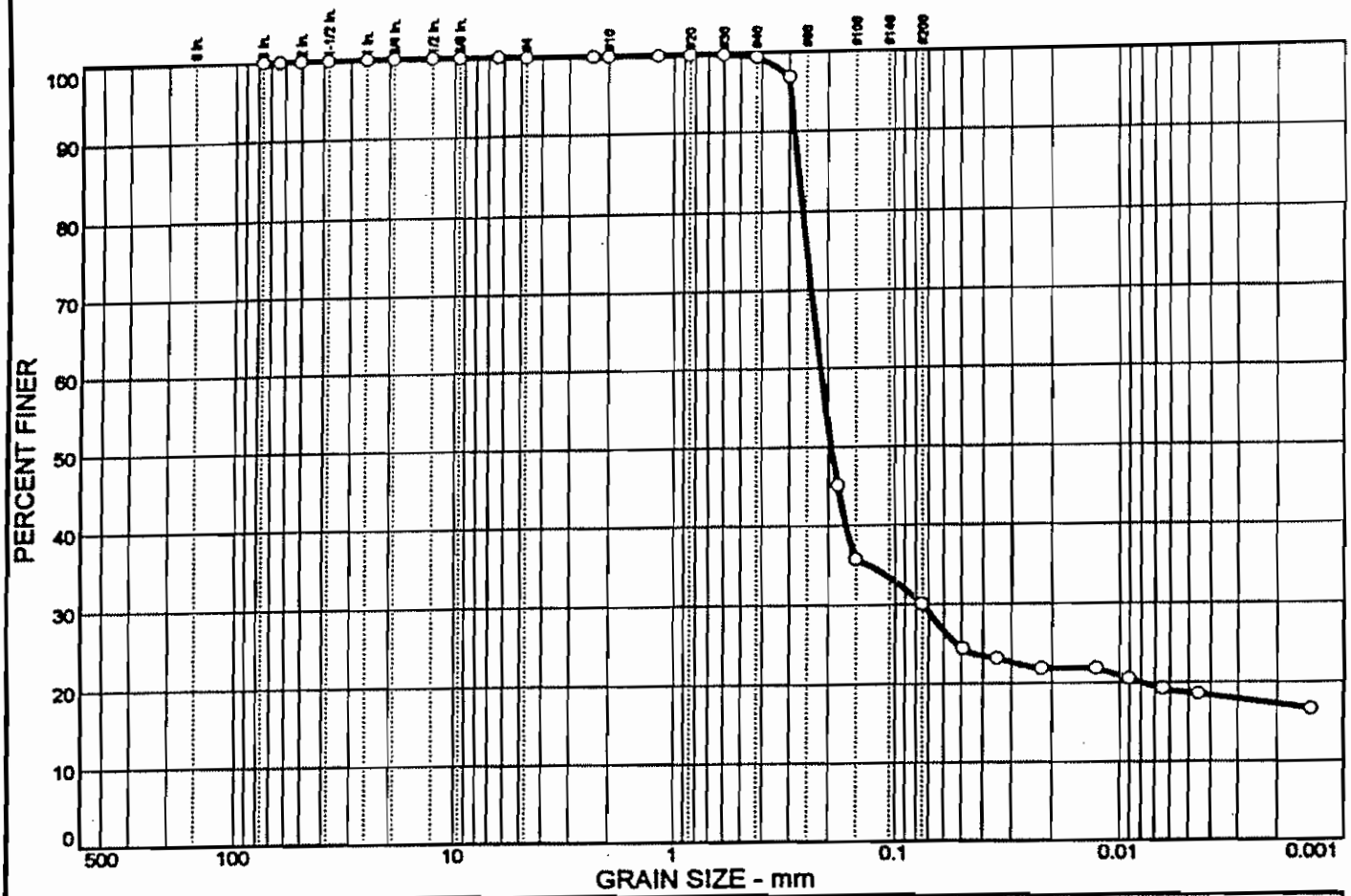
USCS= AASHTO=

Remarks

Sample No.: **Source of Sample:** TP-16 **Date:** 11/4/98
Location: **Elev./Depth:** 2.5-5.5'

RMT, Inc.	**Client:** **Project:** WEYERHAEUSER **Project No:** 5101.02 **Figure:**

GRAIN SIZE DISTRIBUTION TEST REPORT (ASTM D422)



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.1	69.9	11.3	18.7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3.0 in.	100.0		
2.5 in.	100.0		
2.0 in.	100.0		
1.5 in.	100.0		
1.0 in.	100.0		
.75 in.	100.0		
.5 in.	100.0		
.375 in.	100.0		
.25 in.	100.0		
#4	99.9		
#8	99.9		
#10	99.9		
#16	99.9		
#20	99.9		
#30	99.8		
#40	99.5		
#50	96.9		
#80	45.1		
#100	35.8		
#200	30.0		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.271 D_{60}= 0.215 D_{50}= 0.192
D_{30}= 0.0750 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

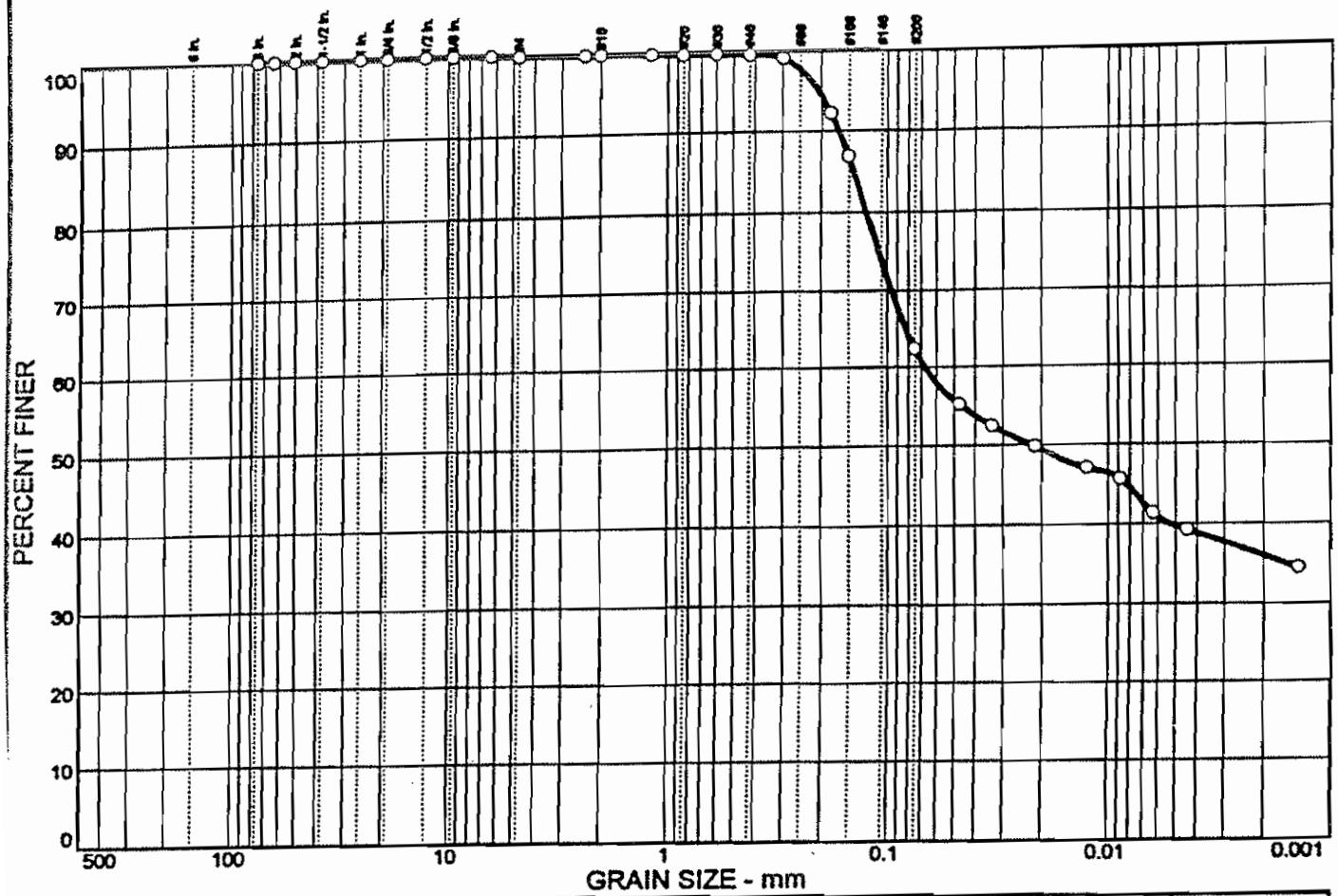
Remarks

Sample No.: **Source of Sample:** TP-22 **Date:** 11/4/98
Location: **Elev./Depth:** 3-4'

RMT, Inc.

Client:
Project: WEYERHAEUSER
Project No: 5101.02 **Figure:**

GRAIN SIZE DISTRIBUTION TEST REPORT (ASTM D422)



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.1	37.5	22.6	39.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3.0 in.	100.0		
2.5 in.	100.0		
2.0 in.	100.0		
1.5 in.	100.0		
1.0 in.	100.0		
.75 in.	100.0		
.5 in.	100.0		
.375 in.	100.0		
.25 in.	100.0		
#4	99.9		
#8	99.9		
#10	99.9		
#16	99.8		
#20	99.7		
#30	99.7		
#40	99.6		
#50	99.1		
#80	92.2		
#100	86.9		
#200	62.4		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.142 D_{60}= 0.0674 D_{50}= 0.0222
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

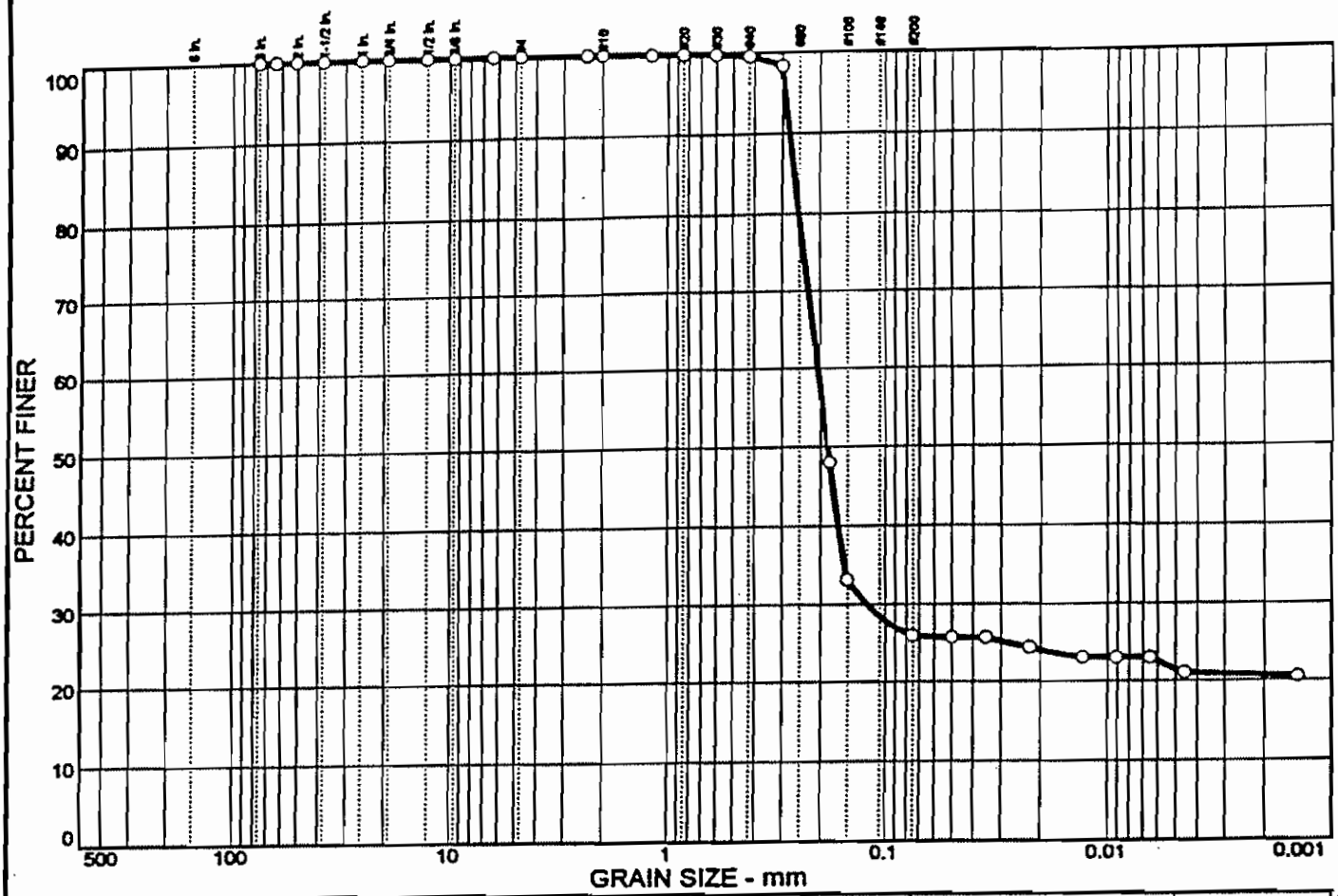
Remarks

Sample No.: **Source of Sample:** TP-22 **Date:** 11/4/98
Location: **Elev./Depth:** 8.5-9.5'

RMT, Inc.

Client:
Project: WEYERHAEUSER
Project No: 5101.02 **Figure:**

GRAIN SIZE DISTRIBUTION TEST REPORT (ASTM D422)



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	74.1	4.4	21.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3.0 in.	100.0		
2.5 in.	100.0		
2.0 in.	100.0		
1.5 in.	100.0		
1.0 in.	100.0		
.75 in.	100.0		
.5 in.	100.0		
.375 in.	100.0		
.25 in.	100.0		
#4	100.0		
#8	100.0		
#10	100.0		
#16	99.9		
#20	99.9		
#30	99.8		
#40	99.6		
#50	98.3		
#80	48.0		
#100	33.1		
#200	25.9		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.263 D_{60}= 0.204 D_{50}= 0.184
D_{30}= 0.121 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

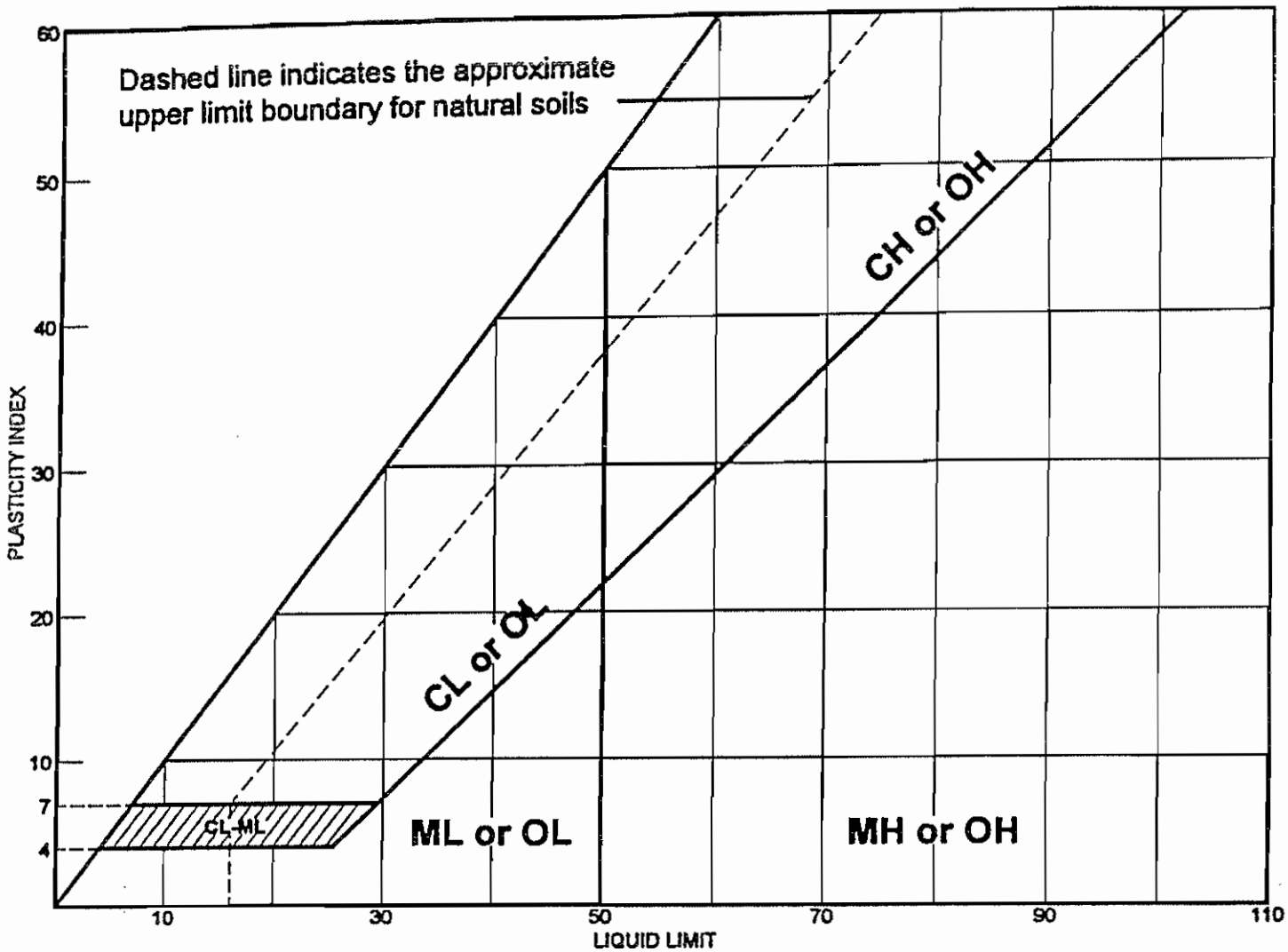
Sample No.: **Source of Sample:** TP-25 **Date:** 11/4/98
Location: **Elev./Depth:** 5.5'

RMT, Inc.

Client:
Project: WEYERHAEUSER
Project No: 5101.02 **Figure:**

✓ HA

LIQUID AND PLASTIC LIMITS TEST REPORT (ASTM D4318)



MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
Lean clay with sand	43	23	20	96.7	78.9	CL

Project No. 5101.02 Client:

Project: WEYERHAEUSER

Source: TP-8 Elev./Depth: 10.5-11'

Remarks:

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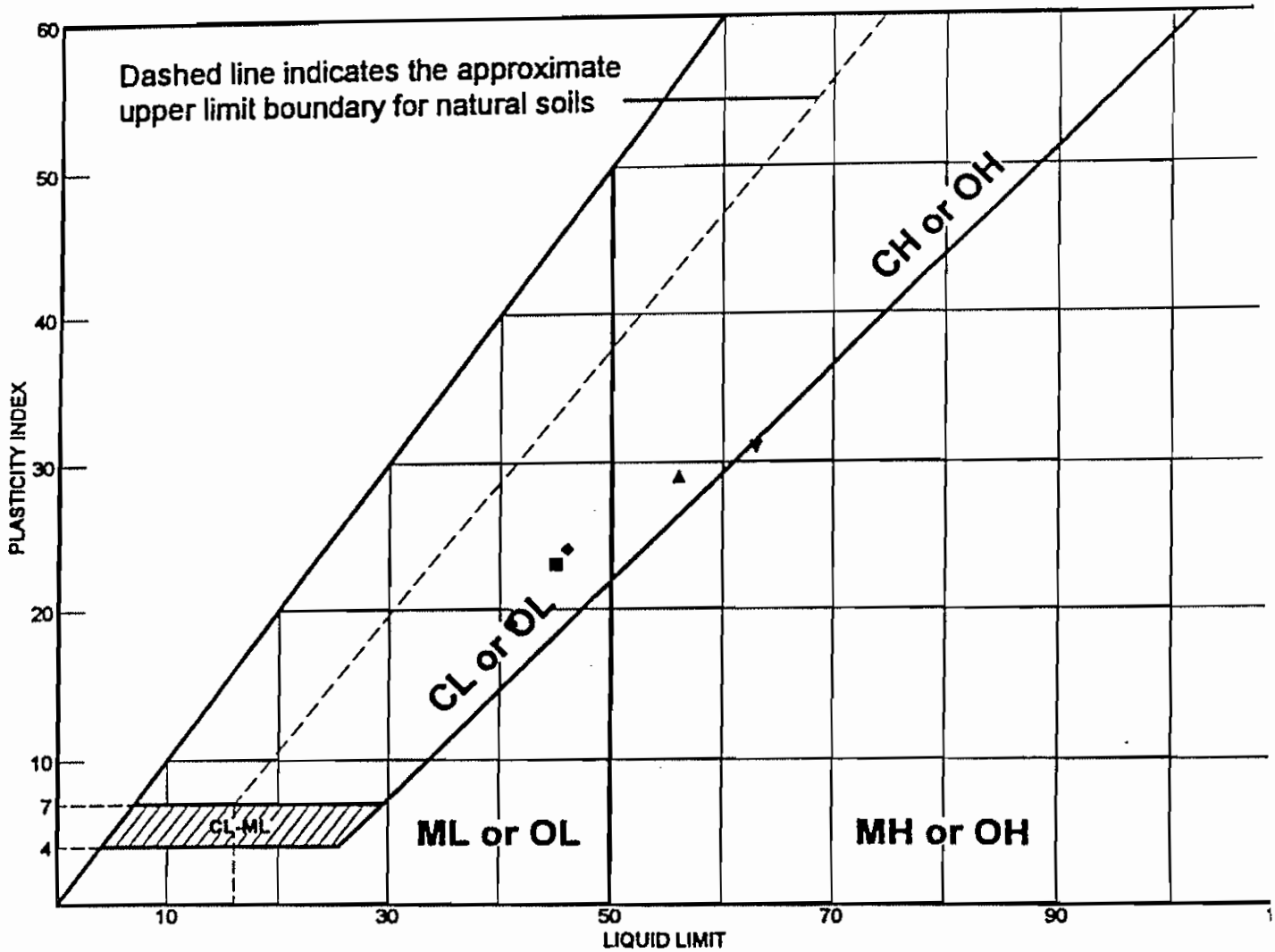
LIQUID AND PLASTIC LIMITS TEST REPORT (ASTM D4318)

RMT, Inc.

Figure:

LIQUID AND PLASTIC LIMITS TEST REPORT (ASTM D4318)



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		41	22	19			
■		45	22	23			
▲		56	27	29			
◆		46	22	24			
▼		63	32	31			

Project No. 5101.02 **Client:**

Project: WEYERHAEUSER

● **Source:** TP-2 **Elev./Depth:** 0.5'

■ **Source:** TP-5 **Elev./Depth:** 0.5-3'

▲ **Source:** TP-5 **Elev./Depth:** 7-11'

◆ **Source:** TP-6 **Elev./Depth:** 2-5'

▼ **Source:** TP-6 **Elev./Depth:** 7-8.5'

Remarks:

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LIQUID AND PLASTIC LIMITS TEST REPORT (ASTM D4318)

RMT, Inc.

Figure:

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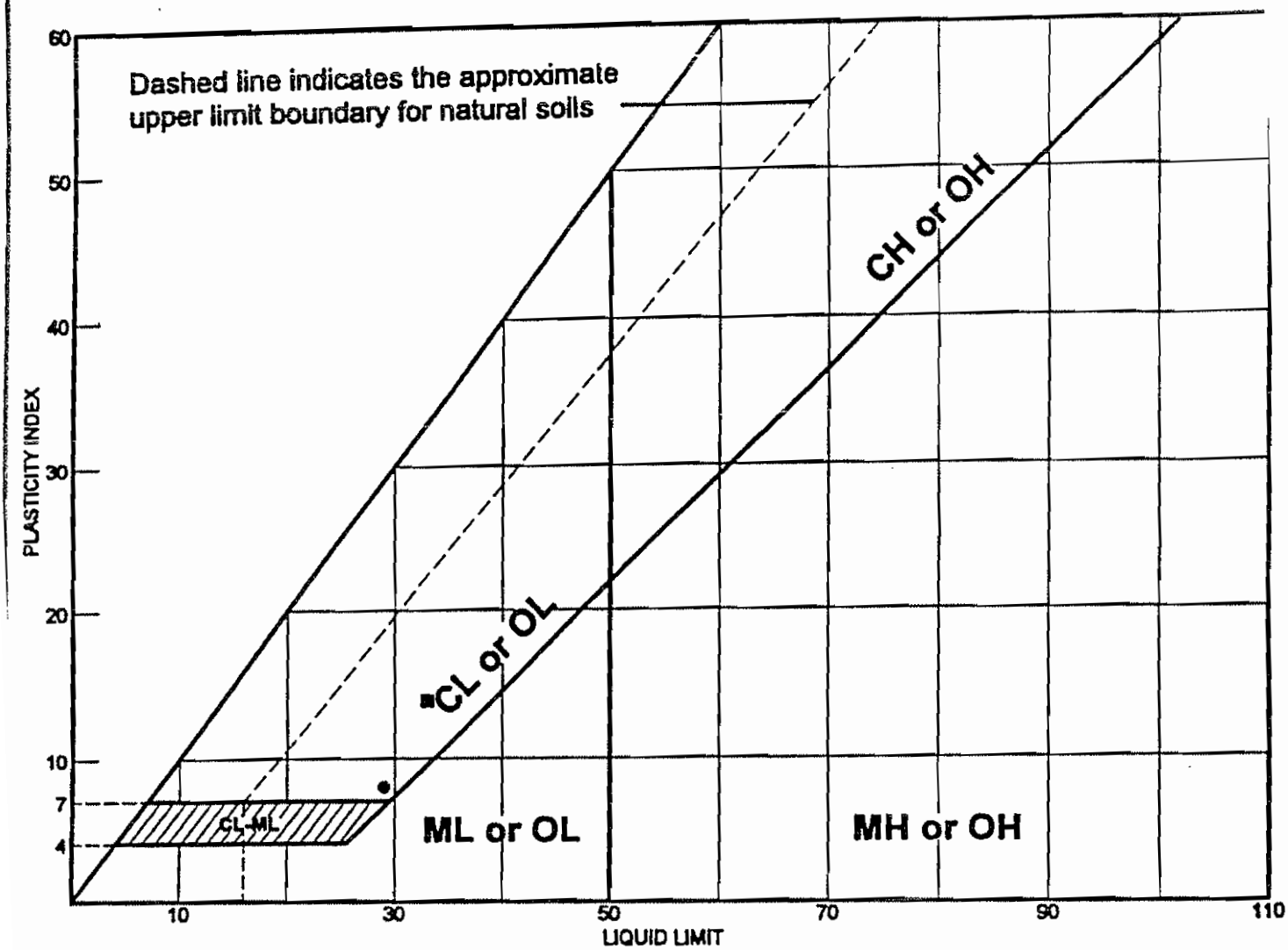
LIQUID AND PLASTIC LIMITS TEST REPORT (ASTM D4318)



MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
	29	21	8		36.3	
	33	19	14		37.6	

Project No. 5101.02 Client:

Project: WEYERHAEUSER

Source: TP-3 Elev./Depth: 1-6'

Source: TP-18 Elev./Depth: 3-8'

Remarks:

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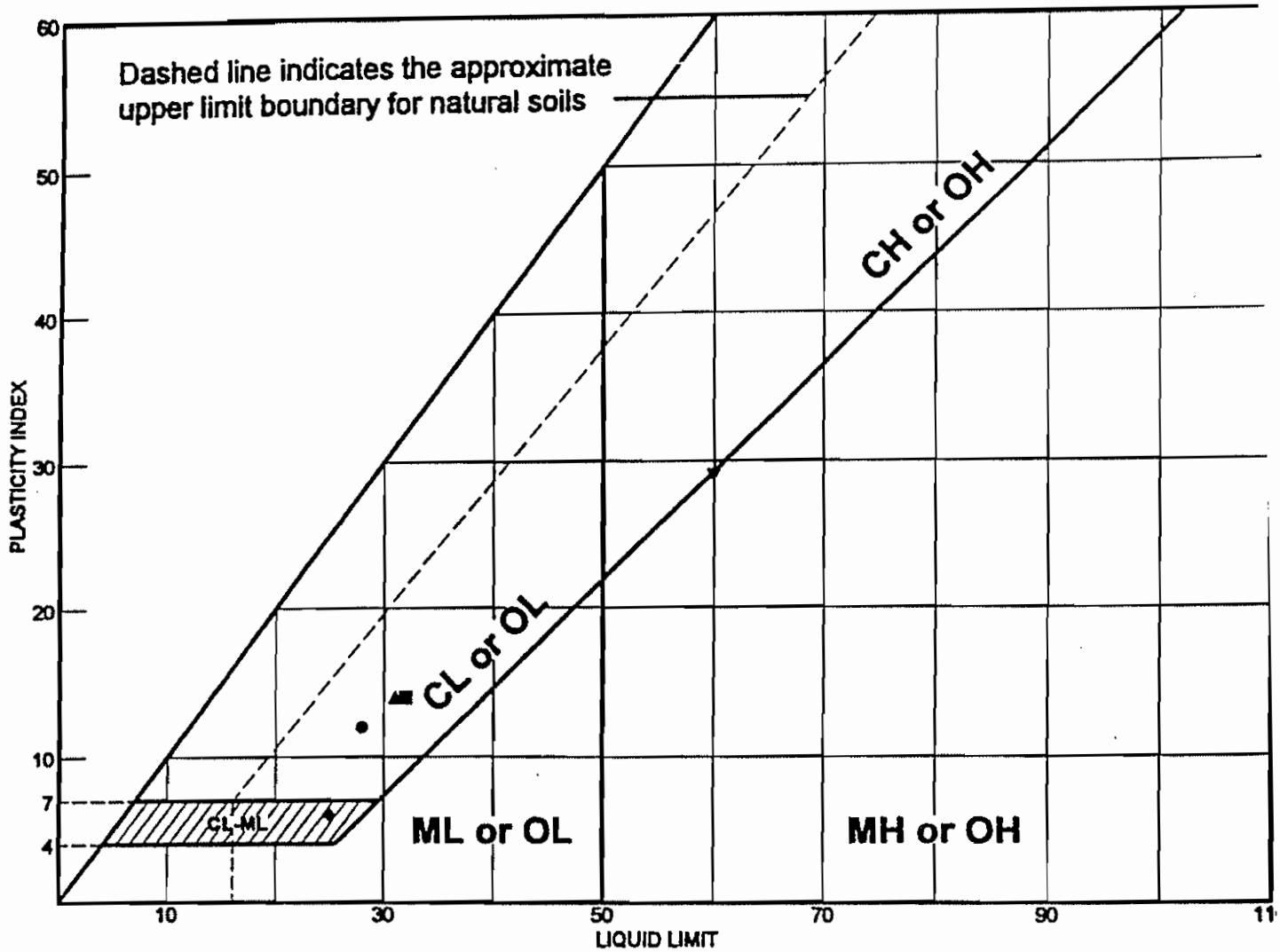
LIQUID AND PLASTIC LIMITS TEST REPORT (ASTM D4318)

RMT, Inc.

Figure:

LIQUID AND PLASTIC LIMITS TEST REPORT (ASTM D4318)



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		28	16	12			
■		32	18	14			
▲		31	17	14			
◆		25	19	6			
▼		60	31	29			

Project No. 5101.02 **Client:**

Project: WEYERHAEUSER

● **Source:** TP-12 **Elev./Depth:** 4.5'
■ **Source:** TP-13 **Elev./Depth:** 5'
▲ **Source:** TP-19 **Elev./Depth:** 1.5-2.5'
◆ **Source:** TP-21 **Elev./Depth:** 2.5-6.5'
▼ **Source:** TP-25 **Elev./Depth:** 2-3.5'

Remarks:
●
■
▲
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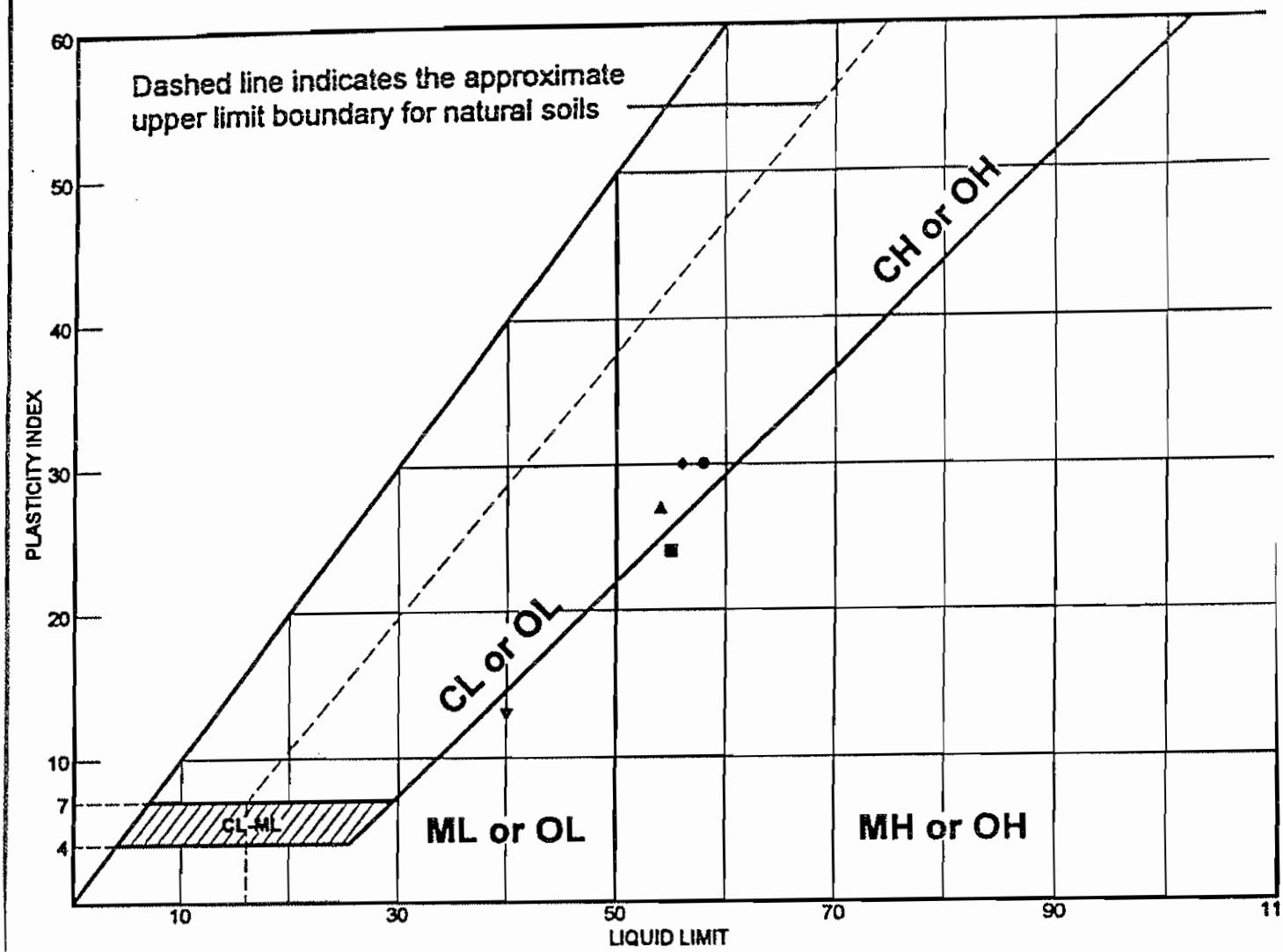
LIQUID AND PLASTIC LIMITS TEST REPORT (ASTM D4318)

RMT, Inc.

Figure:

LIQUID AND PLASTIC LIMITS TEST REPORT (ASTM D4318)



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Fat clay with sand	58	28	30	99.5	75.0	CH
■	Elastic silt	55	31	24	99.2	87.6	MH
▲	Fat clay with sand	54	27	27	99.3	84.2	CH
◆	Sandy fat clay	56	26	30	99.6	66.9	CH
▼	Clayey sand	40	27	13	99.7	48.7	SC

Project No. 5101.02 **Client:**

Project: WEYERHAEUSER

Source: TP-4 **Elev./Depth:** 8"-5.0'

Source: TP-4 **Elev./Depth:** 10-11'

Source: TP-7 **Elev./Depth:** 8-10'

Source: TP-9 **Elev./Depth:** 1.5-6'

Source: TP-13 **Elev./Depth:** 2-5'

Remarks:

●

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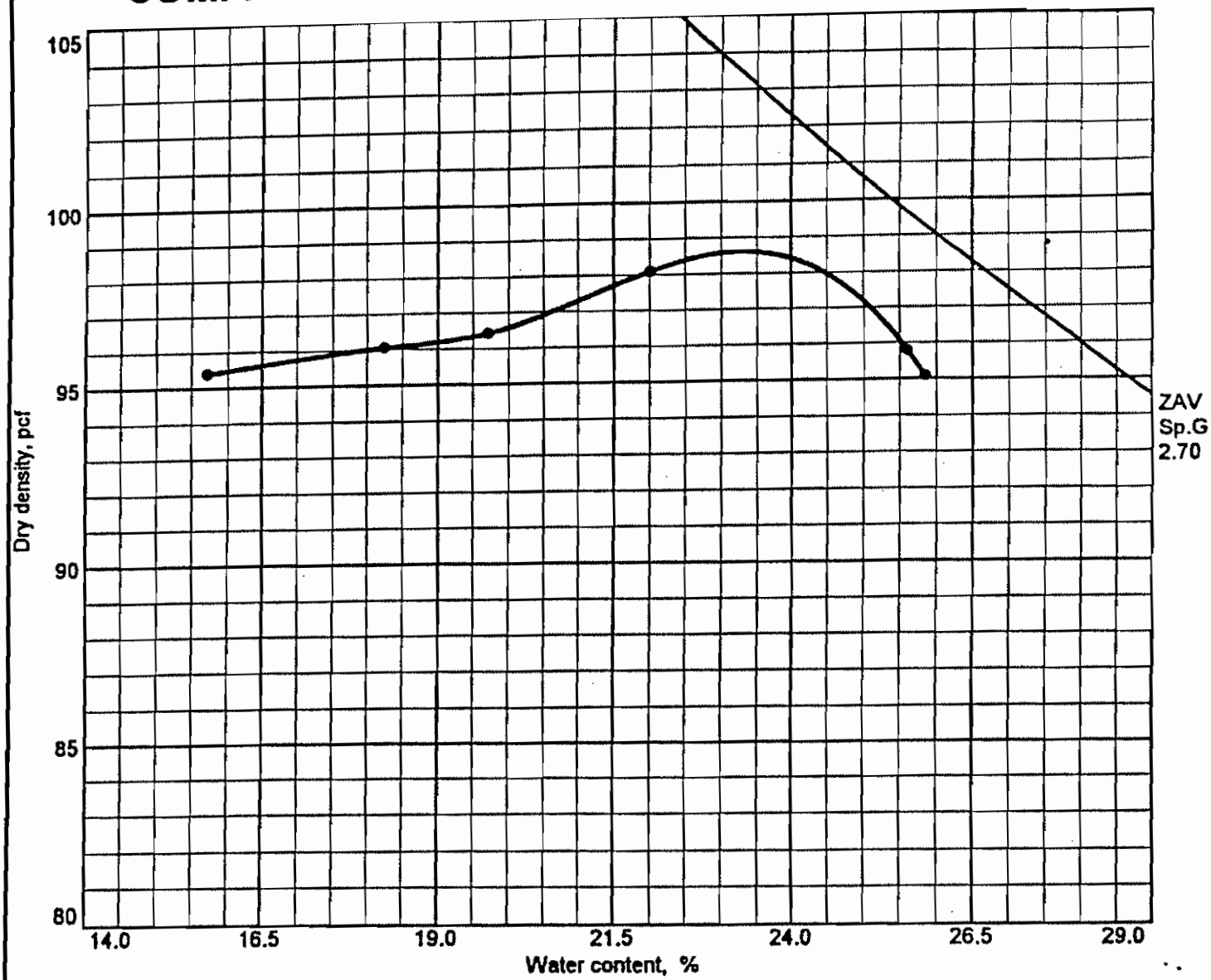
LIQUID AND PLASTIC LIMITS TEST REPORT (ASTM D4318)

RMT, Inc.

Figure:

COMPACTION TEST REPORT (ASTM D698 or D1557)



Test specification: ASTM D 698-91 Procedure A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
8"-5.0'	CH		25.3		58	30	0.0	75.0

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 98.6 pcf Optimum moisture = 23.3 %	Fat clay with sand

Project No. 5101.02 **Client:**
Project: WEYERHAEUSER

● **Source:** TP-4 **Elev./Depth:** 8"-5.0'

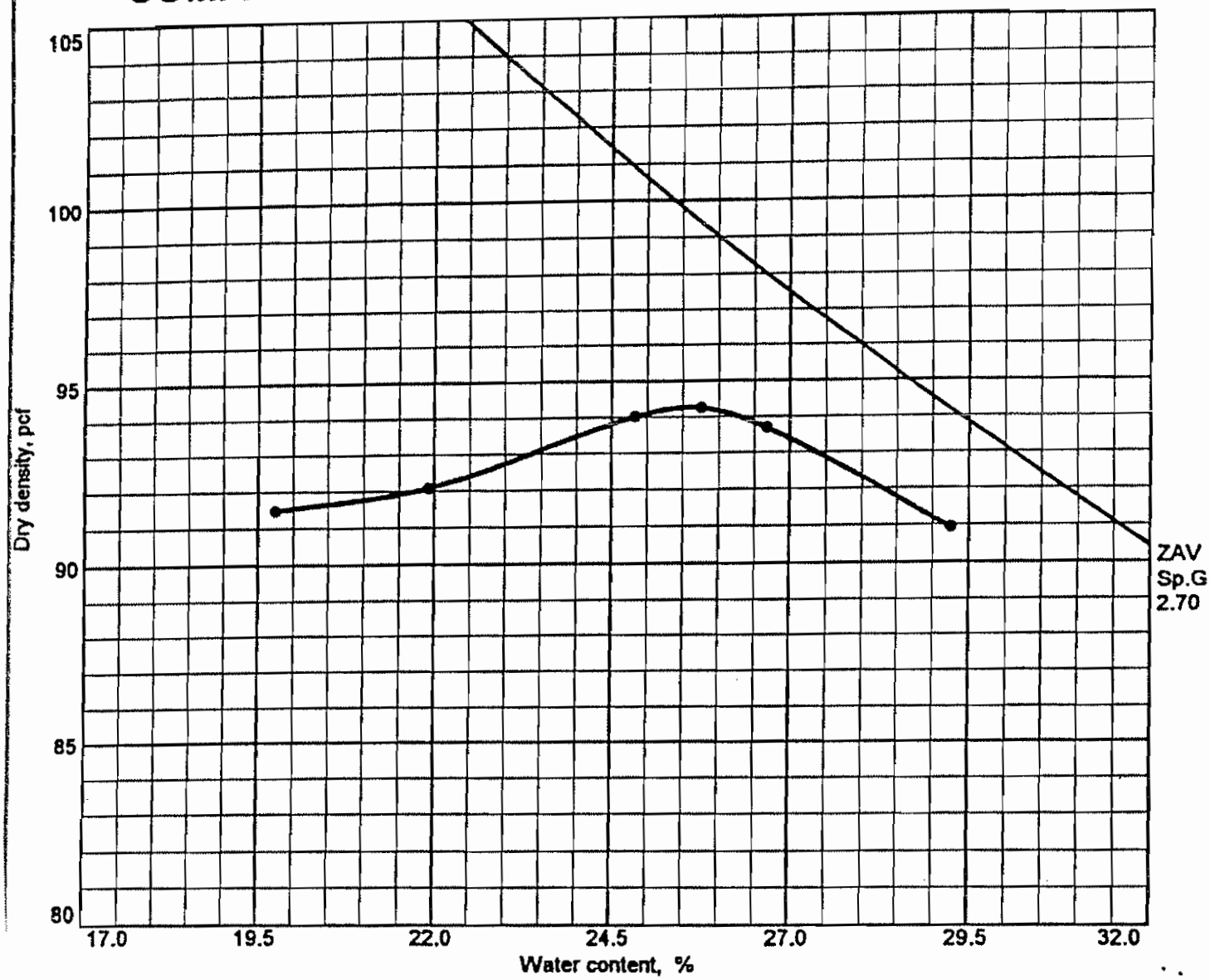
Remarks:

COMPACTION TEST REPORT (ASTM D698 or D1557)

RMT, Inc.

Figure:

COMPACTION TEST REPORT (ASTM D698 or D1557)



Test specification: ASTM D 698-91 Procedure A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
10-11'	MH		41.0		55	24	0.0	87.6

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 94.3 pcf Optimum moisture = 25.6 %	Elastic silt

Project No. 5101.02 Client:
Project: WEYERHAEUSER

Source: TP-4 Elev./Depth: 10-11'

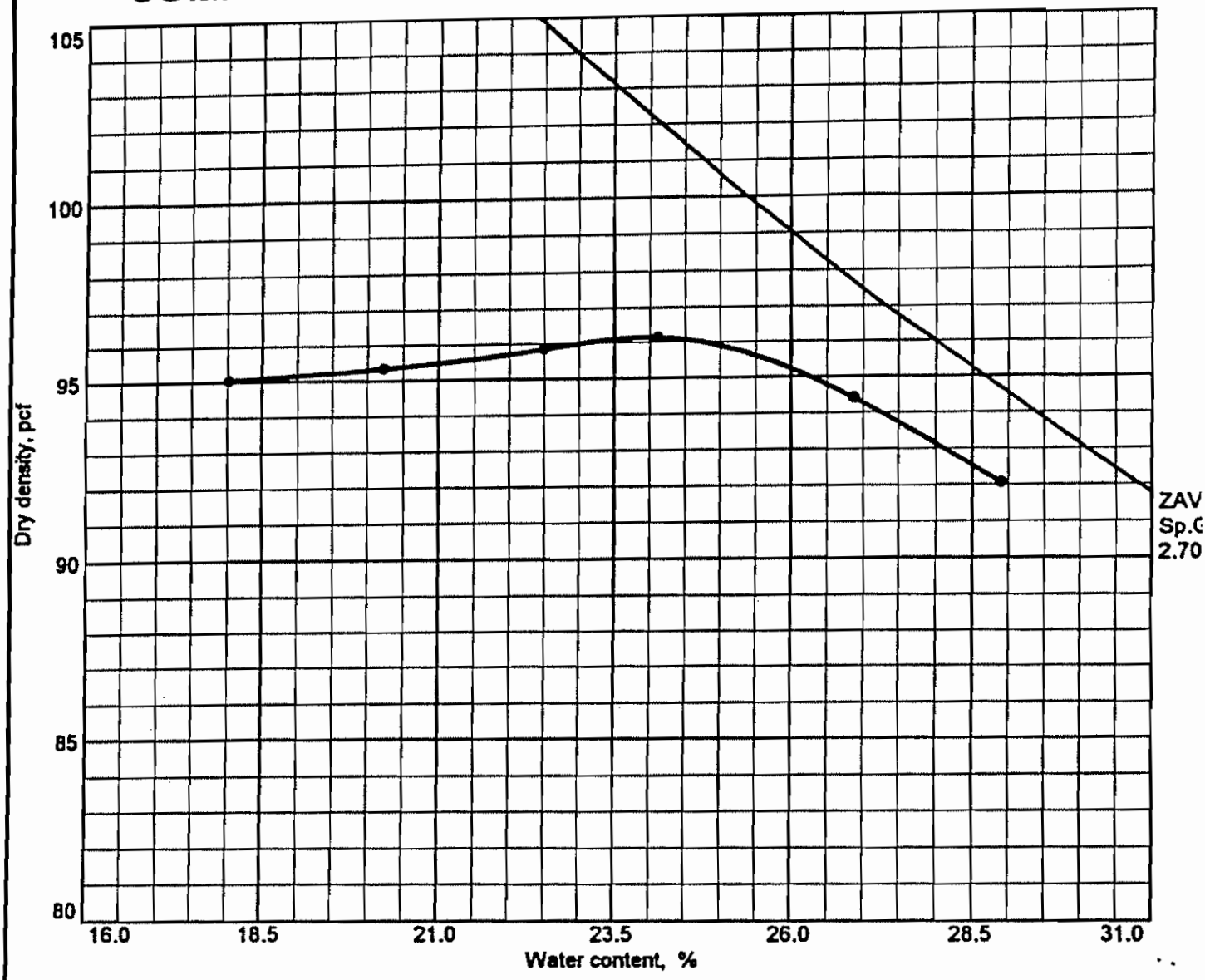
Remarks:

COMPACTION TEST REPORT (ASTM D698 or D1557)

RMT, Inc.

Figure:

COMPACTION TEST REPORT (ASTM D698 or D1557)



Test specification: ASTM D 698-91 Procedure A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
8-10'	CH		27.3		54	27	0.0	84.2

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 96.1 pcf Optimum moisture = 24.0 %	Fat clay with sand

Project No. 5101.02 **Client:**
Project: WEYERHAEUSER

● **Source:** TP-7 **Elev./Depth:** 8-10'

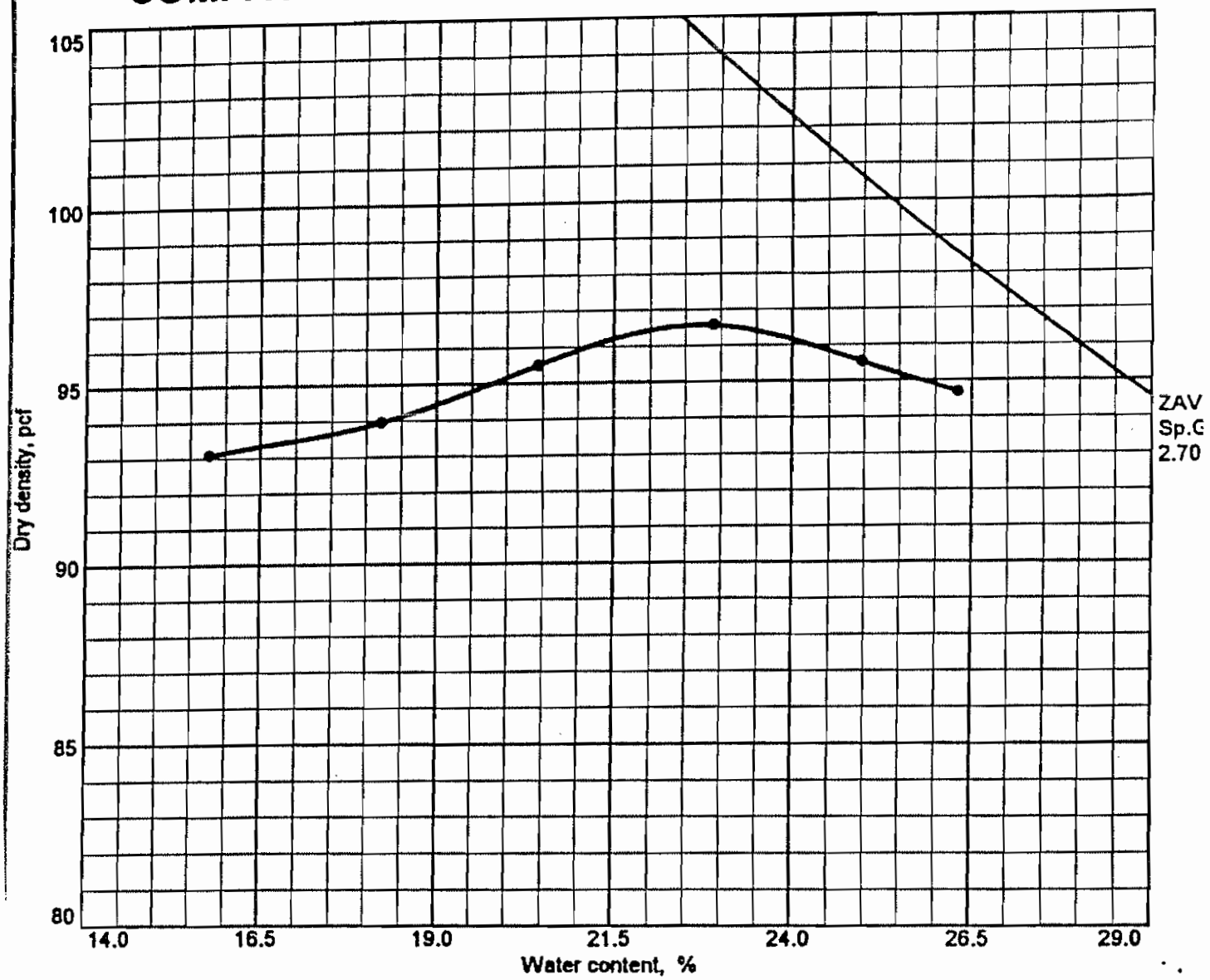
Remarks:

COMPACTION TEST REPORT (ASTM D698 or D1557)

RMT, Inc.

Figure:

COMPACTION TEST REPORT (ASTM D698 or D1557)

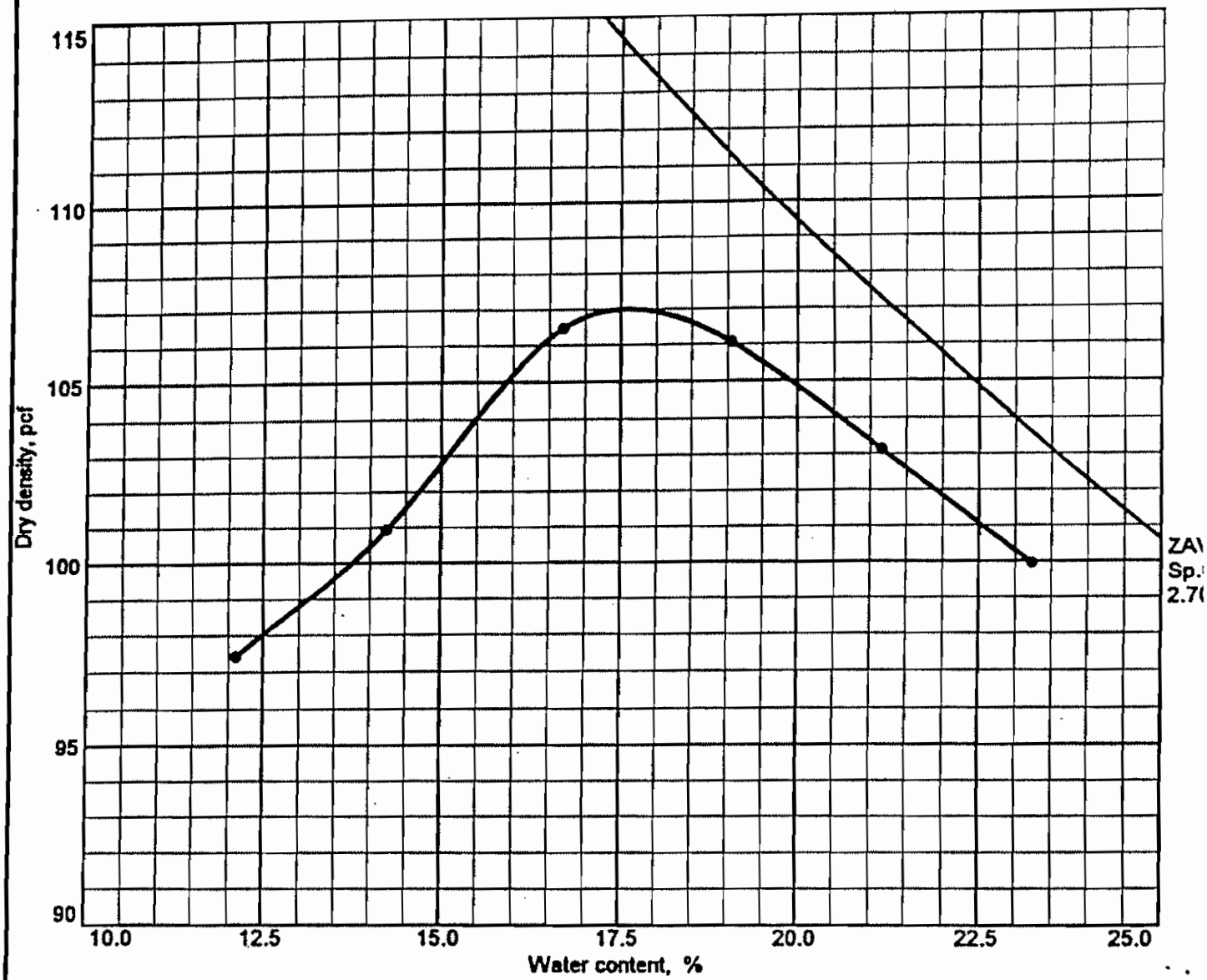


Test specification: ASTM D 698-91 Procedure A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
1.5-6'	CH		22.8		56	30	0.0	66.9

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 96.6 pcf Optimum moisture = 22.7 %	Sandy fat clay
Project No. 5101.02 Client: Project: WEYERHAEUSER Source: TP-9 Elev./Depth: 1.5-6'	Remarks:
COMPACTION TEST REPORT (ASTM D698 or D1557) **RMT, Inc.**	Figure:

COMPACTION TEST REPORT (ASTM D698 or D1557)



Test specification: ASTM D 698-91 Procedure A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.20
	USCS	AASHTO						
2-5'	SC		20.3		40	13	0.0	48.7

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 107.0 pcf Optimum moisture = 17.6 %	Clayey sand

Project No. 5101.02 **Client:**
Project: WEYERHAEUSER

● **Source:** TP-13 **Elev./Depth:** 2-5'

Remarks:

COMPACTION TEST REPORT (ASTM D698 or D1557)

RMT, Inc.

Figure:

RMT, Inc.

Falling Head Permeability Test

QC:

QA:

Project Name:	WEYERHAEUSER	Cell #:	
Project #:	5101.02	USCS Description:	Fat clay with s
Sample Name:	TP-4, 8"-5.0'	USCS Classification:	
Visual Descript:	Fat clay with sand	Average Kv =	9.6E-09 cm/

Sample Type: Remolded	Initial Values	Final Values		
Sample Dia. (in)	2.87	2.87	Maximum Proctor Density:	98.6
Sample Ht. (in)	2.30	2.28	Optimum Moisture Content:	23.3
Tare & Wet (g)	458.00	750.60	Permeant:	Water
Tare & Dry (g)	365.56	644.60	Permeant Specific Gravity:	1.00
Tare (g)	0.00	276.89	Sample Specific Gravity:	2.67
Sample Wt. (g)	458.00	473.71	Confining Pressure (psi):	100.0
			Burette Diameter (in):	0.250
			Burette Zero (cm):	100.0
% of Proctor Density:	94.9%	96.3%		
% (+/-) of Optimum Moisture Content:	2.0%	5.5%		
Moisture (%)	25.3	28.8	Maximum Gradient:	
Wet Density (pcf)	117.3	122.4	Average Gradient:	
Dry Density (pcf)	93.6	95.0	Max. Effect. Stress (psi):	6.3
Saturation (%)	86.6	102.0	Min. Effect. Stress (psi):	4.9
			Ave. Effect. Stress (psi):	5.4

	Date			Time		Run	Temp	Pressure (psi)			Cham.		Bot.		Top	Flow	Kv ***	Ave.
	Yr.	Mo.	Day	Hr.	Min.	Time	C***	Bot	Top	Cham	Dif.	Bot	Dif.	Top	Dif.	Dif.%	cm/sec	0.1
1	98	11	12	4	57.00		0.0	95	95	5.15		21.95		99.05				
2	98	11	12	7	0.00	7380	21.0	95	95	28.90	23.75	22.05	0.10	98.35	0.70	-75.0	3.0E-08	
3	98	11	12	8	53.00	6780	21.5	95	95	30.90	2.00	22.30	0.25	98.30	0.05	66.7	1.2E-08	
4	98	11	12	10	54.00	7260	21.5	95	95	31.30	0.40	22.55	0.25	98.15	0.15	25.0	1.6E-08	
5	98	11	12	12	54.00	7200	21.5	95	95	31.70	0.40	22.80	0.25	98.05	0.10	42.9	1.4E-08	
6	98	11	12	14	54.00	7200	22.0	95	95	32.00	0.30	23.00	0.20	97.85	0.20	0.0	1.5E-08	
7	98	11	12	16	20.00	5160	22.0	95	95	32.10	0.10	23.15	0.15	97.80	0.05	50.0	1.1E-08	
8	98	11	13	4	47.00	44820	20.0	95	95	32.10	0.00	24.35	1.20	97.05	0.75	23.1	1.3E-08	
9	98	11	13	6	46.00	7140	20.5	95	95	32.35	0.25	24.55	0.20	96.90	0.15	14.3	1.5E-08	
10	98	11	13	8	55.00	7740	21.0	95	95	32.90	0.55	24.80	0.25	96.80	0.10	42.9	1.3E-08	
11	98	11	13	10	58.00	7380	21.5	95	95	33.15	0.25	25.00	0.20	96.70	0.10	33.3	1.2E-08	
12	98	11	13	12	50.00	6720	22.0	95	95	33.45	0.30	25.15	0.15	96.55	0.15	0.0	1.3E-08	
13	98	11	13	16	22.00	12720	22.5	95	95	33.80	0.35	25.50	0.35	96.40	0.15	40.0	1.2E-08	
14	98	11	16	6	45.00	224580	20.0	95	95	35.30	1.50	29.90	4.40	93.25	3.15	16.6	1.1E-08	
15	98	11	16	8	45.00	7200	21.0	95	95	35.80	0.50	30.05	0.15	93.20	0.05	50.0	9.4E-09	
16	98	11	16	10	14.00	5340	21.5	95	95	36.10	0.30	30.20	0.15	93.15	0.05	50.0	1.3E-08	
17	98	11	16	11	11.00		0.0	95	95	36.50		30.40		93.25				
18	98	11	16	13	11.00	7200	21.5	95	95	36.40	-0.10	30.70	0.30	93.20	0.05	71.4	1.7E-08	
19	98	11	16	15	12.00	7260	21.5	95	95	36.40	0.00	30.85	0.15	93.05	0.15	0.0	1.4E-08	
20	98	11	16	16	52.00	6000	21.5	95	95	36.00	-0.40	30.95	0.10	93.00	0.05	33.3	8.6E-09	
21	98	11	17	7	19.00	52020	20.5	95	95	36.00	0.00	31.95	1.00	92.25	0.75	14.3	1.2E-08	
22	98	11	17	9	21.00	7320	21.0	95	95	36.40	0.40	32.15	0.20	92.20	0.05	60.0	1.2E-08	
23	98	11	17	11	27.00	7560	21.5	95	95	36.75	0.35	32.30	0.15	92.15	0.05	50.0	9.5E-09	
24	98	11	17	13	38.00	7860	22.0	95	95	36.60	-0.15	32.45	0.15	91.95	0.20	-14.3	1.6E-08	
25	98	11	17	16	25.00	10020	22.0	95	95	36.60	0.00	32.55	0.10	91.80	0.15	-20.0	8.8E-09	
26	98	11	18	5	59.00	48840	20.5	95	95	36.10	-0.50	33.40	0.85	91.05	0.75	6.3	1.2E-08	

**A zero in this column starts a series of measurements.

*Average Kv for those rows with a 1 in the Ave. column.

(Termination determined by stable Kv and low flow differential.)

***Kv adjusted for temperature.

RMT, Inc.

Falling Head Permeability Test

QC: HJW

QA: [illegible]

Project Name:	WEYERHAEUSER	Cell #:	
Project #:	5101.02	USCS Description:	Fat clay with s
Sample Name:	TP-4, 8"-5.0'	USCS Classification:	
Visual Descript:	Fat clay with sand		

Sample Type: Remolded	Initial Values	Final Values		
			Maximum Proctor Density:	98.6
			Optimum Moisture Content:	23.3
Sample Dia. (in)	2.87	2.87	Permeant:	Water
Sample Ht. (in)	2.30	2.28	Permeant Specific Gravity:	1.00
Tare & Wet (g)	458.00	750.60	Sample Specific Gravity:	2.67
Tare & Dry (g)	365.56	644.60	Confining Pressure (psi):	100.0
Tare (g)	0.00	276.89	Burette Diameter (in):	0.250
Sample Wt. (g)	458.00	473.71	Burette Zero (cm):	100.0
% of Proctor Density:	94.9%	96.3%		
% (+/-) of Optimum Moisture Content:	2.0%	5.5%		
Moisture (%)	25.3	28.8	Maximum Gradient:	9.8
Wet Density (pcf)	117.3	122.4	Average Gradient:	9.6
Dry Density (pcf)	93.6	95.0	Max. Effect. Stress (psi):	6.2
Saturation (%)	86.6	102.0	Min. Effect. Stress (psi):	4.9
			Ave. Effect. Stress (psi):	5.4

	Date			Time		Run	Temp	Pressure (psi)			Cham.		Bot.		Top	Flow	Kv ***	Ave
	Yr.	Mo.	Day	Hr.	Min.	Time	C***	Bot	Top	Cham	Dif.	Bot	Dif.	Top	Dif.	Dif.%	cm/sec	0,1
1	98	11	18	5	59.00		0.0	95	95	36.10		33.40		91.05				
2	98	11	18	8	2.00	7380	21.0	95	95	36.75	0.65	33.55	0.15	91.05	0.00	100.0	7.6E-09	
3	98	11	18	10	2.00	7200	21.5	95	95	37.20	0.45	33.70	0.15	91.00	0.05	50.0	1.0E-08	
4	98	11	18	12	7.00	7500	22.5	95	95	37.80	0.60	33.80	0.10	90.95	0.05	33.3	7.3E-09	
5	98	11	18	14	6.00	7140	23.5	95	95	3.15	-34.65	33.90	0.10	90.80	0.15	-20.0	1.3E-08	
6	98	11	18	16	12.00	7560	23.0	95	95	37.75	34.60	34.05	0.15	90.75	0.05	50.0	9.5E-09	
7	98	11	19	6	29.00	51420	20.5	95	95	36.50	-1.25	34.80	0.75	90.05	0.70	3.4	1.1E-08	
8	98	11	19	8	45.00	8160	21.0	95	95	37.05	0.55	34.90	0.10	89.95	0.10	0.0	9.5E-09	
9	98	11	19	10	29.00	6240	21.0	95	95	37.05	0.00	35.00	0.10	89.90	0.05	33.3	9.4E-09	
10	98	11	19	12	29.00		0.0	95	95	37.20		35.20		89.85				
11	98	11	19	14	28.00	7140	21.0	95	95	37.10	-0.10	35.30	0.10	89.80	0.05	33.3	8.3E-09	
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**A zero in this column starts a series of measurements.

(Termination determined by stable Kv and low flow differential.)

*Average Kv for those rows with a 1 in the Ave. column.

9.6E-09 cm/se

***Kv adjusted for temperature.

RMT, Inc.

Falling Head Permeability Test

QC: KJW

QA: [illegible]

Project Name:	WEYERHAEUSER	Cell #:	
Project #:	5101.02	USCS Description:	Elastic s
Sample Name:	TP-4, 10-11'	USCS Classification:	M
Visual Descript:	Elastic silt	Average Kv =	1.2E-08 cm/se

Sample Type: Remolded	Initial Values	Final Values		
Sample Dia. (in)	2.87	2.87	Maximum Proctor Density:	94.3
Sample Ht. (in)	2.30	2.29	Optimum Moisture Content:	25.6
Tare & Wet (g)	445.95	730.20	Permeant:	Water
Tare & Dry (g)	349.49	618.60	Permeant Specific Gravity:	1.00
Tare (g)	0.00	267.33	Sample Specific Gravity:	2.65 Es
Sample Wt. (g)	445.95	462.87	Confining Pressure (psi):	100.0
			Burette Diameter (in):	0.250
			Burette Zero (cm):	100.0
% of Proctor Density:	94.9%	95.8%		
% (+/-) of Optimum Moisture Content:	2.0%	6.2%		
Moisture (%)	27.6	31.8	Maximum Gradient:	
Wet Density (pcf)	114.2	119.0	Average Gradient:	
Dry Density (pcf)	89.5	90.3	Max. Effect. Stress (psi):	6.2
Saturation (%)	86.3	101.4	Min. Effect. Stress (psi):	5.1
			Ave. Effect. Stress (psi):	5.6

	Date Yr.	Mo.	Day	Time Hr.	Min.	Run Time	Temp C***	Pressure (psi) Bot	Top	Cham	Cham. Dif.	Bot	Bot Dif.	Top	Top Dif.	Flow Dif.%	Kv *** cm/sec	Ave.* 0.1
1	98	11	12	4	58.00		0.0	95	95	13.10		18.85		96.80				
2	98	11	12	7	1.00	7380	21.0	95	95	13.95	0.85	19.15	0.30	96.40	0.40	-14.3	2.6E-08	
3	98	11	12	8	54.00	6780	21.5	95	95	14.10	0.15	19.45	0.30	96.35	0.05	71.4	1.4E-08	
4	98	11	12	10	55.00	7260	21.5	95	95	14.50	0.40	19.70	0.25	96.25	0.10	42.9	1.4E-08	
5	98	11	12	12	55.00	7200	22.0	95	95	14.70	0.20	20.10	0.40	96.15	0.10	60.0	1.9E-08	
6	98	11	12	14	55.00	7200	22.0	95	95	14.85	0.15	20.35	0.25	96.00	0.15	25.0	1.5E-08	
7	98	11	12	16	22.00	5220	22.0	95	95	14.90	0.05	20.45	0.10	95.90	0.10	0.0	1.1E-08	
8	98	11	13	4	48.00	44760	20.0	95	95	14.90	0.00	22.15	1.70	95.05	0.85	33.3	1.7E-08	
9	98	11	13	6	47.00	7140	20.5	95	95	15.15	0.25	22.40	0.25	94.85	0.20	11.1	1.9E-08	
10	98	11	13	8	58.00	7860	21.0	95	95	15.10	-0.05	22.65	0.25	94.75	0.10	42.9	1.3E-08	
11	98	11	13	10	59.00	7260	21.5	95	95	15.80	0.70	22.90	0.25	94.60	0.15	25.0	1.7E-08	
12	98	11	13	12	51.00	6720	22.0	95	95	16.15	0.35	23.15	0.25	94.55	0.05	66.7	1.3E-08	
13	98	11	13	16	24.00	12780	22.5	95	95	16.30	0.15	23.55	0.40	94.25	0.30	14.3	1.6E-08	
14	98	11	16	6	45.00	224460	20.0	95	95	17.85	1.55	29.75	6.20	89.85	4.40	17.0	1.6E-08	
15	98	11	16	8	46.00	7260	21.0	95	95	18.25	0.40	29.95	0.20	89.70	0.15	14.3	1.7E-08	
16	98	11	16	10	15.00	5340	21.5	95	95	18.55	0.30	30.10	0.15	89.65	0.05	50.0	1.4E-08	
17	98	11	16	11	12.00		0.0	95	95	18.90		30.15		89.60				
18	98	11	16	13	13.00	7260	21.5	95	95	18.80	-0.10	30.30	0.15	89.50	0.10	20.0	1.3E-08	
19	98	11	16	15	13.00	7200	21.5	95	95	18.70	-0.10	30.40	0.10	89.40	0.10	0.0	1.0E-08	
20	98	11	16	16	52.00	5940	21.5	95	95	18.40	-0.30	30.60	0.20	89.30	0.10	33.3	1.8E-08	
21	98	11	17	7	20.00	52080	20.5	95	95	18.65	0.25	31.70	1.10	88.50	0.80	15.8	1.4E-08	
22	98	11	17	9	22.00	7320	21.0	95	95	19.05	0.40	31.90	0.20	88.45	0.05	60.0	1.3E-08	
23	98	11	17	11	28.00	7560	21.5	95	95	19.20	0.15	32.05	0.15	88.40	0.05	50.0	1.0E-08	
24	98	11	17	13	39.00	7860	22.0	95	95	19.20	0.00	32.25	0.20	88.30	0.10	33.3	1.4E-08	
25	98	11	17	16	26.00	10020	22.0	95	95	19.00	-0.20	32.40	0.15	88.15	0.15	0.0	1.1E-08	
26	98	11	18	6	0.00	48840	20.5	95	95	18.90	-0.10	33.40	1.00	87.40	0.75	14.3	1.4E-08	

**A zero in this column starts a series of measurements.

*Average Kv for those rows with a 1 in the Ave. column.

(Termination determined by stable Kv and low flow differential.)

***Kv adjusted for temperature.

RMT, Inc.

Falling Head Permeability Test

QC: [illegible]
QA: [illegible]

Project Name:	WEYERHAEUSER	Cell #:	
Project #:	5101.02	USCS Description:	Elastic
Sample Name:	TP-4, 10-11'	USCS Classification:	M
Visual Descript:	Elastic silt		

Sample Type: Remolded	Initial Values	Final Values		
Sample Dia. (in)	2.87	2.87	Maximum Proctor Density:	94.3
Sample Ht. (in)	2.30	2.29	Optimum Moisture Content:	25.6
Tare & Wet (g)	445.95	730.20	Permeant:	Water
Tare & Dry (g)	349.49	618.60	Permeant Specific Gravity:	1.00
Tare (g)	0.00	267.33	Sample Specific Gravity:	2.65
Sample Wt. (g)	445.95	462.87	Confining Pressure (psi):	100.0
			Burette Diameter (in):	0.250
			Burette Zero (cm):	100.0

% of Proctor Density:	94.9%	95.8%		
% (+/-) of Optimum Moisture Content:	2.0%	6.2%		
Moisture (%)	27.6	31.8	Maximum Gradient:	9.1
Wet Density (pcf)	114.2	119.0	Average Gradient:	8.8
Dry Density (pcf)	89.5	90.3	Max. Effect. Stress (psi):	6.0
Saturation (%)	86.3	101.4	Min. Effect. Stress (psi):	5.2
			Ave. Effect. Stress (psi):	5.6

	Date			Time		Run	Temp	Pressure (psi)			Cham.		Bot.		Top	Flow	Kv ***	Ave.*
	Yr.	Mo.	Day	Hr.	Min.	Time	C***	Bot	Top	Cham	Dif.	Bot	Dif.	Top	Dif.	Dif.%	cm/sec	0.1
1	98	11	18	6	0.00		0.0	95	95	18.90		33.40		87.40				
2	98	11	18	8	4.00	7440	21.0	95	95	19.40	0.50	33.55	0.15	87.30	0.10	20.0	1.3E-08	
3	98	11	18	10	3.00	7140	21.5	95	95	19.80	0.40	33.75	0.20	87.25	0.05	60.0	1.4E-08	
4	98	11	18	12	8.00	7500	22.5	95	95	20.40	0.60	33.90	0.15	87.15	0.10	20.0	1.3E-08	
5	98	11	18	14	1.00	6780	23.5	95	95	20.50	0.10	34.00	0.10	87.10	0.05	33.3	8.5E-09	
6	98	11	18	16	13.00	7920	23.0	95	95	20.20	-0.30	34.15	0.15	86.95	0.15	0.0	1.5E-08	
7	98	11	19	6	30.00	51420	20.5	95	95	19.20	-1.00	35.10	0.95	86.05	0.90	2.7	1.5E-08	1
8	98	11	19	8	46.00	8160	21.0	95	95	19.65	0.45	35.20	0.10	85.95	0.10	0.0	1.0E-08	1
9	98	11	19	10	31.00		0.0	95	95	19.65		35.40		85.90				
10	98	11	19	12	31.00	7200	21.0	95	95	19.70	0.05	35.50	0.10	85.80	0.10	0.0	1.2E-08	1
11	98	11	19	14	29.00	7080	21.0	95	95	19.70	0.00	35.60	0.10	85.70	0.10	0.0	1.2E-08	1
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**A zero in this column starts a series of measurements.

*Average Kv for those rows with a 1 in the Ave. column. 1.2E-08 cm/sec

(Termination determined by stable Kv and low flow differential.)

***Kv adjusted for temperature.

RMT, Inc.

Falling Head Permeability Test

QC: NJW

QA: [illegible]

Project Name:	WEYERHAEUSER	Cell #:	
Project #:	5101.02	USCS Description:	Fat clay with s
Sample Name:	TP-7, 8-10'	USCS Classification:	
Visual Descript:	Fat clay with sand	Average Kv =	1.1E-06 cm/

Sample Type: Remolded	Initial Values	Final Values		
Sample Dia. (in)	2.87	2.87	Maximum Proctor Density:	96.1
Sample Ht. (in)	2.30	2.27	Optimum Moisture Content:	24.0
Tare & Wet (g)	453.36	730.00	Permeant:	Water
Tare & Dry (g)	356.14	625.20	Permeant Specific Gravity:	1.00
Tare (g)	0.00	265.64	Sample Specific Gravity:	2.67
Sample Wt. (g)	453.36	464.36	Confining Pressure (psi):	100.0
			Burette Diameter (in):	0.250
			Burette Zero (cm):	100.0
% of Proctor Density:	94.9%	97.1%		
% (+/-) of Optimum Moisture Content:	3.3%	5.1%		
Moisture (%)	27.3	29.1	Maximum Gradient:	
Wet Density (pcf)	116.1	120.5	Average Gradient:	
Dry Density (pcf)	91.2	93.3	Max. Effect. Stress (psi):	6.0
Saturation (%)	88.1	99.0	Min. Effect. Stress (psi):	4.9
			Ave. Effect. Stress (psi):	5.4

	Date			Time		Run	Temp	Pressure (psi)			Cham.		Bot.		Top		Flow	Kv ***	Ave
	Yr.	Mo.	Day	Hr.	Min.	Time	C***	Bot	Top	Cham	Dif.	Bot	Dif.	Top	Dif.	Dif.%	cm/sec	0,1
1	98	11	12	4	58.00		0.0	95	95	20.00		16.65		93.35				
2	98	11	12	7	2.00	7440	21.0	95	95	21.60	1.60	16.85	0.20	92.85	0.50	-42.9	2.6E-08	
3	98	11	12	8	55.00	6780	21.5	95	95	21.30	-0.30	17.10	0.25	92.75	0.10	42.9	1.5E-08	
4	98	11	12	10	56.00	7260	21.5	95	95	21.50	0.20	17.30	0.20	92.65	0.10	33.3	1.2E-08	
5	98	11	12	12	56.00	7200	21.5	95	95	21.80	0.30	17.50	0.20	92.66	-0.01	110.5	7.5E-09	
6	98	11	12	14	56.00	7200	22.0	95	95	22.05	0.25	17.70	0.20	92.40	0.26	-13.0	1.8E-08	
7	98	11	12	16	23.00	5220	22.0	95	95	22.05	0.00	17.80	0.10	92.30	0.10	0.0	1.1E-08	
8	98	11	13	4	48.00	44700	20.0	95	95	22.15	0.10	18.90	1.10	91.60	0.70	22.2	1.2E-08	
9	98	11	13	6	48.00	7200	20.5	95	95	22.35	0.20	19.05	0.15	91.45	0.15	0.0	1.3E-08	
10	98	11	13	8	58.00	7800	21.0	95	95	22.80	0.45	19.25	0.20	91.40	0.05	60.0	9.5E-09	
11	98	11	13	11	0.00	7320	21.5	95	95	23.20	0.40	19.40	0.15	91.30	0.10	20.0	1.0E-08	
12	98	11	13	12	52.00	6720	22.0	95	95	23.60	0.40	19.55	0.15	91.15	0.15	0.0	1.3E-08	
13	98	11	13	16	25.00	12780	22.5	95	95	23.90	0.30	19.95	0.40	91.05	0.10	60.0	1.1E-08	
14	98	11	16	6	46.00	224460	20.0	95	95	25.75	1.85	24.20	4.25	87.55	3.50	9.7	1.1E-08	
15	98	11	16	8	47.00	7260	21.0	95	95	26.20	0.45	24.30	0.10	87.45	0.10	0.0	9.3E-09	
16	98	11	16	10	16.00	5340	21.5	95	95	26.50	0.30	24.45	0.15	87.40	0.05	50.0	1.3E-08	
17	98	11	16	11	13.00		0.0	95	95	26.60		24.60		87.45				
18	98	11	16	13	13.00	7200	21.5	95	95	26.55	-0.05	24.70	0.10	87.40	0.05	33.3	7.1E-09	
19	98	11	16	15	14.00	7260	21.5	95	95	26.50	-0.05	24.85	0.15	87.25	0.15	0.0	1.4E-08	
20	98	11	16	16	53.00	5940	21.5	95	95	26.10	-0.40	24.90	0.05	87.10	0.15	-50.0	1.2E-08	
21	98	11	17	7	20.00	52020	20.5	95	95	26.45	0.35	25.85	0.95	86.30	0.80	8.6	1.2E-08	
22	98	11	17	9	23.00	7380	21.0	95	95	26.85	0.40	26.00	0.15	86.25	0.05	50.0	9.6E-09	
23	98	11	17	11	29.00	7560	21.5	95	95	27.00	0.15	26.15	0.15	86.15	0.10	20.0	1.2E-08	
24	98	11	17	13	39.00	7800	22.0	95	95	27.00	0.00	26.30	0.15	86.05	0.10	20.0	1.1E-08	
25	98	11	17	16	26.00	10020	22.0	95	95	26.85	-0.15	26.40	0.10	85.95	0.10	0.0	7.0E-09	
26	98	11	18	6	1.00	48900	20.5	95	95	26.75	-0.10	27.25	0.85	85.15	0.80	3.0	1.3E-08	

**A zero in this column starts a series of measurements.

*Average Kv for those rows with a 1 in the Ave. column.

(Termination determined by stable Kv and low flow differential.)

***Kv adjusted for temperature.

RMT, Inc.

Falling Head Permeability Test

QC: [illegible]

QA: [illegible]

Project Name:	WEYERHAEUSER	Cell #:	
Project #:	5101.02	USCS Description:	Fat clay with sa
Sample Name:	TP-7, 8-10'	USCS Classification:	(
Visual Descript:	Fat clay with sand		

Sample Type: Remolded	Initial Values	Final Values		
			Maximum Proctor Density:	96.1
			Optimum Moisture Content:	24.0
Sample Dia. (in)	2.87	2.87	Permeant:	Water
Sample Ht. (in)	2.30	2.27	Permeant Specific Gravity:	1.00
Tare & Wet (g)	453.36	730.00	Sample Specific Gravity:	2.67 E
Tare & Dry (g)	356.14	625.20	Confining Pressure (psi):	100.0
Tare (g)	0.00	265.64	Burette Diameter (in):	0.250
Sample Wt. (g)	453.36	464.36	Burette Zero (cm):	100.0

% of Proctor Density:	94.9%	97.1%		
% (+/-) of Optimum Moisture Content:	3.3%	5.1%		
Moisture (%)	27.3	29.1	Maximum Gradient:	9.9
Wet Density (pcf)	116.1	120.5	Average Gradient:	9.7
Dry Density (pcf)	91.2	93.3	Max. Effect. Stress (psi):	5.8
Saturation (%)	88.1	99.0	Min. Effect. Stress (psi):	5.0
			Ave. Effect. Stress (psi):	5.4

	Date			Time		Run	Temp	Pressure (psi)			Cham.		Bot.		Top	Flow	Kv ***	Ave.
	Yr.	Mo.	Day	Hr.	Min.	Time	C***	Bot	Top	Cham	Dif.	Bot	Dif.	Top	Dif.	Dif.%	cm/sec	0,1
1	98	11	18	6	1.00		0.0	95	95	26.75		27.25		85.15				
2	98	11	18	8	6.00	7500	21.0	95	95	27.20	0.45	27.40	0.15	85.05	0.10	20.0	1.2E-08	
3	98	11	18	10	3.00	7020	21.5	95	95	27.55	0.35	27.50	0.10	85.00	0.05	33.3	7.9E-09	
4	98	11	18	12	9.00	7560	22.5	95	95	28.30	0.75	27.70	0.20	84.90	0.10	33.3	1.4E-08	
5	98	11	18	14	1.00	6720	23.5	95	95	28.45	0.15	27.80	0.10	84.85	0.05	33.3	8.0E-09	
6	98	11	18	16	14.00	7980	23.0	95	95	28.00	-0.45	27.90	0.10	84.75	0.10	0.0	9.0E-09	
7	98	11	19	6	31.00	51420	20.5	95	95	27.10	-0.90	28.65	0.75	83.90	0.85	-6.2	1.2E-08	1
8	98	11	19	8	46.00	8100	21.0	95	95	27.55	0.45	28.75	0.10	83.80	0.10	0.0	9.6E-09	1
9	98	11	19	10	32.00		0.0	95	95	27.50		28.90		83.75				
10	98	11	19	12	32.00	7200	21.0	95	95	27.60	0.10	29.00	0.10	83.65	0.10	0.0	1.1E-08	1
11	98	11	19	14	30.00	7080	21.0	95	95	27.50	-0.10	29.10	0.10	83.55	0.10	0.0	1.1E-08	1
12																		
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24																		
25																		
26																		

**A zero in this column starts a series of measurements.

*Average Kv for those rows with a 1 in the Ave. column.

1.1E-08 cm/sec

(Termination determined by stable Kv and low flow differential.)

***Kv adjusted for temperature.

RMT, Inc.

Falling Head Permeability Test

QC: [illegible]

QA: [illegible]

Project Name:	WEYERHAEUSER	Cell #:	
Project #:	5101.02	USCS Description:	Sandy fat cla
Sample Name:	TP-9, 1.5-6'	USCS Classification:	C
Visual Descript:	Sandy fat clay	Average Kv =	2.9E-08 cm/se

Sample Type: Remolded	Initial Values	Final Values		
Sample Dia. (in)	2.87	2.87	Maximum Proctor Density:	96.6
Sample Ht. (in)	2.30	2.28	Optimum Moisture Content:	22.7
Tare & Wet (g)	446.50	743.60	Permeant:	Water
Tare & Dry (g)	358.06	638.60	Permeant Specific Gravity:	1.00
Tare (g)	0.00	278.00	Sample Specific Gravity:	2.67 Est
Sample Wt. (g)	446.50	465.60	Confining Pressure (psi):	100.0
			Burette Diameter (in):	0.250
			Burette Zero (cm):	100.0
% of Proctor Density:	94.9%	96.4%		
% (+/-) of Optimum Moisture Content:	2.0%	6.4%		
Moisture (%)	24.7	29.1	Maximum Gradient:	
Wet Density (pcf)	114.3	120.3	Average Gradient:	
Dry Density (pcf)	91.7	93.1	Max. Effect. Stress (psi):	6.0
Saturation (%)	80.7	98.6	Min. Effect. Stress (psi):	4.8
			Ave. Effect. Stress (psi):	5.3

	Date			Time		Run	Temp	Pressure (psi)			Cham.		Bot.		Top	Flow	Kv ***	Ave.*
	Yr.	Mo.	Day	Hr.	Min.	Time	C***	Bot	Top	Cham	Dif.	Bot	Dif.	Top	Dif.	Dif.%	cm/sec	0,1
1	98	11	12	4	59.00		0.0	95	95	28.20		13.90		97.35				
2	98	11	12	7	2.00	7380	21.0	95	95	29.05	0.85	15.65	1.75	95.25	2.10	-9.1	1.4E-07	
3	98	11	12	8	57.00	6900	21.5	95	95	29.40	0.35	16.90	1.25	94.20	1.05	8.7	9.1E-08	
4	98	11	12	10	57.00	7200	21.5	95	95	29.65	0.25	18.00	1.10	93.30	0.90	10.0	7.8E-08	
5	98	11	12	12	57.00	7200	21.5	95	95	30.00	0.35	18.90	0.90	92.45	0.85	2.9	7.0E-08	
6	98	11	12	14	58.00	7260	22.0	95	95	30.30	0.30	19.80	0.90	91.70	0.75	9.1	6.5E-08	
7	98	11	12	16	23.00	5100	22.0	95	95	30.35	0.05	20.40	0.60	91.25	0.45	14.3	6.0E-08	
8	98	11	13	4	49.00	44760	20.0	95	95	30.60	0.25	24.20	3.80	87.90	3.35	6.3	5.2E-08	
9	98	11	13	6	49.00	7200	20.5	95	95	30.75	0.15	24.75	0.55	87.50	0.40	15.8	4.6E-08	
10	98	11	13	8	59.00	7800	21.0	95	95	31.20	0.45	25.30	0.55	87.10	0.40	15.8	4.2E-08	
11	98	11	13	11	0.00	7260	21.5	95	95	31.40	0.20	25.80	0.50	86.70	0.40	11.1	4.3E-08	
12	98	11	13	12	53.00	6780	22.0	95	95	31.80	0.40	26.25	0.45	86.35	0.35	12.5	4.1E-08	
13	98	11	13	16	26.00	12780	22.5	95	95	31.90	0.10	27.10	0.85	85.70	0.65	13.3	4.1E-08	
14	98	11	16	6	46.00	224400	20.0	95	95	33.95	2.05	37.45	10.35	76.95	8.75	8.4	3.9E-08	
15	98	11	16	8	48.00	7320	21.0	95	95	34.40	0.45	37.90	0.45	76.75	0.20	38.5	4.9E-08	
16	98	11	16	10	17.00	5340	21.5	95	95	34.70	0.30	37.90	0.00	76.65	0.10	-100.0	1.0E-08	
17	98	11	16	11	13.00		0.0	95	95	35.20		37.90		76.50				
18	98	11	16	13	15.00	7320	21.5	95	95	35.00	-0.20	38.10	0.20	76.40	0.10	33.3	2.3E-08	
19	98	11	16	15	14.00	7140	21.5	95	95	35.10	0.10	38.30	0.20	76.20	0.20	0.0	3.2E-08	
20	98	11	16	16	53.00	5940	21.5	95	95	34.70	-0.40	38.50	0.20	76.00	0.20	0.0	3.8E-08	
21	98	11	17	7	21.00	52080	20.5	95	95	35.10	0.40	40.05	1.55	74.80	1.20	12.7	3.2E-08	
22	98	11	17	9	25.00	7440	21.0	95	95	35.45	0.35	40.30	0.25	74.70	0.10	42.9	2.9E-08	
23	98	11	17	11	30.00	7500	21.5	95	95	35.70	0.25	40.50	0.20	74.50	0.20	0.0	3.3E-08	
24	98	11	17	13	40.00	7800	22.0	95	95	35.65	-0.05	40.65	0.15	74.35	0.15	0.0	2.4E-08	
25	98	11	17	16	29.00	10140	22.0	95	95	35.40	-0.25	40.90	0.25	74.10	0.25	0.0	3.1E-08	
26	98	11	18	6	1.00	48720	20.5	95	95	35.45	0.05	42.05	1.15	73.15	0.95	9.5	2.9E-08	

**A zero in this column starts a series of measurements.

*Average Kv for those rows with a 1 in the Ave. column.

(Termination determined by stable Kv and low flow differential.)

***Kv adjusted for temperature.

RMT, Inc.

Falling Head Permeability Test

QC: [illegible]
QA: [illegible]

Project Name:	WEYERHAEUSER	Cell #:	
Project #:	5101.02	USCS Description:	Sandy fat c
Sample Name:	TP-9, 1.5-6'	USCS Classification:	(
Visual Descript:	Sandy fat clay		

Sample Type: Remolded	Initial Values	Final Values		
Sample Dia. (in)	2.87	2.87	Maximum Proctor Density:	96.6
Sample Ht. (in)	2.30	2.28	Optimum Moisture Content:	22.7
Tare & Wet (g)	446.50	743.60	Permeant:	Water
Tare & Dry (g)	358.06	638.60	Permeant Specific Gravity:	1.00
Tare (g)	0.00	278.00	Sample Specific Gravity:	2.67 E
Sample Wt. (g)	446.50	465.60	Confining Pressure (psi):	100.0
			Burette Diameter (in):	0.250
			Burette Zero (cm):	100.0

% of Proctor Density:	94.9%	96.4%		
% (+/-) of Optimum Moisture Content:	2.0%	6.4%		
Moisture (%)	24.7	29.1	Maximum Gradient:	5.2
Wet Density (pcf)	114.3	120.3	Average Gradient:	4.9
Dry Density (pcf)	91.7	93.1	Max. Effect. Stress (psi):	5.5
Saturation (%)	80.7	98.6	Min. Effect. Stress (psi):	5.1
			Ave. Effect. Stress (psi):	5.3

	Date			Time		Run	Temp	Pressure (psi)			Cham.		Bot.		Top	Flow	Kv ***	Ave.*
	Yr.	Mo.	Day	Hr.	Min.	Time	C***	Bot	Top	Cham	Dif.	Bot	Dif.	Top	Dif.	Dif.%	cm/sec	0.1
1	98	11	18	6	1.00		0.0	95	95	35.45		42.05		73.15				
2	98	11	18	8	8.00	7620	21.0	95	95	35.90	0.45	42.30	0.25	73.00	0.15	25.0	3.6E-08	
3	98	11	18	10	4.00	6960	21.5	95	95	36.30	0.40	42.45	0.15	72.90	0.10	20.0	2.5E-08	
4	98	11	18	12	10.00	7560	22.5	95	95	37.00	0.70	42.60	0.15	72.80	0.10	20.0	2.3E-08	
5	98	11	18	14	2.00	6720	23.5	95	95	37.25	0.25	42.80	0.20	72.70	0.10	33.3	3.0E-08	
6	98	11	18	16	14.00	7920	23.0	95	95	36.80	-0.45	42.95	0.15	72.55	0.15	0.0	2.6E-08	1
7	98	11	19	6	31.00	51420	20.5	95	95	35.90	-0.90	43.95	1.00	71.55	1.00	0.0	3.0E-08	1
8	98	11	19	8	47.00	8160	21.0	95	95	36.30	0.40	44.15	0.20	71.40	0.15	14.3	3.4E-08	1
9	98	11	19	10	33.00	6360	21.0	95	95	36.30	0.00	44.30	0.15	71.30	0.10	20.0	3.1E-08	1
10	98	11	19	12	33.00	7200	21.0	95	95	36.40	0.10	44.40	0.10	71.20	0.10	0.0	2.2E-08	1
11	98	11	19	14	31.00	7080	21.0	95	95	36.30	-0.10	44.55	0.15	71.10	0.10	20.0	2.8E-08	1
12																		
13																		
14																		
15																		
16																		
17																		
18																		
19																		
20																		
21																		
22																		
23																		
24																		
25																		
26																		

**A zero in this column starts a series of measurements.

*Average Kv for those rows with a 1 in the Ave. column.

2.9E-08 cm/sec

(Termination determined by stable Kv and low flow differential.)

***Kv adjusted for temperature.

RMT, Inc.

Falling Head Permeability Test

QC: HJS

QA: JGH

Project Name:	WEYERHAEUSER	Cell #:	4
Project #:	5101.02	USCS Description:	Clayey sand
Sample Name:	TP-13, 2-5'	USCS Classification:	SC
Visual Descript:	Clayey sand	Average Kv =	6.0E-08 cm/sec

Sample Type: Remolded	Initial Values	Final Values		
Sample Dia. (in)	2.87	2.87	Maximum Proctor Density:	107.0
Sample Ht. (in)	2.29	2.28	Optimum Moisture Content:	17.6
Tare & Wet (g)	476.12	745.20	Permeant:	Water
Tare & Dry (g)	395.77	657.50	Permeant Specific Gravity:	1.00
Tare (g)	0.00	258.84	Sample Specific Gravity:	2.67 Est.
Sample Wt. (g)	476.12	486.36	Confining Pressure (psi):	100.0
			Burette Diameter (in):	0.250
			Burette Zero (cm):	100.0
% of Proctor Density:	95.1%	96.2%		
% (+/-) of Optimum Moisture Content:	2.7%	4.4%		
Moisture (%)	20.3	22.0	Maximum Gradient:	
Wet Density (pcf)	122.4	125.6	Average Gradient:	
Dry Density (pcf)	101.8	103.0	Max. Effect. Stress (psi):	6.0
Saturation (%)	85.1	95.0	Min. Effect. Stress (psi):	4.6
			Ave. Effect. Stress (psi):	5.2

	Date			Time		Run	Temp	Pressure (psi)			Cham.		Bot.		Top	Flow	Kv ***	Ave.*
	Yr.	Mo.	Day	Hr.	Min.	Time	C***	Bot	Top	Cham	Dif.	Bot	Dif.	Top	Dif.	Dif.%	cm/sec	0,1
1	98	11	12	4	59.00		0.0	95	95	26.80		12.15		97.20				
2	98	11	12	7	3.00	7440	21.0	95	95	28.00	1.20	16.95	4.80	92.05	5.15	-3.5	3.6E-07	
3	98	11	12	8	58.00	6900	21.5	95	95	28.60	0.60	20.70	3.75	88.50	3.55	2.7	3.2E-07	
4	98	11	12	10	58.00	7200	21.5	95	95	29.10	0.50	24.10	3.40	85.30	3.20	3.0	3.1E-07	
5	98	11	12	13	0.00	7320	21.5	95	95	29.65	0.55	27.00	2.90	82.40	2.90	0.0	2.9E-07	
6	98	11	12	14	59.00	7140	22.0	95	95	30.15	0.50	29.60	2.60	79.95	2.45	3.0	2.8E-07	
7	98	11	12	16	24.00	5100	22.0	95	95	30.30	0.15	31.30	1.70	78.30	1.65	1.5	2.8E-07	
8	98	11	13	4	49.00	44700	20.0	95	95	30.85	0.55	41.25	9.95	68.70	9.60	1.8	2.6E-07	
9	98	11	13	4	51.00		0.0	95	95	31.05		5.85		98.75				
10	98	11	13	6	49.00	7080	20.5	95	95	31.05	0.00	9.60	3.75	94.80	3.95	-2.6	2.7E-07	
11	98	11	13	9	0.00	7860	21.0	95	95	31.65	0.60	13.15	3.55	91.45	3.35	2.9	2.3E-07	
12	98	11	13	11	1.00	7260	21.0	95	95	32.20	0.55	15.95	2.80	88.80	2.65	2.8	2.1E-07	
13	98	11	13	12	53.00	6720	22.0	95	95	32.75	0.55	18.20	2.25	86.50	2.30	-1.1	2.0E-07	
14	98	11	13	16	27.00	12840	22.5	95	95	33.30	0.55	31.90	13.70	82.90	3.60	58.4	4.8E-07	
15	98	11	16	6	47.00		0.0	95	95	36.20		4.75		99.40				
16	98	11	16	8	49.00	7320	21.0	95	95	36.60	0.40	7.55	2.80	96.30	3.10	-5.1	1.9E-07	
17	98	11	16	10	18.00	5340	21.5	95	95	36.90	0.30	9.55	2.00	94.40	1.90	2.6	1.8E-07	
18	98	11	16	11	14.00		0.0	95	95	37.05		10.40		93.65				
19	98	11	16	13	15.00	7260	21.5	95	95	36.90	-0.15	13.10	2.70	90.90	2.75	-0.9	2.0E-07	
20	98	11	16	15	15.00	7200	21.5	95	95	36.95	0.05	15.65	2.55	88.40	2.50	1.0	2.0E-07	
21	98	11	16	16	54.00	5940	21.5	95	95	36.80	-0.15	17.50	1.85	86.45	1.95	-2.6	1.9E-07	
22	98	11	17	7	22.00	52080	20.5	95	95	36.90	0.10	29.75	12.25	74.30	12.15	0.4	1.8E-07	
23	98	11	17	9	26.00	7440	21.0	95	95	37.40	0.50	31.05	1.30	73.05	1.25	2.0	1.7E-07	
24	98	11	17	11	31.00	7500	21.5	95	95	37.65	0.25	32.30	1.25	71.90	1.15	4.2	1.7E-07	
25	98	11	17	13	47.00	8160	22.0	95	95	37.70	0.05	33.50	1.20	70.70	1.20	0.0	1.6E-07	
26	98	11	17	16	30.00	9780	22.0	95	95	37.60	-0.10	34.80	1.30	69.35	1.35	-1.9	1.6E-07	

**A zero in this column starts a series of measurements.

*Average Kv for those rows with a 1 in the Ave. column.

(Termination determined by stable Kv and low flow differential.)

***Kv adjusted for temperature.

RMT, Inc.

Falling Head Permeability Test

QC: Hke

QA: [illegible]

Project Name:	WEYERHAEUSER	Cell #:	4
Project #:	5101.02	USCS Description:	Clayey sand
Sample Name:	TP-13, 2-5'	USCS Classification:	SC
Visual Descript:	Clayey sand		

Sample Type: Remolded	Initial Values	Final Values			
Sample Dia. (in)	2.87	2.87	Maximum Proctor Density:	107.0	
Sample Ht. (in)	2.29	2.28	Optimum Moisture Content:	17.6	
Tare & Wet (g)	476.12	745.20	Permeant:	Water	
Tare & Dry (g)	395.77	657.50	Permeant Specific Gravity:	1.00	
Tare (g)	0.00	258.84	Sample Specific Gravity:	2.67	Est.
Sample Wt. (g)	476.12	486.36	Confining Pressure (psi):	100.0	
			Burette Diameter (in):	0.250	
			Burette Zero (cm):	100.0	
% of Proctor Density:	95.1%	96.2%			
% (+/-) of Optimum Moisture Content:	2.7%	4.4%			
Moisture (%)	20.3	22.0	Maximum Gradient:		
Wet Density (pcf)	122.4	125.6	Average Gradient:		
Dry Density (pcf)	101.8	103.0	Max. Effect. Stress (psi):	5.9	
Saturation (%)	85.1	95.0	Min. Effect. Stress (psi):	4.5	
			Ave. Effect. Stress (psi):	5.3	

	Date			Time		Run	Temp	Pressure (psi)			Chan.		Bot.		Top	Flow	Ky ***	Ave.*
	Yr.	Mo.	Day	Hr.	Min.	Time	C***	Bot	Top	Chan	Dif.	Bot	Dif.	Top	Dif.	Dif.%	cm/sec	0,1
1	98	11	17	16	30.00		0.0	95	95	37.60		34.80		69.35				
2	98	11	18	6	3.00	48780	20.5	95	95	37.50	-0.10	39.90	5.10	94.25	-24.90	-151.5	-2.0E-07	
3	98	11	18	6	4.00		0.0	95	95	37.50		39.90		99.40				
4	98	11	18	8	9.00	7500	21.0	95	95	38.10	0.60	41.40	1.50	97.55	1.85	-10.4	1.7E-07	
5	98	11	18	10	5.00	6960	21.5	95	95	38.45	0.35	42.70	1.30	96.30	1.25	2.0	1.4E-07	
6	98	11	18	12	12.00	7620	22.5	95	95	39.40	0.95	44.00	1.30	95.05	1.25	2.0	1.3E-07	
7	98	11	18	14	3.00	6660	23.5	95	95	39.70	0.30	45.10	1.10	94.00	1.05	2.3	1.3E-07	
8	98	11	18	16	15.00	7920	23.0	95	95	39.30	-0.40	46.30	1.20	92.00	2.00	-25.0	1.7E-07	
9	98	11	19	6	32.00	51420	20.5	95	95	38.30	-1.00	52.35	6.05	86.55	5.45	5.2	1.2E-07	
10	98	11	19	8	50.00	8280	21.0	95	95	38.70	0.40	53.15	0.80	85.80	0.75	3.2	1.2E-07	
11	98	11	19	10	34.00	6240	21.0	95	95	38.70	0.00	53.65	0.50	85.30	0.50	0.0	1.1E-07	
12	98	11	19	12	33.00	7140	21.0	95	95	38.80	0.10	54.25	0.60	84.75	0.55	4.3	1.1E-07	
13	98	11	19	14	32.00	7140	21.0	95	95	38.75	-0.05	54.80	0.55	84.20	0.55	0.0	1.1E-07	
14	98	11	19	16	42.00	7800	21.0	95	95	38.70	-0.05	55.35	0.55	83.70	0.50	4.8	1.0E-07	
15	98	11	20	7	20.00	52680	21.0	95	95	39.05	0.35	58.55	3.20	80.55	3.15	0.8	1.0E-07	
16	98	11	20	7	27.00		0.0	95	95	39.25		4.50		99.05				
17	98	11	20	9	28.00	7260	21.0	95	95	39.00	-0.25	6.65	2.15	97.30	1.75	10.3	1.2E-07	
18	98	11	20	11	51.00	8580	21.0	95	95	39.25	0.25	8.80	2.15	95.20	2.10	1.2	1.2E-07	
19	98	11	20	13	28.00	5820	21.0	95	95	39.30	0.05	10.30	1.50	93.80	1.40	3.4	1.3E-07	
20	98	11	20	15	28.00	7200	21.0	95	95	39.45	0.15	11.90	1.60	92.20	1.60	0.0	1.2E-07	
21	98	11	21	6	51.00	55380	20.5	95	95	39.05	-0.40	21.35	9.45	82.80	9.40	0.3	1.1E-07	
22	98	11	21	9	12.00	8460	21.0	95	95	39.05	0.00	22.45	1.10	81.80	1.00	4.8	8.8E-08	
23	98	11	23	7	15.00	165780	21.0	95	95	40.50	1.45	35.55	13.10	68.95	12.85	1.0	7.4E-08	
24	98	11	23	9	16.00	7260	21.5	95	95	41.35	0.85	35.85	0.30	68.70	-0.25	9.1	4.9E-08	
25	98	11	23	11	16.00	7200	23.5	95	95	41.80	0.45	36.25	0.40	68.35	0.35	6.7	6.6E-08	
26	98	11	23	13	16.00	7200	23.5	95	95	42.50	0.70	36.60	0.35	68.00	0.35	0.0	6.3E-08	

**A zero in this column starts a series of measurements.

*Average Kv for those rows with a 1 in the Ave. column.

(Termination determined by stable Kv and low flow differential.)

***Kv adjusted for temperature.

RMT, Inc.

Falling Head Permeability Test

QC: HRI

QA: [illegible]

Project Name:	WEYERHAEUSER	Cell #:	4
Project #:	5101.02	USCS Description:	Clayey san
Sample Name:	TP-13, 2-5'	USCS Classification:	SC
Visual Descript:	Clayey sand		

Sample Type: Remolded	Initial Values	Final Values			
Sample Dia. (in)	2.87	2.87	Maximum Proctor Density:	107.0	
Sample Ht. (in)	2.29	2.28	Optimum Moisture Content:	17.6	
Tare & Wet (g)	476.12	745.20	Permeant:	Water	
Tare & Dry (g)	395.77	657.50	Permeant Specific Gravity:	1.00	
Tare (g)	0.00	258.84	Sample Specific Gravity:	2.67	Est
Sample Wt. (g)	476.12	486.36	Confining Pressure (psi):	100.0	
			Burette Diameter (in):	0.250	
			Burette Zero (cm):	100.0	
% of Proctor Density:	95.1%	96.2%			
% (+/-) of Optimum Moisture Content:	2.7%	4.4%			
Moisture (%)	20.3	22.0	Maximum Gradient:	16.3	
Wet Density (pcf)	122.4	125.6	Average Gradient:	7.8	
Dry Density (pcf)	101.8	103.0	Max. Effect. Stress (psi):	5.8	
Saturation (%)	85.1	95.0	Min. Effect. Stress (psi):	4.4	
			Ave. Effect. Stress (psi):	5.1	

	Date			Time		Run	Temp	Pressure (psi)			Cham.		Bot.		Top	Flow	Kv ***	Ave.*
	Yr.	Mo.	Day	Hr.	Min.	Time	C***	Bot	Top	Cham	Dif.	Bot	Dif.	Top	Dif.	Dif.%	cm/sec	0.1
1	98	11	24	9	32.00		0.0	95	95	41.60		5.00		97.05				
2	98	11	24	11	27.00	6900	22.0	95	95	42.10	0.50	5.50	0.50	95.75	1.30	-44.4	6.0E-08	
3	98	11	24	13	26.00	7140	24.0	95	95	42.90	0.80	7.20	1.70	94.60	1.15	19.3	9.0E-08	
4	98	11	24	15	28.00	7320	24.0	95	95	42.50	-0.40	9.10	1.90	93.40	1.20	22.6	9.9E-08	
5	98	11	25	7	26.00	57480	21.0	95	95	41.30	-1.20	17.20	8.10	85.60	7.80	1.9	7.8E-08	
6	98	11	25	9	26.00	7200	21.5	95	95	42.00	0.70	18.00	0.80	84.80	0.80	0.0	7.0E-08	
7	98	11	25	12	59.00	12780	22.5	95	95	42.50	0.50	19.40	1.40	83.50	1.30	3.7	6.8E-08	
8	98	11	25	15	6.00	7620	23.5	95	95	43.15	0.65	20.30	0.90	82.80	0.70	12.5	6.8E-08	
9	98	11	26	8	20.00	62040	21.0	95	95	41.90	-1.25	25.80	5.50	77.30	5.50	0.0	6.7E-08	
10	98	11	26	10	1.00	6060	21.0	95	95	42.25	0.35	26.30	0.50	76.85	0.45	5.3	6.6E-08	
11	98	11	28	9	45.00	171840	21.0	95	95	43.75	1.50	35.90	9.60	67.70	9.15	2.4	5.8E-08	1
12	98	11	28	14	19.00	16440	22.0	95	95	44.30	0.55	36.60	0.70	67.10	0.60	7.7	5.3E-08	1
13	98	11	30	7	55.00		0.0	95	95	47.60		3.85		98.05				
14	98	11	30	9	48.00	6780	23.5	95	95	49.00	1.40	4.90	1.05	96.90	1.15	-4.5	7.1E-08	1
15	98	11	30	11	57.00	7740	23.0	95	95	48.20	-0.80	5.90	1.00	95.90	1.00	0.0	5.8E-08	1
16	98	11	30	13	48.00	6660	22.0	95	95	47.45	-0.75	6.70	0.80	95.05	0.85	-3.0	5.8E-08	1
17																		
18																		
19																		
20																		
21																		
22																		
23																		
24																		
25																		
26																		

**A zero in this column starts a series of measurements.

*Average Kv for those rows with a 1 in the Ave. column. 6.0E-08 cm/sec

(Termination determined by stable Kv and low flow differential.)

***Kv adjusted for temperature.

Appendix L
Stormwater/Erosion and Sedimentation Calculations

Attachment L1	**Stormwater/Erosion and Sediment Control Design**
Attachment L2	**Predevelopment Stormwater Design Calculations**
Attachment L3	**Post Development Stormwater Design Calculations – North Area**
Attachment L4	**Post Development Stormwater Design Calculations – East Area**
Attachment L5	**Post Development Stormwater Design Calculations – West Area**
Attachment L6	**Post Development Stormwater Design Calculations – North West Area**
Attachment L7	**Box Culvert Design Calculations**
Attachment L8	**Articulated Block Drainage Channel Design Calculations**
Attachment L9	**Steep Gradient Design Calculations**
Attachment L10	**Sizing of Outlet Protection**

Attachment L1
Stormwater/Erosion Control Design

Stormwater/Erosion and Sediment Control Design

Hydrograph Generation

1. The landfill was split into three areas (north, east, and west) for pre-development and post-development analyses. Two detention basins were designed for the north area (a north basin and a northwest basin). Each post-development area was further subdivided by establishing each terrace as a separate subwatershed (see attached figures).
2. Hydrographs for the existing terrain (pre-development) conditions for a 25-year, 24-hour storm were computed with a computer program that uses SCS TR-55 methodology.
3. A 25-year, 24-hour storm hydrograph was computed from each subwatershed area and routed together to obtain the peak flow rate into the detention basin and the amount of sediment erosion due to runoff using the Sedimot II modeling program.

Detention Basin Design

A post-development peak flow rate for each area was estimated for the 25-year, 24-hour storm event based on procedures outlined in the North Carolina Erosion and Sediment Control Planning and Design Manual (NCE&SCP&DM). The volume of runoff for the 10-year, 24-hour storm event was also estimated for each drainage basin. The peak flow rate, the runoff volume, the drainage basin area, and the recommendations provided in the NCE&SCP&DM were used to size the sediment pond, the principal spillway, and the emergency spillway for each drainage basin.

Flow above the riser was calculated with a program that uses culvert hydraulics to determine the flow rate from the principal spillway pipe. The program calculates the controlling flow in the detention basin due to the riser and principal spillway pipe.

1. Flow through the perforated riser was calculated using a "Discharge From Perforated Riser" Excel™ spreadsheet. The flow above the riser was added to the flow through the riser to obtain a total flow at each stage.
2. The following input is required by Sedimot II to begin the sedimentology analysis:
   - Specific gravity for sediment
   - Coefficient for distributing sediment load
   - Submerged bulk-specific gravity
   - Number of particle size distributions
   - Number of data values per particle size distribution

- Particle size distribution data (mm)
- Percent finer values corresponding to the particle size values

The specific gravity used was an average specific gravity of 2.64, which is representative of the on-site soils based on data contained in the Hydrogeologic Report (Appendix B). The eroded particle size distribution data and corresponding "percent finer" values are also representative of the on-site soils. The distribution curve used may be found in the attached calculations.

The Sedimot II user's manual recommended a coefficient of between 1.0 and 2.0 for distributing sediment load equal if the concentration varies linearly with flow rate. A coefficient of 2.00 was used.

Based on recommended values and sediment size distribution, 1.35 was chosen as the submerged bulk-specific gravity.

Sedimot II has two options available to calculate sediment yield: the Modified Universal Soil Loss Equation (MUSLE) and the Soil Loss (SLOSS). The following parameters are used in both sediment yield options for each subwatershed:

- Soil erodibility factor
- Average slope length
- Average slope in percent
- Control practice factor
- Particle size distribution

A soil erodibility factor was selected using the Soil Conservation Commission Soil Survey of Washington County, North Carolina. The site, shown on Sheet No. 4 of the soil survey, is comprised of Altavista, Conetoe, and Wickham soils. The majority of the soils at the site are Altavista and Wickham and have an erodibility factor of 0.20.

The average slope length and average slope is defined as the distance from the point of origin of overland flow until the flow enters a defined channel. The terrace face length and slope were used.

The control practice factor is defined as the ratio of sediment loss from an area with a given cover and conservation practice to that of a field in continuous fallow. A value of 0.4 for a condition of permanent seedlings from 0 to 60 days was considered to be a conservative situation and was used in this analysis.

Sedimot II gives the user the option of selecting different particle size distributions for each subwatershed. A particle size distribution from the hydrogeologic report was used. In this situation, the same distribution was utilized for all subwatershed analysis.

The MUSLE option for sediment yield was selected for each subwatershed. MUSLE calculates sediment yield, using the Williams' Modified Universal Soil Loss Equation. Eroded sediment and the combined hydrographs are routed to the "structure" (the detention basin) by travel time constants.

The outfall structure of the hydrograph was selected as a pond. The Sedimot II model predicts the performance of a user-designed sediment basin by two methods:
1) Modified Deposits Performance Of Sediments In Trap Structures (DEPOSITS); and
2) Continuous Stirred Type Reactors (CSTRs), which predicts the performance of a CSTR. The CSTRs method was selected. This method accounts for mixing between inflow concentration once flow has entered the pond. CSTRs is more reflective of sediment basin performance than the DEPOSITS prediction. The following input is required for basin analysis using CSTRs:

- Number of continuous stirred type reactors
- Time increment of routed hydrograph
- Non-ideal settling correction factor
- Percent of pool that is dead space
- Outflow withdrawal option
- Inflow vertical concentration

Sedimot II allows for up to nine CSTRs to be used, but recommends that at least two CSTRs be used. We used three CSTRs for this analysis.

Sedimot II requires that the time increment of the routed hydrograph is an integer multiple of the inflow hydrograph time increment. The default value was selected, which automatically set the value equal to the inflow time increment.

A non-ideal settling factor for a highly turbulent pond is greater than one. If natural or chemical flocculation occurs, the value is less than one. The default value of one was selected.

The percent of permanent pool that is dead storage was set at 35 percent for all three ponds.

The outflow withdrawal option is used to select the percent of water (and associated sediment) that is drawn from each of four horizontal layers of the pond. This outflow withdrawal occurs at the principal and/or emergency spillway. The options are uniform, bed, surface, and input. The uniform withdrawal system assumes that the outflow concentration is equally weighted by the concentration from each layer. A bed withdrawal system uses only the concentration from the bottommost layer to determine effluent concentration. In the surface withdrawal option, the effluent concentration is equal to the concentration of the top fall depth layer. The input option is used strictly as a research tool. The surface withdrawal option was selected.

The inflow vertical concentration option, which assumed that the inflow is completely mixed, was selected.

A stage-discharge relationship was developed so that a 10-year, 24-hour storm event could be held and then released from the detention basins. The principal spillway has the capacity to carry a 25-year, 24-hour storm event without overflowing into the emergency spillway.

The emergency spillway was designed to handle the overflow of a 100-year, 24-hour storm event. Sedimot II was run to evaluate the emergency spillway for a 100-year, 24-hour storm event. Sedimot II was also run for the 2-year, the 10-year, and the 25-year, 24-hour storm events.

DESIGN SHEET

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

PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER - PLYMOUTH, NC	DYK	6/7/99	EWT	7/12/99	05101.01

PROBLEM:

SIZE (3) SEDIMENT/EXTENDED DRY DETENTION BASINS TO MANAGE 25 YR-24 HR STORM EVENT. DESIGN SUCH THAT DISCHARGE FLOW RATE WILL BE LESS THAN PRE-DEVELOPMENT PEAK FLOW RATE. SIZE EMERGENCY SPILLWAY TO MANAGE 100 YR-STORM EVENT. SEDIMENT BASIN ALONG WITH BEST MANAGEMENT PRACTICES (BMP'S) WILL TRAP 85% OF TOTAL SUSPENDED SOLIDS. BMP'S WILL INCLUDE GRASS SWALES AROUND THE TERRACES OF THE LANDFILL.

METHODOLOGY + REFERENCES:

- SCS SOIL SURVEY, WASHINGTON COUNTY, NC, SHEET 4
- NORTH CAROLINA EROSION + SEDIMENT CONTROL PLANNING + DESIGN MANUAL (9/1/88)
- SCS TECHNICAL RELEASE NO. 55, URBAN HYDROLOGY FOR SMALL WATERSHEDS. + GALILEO SOFTWARE
- SEDIMOT II COMPUTER PROGRAM (WILSON, BARFIELD + MOORE, 1982)

RAINFALL DATA:

2 YR - 24 HR = 4.00 IN
10 YR - 24 HR = 6.25 IN
25 YR - 24 HR = 7.25 IN
100 YR - 24 HR = 9.00 IN

SCS - TYPE III STORM (TR 55, FIG B2)

PRE-DOMINANT SOILS:

ALTAVISTA	HSG = C	K = 0.20	K ~ ERODIBILITY SOIL FACTOR
CONCIDE	HSG = A	K = 0.15	$K_{AVG} \simeq 0.20$
WICKHAM	HSG = B	K = 0.15 - 0.24	

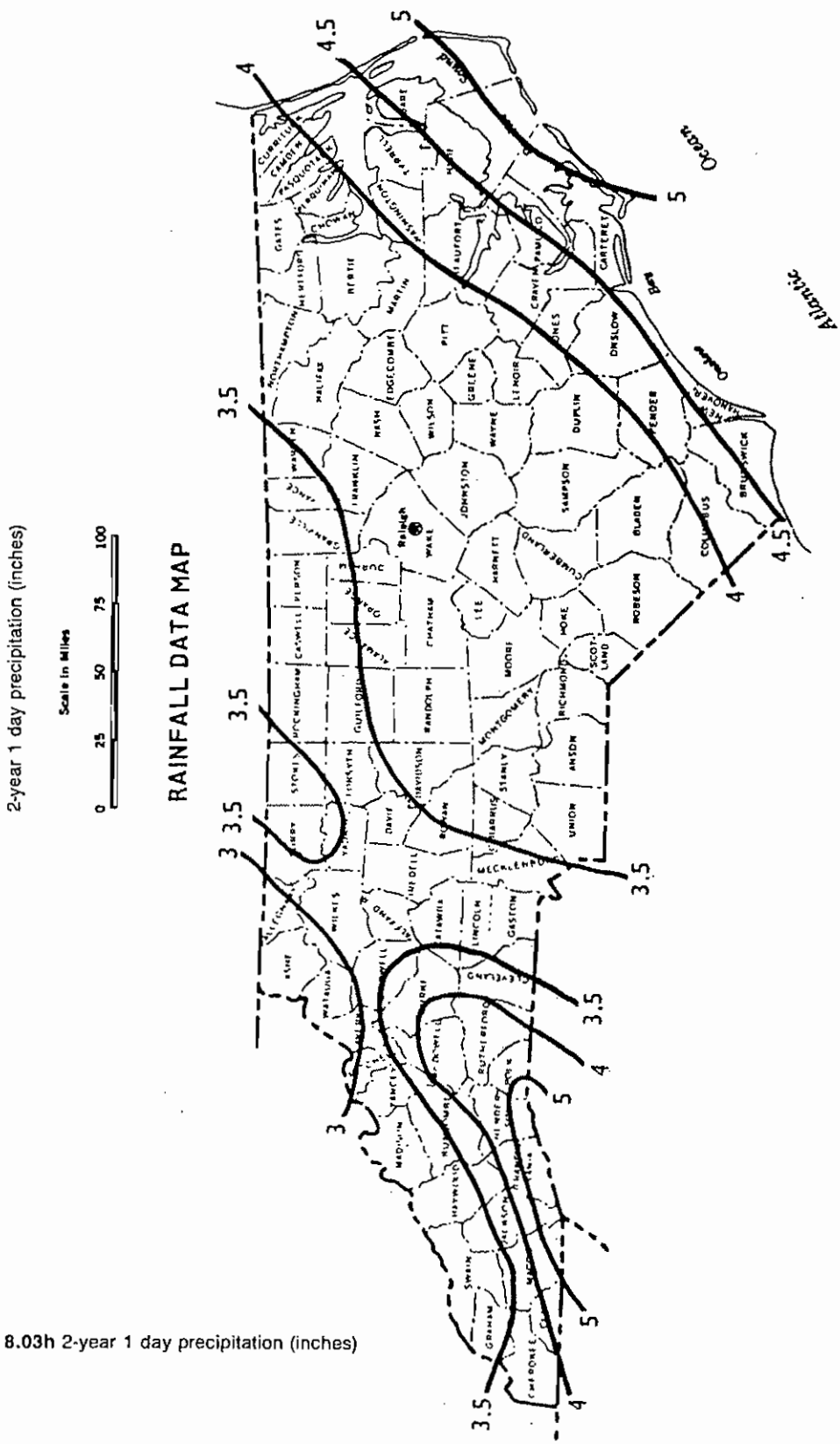

Figure 8.03h 2-year 1 day precipitation (inches)

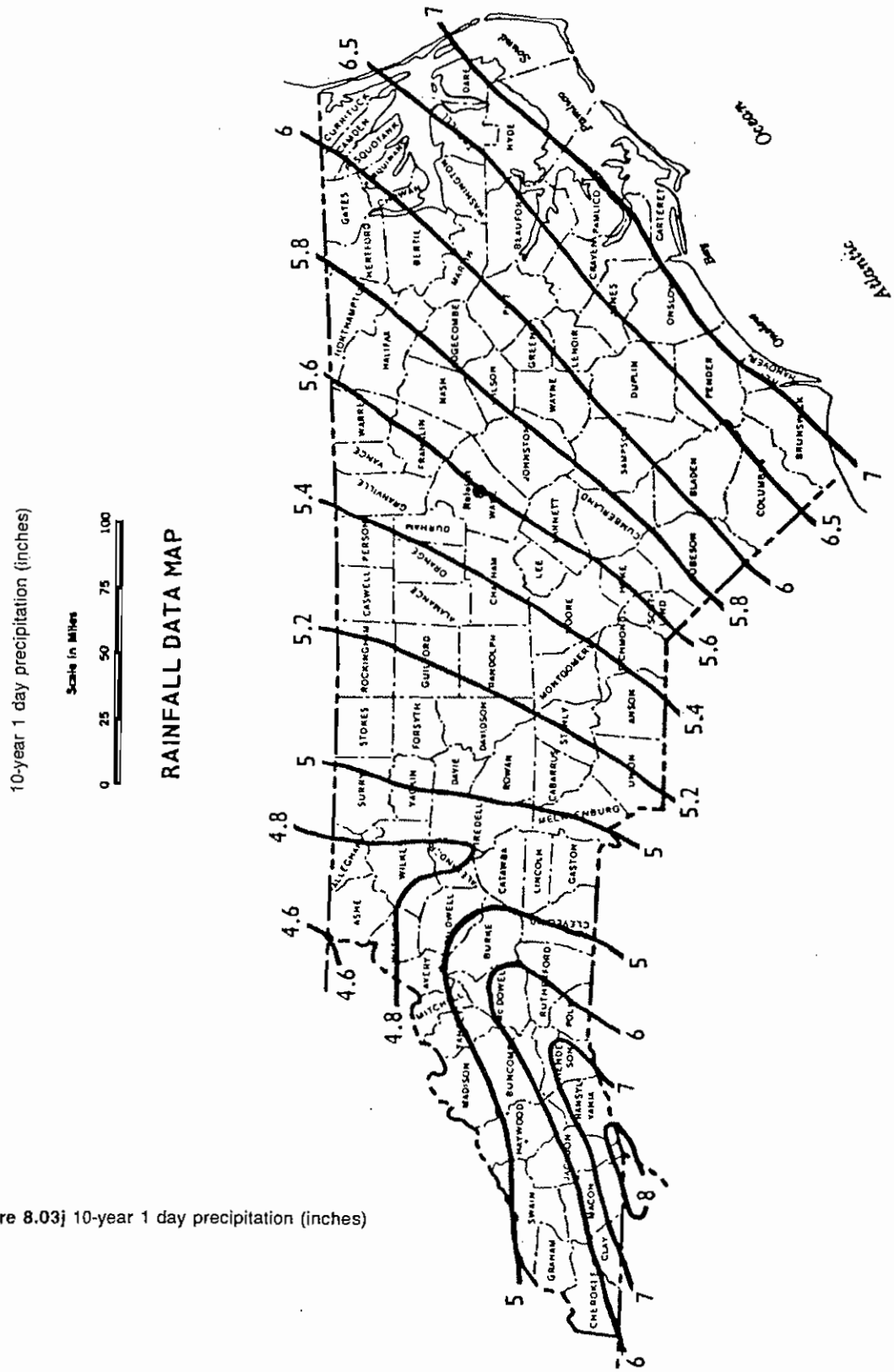

Figure 8.03j 10-year 1 day precipitation (inches)

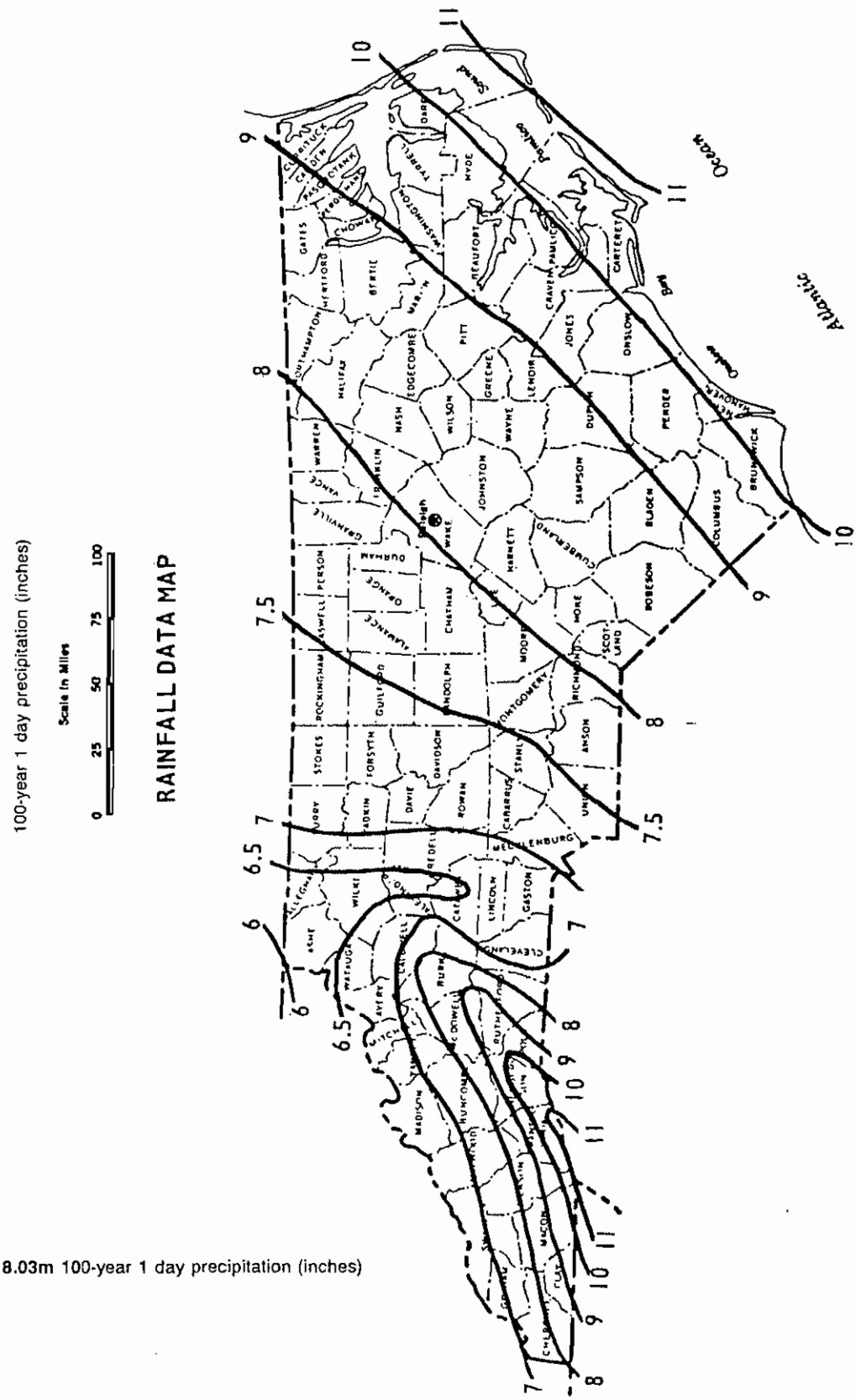

Figure 8.03m 100-year 1 day precipitation (inches)

5/5

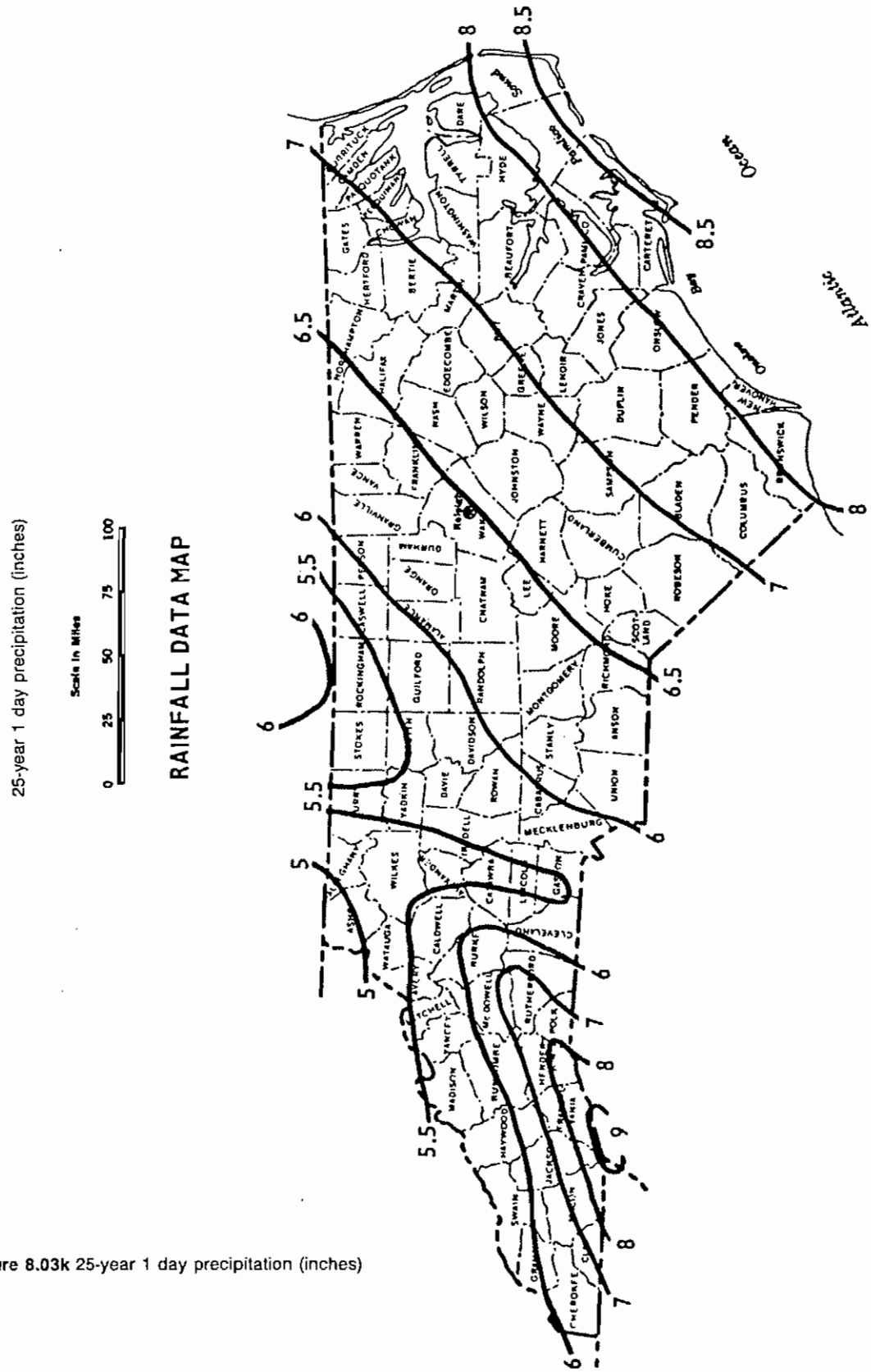

Figure 8.03k 25-year 1 day precipitation (inches)

Attachment L2
Predevelopment Stormwater Design Calculations

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WEYERHAEUSER - PLYMOUTH	SYK	6/7/99	EWT	7/8/99	05101.01

DETERMINE THE PEAK FLOW RATES USING SCS TR-55 METHODOLOGY FOR PRE-DEVELOPMENT LAND USE:

NORTH AREA (#1) ≈ 22.6 ACRES ≈ 0.0353 SQ. MILES

6% WOODED : $n = 0.60$
94% OPEN SPACE : $n = 0.06$
100% TOTAL AREA : $\bar{n} = 0.0924$

HYDRALIC LENGTH = 1900 FT
AVG. SLOPE = 0.01895 FT/FT

EAST AREA (#2) ≈ 55.6 ACRES ≈ 0.0869 SQ. MILES

43% WOODED : $n = 0.60$
57% OPEN SPACE : $n = 0.06$
100% TOTAL AREA : $\bar{n} = 0.2922$

HYDRAULIC LENGTH = 2300 FT
AVG. SLOPE = 0.00956 FT/FT

WEST AREA (#3) ≈ 35.0 ACRES ≈ 0.0547 SQ. MILES

41% WOODED : $n = 0.60$
59% OPEN SPACE : $n = 0.06$
100% TOTAL AREA : $n = 0.2814$

HYDRAULIC LENGTH = 2200 FT
AVG SLOPE = 0.01318 FT/FT

n ~ values are derived from SCS TR-55 (Table 3.1)
RUNOFF CURVE NOS. ARE AS FOLLOWS FOR HYDROLOGIC SOIL GROUP "B"
WOODS (GOOD CONDITION) → CN=58
OPEN SPACE (POOR CONDITION - BRUSH + WEEDS → CN=67

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WEYERHAEUSER-PLYMOUTH	SYK	6/7/99	BWK	7/8/99	05101.01

DETERMINE PRE-DEVELOPMENT T_c + $\overline{CN}$ FOR EACH AREA:

NORTH AREA (#1):

(0'-300') $T_{t_{0-300}} = \frac{0.007\,(nL)^{0.8}}{(P_2)^{0.5}\,(S)^{0.4}} = \frac{(0.007)\,[(0.0924)(300')]^{0.8}}{(4.0)^{0.5}\cdot(0.01895\,\frac{FT}{FT})^{0.4}}$

$T_{t_{0-300}} = 0.244$ hrs ✓

(300'-1900') VELOCITY* $\cong f(S = 0.01895\ FT/FT, UNPAVED) = 2.25$ FPS

$T_t = \left(\frac{DISTANCE}{VELOCITY}\right) = \left(\frac{1900'-300'}{2.25\ FPS}\right)\left(\frac{1\ MIN}{60S}\right)\left(\frac{1\ HR}{60M}\right)$

$T_{t_{300-1900}} = 0.198$ hrs

$T_c = \sum T_t = 0.244 + 0.198$

$T_c = 0.442$ hrs

$\overline{CN} = (0.06)(58) + (0.94)(67)$

$\overline{CN} \approx 66$

* VELOCITY FROM SCS-TR-55, FIGURE 3.1

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WEYERHAEUSER - PLYMOUTH	SYK	6/7/99	KMT	7/8/99	05101.01

DETERMINE PRE-DEVELOPMENT T_c + CN FOR EACH AREA

EAST AREA (#2)

(0-300') $T_{t_{0-300'}} = \dfrac{0.007\,(0.2922\,(300'))^{0.8}}{(4.0)^{0.5}\cdot(0.00956)^{0.4}}$

$T_{t_{0-300'}} = 0.806$ hrs

(300'-2300') VELOCITY* = f (S = 0.00956 ↓ FIG 3.1, UNPAVED)

VELOCITY ≅ 1.55 FPS.

$T_{t_{300-2300}} = \left(\dfrac{2300'-300'}{1.55\text{ FPS}} \cdot \dfrac{1\text{ m}}{60\text{ s}} \cdot \dfrac{1\text{ h}}{60\text{ m}}\right)$

$T_{t_{300-2300}} = 0.358$ hrs

$T_c = \Sigma T_t = 0.806\text{ hrs} + 0.358\text{ hrs}$

$T_c = 1.164$ hrs

$\bar{CN} = (0.43)(58) + (0.57)(67)$

$\bar{CN} \cong 63$

* VELOCITY FROM SCS-TR-55, FIG 3.1

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WEYERHAEUSER - PLYMOUTH	SJK	6/7/99	BJT	7/8/99	05101.01

DETERMINE PRE-DEVELOPMENT T_c + CN FOR EACH AREA.

WEST AREA (#3)

(0-300') $T_{t_{0-300'}} = \dfrac{(0.007)((0.2814)(300'))^{0.8}}{(4.0)^{0.5}(0.01318)^{0.4}}$ 0.2424 / 0.3540

$T_{t_{0-300'}} = 0.687$ hrs ✓

(300'-2200') VELOCITY* = f(S = 0.01318 FT/FT, UNPAVED, FIG 3-1)
VELOCITY ≅ 1.85 FPS

$T_{t_{300'-2200'}} = \left(\dfrac{2200'-300'}{1.85\ \text{FPS}} \cdot \dfrac{1\ \text{M}}{60\ \text{S}} \cdot \dfrac{1\ \text{HR}}{60\ \text{M}}\right)$

$T_{t_{300'-2200'}} = 0.285$ hrs

$T_c = \sum T_t = 0.687$ hrs + 0.285 hrs.

$T_c = 0.972$ hrs

$\overline{CN} = (0.41)(58) + (0.59)(67)$

$\overline{CN} \approx 63$

* VELOCITY FROM SCS-TR-55 FIG. 3.1

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PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER - PLYMOUTH	SYK	6/7/99			05101.01

PRE-DEVELOPMENT:

USE TR-55 BASED COMPUTER MODEL TO CALCULATE THE PRE-DEVELOPMENT FLOW RATE & RUNOFF VOLUME (SEE ATTACHED OUTPUT)

SUMMARY OF PRE-DEVELOPMENT FLOW RATES & RUNOFF VOLUMES FROM COMPUTER OUTPUT

PEAK FLOW RATES (CFS)	NORTH AREA (#1)	EAST AREA (#2)	WEST AREA (#3)
$Q_{10YR/24HR}$	40.66	52.89	37.61
$Q_{25YR/24HR}$	53.21	70.65	50.22
$Q_{100YR/24HR}$	76.20	104.00	73.63

PEAK RUNOFF VOLUME (AC-FT)	NORTH AREA (#1)	EAST AREA (#2)	WEST AREA (#3)
$\forall_{10YR/24HR}$	4.95	10.90	6.86
$\forall_{25YR/24HR}$	6.40	14.32	9.01
$\forall_{100YR/24HR}$	9.11	20.72	13.04

PRE-DEVELOPMENT

6/14

SCS Hydrograph Generation Program

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WEYERHAEUSER PLYMOUTH - NORTH AREA 10YR/24HR STORM

DRAINAGE AREA = .0353 SQUARE MILES
TIME OF CONCENTRATION = .442 HOURS
RUNOFF CURVE NUMBER = 66
STORM DURATION = 24 HOURS
SCS TYPE 3 STORM
RAINFALL = 6.25 INCHES
RUNOFF = 2.63 INCHES = 4.95 ACRE FEET

VOLUME ADJUSTMENT FACTOR = 1.00

*** MAXIMUM FLOW = 40.66 CFS AT 12.3 HOURS ***

TIME (HOURS)	CUM. RAINFALL (INCHES)	CUM. RUNOFF (INCHES)	FLOW (CFS)
0.00	0.00	0.00	0.00
1.00	0.06	0.00	0.00
2.00	0.13	0.00	0.00
3.00	0.19	0.00	0.00
4.00	0.27	0.00	0.00
5.00	0.35	0.00	0.00
6.00	0.45	0.00	0.00
7.00	0.57	0.00	0.00
8.00	0.71	0.00	0.00
9.00	0.91	0.00	0.00
10.00	1.18	0.00	0.15
11.00	1.56	0.05	1.28
12.00	3.13	0.61	15.72
13.00	4.69	1.52	11.28
14.00	5.07	1.77	5.49
15.00	5.34	1.96	4.10
16.00	5.54	2.10	3.02
17.00	5.68	2.21	2.33
18.00	5.80	2.29	1.83
19.00	5.90	2.36	1.57
20.00	5.98	2.43	1.42
21.00	6.06	2.49	1.33
22.00	6.13	2.54	1.18
23.00	6.19	2.58	1.07
24.00	6.25	2.63	0.95
25.00	6.25	2.63	0.01

PRE-DEVELOPMENT

7/14

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WEYERHAEUSER PLYMOUTH - NORTH AREA 25YR/24HR STORM

DRAINAGE AREA = .0353 SQUARE MILES
TIME OF CONCENTRATION = .442 HOURS
RUNOFF CURVE NUMBER = 66
STORM DURATION = 24 HOURS
SCS TYPE 3 STORM
RAINFALL = 7.25 INCHES
RUNOFF = 3.40 INCHES = 6.40 ACRE FEET

VOLUME ADJUSTMENT FACTOR = 1.00

*** MAXIMUM FLOW = 53.21 CFS AT 12.3 HOURS ***

TIME (HOURS)	CUM. RAINFALL (INCHES)	CUM. RUNOFF (INCHES)	FLOW (CFS)
0.00	0.00	0.00	0.00
1.00	0.07	0.00	0.00
2.00	0.14	0.00	0.00
3.00	0.22	0.00	0.00
4.00	0.31	0.00	0.00
5.00	0.41	0.00	0.00
6.00	0.52	0.00	0.00
7.00	0.66	0.00	0.00
8.00	0.83	0.00	0.00
9.00	1.06	0.00	0.00
10.00	1.37	0.02	0.63
11.00	1.81	0.10	2.20
12.00	3.63	0.87	21.68
13.00	5.44	2.03	14.24
14.00	5.88	2.35	6.84
15.00	6.19	2.58	5.08
16.00	6.42	2.76	3.73
17.00	6.59	2.89	2.87
18.00	6.73	2.99	2.25
19.00	6.84	3.08	1.92
20.00	6.94	3.16	1.74
21.00	7.03	3.23	1.63
22.00	7.11	3.29	1.45
23.00	7.18	3.35	1.31
24.00	7.25	3.40	1.16
25.00	7.25	3.40	0.01

PRE - DEVELOPMENT

9/14

SCS Hydrograph Generation Program
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WEYERHAEUSER PLYMOUTH - NORTH AREA 100YR/24HR STORM

DRAINAGE AREA = .0353 SQUARE MILES
TIME OF CONCENTRATION = .442 HOURS
RUNOFF CURVE NUMBER = 66
STORM DURATION = 24 HOURS
SCS TYPE 3 STORM
RAINFALL = 9 INCHES
RUNOFF = 4.84 INCHES = 9.11 ACRE FEET

VOLUME ADJUSTMENT FACTOR = 1.00

*** MAXIMUM FLOW = 76.20 CFS AT 12.3 HOURS ***

TIME (HOURS)	CUM. RAINFALL (INCHES)	CUM. RUNOFF (INCHES)	FLOW (CFS)
0.00	0.00	0.00	0.00
1.00	0.09	0.00	0.00
2.00	0.18	0.00	0.00
3.00	0.28	0.00	0.00
4.00	0.39	0.00	0.00
5.00	0.51	0.00	0.00
6.00	0.65	0.00	0.00
7.00	0.81	0.00	0.00
8.00	1.03	0.00	0.00
9.00	1.31	0.01	0.46
10.00	1.70	0.08	1.66
11.00	2.25	0.23	4.05
12.00	4.50	1.40	32.95
13.00	6.75	3.01	19.52
14.00	7.30	3.44	9.23
15.00	7.69	3.75	6.82
16.00	7.97	3.99	4.98
17.00	8.19	4.16	3.82
18.00	8.35	4.30	2.99
19.00	8.49	4.41	2.56
20.00	8.61	4.52	2.31
21.00	8.73	4.61	2.15
22.00	8.83	4.69	1.91
23.00	8.92	4.77	1.73
24.00	9.00	4.84	1.54
25.00	9.00	4.84	0.01

PREDEVELOPMENT

9/14

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WEYERHAEUSER PLYMOUTH - EAST AREA 10YR/24HR STORM

DRAINAGE AREA = .0869 SQUARE MILES
TIME OF CONCENTRATION = 1.164 HOURS
RUNOFF CURVE NUMBER = 63
STORM DURATION = 24 HOURS
SCS TYPE 3 STORM
RAINFALL = 6.25 INCHES
RUNOFF = 2.35 INCHES = 10.90 ACRE FEET

VOLUME ADJUSTMENT FACTOR = 1.00

*** MAXIMUM FLOW = 52.89 CFS AT 12.9 HOURS ***

TIME (HOURS)	CUM. RAINFALL (INCHES)	CUM. RUNOFF (INCHES)	FLOW (CFS)
0.00	0.00	0.00	0.00
1.00	0.06	0.00	0.00
2.00	0.13	0.00	0.00
3.00	0.19	0.00	0.00
4.00	0.27	0.00	0.00
5.00	0.35	0.00	0.00
6.00	0.45	0.00	0.00
7.00	0.57	0.00	0.00
8.00	0.71	0.00	0.00
9.00	0.91	0.00	0.00
10.00	1.18	0.00	0.00
11.00	1.56	0.02	0.56
12.00	3.13	0.49	7.20
13.00	4.69	1.31	51.20
14.00	5.07	1.55	20.70
15.00	5.34	1.73	11.98
16.00	5.54	1.86	8.59
17.00	5.68	1.96	6.33
18.00	5.80	2.04	4.98
19.00	5.90	2.10	3.99
20.00	5.98	2.16	3.52
21.00	6.06	2.22	3.19
22.00	6.13	2.27	2.90
23.00	6.19	2.31	2.65
24.00	6.25	2.35	2.38
25.00	6.25	2.35	0.85
26.00	6.25	2.35	0.10
27.00	6.25	2.35	0.01

PRE-DEVELOPMENT

10/11

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WEYERHAEUSER PLYMOUTH - EAST AREA 25YR/24HR STORM

DRAINAGE AREA = .0869 SQUARE MILES
TIME OF CONCENTRATION = 1.164 HOURS
RUNOFF CURVE NUMBER = 63
STORM DURATION = 24 HOURS
SCS TYPE 3 STORM
RAINFALL = 7.25 INCHES
RUNOFF = 3.09 INCHES = 14.32 ACRE FEET

VOLUME ADJUSTMENT FACTOR = 1.00

*** MAXIMUM FLOW = 70.65 CFS AT 12.8 HOURS ***

TIME (HOURS)	CUM. RAINFALL (INCHES)	CUM. RUNOFF (INCHES)	FLOW (CFS)
0.00	0.00	0.00	0.00
1.00	0.07	0.00	0.00
2.00	0.14	0.00	0.00
3.00	0.22	0.00	0.00
4.00	0.31	0.00	0.00
5.00	0.41	0.00	0.00
6.00	0.52	0.00	0.00
7.00	0.66	0.00	0.00
8.00	0.83	0.00	0.00
9.00	1.06	0.00	0.00
10.00	1.37	0.01	0.09
11.00	1.81	0.06	1.77
12.00	3.63	0.72	11.36
13.00	5.44	1.79	67.89
14.00	5.88	2.09	26.59
15.00	6.19	2.31	15.12
16.00	6.42	2.48	10.75
17.00	6.59	2.60	7.89
18.00	6.73	2.70	6.20
19.00	6.84	2.78	4.96
20.00	6.94	2.85	4.37
21.00	7.03	2.92	3.96
22.00	7.11	2.98	3.59
23.00	7.18	3.04	3.28
24.00	7.25	3.09	2.95
25.00	7.25	3.09	1.05
26.00	7.25	3.09	0.12
27.00	7.25	3.09	0.01

PRE - DEVELOPMENT

11/14

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WEYERHAEUSER PLYMOUTH - EAST AREA 100YR/24HR STORM

DRAINAGE AREA = .0869 SQUARE MILES
TIME OF CONCENTRATION = 1.164 HOURS
RUNOFF CURVE NUMBER = 63
STORM DURATION = 24 HOURS
SCS TYPE 3 STORM
RAINFALL = 9 INCHES
RUNOFF = 4.47 INCHES = 20.72 ACRE FEET

VOLUME ADJUSTMENT FACTOR = 1.00

*** MAXIMUM FLOW = 104.00 CFS AT 12.8 HOURS ***

TIME (HOURS)	CUM. RAINFALL (INCHES)	CUM. RUNOFF (INCHES)	FLOW (CFS)
0.00	0.00	0.00	0.00
1.00	0.09	0.00	0.00
2.00	0.18	0.00	0.00
3.00	0.28	0.00	0.00
4.00	0.39	0.00	0.00
5.00	0.51	0.00	0.00
6.00	0.65	0.00	0.00
7.00	0.81	0.00	0.00
8.00	1.03	0.00	0.00
9.00	1.31	0.00	0.03
10.00	1.70	0.04	1.24
11.00	2.25	0.17	4.64
12.00	4.50	1.20	19.63
13.00	6.75	2.72	98.73
14.00	7.30	3.13	37.27
15.00	7.69	3.43	20.74
16.00	7.97	3.65	14.60
17.00	8.19	3.82	10.67
18.00	8.35	3.95	8.36
19.00	8.49	4.06	6.67
20.00	8.61	4.16	5.87
21.00	8.73	4.25	5.31
22.00	8.83	4.33	4.81
23.00	8.92	4.40	4.38
24.00	9.00	4.47	3.94
25.00	9.00	4.47	1.41
26.00	9.00	4.47	0.17
27.00	9.00	4.47	0.02

PRE-DEVELOPMENT

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12/14

WEYERHAEUSER PLYMOUTH - WEST AREA 10YR/24HR STORM

DRAINAGE AREA = .0547 SQUARE MILES
TIME OF CONCENTRATION = .963 HOURS 0.972
RUNOFF CURVE NUMBER = 63
STORM DURATION = 24 HOURS
SCS TYPE 3 STORM
RAINFALL = 6.25 INCHES
RUNOFF = 2.35 INCHES = 6.86 ACRE FEET

VOLUME ADJUSTMENT FACTOR = 1.00

*** MAXIMUM FLOW = 37.61 CFS AT 12.7 HOURS ***

TIME (HOURS)	CUM. RAINFALL (INCHES)	CUM. RUNOFF (INCHES)	FLOW (CFS)
0.00	0.00	0.00	0.00
1.00	0.06	0.00	0.00
2.00	0.13	0.00	0.00
3.00	0.19	0.00	0.00
4.00	0.27	0.00	0.00
5.00	0.35	0.00	0.00
6.00	0.45	0.00	0.00
7.00	0.57	0.00	0.00
8.00	0.71	0.00	0.00
9.00	0.91	0.00	0.00
10.00	1.18	0.00	0.00
11.00	1.56	0.02	0.50
12.00	3.13	0.49	6.28
13.00	4.69	1.31	31.14
14.00	5.07	1.55	11.07
15.00	5.34	1.73	6.88
16.00	5.54	1.86	5.11
17.00	5.68	1.96	3.79
18.00	5.80	2.04	3.00
19.00	5.90	2.10	2.43
20.00	5.98	2.16	2.18
21.00	6.06	2.22	1.98
22.00	6.13	2.27	1.79
23.00	6.19	2.31	1.64
24.00	6.25	2.35	1.47
25.00	6.25	2.35	0.33
26.00	6.25	2.35	0.02
27.00	6.25	2.35	0.00

PRE-DEVELOPMENT

13/14

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WEYERHAEUSER PLYMOUTH - WEST AREA 25YR/24HR STORM

DRAINAGE AREA = .0547 SQUARE MILES
TIME OF CONCENTRATION = ~~.963~~ HOURS 0.972
RUNOFF CURVE NUMBER = 63
STORM DURATION = 24 HOURS
SCS TYPE 3 STORM
RAINFALL = 7.25 INCHES
RUNOFF = 3.09 INCHES = 9.01 ACRE FEET

VOLUME ADJUSTMENT FACTOR = 1.00

*** MAXIMUM FLOW = 50.22 CFS AT 12.7 HOURS ***

TIME (HOURS)	CUM. RAINFALL (INCHES)	CUM. RUNOFF (INCHES)	FLOW (CFS)
0.00	0.00	0.00	0.00
1.00	0.07	0.00	0.00
2.00	0.14	0.00	0.00
3.00	0.22	0.00	0.00
4.00	0.31	0.00	0.00
5.00	0.41	0.00	0.00
6.00	0.52	0.00	0.00
7.00	0.66	0.00	0.00
8.00	0.83	0.00	0.00
9.00	1.06	0.00	0.00
10.00	1.37	0.01	0.09
11.00	1.81	0.06	1.40
12.00	3.63	0.72	9.61
13.00	5.44	1.79	40.91
14.00	5.88	2.09	14.11
15.00	6.19	2.31	8.65
16.00	6.42	2.48	6.39
17.00	6.59	2.60	4.72
18.00	6.73	2.70	3.73
19.00	6.84	2.78	3.02
20.00	6.94	2.85	2.70
21.00	7.03	2.92	2.45
22.00	7.11	2.98	2.22
23.00	7.18	3.04	2.03
24.00	7.25	3.09	1.82
25.00	7.25	3.09	0.41
26.00	7.25	3.09	0.03
27.00	7.25	3.09	0.00

PRE-DEVELOPMENT

14/

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WEYERHAEUSER PLYMOUTH - WEST AREA 100YR/24HR STORM

DRAINAGE AREA = .0547 SQUARE MILES
TIME OF CONCENTRATION = ~~.963~~ HOURS 0.972
RUNOFF CURVE NUMBER = 63
STORM DURATION = 24 HOURS
SCS TYPE 3 STORM
RAINFALL = 9 INCHES
RUNOFF = 4.47 INCHES = 13.04 ACRE FEET

VOLUME ADJUSTMENT FACTOR = 1.00

*** MAXIMUM FLOW = 73.63 CFS AT 12.7 HOURS ***

TIME (HOURS)	CUM. RAINFALL (INCHES)	CUM. RUNOFF (INCHES)	FLOW (CFS)
0.00	0.00	0.00	0.00
1.00	0.09	0.00	0.00
2.00	0.18	0.00	0.00
3.00	0.28	0.00	0.00
4.00	0.39	0.00	0.00
5.00	0.51	0.00	0.00
6.00	0.65	0.00	0.00
7.00	0.81	0.00	0.00
8.00	1.03	0.00	0.00
9.00	1.31	0.00	0.03
10.00	1.70	0.04	0.99
11.00	2.25	0.17	3.41
12.00	4.50	1.20	16.18
13.00	6.75	2.72	58.88
14.00	7.30	3.13	19.60
15.00	7.69	3.43	11.81
16.00	7.97	3.65	8.66
17.00	8.19	3.82	6.38
18.00	8.35	3.95	5.03
19.00	8.49	4.06	4.06
20.00	8.61	4.16	3.62
21.00	8.73	4.25	3.29
22.00	8.83	4.33	2.97
23.00	8.92	4.40	2.71
24.00	9.00	4.47	2.43
25.00	9.00	4.47	0.54
26.00	9.00	4.47	0.04
27.00	9.00	4.47	0.00

Attachment L3
Post Development Stormwater Design Calculations – North Area

DESIGN SHEET

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PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
[illegible]	SYE	[illegible]	ANT	1/8/99	CS101.01

POST DEVELOPMENT STORM WATER ANALYSIS;

DETERMINE: PEAK RUNOFF RATE FOR AREA 1 / NORTH BASIN USING THE SCS METHOD & 25 YR - 24 HR STORM, (Q_P) 25, 24

GIVEN: LOCATION: PLYMOUTH, NC
HYDROLOGIC SOIL GROUP (HSG): B
TOTAL AREA OF WATERSHED: 33.09 AC
MAXIMUM HYDRAULIC LENGTH = 2890 FT
EXTERIOR FACE OF TERRACE LENGTH: 60 FT
(Q: 3 [illegible] SLOPE, 20' HIGH)
DESIGN FOR 25 YR - 24 HR STORM EVENT
FACE OF TERRACE SLOPE = 33.3 %
TOTAL HYDRAULIC LENGTH = 2890 FT

% HYDRAULIC LENGTH MODIFIED = 0
% IMPERVIOUS AREA = 0

SOLUTION:

DETERMINE: 25 YR - 24 HR STORM = 7.25 INCHES (F. 8.03 K)

DETERMINE: CN = 69 FOR FAIR CONDITION GRASS COVER ON 50 TO 75% OF THE AREA - HSG "B" (ASSUME LAPPING - VEGETATION [illegible] WITH [illegible])
(T. 8.03b)

DETERMINE: RUNOFF DEPTH (INCHES) USING T. 8.03 C
7.25 INCHES OF RAINFALL & CN = 69
BY DOUBLE INTERPOLATION.

RUNOFF DEPTH = 3.73 INCHES → 25 YR EVENT

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WEYERHAEUSER - [illegible]	SYR	5/6/99	[illegible]	[illegible]	CS101.01

25yr-TOTAL RUNOFF VOLUME = (3.73 IN)(33.09 AC)(1 FT/12 IN)
= 10.3 ACRE-FT

EQUIVALENT DRAINAGE AREA = f (HYDRAULIC LENGTH = 3660')

$a = (L/209)^{(1/0.6)}$

$a = (2890/209)^{1.67}$

$a = 80$ ACRES

USE MAXIMUM WATERSHED SLOPE OF 33.3% AS THE AVERAGE WATERSHED SLOPE (CONSERVATIVE)

PEAK RATE OF DISCHARGE: (F. 8.03 g), 80 ACRES, CN=69
PEAK RATE OF DISCHARGE = 70 CFS/IN

PEAK DISCHARGE FOR EQUIVALENT WATERSHED = (70 CFS/IN)(3.73 IN)

$Q_1 = 261.1$ CFS

PEAK DISCHARGE $Q_2 = (261.1 \text{ CFS})\left(\frac{33.09 \text{ AC}}{80 \text{ AC}}\right) = 108$ CFS

ADJUST PEAK DISCHARGE FOR AVG WATERSHED SLOPE (33.3%)
(TABLE 8.03.d)

$Q_3 = (108 \text{ AC})(1.14)$ BY DOUBLE INTERPOLATION

$Q_{P_{25,24}} = 123$ CFS

DESIGN SHEET

RMT INC

SHEET 3 OF 8

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WEYERHAEUSER - PLYMOUTH, NC	SYK	5/7/99	BJT	7/8/99	05101.01

SEDIMENT BASIN DESIGN - NORTH SEDIMENT BASIN

- RUN OFF FROM AREA THAT EQUALS 33.09 ACRES WILL ENTER THE NORTH BASIN

- $Q_{25,24} = 123$ CFS.

- AREA OF BASIN 2VV:1L OR GREATER
- BASIN SIDE SLOPES 3H:1V
- TOP OF DIKE 8' WIDE
- BOTTOM OF DIKE ≥ 2' ABOVE HIGH GROUNDWATER TABLE

DETERMINE BASIN VOLUME:

→ $V_{MIN} = (1800\ ft^3/acre)(33.09\ acres) = 59,562\ ft^3 = 1.4\ acft$

→ MAXIMUM SIZE BASIN THE NORTH AREA WILL ACCOMMODATE

EL. 8	140' x 330' =	46,200 SF	BOTTOM OF BASIN
EL. 14	176' x 366' =	64,416 SF	TOP OF PRICIPAL SPILLWAY (RISER PIPE)
EL. 16	188' x 378' =	71,064 SF	BOTTOM OF EMERGENCY SPILLWAY
EL. 18	200' x 390' =	78,000 SF	TOP OF DIKE

10 YR, 24 HR STORM :	6.25"	RUNOFF (CN=69)	2.91"	*
25 YR, 24 HR STORM :	7.25"	RUNOFF (CN=69)	3.73"	*

* FROM FIG 8.03j, 8.03k T. 8.03c (by double interpolation)

→ $V_{MAX} \leq 10$ acre ft = 435,600 cf.

$$V_{El.8-18} = \frac{10}{3}\left(46,200 + 78,000 + \sqrt{(46,200)(78,000)}\right) = 614,100\ cf = 14.1\ ac\text{-}ft$$

$V_{El.8-18} > V_{MAX}$, therefore reduce V to V_{MAX}

MINIMUM AREA OF BASIN AT PRINCIPAL SPILLWAY

$A_P \geq Q(0.01)$ TO MAXIMIZE TRAPPING EFFICIENCY

$A_P \geq (123\ cfs)(0.01) \cong 1.23$ ACRES $= 53,579\ ft^2$

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WEYERHAEUSER - PLYMOUTH	SYK	5/7/99	BMT	7/8/99	05101.01

SIZE PRINCIPAL SPILLWAY

$Q_{P_{MIN}} = (0.2\ CFS/AC)(\text{TOTAL AREA OF DRAINAGE BASIN})$
$Q_{P_{MIN}} = (0.2\ CFS/AC)(33.09\ AC$
$Q_{P_{MIN}} = 6.62\ CFS$

IF: $H_{MIN} = 4\ ft$
$D = 24\ IN$ (CMP - BARREL)
$L = 100\ ft$
THEN: $Q_{MIN} = (22.06\ CFS)(0.89) = 19.6\ CFS$ (T. 8.07 A).
$d_{RISER} = 30\ IN$ (CMP - PERFORATED

MINIMUM HEAD REQUIRED

$Q = 22\ CFS$
$d_{RISER} = 30\ IN$
T. 8.07b
$\Big\}\ h_{MIN} = 0.9\ ft$

HT OF RISER (Z): $Z = 2D = (2)(2\ ft) = 4\ ft$

HT. OF EMERGENCY SPILLWAY: $(h + Z) = 0.9' + 4' = 4.9'$ MIN

TOP OF DIKE: $(2' + Z + h) = 2' + 4' + 0.9' = 6.9'$ MIN

EMERGENCY SPILLWAY DESIGN

$Q_P = f\ (H = 8',\ D = 2',\ L = 100'$ + T. 8.07A, CMP$) = (31.19_{CFS})(0.89)$
$Q_P = 27.8\ CFS.$

$Q_{ES} = Q_{P_{25/24}} - Q_P = 123\ CFS - 27.8\ CFS = 95.2\ CFS.$

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WEYERHAUSER - PLYMOUTH	JYK	5/7/99	BMK	7/2/99	05101.01

(E.S. DESIGN) -

DIMENSIONS FROM T. 8.07 C & Q_E = 100 CFS

STAGE = 1.13 FT

BOTTOM WIDTH = 36 FT

MAX. SLOPE = 6.1%

MIN SLOPE = 2.8 %

SPECIFY SEDIMENT CLEANOUT LEVEL TO BE MARKED ON [illegible] (ONE-HALF THE DESIGN SEDIMENT STORAGE VOLUME).

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WEYERHAEUSER - PLYMOUTH	SYK	5/12/99	[illegible]	7/6/00	05101.01

NORTH BASIN

POST DEVELOPMENT LAND USE:

- OPEN SPACE, FAIR CONDITIONS GRASS COVER ON 50 TO 75% OF SITE, HYDROLOGIC SOIL GROUP 'B'
  → USE CURVE NO. 69

- PERMANENT SEEDING FROM 0-60 DAYS
  → CONTROL PRACTICE FACTOR = 0.4

DETERMINE POST DEVELOPMENT PEAK FLOWRATES USING SCS METHODOLOGY & SEDNET II MODEL

- CALCULATE TIME OF CONCENTRATION FOR SHEET FLOW (0-60'), CHANNELIZED FLOW ALONG BASE OF TERRACE, & CHANNELIZED FLOW ALONG BASE OF LANDFILL FROM ARTICULATED BLOCK CHANNEL (NORTHWEST) TO THE SEDIMENT BASIN. ASSUME TRAVEL TIME DOWN ARTICULATED BLOCK CHANNEL HAPPENS INSTANTANEOUS (CONSERVATIVE ASSUMPTION) AND IS ZERO.

SHEET FLOW: (0-60')

$$T_{t_{0-60'}} = \frac{0.007(nL)^{0.8}}{\sqrt{P_2'} \cdot S^{0.4}} = \frac{(0.007)(0.15(60))^{0.8}}{\sqrt{4'} \cdot (0.333)^{0.4}}$$

$$T_{t_{0-60'}} = 0.032 \text{ hrs}$$

where:

P_2 = 2 yr, 24 hr storm = 4 inches
S = slope = 1ft/3ft = 0.333
n = Manning's roughness coefficient for Sheet Flow
n = 0.15 (short prairie grass)
L = flow length = 60 ft

DESIGN SHEET

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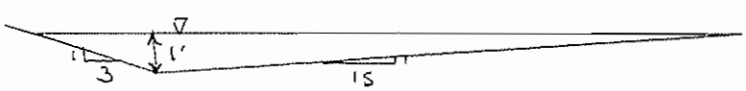
PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER PLYMOUTH	SYK	5/12/99	[illegible]	[illegible]	05101.01

TRAPEZOIDAL CHANNEL FLOW

$$V_{el} = \frac{1.49\, r^{2/3} \cdot S^{1/2}}{n}$$

where: n = Manning Roughness Coeff for Channel Flow
$n = 0.035$ (earth with weeds + stone)
S = Slope = 0.005 ft/ft
r = hydraulic radius = a/p_w
a = cross-sectional flow area, ft^2
p_w = wetted perimeter

CHANNEL ALONG BASE OF TERRACE



$a = (1)(3)(1/2) + (1)(15)(1/2) = 9.0\ ft^2$

$p_w = \left(\sqrt{1^2+3^2} + \sqrt{1^2+15^2}\right) = 18.2\ ft$

$r = a/p_w = 0.495\ ft$

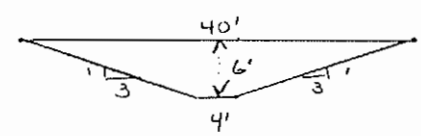
$$V_{el} = \frac{1.49\,(0.495)^{2/3} \cdot (0.005)^{1/2}}{0.035}$$

$V_{el} = 1.88$ ft/sec

$T_t = \left(\frac{DIST}{VEL}\right) / (3600\ sec/HR)$

DIST. VARIES = MAX CHANNEL LENGTH ALONG TERRACE

CHANNEL ALONG BASE OF LANDFILL CAP



$a = \left(\frac{4'+40'}{2}\right)(6') = 132\ ft^2$

$p_w = 2\left(\sqrt{6^2+18^2}\right) + 4 = 41.95\ ft$

$r = a/p_w = \frac{132\ ft^2}{41.95\ ft} = 3.147\ ft$

$$V_{el} = \frac{1.49\,(3.147)^{2/3} \cdot (0.005)^{1/2}}{0.035}$$

$V_{el} = 6.46$ ft/sec

$T_t = \left(\frac{DIST}{VEL}\right) / (3600\ sec/HR)$

DIST = 1680 ft

$T_t = 0.072$ hrs
BASE CHANNEL

DESIGN SHEET

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

PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER - PLYMOUTH	SYK	5/12/99	[illegible]	11/5/99	05101.01

AREA 1 (NORTH BASIN)

WATERSHED #	AREA (AC)	MAX CHANNEL* LENGTH ALONG TERRACE (FT)	T_t TERRACE CHANNEL	T_t BASE CHANNEL	T_t SHEET FLOW	$T_c = \sum T_t$
1	3.19	1475	0.218	—	0.032	0.250
2	4.90	1430	0.211	—	0.032	0.243
3	8.65	1360	0.201	—	0.032	0.233
4	0.52	570	0.084	0.072	0.032	0.188
5	1.50	595	0.088	0.072	0.032	0.192
6	1.86	680	0.100	0.072	0.032	0.204
7	2.07	750	0.111	0.072	0.032	0.215
8	2.33	825	0.122	0.072	0.032	0.226
9	2.15	845	0.125	0.072	0.032	0.229
10	1.88	760	0.112	0.072	0.032	0.216
11	1.62	680	0.100	0.072	0.032	0.204
12	1.31	600	0.089	0.072	0.032	0.193
13*	1.11	515	0.076	0.072	0.108	0.256

33.09 AIRES

$$T_c = T_{t_{SHEET\ FLOW}} + T_{t_{BASE\ CHANNEL}} + T_{t_{TERRACE\ CHANNEL}} + T_{t_{ARTICULATE\ BLOCK\ CHANNEL}}$$

$$T^*_{t_{SHEET\ FLOW}} = 0.032 + \frac{0.007(0.15(70'))^{0.8}}{\sqrt{4}\cdot(0.05)^{0.4}}$$

$$T^*_{t_{SF}} = 0.108\ hrs$$

** Assume $T_{t_{ARTICULATED\ BLOCK\ CHANNEL}}$ equals zero (conservative).

OUTFLOW STRUCTURE EVALUATION

RETENTION POND # 1 (North Area)

Weyerhaeuser No. 3 Landfill Permit Application ***RMT Job No. 5101.01***

Plymouth, North Carolina

POND WIDTH	**120**	(feet)
POND LENGTH	**290**	(feet)
SIDE SLOPE	**3**	(Z:1)
DEPTH INCREMENT	**0.5**	(feet)

Depth (ft.)	Width (ft.)	Length (ft.)	Area (sq. ft.)	Area (acres)	Avg. Area (sq. ft.)	Storage (acre-ft.)
0	120	290	34,800	0.80		0
					35,420	
0.5	123	293	36,039	0.83		0.41
					36,668	
1	126	296	37,296	0.86		0.83
					37,934	
1.5	129	299	38,571	0.89		1.26
					39,218	
2	132	302	39,864	0.92		1.71
					40,520	
2.5	135	305	41,175	0.95		2.18
					41,840	
3	138	308	42,504	0.98		2.66
					43,178	
3.5	141	311	43,851	1.01		3.15
					44,534	
4	144	314	45,216	1.04		3.67
					45,908	
4.5	147	317	46,599	1.07		4.19
					47,300	
5	150	320	48,000	1.10		4.74
					48,710	
5.5	153	323	49,419	1.13		5.29
					50,138	
6	156	326	50,856	1.17		5.87
					51,584	
6.5	159	329	52,311	1.20		6.46
					53,048	
7	162	332	53,784	1.23		7.07
					54,530	
7.5	165	335	55,275	1.27		7.70
					56,030	
8	168	338	56,784	1.30		8.34
					57,548	
8.5	171	341	58,311	1.34		9.00

~(Continued)~OUTFLOW STRUCTURE EVALUATION

RETENTION POND # 1 (North Area)

Weyerhaeuser No. 3 Landfill Permit Application ***RMT Job No. 5101.01***

Plymouth, North Carolina

Depth (ft.)	Width (ft.)	Length (ft.)	Area (sq. ft.)	Area (acres)	Avg. Area (sq. ft.)	Storage (acre-ft.)
					59,084	
9	174	344	59,856	1.37		9.68
					60,638	
9.5	177	347	61,419	1.41		10.37
					62,210	
10	180	350	63,000	1.45		11.09
					63,800	
10.5	183	353	64,599	1.48		11.82
					65,408	
11	186	356	66,216	1.52		12.57
					67,034	
11.5	189	359	67,851	1.56		13.34
					68,678	
12	192	362	69,504	1.60		14.13
					70,340	
12.5	195	365	71,175	1.63		14.94
					72,020	
13	198	368	72,864	1.67		15.76
					73,718	
13.5	201	371	74,571	1.71		16.61
					75,434	
14	204	374	76,296	1.75		17.48
					77,168	
14.5	207	377	78,039	1.79		18.36
					78,920	
15	210	380	79,800	1.83		19.27
					80,690	
15.5	213	383	81,579	1.87		20.19
					82,478	
16	216	386	83,376	1.91		21.14
					84,284	
16.5	219	389	85,191	1.96		22.11
					86,108	
17	222	392	87,024	2.00		23.10
					87,950	
17.5	225	395	88,875	2.04		24.11
					89,810	
18	228	398	90,744	2.08		25.14
					91,688	
18.5	231	401	92,631	2.13		26.19

Weyerhaeuser No. 3 Landfill Permit Application
Plymouth, North Carolina

Detention Pond # *1*
Height of Riser (ft.) *6*
Height of Emergency Spillway (ft.) *8*

RMT Job No. 05101.01

HEAD	ROW																								
ELEV.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	PRIN.	EMER.	TOTAL
0.00	-																						0	0	-
0.50	0.18	-																					0	0	0.18
1.00	0.26	0.18	-																				0	0	0.44
1.50	0.32	0.26	0.18	-																			0	0	0.75
2.00	0.36	0.32	0.26	0.18	-																		0	0	1.12
2.50	0.41	0.36	0.32	0.26	0.18	-																	0	0	1.52
3.00	0.45	0.41	0.36	0.32	0.26	0.18	-																0	0	1.97
3.50	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-															0	0	2.45
4.00	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-														0	0	2.97
4.50	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-													0	0	3.51
5.00	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-												0	0	4.09
5.50	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-											0	0	4.69
6.00	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-										0	0	5.32
6.50	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-									9.2	0	15.18
7.00	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-								24.4	0	31.06
7.50	0.70	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-							29.9	0	37.26
8.00	0.73	0.70	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-						34.5	0	42.59
8.50	0.75	0.73	0.70	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-					38.6	34.65	82.09
9.00	0.77	0.75	0.73	0.70	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-				42.3	112.28	164.19
9.50	0.79	0.77	0.75	0.73	0.70	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-			45.7	225.57	281.67
10.00	0.81	0.79	0.77	0.75	0.73	0.70	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-		48.8	372.83	432.85
10.50	0.83	0.81	0.79	0.77	0.75	0.73	0.70	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-	51.8	553.7	617.55
11.00	0.85	0.83	0.81	0.79	0.77	0.75	0.73	0.70	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	54.6	768.7	*836.20*

TOTAL FLOW RATE PER ROW OF PERFORATED RISER PIPE USING THE ORIFICE EQUATION:

$$Q=n*C_d*A_o*(2*g*y)^{0.5}$$

WHERE:

D =	diameter of riser pipe (inches)	LET: D =	30	$n*C_d*A_o$ = 0.0321
s =	lateral spacing of orifice holes on riser (inches)	s ~	4	$(2*g)^{0.5}$ = 8.025
n =	number of holes per row =(3.14*D/s)+/-1	n =	24	increment= 0.5
d =	diameter of orifice (inches)	d =	0.500	
A_o =	orifice area (sq. ft.) = $(3.14*(d^2/4))/144$	A_o =	0.0014	
g =	32.2 ft/sec^2	g =	32.2	
y =	elevation head (ft)	y =	(see first column in table)	
A_2 =	jet area (sq. ft.)	A_2 =	A_o	
C_v =	0.95 (sqr. edge) to 0.99 (round edge)	C_v =	0.98	
C_c =	A_2/A_o	C_c =	1	
C_d =	discharge coefficient $=C_c*C_v$	C_d =	0.98	

Normal Depth Channel Analysis Program
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WEYERHAEUSER PLYMOUTH NO. 3 LANDFILL

CHANNEL SLOPE = .005 FT/FT
MANNINGS N = .035

TRAPEZOIDAL CHANNEL OUTPUT

BOTTOM WIDTH = 36 FT
LEFT SIDE SLOPE = 4 FT/FT
RIGHT SIDE SLOPE = 4 FT/FT

DEPTH (FT)	FLOW (CFS)	AREA (SQ FT)	WP (FT)	VEL (FT/SEC)	CR. DEP. (FT)
0.50	34.65	19.00	40.12	1.82	0.30
1.00	112.28	40.00	44.25	2.81	0.65
1.50	225.57	63.00	48.37	3.58	1.03
2.00	372.83	88.00	52.49	4.24	1.41
2.50	553.74	115.00	56.62	4.82	1.81
3.00	768.65	144.00	60.74	5.34	2.22
3.50	1018.22	175.00	64.86	5.82	2.63

OUTFLOW RATING TABLE FOR FLOW ABOVE THE RISER FOR DETENTION POND NO. 1

NORTH AREA

Weyerhaeuser No. 3 Landfill Permit Application ***RMT Job No.*** ***5101.01***

Plymouth, North Carolina

RISER DIAMETER.	2.5	FT.
HEIGHT OF RISER	6	FT.
OUTFLOW PIPE DIAMETER.	2	FT.
OUTFLOW PIPE LENGTH.	100	FT.
OUTFLOW PIPE SLOPE.	1	%
MANNING N-VALUE.	0.023	(corrugated metal pipe)
ENTRANCE LOSS COEFFICIENT.	1	
BEND LOSS COEFICIENT.	1	
WEIR COEFICIENT.	3.33	(english units)
ORIFICE COEFFICIENT (Cd)	0.62	(into riser pipe)
TAILWATER DEPTH	2.5	FT.
THICKNESS OF WEIR.	1	FT.

HEAD (FT.)	FLOW (CFS)	CONTROL
0	0	
0.25	3.3	WEIR
0.50	9.2	WEIR
0.75	17.0	WEIR
1.00	24.4	ORIFICE
1.25	27.3	ORIFICE
1.50	29.9	ORIFICE
1.75	32.3	ORIFICE
2.00	34.5	ORIFICE
2.25	36.6	ORIFICE
2.50	38.6	ORIFICE
2.75	40.5	ORIFICE
3.00	42.3	ORIFICE
3.25	44.0	ORIFICE
3.50	45.7	ORIFICE
3.75	47.3	ORIFICE
4.00	48.8	ORIFICE
4.25	50.3	ORIFICE
4.50	51.8	ORIFICE
4.75	53.2	ORIFICE
5.00	54.6	ORIFICE

WEIR FLOW: $Q=C_w*L*H^{1.5}$ ORIFICE FLOW: $Q=C_d*A_o*(2*g*H)^{0.5}$

where: Cw = weir coefficient =3.33 (english units) Cd = C_c* C_v (or see attached sheet)

L = weir length or perimeter of riser (ft.) Ao = orifice area (sq.ft.)

H = head (feet) g = 32.2 ft/s^2

Cc = A_2/A_o (or see attached sheet) *Cv = 0.99 (rounded) to 0.95 (square) orifice*

```
*****************************************************************************
*          (program name)                * SEDIMOT S/N  :                    *
*                                        * HMVersion    :  3.20              *
*       (program description)            * Date         :  5/25/99           *
*                                        * Time         : 15:54:18           *
*                                        * Input file   : WPN1D.INP          *
*                                        * Output file  : WPN1D.OUT          *
*                                        *                                   *
*                                        *                                   *
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 xxxxx   xxxxxxx  xxxxxx   xxxxx  x     x   xxxxx   xxxxxxx
x     x  x        x     x    x    xx   xx  x     x     x
x        x        x     x    x    x x x x  x     x     x
 xxxxx   xxxxx    x     x    x    x  x  x  x     x     x
      x  x        x     x    x    x     x  x     x     x
x     x  x        x     x    x    x     x  x     x     x
 xxxxx   xxxxxxx  xxxxxx   xxxxx  x     x   xxxxx      x
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:::                                      :::
:::  Full Microcomputer Implementation   :::
:::                 by                   :::
:::        Haestad Methods, Inc.         :::
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*************************************************************
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        UNIVERSITY OF KENTUCKY COMPUTER MODEL
        OF SURFACE MINE HYDROLOGY AND SEDIMENTOLOGY
        FOR MORE INFORMATION CONTACT THE AGRICULTURAL
        ENGINEERING DEPARTMENT

        THE UK MODEL IS A DESIGN MODEL DEVELOPED TO PREDICT
        THE HYDRAULIC AND SEDIMENT RESPONSE FROM SURFACE
        MINED LANDS FOR A SPECIFIED RAINFALL EVENT (SINGLE STORM)

        VERSION DATE 5-25-83

        DISCLAIMER: NEITHER THE UNIVERSITY NOR ANY OF ITS EMPLOYEES
        ACCEPT ANY RESPONSIBILITY OR LEGAL LIABILITY FOR THE
        CONCLUSIONS DRAWN FROM THE RESULTS OF THIS MODEL


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            *********************************************
                 WATERSHED IDENTIFICATION CODE
                 -----------------------------
                 WEYERHAEUSER PLYMOUTH/NORTH AREA/290'X 120'X 6'/2YR-24HR STO
            *********************************************


============================  STORM  INPUT  ============================

QUESTION
   NO.

    1. STORM TYPE -                                          SCS'S TYPE 2
    2. RAINFALL DEPTH -                                        4.00 INCHES
    3. STORM DURATION -                                       24.00 HOURS
    4. TIME INCREMENT -                                         .10 HOURS

=====================================================================


============================  WATERSHED DATA  ==========================

QUESTION
   NO.
    1. NUMBER OF JUNCTIONS - 1
    2. JUNCTION     NUMBER OF BRANCHES
```

```
          1                 1
    3. COMPUTATION - BOTH HYDROLOGY AND SEDIMENTOLOGY

==========================================================================



========================  SEDIMENTOLOGY INPUTS  =======================

QUESTION
   NO.
    1. SPECIFIC GRAVITY -                                          2.64
    2. COEFFICIENT FOR DISTRIBUTING SEDIMENT LOAD -                2.00
    3. SUBMERGED BULK SPECIFIC GRAVITY -                           1.35
    4. NUMBER OF PARTICLE SIZE DISTRIBUTIONS -                     1
    5. NUMBER OF DATA VALUES PER PARTICLE SIZE DISTRIBUTION -     11

==========================================================================



================= INPUT PARTICLE SIZE DISTRIBUTIONS ====================

                        VALUE
                         NO.        SIZE, MM

                          1           1.0000
                          2            .5000
                          3            .2000
                          4            .1000
                          5            .0800
                          6            .0500
                          7            .0100
                          8            .0090
                          9            .0050
                         10            .0020
                         11            .0001

==========================================================================



====================  PERCENT FINER DISTRIBUTIONS  =====================

VALUE                       PARTICLE SIZE #
 NO.
            1
  1    100.00
  2     99.90
  3     87.50
  4     50.50
  5     44.50
  6     36.50
  7     32.00
  8     31.00
  9     29.00
 10     24.50
 11       .00

==========================================================================
```

========== STRUCTURE INPUT FOR JUNCTION #1 ==========

BRANCH	NUMBER OF STRUCTURES
1	1

==========

========== BETWEEN STRUCTURE ROUTING PARAMETERS ==========

BRANCH NO.	BETWEEN	PARAMETERS 1 TIME	2 MUSK. K	3 MUSK. X,
1	PRIOR J OR S TO STRUCTURE 1	.00	.00	.00

==========

========== STRUCTURE DATA FOR JUNCTION #1 ==========

QUESTION NO.		
1.	NUMBER OF SUBWATERSHEDS -	13
2.	TYPE OF SEDIMENT CONTROL STRUCTURE -	POND

==========

* *
JUNCTION 1, BRANCH 1, STRUCTURE 1
* *

*** HYDRAULIC INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	AREA ACRES	CURVE NUMBER	TC HR	TT HR	ROUTING COEFFICIENTS K-HRS	X,	UNIT HYDRO
1	3.19	69.00	.250	.000	.000	.00	2.0
2	4.90	69.00	.243	.000	.000	.00	2.0
3	8.65	69.00	.233	.000	.000	.00	2.0
4	.52	69.00	.188	.000	.000	.00	2.0
5	1.50	69.00	.192	.000	.000	.00	2.0
6	1.86	69.00	.204	.000	.000	.00	2.0
7	2.07	69.00	.215	.000	.000	.00	2.0
8	2.33	69.00	.226	.000	.000	.00	2.0
9	2.15	69.00	.229	.000	.000	.00	2.0
10	1.88	69.00	.216	.000	.000	.00	2.0
11	1.62	69.00	.204	.000	.000	.00	2.0
12	1.31	69.00	.193	.000	.000	.00	2.0
13	1.11	69.00	.256	.000	.000	.00	2.0

*** SEDIMENT INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	SEG NUM	SOIL K	LENGTH FEET	SLOPE PCT	CP VALUE	PART OPT	SURF COND
1	1	.20	60.0	33.30	.400	1.0	.0
2	1	.20	60.0	33.30	.400	1.0	.0
3	1	.40	60.0	33.30	.400	1.0	.0
4	1	.20	60.0	33.30	.400	1.0	.0
5	1	.20	60.0	33.30	.400	1.0	.0
6	1	.20	60.0	33.30	.400	1.0	.0
7	1	.20	60.0	33.30	.400	1.0	.0
8	1	.20	60.0	33.30	.400	1.0	.0
9	1	.20	60.0	33.30	.400	1.0	.0
10	1	.20	60.0	33.30	.400	1.0	.0
11	1	.20	60.0	33.30	.400	1.0	.0
12	1	.20	60.0	33.30	.400	1.0	.0
13	1	.20	60.0	33.30	.400	1.0	.0

* * * COMPUTED VALUES FOR INDIVIDUAL WATERSHEDS * * *

WATERSHED	PEAK FLOW (CFS)	RUNOFF (INCHES)	SEDIMENT TONS	DIAM (MM)	DELIVERY RATIO 1	DELIVERY RATIO 2
1	2.91	1.27	58.94	.057	.775	1.000
2	4.53	1.27	95.96	.058	.781	1.000
3	8.14	1.27	366.20	.059	.788	1.000
4	.53	1.27	8.22	.066	.824	1.000
5	1.52	1.27	26.79	.065	.820	1.000
6	1.83	1.27	33.61	.063	.809	1.000
7	2.01	1.27	37.52	.062	.801	1.000
8	2.22	1.27	42.41	.060	.793	1.000
9	2.04	1.27	38.65	.060	.791	1.000
10	1.82	1.27	33.65	.061	.800	1.000
11	1.60	1.27	28.79	.063	.809	1.000
12	1.32	1.27	22.99	.065	.819	1.000
13	1.00	1.27	17.96	.056	.771	1.000

***** SUMMARY TABLE FOR TOTAL WATERSHED *****

STORM DURATION	=	24.00	HOURS
PRECIPITATION DEPTH	=	4.00	INCHES
RUNOFF VOLUME	=	3.4927	ACRE-FT
PEAK DISCHARGE	=	31.4647	CFS
AREA	=	33.0900	ACRES
TIME OF PEAK DISCHARGE	=	12.10	HRS
LOAD RATE EXPONENT FACTOR	=	2.00	
BETA	=	1.0000	
SUBMERGE BULK SPECIFIC GRAVITY	=	1.35	
RAINFALL EROSITIVITY FACTOR	=	98.49	EI UNIT
PEAK CONCENTRATION	=	398557.60	MG/L
PEAK SETTLEABLE CONCENTRATION	=	174.0493	ML/L
PEAK SETTLEABLE CONCENTRATION	=	234966.50	MG/L
TOTAL SEDIMENT YIELD	=	811.6982	TONS
REPRESENTATIVE PARTICLE SIZE	=	.0598	MM

TIME OF PEAK CONCENTRATION	=	12.10	HRS
PERIOD OF SIGNIFICANT CONCENTRATION	=	14.10	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	66.39	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	66.39	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	18.69	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	10.98	ML/L

========== POND INPUT ==========

QUESTION NO.		
1.	TIME INCREMENT OF THE ROUTED HYDROGRAPH -	.10 HOURS
2.	NON-IDEAL SETTLING CORRECTION FACTOR -	1.00
3.	PERCENT OF PERMANENT POOL THAT IS DEAD SPACE -	35.00
4.	OUTFLOW WITHDRAWAL OPTION -	SURFACE
5.	INFLOW VERTICAL CONCENTRATION -	COMP. MIXED
6.	NUMBER OF STAGE POINTS -	13
7.	NUMBER OF ROUTED HYDROGRAPH POINTS -	500
8.	STAGE-DISCHARGE OPTION -	INPUT
9.	OUTPUT OPTION -	SUM. TABLES
10.	NUMBER OF CONTINUOUS STIRRED REACTORS	3

==========

========== POND STAGE DATA ==========

STAGE POINT	VALUE
1	.00
2	3.50
3	4.00
4	4.50
5	5.00
6	5.50
7	6.00
8	6.50
9	7.00
10	7.50
11	8.00
12	8.50
13	9.00

==========

========== POND AREA DATA ==========

AREA POINT	VALUE

1	.80
2	1.01
3	1.04
4	1.07
5	1.10
6	1.13
7	1.17
8	1.20
9	1.23
10	1.27
11	1.30
12	1.34
13	1.37

==========

========== POND DISCHARGE DATA ==========

DISCHARGE POINT	VALUE
1	.00
2	.00
3	2.97
4	3.51
5	4.09
6	4.69
7	5.32
8	15.18
9	31.06
10	37.26
11	42.59
12	82.09
13	164.10

==========

* *

POND RESULTS

* *

***** BASIN GEOMETRY *****

STAGE (FT)	AREA (ACRES)	AVERAGE DEPTH (FT)	DISCHARGE (CFS)	CAPACITY (ACRES-FT)

.00	.800	.00	.00	.00
3.50	1.010	3.30	.00	3.17
4.00	1.040	3.77	2.97	3.68
4.50	1.070	4.23	3.51	4.21
5.00	1.100	4.69	4.09	4.75
5.50	1.130	5.15	4.69	5.31
6.00	1.170	5.59	5.32	5.88
6.50	1.200	6.04	15.18	6.47
7.00	1.230	6.47	31.06	7.08
7.50	1.270	6.91	37.26	7.71
8.00	1.300	7.34	42.59	8.35
8.50	1.340	7.76	82.09	9.01
9.00	1.370	8.19	164.10	9.69

***** STORM EVENT SUMMARY *****

TURBULENCE FACTOR	=	1.00	
PERMANENT POOL CAPACITY	=	3.168	ACRE-FT
DEAD STORAGE	=	35.00	PERCENT
TIME INCREMENT OUTFLOW	=	.10	HRS
VISCOSITY	=	.009	CM**2/SEC
INFLOW RUNOFF VOLUME	=	3.493	ACRE-FT
OUTFLOW ROUTED VOLUME	=	3.493	ACRE-FT
STORM VOLUME DISCHARGED	=	3.493	ACRE-FT
POND VOLUME AT PEAK STAGE	=	4.713	ACRE-FT
PEAK STAGE	=	4.966	FT
PEAK INFLOW RATE	=	31.465	CFS
PEAK DISCHARGE RATE	=	4.050	CFS
PEAK INFLOW SEDIMENT CONCENTRATION	=	398557.60	MG/L
PEAK EFFLUENT SEDIMENT CONCENTRATION	=	48199.90	MG/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	.0001	ML/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	.07	MG/L
STORM AVERAGE EFFLUENT CONCENTRATION	=	39767.48	MG/L
AVERAGE EFFLUENT SEDIMENT CONCENTRATION	=	39767.48	MG/L
BASIN TRAP EFFICIENCY	=	76.64	PERCENT
DETENTION TIME OF FLOW WITH SEDIMENT	=	3.36	HRS
DETENTION TIME FROM HYDROGRAPH CENTERS	=	3.36	HRS
DETENTION TIME INCLUDING STORED FLOW	=	3.36	HRS
SEDIMENT LOAD DISCHARGED	=	189.61	TONS
PERIOD OF SIGNIFICANT CONCENTRATION	=	28.30	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L

```
*****************************************************************************
*          (program name)                * SEDIMOT S/N  :                    *
*                                        * HMVersion    :  3.20              *
*       (program description)            * Date         :  5/17/99           *
*                                        * Time         : 11:38:39           *
*                                        * Input file   : WPN1A.INP          *
*                                        * Output file  : WPN1A.OUT          *
*                                        *                                   *
*                                        *                                   *
*****************************************************************************
```

```
 XXXXX   XXXXXXX  XXXXXX   XXXXX  X     X   XXXXX   XXXXXXX
X     X  X        X     X    X    XX   XX  X     X     X
X        X        X     X    X    X X X X  X     X     X
 XXXXX   XXXXX    X     X    X    X  X  X  X     X     X
      X  X        X     X    X    X     X  X     X     X
X     X  X        X     X    X    X     X  X     X     X
 XXXXX   XXXXXXX  XXXXXX   XXXXX  X     X   XXXXX      X
```

```
::::::::::::::::::::::::::::::::::::::::::::
::::::::::::::::::::::::::::::::::::::::::::
:::                                      :::
:::  Full Microcomputer Implementation   :::
:::                 by                   :::
:::        Haestad Methods, Inc.         :::
:::                                      :::
::::::::::::::::::::::::::::::::::::::::::::
::::::::::::::::::::::::::::::::::::::::::::
```

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```
*************************************************************
*************************************************************

        UNIVERSITY OF KENTUCKY COMPUTER MODEL
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        VERSION DATE 5-25-83

        DISCLAIMER: NEITHER THE UNIVERSITY NOR ANY OF ITS EMPLOYEES
        ACCEPT ANY RESPONSIBILITY OR LEGAL LIABILITY FOR THE
        CONCLUSIONS DRAWN FROM THE RESULTS OF THIS MODEL


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


            *********************************************
                 WATERSHED IDENTIFICATION CODE
                 -----------------------------
                 WEYERHAEUSER PLYMOUTH/NORTH AREA/290'X 120'X 6'/10YR-24HR ST
            *********************************************


============================  STORM  INPUT  ============================

QUESTION
   NO.

    1. STORM TYPE -                                          SCS'S TYPE 2
    2. RAINFALL DEPTH -                                        6.25 INCHES
    3. STORM DURATION -                                       24.00 HOURS
    4. TIME INCREMENT -                                         .10 HOURS

=====================================================================


===========================  WATERSHED DATA  ==========================

QUESTION
   NO.
    1. NUMBER OF JUNCTIONS - 1
    2. JUNCTION     NUMBER OF BRANCHES
```

```
          1                 1
   3. COMPUTATION - BOTH HYDROLOGY AND SEDIMENTOLOGY

=====================================================================


=======================  SEDIMENTOLOGY INPUTS  =======================

QUESTION
   NO.
    1. SPECIFIC GRAVITY -                                          2.64
    2. COEFFICIENT FOR DISTRIBUTING SEDIMENT LOAD -                2.00
    3. SUBMERGED BULK SPECIFIC GRAVITY -                           1.35
    4. NUMBER OF PARTICLE SIZE DISTRIBUTIONS -                     1
    5. NUMBER OF DATA VALUES PER PARTICLE SIZE DISTRIBUTION -     11

=====================================================================


================= INPUT PARTICLE SIZE DISTRIBUTIONS ===================

                        VALUE
                         NO.        SIZE, MM

                          1           1.0000
                          2            .5000
                          3            .2000
                          4            .1000
                          5            .0800
                          6            .0500
                          7            .0100
                          8            .0090
                          9            .0050
                         10            .0020
                         11            .0001

=====================================================================


===================  PERCENT FINER DISTRIBUTIONS  ====================

VALUE                        PARTICLE SIZE #
 NO.
          1
  1    100.00
  2     99.90
  3     87.50
  4     50.50
  5     44.50
  6     36.50
  7     32.00
  8     31.00
  9     29.00
 10     24.50
 11       .00

=====================================================================
```

========== STRUCTURE INPUT FOR JUNCTION #1 ==========

BRANCH	NUMBER OF STRUCTURES
1	1

==========

========== BETWEEN STRUCTURE ROUTING PARAMETERS ==========

BRANCH NO.	BETWEEN	PARAMETERS 1 TIME	2 MUSK. K	3 MUSK. X,
1	PRIOR J OR S TO STRUCTURE 1	.00	.00	.00

==========

========== STRUCTURE DATA FOR JUNCTION #1 ==========

QUESTION NO.		
1.	NUMBER OF SUBWATERSHEDS -	13
2.	TYPE OF SEDIMENT CONTROL STRUCTURE -	POND

==========

* *
JUNCTION 1, BRANCH 1, STRUCTURE 1
* *

*** HYDRAULIC INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	AREA ACRES	CURVE NUMBER	TC HR	TT HR	ROUTING COEFFICIENTS K-HRS	X,	UNIT HYDRO
1	3.19	69.00	.250	.000	.000	.00	2.0
2	4.90	69.00	.243	.000	.000	.00	2.0
3	8.65	69.00	.233	.000	.000	.00	2.0
4	.52	69.00	.188	.000	.000	.00	2.0
5	1.50	69.00	.192	.000	.000	.00	2.0
6	1.86	69.00	.204	.000	.000	.00	2.0
7	2.07	69.00	.215	.000	.000	.00	2.0
8	2.33	69.00	.226	.000	.000	.00	2.0
9	2.15	69.00	.229	.000	.000	.00	2.0
10	1.88	69.00	.216	.000	.000	.00	2.0
11	1.62	69.00	.204	.000	.000	.00	2.0
12	1.31	69.00	.193	.000	.000	.00	2.0
13	1.11	69.00	.256	.000	.000	.00	2.0

*** SEDIMENT INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	SEG NUM	SOIL K	LENGTH FEET	SLOPE PCT	CP VALUE	PART OPT	SURF COND
1	1	.20	60.0	33.30	.400	1.0	.0
2	1	.20	60.0	33.30	.400	1.0	.0
3	1	.40	60.0	33.30	.400	1.0	.0
4	1	.20	60.0	33.30	.400	1.0	.0
5	1	.20	60.0	33.30	.400	1.0	.0
6	1	.20	60.0	33.30	.400	1.0	.0
7	1	.20	60.0	33.30	.400	1.0	.0
8	1	.20	60.0	33.30	.400	1.0	.0
9	1	.20	60.0	33.30	.400	1.0	.0
10	1	.20	60.0	33.30	.400	1.0	.0
11	1	.20	60.0	33.30	.400	1.0	.0
12	1	.20	60.0	33.30	.400	1.0	.0
13	1	.20	60.0	33.30	.400	1.0	.0

* * * COMPUTED VALUES FOR INDIVIDUAL WATERSHEDS * * *

WATERSHED	PEAK FLOW (CFS)	RUNOFF (INCHES)	SEDIMENT TONS	DIAM (MM)	DELIVERY RATIO 1	DELIVERY RATIO 2
1	7.00	2.91	153.33	.065	.821	1.000
2	10.86	2.91	249.36	.066	.825	1.000
3	19.43	2.91	949.81	.067	.832	1.000
4	1.25	2.91	21.15	.074	.863	1.000
5	3.57	2.91	68.95	.073	.859	1.000
6	4.33	2.91	86.59	.071	.848	1.000
7	4.76	2.91	96.93	.069	.842	1.000
8	5.28	2.91	109.85	.068	.836	1.000
9	4.86	2.91	100.17	.068	.834	1.000
10	4.31	2.91	86.96	.069	.842	1.000
11	3.77	2.91	74.18	.071	.848	1.000
12	3.11	2.91	59.18	.073	.858	1.000
13	2.41	2.91	46.78	.064	.817	1.000

***** SUMMARY TABLE FOR TOTAL WATERSHED *****

STORM DURATION	=	24.00	HOURS
PRECIPITATION DEPTH	=	6.25	INCHES
RUNOFF VOLUME	=	8.0219	ACRE-FT
PEAK DISCHARGE	=	74.9375	CFS
AREA	=	33.0900	ACRES
TIME OF PEAK DISCHARGE	=	12.10	HRS
LOAD RATE EXPONENT FACTOR	=	2.00	
BETA	=	1.0000	
SUBMERGE BULK SPECIFIC GRAVITY	=	1.35	
RAINFALL EROSITIVITY FACTOR	=	260.30	EI UNIT
PEAK CONCENTRATION	=	417561.80	MG/L
PEAK SETTLEABLE CONCENTRATION	=	188.8485	ML/L
PEAK SETTLEABLE CONCENTRATION	=	254945.40	MG/L
TOTAL SEDIMENT YIELD	=	2103.2350	TONS
REPRESENTATIVE PARTICLE SIZE	=	.0679	MM

TIME OF PEAK CONCENTRATION	=	12.10	HRS
PERIOD OF SIGNIFICANT CONCENTRATION	=	15.90	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	76.60	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	76.60	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	17.40	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	11.52	ML/L

========== POND INPUT ==========

QUESTION NO.		
1.	TIME INCREMENT OF THE ROUTED HYDROGRAPH -	.10 HOURS
2.	NON-IDEAL SETTLING CORRECTION FACTOR -	1.00
3.	PERCENT OF PERMANENT POOL THAT IS DEAD SPACE -	35.00
4.	OUTFLOW WITHDRAWAL OPTION -	SURFACE
5.	INFLOW VERTICAL CONCENTRATION -	COMP. MIXED
6.	NUMBER OF STAGE POINTS -	13
7.	NUMBER OF ROUTED HYDROGRAPH POINTS -	500
8.	STAGE-DISCHARGE OPTION -	INPUT
9.	OUTPUT OPTION -	SUM. TABLES
10.	NUMBER OF CONTINUOUS STIRRED REACTORS	3

==========

========== POND STAGE DATA ==========

STAGE POINT	VALUE
1	.00
2	3.50
3	4.00
4	4.50
5	5.00
6	5.50
7	6.00
8	6.50
9	7.00
10	7.50
11	8.00
12	8.50
13	9.00

==========

========== POND AREA DATA ==========

AREA POINT	VALUE

1	.80
2	1.01
3	1.04
4	1.07
5	1.10
6	1.13
7	1.17
8	1.20
9	1.23
10	1.27
11	1.30
12	1.34
13	1.37

==========

========== POND DISCHARGE DATA ==========

DISCHARGE POINT	VALUE
1	.00
2	.00
3	2.97
4	3.51
5	4.09
6	4.69
7	5.32
8	15.18
9	31.06
10	37.26
11	42.59
12	82.09
13	164.10

==========

* *

POND RESULTS

* *

***** BASIN GEOMETRY *****

STAGE (FT)	AREA (ACRES)	AVERAGE DEPTH (FT)	DISCHARGE (CFS)	CAPACITY (ACRES-FT)

.00	.800	.00	.00	.00
3.50	1.010	3.30	.00	3.17
4.00	1.040	3.77	2.97	3.68
4.50	1.070	4.23	3.51	4.21
5.00	1.100	4.69	4.09	4.75
5.50	1.130	5.15	4.69	5.31
6.00	1.170	5.59	5.32	5.88
6.50	1.200	6.04	15.18	6.47
7.00	1.230	6.47	31.06	7.08
7.50	1.270	6.91	37.26	7.71
8.00	1.300	7.34	42.59	8.35
8.50	1.340	7.76	82.09	9.01
9.00	1.370	8.19	164.10	9.69

***** STORM EVENT SUMMARY *****

TURBULENCE FACTOR	=	1.00	
PERMANENT POOL CAPACITY	=	3.168	ACRE-FT
DEAD STORAGE	=	35.00	PERCENT
TIME INCREMENT OUTFLOW	=	.10	HRS
VISCOSITY	=	.009	CM**2/SEC
INFLOW RUNOFF VOLUME	=	8.022	ACRE-FT
OUTFLOW ROUTED VOLUME	=	8.022	ACRE-FT
STORM VOLUME DISCHARGED	=	8.022	ACRE-FT
POND VOLUME AT PEAK STAGE	=	6.680	ACRE-FT
PEAK STAGE	=	6.668	FT
PEAK INFLOW RATE	=	74.937	CFS
PEAK DISCHARGE RATE	=	20.529	CFS
PEAK INFLOW SEDIMENT CONCENTRATION	=	417561.80	MG/L
PEAK EFFLUENT SEDIMENT CONCENTRATION	=	77211.64	MG/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	.0007	ML/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	.96	MG/L
STORM AVERAGE EFFLUENT CONCENTRATION	=	60364.82	MG/L
AVERAGE EFFLUENT SEDIMENT CONCENTRATION	=	60364.82	MG/L
BASIN TRAP EFFICIENCY	=	68.54	PERCENT
DETENTION TIME OF FLOW WITH SEDIMENT	=	4.05	HRS
DETENTION TIME FROM HYDROGRAPH CENTERS	=	4.05	HRS
DETENTION TIME INCLUDING STORED FLOW	=	4.05	HRS
SEDIMENT LOAD DISCHARGED	=	661.65	TONS
PERIOD OF SIGNIFICANT CONCENTRATION	=	34.10	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L

*** RUN COMPLETED ****

```
*****************************************************************************
*          (program name)                * SEDIMOT S/N  :                    *
*                                        * HMVersion    :  3.20              *
*       (program description)            * Date         :  5/17/99           *
*                                        * Time         : 11:40:52           *
*                                        * Input file   : WPN1B.INP          *
*                                        * Output file  : WPN1B.OUT          *
*                                        *                                   *
*                                        *                                   *
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 xxxxx   xxxxxxx  xxxxxx   xxxxx  x     x   xxxxx   xxxxxxx
x     x  x        x     x    x    xx   xx  x     x     x
x        x        x     x    x    x x x x  x     x     x
 xxxxx   xxxxx    x     x    x    x  x  x  x     x     x
      x  x        x     x    x    x     x  x     x     x
x     x  x        x     x    x    x     x  x     x     x
 xxxxx   xxxxxxx  xxxxxx   xxxxx  x     x   xxxxx      x
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:::                                      :::
:::  Full Microcomputer Implementation   :::
:::                 by                   :::
:::        Haestad Methods, Inc.         :::
:::                                      :::
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```

37 Brookside Road * Waterbury, Connecticut 06708 * (203) 755-1666

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*************************************************************
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        VERSION DATE 5-25-83

        DISCLAIMER: NEITHER THE UNIVERSITY NOR ANY OF ITS EMPLOYEES
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*************************************************************
*************************************************************


            ********************************************
                 WATERSHED IDENTIFICATION CODE
                 -----------------------------
                 WEYERHAEUSER PLYMOUTH/NORTH AREA/290'X 120'X 6'/25YR-24HR ST
            ********************************************


============================  STORM  INPUT  ============================

QUESTION
   NO.

    1. STORM TYPE -                                          SCS'S TYPE 2
    2. RAINFALL DEPTH -                                        7.25 INCHES
    3. STORM DURATION -                                       24.00 HOURS
    4. TIME INCREMENT -                                         .10 HOURS

=====================================================================


==========================  WATERSHED DATA  ==========================

QUESTION
   NO.
    1. NUMBER OF JUNCTIONS - 1
    2. JUNCTION     NUMBER OF BRANCHES
```

```
          1                 1
    3. COMPUTATION - BOTH HYDROLOGY AND SEDIMENTOLOGY

=====================================================================


======================  SEDIMENTOLOGY INPUTS  =======================

QUESTION
   NO.
    1. SPECIFIC GRAVITY -                                          2.64
    2. COEFFICIENT FOR DISTRIBUTING SEDIMENT LOAD -                2.00
    3. SUBMERGED BULK SPECIFIC GRAVITY -                           1.35
    4. NUMBER OF PARTICLE SIZE DISTRIBUTIONS -                     1
    5. NUMBER OF DATA VALUES PER PARTICLE SIZE DISTRIBUTION -     11

=====================================================================


================ INPUT PARTICLE SIZE DISTRIBUTIONS ==================

                        VALUE
                         NO.       SIZE, MM

                          1          1.0000
                          2           .5000
                          3           .2000
                          4           .1000
                          5           .0800
                          6           .0500
                          7           .0100
                          8           .0090
                          9           .0050
                         10           .0020
                         11           .0001

=====================================================================


==================  PERCENT FINER DISTRIBUTIONS  ====================

VALUE                      PARTICLE SIZE #
 NO.
          1
  1    100.00
  2     99.90
  3     87.50
  4     50.50
  5     44.50
  6     36.50
  7     32.00
  8     31.00
  9     29.00
 10     24.50
 11       .00

=====================================================================
```

========== STRUCTURE INPUT FOR JUNCTION #1 ==========

BRANCH	NUMBER OF STRUCTURES
1	1

==========

========== BETWEEN STRUCTURE ROUTING PARAMETERS ==========

BRANCH NO.	BETWEEN	PARAMETERS 1 TIME	2 MUSK. K	3 MUSK. X,
1	PRIOR J OR S TO STRUCTURE 1	.00	.00	.00

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========== STRUCTURE DATA FOR JUNCTION #1 ==========

QUESTION NO.		
1.	NUMBER OF SUBWATERSHEDS -	13
2.	TYPE OF SEDIMENT CONTROL STRUCTURE -	POND

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* *
JUNCTION 1, BRANCH 1, STRUCTURE 1
* *

*** HYDRAULIC INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	AREA ACRES	CURVE NUMBER	TC HR	TT HR	ROUTING COEFFICIENTS K-HRS	X,	UNIT HYDRO
1	3.19	69.00	.250	.000	.000	.00	2.0
2	4.90	69.00	.243	.000	.000	.00	2.0
3	8.65	69.00	.233	.000	.000	.00	2.0
4	.52	69.00	.188	.000	.000	.00	2.0
5	1.50	69.00	.192	.000	.000	.00	2.0
6	1.86	69.00	.204	.000	.000	.00	2.0
7	2.07	69.00	.215	.000	.000	.00	2.0
8	2.33	69.00	.226	.000	.000	.00	2.0
9	2.15	69.00	.229	.000	.000	.00	2.0
10	1.88	69.00	.216	.000	.000	.00	2.0
11	1.62	69.00	.204	.000	.000	.00	2.0
12	1.31	69.00	.193	.000	.000	.00	2.0
13	1.11	69.00	.256	.000	.000	.00	2.0

*** SEDIMENT INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	SEG NUM	SOIL K	LENGTH FEET	SLOPE PCT	CP VALUE	PART OPT	SURF COND
1	1	.20	60.0	33.30	.400	1.0	.0
2	1	.20	60.0	33.30	.400	1.0	.0
3	1	.40	60.0	33.30	.400	1.0	.0
4	1	.20	60.0	33.30	.400	1.0	.0
5	1	.20	60.0	33.30	.400	1.0	.0
6	1	.20	60.0	33.30	.400	1.0	.0
7	1	.20	60.0	33.30	.400	1.0	.0
8	1	.20	60.0	33.30	.400	1.0	.0
9	1	.20	60.0	33.30	.400	1.0	.0
10	1	.20	60.0	33.30	.400	1.0	.0
11	1	.20	60.0	33.30	.400	1.0	.0
12	1	.20	60.0	33.30	.400	1.0	.0
13	1	.20	60.0	33.30	.400	1.0	.0

* * * COMPUTED VALUES FOR INDIVIDUAL WATERSHEDS * * *

WATERSHED	PEAK FLOW (CFS)	RUNOFF (INCHES)	SEDIMENT TONS	DIAM (MM)	DELIVERY RATIO 1	DELIVERY RATIO 2
1	8.99	3.72	202.44	.068	.832	1.000
2	13.94	3.72	329.20	.068	.837	1.000
3	24.95	3.72	1253.79	.070	.843	1.000
4	1.59	3.72	27.83	.076	.872	1.000
5	4.56	3.72	90.73	.075	.868	1.000
6	5.55	3.72	114.27	.073	.860	1.000
7	6.10	3.72	127.93	.072	.854	1.000
8	6.78	3.72	145.00	.071	.847	1.000
9	6.23	3.72	132.23	.070	.846	1.000
10	5.54	3.72	114.78	.072	.853	1.000
11	4.84	3.72	97.89	.073	.860	1.000
12	3.97	3.72	77.88	.075	.867	1.000
13	3.10	3.72	61.76	.067	.828	1.000

***** SUMMARY TABLE FOR TOTAL WATERSHED *****

STORM DURATION	=	24.00	HOURS
PRECIPITATION DEPTH	=	7.25	INCHES
RUNOFF VOLUME	=	10.2580	ACRE-FT
PEAK DISCHARGE	=	94.9414	CFS
AREA	=	33.0900	ACRES
TIME OF PEAK DISCHARGE	=	12.10	HRS
LOAD RATE EXPONENT FACTOR	=	2.00	
BETA	=	1.0000	
SUBMERGE BULK SPECIFIC GRAVITY	=	1.35	
RAINFALL EROSITIVITY FACTOR	=	359.62	EI UNIT
PEAK CONCENTRATION	=	423574.00	MG/L
PEAK SETTLEABLE CONCENTRATION	=	193.2118	ML/L
PEAK SETTLEABLE CONCENTRATION	=	260835.90	MG/L
TOTAL SEDIMENT YIELD	=	2775.7090	TONS
REPRESENTATIVE PARTICLE SIZE	=	.0702	MM

TIME OF PEAK CONCENTRATION	=	12.10	HRS
PERIOD OF SIGNIFICANT CONCENTRATION	=	16.70	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	79.45	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	79.45	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	17.05	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	11.87	ML/L

========== POND INPUT ==========

QUESTION NO.		
1.	TIME INCREMENT OF THE ROUTED HYDROGRAPH -	.10 HOURS
2.	NON-IDEAL SETTLING CORRECTION FACTOR -	1.00
3.	PERCENT OF PERMANENT POOL THAT IS DEAD SPACE -	35.00
4.	OUTFLOW WITHDRAWAL OPTION -	SURFACE
5.	INFLOW VERTICAL CONCENTRATION -	COMP. MIXED
6.	NUMBER OF STAGE POINTS -	13
7.	NUMBER OF ROUTED HYDROGRAPH POINTS -	500
8.	STAGE-DISCHARGE OPTION -	INPUT
9.	OUTPUT OPTION -	SUM. TABLES
10.	NUMBER OF CONTINUOUS STIRRED REACTORS	3

==========

========== POND STAGE DATA ==========

STAGE POINT	VALUE
1	.00
2	3.50
3	4.00
4	4.50
5	5.00
6	5.50
7	6.00
8	6.50
9	7.00
10	7.50
11	8.00
12	8.50
13	9.00

==========

========== POND AREA DATA ==========

AREA POINT	VALUE

1	.80
2	1.01
3	1.04
4	1.07
5	1.10
6	1.13
7	1.17
8	1.20
9	1.23
10	1.27
11	1.30
12	1.34
13	1.37

==========

========== POND DISCHARGE DATA ==========

DISCHARGE POINT	VALUE
1	.00
2	.00
3	2.97
4	3.51
5	4.09
6	4.69
7	5.32
8	15.18
9	31.06
10	37.26
11	42.59
12	82.09
13	164.10

==========

* *

POND RESULTS

* *

***** BASIN GEOMETRY *****

STAGE (FT)	AREA (ACRES)	AVERAGE DEPTH (FT)	DISCHARGE (CFS)	CAPACITY (ACRES-FT)

.00	.800	.00	.00	.00
3.50	1.010	3.30	.00	3.17
4.00	1.040	3.77	2.97	3.68
4.50	1.070	4.23	3.51	4.21
5.00	1.100	4.69	4.09	4.75
5.50	1.130	5.15	4.69	5.31
6.00	1.170	5.59	5.32	5.88
6.50	1.200	6.04	15.18	6.47
7.00	1.230	6.47	31.06	7.08
7.50	1.270	6.91	37.26	7.71
8.00	1.300	7.34	42.59	8.35
8.50	1.340	7.76	82.09	9.01
9.00	1.370	8.19	164.10	9.69

***** STORM EVENT SUMMARY *****

TURBULENCE FACTOR	=	1.00	
PERMANENT POOL CAPACITY	=	3.168	ACRE-FT
DEAD STORAGE	=	35.00	PERCENT
TIME INCREMENT OUTFLOW	=	.10	HRS
VISCOSITY	=	.009	CM**2/SEC
INFLOW RUNOFF VOLUME	=	10.258	ACRE-FT
OUTFLOW ROUTED VOLUME	=	10.258	ACRE-FT
STORM VOLUME DISCHARGED	=	10.258	ACRE-FT
POND VOLUME AT PEAK STAGE	=	7.252	ACRE-FT
PEAK STAGE	=	7.136	FT
PEAK INFLOW RATE	=	94.941	CFS
PEAK DISCHARGE RATE	=	32.746	CFS
PEAK INFLOW SEDIMENT CONCENTRATION	=	423574.00	MG/L
PEAK EFFLUENT SEDIMENT CONCENTRATION	=	89965.98	MG/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	.0059	ML/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	7.94	MG/L
STORM AVERAGE EFFLUENT CONCENTRATION	=	65774.48	MG/L
AVERAGE EFFLUENT SEDIMENT CONCENTRATION	=	65774.48	MG/L
BASIN TRAP EFFICIENCY	=	66.78	PERCENT
DETENTION TIME OF FLOW WITH SEDIMENT	=	3.58	HRS
DETENTION TIME FROM HYDROGRAPH CENTERS	=	3.58	HRS
DETENTION TIME INCLUDING STORED FLOW	=	3.58	HRS
SEDIMENT LOAD DISCHARGED	=	922.07	TONS
PERIOD OF SIGNIFICANT CONCENTRATION	=	35.60	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L

```
*****************************************************************************
*          (program name)                * SEDIMOT S/N  :                    *
*                                        * HMVersion    :  3.20              *
*       (program description)            * Date         :  5/17/99           *
*                                        * Time         : 11:43:04           *
*                                        * Input file   : WPN1C.INP          *
*                                        * Output file  : WPN1C.OUT          *
*                                        *                                   *
*                                        *                                   *
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```

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 XXXXX   XXXXXXX  XXXXXX   XXXXX  X     X   XXXXX   XXXXXXX
X     X  X        X     X    X    XX   XX  X     X     X
X        X        X     X    X    X X X X  X     X     X
 XXXXX   XXXXX    X     X    X    X  X  X  X     X     X
      X  X        X     X    X    X     X  X     X     X
X     X  X        X     X    X    X     X  X     X     X
 XXXXX   XXXXXXX  XXXXXX   XXXXX  X     X   XXXXX      X
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:::                                      :::
:::  Full Microcomputer Implementation   :::
:::                 by                   :::
:::        Haestad Methods, Inc.         :::
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37 Brookside Road * Waterbury, Connecticut 06708 * (203) 755-1666

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       UNIVERSITY OF KENTUCKY COMPUTER MODEL
       OF SURFACE MINE HYDROLOGY AND SEDIMENTOLOGY
       FOR MORE INFORMATION CONTACT THE AGRICULTURAL
       ENGINEERING DEPARTMENT

       THE UK MODEL IS A DESIGN MODEL DEVELOPED TO PREDICT
       THE HYDRAULIC AND SEDIMENT RESPONSE FROM SURFACE
       MINED LANDS FOR A SPECIFIED RAINFALL EVENT (SINGLE STORM)

       VERSION DATE 5-25-83

       DISCLAIMER: NEITHER THE UNIVERSITY NOR ANY OF ITS EMPLOYEES
       ACCEPT ANY RESPONSIBILITY OR LEGAL LIABILITY FOR THE
       CONCLUSIONS DRAWN FROM THE RESULTS OF THIS MODEL


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            ********************************************
                 WATERSHED IDENTIFICATION CODE
                 -----------------------------
                 WEYERHAEUSER PLYMOUTH/NORTH AREA/290'X 120'X 6'/100YR-24HR S
            ********************************************


============================  STORM  INPUT  ============================

QUESTION
   NO.

    1. STORM TYPE -                                          SCS'S TYPE 2
    2. RAINFALL DEPTH -                                        9.00 INCHES
    3. STORM DURATION -                                       24.00 HOURS
    4. TIME INCREMENT -                                         .10 HOURS

=====================================================================


==========================  WATERSHED DATA  ==========================

QUESTION
   NO.
    1. NUMBER OF JUNCTIONS - 1
    2. JUNCTION     NUMBER OF BRANCHES
```

```
            1                 1
    3. COMPUTATION - BOTH HYDROLOGY AND SEDIMENTOLOGY

==========================================================================


========================  SEDIMENTOLOGY INPUTS  ========================

QUESTION
   NO.
    1. SPECIFIC GRAVITY -                                            2.64
    2. COEFFICIENT FOR DISTRIBUTING SEDIMENT LOAD -                  2.00
    3. SUBMERGED BULK SPECIFIC GRAVITY -                             1.35
    4. NUMBER OF PARTICLE SIZE DISTRIBUTIONS -                       1
    5. NUMBER OF DATA VALUES PER PARTICLE SIZE DISTRIBUTION -       11

==========================================================================


================= INPUT PARTICLE SIZE DISTRIBUTIONS ====================

                        VALUE
                         NO.        SIZE, MM

                          1           1.0000
                          2            .5000
                          3            .2000
                          4            .1000
                          5            .0800
                          6            .0500
                          7            .0100
                          8            .0090
                          9            .0050
                         10            .0020
                         11            .0001

==========================================================================


===================  PERCENT FINER DISTRIBUTIONS  =====================

VALUE                       PARTICLE SIZE #
 NO.
            1
  1    100.00
  2     99.90
  3     87.50
  4     50.50
  5     44.50
  6     36.50
  7     32.00
  8     31.00
  9     29.00
 10     24.50
 11       .00

==========================================================================
```

========== STRUCTURE INPUT FOR JUNCTION #1 ==========

BRANCH	NUMBER OF STRUCTURES
1	1

==========

========== BETWEEN STRUCTURE ROUTING PARAMETERS ==========

BRANCH NO.	BETWEEN	PARAMETERS 1 TIME	2 MUSK. K	3 MUSK. X,
1	PRIOR J OR S TO STRUCTURE 1	.00	.00	.00

==========

========== STRUCTURE DATA FOR JUNCTION #1 ==========

QUESTION NO.		
1.	NUMBER OF SUBWATERSHEDS -	13
2.	TYPE OF SEDIMENT CONTROL STRUCTURE -	POND

==========

* *
JUNCTION 1, BRANCH 1, STRUCTURE 1
* *

*** HYDRAULIC INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	AREA ACRES	CURVE NUMBER	TC HR	TT HR	ROUTING COEFFICIENTS K-HRS	X,	UNIT HYDRO
1	3.19	69.00	.250	.000	.000	.00	2.0
2	4.90	69.00	.243	.000	.000	.00	2.0
3	8.65	69.00	.233	.000	.000	.00	2.0
4	.52	69.00	.188	.000	.000	.00	2.0
5	1.50	69.00	.192	.000	.000	.00	2.0
6	1.86	69.00	.204	.000	.000	.00	2.0
7	2.07	69.00	.215	.000	.000	.00	2.0
8	2.33	69.00	.226	.000	.000	.00	2.0
9	2.15	69.00	.229	.000	.000	.00	2.0
10	1.88	69.00	.216	.000	.000	.00	2.0
11	1.62	69.00	.204	.000	.000	.00	2.0
12	1.31	69.00	.193	.000	.000	.00	2.0
13	1.11	69.00	.256	.000	.000	.00	2.0

*** SEDIMENT INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	SEG NUM	SOIL K	LENGTH FEET	SLOPE PCT	CP VALUE	PART OPT	SURF COND
1	1	.20	60.0	33.30	.400	1.0	.0
2	1	.20	60.0	33.30	.400	1.0	.0
3	1	.40	60.0	33.30	.400	1.0	.0
4	1	.20	60.0	33.30	.400	1.0	.0
5	1	.20	60.0	33.30	.400	1.0	.0
6	1	.20	60.0	33.30	.400	1.0	.0
7	1	.20	60.0	33.30	.400	1.0	.0
8	1	.20	60.0	33.30	.400	1.0	.0
9	1	.20	60.0	33.30	.400	1.0	.0
10	1	.20	60.0	33.30	.400	1.0	.0
11	1	.20	60.0	33.30	.400	1.0	.0
12	1	.20	60.0	33.30	.400	1.0	.0
13	1	.20	60.0	33.30	.400	1.0	.0

* * * COMPUTED VALUES FOR INDIVIDUAL WATERSHEDS * * *

WATERSHED	PEAK FLOW (CFS)	RUNOFF (INCHES)	SEDIMENT TONS	DIAM (MM)	DELIVERY RATIO 1	DELIVERY RATIO 2
1	12.59	5.21	295.30	.070	.847	1.000
2	19.53	5.21	480.18	.071	.851	1.000
3	34.94	5.21	1828.67	.073	.858	1.000
4	2.23	5.21	40.51	.079	.886	1.000
5	6.38	5.21	132.25	.078	.883	1.000
6	7.77	5.21	166.60	.076	.874	1.000
7	8.54	5.21	186.55	.075	.868	1.000
8	9.50	5.21	211.46	.074	.862	1.000
9	8.73	5.21	192.85	.073	.860	1.000
10	7.75	5.21	167.38	.075	.867	1.000
11	6.77	5.21	142.72	.076	.874	1.000
12	5.56	5.21	113.53	.078	.882	1.000
13	4.34	5.21	90.09	.070	.842	1.000

***** SUMMARY TABLE FOR TOTAL WATERSHED *****

STORM DURATION	=	24.00	HOURS
PRECIPITATION DEPTH	=	9.00	INCHES
RUNOFF VOLUME	=	14.3704	ACRE-FT
PEAK DISCHARGE	=	132.0035	CFS
AREA	=	33.0900	ACRES
TIME OF PEAK DISCHARGE	=	12.10	HRS
LOAD RATE EXPONENT FACTOR	=	2.00	
BETA	=	1.0000	
SUBMERGE BULK SPECIFIC GRAVITY	=	1.35	
RAINFALL EROSITIVITY FACTOR	=	575.89	EI UNIT
PEAK CONCENTRATION	=	434191.70	MG/L
PEAK SETTLEABLE CONCENTRATION	=	200.1067	ML/L
PEAK SETTLEABLE CONCENTRATION	=	270144.00	MG/L
TOTAL SEDIMENT YIELD	=	4048.0960	TONS
REPRESENTATIVE PARTICLE SIZE	=	.0732	MM

TIME OF PEAK CONCENTRATION	=	12.10	HRS
PERIOD OF SIGNIFICANT CONCENTRATION	=	17.80	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	83.15	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	83.15	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	16.68	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	12.37	ML/L

========== POND INPUT ==========

QUESTION NO.		
1.	TIME INCREMENT OF THE ROUTED HYDROGRAPH -	.10 HOURS
2.	NON-IDEAL SETTLING CORRECTION FACTOR -	1.00
3.	PERCENT OF PERMANENT POOL THAT IS DEAD SPACE -	35.00
4.	OUTFLOW WITHDRAWAL OPTION -	SURFACE
5.	INFLOW VERTICAL CONCENTRATION -	COMP. MIXED
6.	NUMBER OF STAGE POINTS -	13
7.	NUMBER OF ROUTED HYDROGRAPH POINTS -	500
8.	STAGE-DISCHARGE OPTION -	INPUT
9.	OUTPUT OPTION -	SUM. TABLES
10.	NUMBER OF CONTINUOUS STIRRED REACTORS	3

==========

========== POND STAGE DATA ==========

STAGE POINT	VALUE
1	.00
2	3.50
3	4.00
4	4.50
5	5.00
6	5.50
7	6.00
8	6.50
9	7.00
10	7.50
11	8.00
12	8.50
13	9.00

==========

========== POND AREA DATA ==========

AREA POINT	VALUE

1	.80
2	1.01
3	1.04
4	1.07
5	1.10
6	1.13
7	1.17
8	1.20
9	1.23
10	1.27
11	1.30
12	1.34
13	1.37

==========

========== POND DISCHARGE DATA ==========

DISCHARGE POINT	VALUE
1	.00
2	.00
3	2.97
4	3.51
5	4.09
6	4.69
7	5.32
8	15.18
9	31.06
10	37.26
11	42.59
12	82.09
13	164.10

==========

* *

POND RESULTS

* *

***** BASIN GEOMETRY *****

STAGE (FT)	AREA (ACRES)	AVERAGE DEPTH (FT)	DISCHARGE (CFS)	CAPACITY (ACRES-FT)

.00	.800	.00	.00	.00
3.50	1.010	3.30	.00	3.17
4.00	1.040	3.77	2.97	3.68
4.50	1.070	4.23	3.51	4.21
5.00	1.100	4.69	4.09	4.75
5.50	1.130	5.15	4.69	5.31
6.00	1.170	5.59	5.32	5.88
6.50	1.200	6.04	15.18	6.47
7.00	1.230	6.47	31.06	7.08
7.50	1.270	6.91	37.26	7.71
8.00	1.300	7.34	42.59	8.35
8.50	1.340	7.76	82.09	9.01
9.00	1.370	8.19	164.10	9.69

***** STORM EVENT SUMMARY *****

TURBULENCE FACTOR	=	1.00	
PERMANENT POOL CAPACITY	=	3.168	ACRE-FT
DEAD STORAGE	=	35.00	PERCENT
TIME INCREMENT OUTFLOW	=	.10	HRS
VISCOSITY	=	.009	CM**2/SEC
INFLOW RUNOFF VOLUME	=	14.370	ACRE-FT
OUTFLOW ROUTED VOLUME	=	14.370	ACRE-FT
STORM VOLUME DISCHARGED	=	14.370	ACRE-FT
POND VOLUME AT PEAK STAGE	=	8.547	ACRE-FT
PEAK STAGE	=	8.149	FT
PEAK INFLOW RATE	=	132.003	CFS
PEAK DISCHARGE RATE	=	54.369	CFS
PEAK INFLOW SEDIMENT CONCENTRATION	=	434191.70	MG/L
PEAK EFFLUENT SEDIMENT CONCENTRATION	=	103556.70	MG/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	.0268	ML/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	36.21	MG/L
STORM AVERAGE EFFLUENT CONCENTRATION	=	71573.78	MG/L
AVERAGE EFFLUENT SEDIMENT CONCENTRATION	=	71573.78	MG/L
BASIN TRAP EFFICIENCY	=	65.28	PERCENT
DETENTION TIME OF FLOW WITH SEDIMENT	=	3.08	HRS
DETENTION TIME FROM HYDROGRAPH CENTERS	=	3.08	HRS
DETENTION TIME INCLUDING STORED FLOW	=	3.08	HRS
SEDIMENT LOAD DISCHARGED	=	1405.65	TONS
PERIOD OF SIGNIFICANT CONCENTRATION	=	37.90	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.02	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.02	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.01	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.01	ML/L

DESIGN SHEET

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

PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER - PLYMOUTH	JYK	6/17/99	[illegible]	7/6/99	05101.01

SUMMARY OF NORTH AREA SEDIMENT BASIN DESIGN

BASIN DIMENSIONS: BASE AREA → 120' x 290'
SIDE SLOPES → 3H : 1V

PRINCIPAL SPILLWAY: 30" CMP RISER DIAM.
24" CMP BARREL DIAM.
0.5" DIAMETER PERFORATIONS
→ 4" O.C HORIZONTALLY
→ 6" O.C VERTICALLY
6 FEET FROM POND BOTTOM TO TOP OF RISER
100 FEET LONG
1% SLOPE

EMERGENCY SPILLWAY: BASE WIDTH → 36 FEET
SIDE SLOPES: 4H:1V
8 FEET FROM POND BOTTOM TO BASE OF EMERGENCY SPILLWAY
2-FOOT DEEP

	POST-DEVELOPMENT		PRE-DEVELOPMENT		
$Q_{POND,10y}$	= 20.5	CFS	< 40.7	CFS	✓
$Q_{POND,25y}$	= 32.7	CFS	< 53.2	CFS	✓
$Q_{POND,100y}$	= 54.3	CFS	< 76.2	CFS	✓

TE_{2YR} = 76.6% > 70% ✓ (≥70% FOR HIGH QUALITY WATERS FOR 2YR EVENT)
TE_{10YR} = 68.5% > 60% ✓
TE_{25YR} = 66.8% > 60% ✓
TE_{100YR} = 65.2% > 60% ✓

Attachment L4
Post Development Stormwater Design Calculations – East Area

DESIGN SHEET

SHEET 1 OF 0

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PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER - PLYMOUTH	SVK	5/17/99	[illegible]	7/12/99	05101.01

POST DEVELOPMENT STORM WATER ANALYSIS

DETERMINE: PEAK RUNOFF RATE FOR AREA 2 / EAST BASIN USING SCS METHOD & 25 YR - 24 HR STORM ($Q_{p_{25,24}}$)

GIVEN:

LOCATION - PLYMOUTH, NC
HYDROLOGIC SOIL GROUP (HSG) = B
TOTAL AREA OF WATERSHED - 30.80 AC
MAXIMUM HYDRAULIC LENGTH - 2160 ft
MAXIMUM SLOPE: (3:1, H:V) ≈ 33.3%
DESIGN EVENT: 25 YR - 24 HR STORM = 7.25 INCHES
% HYDRALIC LENGTH MODIFIED = 0 %.
% IMPERVIOUS AREA = 0 %

DETERMINE: CN = 69 FOR FAIR CONDITIONS GRASS COVER ON 50-75% OF THE AREA & HSG = B. [T. 8.03 b]. ASSUME CAPPING & VEGETATION PROGRESS WITH LANDFILL CONSTRUCTION

RUNOFF DEPTH = 3.73" FROM TABLE 8.03C FOR 7.25" EVENT & CN=69, BY DOUBLE INTERPOLATION

25yr-TOTAL RUNOFF VOL = (3.73")(1/12')(30.8 AC)
= 9.57 ac-ft

EQUIVALENT DRAINAGE AREA, a = f(HYDRAULIC LENGTH, L=2220)

$a = (L/209)^{(1/0.6)}$
$a = (2160/209)^{(1/0.6)}$
$a = 49.0$ ac

DESIGN SHEET

SHEET 2 OF

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WEYERHAEUSER PLYMOUTH	SYK	5/17/99	[illegible]	[illegible]	05101.01

EAST BASIN

DETERMINE: PEAK RATE OF DISCHARGE, USING THE MAXIMUM WATERSHED SLOPE OF 33.3% AS THE AVERAGE WATERSHED SLOPE (CONSERVATIVE), F. 8.03q, CN=69, a: 49.0 acres.

PEAK RATE OF DISCHARGE ≈ 48.0 CFS/IN OF RUNOFF

PEAK DISCHARGE FOR EQUIVALENT WATERSHED $Q_1 = (48 \text{ CFS/IN})(3.73 \text{ IN}) = 179$ CFS.

PEAK DISCHARGE, $Q_2 = (179 \text{ CFS})\left(\frac{30.80 \text{ AC}}{49.00 \text{ AC}}\right) = 113$ CFS

ADJUST Q_2 FOR SLOPE (33.3%) FROM T. 8.03 d & DOUBLE INTERPOLATION

$Q_3 = (113 \text{ CFS})(1.15)$

$Q_3 = 130$ CFS

$Q_{P_{25,24}} = 130$ CFS

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PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER - PLYMOUTH	SYK	5/17/99	[illegible]	7/3/99	

SEDIMENT BASIN DESIGN - EAST BASIN

GIVEN: DRAINAGE BASIN TOTAL AREA = 30.8 AC
$Q_{25,24}$ = 130 CFS
BOTTOM OF BASIN EL ≥ 2' + EL. HIGH GWT.
TOP OF DIKE WIDTH = 8' TO 10'
SIDE SLOPES 3:1 (H:V)
POND LENGTH TO WIDTH RATIO ~ 2:1 OR GREATER

DETERMINE BASIN VOLUME

MIN VOLUME = (1800 ft³/acre)(30.8 acres) = 55,440 ft³.
= 1.27 acre-ft.

RECOMMENDED AREA OF BASIN AT PRINCIPLE SPILLWAY EL.

$A_p \geq Q(0.01) = (130\text{ cfs})(0.01) = 1.30\text{ acres} = 56{,}628\text{ ft}^2$

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PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER - PLYMOUTH	SJK	5/24/99	FLK	7/12/99	05101.01

EAST BASIN

RECOMMENDED AREA @ PRINCIPAL SPILLWAY IS
56,628 SF ≈ 1.3 ACRES

SIDE SLOPES 3:1 (H:V)
TOP OF DIKE EL 38 (MAX)
BOTTOM OF POND EL 28 TO 27

IF TOP OF DIKE = EL 36
BOTTOM OF POND = EL 28
EMERGENCY SPILLWAY (ES) = EL 34
PRINCIPAL SPILLWAY (PS) = EL 32
POND L:W RATIO @ P.S. ~ 2:1 OR GREATER.

RECTANGULAR BASIN - SIZE

$W_P = \sqrt{56628/2} = 168$ ft
$L_P = 2W_P = 337$ ft

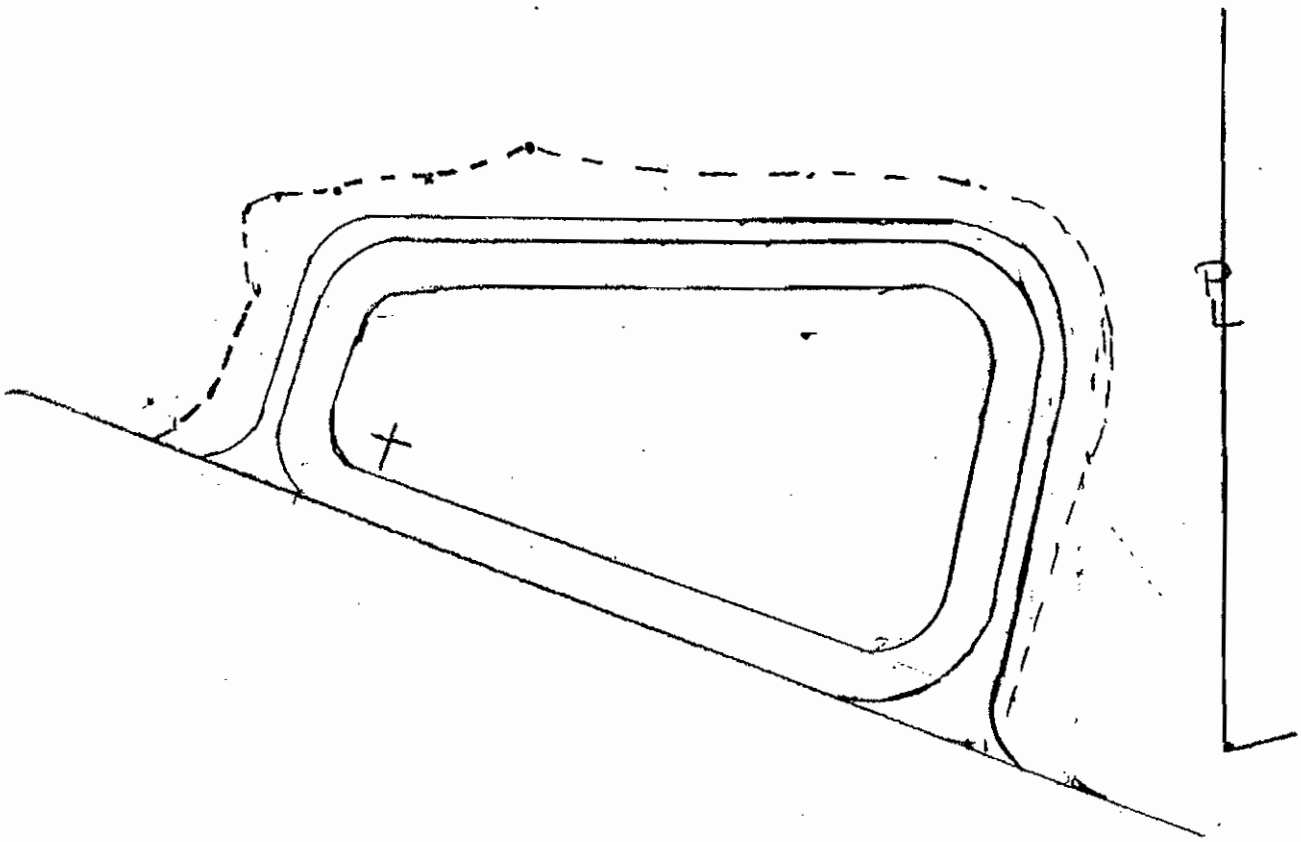
$W_B = 168 - (2 \cdot 3 \cdot (32'-28')) = 144'$
$L_B = 337 - (2 \cdot 3 \cdot (32'-28')) = 313'$

HOWEVER AREA WILL ONLY ACCOMODATE RECTANGULAR BASIN OF ABOUT 350' X 90', THEREFORE TRY A NON-RECTANGULAR SHAPED BASIN TO MAXIMIZE POND SIZE IN LIMITED IRREGULAR SHAPE AREA. (SEE ATTACHED SKETCH AND AREA/VOLUME CALCULATIONS

AT TOP OF PRINCIPAL SPILLWAY RISER AT 4 FT, THE BASIN AREA IS 1.35 ACRES WHICH IS GREATER THAN THE RECOMMENDED 1.3 ACRES. THE TOTAL VOLUME AT 6 FT IS 7.66 AC-FT WHICH IS LESS THAN 10 ACRE-FT (MAXIMUM).

EAST BASIN

5/26/99



EL 28 ~ 1.07 acres
El 36. ~ 1.62 acres.

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PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYER-FENSER - [illegible]	SJK	[illegible]	[illegible]	7/8/99	05101.01

EAST BASIN

LET BOTTOM OF POND = 0' (EL. 28)
TOP OF RISER = 4' (EL. 32)
EMERGENCY SPILLWAY = 6' (EL. 34)
TOP OF DIKE = 8' (EL. 36)

SIZE PRINCIPAL SPILLWAY, $Q_{P_{MIN}} = (0.2\,CFS/AC)(30.8\,AC)$
$Q_{P_{MIN}} = 6.2\,CFS$

LET PRINCIPAL SPILLWAY RISER DIAMETER = 30" = d
THEN PRINCIPAL SPILLWAY BARREL DIAMETER = 24" = D

HT OF RISER ≈ 2D = (2)(2') = 4 ft (MIN)

IF H_{MIN} = 4 FT & L = 70 FT FOR 24" CMP
PERFORATED RISER, THEN Q = 22 CFS (T.8.07A)

MIN. HEAD(h) REQUIRED FOR Q = 22 CFS, d = 30 IN
→ 0.63 ft (FIG. 8.07.B)

MIN. HT. OF EMERGENCY SPILLWAY = 0.63 FT + 4 FT
= 4.63 FT.

EMERGENCY SPILLWAY

$Q_P = f(H = 6', D = 2', L = 70', + T.8.07A, CMP)$
$Q_P = 27.0\,CFS$

$Q_{ES} = Q_{o_{25/24}} - Q_o = 130\,CFS - 27\,CFS = 103\,CFS$

FROM T.8.07C & Q = 120 CFS, USE BTM WIDTH = 36' SLOPES 27% TO 4.8%, 4H:1V SIDE SLOPES

DESIGN SHEET

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PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER - PLYMOUTH	SYK	3/12/99	EAT	1/9/99	05101.01

POST DEVELOPMENT LAND USE:

- OPEN SPACE, FAIR CONDITIONS GRASS COVER ON 50 TO 75% OF SITE, HYDROLOGIC SOIL GROUP "B"
  ↳ USE CURVE NO. 69

- PERMANENT SEEDINGS FROM 0-60 DAYS
  ↳ CONTROL PRACTICE FACTOR = 0.4

DETERMINE POST DEVELOPMENT PEAK FLOWRATES USING SCS METHODOLOGY & SEDIMOT II MODEL

- CALCULATE TIME OF CONCENTRATION FOR SHEET FLOW (0-60'), CHANNELIZED FLOW (ALONG BASE OF TERRACE, & CHANNELIZED FLOW ALONG BASE OF LANDFILL FROM ARTICULATED BLOCK CHANNEL (NORTHWEST) TO THE SEDIMENT BASIN. ASSUME TRAVEL TIME DOWN ARTICULATED BLOCK CHANNEL HAPPENS INSTANTANEOUS (CONSERVATIVE ASSUMPTION) AND IS ZERO.

SHEET FLOW: (0-60')

$$T_{t_{0-60'}} = \frac{0.007(nL)^{0.8}}{\sqrt{P_2} \cdot S^{0.4}} = \frac{(0.007)(0.15(60))^{0.8}}{\sqrt{4} \cdot (0.333)^{0.4}}$$

$$T_{t_{0-60'}} = 0.032 \text{ hrs}$$

where:
P_2 = 2 yr, 24 hr storm = 4 inches
S = slope = 1ft/3ft = 0.333
n = Manning's Roughness Coefficient for Sheet Flow
n = 0.15 (short prairie grass)
L = flow length = 60 ft

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PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER PLYMOUTH	SYK	5/12/99	BWT	7/6/99	05101.01

TRAPEZOIDAL CHANNEL FLOW

$$V_{el} = \frac{1.49\, r^{2/3} \cdot S^{1/2}}{n}$$

where: n = Manning Roughness Coeff for Channel Flow

$n = 0.035$ (earth with weeds + stone)

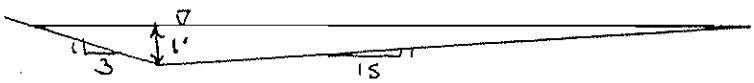
S = slope = 0.005 ft/ft

r = hydraulic radius = a/p_w

a = cross-sectional flow area, ft^2

p_w = wetted perimeter

CHANNEL ALONG BASE OF TERRACE



$a = (1)(3)(1/2) + (1)(15)(1/2) = 9.0\ ft^2$

$p_w = \left(\sqrt{1^2+3^2} + \sqrt{1^2+15^2}\right) = 18.2\ ft$

$r = a/p_w = 0.495\ ft$

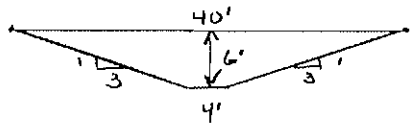
$$V_{el} = \frac{1.49\,(0.495)^{2/3} \cdot (0.005)^{1/2}}{0.035}$$

$V_{el} = 1.88\ ft/sec$

$T_t = \left(\frac{DIST}{VEL}\right) / (3600\ sec/HR)$

DIST. VARIES = MAX CHANNEL LENGTH ALONG TERRACE

CHANNEL ALONG BASE OF LANDFILL CAP



$a = \left(\frac{4'+40'}{2}\right)(6') = 132\ ft^2$

$p_w = 2\left(\sqrt{6^2+18^2}\right) + 4 = 41.95\ ft$

$r = a/p_w = \frac{132\ ft^2}{41.95\ ft} = 3.147\ ft$

$$V_{el} = \frac{1.49\,(3.147)^{2/3} \cdot (0.005)^{1/2}}{0.035}$$

$V_{el} = 6.46\ ft/sec$

$T_t = \left(\frac{DIST}{VEL}\right) / (3600\ sec/HR)$

DIST = 1680 ft

$T_t = 0.072\ hrs$

BASE CHANNEL

DESIGN SHEET

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PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER	JJK	5/20/99	[illegible]	7/26/99	05101.01

AREA 2 (EAST BASIN)

WATERSHED #	AREA (AC)	MAX CHANNEL LENGTH ALONG TERRACE (FT)	$T_{t_{TERRACE\ CHANNEL}}$	$T_{t_{BASE\ CHANNEL}}$	$T_{SHEET\ FLOW}$	$T_c = \sum_1^1 T_T$
1	5.03	2100	0.310	—	0.032	0.342
2	4.64	1850	0.273	—	0.032	0.305
3	4.44	1740	0.257	—	0.032	0.289
4	3.58	1585	0.234	—	0.032	0.266
5	3.16	1420	0.210	—	0.032	0.242
6	2.74	1245	0.184	—	0.032	0.216
7	2.63	1110	0.164	—	0.032	0.196
8	1.47	635	0.094	—	0.032	0.126
9	3.11	470	0.069	—	0.187	0.256
	30.80					

$$T_c \doteq T_{t_{SHEET\ FLOW}} + T_{t_{BASE\ CHANNEL}} + T_{t_{TERRACE\ CHANNEL}} + T_{t_{ARTICULATE\ BLOCK\ CHANNEL}}$$

$$T_{t_{TC}} = \left(\frac{DIST}{1.88 ft/s}\right) / (3600\ sec/hr)$$

* Assume $T_{t_{BASE\ CHANNEL}}$ equals zero (conservative).

** Assume $T_{t_{ART\ BLOCK\ CHANNEL}}$ equals zero (conservative).

$$T^*_{t_{SF}} = 0.032 + \frac{0.007\,(0.15(170'))^{0.8}}{\sqrt{4}\cdot(0.05)^{0.4}}$$

$$T^*_{t_{SF}} = 0.187$$

AREA/VOLUME CALCULATIONS FOR A NON-RECTANGULAR SHAPED BASIN

OUTFLOW STRUCTURE EVALUATION

RETENTION POND # 3 (East Area)

Weyerhaeuser No. 3 Landfill Permit Application ***RMT Job No. 5101.01***

Plymouth, North Carolina

DEPTH INCREMENT **0.5** (feet)

Depth (ft.)	Area (acres)	Avg. Area (sq. ft.)	Storage (acre-ft.)
0	1.07		0
		1.09	
0.5	1.10		0.54
		1.12	
1	1.14		1.10
		1.16	
1.5	1.17		1.68
		1.19	
2	1.21		2.28
		1.22	
2.5	1.24		2.89
		1.26	
3	1.28		3.52
		1.29	
3.5	1.31		4.17
		1.33	
4	1.35		4.83
		1.36	
4.5	1.38		5.51
		1.40	
5	1.41		6.21
		1.43	
5.5	1.45		6.92
		1.47	
6	1.48		7.66
		1.50	
6.5	1.52		8.41
		1.53	
7	1.55		9.17
		1.57	
7.5	1.59		9.96
		1.60	
8	1.62		10.76

Weyerhaeuser No. 3 Landfill Permit Application
Plymouth, North Carolina

Detention Pond # *2*
Height of Riser (ft.) *4*
Height of Emergency Spillway (ft.) *6*

RMT Job No. 05101.01

HEAD	ROW																								
ELEV.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	PRIN.	EMER.	TOTAL
0.00	-																						0	0	-
0.50	0.18	-																					0	0	0.18
1.00	0.26	0.18	-																				0	0	0.44
1.50	0.32	0.26	0.18	-																			0	0	0.75
2.00	0.36	0.32	0.26	0.18	-																		0	0	1.12
2.50	0.41	0.36	0.32	0.26	0.18	-																	0	0	1.52
3.00	0.45	0.41	0.36	0.32	0.26	0.18	-																0	0	1.97
3.50	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-															0	0	2.45
4.00	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-														0	0	2.97
4.50	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-													9.2	0	12.71
5.00	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-												24.4	0	28.49
5.50	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-											29.9	0	34.59
6.00	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-										34.5	0	39.82
6.50	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-									38.6	34.65	79.23
7.00	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-								42.3	112.28	161.24
7.50	0.70	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-							45.7	225.57	278.63
8.00	0.73	0.70	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-						48.8	372.83	429.72
8.50	0.75	0.73	0.70	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-					51.8	553.74	614.38
9.00	0.77	0.75	0.73	0.70	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-				54.6	0	64.21
9.50	0.79	0.77	0.75	0.73	0.70	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-			0	0	10.40
10.00	0.81	0.79	0.77	0.75	0.73	0.70	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-		0	0	11.22
10.50	0.83	0.81	0.79	0.77	0.75	0.73	0.70	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-	0	0	12.05
11.00	0.85	0.83	0.81	0.79	0.77	0.75	0.73	0.70	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	0	0	12.9

TOTAL FLOW RATE PER ROW OF PERFORATED RISER PIPE USING THE ORIFICE EQUATION:

$$Q=n*C_d*A_o*(2*g*y)^{0.5}$$

WHERE:

D =	diameter of riser pipe (inches)	LET: D =	30	$n*C_d*A_o$ =	0.0321
s =	lateral spacing of orifice holes on riser (inches)	s ~	4	$(2*g)^{0.5}$ =	8.025
n =	number of holes per row =(3.14*D/s)+/-1	n =	24	increment=	0.5
d =	diameter of orifice (inches)	d =	0.500		
A_o =	orifice area (sq. ft.) = $(3.14*(d^2/4))/144$	A_o =	0.0014		
g =	32.2 ft/sec^2	g =	32.2		
y =	elevation head (ft)	y =	(see first column in table)		
A_2 =	jet area (sq. ft.)	A_2 =	A_o		
C_v =	0.95 (sqr. edge) to 0.99 (round edge)	C_v =	0.98		
C_c =	A_2/A_o	C_c =	1		
C_d =	discharge coefficient $=C_c*C_v$	C_d =	0.98		

Normal Depth Channel Analysis Program
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WEYERHAEUSER PLYMOUTH\EAST BASIN

CHANNEL SLOPE = .005 FT/FT
MANNINGS N = .035

TRAPEZOIDAL CHANNEL OUTPUT

BOTTOM WIDTH = 36 FT
LEFT SIDE SLOPE = 4 FT/FT
RIGHT SIDE SLOPE = 4 FT/FT

DEPTH (FT)	FLOW (CFS)	AREA (SQ FT)	WP (FT)	VEL (FT/SEC)	CR. DEP. (FT)
0.25	10.81	9.25	38.06	1.17	0.14
0.50	34.65	19.00	40.12	1.82	0.30
0.75	68.79	29.25	42.18	2.35	0.48
1.00	112.28	40.00	44.25	2.81	0.65
1.25	164.62	51.25	46.31	3.21	0.84
1.50	225.57	63.00	48.37	3.58	1.03
1.75	295.00	75.25	50.43	3.92	1.22
2.00	372.83	88.00	52.49	4.24	1.41
2.25	459.07	101.25	54.55	4.53	1.61
2.50	553.74	115.00	56.62	4.82	1.81

OUTFLOW RATING TABLE FOR FLOW ABOVE THE RISER FOR DETENTION POND NO.			2
			EAST AREA
Weyerhaeuser No. 3 Landfill Permit Application		***RMT Job No.***	***5101.01***
Plymouth, North Carolina			
RISER DIAMETER.	***2.5***	FT.	
HEIGHT OF RISER	***4***	FT.	
OUTFLOW PIPE DIAMETER.	***2***	FT.	
OUTFLOW PIPE LENGTH.	***70***	FT.	
OUTFLOW PIPE SLOPE.	***1***	%	
MANNING N-VALUE.	***0.023***	(corrugated metal pipe)	
ENTRANCE LOSS COEFFICIENT.	1		
BEND LOSS COEFICIENT.	1		
WEIR COEFICIENT.	***3.33***	(english units)	
ORIFICE COEFFICIENT (Cd)	***0.62***	(into riser pipe)	
TAILWATER DEPTH	***2.5***	FT.	
THICKNESS OF WEIR.	***1***	FT.	

HEAD (FT.)	FLOW (CFS)	CONTROL
0	**0**	
0.25	3.3	WEIR
0.50	**9.2**	WEIR
0.75	17.0	WEIR
1.00	**24.4**	ORIFICE
1.25	27.3	ORIFICE
1.50	**29.9**	ORIFICE
1.75	32.3	ORIFICE
2.00	**34.5**	ORIFICE
2.25	36.6	ORIFICE
2.50	**38.6**	ORIFICE
2.75	40.5	ORIFICE
3.00	**42.3**	ORIFICE
3.25	44.0	ORIFICE
3.50	**45.7**	ORIFICE
3.75	47.3	ORIFICE
4.00	**48.8**	ORIFICE
4.25	50.3	ORIFICE
4.50	**51.8**	ORIFICE
4.75	53.2	ORIFICE
5.00	**54.6**	ORIFICE

WEIR FLOW: $Q=C_w*L*H^{1.5}$ ORIFICE FLOW: $Q=C_d*A_o*(2*g*H)^{0.5}$

where:	Cw = weir coefficient =3.33 (english units)	Cd = C_c* C_v (or see attached sheet)
	L = weir length or perimeter of riser (ft.)	Ao = orifice area (sq.ft.)
	H = head (feet)	g = 32.2 ft/s^2
	Cc = A_2/A_o (or see attached sheet)	*Cv = 0.99 (rounded) to 0.95 (square) orifice*

```
*************************************************************
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       MINED LANDS FOR A SPECIFIED RAINFALL EVENT (SINGLE STORM)

       VERSION DATE 5-25-83

       DISCLAIMER: NEITHER THE UNIVERSITY NOR ANY OF ITS EMPLOYEES
       ACCEPT ANY RESPONSIBILITY OR LEGAL LIABILITY FOR THE
       CONCLUSIONS DRAWN FROM THE RESULTS OF THIS MODEL


*************************************************************
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            ********************************************
                 WATERSHED IDENTIFICATION CODE
                 -----------------------------
                 WEYERHAEUSER PLYMOUTH/EAST BASIN/1.10 ACRES X 4'/2YR-24HR ST
            ********************************************


============================  STORM  INPUT  ============================

QUESTION
   NO.

    1. STORM TYPE -                                          SCS'S TYPE 2
    2. RAINFALL DEPTH -                                        4.00 INCHES
    3. STORM DURATION -                                       24.00 HOURS
    4. TIME INCREMENT -                                         .10 HOURS

=====================================================================


===========================  WATERSHED DATA  ==========================

QUESTION
   NO.
    1. NUMBER OF JUNCTIONS - 1
    2. JUNCTION     NUMBER OF BRANCHES
```

```
          1                 1
    3. COMPUTATION - BOTH HYDROLOGY AND SEDIMENTOLOGY

==========================================================================



=======================  SEDIMENTOLOGY INPUTS  =======================

QUESTION
   NO.
    1. SPECIFIC GRAVITY -                                          2.64
    2. COEFFICIENT FOR DISTRIBUTING SEDIMENT LOAD -                2.00
    3. SUBMERGED BULK SPECIFIC GRAVITY -                           1.35
    4. NUMBER OF PARTICLE SIZE DISTRIBUTIONS -                     1
    5. NUMBER OF DATA VALUES PER PARTICLE SIZE DISTRIBUTION -     11

==========================================================================



================= INPUT PARTICLE SIZE DISTRIBUTIONS ==================

                        VALUE
                         NO.        SIZE, MM

                          1           1.0000
                          2            .5000
                          3            .2000
                          4            .1000
                          5            .0800
                          6            .0500
                          7            .0100
                          8            .0090
                          9            .0050
                         10            .0020
                         11            .0001

==========================================================================



===================  PERCENT FINER DISTRIBUTIONS  ====================

VALUE                      PARTICLE SIZE #
 NO.
            1
  1    100.00
  2     99.90
  3     87.50
  4     50.50
  5     44.50
  6     36.50
  7     32.00
  8     31.00
  9     29.00
 10     24.50
 11       .00

==========================================================================
```

========== STRUCTURE INPUT FOR JUNCTION #1 ==========

BRANCH	NUMBER OF STRUCTURES
1	1

==========

========== BETWEEN STRUCTURE ROUTING PARAMETERS ==========

BRANCH NO.	BETWEEN	PARAMETERS 1 TIME	2 MUSK. K	3 MUSK. X,
1	PRIOR J OR S TO STRUCTURE 1	.00	.00	.00

==========

========== STRUCTURE DATA FOR JUNCTION #1 ==========

QUESTION NO.		
1.	NUMBER OF SUBWATERSHEDS -	9
2.	TYPE OF SEDIMENT CONTROL STRUCTURE -	POND

==========

* *
JUNCTION 1, BRANCH 1, STRUCTURE 1
* *

*** HYDRAULIC INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	AREA ACRES	CURVE NUMBER	TC HR	TT HR	ROUTING COEFFICIENTS K-HRS	X,	UNIT HYDRO
1	5.03	69.00	.342	.000	.000	.00	2.0
2	4.64	69.00	.305	.000	.000	.00	2.0
3	4.44	69.00	.289	.000	.000	.00	2.0
4	3.58	69.00	.266	.000	.000	.00	2.0
5	3.16	69.00	.242	.000	.000	.00	2.0
6	2.74	69.00	.216	.000	.000	.00	2.0
7	2.63	69.00	.196	.000	.000	.00	2.0
8	1.47	69.00	.126	.000	.000	.00	2.0
9	3.11	69.00	.256	.000	.000	.00	2.0

*** SEDIMENT INPUT VALUES FOR SUBWATERSHEDS ***

WATER	SEG	SOIL	LENGTH	SLOPE	CP	PART	SURF

SHED	NUM	K	FEET	PCT	VALUE	OPT	COND
1	1	.20	60.0	33.30	.400	1.0	.0
2	1	.20	60.0	33.30	.400	1.0	.0
3	1	.20	60.0	33.30	.400	1.0	.0
4	1	.20	60.0	33.30	.400	1.0	.0
5	1	.20	60.0	33.30	.400	1.0	.0
6	1	.20	60.0	33.30	.400	1.0	.0
7	1	.20	60.0	33.30	.400	1.0	.0
8	1	.20	60.0	33.30	.400	1.0	.0
9	1	.20	60.0	33.30	.400	1.0	.0

* * * COMPUTED VALUES FOR INDIVIDUAL WATERSHEDS * * *

WATERSHED	PEAK FLOW (CFS)	RUNOFF (INCHES)	SEDIMENT TONS	DIAM (MM)	DELIVERY RATIO 1	DELIVERY RATIO 2
1	4.04	1.27	91.25	.042	.721	1.000
2	3.90	1.27	85.59	.052	.740	1.000
3	3.82	1.27	82.50	.053	.749	1.000
4	3.19	1.27	66.07	.055	.764	1.000
5	2.93	1.27	58.77	.058	.781	1.000
6	2.65	1.27	51.32	.061	.800	1.000
7	2.64	1.27	49.99	.064	.816	1.000
8	1.57	1.27	26.99	.070	.846	1.000
9	2.81	1.27	56.95	.056	.771	1.000

***** SUMMARY TABLE FOR TOTAL WATERSHED *****

STORM DURATION	=	24.00	HOURS
PRECIPITATION DEPTH	=	4.00	INCHES
RUNOFF VOLUME	=	3.2510	ACRE-FT
PEAK DISCHARGE	=	27.5333	CFS
AREA	=	30.8000	ACRES
TIME OF PEAK DISCHARGE	=	12.10	HRS
LOAD RATE EXPONENT FACTOR	=	2.00	
BETA	=	1.0000	
SUBMERGE BULK SPECIFIC GRAVITY	=	1.35	
RAINFALL EROSITIVITY FACTOR	=	98.49	EI UNIT
PEAK CONCENTRATION	=	308964.80	MG/L
PEAK SETTLEABLE CONCENTRATION	=	131.6135	ML/L
PEAK SETTLEABLE CONCENTRATION	=	177678.20	MG/L
TOTAL SEDIMENT YIELD	=	569.4261	TONS
REPRESENTATIVE PARTICLE SIZE	=	.0553	MM
TIME OF PEAK CONCENTRATION	=	12.10	HRS
PERIOD OF SIGNIFICANT CONCENTRATION	=	14.30	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	50.20	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	50.20	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	14.40	ML/L

ARITHMETIC AVERAGE SETTLEABLE
CONCENTRATION DURING PEAK 24 HOUR
PERIOD = 8.58 ML/L

========== POND INPUT ==========

QUESTION NO.		
1.	TIME INCREMENT OF THE ROUTED HYDROGRAPH -	.10 HOURS
2.	NON-IDEAL SETTLING CORRECTION FACTOR -	1.00
3.	PERCENT OF PERMANENT POOL THAT IS DEAD SPACE -	35.00
4.	OUTFLOW WITHDRAWAL OPTION -	SURFACE
5.	INFLOW VERTICAL CONCENTRATION -	COMP. MIXED
6.	NUMBER OF STAGE POINTS -	12
7.	NUMBER OF ROUTED HYDROGRAPH POINTS -	500
8.	STAGE-DISCHARGE OPTION -	INPUT
9.	OUTPUT OPTION -	SUM. TABLES
10.	NUMBER OF CONTINUOUS STIRRED REACTORS	3

==========

========== POND STAGE DATA ==========

STAGE POINT	VALUE
1	.00
2	2.00
3	2.50
4	3.00
5	3.50
6	4.00
7	4.50
8	5.00
9	5.50
10	6.00
11	6.50
12	7.00

==========

========== POND AREA DATA ==========

AREA POINT	VALUE
1	1.07
2	1.21
3	1.24
4	1.28
5	1.31
6	1.35
7	1.38
8	1.41
9	1.45
10	1.48
11	1.52
12	1.55

==========

========== POND DISCHARGE DATA ==========

DISCHARGE POINT	VALUE
1	.00
2	.00
3	1.52
4	1.97
5	2.45
6	2.97
7	12.71
8	28.49
9	34.59
10	39.80
11	79.23
12	161.24

==========

* *

POND RESULTS

* *

***** BASIN GEOMETRY *****

STAGE (FT)	AREA (ACRES)	AVERAGE DEPTH (FT)	DISCHARGE (CFS)	CAPACITY (ACRES-FT)
.00	1.070	.00	.00	.00
2.00	1.210	1.94	.00	2.28
2.50	1.240	2.42	1.52	2.89
3.00	1.280	2.90	1.97	3.52
3.50	1.310	3.37	2.45	4.17
4.00	1.350	3.84	2.97	4.84
4.50	1.380	4.30	12.71	5.52
5.00	1.410	4.76	28.49	6.22
5.50	1.450	5.22	34.59	6.93
6.00	1.480	5.67	39.80	7.66
6.50	1.520	6.12	79.23	8.41
7.00	1.550	6.57	161.24	9.18

***** STORM EVENT SUMMARY *****

TURBULENCE FACTOR	=	1.00	
PERMANENT POOL CAPACITY	=	2.280	ACRE-FT
DEAD STORAGE	=	35.00	PERCENT
TIME INCREMENT OUTFLOW	=	.10	HRS
VISCOSITY	=	.009	CM**2/SEC
INFLOW RUNOFF VOLUME	=	3.251	ACRE-FT
OUTFLOW ROUTED VOLUME	=	3.244	ACRE-FT
STORM VOLUME DISCHARGED	=	3.244	ACRE-FT
POND VOLUME AT PEAK STAGE	=	3.981	ACRE-FT
PEAK STAGE	=	3.354	FT
PEAK INFLOW RATE	=	27.533	CFS
PEAK DISCHARGE RATE	=	2.310	CFS
PEAK INFLOW SEDIMENT CONCENTRATION	=	308964.80	MG/L
PEAK EFFLUENT SEDIMENT CONCENTRATION	=	37195.80	MG/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	.0000	ML/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	.06	MG/L
STORM AVERAGE EFFLUENT CONCENTRATION	=	32499.58	MG/L
AVERAGE EFFLUENT SEDIMENT CONCENTRATION	=	32499.58	MG/L
BASIN TRAP EFFICIENCY	=	74.75	PERCENT
DETENTION TIME OF FLOW WITH SEDIMENT	=	7.23	HRS
DETENTION TIME FROM HYDROGRAPH CENTERS	=	7.23	HRS
DETENTION TIME INCLUDING STORED FLOW	=	7.23	HRS
SEDIMENT LOAD DISCHARGED	=	143.79	TONS
PERIOD OF SIGNIFICANT CONCENTRATION	=	38.40	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L

*** RUN COMPLETED ****

```
*****************************************************************************
*          (program name)                * SEDIMOT S/N  :                    *
*                                        * HMVersion    :  3.20              *
*       (program description)            * Date         :  5/26/99           *
*                                        * Time         : 10:57:02           *
*                                        * Input file   : wpn2a.inp          *
*                                        * Output file  : wpn2a.out          *
*                                        *                                   *
*                                        *                                   *
*****************************************************************************
```

```
 XXXXX   XXXXXXX  XXXXXX   XXXXX  X     X   XXXXX   XXXXXXX
X     X  X        X     X    X    XX   XX  X     X     X
X        X        X     X    X    X X X X  X     X     X
 XXXXX   XXXXX    X     X    X    X  X  X  X     X     X
      X  X        X     X    X    X     X  X     X     X
X     X  X        X     X    X    X     X  X     X     X
 XXXXX   XXXXXXX  XXXXXX   XXXXX  X     X   XXXXX      X
```

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::::::::::::::::::::::::::::::::::::::::::::
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:::                                      :::
:::  Full Microcomputer Implementation   :::
:::                 by                   :::
:::        Haestad Methods, Inc.         :::
:::                                      :::
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37 Brookside Road * Waterbury, Connecticut 06708 * (203) 755-1666

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            ********************************************
                 WATERSHED IDENTIFICATION CODE
                 -----------------------------
                 WEYERHAEUSER PLYMOUTH/EAST BASIN/1.10 ACRES X 4'/10YR-24HR S
            ********************************************


============================  STORM  INPUT  ============================

QUESTION
   NO.

    1. STORM TYPE -                                          SCS'S TYPE 2
    2. RAINFALL DEPTH -                                        6.25 INCHES
    3. STORM DURATION -                                       24.00 HOURS
    4. TIME INCREMENT -                                         .10 HOURS

=====================================================================


===========================  WATERSHED DATA  ==========================

QUESTION
   NO.
    1. NUMBER OF JUNCTIONS - 1
    2. JUNCTION     NUMBER OF BRANCHES
```

1 1

3. COMPUTATION - BOTH HYDROLOGY AND SEDIMENTOLOGY

==========

========== SEDIMENTOLOGY INPUTS ==========

QUESTION NO.		
1.	SPECIFIC GRAVITY -	2.64
2.	COEFFICIENT FOR DISTRIBUTING SEDIMENT LOAD -	2.00
3.	SUBMERGED BULK SPECIFIC GRAVITY -	1.35
4.	NUMBER OF PARTICLE SIZE DISTRIBUTIONS -	1
5.	NUMBER OF DATA VALUES PER PARTICLE SIZE DISTRIBUTION -	11

==========

========== INPUT PARTICLE SIZE DISTRIBUTIONS ==========

VALUE NO.	SIZE, MM
1	1.0000
2	.5000
3	.2000
4	.1000
5	.0800
6	.0500
7	.0100
8	.0090
9	.0050
10	.0020
11	.0001

==========

========== PERCENT FINER DISTRIBUTIONS ==========

VALUE NO.	PARTICLE SIZE # 1
1	100.00
2	99.90
3	87.50
4	50.50
5	44.50
6	36.50
7	32.00
8	31.00
9	29.00
10	24.50
11	.00

==========

========== STRUCTURE INPUT FOR JUNCTION #1 ==========

BRANCH	NUMBER OF STRUCTURES
1	1

==========

========== BETWEEN STRUCTURE ROUTING PARAMETERS ==========

BRANCH NO.	BETWEEN	PARAMETERS 1 TIME	2 MUSK. K	3 MUSK. X,
1	PRIOR J OR S TO STRUCTURE 1	.00	.00	.00

==========

========== STRUCTURE DATA FOR JUNCTION #1 ==========

QUESTION NO.		
1.	NUMBER OF SUBWATERSHEDS -	9
2.	TYPE OF SEDIMENT CONTROL STRUCTURE -	POND

==========

* *
JUNCTION 1, BRANCH 1, STRUCTURE 1
* *

*** HYDRAULIC INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	AREA ACRES	CURVE NUMBER	TC HR	TT HR	ROUTING COEFFICIENTS K-HRS	X,	UNIT HYDRO
1	5.03	69.00	.342	.000	.000	.00	2.0
2	4.64	69.00	.305	.000	.000	.00	2.0
3	4.44	69.00	.289	.000	.000	.00	2.0
4	3.58	69.00	.266	.000	.000	.00	2.0
5	3.16	69.00	.242	.000	.000	.00	2.0
6	2.74	69.00	.216	.000	.000	.00	2.0
7	2.63	69.00	.196	.000	.000	.00	2.0
8	1.47	69.00	.126	.000	.000	.00	2.0
9	3.11	69.00	.256	.000	.000	.00	2.0

*** SEDIMENT INPUT VALUES FOR SUBWATERSHEDS ***

WATER	SEG	SOIL	LENGTH	SLOPE	CP	PART	SURF

SHED	NUM	K	FEET	PCT	VALUE	OPT	COND
1	1	.20	60.0	33.30	.400	1.0	.0
2	1	.20	60.0	33.30	.400	1.0	.0
3	1	.20	60.0	33.30	.400	1.0	.0
4	1	.20	60.0	33.30	.400	1.0	.0
5	1	.20	60.0	33.30	.400	1.0	.0
6	1	.20	60.0	33.30	.400	1.0	.0
7	1	.20	60.0	33.30	.400	1.0	.0
8	1	.20	60.0	33.30	.400	1.0	.0
9	1	.20	60.0	33.30	.400	1.0	.0

* * * COMPUTED VALUES FOR INDIVIDUAL WATERSHEDS * * *

WATERSHED	PEAK FLOW (CFS)	RUNOFF (INCHES)	SEDIMENT TONS	DIAM (MM)	DELIVERY RATIO 1	DELIVERY RATIO 2
1	9.85	2.91	239.61	.056	.770	1.000
2	9.49	2.91	224.28	.059	.789	1.000
3	9.26	2.91	215.85	.061	.798	1.000
4	7.68	2.91	172.33	.063	.811	1.000
5	7.01	2.91	152.69	.066	.826	1.000
6	6.29	2.91	132.61	.069	.842	1.000
7	6.21	2.91	128.71	.072	.855	1.000
8	3.68	2.91	69.36	.079	.884	1.000
9	6.76	2.91	148.30	.064	.817	1.000

***** SUMMARY TABLE FOR TOTAL WATERSHED *****

STORM DURATION	=	24.00	HOURS
PRECIPITATION DEPTH	=	6.25	INCHES
RUNOFF VOLUME	=	7.4668	ACRE-FT
PEAK DISCHARGE	=	66.2382	CFS
AREA	=	30.8000	ACRES
TIME OF PEAK DISCHARGE	=	12.10	HRS
LOAD RATE EXPONENT FACTOR	=	2.00	
BETA	=	1.0000	
SUBMERGE BULK SPECIFIC GRAVITY	=	1.35	
RAINFALL EROSITIVITY FACTOR	=	260.30	EI UNIT
PEAK CONCENTRATION	=	328773.10	MG/L
PEAK SETTLEABLE CONCENTRATION	=	145.8929	ML/L
PEAK SETTLEABLE CONCENTRATION	=	196955.40	MG/L
TOTAL SEDIMENT YIELD	=	1483.7380	TONS
REPRESENTATIVE PARTICLE SIZE	=	.0633	MM
TIME OF PEAK CONCENTRATION	=	12.10	HRS
PERIOD OF SIGNIFICANT CONCENTRATION	=	16.20	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	58.71	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	58.71	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	13.51	ML/L

ARITHMETIC AVERAGE SETTLEABLE
CONCENTRATION DURING PEAK 24 HOUR
PERIOD = 9.12 ML/L

========== POND INPUT ==========

QUESTION NO.		
1.	TIME INCREMENT OF THE ROUTED HYDROGRAPH -	.10 HOURS
2.	NON-IDEAL SETTLING CORRECTION FACTOR -	1.00
3.	PERCENT OF PERMANENT POOL THAT IS DEAD SPACE -	35.00
4.	OUTFLOW WITHDRAWAL OPTION -	SURFACE
5.	INFLOW VERTICAL CONCENTRATION -	COMP. MIXED
6.	NUMBER OF STAGE POINTS -	12
7.	NUMBER OF ROUTED HYDROGRAPH POINTS -	500
8.	STAGE-DISCHARGE OPTION -	INPUT
9.	OUTPUT OPTION -	SUM. TABLES
10.	NUMBER OF CONTINUOUS STIRRED REACTORS	3

==========

========== POND STAGE DATA ==========

STAGE POINT	VALUE
1	.00
2	2.00
3	2.50
4	3.00
5	3.50
6	4.00
7	4.50
8	5.00
9	5.50
10	6.00
11	6.50
12	7.00

==========

========== POND AREA DATA ==========

AREA POINT	VALUE
1	1.07
2	1.21
3	1.24
4	1.28
5	1.31
6	1.35
7	1.38
8	1.41
9	1.45
10	1.48
11	1.52
12	1.55

==========

========== POND DISCHARGE DATA ==========

DISCHARGE POINT	VALUE
1	.00
2	.00
3	1.52
4	1.97
5	2.45
6	2.97
7	12.71
8	28.49
9	34.59
10	39.80
11	79.23
12	161.24

==========

* *

POND RESULTS

* *

***** BASIN GEOMETRY *****

STAGE (FT)	AREA (ACRES)	AVERAGE DEPTH (FT)	DISCHARGE (CFS)	CAPACITY (ACRES-FT)
.00	1.070	.00	.00	.00
2.00	1.210	1.94	.00	2.28
2.50	1.240	2.42	1.52	2.89
3.00	1.280	2.90	1.97	3.52
3.50	1.310	3.37	2.45	4.17
4.00	1.350	3.84	2.97	4.84
4.50	1.380	4.30	12.71	5.52
5.00	1.410	4.76	28.49	6.22
5.50	1.450	5.22	34.59	6.93
6.00	1.480	5.67	39.80	7.66
6.50	1.520	6.12	79.23	8.41
7.00	1.550	6.57	161.24	9.18

***** STORM EVENT SUMMARY *****

TURBULENCE FACTOR	=	1.00	
PERMANENT POOL CAPACITY	=	2.280	ACRE-FT
DEAD STORAGE	=	35.00	PERCENT
TIME INCREMENT OUTFLOW	=	.10	HRS
VISCOSITY	=	.009	CM**2/SEC
INFLOW RUNOFF VOLUME	=	7.467	ACRE-FT
OUTFLOW ROUTED VOLUME	=	7.445	ACRE-FT
STORM VOLUME DISCHARGED	=	7.445	ACRE-FT
POND VOLUME AT PEAK STAGE	=	5.706	ACRE-FT
PEAK STAGE	=	4.635	FT
PEAK INFLOW RATE	=	66.238	CFS
PEAK DISCHARGE RATE	=	16.984	CFS
PEAK INFLOW SEDIMENT CONCENTRATION	=	328773.10	MG/L
PEAK EFFLUENT SEDIMENT CONCENTRATION	=	62607.61	MG/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	.0005	ML/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	.65	MG/L
STORM AVERAGE EFFLUENT CONCENTRATION	=	47175.07	MG/L
AVERAGE EFFLUENT SEDIMENT CONCENTRATION	=	47175.07	MG/L
BASIN TRAP EFFICIENCY	=	67.71	PERCENT
DETENTION TIME OF FLOW WITH SEDIMENT	=	6.32	HRS
DETENTION TIME FROM HYDROGRAPH CENTERS	=	6.32	HRS
DETENTION TIME INCLUDING STORED FLOW	=	6.32	HRS
SEDIMENT LOAD DISCHARGED	=	479.12	TONS
PERIOD OF SIGNIFICANT CONCENTRATION	=	39.80	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L

*** RUN COMPLETED ****

```
*************************************************************
*************************************************************

       UNIVERSITY OF KENTUCKY COMPUTER MODEL
       OF SURFACE MINE HYDROLOGY AND SEDIMENTOLOGY
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       MINED LANDS FOR A SPECIFIED RAINFALL EVENT (SINGLE STORM)

       VERSION DATE 5-25-83

       DISCLAIMER: NEITHER THE UNIVERSITY NOR ANY OF ITS EMPLOYEES
       ACCEPT ANY RESPONSIBILITY OR LEGAL LIABILITY FOR THE
       CONCLUSIONS DRAWN FROM THE RESULTS OF THIS MODEL


*************************************************************
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            ********************************************
                 WATERSHED IDENTIFICATION CODE
                 -----------------------------
                 WEYERHAEUSER PLYMOUTH/EAST BASIN/1.10 ACRES X 4'/25YR-24HR S
            ********************************************


============================  STORM  INPUT  ============================

QUESTION
   NO.

    1. STORM TYPE -                                          SCS'S TYPE 2
    2. RAINFALL DEPTH -                                        7.25 INCHES
    3. STORM DURATION -                                       24.00 HOURS
    4. TIME INCREMENT -                                         .10 HOURS

=======================================================================


==========================  WATERSHED DATA  ==========================

QUESTION
   NO.
    1. NUMBER OF JUNCTIONS - 1
    2. JUNCTION     NUMBER OF BRANCHES
```

```
          1                 1
   3. COMPUTATION - BOTH HYDROLOGY AND SEDIMENTOLOGY

=====================================================================


======================  SEDIMENTOLOGY INPUTS  =======================

QUESTION
   NO.
    1. SPECIFIC GRAVITY -                                          2.64
    2. COEFFICIENT FOR DISTRIBUTING SEDIMENT LOAD -                2.00
    3. SUBMERGED BULK SPECIFIC GRAVITY -                           1.35
    4. NUMBER OF PARTICLE SIZE DISTRIBUTIONS -                     1
    5. NUMBER OF DATA VALUES PER PARTICLE SIZE DISTRIBUTION -     11

=====================================================================


================ INPUT PARTICLE SIZE DISTRIBUTIONS ==================

                        VALUE
                         NO.        SIZE, MM

                          1           1.0000
                          2            .5000
                          3            .2000
                          4            .1000
                          5            .0800
                          6            .0500
                          7            .0100
                          8            .0090
                          9            .0050
                         10            .0020
                         11            .0001

=====================================================================


==================  PERCENT FINER DISTRIBUTIONS  ====================

VALUE                      PARTICLE SIZE #
 NO.
          1
  1    100.00
  2     99.90
  3     87.50
  4     50.50
  5     44.50
  6     36.50
  7     32.00
  8     31.00
  9     29.00
 10     24.50
 11       .00

=====================================================================
```

========== STRUCTURE INPUT FOR JUNCTION #1 ==========

BRANCH	NUMBER OF STRUCTURES
1	1

==========

========== BETWEEN STRUCTURE ROUTING PARAMETERS ==========

BRANCH NO.	BETWEEN	PARAMETERS 1 TIME	2 MUSK. K	3 MUSK. X,
1	PRIOR J OR S TO STRUCTURE 1	.00	.00	.00

==========

========== STRUCTURE DATA FOR JUNCTION #1 ==========

QUESTION NO.		
1.	NUMBER OF SUBWATERSHEDS -	9
2.	TYPE OF SEDIMENT CONTROL STRUCTURE -	POND

==========

* *
JUNCTION 1, BRANCH 1, STRUCTURE 1
* *

*** HYDRAULIC INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	AREA ACRES	CURVE NUMBER	TC HR	TT HR	ROUTING COEFFICIENTS K-HRS	X,	UNIT HYDRO
1	5.03	69.00	.342	.000	.000	.00	2.0
2	4.64	69.00	.305	.000	.000	.00	2.0
3	4.44	69.00	.289	.000	.000	.00	2.0
4	3.58	69.00	.266	.000	.000	.00	2.0
5	3.16	69.00	.242	.000	.000	.00	2.0
6	2.74	69.00	.216	.000	.000	.00	2.0
7	2.63	69.00	.196	.000	.000	.00	2.0
8	1.47	69.00	.126	.000	.000	.00	2.0
9	3.11	69.00	.256	.000	.000	.00	2.0

*** SEDIMENT INPUT VALUES FOR SUBWATERSHEDS ***

WATER	SEG	SOIL	LENGTH	SLOPE	CP	PART	SURF

SHED	NUM	K	FEET	PCT	VALUE	OPT	COND
1	1	.20	60.0	33.30	.400	1.0	.0
2	1	.20	60.0	33.30	.400	1.0	.0
3	1	.20	60.0	33.30	.400	1.0	.0
4	1	.20	60.0	33.30	.400	1.0	.0
5	1	.20	60.0	33.30	.400	1.0	.0
6	1	.20	60.0	33.30	.400	1.0	.0
7	1	.20	60.0	33.30	.400	1.0	.0
8	1	.20	60.0	33.30	.400	1.0	.0
9	1	.20	60.0	33.30	.400	1.0	.0

* * * COMPUTED VALUES FOR INDIVIDUAL WATERSHEDS * * *

WATERSHED	PEAK FLOW (CFS)	RUNOFF (INCHES)	SEDIMENT TONS	DIAM (MM)	DELIVERY RATIO 1	DELIVERY RATIO 2
1	12.68	3.72	316.69	.058	.782	1.000
2	12.20	3.72	296.29	.062	.801	1.000
3	11.90	3.72	285.10	.063	.809	1.000
4	9.87	3.72	227.55	.066	.822	1.000
5	9.00	3.72	201.57	.069	.837	1.000
6	8.07	3.72	175.02	.072	.853	1.000
7	7.94	3.72	169.52	.074	.865	1.000
8	4.70	3.72	91.24	.080	.893	1.000
9	8.69	3.72	195.80	.067	.828	1.000

***** SUMMARY TABLE FOR TOTAL WATERSHED *****

STORM DURATION	=	24.00	HOURS
PRECIPITATION DEPTH	=	7.25	INCHES
RUNOFF VOLUME	=	9.5481	ACRE-FT
PEAK DISCHARGE	=	84.3912	CFS
AREA	=	30.8000	ACRES
TIME OF PEAK DISCHARGE	=	12.10	HRS
LOAD RATE EXPONENT FACTOR	=	2.00	
BETA	=	1.0000	
SUBMERGE BULK SPECIFIC GRAVITY	=	1.35	
RAINFALL EROSITIVITY FACTOR	=	359.62	EI UNIT
PEAK CONCENTRATION	=	333143.80	MG/L
PEAK SETTLEABLE CONCENTRATION	=	149.1958	ML/L
PEAK SETTLEABLE CONCENTRATION	=	201414.30	MG/L
TOTAL SEDIMENT YIELD	=	1958.7900	TONS
REPRESENTATIVE PARTICLE SIZE	=	.0654	MM
TIME OF PEAK CONCENTRATION	=	12.10	HRS
PERIOD OF SIGNIFICANT CONCENTRATION	=	17.00	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	61.00	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	61.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	13.27	ML/L

ARITHMETIC AVERAGE SETTLEABLE
CONCENTRATION DURING PEAK 24 HOUR
PERIOD = 9.40 ML/L

========== POND INPUT ==========

QUESTION NO.		
1.	TIME INCREMENT OF THE ROUTED HYDROGRAPH -	.10 HOURS
2.	NON-IDEAL SETTLING CORRECTION FACTOR -	1.00
3.	PERCENT OF PERMANENT POOL THAT IS DEAD SPACE -	35.00
4.	OUTFLOW WITHDRAWAL OPTION -	SURFACE
5.	INFLOW VERTICAL CONCENTRATION -	COMP. MIXED
6.	NUMBER OF STAGE POINTS -	12
7.	NUMBER OF ROUTED HYDROGRAPH POINTS -	500
8.	STAGE-DISCHARGE OPTION -	INPUT
9.	OUTPUT OPTION -	SUM. TABLES
10.	NUMBER OF CONTINUOUS STIRRED REACTORS	3

==========

========== POND STAGE DATA ==========

STAGE POINT	VALUE
1	.00
2	2.00
3	2.50
4	3.00
5	3.50
6	4.00
7	4.50
8	5.00
9	5.50
10	6.00
11	6.50
12	7.00

==========

========== POND AREA DATA ==========

AREA POINT	VALUE
1	1.07
2	1.21
3	1.24
4	1.28
5	1.31
6	1.35
7	1.38
8	1.41
9	1.45
10	1.48
11	1.52
12	1.55

==========

========== POND DISCHARGE DATA ==========

DISCHARGE POINT	VALUE
1	.00
2	.00
3	1.52
4	1.97
5	2.45
6	2.97
7	12.71
8	28.49
9	34.59
10	39.80
11	79.23
12	161.24

==========

****
****

CAUTION: THE STAGE OF YOUR PRINCIPLE SPILLWAY MAY CAUSE BED SCOUR. SEDIMOT II DOES NOT CONSIDER POSSIBLE BED SCOUR; HENCE, YOUR OBSERVED EFFLUENT MAY NOT MEET THE DESIRED EFFLUENT STANDARD. INCREASE THE STAGE OF YOUR PRINCIPAL SPILLWAY.

****
****

* *

POND RESULTS

* *

***** BASIN GEOMETRY *****

STAGE (FT)	AREA (ACRES)	AVERAGE DEPTH (FT)	DISCHARGE (CFS)	CAPACITY (ACRES-FT)
.00	1.070	.00	.00	.00

2.00	1.210	1.94	.00	2.28
2.50	1.240	2.42	1.52	2.89
3.00	1.280	2.90	1.97	3.52
3.50	1.310	3.37	2.45	4.17
4.00	1.350	3.84	2.97	4.84
4.50	1.380	4.30	12.71	5.52
5.00	1.410	4.76	28.49	6.22
5.50	1.450	5.22	34.59	6.93
6.00	1.480	5.67	39.80	7.66
6.50	1.520	6.12	79.23	8.41
7.00	1.550	6.57	161.24	9.18

***** STORM EVENT SUMMARY *****

TURBULENCE FACTOR	=	1.00	
PERMANENT POOL CAPACITY	=	2.280	ACRE-FT
DEAD STORAGE	=	35.00	PERCENT
TIME INCREMENT OUTFLOW	=	.10	HRS
VISCOSITY	=	.009	CM**2/SEC
INFLOW RUNOFF VOLUME	=	9.548	ACRE-FT
OUTFLOW ROUTED VOLUME	=	9.522	ACRE-FT
STORM VOLUME DISCHARGED	=	9.522	ACRE-FT
POND VOLUME AT PEAK STAGE	=	6.238	ACRE-FT
PEAK STAGE	=	5.016	FT
PEAK INFLOW RATE	=	84.391	CFS
PEAK DISCHARGE RATE	=	28.690	CFS
PEAK INFLOW SEDIMENT CONCENTRATION	=	333143.80	MG/L
PEAK EFFLUENT SEDIMENT CONCENTRATION	=	72181.22	MG/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	.0042	ML/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	5.63	MG/L
STORM AVERAGE EFFLUENT CONCENTRATION	=	51148.39	MG/L
AVERAGE EFFLUENT SEDIMENT CONCENTRATION	=	51148.39	MG/L
BASIN TRAP EFFICIENCY	=	66.08	PERCENT
DETENTION TIME OF FLOW WITH SEDIMENT	=	5.33	HRS
DETENTION TIME FROM HYDROGRAPH CENTERS	=	5.33	HRS
DETENTION TIME INCLUDING STORED FLOW	=	5.33	HRS
SEDIMENT LOAD DISCHARGED	=	664.52	TONS
PERIOD OF SIGNIFICANT CONCENTRATION	=	40.50	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L

```
*****************************************************************************
*          (program name)                * SEDIMOT S/N  :                    *
*                                        * HMVersion    :  3.20              *
*       (program description)            * Date         :  5/26/99           *
*                                        * Time         : 10:46:32           *
*                                        * Input file   : wpn2c.inp          *
*                                        * Output file  : wpn2c.out          *
*                                        *                                   *
*                                        *                                   *
*****************************************************************************
```

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 xxxxx   xxxxxxx  xxxxxx   xxxxx  x     x   xxxxx   xxxxxxx
x     x  x        x     x    x    xx   xx  x     x     x
x        x        x     x    x    x x x x  x     x     x
 xxxxx   xxxxx    x     x    x    x  x  x  x     x     x
      x  x        x     x    x    x     x  x     x     x
x     x  x        x     x    x    x     x  x     x     x
 xxxxx   xxxxxxx  xxxxxx   xxxxx  x     x   xxxxx      x
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::::::::::::::::::::::::::::::::::::::::::::
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:::                                      :::
:::  Full Microcomputer Implementation   :::
:::                 by                   :::
:::        Haestad Methods, Inc.         :::
:::                                      :::
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37 Brookside Road * Waterbury, Connecticut 06708 * (203) 755-1666

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*************************************************************
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            *********************************************
                 WATERSHED IDENTIFICATION CODE
                 -------------------------------
                 WEYERHAEUSER PLYMOUTH/EAST BASIN/1.10 ACRES X 4'/100YR-24HR
            *********************************************


============================  STORM  INPUT  ============================

QUESTION
   NO.

    1. STORM TYPE -                                          SCS'S TYPE 2
    2. RAINFALL DEPTH -                                        9.00 INCHES
    3. STORM DURATION -                                       24.00 HOURS
    4. TIME INCREMENT -                                         .10 HOURS

=====================================================================


===========================  WATERSHED DATA  ==========================

QUESTION
   NO.
    1. NUMBER OF JUNCTIONS - 1
    2. JUNCTION     NUMBER OF BRANCHES
```

```
          1                 1
   3. COMPUTATION - BOTH HYDROLOGY AND SEDIMENTOLOGY

=====================================================================


=======================  SEDIMENTOLOGY INPUTS  =======================

QUESTION
   NO.
    1. SPECIFIC GRAVITY -                                          2.64
    2. COEFFICIENT FOR DISTRIBUTING SEDIMENT LOAD -                2.00
    3. SUBMERGED BULK SPECIFIC GRAVITY -                           1.35
    4. NUMBER OF PARTICLE SIZE DISTRIBUTIONS -                     1
    5. NUMBER OF DATA VALUES PER PARTICLE SIZE DISTRIBUTION -     11

=====================================================================


================= INPUT PARTICLE SIZE DISTRIBUTIONS ===================

                        VALUE
                         NO.       SIZE, MM

                          1          1.0000
                          2           .5000
                          3           .2000
                          4           .1000
                          5           .0800
                          6           .0500
                          7           .0100
                          8           .0090
                          9           .0050
                         10           .0020
                         11           .0001

=====================================================================


===================  PERCENT FINER DISTRIBUTIONS  ====================

VALUE                      PARTICLE SIZE #
 NO.
          1
  1    100.00
  2     99.90
  3     87.50
  4     50.50
  5     44.50
  6     36.50
  7     32.00
  8     31.00
  9     29.00
 10     24.50
 11       .00

=====================================================================
```

========== STRUCTURE INPUT FOR JUNCTION #1 ==========

BRANCH	NUMBER OF STRUCTURES
1	1

==========

========== BETWEEN STRUCTURE ROUTING PARAMETERS ==========

BRANCH NO.	BETWEEN	PARAMETERS 1 TIME	2 MUSK. K	3 MUSK. X,
1	PRIOR J OR S TO STRUCTURE 1	.00	.00	.00

==========

========== STRUCTURE DATA FOR JUNCTION #1 ==========

QUESTION NO.		
1.	NUMBER OF SUBWATERSHEDS -	9
2.	TYPE OF SEDIMENT CONTROL STRUCTURE -	POND

==========

* *
JUNCTION 1, BRANCH 1, STRUCTURE 1
* *

*** HYDRAULIC INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	AREA ACRES	CURVE NUMBER	TC HR	TT HR	ROUTING COEFFICIENTS K-HRS	X,	UNIT HYDRO
1	5.03	69.00	.342	.000	.000	.00	2.0
2	4.64	69.00	.305	.000	.000	.00	2.0
3	4.44	69.00	.289	.000	.000	.00	2.0
4	3.58	69.00	.266	.000	.000	.00	2.0
5	3.16	69.00	.242	.000	.000	.00	2.0
6	2.74	69.00	.216	.000	.000	.00	2.0
7	2.63	69.00	.196	.000	.000	.00	2.0
8	1.47	69.00	.126	.000	.000	.00	2.0
9	3.11	69.00	.256	.000	.000	.00	2.0

*** SEDIMENT INPUT VALUES FOR SUBWATERSHEDS ***

WATER	SEG	SOIL	LENGTH	SLOPE	CP	PART	SURF

SHED	NUM	K	FEET	PCT	VALUE	OPT	COND
1	1	.20	60.0	33.30	.400	1.0	.0
2	1	.20	60.0	33.30	.400	1.0	.0
3	1	.20	60.0	33.30	.400	1.0	.0
4	1	.20	60.0	33.30	.400	1.0	.0
5	1	.20	60.0	33.30	.400	1.0	.0
6	1	.20	60.0	33.30	.400	1.0	.0
7	1	.20	60.0	33.30	.400	1.0	.0
8	1	.20	60.0	33.30	.400	1.0	.0
9	1	.20	60.0	33.30	.400	1.0	.0

* * * COMPUTED VALUES FOR INDIVIDUAL WATERSHEDS * * *

WATERSHED	PEAK FLOW (CFS)	RUNOFF (INCHES)	SEDIMENT TONS	DIAM (MM)	DELIVERY RATIO 1	DELIVERY RATIO 2
1	17.80	5.21	462.61	.061	.796	1.000
2	17.12	5.21	432.56	.064	.815	1.000
3	16.69	5.21	416.13	.066	.824	1.000
4	13.83	5.21	332.00	.068	.836	1.000
5	12.61	5.21	294.02	.072	.852	1.000
6	11.30	5.21	255.22	.075	.867	1.000
7	11.11	5.21	247.14	.078	.879	1.000
8	6.53	5.21	132.52	.082	.905	1.000
9	12.17	5.21	285.64	.070	.842	1.000

***** SUMMARY TABLE FOR TOTAL WATERSHED *****

STORM DURATION	=	24.00	HOURS
PRECIPITATION DEPTH	=	9.00	INCHES
RUNOFF VOLUME	=	13.3759	ACRE-FT
PEAK DISCHARGE	=	118.1525	CFS
AREA	=	30.8000	ACRES
TIME OF PEAK DISCHARGE	=	12.10	HRS
LOAD RATE EXPONENT FACTOR	=	2.00	
BETA	=	1.0000	
SUBMERGE BULK SPECIFIC GRAVITY	=	1.35	
RAINFALL EROSITIVITY FACTOR	=	575.89	EI UNIT
PEAK CONCENTRATION	=	342665.90	MG/L
PEAK SETTLEABLE CONCENTRATION	=	155.1650	ML/L
PEAK SETTLEABLE CONCENTRATION	=	209472.80	MG/L
TOTAL SEDIMENT YIELD	=	2857.8310	TONS
REPRESENTATIVE PARTICLE SIZE	=	.0682	MM
TIME OF PEAK CONCENTRATION	=	12.10	HRS
PERIOD OF SIGNIFICANT CONCENTRATION	=	18.10	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	63.98	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	63.98	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	12.99	ML/L

ARITHMETIC AVERAGE SETTLEABLE
CONCENTRATION DURING PEAK 24 HOUR
PERIOD = 9.80 ML/L

========== POND INPUT ==========

QUESTION NO.		
1.	TIME INCREMENT OF THE ROUTED HYDROGRAPH -	.10 HOURS
2.	NON-IDEAL SETTLING CORRECTION FACTOR -	1.00
3.	PERCENT OF PERMANENT POOL THAT IS DEAD SPACE -	35.00
4.	OUTFLOW WITHDRAWAL OPTION -	SURFACE
5.	INFLOW VERTICAL CONCENTRATION -	COMP. MIXED
6.	NUMBER OF STAGE POINTS -	12
7.	NUMBER OF ROUTED HYDROGRAPH POINTS -	500
8.	STAGE-DISCHARGE OPTION -	INPUT
9.	OUTPUT OPTION -	SUM. TABLES
10.	NUMBER OF CONTINUOUS STIRRED REACTORS	3

==========

========== POND STAGE DATA ==========

STAGE POINT	VALUE
1	.00
2	2.00
3	2.50
4	3.00
5	3.50
6	4.00
7	4.50
8	5.00
9	5.50
10	6.00
11	6.50
12	7.00

==========

========== POND AREA DATA ==========

AREA POINT	VALUE
1	1.07
2	1.21
3	1.24
4	1.28
5	1.31
6	1.35
7	1.38
8	1.41
9	1.45
10	1.48
11	1.52
12	1.55

==========

========== POND DISCHARGE DATA ==========

DISCHARGE POINT	VALUE
1	.00
2	.00
3	1.52
4	1.97
5	2.45
6	2.97
7	12.71
8	28.49
9	34.59
10	39.80
11	79.23
12	161.24

==========

****
****

CAUTION: THE STAGE OF YOUR PRINCIPLE SPILLWAY MAY CAUSE BED SCOUR. SEDIMOT II DOES NOT CONSIDER POSSIBLE BED SCOUR; HENCE, YOUR OBSERVED EFFLUENT MAY NOT MEET THE DESIRED EFFLUENT STANDARD. INCREASE THE STAGE OF YOUR PRINCIPAL SPILLWAY.

****
****

* *

POND RESULTS

* *

***** BASIN GEOMETRY *****

STAGE (FT)	AREA (ACRES)	AVERAGE DEPTH (FT)	DISCHARGE (CFS)	CAPACITY (ACRES-FT)
.00	1.070	.00	.00	.00

2.00	1.210	1.94	.00	2.28
2.50	1.240	2.42	1.52	2.89
3.00	1.280	2.90	1.97	3.52
3.50	1.310	3.37	2.45	4.17
4.00	1.350	3.84	2.97	4.84
4.50	1.380	4.30	12.71	5.52
5.00	1.410	4.76	28.49	6.22
5.50	1.450	5.22	34.59	6.93
6.00	1.480	5.67	39.80	7.66
6.50	1.520	6.12	79.23	8.41
7.00	1.550	6.57	161.24	9.18

***** STORM EVENT SUMMARY *****

TURBULENCE FACTOR	=	1.00	
PERMANENT POOL CAPACITY	=	2.280	ACRE-FT
DEAD STORAGE	=	35.00	PERCENT
TIME INCREMENT OUTFLOW	=	.10	HRS
VISCOSITY	=	.009	CM**2/SEC
INFLOW RUNOFF VOLUME	=	13.376	ACRE-FT
OUTFLOW ROUTED VOLUME	=	13.345	ACRE-FT
STORM VOLUME DISCHARGED	=	13.345	ACRE-FT
POND VOLUME AT PEAK STAGE	=	7.636	ACRE-FT
PEAK STAGE	=	5.982	FT
PEAK INFLOW RATE	=	118.152	CFS
PEAK DISCHARGE RATE	=	39.608	CFS
PEAK INFLOW SEDIMENT CONCENTRATION	=	342665.90	MG/L
PEAK EFFLUENT SEDIMENT CONCENTRATION	=	81014.13	MG/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	.0126	ML/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	17.06	MG/L
STORM AVERAGE EFFLUENT CONCENTRATION	=	55250.30	MG/L
AVERAGE EFFLUENT SEDIMENT CONCENTRATION	=	55250.30	MG/L
BASIN TRAP EFFICIENCY	=	64.80	PERCENT
DETENTION TIME OF FLOW WITH SEDIMENT	=	4.25	HRS
DETENTION TIME FROM HYDROGRAPH CENTERS	=	4.25	HRS
DETENTION TIME INCLUDING STORED FLOW	=	4.25	HRS
SEDIMENT LOAD DISCHARGED	=	1006.00	TONS
PERIOD OF SIGNIFICANT CONCENTRATION	=	41.50	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.01	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.01	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.01	ML/L

DESIGN SHEET

SHEET ____ OF ____

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

PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER - PLYMOUTH	JJK	6/17/99			05101.01

SUMMARY OF EAST AREA SEDIMENT BASIN DESIGN

BASIN DIMENSIONS: BASE AREA → 1.10 ACRES (IRREGULAR SHAPE)
SIDE SLOPES → 3H:1V

PRINCIPAL SPILLWAY: 30" CMP RISER DIAM,
24" CMP BARREL DIAM.
0.5" DIAMETER PERFORATIONS
→ 4" O.C. HORIZONTALLY
→ 6" O.C. VERTICALLY
4 FEET FROM POND BOTTOM TO TOP OF RISER
70 FEET LONG
1% SLOPE

EMERGENCY SPILLWAY: BASE WIDTH → 44 FEET
SIDE SLOPES 4H:1V
6 FEET FROM POND BOTTOM TO BASE OF EMERGENCY SPILLWAY
2-FOOT DEEP

	POST-DEVELOPMENT		PRE-DEVELOPMENT	
$Q_{POND,10Y}$ =	17.0 CFS	<	52.9 CFS	✓
$Q_{POND,25Y}$ =	28.7 CFS	<	70.7 CFS	✓
$Q_{POND,100Y}$ =	39.6 CFS	<	104.0 CFS	✓

TE_{2YR} = 74.8% > 70% (≥70% RQD FOR HQWs FOR 2YR EVENT) ✓
TE_{10YR} = 67.7% > 60% ✓
TE_{25YR} = 66.1% > 60% ✓
TE_{100YR} = 64.8% > 60% ✓

Attachment L5
Post Development Stormwater Design Calculations – West Area

DESIGN SHEET

RMT®

SHEET 1 OF 9

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PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER - PLYMOUTH	SYK	5/19/99	[illegible]	[illegible]	05101.01

POST DEVELOPMENT STORMWATER ANALYSIS:

DETERMINE: PEAK RUNOFF RATE FOR AREA 3 / "WEST BASIN" USING SCS METHOD ~ 25 YR - 24 HR STORM ($Q_{P_{25/24}}$)

GIVEN: LOCATION - PLYMOUTH NC
HSG = B
TOTAL AREA DELINEATED = 40.51 ACRES
MAXIMUM HYDRAULIC LENGTH = 2040 FT
MAXIMUM SLOPE: 33.3% (3H:1V)
DESIGN EVENT: 25 YR - 24 HR STORM = 7.25 INCHES
% HYDRAULIC LENGTH MODIFIED = 0%
% MEADOW AREA = 0%

DETERMINE: CN = 69 FOR FINAL CONDITIONS GRASS COVER ON 50-75% OF THE AREA ~ HSG 'B' [T. 8.03b]. ASSUME GRADING & VEGETATION PROGRESS WITH LANDFILL CONSTRUCTION

RUNOFF DEPTH = 3.73" FROM TABLE 8.03c FOR 7.25" EVENT BY DOUBLE INTERPOLATION FOR CN = 69.

25-YR TOTAL RUNOFF = (3.73")(1/12")(40.51 AC)
= 12.6 AC-FT

EQUIVALENT DRAINAGE AREA, a, = f(HYDRAULIC LENGTH, L = 2040)
$a = (2040'/209)^{(1/0.6)}$
a = 44.58 AC.

DESIGN SHEET

SHEET 2 OF 7

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PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER - PLYMOUTH	SYK	5/24/99	DKT	6/10/99	05101.01

WEST BASIN

DETERMINE: PEAK RATE OF DISCHARGE, USING MAXIMUM WATERSHED SLOPE OF 33.3% AS AN AVG. WATERSHED SLOPE (CONSERVATIVE)
F. 8.03g , CN = 69 , a = 44.58 cfs

PEAK RATE OF DISCHARGE ≅ 45 CFS/IN OF RUNOFF

PK. DISCHARGE FOR EQUIVALENT WATERSHED $= Q_1 = \left(45 \frac{cfs}{in}\right)(3.73\ in) = 168\ cfs$

PK. DISCHARGE $= Q_2 = (168\ cfs)\left(\frac{40.51\ ac}{44.58\ ac}\right) = 153\ cfs$

ADJUST Q_2 FOR (33.3% SLOPE) FROM T.8.03d
& DOUBLE INTERPOLATION

$Q_3 = (153\ cfs)(1.15) = 176\ cfs$

$Q_{p\ 25/24} = 176\ cfs$

DESIGN SHEET

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PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER - PLYMOUTH	JYK	5/2/00	ELT	7/6/00	05101.01

SEDIMENT BASIN DESIGN - WEST BASIN

GIVEN: DRAINAGE BASIN TOTAL AREA = 40.51 ACRES
$Q_{p\,25/24} = 176$ CFS
BOTTOM OF BASIN EL ≥ 2' + EL. HIGH GWT
TOP OF DIKE WIDTH = 8' TO 10'
SIDE SLOPES : (3:1) HORIZONTAL TO VERTICAL
POND LENGTH TO WIDTH RATIO ~ 2:1 OR GREATER

DETERMINE BASIN VOLUME

MIN VOLUME = $(1800\ \frac{ft^3}{ac})(40.51\ ac) = 72{,}918\ ft^3 = 1.67$ ac-ft.

RECOMMENDED AREA AT PRINCIPAL SPILLWAY, $A_p \geq Q_p(0.01)$

$A_p \geq (176\ CFS)(0.01) = 1.76$ acres $= 76{,}666\ ft^2$

LET $2W = L$, THEN $W_p = \sqrt{76{,}666/2} = 196$ ft
$L_p = 2W_p = 392$ ft

TOTAL VOLUME OF RUNOFF FROM THE 10YR-24HR EVENT
6.25 IN = 10YR-24HR EVENT
2.91 IN RUNOFF FROM T. 8.03.C + CN=69 & DOUBLE INTERPOLATION

$V_{10,24} = (2.91\ IN)(1/12)(40.51\ acres) = 9.82$ ac-ft

SIZE PRINCIPAL SPILLWAY, $Q_{p\,MIN} = (0.2\ CFS/AC)(40.51\ AC) = 8.1$ CFS.
LET PRINCIPAL SPILLWAY BARREL = 30" MAX = D
Ht of Riser = 2D = 2(2.5') = 5 FT. (MIN)

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PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER - PLYMOUTH	JL	5/25/99		11/10/00	05101.01

WEST BASIN

IF: $D_{BARREL} = 2.5'$ & $d_{RISER} = 2.0'$

$H = 4.0$ ft.

$L = 70$ ft

RISER IS CMP - PERFORATED

THEN $Q = 22.06$ CFS. (T. 8.07 A) $= f(d = 24'' + H = 4' + L = 70$ ft$)$

MIN. HEAD REQD FOR $(Q = 22$ CFS, $d_{RISER} = 30'')$ — F. 8.07 B.
$(h) \simeq 0.63$ ft.

HT OF EMERGENCY SPILLWAY $\geq 2D + h = (2)(2') + 0.63'$
≥ 4.63 FT.

LET BASIN BOTTOM = 0
TOP OF RISER = 4 (PS)
TOP OF ES = 6'
TOP OF DIKE = 8'
$A_B = 170' \times 320 = 10.44$ AC
$A_P = 194' \times 394' \cong 1.75$ AC ✓

EMERGENCY SPILLWAY

$Q_P = f(H = 6$ FT, $D = 24$, $L = 70'$, T. 8.07A, CMP$)$
$Q_P = 27.01$ CFS

$Q_E = Q_{P_{25/24}} - Q_P = 176$ CFS $- 27$ CFS $= 149$ CFS

FROM T. 8.07C @ $Q = 160$ CFS, USE BOTTOM WIDTH = 44'
SLOPES 2.7 TO 4.3 (MIN TO MAX) & 4:1 (H:V) SIDE SLOPES

DESIGN SHEET

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PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER - PLYMOUTH	SYK	5/12/99	BMT	7/8/99	05101.01

WEST-BASIN

POST DEVELOPMENT LAND USE:

- OPEN SPACE, FAIR CONDITIONS GRASS COVER ON 50 TO 75% OF SITE, HYDROLOGIC SOIL GROUP "B"
  ↳ USE CURVE NO. 69

- PERMANENT SEEDINGS FROM 0-60 DAYS
  ↳ CONTROL PRACTICE FACTOR = 0.4

DETERMINE POST DEVELOPMENT PEAK FLOWRATES USING SCS METHODOLOGY & SEDIMOT II MODEL

- CALCULATE TIME OF CONCENTRATION FOR SHEET FLOW (0-60'), CHANNELIZED FLOW (ALONG BASE OF TERRACE) & CHANNELIZED FLOW ALONG BASE OF LANDFILL FROM ARTICULATED BLOCK CHANNEL (NORTHWEST) TO THE SEDIMENT BASIN. ASSUME TRAVEL TIME DOWN ARTICULATED BLOCK CHANNEL HAPPENS INSTANTANEOUS (CONSERVATIVE ASSUMPTION) AND IS ZERO.

SHEET FLOW: (0-60')

$$T_{t_{0-60}} = \frac{0.007(nL)^{0.8}}{\sqrt{P_2} \cdot S^{0.4}} = \frac{(0.007)(0.15(60))^{0.8}}{\sqrt{4} \cdot (0.333)^{0.4}}$$

$$T_{t_{0'-60'}} = 0.032 \text{ hrs}$$

where:
P_2 = 2 yr, 24 hr storm = 4 inches
S = slope = 1ft/3ft = 0.333
n = Manning's Roughness Coefficient for Sheet Flow
n = 0.15 (short prairie grass)
L = flow length = 60 ft

DESIGN SHEET

SHEET 6 OF 7

RMT® 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 PLYMOUTH	SYK	5/12/99	[illegible]	7/19/99	05101.01

TRAPEZOIDAL CHANNEL FLOW

$$V_{el} = \frac{1.49\, r^{2/3} \cdot S^{1/2}}{n}$$

where: n = Manning Roughness Coeff for Channel Flow

$n = 0.035$ (earth with weeds + stone)

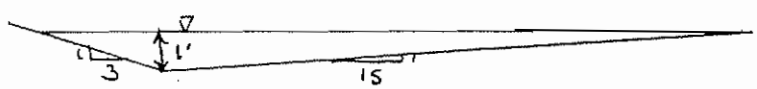
S = Slope = 0.005 ft/ft

r = hydraulic radius = a/p_w

a = cross-sectional flow area, ft^2

p_w = wetted perimeter

CHANNEL ALONG BASE OF TERRACE



$a = (1)(3)(1/2) + (1)(15)(1/2) = 9.0\ ft^2$

$p_w = \left(\sqrt{1^2+3^2} + \sqrt{1^2+15^2}\right) = 18.2\ ft$

$r = a/p_w = 0.495\ ft$

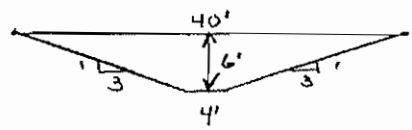
$$V_{el} = \frac{1.49\,(0.495)^{2/3} \cdot (0.005)^{1/2}}{0.035}$$

$V_{el} = 1.88\ ft/sec$

$T_t = \left(\frac{DIST}{VEL}\right) / (3600\ sec/HR)$

DIST. VARIES = MAX CHANNEL LENGTH ALONG TERRACE

CHANNEL ALONG BASE OF LANDFILL CAP



$a = \left(\frac{4'+40'}{2}\right)(6') = 132\ ft^2$

$p_w = 2\left(\sqrt{6^2+18^2}\right) + 4 = 41.95\ ft$

$r = a/p_w = \frac{132\ ft^2}{41.95\ ft} = 3.147\ ft$

$$V_{el} = \frac{1.49\,(3.147)^{2/3} \cdot (0.005)^{1/2}}{0.035}$$

$V_{el} = 6.46\ ft/sec$

$T_t = \left(\frac{DIST}{VEL}\right) / (3600\ sec/HR)$

DIST = 1680 ft

$T_t = 0.072\ hrs$

BASE CHANNEL

DESIGN SHEET

RMT®
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PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER - PLYMOUTH	SYK	5/20/99			05101.01

AREA 3 (WEST BASIN)

WATERSHED #	AREA (ACRES)	MAX CHANNEL LENGTH ALONG TCRACK (FT)	T_t FOR ALL CHANNEL	$T_{SHEET\ FLOW}$	$T_c = \Sigma T_T$
1	3.25	1862	0.275	—	0.275
2	3.62	1980	0.293	0.032	0.325
3	4.30	1915	0.283	0.032	0.315
4	4.31	1855	0.274	0.032	0.306
5	4.31	1735	0.256	0.032	0.288
6	4.39	1630	0.241	0.032	0.273
7	3.96	1400	0.207	0.032	0.239
8	4.01	1035	0.153	0.165 * (L=140')	0.318
9	2.80	1000	0.148	0.032	0.180
10	5.56	640	0.095	0.183 * (L=165)	0.278
TOTAL AREA =	40.51				

$$T_c = T_{t_{SF}} + T_{t_{BC}} + T_{t_{TC}} + T_{t_{ABC}}$$

let $T_{t_{BC}} + T_{t_{ABC}} = 0$. (conservative)

$$* \; T_{t_{SF}} = 0.032 + \frac{0.007(0.15(L))^{0.8}}{\sqrt{4} \cdot (0.05)^{0.4}}$$

CN = 69

$$T_{t_{TC}} = \left(\frac{DIST}{1.88 ft/s}\right)\left(\frac{3600 s/H}{}\right) =$$

OUTFLOW STRUCTURE EVALUATION

RETENTION POND # 3 (West Area)

Weyerhaeuser No. 3 Landfill Permit Application ***RMT Job No.*** ***5101.01***

Plymouth, North Carolina

POND WIDTH	170	(feet)
POND LENGTH	370	(feet)
SIDE SLOPE	3	(Z:1)
DEPTH INCREMENT	0.5	(feet)

Depth (ft.)	Width (ft.)	Length (ft.)	Area (sq. ft.)	Area (acres)	Avg. Area (sq. ft.)	Storage (acre-ft.)
0	170	370	62,900	1.44		0
					63,715	
0.5	173	373	64,529	1.48		0.73
					65,353	
1	176	376	66,176	1.52		1.48
					67,009	
1.5	179	379	67,841	1.56		2.25
					68,683	
2	182	382	69,524	1.60		3.04
					70,375	
2.5	185	385	71,225	1.64		3.85
					72,085	
3	188	388	72,944	1.67		4.67
					73,813	
3.5	191	391	74,681	1.71		5.52
					75,559	
4	194	394	76,436	1.75		6.39
					77,323	
4.5	197	397	78,209	1.80		7.28
					79,105	
5	200	400	80,000	1.84		8.18
					80,905	
5.5	203	403	81,809	1.88		9.11
					82,723	
6	206	406	83,636	1.92		10.06
					84,559	
6.5	209	409	85,481	1.96		11.03
					86,413	
7	212	412	87,344	2.01		12.02
					88,285	
7.5	215	415	89,225	2.05		13.04
					90,175	
8	218	418	91,124	2.09		14.07
					92,083	
8.5	221	421	93,041	2.14		15.13

Normal Depth Channel Analysis Program
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WEYERHAEUSER PLYMOUTH WEST BASIN

CHANNEL SLOPE = .005 FT/FT
MANNINGS N = .035

TRAPEZOIDAL CHANNEL OUTPUT

BOTTOM WIDTH = 44 FT
LEFT SIDE SLOPE = 4 FT/FT
RIGHT SIDE SLOPE = 4 FT/FT

DEPTH (FT)	FLOW (CFS)	AREA (SQ FT)	WP (FT)	VEL (FT/SEC)	CR. DEP. (FT)
0.25	13.20	11.25	46.06	1.17	0.14
0.50	42.21	23.00	48.12	1.84	0.30
0.75	83.62	35.25	50.18	2.37	0.48
1.00	136.19	48.00	52.25	2.84	0.65
1.25	199.24	61.25	54.31	3.25	0.84
1.50	272.38	75.00	56.37	3.63	1.03
1.75	355.38	89.25	58.43	3.98	1.22
2.00	448.08	104.00	60.49	4.31	1.41
2.25	550.42	119.25	62.55	4.62	1.61

OUTFLOW RATING TABLE FOR FLOW ABOVE THE RISER FOR DETENTION POND NO. 3

WEST AREA

Weyerhaeuser No. 3 Landfill Permit Application ***RMT Job No.*** ***5101.01***

Plymouth, North Carolina

RISER DIAMETER.	**2.5**	FT.
HEIGHT OF RISER	***4***	FT.
OUTFLOW PIPE DIAMETER.	***2***	FT.
OUTFLOW PIPE LENGTH.	***70***	FT.
OUTFLOW PIPE SLOPE.	***1***	%
MANNING N-VALUE.	***0.023***	(corrugated metal pipe)
ENTRANCE LOSS COEFFICIENT.	1	
BEND LOSS COEFICIENT.	1	
WEIR COEFICIENT.	***3.33***	(english units)
ORIFICE COEFFICIENT (Cd)	***0.62***	(into riser pipe)
TAILWATER DEPTH	***2.5***	FT.
THICKNESS OF WEIR.	***1***	FT.

HEAD (FT.)	FLOW (CFS)	CONTROL
0	**0**	
0.25	3.3	WEIR
0.50	**9.2**	WEIR
0.75	17.0	WEIR
1.00	**24.4**	ORIFICE
1.25	27.3	ORIFICE
1.50	**29.9**	ORIFICE
1.75	32.3	ORIFICE
2.00	**34.5**	ORIFICE
2.25	36.6	ORIFICE
2.50	**38.6**	ORIFICE
2.75	40.5	ORIFICE
3.00	**42.3**	ORIFICE
3.25	44.0	ORIFICE
3.50	**45.7**	ORIFICE
3.75	47.3	ORIFICE
4.00	**48.8**	ORIFICE
4.25	50.3	ORIFICE
4.50	**51.8**	ORIFICE
4.75	53.2	ORIFICE
5.00	**54.6**	ORIFICE

WEIR FLOW: $Q=C_w*L*H^{1.5}$ ORIFICE FLOW: $Q=C_d*A_o*(2*g*H)^{0.5}$

where: Cw = weir coefficient =3.33 (english units) Cd = C_c* C_v (or see attached sheet)

L = weir length or perimeter of riser (ft.) Ao = orifice area (sq.ft.)

H = head (feet) g = 32.2 ft/s^2

Cc = A_2/A_o (or see attached sheet) *Cv = 0.99 (rounded) to 0.95 (square) orifice*

Weyerhaeuser No. 3 Landfill Permit Application
Plymouth, North Carolina

Detention Pond # *3*
Height of Riser (ft.) *4*
Height of Emergency Spillway (ft.) *6*

RMT Job No. 05101.01

HEAD	ROW																								
ELEV.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	PRIN.	EMER.	TOTAL
0.00	-																						0	0	-
0.50	0.18	-																					0	0	0.18
1.00	0.26	0.18	-																				0	0	0.44
1.50	0.32	0.26	0.18	-																			0	0	0.75
2.00	0.36	0.32	0.26	0.18	-																		0	0	1.12
2.50	0.41	0.36	0.32	0.26	0.18	-																	0	0	1.52
3.00	0.45	0.41	0.36	0.32	0.26	0.18	-																0	0	1.97
3.50	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-															0	0	2.45
4.00	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-														0	0	2.97
4.50	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-													9.2	0	12.71
5.00	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-												24.4	0	28.49
5.50	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-											29.9	0	34.59
6.00	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-										34.5	0	39.82
6.50	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-									38.6	42.21	86.79
7.00	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-								42.3	136.19	185.15
7.50	0.70	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-							45.7	272.38	325.44
8.00	0.73	0.70	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-						48.8	448.08	504.97
8.50	0.75	0.73	0.70	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-					51.8	0	60.64
9.00	0.77	0.75	0.73	0.70	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-				54.6	0	64.21
9.50	0.79	0.77	0.75	0.73	0.70	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-			0	0	10.40
10.00	0.81	0.79	0.77	0.75	0.73	0.70	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18			0	0	11.22
10.50	0.83	0.81	0.79	0.77	0.75	0.73	0.70	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18		0	0	12.08
11.00	0.85	0.83	0.81	0.79	0.77	0.75	0.73	0.70	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	0	0	12.9

TOTAL FLOW RATE PER ROW OF PERFORATED RISER PIPE USING THE ORIFICE EQUATION:

$$Q=n*C_d*A_o*(2*g*y)^{0.5}$$

WHERE:

D =	diameter of riser pipe (inches)	LET: D =	30	$n*C_d*A_o$ =	0.0321
s =	lateral spacing of orifice holes on riser (inches)	s ~	4	$(2*g)^{0.5}$ =	8.025
n =	number of holes per row =(3.14*D/s)+/-1	n =	24	increment=	0.5
d =	diameter of orifice (inches)	d =	0.500		
A_o =	orifice area (sq. ft.) = $(3.14*(d^2/4))/144$	A_o =	0.0014		
g =	32.2 ft/sec^2	g =	32.2		
y =	elevation head (ft)	y =	(see first column in table)		
A_2 =	jet area (sq. ft.)	A_2 =	A_o		
C_v =	0.95 (sqr. edge) to 0.99 (round edge)	C_v =	0.98		
C_c =	A_2/A_o	C_c =	1		
C_d =	discharge coefficient $=C_c*C_v$	C_d =	0.98		

```
*******************************************************************************
*          (program name)                * SEDIMOT S/N  :                      *
*                                        * HMVersion    :  3.20                *
*       (program description)            * Date         :  5/25/99             *
*                                        * Time         : 10:59:28             *
*                                        * Input file   : wpn3d.inp            *
*                                        * Output file  : wpn3d.out            *
*                                        *                                     *
*                                        *                                     *
*******************************************************************************
```

```
 xxxxx   xxxxxxx  xxxxxx   xxxxx  x     x   xxxxx   xxxxxxx
x     x  x        x     x    x    xx   xx  x     x     x
x        x        x     x    x    x x x x  x     x     x
 xxxxx   xxxxx    x     x    x    x  x  x  x     x     x
      x  x        x     x    x    x     x  x     x     x
x     x  x        x     x    x    x     x  x     x     x
 xxxxx   xxxxxxx  xxxxxx   xxxxx  x     x   xxxxx      x
```

```
::::::::::::::::::::::::::::::::::::::::::::
::::::::::::::::::::::::::::::::::::::::::::
:::                                      :::
:::  Full Microcomputer Implementation   :::
:::                 by                   :::
:::        Haestad Methods, Inc.         :::
:::                                      :::
::::::::::::::::::::::::::::::::::::::::::::
::::::::::::::::::::::::::::::::::::::::::::
```

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

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        VERSION DATE 5-25-83

        DISCLAIMER: NEITHER THE UNIVERSITY NOR ANY OF ITS EMPLOYEES
        ACCEPT ANY RESPONSIBILITY OR LEGAL LIABILITY FOR THE
        CONCLUSIONS DRAWN FROM THE RESULTS OF THIS MODEL


*************************************************************
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              ********************************************
                   WATERSHED IDENTIFICATION CODE
                   -----------------------------
                   WEYERHAEUSER PLYMOUTH/WEST AREA/170'X370'X4'/2YR-24HR STORM
              ********************************************


============================  STORM  INPUT  ============================

QUESTION
   NO.

    1. STORM TYPE -                                          SCS'S TYPE 2
    2. RAINFALL DEPTH -                                        4.00 INCHES
    3. STORM DURATION -                                       24.00 HOURS
    4. TIME INCREMENT -                                         .10 HOURS

=====================================================================


==========================  WATERSHED DATA  ==========================

QUESTION
   NO.
    1. NUMBER OF JUNCTIONS - 1
    2. JUNCTION     NUMBER OF BRANCHES
```

1 1

3. COMPUTATION - BOTH HYDROLOGY AND SEDIMENTOLOGY

==========

========== SEDIMENTOLOGY INPUTS ==========

QUESTION NO.		
1.	SPECIFIC GRAVITY -	2.64
2.	COEFFICIENT FOR DISTRIBUTING SEDIMENT LOAD -	2.00
3.	SUBMERGED BULK SPECIFIC GRAVITY -	1.35
4.	NUMBER OF PARTICLE SIZE DISTRIBUTIONS -	1
5.	NUMBER OF DATA VALUES PER PARTICLE SIZE DISTRIBUTION -	11

==========

========== INPUT PARTICLE SIZE DISTRIBUTIONS ==========

VALUE NO.	SIZE, MM
1	1.0000
2	.5000
3	.2000
4	.1000
5	.0800
6	.0500
7	.0100
8	.0090
9	.0050
10	.0020
11	.0001

==========

========== PERCENT FINER DISTRIBUTIONS ==========

VALUE NO.	PARTICLE SIZE # 1
1	100.00
2	99.90
3	87.50
4	50.50
5	44.50
6	36.50
7	32.00
8	31.00
9	29.00
10	24.50
11	.00

==========

========== STRUCTURE INPUT FOR JUNCTION #1 ==========

BRANCH	NUMBER OF STRUCTURES
1	1

==========

========== BETWEEN STRUCTURE ROUTING PARAMETERS ==========

BRANCH NO.	BETWEEN	PARAMETERS 1 TIME	2 MUSK. K	3 MUSK. X,
1	PRIOR J OR S TO STRUCTURE 1	.00	.00	.00

==========

========== STRUCTURE DATA FOR JUNCTION #1 ==========

QUESTION NO.		
1.	NUMBER OF SUBWATERSHEDS -	10
2.	TYPE OF SEDIMENT CONTROL STRUCTURE -	POND

==========

* *
JUNCTION 1, BRANCH 1, STRUCTURE 1
* *

*** HYDRAULIC INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	AREA ACRES	CURVE NUMBER	TC HR	TT HR	ROUTING COEFFICIENTS K-HRS	X,	UNIT HYDRO
1	3.25	69.00	.275	.000	.000	.00	2.0
2	3.62	69.00	.325	.000	.000	.00	2.0
3	4.30	69.00	.315	.000	.000	.00	2.0
4	4.31	69.00	.306	.000	.000	.00	2.0
5	4.31	69.00	.288	.000	.000	.00	2.0
6	4.39	69.00	.273	.000	.000	.00	2.0
7	3.96	69.00	.239	.000	.000	.00	2.0
8	4.01	69.00	.318	.000	.000	.00	2.0
9	2.80	69.00	.180	.000	.000	.00	2.0
10	5.56	69.00	.278	.000	.000	.00	2.0

*** SEDIMENT INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	SEG NUM	SOIL K	LENGTH FEET	SLOPE PCT	CP VALUE	PART OPT	SURF COND
1	1	.20	60.0	33.30	.400	1.0	.0
2	1	.20	60.0	33.30	.400	1.0	.0
3	1	.20	60.0	33.30	.400	1.0	.0
4	1	.20	60.0	33.30	.400	1.0	.0
5	1	.20	60.0	33.30	.400	1.0	.0
6	1	.20	60.0	33.30	.400	1.0	.0
7	1	.20	60.0	33.30	.400	1.0	.0
8	1	.20	60.0	33.30	.400	1.0	.0
9	1	.20	60.0	33.30	.400	1.0	.0
10	1	.20	60.0	33.30	.400	1.0	.0

* * * COMPUTED VALUES FOR INDIVIDUAL WATERSHEDS * * *

WATERSHED	PEAK FLOW (CFS)	RUNOFF (INCHES)	SEDIMENT TONS	DIAM (MM)	DELIVERY RATIO 1	DELIVERY RATIO 2
1	2.85	1.27	58.85	.054	.758	1.000
2	2.96	1.27	63.87	.049	.729	1.000
3	3.57	1.27	78.02	.051	.735	1.000
4	3.62	1.27	78.75	.051	.740	1.000
5	3.71	1.27	79.86	.053	.750	1.000
6	3.87	1.27	82.55	.055	.760	1.000
7	3.69	1.27	75.89	.059	.784	1.000
8	3.31	1.27	71.99	.050	.733	1.000
9	2.91	1.27	54.68	.068	.833	1.000
10	4.86	1.27	107.12	.054	.756	1.000

***** SUMMARY TABLE FOR TOTAL WATERSHED *****

STORM DURATION	=	24.00	HOURS
PRECIPITATION DEPTH	=	4.00	INCHES
RUNOFF VOLUME	=	4.2759	ACRE-FT
PEAK DISCHARGE	=	35.3521	CFS
AREA	=	40.5100	ACRES
TIME OF PEAK DISCHARGE	=	12.10	HRS
LOAD RATE EXPONENT FACTOR	=	2.00	
BETA	=	1.0000	
SUBMERGE BULK SPECIFIC GRAVITY	=	1.35	
RAINFALL EROSITIVITY FACTOR	=	98.49	EI UNIT
PEAK CONCENTRATION	=	307986.60	MG/L
PEAK SETTLEABLE CONCENTRATION	=	130.0334	ML/L
PEAK SETTLEABLE CONCENTRATION	=	175545.00	MG/L
TOTAL SEDIMENT YIELD	=	751.5802	TONS
REPRESENTATIVE PARTICLE SIZE	=	.0538	MM
TIME OF PEAK CONCENTRATION	=	12.10	HRS
PERIOD OF SIGNIFICANT CONCENTRATION	=	14.40	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	49.94	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	49.94	ML/L

ARITHMETIC AVERAGE SETTLEABLE
CONCENTRATION DURING PERIOD OF
SIGNIFICANT CONCENTRATION = 14.42 ML/L
ARITHMETIC AVERAGE SETTLEABLE
CONCENTRATION DURING PEAK 24 HOUR
PERIOD = 8.65 ML/L

========== POND INPUT ==========

QUESTION NO.		
1.	TIME INCREMENT OF THE ROUTED HYDROGRAPH -	.10 HOURS
2.	NON-IDEAL SETTLING CORRECTION FACTOR -	1.00
3.	PERCENT OF PERMANENT POOL THAT IS DEAD SPACE -	35.00
4.	OUTFLOW WITHDRAWAL OPTION -	SURFACE
5.	INFLOW VERTICAL CONCENTRATION -	COMP. MIXED
6.	NUMBER OF STAGE POINTS -	11
7.	NUMBER OF ROUTED HYDROGRAPH POINTS -	500
8.	STAGE-DISCHARGE OPTION -	INPUT
9.	OUTPUT OPTION -	SUM. TABLES
10.	NUMBER OF CONTINUOUS STIRRED REACTORS	3

==========

========== POND STAGE DATA ==========

STAGE POINT	VALUE
1	.00
2	2.50
3	3.00
4	3.50
5	4.00
6	4.50
7	5.00
8	5.50
9	6.00
10	6.50
11	7.00

==========

========== POND AREA DATA ==========

AREA POINT	VALUE
1	1.44
2	1.64
3	1.67
4	1.71
5	1.75
6	1.80
7	1.84
8	1.88
9	1.92
10	1.96

11	2.01

==========

========== POND DISCHARGE DATA ==========

DISCHARGE POINT	VALUE
1	.00
2	.00
3	1.97
4	2.45
5	2.97
6	12.71
7	28.49
8	34.59
9	39.82
10	86.79
11	185.15

==========

* *

POND RESULTS

* *

***** BASIN GEOMETRY *****

STAGE (FT)	AREA (ACRES)	AVERAGE DEPTH (FT)	DISCHARGE (CFS)	CAPACITY (ACRES-FT)
.00	1.440	.00	.00	.00
2.50	1.640	2.42	.00	3.85
3.00	1.670	2.90	1.97	4.68
3.50	1.710	3.38	2.45	5.52
4.00	1.750	3.86	2.97	6.39
4.50	1.800	4.32	12.71	7.27
5.00	1.840	4.79	28.49	8.18
5.50	1.880	5.25	34.59	9.11
6.00	1.920	5.70	39.82	10.06
6.50	1.960	6.16	86.79	11.03
7.00	2.010	6.61	185.15	12.03

***** STORM EVENT SUMMARY *****

TURBULENCE FACTOR	=	1.00	
PERMANENT POOL CAPACITY	=	3.850	ACRE-FT
DEAD STORAGE	=	35.00	PERCENT
TIME INCREMENT OUTFLOW	=	.10	HRS
VISCOSITY	=	.009	CM**2/SEC
INFLOW RUNOFF VOLUME	=	4.276	ACRE-FT
OUTFLOW ROUTED VOLUME	=	4.264	ACRE-FT
STORM VOLUME DISCHARGED	=	4.264	ACRE-FT
POND VOLUME AT PEAK STAGE	=	6.142	ACRE-FT
PEAK STAGE	=	3.858	FT
PEAK INFLOW RATE	=	35.352	CFS
PEAK DISCHARGE RATE	=	2.822	CFS
PEAK INFLOW SEDIMENT CONCENTRATION	=	307986.60	MG/L
PEAK EFFLUENT SEDIMENT CONCENTRATION	=	33125.20	MG/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	.0000	ML/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	.05	MG/L
STORM AVERAGE EFFLUENT CONCENTRATION	=	28748.06	MG/L
AVERAGE EFFLUENT SEDIMENT CONCENTRATION	=	28748.06	MG/L
BASIN TRAP EFFICIENCY	=	77.76	PERCENT
DETENTION TIME OF FLOW WITH SEDIMENT	=	7.80	HRS
DETENTION TIME FROM HYDROGRAPH CENTERS	=	7.80	HRS
DETENTION TIME INCLUDING STORED FLOW	=	7.80	HRS
SEDIMENT LOAD DISCHARGED	=	167.12	TONS
PERIOD OF SIGNIFICANT CONCENTRATION	=	38.40	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L

*** RUN COMPLETED ****

```
*****************************************************************************
*          (program name)                * SEDIMOT S/N  :                    *
*                                        * HMVersion    :  3.20              *
*       (program description)            * Date         :  5/25/99           *
*                                        * Time         : 10:46:54           *
*                                        * Input file   : wpn3a.inp          *
*                                        * Output file  : wpn3a.out          *
*                                        *                                   *
*                                        *                                   *
*****************************************************************************
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 xxxxx   xxxxxxx  xxxxxx   xxxxx  x     x   xxxxx   xxxxxxx
x     x  x        x     x    x    xx   xx  x     x     x
x        x        x     x    x    x x x x  x     x     x
 xxxxx   xxxxx    x     x    x    x  x  x  x     x     x
      x  x        x     x    x    x     x  x     x     x
x     x  x        x     x    x    x     x  x     x     x
 xxxxx   xxxxxxx  xxxxxx   xxxxx  x     x   xxxxx      x
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:::                                      :::
:::  Full Microcomputer Implementation   :::
:::                 by                   :::
:::        Haestad Methods, Inc.         :::
:::                                      :::
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*************************************************************
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            *********************************************
                 WATERSHED IDENTIFICATION CODE
                 -----------------------------
                 WEYERHAEUSER PLYMOUTH/WEST AREA/170'X370'X4'/10YR-24HR STORM
            *********************************************


============================  STORM  INPUT  ============================

QUESTION
   NO.

    1. STORM TYPE -                                          SCS'S TYPE 2
    2. RAINFALL DEPTH -                                        6.25 INCHES
    3. STORM DURATION -                                       24.00 HOURS
    4. TIME INCREMENT -                                         .10 HOURS

=====================================================================


===========================  WATERSHED DATA  ==========================

QUESTION
   NO.
    1. NUMBER OF JUNCTIONS - 1
    2. JUNCTION     NUMBER OF BRANCHES
```

```
          1                1
   3. COMPUTATION - BOTH HYDROLOGY AND SEDIMENTOLOGY

==========================================================================



========================  SEDIMENTOLOGY INPUTS  ========================

QUESTION
   NO.
    1. SPECIFIC GRAVITY -                                            2.64
    2. COEFFICIENT FOR DISTRIBUTING SEDIMENT LOAD -                  2.00
    3. SUBMERGED BULK SPECIFIC GRAVITY -                             1.35
    4. NUMBER OF PARTICLE SIZE DISTRIBUTIONS -                       1
    5. NUMBER OF DATA VALUES PER PARTICLE SIZE DISTRIBUTION -       11

==========================================================================



================= INPUT PARTICLE SIZE DISTRIBUTIONS ===================

                        VALUE
                         NO.        SIZE, MM

                          1           1.0000
                          2            .5000
                          3            .2000
                          4            .1000
                          5            .0800
                          6            .0500
                          7            .0100
                          8            .0090
                          9            .0050
                         10            .0020
                         11            .0001

==========================================================================



====================  PERCENT FINER DISTRIBUTIONS  =====================

VALUE                        PARTICLE SIZE #
 NO.
          1
  1    100.00
  2     99.90
  3     87.50
  4     50.50
  5     44.50
  6     36.50
  7     32.00
  8     31.00
  9     29.00
 10     24.50
 11       .00

==========================================================================
```

========== STRUCTURE INPUT FOR JUNCTION #1 ==========

BRANCH	NUMBER OF STRUCTURES
1	1

==========

========== BETWEEN STRUCTURE ROUTING PARAMETERS ==========

BRANCH NO.	BETWEEN	PARAMETERS 1 TIME	2 MUSK. K	3 MUSK. X,
1	PRIOR J OR S TO STRUCTURE 1	.00	.00	.00

==========

========== STRUCTURE DATA FOR JUNCTION #1 ==========

QUESTION NO.		
1.	NUMBER OF SUBWATERSHEDS -	10
2.	TYPE OF SEDIMENT CONTROL STRUCTURE -	POND

==========

* *
JUNCTION 1, BRANCH 1, STRUCTURE 1
* *

*** HYDRAULIC INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	AREA ACRES	CURVE NUMBER	TC HR	TT HR	ROUTING COEFFICIENTS K-HRS	X,	UNIT HYDRO
1	3.25	69.00	.275	.000	.000	.00	2.0
2	3.62	69.00	.325	.000	.000	.00	2.0
3	4.30	69.00	.315	.000	.000	.00	2.0
4	4.31	69.00	.306	.000	.000	.00	2.0
5	4.31	69.00	.288	.000	.000	.00	2.0
6	4.39	69.00	.273	.000	.000	.00	2.0
7	3.96	69.00	.239	.000	.000	.00	2.0
8	4.01	69.00	.318	.000	.000	.00	2.0
9	2.80	69.00	.180	.000	.000	.00	2.0
10	5.56	69.00	.278	.000	.000	.00	2.0

*** SEDIMENT INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	SEG NUM	SOIL K	LENGTH FEET	SLOPE PCT	CP VALUE	PART OPT	SURF COND
1	1	.20	60.0	33.30	.400	1.0	.0
2	1	.20	60.0	33.30	.400	1.0	.0
3	1	.20	60.0	33.30	.400	1.0	.0
4	1	.20	60.0	33.30	.400	1.0	.0
5	1	.20	60.0	33.30	.400	1.0	.0
6	1	.20	60.0	33.30	.400	1.0	.0
7	1	.20	60.0	33.30	.400	1.0	.0
8	1	.20	60.0	33.30	.400	1.0	.0
9	1	.20	60.0	33.30	.400	1.0	.0
10	1	.20	60.0	33.30	.400	1.0	.0

* * * COMPUTED VALUES FOR INDIVIDUAL WATERSHEDS * * *

WATERSHED	PEAK FLOW (CFS)	RUNOFF (INCHES)	SEDIMENT TONS	DIAM (MM)	DELIVERY RATIO 1	DELIVERY RATIO 2
1	6.90	2.91	153.71	.062	.806	1.000
2	7.22	2.91	167.51	.058	.778	1.000
3	8.68	2.91	204.51	.059	.783	1.000
4	8.80	2.91	206.35	.059	.788	1.000
5	9.00	2.91	208.93	.061	.798	1.000
6	9.34	2.91	215.55	.063	.807	1.000
7	8.82	2.91	197.05	.067	.828	1.000
8	8.07	2.91	188.72	.058	.782	1.000
9	6.83	2.91	140.65	.076	.871	1.000
10	11.76	2.91	279.87	.062	.804	1.000

***** SUMMARY TABLE FOR TOTAL WATERSHED *****

STORM DURATION	=	24.00	HOURS
PRECIPITATION DEPTH	=	6.25	INCHES
RUNOFF VOLUME	=	9.8207	ACRE-FT
PEAK DISCHARGE	=	85.4372	CFS
AREA	=	40.5100	ACRES
TIME OF PEAK DISCHARGE	=	12.10	HRS
LOAD RATE EXPONENT FACTOR	=	2.00	
BETA	=	1.0000	
SUBMERGE BULK SPECIFIC GRAVITY	=	1.35	
RAINFALL EROSITIVITY FACTOR	=	260.30	EI UNIT
PEAK CONCENTRATION	=	329941.80	MG/L
PEAK SETTLEABLE CONCENTRATION	=	145.4608	ML/L
PEAK SETTLEABLE CONCENTRATION	=	196372.10	MG/L
TOTAL SEDIMENT YIELD	=	1962.8640	TONS
REPRESENTATIVE PARTICLE SIZE	=	.0618	MM
TIME OF PEAK CONCENTRATION	=	12.10	HRS
PERIOD OF SIGNIFICANT CONCENTRATION	=	16.20	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	58.67	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	58.67	ML/L

ARITHMETIC AVERAGE SETTLEABLE
CONCENTRATION DURING PERIOD OF
SIGNIFICANT CONCENTRATION = 13.67 ML/L
ARITHMETIC AVERAGE SETTLEABLE
CONCENTRATION DURING PEAK 24 HOUR
PERIOD = 9.22 ML/L

========== POND INPUT ==========

QUESTION NO.		
1.	TIME INCREMENT OF THE ROUTED HYDROGRAPH -	.10 HOURS
2.	NON-IDEAL SETTLING CORRECTION FACTOR -	1.00
3.	PERCENT OF PERMANENT POOL THAT IS DEAD SPACE -	35.00
4.	OUTFLOW WITHDRAWAL OPTION -	SURFACE
5.	INFLOW VERTICAL CONCENTRATION -	COMP. MIXED
6.	NUMBER OF STAGE POINTS -	11
7.	NUMBER OF ROUTED HYDROGRAPH POINTS -	500
8.	STAGE-DISCHARGE OPTION -	INPUT
9.	OUTPUT OPTION -	SUM. TABLES
10.	NUMBER OF CONTINUOUS STIRRED REACTORS	3

==========

========== POND STAGE DATA ==========

STAGE POINT	VALUE
1	.00
2	2.50
3	3.00
4	3.50
5	4.00
6	4.50
7	5.00
8	5.50
9	6.00
10	6.50
11	7.00

==========

========== POND AREA DATA ==========

AREA POINT	VALUE
1	1.44
2	1.64
3	1.67
4	1.71
5	1.75
6	1.80
7	1.84
8	1.88
9	1.92
10	1.96

11 2.01

==========

========== POND DISCHARGE DATA ==========

DISCHARGE POINT	VALUE
1	.00
2	.00
3	1.97
4	2.45
5	2.97
6	12.71
7	28.49
8	34.59
9	39.82
10	86.79
11	185.15

==========

* *

POND RESULTS

* *

***** BASIN GEOMETRY *****

STAGE (FT)	AREA (ACRES)	AVERAGE DEPTH (FT)	DISCHARGE (CFS)	CAPACITY (ACRES-FT)
.00	1.440	.00	.00	.00
2.50	1.640	2.42	.00	3.85
3.00	1.670	2.90	1.97	4.68
3.50	1.710	3.38	2.45	5.52
4.00	1.750	3.86	2.97	6.39
4.50	1.800	4.32	12.71	7.27
5.00	1.840	4.79	28.49	8.18
5.50	1.880	5.25	34.59	9.11
6.00	1.920	5.70	39.82	10.06
6.50	1.960	6.16	86.79	11.03
7.00	2.010	6.61	185.15	12.03

***** STORM EVENT SUMMARY *****

TURBULENCE FACTOR	=	1.00	
PERMANENT POOL CAPACITY	=	3.850	ACRE-FT
DEAD STORAGE	=	35.00	PERCENT
TIME INCREMENT OUTFLOW	=	.10	HRS
VISCOSITY	=	.009	CM**2/SEC
INFLOW RUNOFF VOLUME	=	9.821	ACRE-FT
OUTFLOW ROUTED VOLUME	=	9.795	ACRE-FT
STORM VOLUME DISCHARGED	=	9.795	ACRE-FT
POND VOLUME AT PEAK STAGE	=	8.013	ACRE-FT
PEAK STAGE	=	4.906	FT
PEAK INFLOW RATE	=	85.437	CFS
PEAK DISCHARGE RATE	=	25.514	CFS
PEAK INFLOW SEDIMENT CONCENTRATION	=	329941.80	MG/L
PEAK EFFLUENT SEDIMENT CONCENTRATION	=	61465.19	MG/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	.0002	ML/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	.22	MG/L
STORM AVERAGE EFFLUENT CONCENTRATION	=	47206.12	MG/L
AVERAGE EFFLUENT SEDIMENT CONCENTRATION	=	47206.12	MG/L
BASIN TRAP EFFICIENCY	=	67.87	PERCENT
DETENTION TIME OF FLOW WITH SEDIMENT	=	5.24	HRS
DETENTION TIME FROM HYDROGRAPH CENTERS	=	5.24	HRS
DETENTION TIME INCLUDING STORED FLOW	=	5.24	HRS
SEDIMENT LOAD DISCHARGED	=	630.61	TONS
PERIOD OF SIGNIFICANT CONCENTRATION	=	39.70	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L

*** RUN COMPLETED ****

```
*****************************************************************************
*          (program name)                * SEDIMOT S/N  :                    *
*                                        * HMVersion    :  3.20              *
*       (program description)            * Date         :  5/25/99           *
*                                        * Time         : 10:55:43           *
*                                        * Input file   : wpn3b.inp          *
*                                        * Output file  : wpn3b.out          *
*                                        *                                   *
*                                        *                                   *
*****************************************************************************
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 xxxxx   xxxxxxx  xxxxxx   xxxxx  x     x   xxxxx   xxxxxxx
x     x  x        x     x    x    xx   xx  x     x     x
x        x        x     x    x    x x x x  x     x     x
 xxxxx   xxxxx    x     x    x    x  x  x  x     x     x
      x  x        x     x    x    x     x  x     x     x
x     x  x        x     x    x    x     x  x     x     x
 xxxxx   xxxxxxx  xxxxxx   xxxxx  x     x   xxxxx      x
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:::                                      :::
:::  Full Microcomputer Implementation   :::
:::                 by                   :::
:::        Haestad Methods, Inc.         :::
:::                                      :::
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       OF SURFACE MINE HYDROLOGY AND SEDIMENTOLOGY
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       VERSION DATE 5-25-83

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       CONCLUSIONS DRAWN FROM THE RESULTS OF THIS MODEL


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            *********************************************
                 WATERSHED IDENTIFICATION CODE
                 -----------------------------
                 WEYERHAEUSER PLYMOUTH/WEST AREA/170'X370'X4'/25YR-24HR STORM
            *********************************************


============================  STORM  INPUT  ============================

QUESTION
   NO.

    1. STORM TYPE -                                          SCS'S TYPE 2
    2. RAINFALL DEPTH -                                        7.25 INCHES
    3. STORM DURATION -                                       24.00 HOURS
    4. TIME INCREMENT -                                         .10 HOURS

=====================================================================


==========================  WATERSHED DATA  ==========================

QUESTION
   NO.
    1. NUMBER OF JUNCTIONS - 1
    2. JUNCTION     NUMBER OF BRANCHES
```

1 1

3. COMPUTATION - BOTH HYDROLOGY AND SEDIMENTOLOGY

==========

========== SEDIMENTOLOGY INPUTS ==========

QUESTION NO.		
1.	SPECIFIC GRAVITY -	2.64
2.	COEFFICIENT FOR DISTRIBUTING SEDIMENT LOAD -	2.00
3.	SUBMERGED BULK SPECIFIC GRAVITY -	1.35
4.	NUMBER OF PARTICLE SIZE DISTRIBUTIONS -	1
5.	NUMBER OF DATA VALUES PER PARTICLE SIZE DISTRIBUTION -	11

==========

========== INPUT PARTICLE SIZE DISTRIBUTIONS ==========

VALUE NO.	SIZE, MM
1	1.0000
2	.5000
3	.2000
4	.1000
5	.0800
6	.0500
7	.0100
8	.0090
9	.0050
10	.0020
11	.0001

==========

========== PERCENT FINER DISTRIBUTIONS ==========

VALUE NO.	PARTICLE SIZE # 1
1	100.00
2	99.90
3	87.50
4	50.50
5	44.50
6	36.50
7	32.00
8	31.00
9	29.00
10	24.50
11	.00

==========

========== STRUCTURE INPUT FOR JUNCTION #1 ==========

BRANCH	NUMBER OF STRUCTURES
1	1

==========

========== BETWEEN STRUCTURE ROUTING PARAMETERS ==========

BRANCH NO.	BETWEEN	PARAMETERS 1 TIME	2 MUSK. K	3 MUSK. X,
1	PRIOR J OR S TO STRUCTURE 1	.00	.00	.00

==========

========== STRUCTURE DATA FOR JUNCTION #1 ==========

QUESTION NO.		
1.	NUMBER OF SUBWATERSHEDS -	10
2.	TYPE OF SEDIMENT CONTROL STRUCTURE -	POND

==========

* *
JUNCTION 1, BRANCH 1, STRUCTURE 1
* *

*** HYDRAULIC INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	AREA ACRES	CURVE NUMBER	TC HR	TT HR	ROUTING COEFFICIENTS K-HRS	X,	UNIT HYDRO
1	3.25	69.00	.275	.000	.000	.00	2.0
2	3.62	69.00	.325	.000	.000	.00	2.0
3	4.30	69.00	.315	.000	.000	.00	2.0
4	4.31	69.00	.306	.000	.000	.00	2.0
5	4.31	69.00	.288	.000	.000	.00	2.0
6	4.39	69.00	.273	.000	.000	.00	2.0
7	3.96	69.00	.239	.000	.000	.00	2.0
8	4.01	69.00	.318	.000	.000	.00	2.0
9	2.80	69.00	.180	.000	.000	.00	2.0
10	5.56	69.00	.278	.000	.000	.00	2.0

*** SEDIMENT INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	SEG NUM	SOIL K	LENGTH FEET	SLOPE PCT	CP VALUE	PART OPT	SURF COND
1	1	.20	60.0	33.30	.400	1.0	.0
2	1	.20	60.0	33.30	.400	1.0	.0
3	1	.20	60.0	33.30	.400	1.0	.0
4	1	.20	60.0	33.30	.400	1.0	.0
5	1	.20	60.0	33.30	.400	1.0	.0
6	1	.20	60.0	33.30	.400	1.0	.0
7	1	.20	60.0	33.30	.400	1.0	.0
8	1	.20	60.0	33.30	.400	1.0	.0
9	1	.20	60.0	33.30	.400	1.0	.0
10	1	.20	60.0	33.30	.400	1.0	.0

* * * COMPUTED VALUES FOR INDIVIDUAL WATERSHEDS * * *

WATERSHED	PEAK FLOW (CFS)	RUNOFF (INCHES)	SEDIMENT TONS	DIAM (MM)	DELIVERY RATIO 1	DELIVERY RATIO 2
1	8.87	3.72	202.99	.065	.817	1.000
2	9.29	3.72	221.34	.060	.790	1.000
3	11.17	3.72	270.20	.061	.795	1.000
4	11.32	3.72	272.61	.061	.800	1.000
5	11.57	3.72	275.97	.063	.810	1.000
6	12.00	3.72	284.64	.065	.818	1.000
7	11.33	3.72	260.14	.069	.839	1.000
8	10.37	3.72	249.35	.060	.793	1.000
9	8.72	3.72	185.06	.078	.880	1.000
10	15.11	3.72	369.62	.064	.816	1.000

***** SUMMARY TABLE FOR TOTAL WATERSHED *****

STORM DURATION	=	24.00	HOURS
PRECIPITATION DEPTH	=	7.25	INCHES
RUNOFF VOLUME	=	12.5582	ACRE-FT
PEAK DISCHARGE	=	109.7541	CFS
AREA	=	40.5100	ACRES
TIME OF PEAK DISCHARGE	=	12.10	HRS
LOAD RATE EXPONENT FACTOR	=	2.00	
BETA	=	1.0000	
SUBMERGE BULK SPECIFIC GRAVITY	=	1.35	
RAINFALL EROSITIVITY FACTOR	=	359.62	EI UNIT
PEAK CONCENTRATION	=	336918.40	MG/L
PEAK SETTLEABLE CONCENTRATION	=	149.9510	ML/L
PEAK SETTLEABLE CONCENTRATION	=	202433.90	MG/L
TOTAL SEDIMENT YIELD	=	2591.9030	TONS
REPRESENTATIVE PARTICLE SIZE	=	.0639	MM
TIME OF PEAK CONCENTRATION	=	12.10	HRS
PERIOD OF SIGNIFICANT CONCENTRATION	=	16.90	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	60.98	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	60.98	ML/L

ARITHMETIC AVERAGE SETTLEABLE
CONCENTRATION DURING PERIOD OF
SIGNIFICANT CONCENTRATION = 13.46 ML/L
ARITHMETIC AVERAGE SETTLEABLE
CONCENTRATION DURING PEAK 24 HOUR
PERIOD = 9.48 ML/L

========== POND INPUT ==========

QUESTION NO.		
1.	TIME INCREMENT OF THE ROUTED HYDROGRAPH -	.10 HOURS
2.	NON-IDEAL SETTLING CORRECTION FACTOR -	1.00
3.	PERCENT OF PERMANENT POOL THAT IS DEAD SPACE -	35.00
4.	OUTFLOW WITHDRAWAL OPTION -	SURFACE
5.	INFLOW VERTICAL CONCENTRATION -	COMP. MIXED
6.	NUMBER OF STAGE POINTS -	11
7.	NUMBER OF ROUTED HYDROGRAPH POINTS -	500
8.	STAGE-DISCHARGE OPTION -	INPUT
9.	OUTPUT OPTION -	SUM. TABLES
10.	NUMBER OF CONTINUOUS STIRRED REACTORS	3

==========

========== POND STAGE DATA ==========

STAGE POINT	VALUE
1	.00
2	2.50
3	3.00
4	3.50
5	4.00
6	4.50
7	5.00
8	5.50
9	6.00
10	6.50
11	7.00

==========

========== POND AREA DATA ==========

AREA POINT	VALUE
1	1.44
2	1.64
3	1.67
4	1.71
5	1.75
6	1.80
7	1.84
8	1.88
9	1.92
10	1.96

11	2.01

==========

========== POND DISCHARGE DATA ==========

DISCHARGE POINT	VALUE
1	.00
2	.00
3	1.97
4	2.45
5	2.97
6	12.71
7	28.49
8	34.59
9	39.82
10	86.79
11	185.15

==========

* *

POND RESULTS

* *

***** BASIN GEOMETRY *****

STAGE (FT)	AREA (ACRES)	AVERAGE DEPTH (FT)	DISCHARGE (CFS)	CAPACITY (ACRES-FT)
.00	1.440	.00	.00	.00
2.50	1.640	2.42	.00	3.85
3.00	1.670	2.90	1.97	4.68
3.50	1.710	3.38	2.45	5.52
4.00	1.750	3.86	2.97	6.39
4.50	1.800	4.32	12.71	7.27
5.00	1.840	4.79	28.49	8.18
5.50	1.880	5.25	34.59	9.11
6.00	1.920	5.70	39.82	10.06
6.50	1.960	6.16	86.79	11.03
7.00	2.010	6.61	185.15	12.03

***** STORM EVENT SUMMARY *****

TURBULENCE FACTOR	=	1.00	
PERMANENT POOL CAPACITY	=	3.850	ACRE-FT
DEAD STORAGE	=	35.00	PERCENT
TIME INCREMENT OUTFLOW	=	.10	HRS
VISCOSITY	=	.009	CM**2/SEC
INFLOW RUNOFF VOLUME	=	12.558	ACRE-FT
OUTFLOW ROUTED VOLUME	=	12.529	ACRE-FT
STORM VOLUME DISCHARGED	=	12.529	ACRE-FT
POND VOLUME AT PEAK STAGE	=	8.966	ACRE-FT
PEAK STAGE	=	5.420	FT
PEAK INFLOW RATE	=	109.754	CFS
PEAK DISCHARGE RATE	=	33.610	CFS
PEAK INFLOW SEDIMENT CONCENTRATION	=	336918.40	MG/L
PEAK EFFLUENT SEDIMENT CONCENTRATION	=	69899.31	MG/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	.0034	ML/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	4.57	MG/L
STORM AVERAGE EFFLUENT CONCENTRATION	=	51434.64	MG/L
AVERAGE EFFLUENT SEDIMENT CONCENTRATION	=	51434.64	MG/L
BASIN TRAP EFFICIENCY	=	66.09	PERCENT
DETENTION TIME OF FLOW WITH SEDIMENT	=	4.45	HRS
DETENTION TIME FROM HYDROGRAPH CENTERS	=	4.45	HRS
DETENTION TIME INCLUDING STORED FLOW	=	4.45	HRS
SEDIMENT LOAD DISCHARGED	=	878.91	TONS
PERIOD OF SIGNIFICANT CONCENTRATION	=	40.40	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L

*** RUN COMPLETED ****

```
*****************************************************************************
*          (program name)                * SEDIMOT S/N  :                    *
*                                        * HMVersion    :  3.20              *
*       (program description)            * Date         :  5/25/99           *
*                                        * Time         : 10:53:33           *
*                                        * Input file   : wpn3c.inp          *
*                                        * Output file  : wpn3c.out          *
*                                        *                                   *
*                                        *                                   *
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 XXXXX   XXXXXXX  XXXXXX   XXXXX  X     X   XXXXX   XXXXXXX
X     X  X        X     X    X    XX   XX  X     X     X
X        X        X     X    X    X X X X  X     X     X
 XXXXX   XXXXX    X     X    X    X  X  X  X     X     X
      X  X        X     X    X    X     X  X     X     X
X     X  X        X     X    X    X     X  X     X     X
 XXXXX   XXXXXXX  XXXXXX   XXXXX  X     X   XXXXX      X
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:::  Full Microcomputer Implementation   :::
:::                 by                   :::
:::        Haestad Methods, Inc.         :::
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        VERSION DATE 5-25-83

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*************************************************************
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            *********************************************
                 WATERSHED IDENTIFICATION CODE
                 -----------------------------
                 WEYERHAEUSER PLYMOUTH/WEST AREA/170'X370'X4'/100YR-24HR STOR
            *********************************************


============================  STORM  INPUT  ============================

QUESTION
   NO.

    1. STORM TYPE -                                          SCS'S TYPE 2
    2. RAINFALL DEPTH -                                        9.00 INCHES
    3. STORM DURATION -                                       24.00 HOURS
    4. TIME INCREMENT -                                         .10 HOURS

=====================================================================


===========================  WATERSHED DATA  ==========================

QUESTION
   NO.
    1. NUMBER OF JUNCTIONS - 1
    2. JUNCTION     NUMBER OF BRANCHES
```

```
          1                1
   3. COMPUTATION - BOTH HYDROLOGY AND SEDIMENTOLOGY

==========================================================================



========================  SEDIMENTOLOGY INPUTS  ========================

QUESTION
   NO.
    1. SPECIFIC GRAVITY -                                          2.64
    2. COEFFICIENT FOR DISTRIBUTING SEDIMENT LOAD -                2.00
    3. SUBMERGED BULK SPECIFIC GRAVITY -                           1.35
    4. NUMBER OF PARTICLE SIZE DISTRIBUTIONS -                     1
    5. NUMBER OF DATA VALUES PER PARTICLE SIZE DISTRIBUTION -     11

==========================================================================



================= INPUT PARTICLE SIZE DISTRIBUTIONS ==================

                         VALUE
                          NO.       SIZE, MM

                           1          1.0000
                           2           .5000
                           3           .2000
                           4           .1000
                           5           .0800
                           6           .0500
                           7           .0100
                           8           .0090
                           9           .0050
                          10           .0020
                          11           .0001

==========================================================================



===================  PERCENT FINER DISTRIBUTIONS  =====================

VALUE                       PARTICLE SIZE #
 NO.
           1
  1    100.00
  2     99.90
  3     87.50
  4     50.50
  5     44.50
  6     36.50
  7     32.00
  8     31.00
  9     29.00
 10     24.50
 11       .00

==========================================================================
```

========== STRUCTURE INPUT FOR JUNCTION #1 ==========

BRANCH	NUMBER OF STRUCTURES
1	1

==========

========== BETWEEN STRUCTURE ROUTING PARAMETERS ==========

BRANCH NO.	BETWEEN	PARAMETERS 1 TIME	2 MUSK. K	3 MUSK. X,
1	PRIOR J OR S TO STRUCTURE 1	.00	.00	.00

==========

========== STRUCTURE DATA FOR JUNCTION #1 ==========

QUESTION NO.		
1.	NUMBER OF SUBWATERSHEDS -	10
2.	TYPE OF SEDIMENT CONTROL STRUCTURE -	POND

==========

* *
JUNCTION 1, BRANCH 1, STRUCTURE 1
* *

*** HYDRAULIC INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	AREA ACRES	CURVE NUMBER	TC HR	TT HR	ROUTING COEFFICIENTS K-HRS	X,	UNIT HYDRO
1	3.25	69.00	.275	.000	.000	.00	2.0
2	3.62	69.00	.325	.000	.000	.00	2.0
3	4.30	69.00	.315	.000	.000	.00	2.0
4	4.31	69.00	.306	.000	.000	.00	2.0
5	4.31	69.00	.288	.000	.000	.00	2.0
6	4.39	69.00	.273	.000	.000	.00	2.0
7	3.96	69.00	.239	.000	.000	.00	2.0
8	4.01	69.00	.318	.000	.000	.00	2.0
9	2.80	69.00	.180	.000	.000	.00	2.0
10	5.56	69.00	.278	.000	.000	.00	2.0

*** SEDIMENT INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	SEG NUM	SOIL K	LENGTH FEET	SLOPE PCT	CP VALUE	PART OPT	SURF COND
1	1	.20	60.0	33.30	.400	1.0	.0
2	1	.20	60.0	33.30	.400	1.0	.0
3	1	.20	60.0	33.30	.400	1.0	.0
4	1	.20	60.0	33.30	.400	1.0	.0
5	1	.20	60.0	33.30	.400	1.0	.0
6	1	.20	60.0	33.30	.400	1.0	.0
7	1	.20	60.0	33.30	.400	1.0	.0
8	1	.20	60.0	33.30	.400	1.0	.0
9	1	.20	60.0	33.30	.400	1.0	.0
10	1	.20	60.0	33.30	.400	1.0	.0

* * * COMPUTED VALUES FOR INDIVIDUAL WATERSHEDS * * *

WATERSHED	PEAK FLOW (CFS)	RUNOFF (INCHES)	SEDIMENT TONS	DIAM (MM)	DELIVERY RATIO 1	DELIVERY RATIO 2
1	12.43	5.21	296.21	.067	.832	1.000
2	13.04	5.21	323.21	.062	.804	1.000
3	15.67	5.21	394.50	.063	.809	1.000
4	15.88	5.21	397.98	.064	.814	1.000
5	16.22	5.21	402.79	.066	.824	1.000
6	16.83	5.21	415.36	.068	.833	1.000
7	15.87	5.21	379.43	.072	.854	1.000
8	14.56	5.21	364.08	.063	.808	1.000
9	12.13	5.21	268.85	.080	.892	1.000
10	21.19	5.21	539.40	.067	.830	1.000

***** SUMMARY TABLE FOR TOTAL WATERSHED *****

STORM DURATION	=	24.00	HOURS
PRECIPITATION DEPTH	=	9.00	INCHES
RUNOFF VOLUME	=	17.5928	ACRE-FT
PEAK DISCHARGE	=	153.8100	CFS
AREA	=	40.5100	ACRES
TIME OF PEAK DISCHARGE	=	12.10	HRS
LOAD RATE EXPONENT FACTOR	=	2.00	
BETA	=	1.0000	
SUBMERGE BULK SPECIFIC GRAVITY	=	1.35	
RAINFALL EROSITIVITY FACTOR	=	575.89	EI UNIT
PEAK CONCENTRATION	=	346764.10	MG/L
PEAK SETTLEABLE CONCENTRATION	=	156.0820	ML/L
PEAK SETTLEABLE CONCENTRATION	=	210710.70	MG/L
TOTAL SEDIMENT YIELD	=	3781.8120	TONS
REPRESENTATIVE PARTICLE SIZE	=	.0667	MM
TIME OF PEAK CONCENTRATION	=	12.10	HRS
PERIOD OF SIGNIFICANT CONCENTRATION	=	18.00	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	63.97	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	63.97	ML/L

ARITHMETIC AVERAGE SETTLEABLE
CONCENTRATION DURING PERIOD OF
SIGNIFICANT CONCENTRATION = 13.19 ML/L
ARITHMETIC AVERAGE SETTLEABLE
CONCENTRATION DURING PEAK 24 HOUR
PERIOD = 9.89 ML/L

========== POND INPUT ==========

QUESTION NO.		
1.	TIME INCREMENT OF THE ROUTED HYDROGRAPH -	.10 HOURS
2.	NON-IDEAL SETTLING CORRECTION FACTOR -	1.00
3.	PERCENT OF PERMANENT POOL THAT IS DEAD SPACE -	35.00
4.	OUTFLOW WITHDRAWAL OPTION -	SURFACE
5.	INFLOW VERTICAL CONCENTRATION -	COMP. MIXED
6.	NUMBER OF STAGE POINTS -	11
7.	NUMBER OF ROUTED HYDROGRAPH POINTS -	500
8.	STAGE-DISCHARGE OPTION -	INPUT
9.	OUTPUT OPTION -	SUM. TABLES
10.	NUMBER OF CONTINUOUS STIRRED REACTORS	3

==========

========== POND STAGE DATA ==========

STAGE POINT	VALUE
1	.00
2	2.50
3	3.00
4	3.50
5	4.00
6	4.50
7	5.00
8	5.50
9	6.00
10	6.50
11	7.00

==========

========== POND AREA DATA ==========

AREA POINT	VALUE
1	1.44
2	1.64
3	1.67
4	1.71
5	1.75
6	1.80
7	1.84
8	1.88
9	1.92
10	1.96

11	2.01

==========

========== POND DISCHARGE DATA ==========

DISCHARGE POINT	VALUE
1	.00
2	.00
3	1.97
4	2.45
5	2.97
6	12.71
7	28.49
8	34.59
9	39.82
10	86.79
11	185.15

==========

****
****

CAUTION: THE STAGE OF YOUR PRINCIPLE SPILLWAY
MAY CAUSE BED SCOUR. SEDIMOT II DOES NOT CONSIDER
POSSIBLE BED SCOUR; HENCE, YOUR OBSERVED EFFLUENT
MAY NOT MEET THE DESIRED EFFLUENT STANDARD. INCREASE
THE STAGE OF YOUR PRINCIPAL SPILLWAY.

****
****

* *

POND RESULTS

* *

***** BASIN GEOMETRY *****

STAGE (FT)	AREA (ACRES)	AVERAGE DEPTH (FT)	DISCHARGE (CFS)	CAPACITY (ACRES-FT)
.00	1.440	.00	.00	.00

2.50	1.640	2.42	.00	3.85
3.00	1.670	2.90	1.97	4.68
3.50	1.710	3.38	2.45	5.52
4.00	1.750	3.86	2.97	6.39
4.50	1.800	4.32	12.71	7.27
5.00	1.840	4.79	28.49	8.18
5.50	1.880	5.25	34.59	9.11
6.00	1.920	5.70	39.82	10.06
6.50	1.960	6.16	86.79	11.03
7.00	2.010	6.61	185.15	12.03

***** STORM EVENT SUMMARY *****

TURBULENCE FACTOR	=	1.00	
PERMANENT POOL CAPACITY	=	3.850	ACRE-FT
DEAD STORAGE	=	35.00	PERCENT
TIME INCREMENT OUTFLOW	=	.10	HRS
VISCOSITY	=	.009	CM**2/SEC
INFLOW RUNOFF VOLUME	=	17.593	ACRE-FT
OUTFLOW ROUTED VOLUME	=	17.562	ACRE-FT
STORM VOLUME DISCHARGED	=	17.562	ACRE-FT
POND VOLUME AT PEAK STAGE	=	10.564	ACRE-FT
PEAK STAGE	=	6.257	FT
PEAK INFLOW RATE	=	153.810	CFS
PEAK DISCHARGE RATE	=	64.004	CFS
PEAK INFLOW SEDIMENT CONCENTRATION	=	346764.10	MG/L
PEAK EFFLUENT SEDIMENT CONCENTRATION	=	79668.38	MG/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	.0113	ML/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	15.30	MG/L
STORM AVERAGE EFFLUENT CONCENTRATION	=	55952.21	MG/L
AVERAGE EFFLUENT SEDIMENT CONCENTRATION	=	55952.21	MG/L
BASIN TRAP EFFICIENCY	=	64.56	PERCENT
DETENTION TIME OF FLOW WITH SEDIMENT	=	3.55	HRS
DETENTION TIME FROM HYDROGRAPH CENTERS	=	3.55	HRS
DETENTION TIME INCLUDING STORED FLOW	=	3.55	HRS
SEDIMENT LOAD DISCHARGED	=	1340.18	TONS
PERIOD OF SIGNIFICANT CONCENTRATION	=	41.40	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.01	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.01	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.01	ML/L

DESIGN SHEET

SHEET ____ OF ____

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

PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER - PLYMOUTH	JYK	6/17/99	EWT	7/8/99	05101.01

SUMMARY OF WEST AREA SEDIMENT BASIN DESIGN

BASIN DIMENSIONS: BASE AREA → 170' x 370'
SIDESLOPES → 3H:1V

PRINCIPAL SPILLWAY: 30" CMP RISER DIAM.
24" CMP BARREL DIAM.
0.5" PERFORATIONS DIAM.
→ 4" O.C. HORIZONTALLY
→ 6" O.C. VERTICALLY
4 FEET FROM POND BOTTOM TO TOP OF RISER.
70 FEET LONG
1% SLOPE

EMERGENCY SPILLWAY: BASE WIDTH → 44 FEET
SIDESLOPES → 4H:1V.
6 FEET FROM BOTTOM OF POND TO BASE OF EMERGENCY SPILLWAY
2-FOOT DEEP

	POST-DEVELOPMENT		PRE-DEVELOPMENT
$Q_{POND,10Y}$ =	25.5	CFS <	37.6 CFS
$Q_{POND,25Y}$ =	33.6	CFS <	50.2 CFS
$Q_{POND,100Y}$ =	64.0	CFS <	73.6 CFS

TE_{2YR} =	77.6 %	> 70%	(≥70% REQ FOR HQW'S FOR 2YR EVENT)	✓
TE_{10YR} =	67.9 %	> 60%		✓
TE_{25YR} =	66.0 %	> 60%		✓
TE_{100YR} =	64.6 %	> 60%		✓

Attachment L6
Post Development Stormwater Design Calculations – North West Area

DESIGN SHEET

SHEET 1 OF

PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER PLYMOUTH	SYK	8/13/99	[illegible]	9/13/99	05101.01

POST DEVELOPMENT STORM WATER ANAYSIS: NORTHWEST BASIN

DETERMINE: PEAK RUNOFF RATE FOR AREA 1A (NORTWEST BASIN) USING THE SCS METHOD & 25 YR-24HR STORM $Q_{P_{25,24}}$

GIVEN:

LOCATION: PLYMOUTH, NC
HYDROGEOLOGIC SOIL GROUP (HSG) "B"
TOTAL AREA OF WATERSHED = 16.35 ACRES
MAXIMUM HYDRAULIC LENGTH = 1370
EXTERIOR FACE OF TERRACE LENGTH = 60'
(I.E. 3H:1V SLOPE, 20' HIGH)
DESIGN FOR 25 YR, 24 HR STORM EVENT
FACE OF TERRACE SLOPE = 33.3%

% HYDRAULIC LENGTH MODIFIED = 0
% IMPERVIOUS AREA = 0

SOLUTION:

FROM FIGURE 8.03K, 25 YR-24HR STORM = 7.25 INCHES

FROM TABLE 8.03b, CN = 69 FOR FAIR CONDITION GRASS COVERAGE ON 50 TO 75% OF THE AREA (ASSUME CAPPING & VEGETATION PROGRESS WITH LANDFILL CONSTRUCTION)

FROM TABLE 8.03c, 7.25 INCHES OF RUNOFF, CN = 69, DOUBLE INTERPOLATION
RUNOFF DEPTH = 3.73 INCHES

FOR (25 YR, 24 HR EVENT.

DESIGN SHEET

RMT INC.

SHEET 2 OF

PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER - PLYMOUTH	[illegible]	8/13/09	[illegible]	9/12/09	05101.01

25 YEAR TOTAL RUNOFF VOLUME $= (3.73\ IN)(16.35)(1'/12'') = 5.1$ AC-FT

10 YR TOTAL RUNOFF VOL. $= (2.91\ IN)(16.35)(1/12'') = 4.0$ AC-FT

EQUIVALENT DRAINAGE AREA, $a = f(HL = 1370\ ft)$

$$a = [(HL)/209]^{1/0.6} = [1370/209]^{1/0.6}$$

$$a = 23 \text{ ACRES}$$

USE 27% FOR AVG WATERSHED SLOPE.

RATE OF DISCHARGE: F. 8.03g, 23 ACRES, CN=69, S=33%, TYPE II storm

PEAK RATE OF DISCHARGE = 29 CFS/IN

PEAK DISCHARGE FOR EQUIVALENT WATERSHE = $(29\ CFS/IN)(3.73\ IN)$

$$Q_1 = 108.2 \text{ CFS}$$

PEAK DISCHARGE, $Q_2 = (108.2\ CFS)\left(\frac{16.35}{23.00}\right) = 76.9\ CFS$

ADJUST PEAK DISCHARGE FOR AVG WATERSHED SLOPE (27%) + AREA = 16.35 AC BY DOUBLE INTERPOLATION OF DATA FROM T. 8.03 d.

$$Q_3 = (76.9\ CFS)(1.085) = 83.4\ CFS$$

DESIGN SHEET

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

PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER - PLYMOUTH	SYK	8/16/99			051D1.01

SEDIMENT BASIN DESIGN

V_{min} = MIN VOL = $(1800\ ft^3/ac)(16.35\ ac) = 29{,}430\ ft^3 = 0.68\ ac\text{-}ft$

MIN. AREA OF BASIN @ PRINCIPAL SPILLWAY $= A_{PS} \geq 0.01\ (Q)$

$A_{PS} \geq 0.01\ (83.4\ cfs) = 0.83$ acres

$A_{PS} \geq 36{,}329\ ft^2$

SIZE BASIN:

3H:1V SIDESLOPES
EL 32 TOP OF DIKE
EL. 24 TO 26 BOTTOM OF POND.
EL 30 EMERGENCY SPILLWAY
EL 28 PRINCIPAL SPILLWAY

SIZE PRINCIPAL SPILLWAY

$Q_{P_{MIN}} = (0.2\ cfs/ac)(16.35\ ac) = 3.27\ cfs.$

LET PRINCIPAL SPILLWAY RISER DIAMETER = 30" = d
THEN PRINCIPAL SPILLWAY BARREL DIAMETER = 24" = D
HEIGHT OF RISER = 2D = 48" = 4' MIN

IF H_{MIN} = 4 FT & L_{min} = 80 ft FOR 24" CMP PERFORATED RISER,
THEN Q = 22.06 (0.96) = 21.2 CFS (T. 8.07 A).

MIN. HEAD RQD. FOR Q = 21 CFS & d = 30 IN (T. 8.07 B) = 0.87 ft
MIN. HT. OF EMERGENCY SPILLWAY = 0.87 ft + 4' = 4.87 ft

DESIGN SHEET

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

PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER – PLYMOUTH	SJK	8/1/09	[illegible]	[illegible]	05101.01

ESTIMATE AREA OF BASIN

$A_{PS} \geq 36,329$

Let $A_{PS} = 37,000$ SF $L = 2W$

$W = \sqrt{37,000/2} = 136$

$L = 2W = 272$

A_{PS} 4' BELOW TOP OF BERM & 3H:1V SIDE SLOPES

A_{BERM} (INTER $\approx W: 136 + (4')(2)(3) = 160'$.

$\approx L: 272 + (4')(2)(3) = 296'$

$\hookrightarrow 47,360$

LET $W_{BERM} = 150$ F, THEN $L \approx 315$ FT.

SIZE TOP OF BERM 150' x 335'.

Area Elevation	Width	Length	Area (Ac)
32	150	335	1.153
31	144	329	1.088
30	138	323	1.023
29	132	317	0.960
28	126	311	0.899
27	120	305	0.840
26	114	299	0.782
25	*	*	0.208
24	*	*	0.040

* triangular shape area

b. Determine runoff depth (in inches) from the curve number and rainfall depth using Table 8.03c.

Table 8.03c Runoff Depth

Rainfall (inches)	Curve Number (CN)[1]							
	60	65	70	75	80	85	90	95
1.0	0.00	0.00	0.00	0.03	0.08	0.17	0.32	0.56
1.2	0.00	0.00	0.03	0.07	0.15	0.28	0.46	0.74
1.4	0.00	0.02	0.06	0.13	0.24	0.39	0.61	0.92
1.6	0.01	0.05	0.11	0.20	0.34	0.52	0.76	1.11
1.8	0.03	0.09	0.17	0.29	0.44	0.65	0.93	1.30
2.0	0.06	0.14	0.24	0.38	0.56	0.80	1.09	1.48
2.5	0.17	0.30	0.46	0.65	0.89	1.18	1.53	1.97
3.0	0.33	0.51	0.72	0.96	1.25	1.59	1.98	2.44
4.0	0.76	1.03	1.33	1.67	2.04	2.46	2.92	3.42
5.0	1.30	1.65	2.04	2.45	2.89	3.37	3.88	4.41
6.0	1.92	2.35	2.80	3.28	3.78	4.31	4.85	5.40
7.0	2.60	3.10	3.62	4.15	4.69	5.26	5.82	6.40
8.0	3.33	3.90	4.47	5.04	5.62	6.22	6.81	7.39
9.0	4.10	4.72	5.34	5.95	6.57	7.19	7.79	8.39
10.0	4.90	5.57	6.23	6.88	7.52	8.16	8.78	9.39
11.0	5.72	6.44	7.13	7.82	8.48	9.14	9.77	10.39
12.0	6.56	7.32	8.05	8.76	9.45	10.12	10.76	11.39

[1] To obtain runoff depths for CN's and other rainfall amounts not shown in this table, use an arithmetic interpolation.

The volume of runoff from the site can be calculated by multiplying the area of the site by the runoff depth.

Step 4. Determine the peak rate of runoff for the design storm by adjusting for watershed shape as follows:

a. Determine an "equivalent drainage area" from the hydraulic length of the watershed using Figure 8.03n. Hydraulic length is the length of the flow path from the most remote point in the watershed to the point of discharge.

b. Determine the discharge (cfs/inch of runoff) for the equivalent drainage area from Figure 8.03o through 8.03q:

Figure 8.03o - for average watershed slopes 0-3%
Figure 8.03p - for average watershed slopes 3-7%
Figure 8.03q - for average watershed slopes 8-50%

Calculate the peak discharge, Q_1, of the equivalent watershed by multiplying equivalent watershed area by runoff from Table 8.03c in Step 3b.

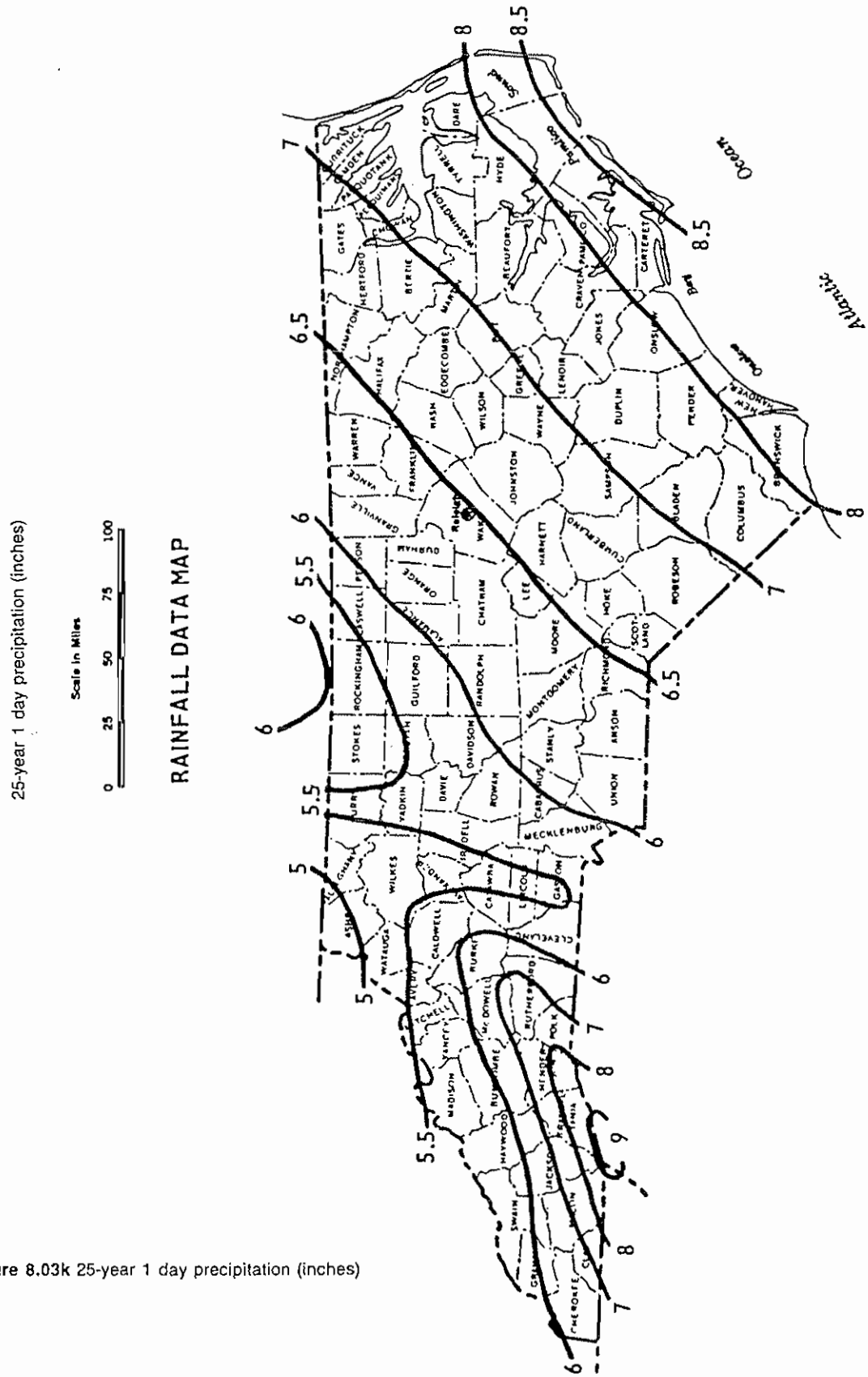


Figure 8.03k 25-year 1 day precipitation (inches)

Table 8.03b
Runoff Curve Numbers (CN)

Land Use/Cover		Hydrologic Soil Group A	B	C	D
Cultivated land					
without conservation		72	81	88	91
with conservation		62	71	78	81
Pasture land					
poor condition		68	79	86	89
fair condition		49	69	79	84
good condition		39	61	74	80
Meadow					
good condition		30	58	71	78
Wood or forest land					
Thin stand - poor cover, no mulch		45	66	77	83
Good stand - good cover		25	55	70	77
Open spaces, lawns, parks, golf courses, cemeteries, etc.					
good condition: grass cover on 75% or more of the area		39	61	74	80
fair condition: grass cover on 50 to 75% of the area		49	69	79	84
Commercial and business areas (85% impervious)		89	92	94	95
Industrial districts (72% impervious)		81	88	91	93
Residential:[1] Development completed and vegetation established					
Average lot size	Average % Impervious				
1/8 acre or less	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acre	15	47	66	77	81
Paved parking lots, roofs, driveways, etc.		98	98	98	98
Streets and roads paved with curbs and storm sewers		98	98	98	98
gravel		76	85	89	91
dirt		72	82	87	89
Newly graded area		81	89	93	95
Residential: Development underway and no vegetation					
Lot sizes of 1/4 acre		88	93	95	97
Lot sizes of 1/2 acre		85	91	94	96
Lot sizes of 1 acre		82	90	93	95
Lot sizes of 2 acres		81	89	92	94

[1]Curve numbers are computed assuming the runoff from the house and driveway is directed toward the street.

source: USDA-SCS

Table 8.03d
Slope Adjustment Factors

	Slope (percent)	10 acres	20 acres	50 acres	100 acres	200 acres
Flat	0.1	0.49	0.47	0.44	0.43	0.42
	0.2	0.61	0.59	0.56	0.55	0.54
	0.3	0.69	0.67	0.65	0.64	0.63
	0.4	0.76	0.74	0.72	0.71	0.70
	0.5	0.82	0.80	0.78	0.77	0.77
	0.7	0.90	0.89	0.88	0.87	0.87
	1.0	1.00	1.00	1.00	1.00	1.00
	1.5	1.13	1.14	1.14	1.15	1.16
Moderate	3	0.93	0.92	0.91	0.90	0.90
	4	1.00	1.00	1.00	1.00	1.00
	5	1.04	1.05	1.07	1.08	1.08
	6	1.07	1.10	1.12	1.14	1.15
	7	1.09	1.13	1.18	1.21	1.22
Steep	8	0.92	0.88	0.84	0.81	0.80
	9	0.94	0.90	0.86	0.84	0.83
	10	0.96	0.92	0.88	0.87	0.86
	11	0.96	0.94	0.91	0.90	0.89
	12	0.97	0.95	0.93	0.92	0.91
	13	0.97	0.97	0.95	0.94	0.94
	14	0.98	0.98	0.97	0.96	0.96
	15	0.99	0.99	0.99	0.98	0.98
	16	1.00	1.00	1.00	1.00	1.00
	20	1.03	1.04	1.05	1.06	1.07
	25	1.06	1.08	1.12	1.14	1.15
	30	1.09	1.11	1.14	1.17	1.20
	40	1.12	1.16	1.20	1.24	1.29
	50	1.17	1.21	1.25	1.29	1.34

source: USDA-SCS

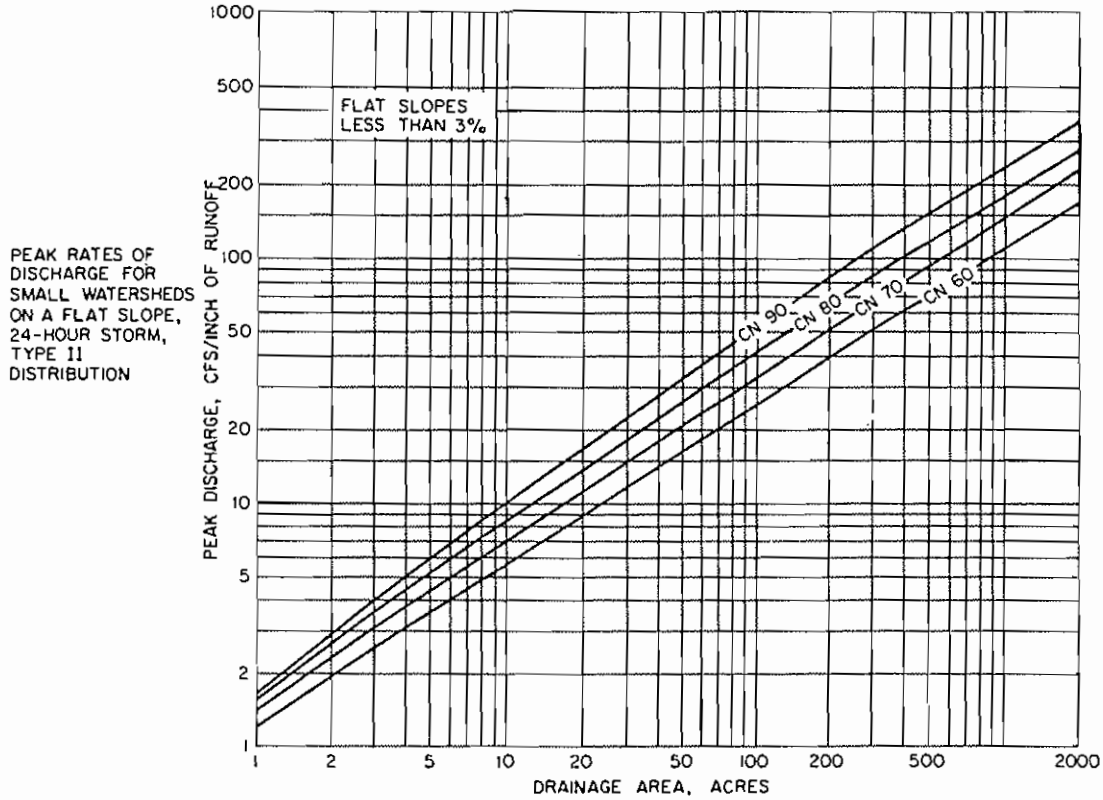


Figure 8.03o Discharge vs equivalent drainage area for average watershed slopes 0 - 3%.

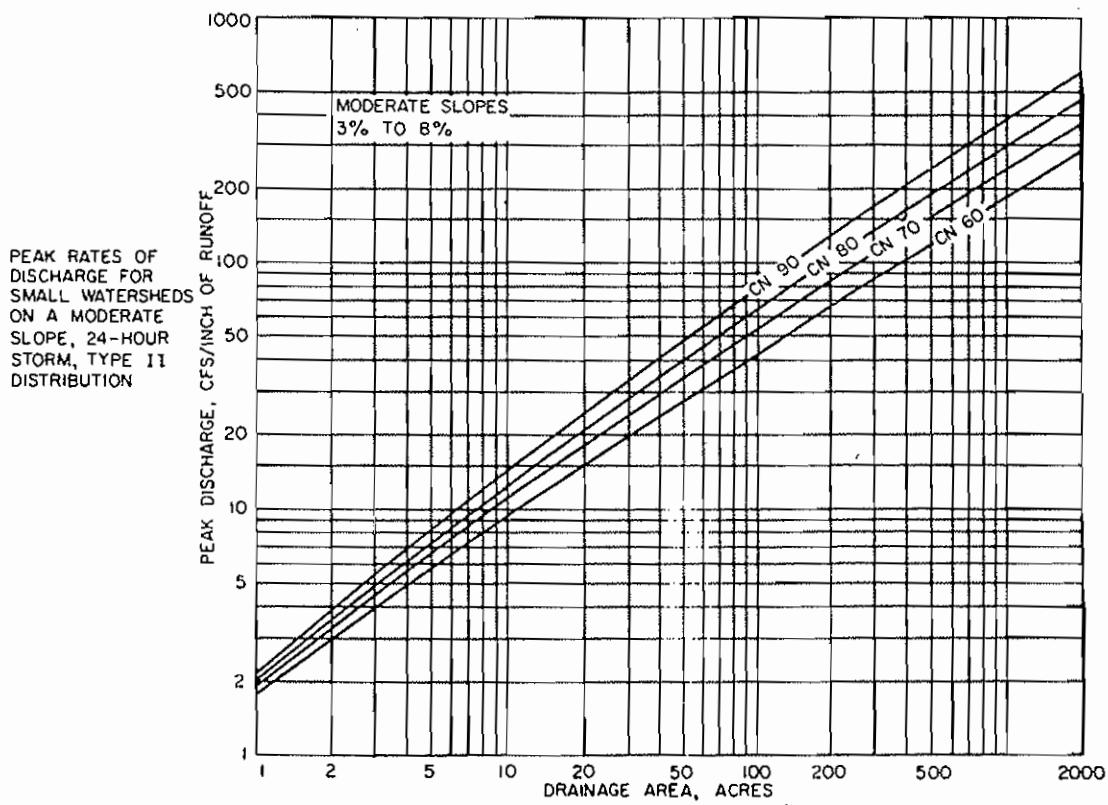
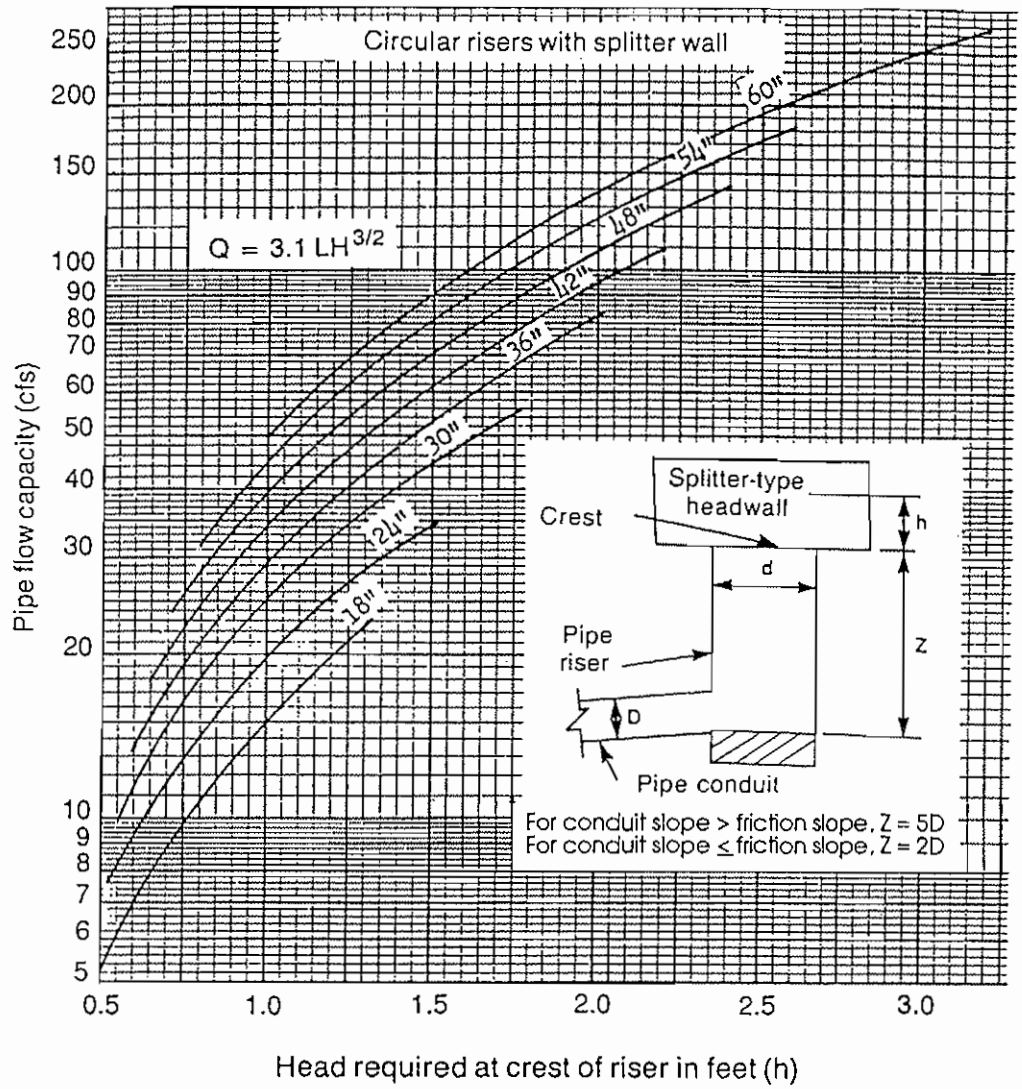


Figure 8.03p Discharge vs equivalent drainage area for average watershed 3 - 8%.



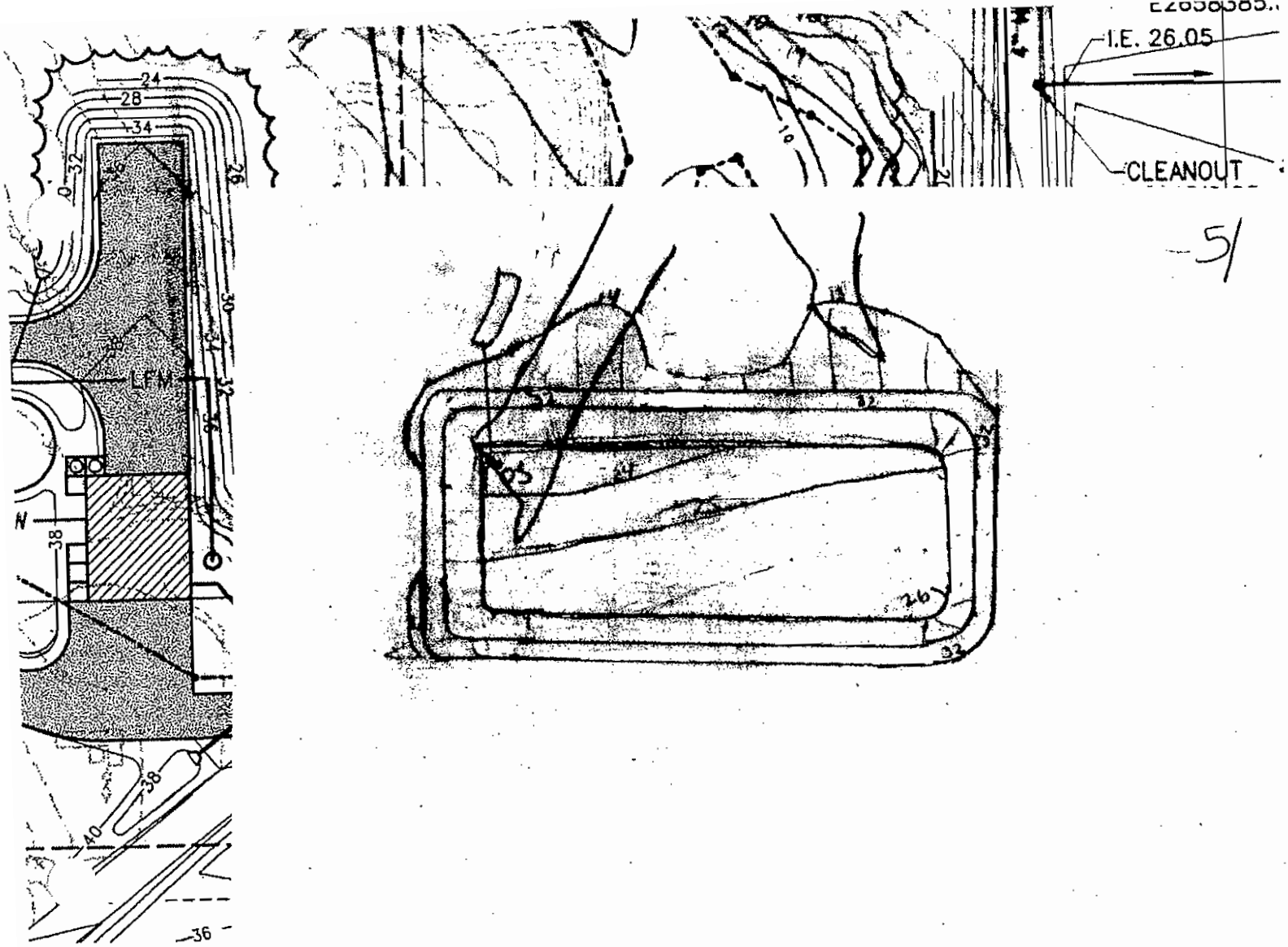
Inlet Proportions	
Pipe Conduit (D) - in	Pipe Riser (d) - in
8-12	18
15	21
18	24
21	30
24	30
30	36
36	48
42	54
48	60

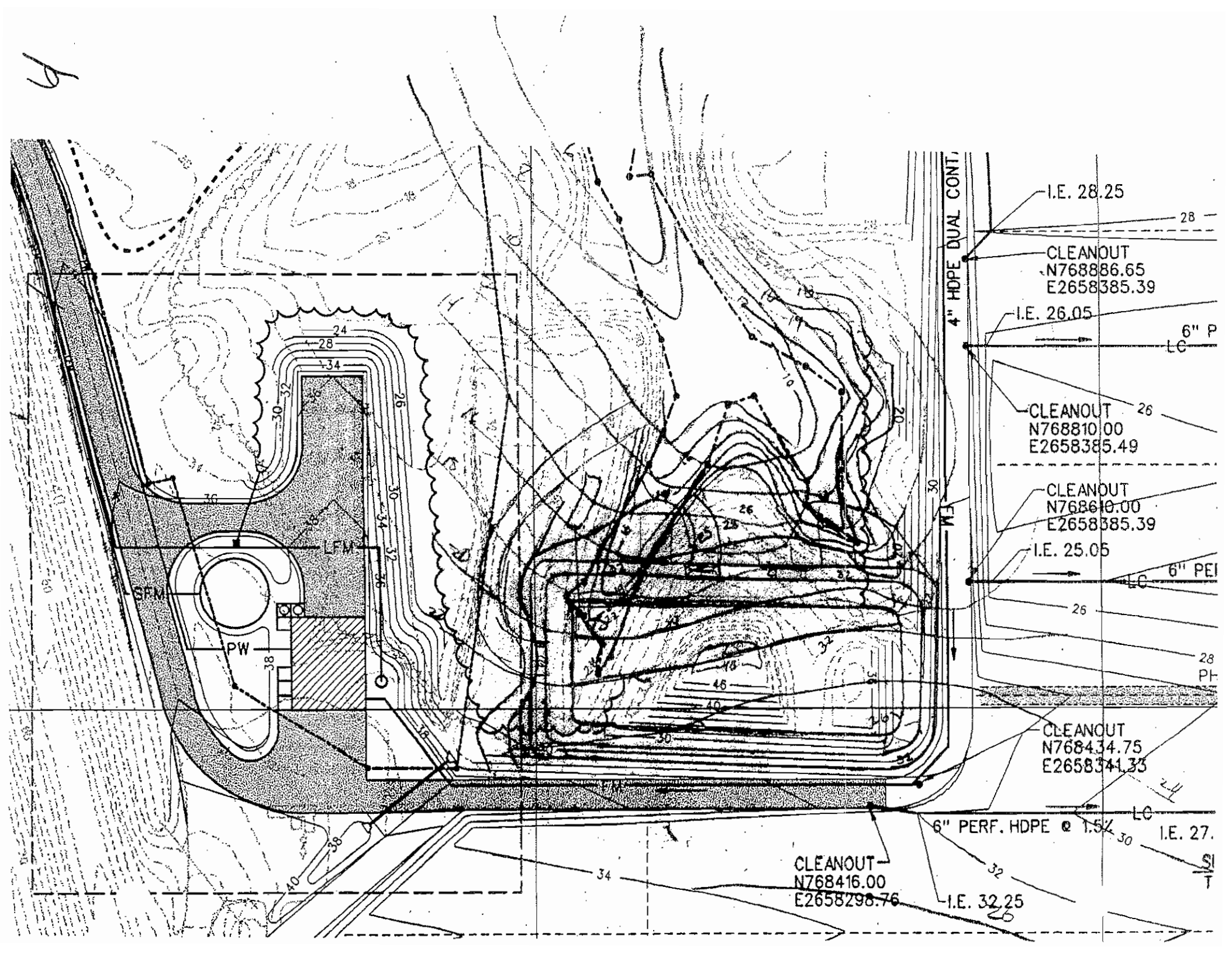
Pipe drop inlet spillway design:

For a given Q and H, refer to Table 8.07a or 8.07b for conduit size. Then determine the riser diameter (d) from the Inlet Proportions Table on this figure. Next, refer to the above curves, using the conduit capacity and riser diameter, and find the head (h) required above the crest of the riser. The height of the riser should not be less than 5D - h, except as noted in the above sketch.

Example - Given: CMP; Q = 20 cfs; H = 14 ft, h max. 1.0 ft; L = 70 ft. From Table 8.07a find conduit size (D) = 18 inches. From Inlet Proportions Table, riser size = 24 inches. Head (h) required for Q = 20 and d = 24 is 1.0 ft.

Figure 8.07b Design chart for riser outlet.


I.E. 26.05
CLEANOUT
LFM
24
28
34
32
26
30
36
38
40
-5/



I.E. 28.25
CLEANOUT
N768886.65
E2658385.39
I.E. 26.05
6" P
LC
CLEANOUT
N768810.00
E2658385.49
CLEANOUT
N768610.00
E2658385.39
I.E. 25.05
6" PE
LC
CLEANOUT
N768434.75
E2658341.33
6" PERF. HDPE @ 1.5%
I.E. 27.
CLEANOUT
N768416.00
E2658298.76
I.E. 32.25
4" HDPE DUAL CONT
FM
LFM
SFM
PW

DESIGN SHEET

SHEET 7 OF

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

PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER - PLYMOUTH	[illegible]	8/17/99	[illegible]	9/13/99	05101.01

EMERGENCY SPILLWAY DESIGN

$Q_P = f(H = 6\text{ ft}, D = 2\text{ ft}, L = 80\text{ ft}$ & T. 8.07 A (CM))

$Q_P = (27.01_{CFS})(0.96) = 25.93$ CFS

$Q_{ES} = Q_{P_{25/24}} - Q_P = 83.4_{CFS} - 25.93_{CFS}$

$Q_{ES} = 57.47$ CFS

FROM T. 8.07C, Q = 60 CFS → 28 FT WIDE
3% to 8.6 % SLOPE RANGE
4H:1V SIDE SLOPES

MIN HT OF ES = 4.9'

SET IT @ 6.0' OR EL. 30.
USE 8.6% EXT SLOPE
B = 28' WIDE

DESIGN SHEET

RMT

SHEET 8 OF

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

PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER - PLYMOUTH	SJK	8/18/98			05101.01

POST DEVELOPMENT LAND USE:

- OPEN SPACE, FAIR CONDITIONS, GRASS COVER ON 50 TO 75% OF SITE HYDROLOGICAL SOIL GROUP "B" → USE CURVE 69

- PERMANENT SEEDINGS FROM 0-60 DAYS
  → CONTROL PRACTICE FACTOR = 0.4.

DETERMINE POST-DEVELOPMENT PEAK FLOW RATES USING SCS METHODOLOGY & SEDIMOT II MODEL

CALCULATE TIME OF CONCENTRATION FOR SHEET FLOW DOWN THE SIDE OF THE TERRACE (0-60') AND CHANNELIZED FLOW ALONG BASE OF TERRACE TO ARTICULATED BLOCK CHANNEL.

ASSUME TRAVEL TIME DOWN ARTICULATED BLOCK CHANNEL HAPPENS INSTANTANEOUSLY (CONSERVATIVE ASSUMPTION) AND IS ZERO.

SHEET FLOW (0-60'): $T_{t_{0-60'}} = \frac{0.007\,(n \cdot L)^{0.8}}{\sqrt{P_2} \cdot S^{0.4}} = \frac{0.007\,(0.15(60))^{0.8}}{\sqrt{4} \cdot (0.333)^{0.4}}$

$T_{0-60'} = 0.032$ hrs

where: P_2 = 2yr, 24 hr storm = 4in
S = slope = 1/3' = 0.333
n = Manning's Roughness Coefficient for Sheet Flow = 0.15 (short prairie grass)
L = flow length = 60 ft

DESIGN SHEET

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

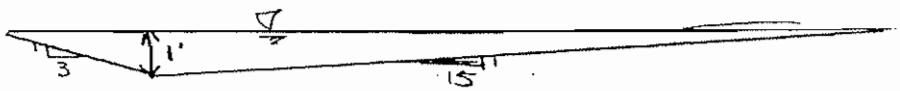
PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
Weyerhaeuser Plymouth	SJK	9/14/99	[illegible]	9/29/99	05101.01

Trapezoidal Channel Flow

$$Vel = \frac{1.49\, r^{2/3} \cdot S^{1/2}}{\eta}$$

where: η = Manning Roughness Coef for Channel Flow
$\eta = 0.035$ (earth w/ weeds + stone)
S = Slope = 0.005 ft/ft
r = hydraulic radius = a/p_w
p_w = wetted perimeter.

CHANNEL ALONG BASE OF TERRACE



$$a = (1)(3)(1/2) + (1)(15)(1/2) = 9.0\ ft^2$$

$$p_w = \left(\sqrt{1^2+3^2}\right) + \left(\sqrt{1^2+15^2}\right) = 18.2\ ft$$

$$r = a/p_w = 9/18.2 = 0.495\ ft$$

$$Vel = \frac{1.49\,(0.495)^{2/3} \cdot (0.005)^{1/2}}{0.035}$$

$$Vel = 1.88\ fps$$

$$T_t = \left(\frac{DIST}{VEL}\right) / (3600\ sec/hr)$$

T_t = terrace channel.

DIST = MAX CHANNEL LENGTH ALONG TERRACE

DESIGN SHEET

RMT®
100 Verdae Boulevard P.O. Box 16778 Greenville, SC 29607-3825 Phone: 864-281-0030 FAX: 864-281-0286

SHEET 10 OF

PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAEUSER - PLYMOUTH	SYK	8/18/99	[illegible]	9/9/99	05101.01

AREA 1A (NORTH WEST BASIN)

WATERSHED #	AREA (AC)	MAX CHANNEL LENGTH ALONG TERRACE	T_t (secs) TERRACE CHANNEL	T_t (secs) SHEET FLOW	$T_c = 4T_t$
* 1	0.52	570	0.084	0.0181	0.102
2	1.50	595	0.088	0.032	0.120
3	1.56	680	0.100	0.032	0.132
4	2.07	750	0.111	0.032	0.143
5	2.33	825	0.122	0.032	0.154
6	2.15	845	0.125	0.032	0.157
7	1.88	760	0.112	0.032	0.144
8	1.62	680	0.100	0.032	0.132
9	1.31	[illegible]	0.089	0.032	0.121
10 **	1.11	515	0.076	0.108**	0.184

$$** \; T_{t_{SF}} = 0.032 + \frac{0.007\,(0.15(70'))^{0.8}}{\sqrt{4}\cdot(0.05)^{0.4}} = 0.1081$$

$$* \; T_{t_{SF}} = \frac{0.007\,(0.15(30'))^{0.8}}{\sqrt{4}\cdot(0.333)^{0.4}} = 0.018$$

DESIGN SHEET

RMT®

SHEET 11 OF

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

PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WEYERHAESER - PLYMOUTH	[illegible]	8/18/99	[illegible]	9/9/99	05101.01

At Emergency Spillway Elevation 30 (6')

Volume of Sedimentation Basin = 4.22 AC-FT

ASSUME DISCHARGE THROUGH RISER STARTS @ 2.0 FT

	STAGE	AREA	DISCHARGE
1	0	0.040	0
2	1	0.208	0
3	2	0.782	1.12
4	3.5	0.871	2.45
5	4	0.899	2.97
6	4.5	0.929	12.71
7	5.0	0.960	28.49
8	5.5	0.991	34.59
9	6.0	1.023	39.82
10	6.5	1.055	71.68
11	7.0	1.088	137.37

2 yr STORM	TE = 72.2%	PK STG = 2.4 FT	ok
10 yr STORM	TE = 71.92%	PK STAGE = 4.0 FT	✓
25 yr STORM	TE = 70.86%	PK STG = 4.4 FT	✓
100 yr STORM	TE 69.4%	PK STG = 4.9 FT	✓

OUTFLOW STRUCTURE EVALUATION

RETENTION POND # **1A** **(Northwest Area)**

Weyerhaeuser No. 3 Landfill ***RMT Job No. 5101.01***

Plymouth, North Carolina

DEPTH INCREMENT **1** (feet)

Depth (ft.)	Area (acres)	Avg. Area (sq. ft.)	Storage (acre-ft.)
0	0.0400		0
		0.124	
1	0.2080		0.12
		0.495	
2	0.7820		0.62
		0.811	
3	0.8400		1.43
		0.870	
4	0.8990		2.30
		0.930	
5	0.9600		3.23
		0.992	
6	1.0230		4.22
		1.056	
7	1.0880		5.28
		1.121	
8	1.1530		6.40

Weyerhaeuser No. 3 Landfill
Plymouth, North Carolina

Detention Pond # *1*
Height of Riser (ft.) *4*
Height of Emergency Spillway (ft.) *6*

RMT Job No. 05101.01

HEAD	ROW																								
ELEV.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	PRIN.	EMER.	**TOTAL**
0.00	-																						0	0	-
0.50	0.18	-																					0	0	0.18
1.00	0.26	0.18	-																				0	0	**0.44**
1.50	0.32	0.26	0.18	-																			0	0	0.75
2.00	0.36	0.32	0.26	0.18	-																		0	0	**1.12**
2.50	0.41	0.36	0.32	0.26	0.18	-																	0	0	1.52
3.00	0.45	0.41	0.36	0.32	0.26	0.18	-																0	0	**1.97**
3.50	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-															0	0	2.45
4.00	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-														0	0	**2.97**
4.50	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-													9.2	0	**12.71**
5.00	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-												24.4	0	**28.49**
5.50	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-											29.9	0	**34.59**
6.00	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-										34.5	0	**39.82**
6.50	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-									38.6	27.1	**71.68**
7.00	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-								42.3	88.41	**137.37**
7.50	0.70	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-							45.7	178.93	231.99
8.00	0.73	0.70	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-						48.8	297.94	354.83
8.50	0.75	0.73	0.70	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-					51.8	445.78	506.42
9.00	0.77	0.75	0.73	0.70	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-				54.6	623.24	687.45
9.50	0.79	0.77	0.75	0.73	0.70	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-			0	831.29	841.69
10.00	0.81	0.79	0.77	0.75	0.73	0.70	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-		0	0	11.22
10.50	0.83	0.81	0.79	0.77	0.75	0.73	0.70	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	-	0	0	12.05
11.00	0.85	0.83	0.81	0.79	0.77	0.75	0.73	0.70	0.68	0.66	0.63	0.60	0.58	0.55	0.51	0.48	0.45	0.41	0.36	0.32	0.26	0.18	0	0	12.90

TOTAL FLOW RATE PER ROW OF PERFORATED RISER PIPE USING THE ORIFICE EQUATION:

$$Q=n*C_d*A_o*(2*g*y)^{0.5}$$

WHERE:

D =	diameter of riser pipe (inches)	LET: D =	30	$n*C_d*A_o$ =	0.0321
s =	lateral spacing of orifice holes on riser (inches)	s ~	4	$(2*g)^{0.5}$ =	8.025
n =	number of holes per row =(3.14*D/s)+/-1	n =	24	increment=	0.5
d =	diameter of orifice (inches)	d =	0.500		
A_o =	orifice area (sq. ft.) = $(3.14*(d^2/4))/144$	A_o =	0.0014		
g =	32.2 ft/sec^2	g =	32.2		
y =	elevation head (ft)	y =	(see first column in table)		
A_2 =	jet area (sq. ft.)	A_2 =	A_o		
C_v =	0.95 (sqr. edge) to 0.99 (round edge)	C_v =	0.98		
C_c =	A_2/A_o	C_c =	1		
C_d =	discharge coefficient $=C_c*C_v$	C_d =	0.98		

Normal Depth Channel Analysis Program
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WEYERHAEUSER PLYMOUTH NORTHWEST BASIN

CHANNEL SLOPE = .005 FT/FT
MANNINGS N = .035

TRAPEZOIDAL CHANNEL OUTPUT

BOTTOM WIDTH = 28 FT
LEFT SIDE SLOPE = 4 FT/FT
RIGHT SIDE SLOPE = 4 FT/FT

DEPTH (FT)	FLOW (CFS)	AREA (SQ FT)	WP (FT)	VEL (FT/SEC)	CR. DEP. (FT)
0.50	27.10	15.00	32.12	1.81	0.30
1.00	88.41	32.00	36.25	2.76	0.65
1.50	178.93	51.00	40.37	3.51	1.03
2.00	297.94	72.00	44.49	4.14	1.42
2.50	445.78	95.00	48.62	4.69	1.82
3.00	623.24	120.00	52.74	5.19	2.22
3.50	831.29	147.00	56.86	5.66	2.64

OUTFLOW RATING TABLE FOR FLOW ABOVE THE RISER FOR DETENTION POND NO. 1A

Northwest Area

Weyerhaeuser No. 3 Landfill ***RMT Job No.*** *5101.01*

Plymouth, North Carolina

RISER DIAMETER.	2.5	FT.
HEIGHT OF RISER	4	FT.
OUTFLOW PIPE DIAMETER.	2	FT.
OUTFLOW PIPE LENGTH.	100	FT.
OUTFLOW PIPE SLOPE.	2	%
MANNING N-VALUE.	0.023	(corrugated metal pipe)
ENTRANCE LOSS COEFFICIENT.	1	
BEND LOSS COEFICIENT.	1	
WEIR COEFICIENT.	3.33	(english units)
ORIFICE COEFFICIENT (Cd)	0.62	(into riser pipe)
TAILWATER DEPTH	2.5	FT.
THICKNESS OF WEIR.	1	FT.

HEAD (FT.)	FLOW (CFS)	CONTROL
0	0	
0.25	3.3	WEIR
0.50	9.2	WEIR
0.75	17.0	WEIR
1.00	24.4	ORIFICE
1.25	27.3	ORIFICE
1.50	29.9	ORIFICE
1.75	32.3	ORIFICE
2.00	34.5	ORIFICE
2.25	36.6	ORIFICE
2.50	38.6	ORIFICE
2.75	40.5	ORIFICE
3.00	42.3	ORIFICE
3.25	44.0	ORIFICE
3.50	45.7	ORIFICE
3.75	47.3	ORIFICE
4.00	48.8	ORIFICE
4.25	50.3	ORIFICE
4.50	51.8	ORIFICE
4.75	53.2	ORIFICE
5.00	54.6	ORIFICE

WEIR FLOW: $Q=C_w*L*H^{1.5}$ ORIFICE FLOW: $Q=C_d*A_o*(2*g*H)^{0.5}$

where:

Cw = weir coefficient =3.33 (english units)

L = weir length or perimeter of riser (ft.)

H = head (feet)

$Cc = A_2/A_o$ (or see attached sheet)

$Cd = C_c * C_v$ (or see attached sheet)

Ao = orifice area (sq.ft.)

$g = 32.2\ ft/s^2$

Cv = 0.99 (rounded) to 0.95 (square) orifice

```
*****************************************************************************
*          (program name)                * SEDIMOT S/N  :                    *
*                                        * HMVersion    :  3.20              *
*       (program description)            * Date         :  8/18/99           *
*                                        * Time         : 16:00:44           *
*                                        * Input file   : WPN4A.INP          *
*                                        * Output file  : WPN4A.OUT          *
*                                        *                                   *
*                                        *                                   *
*****************************************************************************
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 XXXXX   XXXXXXX  XXXXXX   XXXXX  X     X   XXXXX   XXXXXXX
X     X  X        X     X    X    XX   XX  X     X     X
X        X        X     X    X    X X X X  X     X     X
 XXXXX   XXXXX    X     X    X    X  X  X  X     X     X
      X  X        X     X    X    X     X  X     X     X
X     X  X        X     X    X    X     X  X     X     X
 XXXXX   XXXXXXX  XXXXXX   XXXXX  X     X   XXXXX      X
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::::::::::::::::::::::::::::::::::::::::::::
::::::::::::::::::::::::::::::::::::::::::::
:::                                      :::
:::  Full Microcomputer Implementation   :::
:::                 by                   :::
:::        Haestad Methods, Inc.         :::
:::                                      :::
::::::::::::::::::::::::::::::::::::::::::::
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37 Brookside Road * Waterbury, Connecticut 06708 * (203) 755-1666

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

        UNIVERSITY OF KENTUCKY COMPUTER MODEL
        OF SURFACE MINE HYDROLOGY AND SEDIMENTOLOGY
        FOR MORE INFORMATION CONTACT THE AGRICULTURAL
        ENGINEERING DEPARTMENT

        THE UK MODEL IS A DESIGN MODEL DEVELOPED TO PREDICT
        THE HYDRAULIC AND SEDIMENT RESPONSE FROM SURFACE
        MINED LANDS FOR A SPECIFIED RAINFALL EVENT (SINGLE STORM)

        VERSION DATE 5-25-83

        DISCLAIMER: NEITHER THE UNIVERSITY NOR ANY OF ITS EMPLOYEES
        ACCEPT ANY RESPONSIBILITY OR LEGAL LIABILITY FOR THE
        CONCLUSIONS DRAWN FROM THE RESULTS OF THIS MODEL


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


            ********************************************
                 WATERSHED IDENTIFICATION CODE
                 -----------------------------
                 WEYERHAEUSER PLYMOUTH/NORTHWEST BASIN/0.8 ACRES X 4'/10YR-24
            ********************************************


============================  STORM  INPUT  ============================

QUESTION
   NO.

    1. STORM TYPE -                                          SCS'S TYPE 2
    2. RAINFALL DEPTH -                                        6.25 INCHES
    3. STORM DURATION -                                       24.00 HOURS
    4. TIME INCREMENT -                                         .10 HOURS

=====================================================================


==========================  WATERSHED DATA  ==========================

QUESTION
   NO.
    1. NUMBER OF JUNCTIONS - 1
    2. JUNCTION     NUMBER OF BRANCHES
```

1 1

3. COMPUTATION - BOTH HYDROLOGY AND SEDIMENTOLOGY

==========

========== SEDIMENTOLOGY INPUTS ==========

QUESTION NO.		
1.	SPECIFIC GRAVITY -	2.64
2.	COEFFICIENT FOR DISTRIBUTING SEDIMENT LOAD -	2.00
3.	SUBMERGED BULK SPECIFIC GRAVITY -	1.35
4.	NUMBER OF PARTICLE SIZE DISTRIBUTIONS -	1
5.	NUMBER OF DATA VALUES PER PARTICLE SIZE DISTRIBUTION -	11

==========

========== INPUT PARTICLE SIZE DISTRIBUTIONS ==========

VALUE NO.	SIZE, MM
1	1.0000
2	.5000
3	.2000
4	.1000
5	.0800
6	.0500
7	.0100
8	.0090
9	.0050
10	.0020
11	.0001

==========

========== PERCENT FINER DISTRIBUTIONS ==========

VALUE NO.	PARTICLE SIZE # 1
1	100.00
2	99.90
3	87.50
4	50.50
5	44.50
6	36.50
7	32.00
8	31.00
9	29.00
10	24.50
11	.00

==========

========== STRUCTURE INPUT FOR JUNCTION #1 ==========

BRANCH	NUMBER OF STRUCTURES
1	1

==========

========== BETWEEN STRUCTURE ROUTING PARAMETERS ==========

BRANCH NO.	BETWEEN	PARAMETERS 1 TIME	2 MUSK. K	3 MUSK. X,
1	PRIOR J OR S TO STRUCTURE 1	.00	.00	.00

==========

========== STRUCTURE DATA FOR JUNCTION #1 ==========

QUESTION NO.		
1.	NUMBER OF SUBWATERSHEDS -	10
2.	TYPE OF SEDIMENT CONTROL STRUCTURE -	POND

==========

* *
JUNCTION 1, BRANCH 1, STRUCTURE 1
* *

*** HYDRAULIC INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	AREA ACRES	CURVE NUMBER	TC HR	TT HR	ROUTING COEFFICIENTS K-HRS	X,	UNIT HYDRO
1	.52	69.00	.102	.000	.000	.00	.0
2	1.50	69.00	.120	.000	.000	.00	.0
3	1.86	69.00	.132	.000	.000	.00	2.0
4	2.07	69.00	.143	.000	.000	.00	2.0
5	2.33	69.00	.154	.000	.000	.00	2.0
6	2.15	69.00	.157	.000	.000	.00	2.0
7	1.88	69.00	.144	.000	.000	.00	2.0
8	1.62	69.00	.132	.000	.000	.00	2.0
9	1.31	69.00	.121	.000	.000	.00	.0
10	1.11	69.00	.184	.000	.000	.00	2.0

*** SEDIMENT INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	SEG NUM	SOIL K	LENGTH FEET	SLOPE PCT	CP VALUE	PART OPT	SURF COND
1	1	.20	60.0	33.30	.400	1.0	.0
2	1	.20	60.0	33.30	.400	1.0	.0
3	1	.20	60.0	33.30	.400	1.0	.0
4	1	.20	60.0	33.30	.400	1.0	.0
5	1	.20	60.0	33.30	.400	1.0	.0
6	1	.20	60.0	33.30	.400	1.0	.0
7	1	.20	60.0	33.30	.400	1.0	.0
8	1	.20	60.0	33.30	.400	1.0	.0
9	1	.20	60.0	33.30	.400	1.0	.0
10	1	.20	60.0	33.30	.400	1.0	.0

* * * COMPUTED VALUES FOR INDIVIDUAL WATERSHEDS * * *

WATERSHED	PEAK FLOW (CFS)	RUNOFF (INCHES)	SEDIMENT TONS	DIAM (MM)	DELIVERY RATIO 1	DELIVERY RATIO 2
1	1.60	2.91	24.26	.098	1.000	1.000
2	4.60	2.91	79.47	.098	1.000	1.000
3	4.66	2.91	90.28	.079	.884	1.000
4	5.19	2.91	101.77	.079	.884	1.000
5	5.84	2.91	116.19	.079	.884	1.000
6	5.39	2.91	106.18	.079	.884	1.000
7	4.71	2.91	91.36	.079	.884	1.000
8	4.06	2.91	77.33	.079	.884	1.000
9	4.02	2.91	68.29	.098	1.000	1.000
10	2.69	2.91	49.67	.075	.867	1.000

***** SUMMARY TABLE FOR TOTAL WATERSHED *****

STORM DURATION	=	24.00	HOURS
PRECIPITATION DEPTH	=	6.25	INCHES
RUNOFF VOLUME	=	3.9637	ACRE-FT
PEAK DISCHARGE	=	39.8126	CFS
AREA	=	16.3500	ACRES
TIME OF PEAK DISCHARGE	=	12.00	HRS
LOAD RATE EXPONENT FACTOR	=	2.00	
BETA	=	1.0000	
SUBMERGE BULK SPECIFIC GRAVITY	=	1.35	
RAINFALL EROSITIVITY FACTOR	=	260.30	EI UNIT
PEAK CONCENTRATION	=	323124.60	MG/L
PEAK SETTLEABLE CONCENTRATION	=	153.4626	ML/L
PEAK SETTLEABLE CONCENTRATION	=	207174.50	MG/L
TOTAL SEDIMENT YIELD	=	804.7990	TONS
REPRESENTATIVE PARTICLE SIZE	=	.0823	MM
TIME OF PEAK CONCENTRATION	=	12.10	HRS
PERIOD OF SIGNIFICANT CONCENTRATION	=	15.50	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	63.61	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	63.61	ML/L

ARITHMETIC AVERAGE SETTLEABLE
CONCENTRATION DURING PERIOD OF
SIGNIFICANT CONCENTRATION = 13.67 ML/L
ARITHMETIC AVERAGE SETTLEABLE
CONCENTRATION DURING PEAK 24 HOUR
PERIOD = 8.83 ML/L

========== POND INPUT ==========

QUESTION NO.		
1.	TIME INCREMENT OF THE ROUTED HYDROGRAPH -	.10 HOURS
2.	NON-IDEAL SETTLING CORRECTION FACTOR -	1.00
3.	PERCENT OF PERMANENT POOL THAT IS DEAD SPACE -	35.00
4.	OUTFLOW WITHDRAWAL OPTION -	SURFACE
5.	INFLOW VERTICAL CONCENTRATION -	COMP. MIXED
6.	NUMBER OF STAGE POINTS -	11
7.	NUMBER OF ROUTED HYDROGRAPH POINTS -	500
8.	STAGE-DISCHARGE OPTION -	INPUT
9.	OUTPUT OPTION -	SUM. TABLES
10.	NUMBER OF CONTINUOUS STIRRED REACTORS	3

==========

========== POND STAGE DATA ==========

STAGE POINT	VALUE
1	.00
2	1.00
3	2.00
4	3.50
5	4.00
6	4.50
7	5.00
8	5.50
9	6.00
10	6.50
11	7.00

==========

========== POND AREA DATA ==========

AREA POINT	VALUE
1	.04
2	.21
3	.78
4	.87
5	.90
6	.93
7	.96
8	.99
9	1.02
10	1.05

11 1.09

==========

========== POND DISCHARGE DATA ==========

DISCHARGE POINT	VALUE
1	.00
2	.00
3	1.12
4	2.45
5	2.97
6	12.71
7	28.49
8	34.59
9	39.82
10	71.68
11	137.37

==========

****
****

CAUTION: THE STAGE OF YOUR PRINCIPLE SPILLWAY
MAY CAUSE BED SCOUR. SEDIMOT II DOES NOT CONSIDER
POSSIBLE BED SCOUR; HENCE, YOUR OBSERVED EFFLUENT
MAY NOT MEET THE DESIRED EFFLUENT STANDARD. INCREASE
THE STAGE OF YOUR PRINCIPAL SPILLWAY.

****
****

* *

POND RESULTS

* *

***** BASIN GEOMETRY *****

STAGE (FT)	AREA (ACRES)	AVERAGE DEPTH (FT)	DISCHARGE (CFS)	CAPACITY (ACRES-FT)
.00	.040	.00	.00	.00

1.00	.208	.66	.00	.12
2.00	.782	1.10	1.12	.62
3.50	.871	2.34	2.45	1.86
4.00	.899	2.79	2.97	2.30
4.50	.929	3.25	12.71	2.76
5.00	.960	3.70	28.49	3.23
5.50	.991	4.15	34.59	3.72
6.00	1.023	4.59	39.82	4.22
6.50	1.055	5.03	71.68	4.74
7.00	1.088	5.47	137.37	5.28

***** STORM EVENT SUMMARY *****

TURBULENCE FACTOR	=	1.00	
PERMANENT POOL CAPACITY	=	.124	ACRE-FT
DEAD STORAGE	=	35.00	PERCENT
TIME INCREMENT OUTFLOW	=	.10	HRS
VISCOSITY	=	.009	CM**2/SEC
INFLOW RUNOFF VOLUME	=	3.964	ACRE-FT
OUTFLOW ROUTED VOLUME	=	3.950	ACRE-FT
STORM VOLUME DISCHARGED	=	3.950	ACRE-FT
POND VOLUME AT PEAK STAGE	=	2.340	ACRE-FT
PEAK STAGE	=	4.042	FT
PEAK INFLOW RATE	=	39.813	CFS
PEAK DISCHARGE RATE	=	3.795	CFS
PEAK INFLOW SEDIMENT CONCENTRATION	=	323124.60	MG/L
PEAK EFFLUENT SEDIMENT CONCENTRATION	=	71420.45	MG/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	.0001	ML/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	.20	MG/L
STORM AVERAGE EFFLUENT CONCENTRATION	=	41696.29	MG/L
AVERAGE EFFLUENT SEDIMENT CONCENTRATION	=	41696.29	MG/L
BASIN TRAP EFFICIENCY	=	71.92	PERCENT
DETENTION TIME OF FLOW WITH SEDIMENT	=	7.58	HRS
DETENTION TIME FROM HYDROGRAPH CENTERS	=	7.58	HRS
DETENTION TIME INCLUDING STORED FLOW	=	7.58	HRS
SEDIMENT LOAD DISCHARGED	=	226.02	TONS
PERIOD OF SIGNIFICANT CONCENTRATION	=	40.40	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L

```
*****************************************************************************
*          (program name)                * SEDIMOT S/N  :                    *
*                                        * HMVersion    :  3.20              *
*       (program description)            * Date         :  8/18/99           *
*                                        * Time         : 16:08:16           *
*                                        * Input file   : WPN4B.INP          *
*                                        * Output file  : WPN4B.OUT          *
*                                        *                                   *
*                                        *                                   *
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x     x  x        x     x    x    xx   xx  x     x     x
x        x        x     x    x    x x x x  x     x     x
 xxxxx   xxxxx    x     x    x    x  x  x  x     x     x
      x  x        x     x    x    x     x  x     x     x
x     x  x        x     x    x    x     x  x     x     x
 xxxxx   xxxxxxx  xxxxxx   xxxxx  x     x   xxxxx      x
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:::                                      :::
:::  Full Microcomputer Implementation   :::
:::                 by                   :::
:::        Haestad Methods, Inc.         :::
:::                                      :::
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37 Brookside Road * Waterbury, Connecticut 06708 * (203) 755-1666

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        UNIVERSITY OF KENTUCKY COMPUTER MODEL
        OF SURFACE MINE HYDROLOGY AND SEDIMENTOLOGY
        FOR MORE INFORMATION CONTACT THE AGRICULTURAL
        ENGINEERING DEPARTMENT

        THE UK MODEL IS A DESIGN MODEL DEVELOPED TO PREDICT
        THE HYDRAULIC AND SEDIMENT RESPONSE FROM SURFACE
        MINED LANDS FOR A SPECIFIED RAINFALL EVENT (SINGLE STORM)

        VERSION DATE 5-25-83

        DISCLAIMER: NEITHER THE UNIVERSITY NOR ANY OF ITS EMPLOYEES
        ACCEPT ANY RESPONSIBILITY OR LEGAL LIABILITY FOR THE
        CONCLUSIONS DRAWN FROM THE RESULTS OF THIS MODEL


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              *********************************************
                   WATERSHED IDENTIFICATION CODE
                   -----------------------------
                   WEYERHAEUSER PLYMOUTH/NORTHWEST BASIN/0.8 ACRES X 4'/25YR-24
              *********************************************


============================  STORM  INPUT  ============================

QUESTION
   NO.

    1. STORM TYPE -                                          SCS'S TYPE 2
    2. RAINFALL DEPTH -                                        7.25 INCHES
    3. STORM DURATION -                                       24.00 HOURS
    4. TIME INCREMENT -                                         .10 HOURS

=========================================================================


===========================  WATERSHED DATA  ==========================

QUESTION
   NO.
    1. NUMBER OF JUNCTIONS - 1
    2. JUNCTION     NUMBER OF BRANCHES
```

1 1

3. COMPUTATION - BOTH HYDROLOGY AND SEDIMENTOLOGY

==========

========== SEDIMENTOLOGY INPUTS ==========

QUESTION NO.		
1.	SPECIFIC GRAVITY -	2.64
2.	COEFFICIENT FOR DISTRIBUTING SEDIMENT LOAD -	2.00
3.	SUBMERGED BULK SPECIFIC GRAVITY -	1.35
4.	NUMBER OF PARTICLE SIZE DISTRIBUTIONS -	1
5.	NUMBER OF DATA VALUES PER PARTICLE SIZE DISTRIBUTION -	11

==========

========== INPUT PARTICLE SIZE DISTRIBUTIONS ==========

VALUE NO.	SIZE, MM
1	1.0000
2	.5000
3	.2000
4	.1000
5	.0800
6	.0500
7	.0100
8	.0090
9	.0050
10	.0020
11	.0001

==========

========== PERCENT FINER DISTRIBUTIONS ==========

VALUE NO.	PARTICLE SIZE # 1
1	100.00
2	99.90
3	87.50
4	50.50
5	44.50
6	36.50
7	32.00
8	31.00
9	29.00
10	24.50
11	.00

==========

========== STRUCTURE INPUT FOR JUNCTION #1 ==========

BRANCH	NUMBER OF STRUCTURES
1	1

==========

========== BETWEEN STRUCTURE ROUTING PARAMETERS ==========

BRANCH NO.	BETWEEN	PARAMETERS 1 TIME	2 MUSK. K	3 MUSK. X,
1	PRIOR J OR S TO STRUCTURE 1	.00	.00	.00

==========

========== STRUCTURE DATA FOR JUNCTION #1 ==========

QUESTION NO.		
1.	NUMBER OF SUBWATERSHEDS -	10
2.	TYPE OF SEDIMENT CONTROL STRUCTURE -	POND

==========

* *
JUNCTION 1, BRANCH 1, STRUCTURE 1
* *

*** HYDRAULIC INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	AREA ACRES	CURVE NUMBER	TC HR	TT HR	ROUTING COEFFICIENTS K-HRS	X,	UNIT HYDRO
1	.52	69.00	.102	.000	.000	.00	.0
2	1.50	69.00	.120	.000	.000	.00	.0
3	1.86	69.00	.132	.000	.000	.00	2.0
4	2.07	69.00	.143	.000	.000	.00	2.0
5	2.33	69.00	.154	.000	.000	.00	2.0
6	2.15	69.00	.157	.000	.000	.00	2.0
7	1.88	69.00	.144	.000	.000	.00	2.0
8	1.62	69.00	.132	.000	.000	.00	2.0
9	1.31	69.00	.121	.000	.000	.00	.0
10	1.11	69.00	.184	.000	.000	.00	2.0

*** SEDIMENT INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	SEG NUM	SOIL K	LENGTH FEET	SLOPE PCT	CP VALUE	PART OPT	SURF COND
1	1	.20	60.0	33.30	.400	1.0	.0
2	1	.20	60.0	33.30	.400	1.0	.0
3	1	.20	60.0	33.30	.400	1.0	.0
4	1	.20	60.0	33.30	.400	1.0	.0
5	1	.20	60.0	33.30	.400	1.0	.0
6	1	.20	60.0	33.30	.400	1.0	.0
7	1	.20	60.0	33.30	.400	1.0	.0
8	1	.20	60.0	33.30	.400	1.0	.0
9	1	.20	60.0	33.30	.400	1.0	.0
10	1	.20	60.0	33.30	.400	1.0	.0

* * * COMPUTED VALUES FOR INDIVIDUAL WATERSHEDS * * *

WATERSHED	PEAK FLOW (CFS)	RUNOFF (INCHES)	SEDIMENT TONS	DIAM (MM)	DELIVERY RATIO 1	DELIVERY RATIO 2
1	2.00	3.72	31.64	.098	1.000	1.000
2	5.78	3.72	103.63	.098	1.000	1.000
3	5.95	3.72	118.75	.080	.893	1.000
4	6.62	3.72	133.87	.080	.893	1.000
5	7.45	3.72	152.84	.080	.893	1.000
6	6.87	3.72	139.67	.080	.893	1.000
7	6.01	3.72	120.18	.080	.893	1.000
8	5.18	3.72	101.73	.080	.893	1.000
9	5.05	3.72	89.04	.098	1.000	1.000
10	3.43	3.72	65.36	.077	.876	1.000

***** SUMMARY TABLE FOR TOTAL WATERSHED *****

STORM DURATION	=	24.00	HOURS
PRECIPITATION DEPTH	=	7.25	INCHES
RUNOFF VOLUME	=	5.0686	ACRE-FT
PEAK DISCHARGE	=	51.0742	CFS
AREA	=	16.3500	ACRES
TIME OF PEAK DISCHARGE	=	12.00	HRS
LOAD RATE EXPONENT FACTOR	=	2.00	
BETA	=	1.0000	
SUBMERGE BULK SPECIFIC GRAVITY	=	1.35	
RAINFALL EROSITIVITY FACTOR	=	359.62	EI UNIT
PEAK CONCENTRATION	=	327132.20	MG/L
PEAK SETTLEABLE CONCENTRATION	=	156.0727	ML/L
PEAK SETTLEABLE CONCENTRATION	=	210698.10	MG/L
TOTAL SEDIMENT YIELD	=	1056.7030	TONS
REPRESENTATIVE PARTICLE SIZE	=	.0835	MM
TIME OF PEAK CONCENTRATION	=	12.10	HRS
PERIOD OF SIGNIFICANT CONCENTRATION	=	16.30	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	65.45	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	65.45	ML/L

ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION = 13.22 ML/L

ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD = 8.98 ML/L

========== POND INPUT ==========

QUESTION NO.		
1.	TIME INCREMENT OF THE ROUTED HYDROGRAPH -	.10 HOURS
2.	NON-IDEAL SETTLING CORRECTION FACTOR -	1.00
3.	PERCENT OF PERMANENT POOL THAT IS DEAD SPACE -	35.00
4.	OUTFLOW WITHDRAWAL OPTION -	SURFACE
5.	INFLOW VERTICAL CONCENTRATION -	COMP. MIXED
6.	NUMBER OF STAGE POINTS -	11
7.	NUMBER OF ROUTED HYDROGRAPH POINTS -	500
8.	STAGE-DISCHARGE OPTION -	INPUT
9.	OUTPUT OPTION -	SUM. TABLES
10.	NUMBER OF CONTINUOUS STIRRED REACTORS	3

==========

========== POND STAGE DATA ==========

STAGE POINT	VALUE
1	.00
2	1.00
3	2.00
4	3.50
5	4.00
6	4.50
7	5.00
8	5.50
9	6.00
10	6.50
11	7.00

==========

========== POND AREA DATA ==========

AREA POINT	VALUE
1	.04
2	.21
3	.78
4	.87
5	.90
6	.93
7	.96
8	.99
9	1.02
10	1.05

11 1.09

==========

========== POND DISCHARGE DATA ==========

DISCHARGE POINT	VALUE
1	.00
2	.00
3	1.12
4	2.45
5	2.97
6	12.71
7	28.49
8	34.59
9	39.82
10	71.68
11	137.37

==========

****
****

CAUTION: THE STAGE OF YOUR PRINCIPLE SPILLWAY
MAY CAUSE BED SCOUR. SEDIMOT II DOES NOT CONSIDER
POSSIBLE BED SCOUR; HENCE, YOUR OBSERVED EFFLUENT
MAY NOT MEET THE DESIRED EFFLUENT STANDARD. INCREASE
THE STAGE OF YOUR PRINCIPAL SPILLWAY.

****
****

* *

POND RESULTS

* *

***** BASIN GEOMETRY *****

STAGE (FT)	AREA (ACRES)	AVERAGE DEPTH (FT)	DISCHARGE (CFS)	CAPACITY (ACRES-FT)
.00	.040	.00	.00	.00

1.00	.208	.66	.00	.12
2.00	.782	1.10	1.12	.62
3.50	.871	2.34	2.45	1.86
4.00	.899	2.79	2.97	2.30
4.50	.929	3.25	12.71	2.76
5.00	.960	3.70	28.49	3.23
5.50	.991	4.15	34.59	3.72
6.00	1.023	4.59	39.82	4.22
6.50	1.055	5.03	71.68	4.74
7.00	1.088	5.47	137.37	5.28

***** STORM EVENT SUMMARY *****

TURBULENCE FACTOR	=	1.00	
PERMANENT POOL CAPACITY	=	.124	ACRE-FT
DEAD STORAGE	=	35.00	PERCENT
TIME INCREMENT OUTFLOW	=	.10	HRS
VISCOSITY	=	.009	CM**2/SEC
INFLOW RUNOFF VOLUME	=	5.069	ACRE-FT
OUTFLOW ROUTED VOLUME	=	5.053	ACRE-FT
STORM VOLUME DISCHARGED	=	5.053	ACRE-FT
POND VOLUME AT PEAK STAGE	=	2.658	ACRE-FT
PEAK STAGE	=	4.390	FT
PEAK INFLOW RATE	=	51.074	CFS
PEAK DISCHARGE RATE	=	10.567	CFS
PEAK INFLOW SEDIMENT CONCENTRATION	=	327132.20	MG/L
PEAK EFFLUENT SEDIMENT CONCENTRATION	=	75453.61	MG/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	.0013	ML/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	1.79	MG/L
STORM AVERAGE EFFLUENT CONCENTRATION	=	44404.16	MG/L
AVERAGE EFFLUENT SEDIMENT CONCENTRATION	=	44404.16	MG/L
BASIN TRAP EFFICIENCY	=	70.86	PERCENT
DETENTION TIME OF FLOW WITH SEDIMENT	=	6.55	HRS
DETENTION TIME FROM HYDROGRAPH CENTERS	=	6.55	HRS
DETENTION TIME INCLUDING STORED FLOW	=	6.55	HRS
SEDIMENT LOAD DISCHARGED	=	307.93	TONS
PERIOD OF SIGNIFICANT CONCENTRATION	=	41.10	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L

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*****************************************************************************
*          (program name)                * SEDIMOT S/N  :                    *
*                                        * HMVersion    :  3.20              *
*       (program description)            * Date         :  8/18/99           *
*                                        * Time         : 16:10:52           *
*                                        * Input file   : WPN4C.INP          *
*                                        * Output file  : WPN4C.OUT          *
*                                        *                                   *
*                                        *                                   *
*****************************************************************************
```

```
 XXXXX   XXXXXXX  XXXXXX   XXXXX  X     X   XXXXX   XXXXXXX
X     X  X        X     X    X    XX   XX  X     X     X
X        X        X     X    X    X X X X  X     X     X
 XXXXX   XXXXX    X     X    X    X  X  X  X     X     X
      X  X        X     X    X    X     X  X     X     X
X     X  X        X     X    X    X     X  X     X     X
 XXXXX   XXXXXXX  XXXXXX   XXXXX  X     X   XXXXX      X
```

```
::::::::::::::::::::::::::::::::::::::::::::
::::::::::::::::::::::::::::::::::::::::::::
:::                                      :::
:::  Full Microcomputer Implementation   :::
:::                 by                   :::
:::        Haestad Methods, Inc.         :::
:::                                      :::
::::::::::::::::::::::::::::::::::::::::::::
::::::::::::::::::::::::::::::::::::::::::::
```

37 Brookside Road * Waterbury, Connecticut 06708 * (203) 755-1666

```
*************************************************************
*************************************************************

        UNIVERSITY OF KENTUCKY COMPUTER MODEL
        OF SURFACE MINE HYDROLOGY AND SEDIMENTOLOGY
        FOR MORE INFORMATION CONTACT THE AGRICULTURAL
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        MINED LANDS FOR A SPECIFIED RAINFALL EVENT (SINGLE STORM)

        VERSION DATE 5-25-83

        DISCLAIMER: NEITHER THE UNIVERSITY NOR ANY OF ITS EMPLOYEES
        ACCEPT ANY RESPONSIBILITY OR LEGAL LIABILITY FOR THE
        CONCLUSIONS DRAWN FROM THE RESULTS OF THIS MODEL


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


              *********************************************
                   WATERSHED IDENTIFICATION CODE
                   -----------------------------
                   WEYERHAEUSER PLYMOUTH/NORTHWEST BASIN/0.8 AC X 4'/100YR-24
              *********************************************


========================== STORM INPUT ==========================

QUESTION
   NO.

    1. STORM TYPE -                                        SCS'S TYPE 2
    2. RAINFALL DEPTH -                                      9.00 INCHES
    3. STORM DURATION -                                     24.00 HOURS
    4. TIME INCREMENT -                                       .10 HOURS

=================================================================


========================= WATERSHED DATA =========================

QUESTION
   NO.
    1. NUMBER OF JUNCTIONS - 1
    2. JUNCTION     NUMBER OF BRANCHES
```

1 1

3. COMPUTATION - BOTH HYDROLOGY AND SEDIMENTOLOGY

==========

========== SEDIMENTOLOGY INPUTS ==========

QUESTION NO.		
1.	SPECIFIC GRAVITY -	2.64
2.	COEFFICIENT FOR DISTRIBUTING SEDIMENT LOAD -	2.00
3.	SUBMERGED BULK SPECIFIC GRAVITY -	1.35
4.	NUMBER OF PARTICLE SIZE DISTRIBUTIONS -	1
5.	NUMBER OF DATA VALUES PER PARTICLE SIZE DISTRIBUTION -	11

==========

========== INPUT PARTICLE SIZE DISTRIBUTIONS ==========

VALUE NO.	SIZE, MM
1	1.0000
2	.5000
3	.2000
4	.1000
5	.0800
6	.0500
7	.0100
8	.0090
9	.0050
10	.0020
11	.0001

==========

========== PERCENT FINER DISTRIBUTIONS ==========

VALUE NO.	PARTICLE SIZE # 1
1	100.00
2	99.90
3	87.50
4	50.50
5	44.50
6	36.50
7	32.00
8	31.00
9	29.00
10	24.50
11	.00

==========

========== STRUCTURE INPUT FOR JUNCTION #1 ==========

BRANCH	NUMBER OF STRUCTURES
1	1

==========

========== BETWEEN STRUCTURE ROUTING PARAMETERS ==========

BRANCH NO.	BETWEEN	PARAMETERS 1 TIME	2 MUSK. K	3 MUSK. X,
1	PRIOR J OR S TO STRUCTURE 1	.00	.00	.00

==========

========== STRUCTURE DATA FOR JUNCTION #1 ==========

QUESTION NO.		
1.	NUMBER OF SUBWATERSHEDS -	10
2.	TYPE OF SEDIMENT CONTROL STRUCTURE -	POND

==========

* *
JUNCTION 1, BRANCH 1, STRUCTURE 1
* *

*** HYDRAULIC INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	AREA ACRES	CURVE NUMBER	TC HR	TT HR	ROUTING COEFFICIENTS K-HRS	X,	UNIT HYDRO
1	.52	69.00	.102	.000	.000	.00	.0
2	1.50	69.00	.120	.000	.000	.00	.0
3	1.86	69.00	.132	.000	.000	.00	2.0
4	2.07	69.00	.143	.000	.000	.00	2.0
5	2.33	69.00	.154	.000	.000	.00	2.0
6	2.15	69.00	.157	.000	.000	.00	2.0
7	1.88	69.00	.144	.000	.000	.00	2.0
8	1.62	69.00	.132	.000	.000	.00	2.0
9	1.31	69.00	.121	.000	.000	.00	.0
10	1.11	69.00	.184	.000	.000	.00	2.0

*** SEDIMENT INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	SEG NUM	SOIL K	LENGTH FEET	SLOPE PCT	CP VALUE	PART OPT	SURF COND
1	1	.20	60.0	33.30	.400	1.0	.0
2	1	.20	60.0	33.30	.400	1.0	.0
3	1	.20	60.0	33.30	.400	1.0	.0
4	1	.20	60.0	33.30	.400	1.0	.0
5	1	.20	60.0	33.30	.400	1.0	.0
6	1	.20	60.0	33.30	.400	1.0	.0
7	1	.20	60.0	33.30	.400	1.0	.0
8	1	.20	60.0	33.30	.400	1.0	.0
9	1	.20	60.0	33.30	.400	1.0	.0
10	1	.20	60.0	33.30	.400	1.0	.0

* * * COMPUTED VALUES FOR INDIVIDUAL WATERSHEDS * * *

WATERSHED	PEAK FLOW (CFS)	RUNOFF (INCHES)	SEDIMENT TONS	DIAM (MM)	DELIVERY RATIO 1	DELIVERY RATIO 2
1	2.73	5.21	45.45	.098	1.000	1.000
2	7.88	5.21	148.89	.098	1.000	1.000
3	8.27	5.21	172.48	.082	.905	1.000
4	9.20	5.21	194.43	.082	.905	1.000
5	10.36	5.21	221.98	.082	.905	1.000
6	9.56	5.21	202.86	.082	.905	1.000
7	8.36	5.21	174.55	.082	.905	1.000
8	7.20	5.21	147.75	.082	.905	1.000
9	6.88	5.21	127.93	.098	1.000	1.000
10	4.78	5.21	95.04	.080	.889	1.000

***** SUMMARY TABLE FOR TOTAL WATERSHED *****

STORM DURATION	=	24.00	HOURS
PRECIPITATION DEPTH	=	9.00	INCHES
RUNOFF VOLUME	=	7.1005	ACRE-FT
PEAK DISCHARGE	=	71.7318	CFS
AREA	=	16.3500	ACRES
TIME OF PEAK DISCHARGE	=	12.00	HRS
LOAD RATE EXPONENT FACTOR	=	2.00	
BETA	=	1.0000	
SUBMERGE BULK SPECIFIC GRAVITY	=	1.35	
RAINFALL EROSITIVITY FACTOR	=	575.89	EI UNIT
PEAK CONCENTRATION	=	331508.70	MG/L
PEAK SETTLEABLE CONCENTRATION	=	159.0372	ML/L
PEAK SETTLEABLE CONCENTRATION	=	214700.30	MG/L
TOTAL SEDIMENT YIELD	=	1531.3720	TONS
REPRESENTATIVE PARTICLE SIZE	=	.0849	MM
TIME OF PEAK CONCENTRATION	=	12.10	HRS
PERIOD OF SIGNIFICANT CONCENTRATION	=	17.30	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	67.85	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	67.85	ML/L

ARITHMETIC AVERAGE SETTLEABLE
CONCENTRATION DURING PERIOD OF
SIGNIFICANT CONCENTRATION = 12.81 ML/L
ARITHMETIC AVERAGE SETTLEABLE
CONCENTRATION DURING PEAK 24 HOUR
PERIOD = 9.24 ML/L

========== POND INPUT ==========

QUESTION NO.		
1.	TIME INCREMENT OF THE ROUTED HYDROGRAPH -	.10 HOURS
2.	NON-IDEAL SETTLING CORRECTION FACTOR -	1.00
3.	PERCENT OF PERMANENT POOL THAT IS DEAD SPACE -	35.00
4.	OUTFLOW WITHDRAWAL OPTION -	SURFACE
5.	INFLOW VERTICAL CONCENTRATION -	COMP. MIXED
6.	NUMBER OF STAGE POINTS -	11
7.	NUMBER OF ROUTED HYDROGRAPH POINTS -	500
8.	STAGE-DISCHARGE OPTION -	INPUT
9.	OUTPUT OPTION -	SUM. TABLES
10.	NUMBER OF CONTINUOUS STIRRED REACTORS	3

==========

========== POND STAGE DATA ==========

STAGE POINT	VALUE
1	.00
2	1.00
3	2.00
4	3.50
5	4.00
6	4.50
7	5.00
8	5.50
9	6.00
10	6.50
11	7.00

==========

========== POND AREA DATA ==========

AREA POINT	VALUE
1	.04
2	.21
3	.78
4	.87
5	.90
6	.93
7	.96
8	.99
9	1.02
10	1.05

11	1.09

==========

========== POND DISCHARGE DATA ==========

DISCHARGE POINT	VALUE
1	.00
2	.00
3	1.12
4	2.45
5	2.97
6	12.71
7	28.49
8	34.59
9	39.82
10	71.68
11	137.37

==========

****
****

CAUTION: THE STAGE OF YOUR PRINCIPLE SPILLWAY
MAY CAUSE BED SCOUR. SEDIMOT II DOES NOT CONSIDER
POSSIBLE BED SCOUR; HENCE, YOUR OBSERVED EFFLUENT
MAY NOT MEET THE DESIRED EFFLUENT STANDARD. INCREASE
THE STAGE OF YOUR PRINCIPAL SPILLWAY.

****
****

* *

POND RESULTS

* *

***** BASIN GEOMETRY *****

STAGE (FT)	AREA (ACRES)	AVERAGE DEPTH (FT)	DISCHARGE (CFS)	CAPACITY (ACRES-FT)
.00	.040	.00	.00	.00

1.00	.208	.66	.00	.12
2.00	.782	1.10	1.12	.62
3.50	.871	2.34	2.45	1.86
4.00	.899	2.79	2.97	2.30
4.50	.929	3.25	12.71	2.76
5.00	.960	3.70	28.49	3.23
5.50	.991	4.15	34.59	3.72
6.00	1.023	4.59	39.82	4.22
6.50	1.055	5.03	71.68	4.74
7.00	1.088	5.47	137.37	5.28

***** STORM EVENT SUMMARY *****

TURBULENCE FACTOR	=	1.00	
PERMANENT POOL CAPACITY	=	.124	ACRE-FT
DEAD STORAGE	=	35.00	PERCENT
TIME INCREMENT OUTFLOW	=	.10	HRS
VISCOSITY	=	.009	CM**2/SEC
INFLOW RUNOFF VOLUME	=	7.101	ACRE-FT
OUTFLOW ROUTED VOLUME	=	7.081	ACRE-FT
STORM VOLUME DISCHARGED	=	7.081	ACRE-FT
POND VOLUME AT PEAK STAGE	=	3.164	ACRE-FT
PEAK STAGE	=	4.929	FT
PEAK INFLOW RATE	=	71.732	CFS
PEAK DISCHARGE RATE	=	26.255	CFS
PEAK INFLOW SEDIMENT CONCENTRATION	=	331508.70	MG/L
PEAK EFFLUENT SEDIMENT CONCENTRATION	=	83405.70	MG/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	.0059	ML/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	7.90	MG/L
STORM AVERAGE EFFLUENT CONCENTRATION	=	48222.98	MG/L
AVERAGE EFFLUENT SEDIMENT CONCENTRATION	=	48222.98	MG/L
BASIN TRAP EFFICIENCY	=	69.39	PERCENT
DETENTION TIME OF FLOW WITH SEDIMENT	=	5.26	HRS
DETENTION TIME FROM HYDROGRAPH CENTERS	=	5.26	HRS
DETENTION TIME INCLUDING STORED FLOW	=	5.26	HRS
SEDIMENT LOAD DISCHARGED	=	468.75	TONS
PERIOD OF SIGNIFICANT CONCENTRATION	=	42.20	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L

```
*****************************************************************************
*          (program name)                * SEDIMOT S/N  :                     *
*                                        * HMVersion    :  3.20               *
*       (program description)            * Date         :  8/18/99            *
*                                        * Time         : 16:13:37            *
*                                        * Input file   : WPN4D.INP           *
*                                        * Output file  : WPN4D.OUT           *
*                                        *                                    *
*                                        *                                    *
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 xxxxx   xxxxxxx  xxxxxx   xxxxx  x     x   xxxxx   xxxxxxx
x     x  x        x     x    x    xx   xx  x     x     x
x        x        x     x    x    x x x x  x     x     x
 xxxxx   xxxxx    x     x    x    x  x  x  x     x     x
      x  x        x     x    x    x     x  x     x     x
x     x  x        x     x    x    x     x  x     x     x
 xxxxx   xxxxxxx  xxxxxx   xxxxx  x     x   xxxxx      x
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:::                                      :::
:::  Full Microcomputer Implementation   :::
:::                 by                   :::
:::        Haestad Methods, Inc.         :::
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*************************************************************
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*************************************************************
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              *******************************************
                   WATERSHED IDENTIFICATION CODE
                   -----------------------------
                   WEYERHAEUSER PLYMOUTH/NORTHWEST BASIN/0.8 AC X 4'/2YR-24
              *******************************************


============================  STORM  INPUT  ============================

QUESTION
   NO.

    1. STORM TYPE -                                          SCS'S TYPE 2
    2. RAINFALL DEPTH -                                        4.00 INCHES
    3. STORM DURATION -                                       24.00 HOURS
    4. TIME INCREMENT -                                         .10 HOURS

=====================================================================


===========================  WATERSHED DATA  ==========================

QUESTION
   NO.
    1. NUMBER OF JUNCTIONS - 1
    2. JUNCTION     NUMBER OF BRANCHES
```

```
          1                 1
   3. COMPUTATION - BOTH HYDROLOGY AND SEDIMENTOLOGY

=====================================================================


=======================  SEDIMENTOLOGY INPUTS  =======================

QUESTION
   NO.
    1. SPECIFIC GRAVITY -                                          2.64
    2. COEFFICIENT FOR DISTRIBUTING SEDIMENT LOAD -                2.00
    3. SUBMERGED BULK SPECIFIC GRAVITY -                           1.35
    4. NUMBER OF PARTICLE SIZE DISTRIBUTIONS -                     1
    5. NUMBER OF DATA VALUES PER PARTICLE SIZE DISTRIBUTION -     11

=====================================================================


================ INPUT PARTICLE SIZE DISTRIBUTIONS ==================

                        VALUE
                         NO.       SIZE, MM

                          1          1.0000
                          2           .5000
                          3           .2000
                          4           .1000
                          5           .0800
                          6           .0500
                          7           .0100
                          8           .0090
                          9           .0050
                         10           .0020
                         11           .0001

=====================================================================


==================  PERCENT FINER DISTRIBUTIONS  ====================

VALUE                        PARTICLE SIZE #
 NO.
          1
  1    100.00
  2     99.90
  3     87.50
  4     50.50
  5     44.50
  6     36.50
  7     32.00
  8     31.00
  9     29.00
 10     24.50
 11       .00

=====================================================================
```

========== STRUCTURE INPUT FOR JUNCTION #1 ==========

BRANCH	NUMBER OF STRUCTURES
1	1

==========

========== BETWEEN STRUCTURE ROUTING PARAMETERS ==========

BRANCH NO.	BETWEEN	PARAMETERS 1 TIME	2 MUSK. K	3 MUSK. X,
1	PRIOR J OR S TO STRUCTURE 1	.00	.00	.00

==========

========== STRUCTURE DATA FOR JUNCTION #1 ==========

QUESTION NO.		
1.	NUMBER OF SUBWATERSHEDS -	10
2.	TYPE OF SEDIMENT CONTROL STRUCTURE -	POND

==========

* *
JUNCTION 1, BRANCH 1, STRUCTURE 1
* *

*** HYDRAULIC INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	AREA ACRES	CURVE NUMBER	TC HR	TT HR	ROUTING COEFFICIENTS K-HRS	X,	UNIT HYDRO
1	.52	69.00	.102	.000	.000	.00	.0
2	1.50	69.00	.120	.000	.000	.00	.0
3	1.86	69.00	.132	.000	.000	.00	2.0
4	2.07	69.00	.143	.000	.000	.00	2.0
5	2.33	69.00	.154	.000	.000	.00	2.0
6	2.15	69.00	.157	.000	.000	.00	2.0
7	1.88	69.00	.144	.000	.000	.00	2.0
8	1.62	69.00	.132	.000	.000	.00	2.0
9	1.31	69.00	.121	.000	.000	.00	.0
10	1.11	69.00	.184	.000	.000	.00	2.0

*** SEDIMENT INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	SEG NUM	SOIL K	LENGTH FEET	SLOPE PCT	CP VALUE	PART OPT	SURF COND
1	1	.20	60.0	33.30	.400	1.0	.0
2	1	.20	60.0	33.30	.400	1.0	.0
3	1	.20	60.0	33.30	.400	1.0	.0
4	1	.20	60.0	33.30	.400	1.0	.0
5	1	.20	60.0	33.30	.400	1.0	.0
6	1	.20	60.0	33.30	.400	1.0	.0
7	1	.20	60.0	33.30	.400	1.0	.0
8	1	.20	60.0	33.30	.400	1.0	.0
9	1	.20	60.0	33.30	.400	1.0	.0
10	1	.20	60.0	33.30	.400	1.0	.0

* * * COMPUTED VALUES FOR INDIVIDUAL WATERSHEDS * * *

WATERSHED	PEAK FLOW (CFS)	RUNOFF (INCHES)	SEDIMENT TONS	DIAM (MM)	DELIVERY RATIO 1	DELIVERY RATIO 2
1	.73	1.27	9.81	.098	1.000	1.000
2	2.10	1.27	32.12	.098	1.000	1.000
3	1.98	1.27	35.13	.070	.846	1.000
4	2.21	1.27	39.60	.070	.846	1.000
5	2.49	1.27	45.21	.070	.846	1.000
6	2.29	1.27	41.32	.070	.846	1.000
7	2.01	1.27	35.55	.070	.846	1.000
8	1.73	1.27	30.09	.070	.846	1.000
9	1.83	1.27	27.60	.098	1.000	1.000
10	1.14	1.27	19.31	.067	.829	1.000

***** SUMMARY TABLE FOR TOTAL WATERSHED *****

STORM DURATION	=	24.00	HOURS
PRECIPITATION DEPTH	=	4.00	INCHES
RUNOFF VOLUME	=	1.7258	ACRE-FT
PEAK DISCHARGE	=	16.5374	CFS
AREA	=	16.3500	ACRES
TIME OF PEAK DISCHARGE	=	12.00	HRS
LOAD RATE EXPONENT FACTOR	=	2.00	
BETA	=	1.0000	
SUBMERGE BULK SPECIFIC GRAVITY	=	1.35	
RAINFALL EROSITIVITY FACTOR	=	98.49	EI UNIT
PEAK CONCENTRATION	=	312196.20	MG/L
PEAK SETTLEABLE CONCENTRATION	=	145.3194	ML/L
PEAK SETTLEABLE CONCENTRATION	=	196181.20	MG/L
TOTAL SEDIMENT YIELD	=	315.7376	TONS
REPRESENTATIVE PARTICLE SIZE	=	.0764	MM
TIME OF PEAK CONCENTRATION	=	12.10	HRS
PERIOD OF SIGNIFICANT CONCENTRATION	=	13.80	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	56.60	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	56.60	ML/L

ARITHMETIC AVERAGE SETTLEABLE
CONCENTRATION DURING PERIOD OF
SIGNIFICANT CONCENTRATION = 15.02 ML/L
ARITHMETIC AVERAGE SETTLEABLE
CONCENTRATION DURING PEAK 24 HOUR
PERIOD = 8.64 ML/L

========== POND INPUT ==========

QUESTION NO.		
1.	TIME INCREMENT OF THE ROUTED HYDROGRAPH -	.10 HOURS
2.	NON-IDEAL SETTLING CORRECTION FACTOR -	1.00
3.	PERCENT OF PERMANENT POOL THAT IS DEAD SPACE -	35.00
4.	OUTFLOW WITHDRAWAL OPTION -	SURFACE
5.	INFLOW VERTICAL CONCENTRATION -	COMP. MIXED
6.	NUMBER OF STAGE POINTS -	11
7.	NUMBER OF ROUTED HYDROGRAPH POINTS -	500
8.	STAGE-DISCHARGE OPTION -	INPUT
9.	OUTPUT OPTION -	SUM. TABLES
10.	NUMBER OF CONTINUOUS STIRRED REACTORS	3

==========

========== POND STAGE DATA ==========

STAGE POINT	VALUE
1	.00
2	1.00
3	2.00
4	3.50
5	4.00
6	4.50
7	5.00
8	5.50
9	6.00
10	6.50
11	7.00

==========

========== POND AREA DATA ==========

AREA POINT	VALUE
1	.04
2	.21
3	.78
4	.87
5	.90
6	.93
7	.96
8	.99
9	1.02
10	1.05

11	1.09

==========

========== POND DISCHARGE DATA ==========

DISCHARGE POINT	VALUE
1	.00
2	.00
3	1.12
4	2.45
5	2.97
6	12.71
7	28.49
8	34.59
9	39.82
10	71.68
11	137.37

==========

* *

POND RESULTS

* *

***** BASIN GEOMETRY *****

STAGE (FT)	AREA (ACRES)	AVERAGE DEPTH (FT)	DISCHARGE (CFS)	CAPACITY (ACRES-FT)
.00	.040	.00	.00	.00
1.00	.208	.66	.00	.12
2.00	.782	1.10	1.12	.62
3.50	.871	2.34	2.45	1.86
4.00	.899	2.79	2.97	2.30
4.50	.929	3.25	12.71	2.76
5.00	.960	3.70	28.49	3.23
5.50	.991	4.15	34.59	3.72
6.00	1.023	4.59	39.82	4.22
6.50	1.055	5.03	71.68	4.74
7.00	1.088	5.47	137.37	5.28

***** STORM EVENT SUMMARY *****

TURBULENCE FACTOR	=	1.00	
PERMANENT POOL CAPACITY	=	.124	ACRE-FT
DEAD STORAGE	=	35.00	PERCENT
TIME INCREMENT OUTFLOW	=	.10	HRS
VISCOSITY	=	.009	CM**2/SEC
INFLOW RUNOFF VOLUME	=	1.726	ACRE-FT
OUTFLOW ROUTED VOLUME	=	1.722	ACRE-FT
STORM VOLUME DISCHARGED	=	1.722	ACRE-FT
POND VOLUME AT PEAK STAGE	=	.990	ACRE-FT
PEAK STAGE	=	2.449	FT
PEAK INFLOW RATE	=	16.537	CFS
PEAK DISCHARGE RATE	=	1.518	CFS
PEAK INFLOW SEDIMENT CONCENTRATION	=	312196.20	MG/L
PEAK EFFLUENT SEDIMENT CONCENTRATION	=	67670.43	MG/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	.0001	ML/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	.10	MG/L
STORM AVERAGE EFFLUENT CONCENTRATION	=	37160.52	MG/L
AVERAGE EFFLUENT SEDIMENT CONCENTRATION	=	37160.52	MG/L
BASIN TRAP EFFICIENCY	=	72.19	PERCENT
DETENTION TIME OF FLOW WITH SEDIMENT	=	5.97	HRS
DETENTION TIME FROM HYDROGRAPH CENTERS	=	5.97	HRS
DETENTION TIME INCLUDING STORED FLOW	=	5.97	HRS
SEDIMENT LOAD DISCHARGED	=	87.80	TONS
PERIOD OF SIGNIFICANT CONCENTRATION	=	38.70	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L

*** RUN COMPLETED ****

DESIGN SHEET

SHEET ____ OF ____

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WEYERHAEUSER - PLYMOUTH	SYK	8/15/99	[illegible]	7/10/00	05101.01

SUMMARY OF NORTHWEST BASIN DESIGN

BASIN DIMENSIONS: SEE SHEET 5

EL. 24 A ~ 0.04 AC
25 A ~ 0.21 AC
26 (114' X 299')
32 (150' X 335')

(SIDE SLOPE → 3H:1V)

PRINCIPAL SPILLWAY (P.S.):
30" CMP RISER DIAMETER
24" CMP BARREL DIAMETER
0.5" PERFORATIONS DIAMETER
→ 4" O.C. HORIZONTALLY
→ 6" O.C. VERTICALLY
80 FT LONG
1% SLOPE

EMERGENCY SPILLWAY (E.S.):
BASE WIDTH → 28 FT
SIDESLOPES 4H:1V
6 FT FROM POND BOTTOM (EL 30) TO BASE OF E.S.
2 FT DEEP

	POST-DEV		PRE-DEV				
$Q_{POND(10y)}$ =	3.8	<	40.7 ✓	TE_{2yr} =	72	>	70% ✓ (FOR HQW)
$Q_{POND(25y)}$ =	10.6	<	53.2 ✓	TE_{10yr} =	71.9	>	60% ✓
$Q_{POND(100y)}$ =	26.2	<	76.2 ✓	TE_{25yr} =	70.9	>	60% ✓
				TE_{100yr} =	69.4	>	60% ✓

Attachment L7
Box Culvert Design Calculations

DESIGN SHEET

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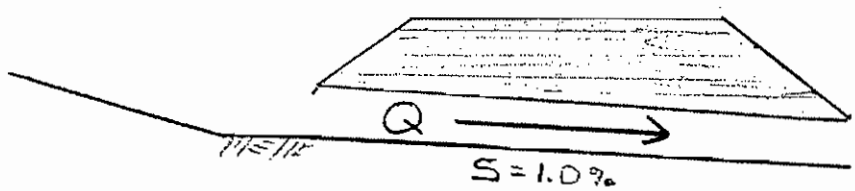
BOX CULVERT DESIGN



REINFORCED CONCRETE BOX CULVERT

PROBLEM:

SIZE A BOX CULVERT WHICH WILL CONVEY THE PEAK FLOWRATE (25 YR-24 HR) FROM EACH DRAINAGE AREA TO THE APPROPRIATE SEDIMENT POND. FROM THE SEDIMOT MODEL, $Q_{25,24}$ FROM EACH DRAINAGE AREA IS AS FOLLOWS:

NORTH AREA (NO. 1) = 95 CFS

EAST AREA (NO. 2) = 85 CFS

WEST AREA (NO. 3) = 110 CFS

NORTHWEST AREA (NO. 1A) = 52 CFS

DESIGN SHEET

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WEYERHAEUSER - PLYMOUTH	SYK	6/2 NA	RMT	7/7/99	05101.01

SOLUTION

SINCE THE ARTICULATED BLOCK CHANNEL IS 10 FT WIDE, USE THIS DIMENSION AS THE WIDTH, USE NOMOGRAPH DEVELOPED BY BUREAU OF PUBLIC ROADS TO SIZE THE BOX CULVERT WITH INLET CONTROL (SOURCE: USDOT - FHA - HYDRAULIC ENGINEERING CIRCULAR NO. 5)

NORTH AREA (#1)

Q = 95 CFS.
Q/B = 95 CFS/10 FT = 9.5 SFS
ASSUME HEADWALL @ 30° TO 75°
TRY 30 INCHES DEPTH. Hw/D TO BE < 1

FROM NOMOGRAPH, Hw/D = 0.88 (SEE ATTACHED)
HW = (30 IN)(0.88) = 26.4 IN < 30 IN

USE 30" (D) X 10' (L)

EAST AREA

Q = 85 CFS
Q/B = 85/10 = 8.5 SFS
ASSUME HEADWALL @ 30° TO 75°
TRY 30 INCHES DEPTH. Hw/D TO BE < 1

FROM NOMOGRAPH, Hw/D = 0.81 (SEE ATTACHED)
HW = (30 IN)(0.81) = 24.3 IN < 30 IN

USE 30" (D) X 10' (L)

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WEYERHAEUSER - PLYMOUTH	SYK	6/2/99	EWT	7/7/99	05101.01

WEST AREA

Q = 110 CFS
Q/B = 110/10 = 11 SFS
ASSUME HEADWALL @ 30° TO 75°
TRY 30 INCHES DEPTH. H_w/D TO BE < 1

FROM NOMOGRAPH, $H_w/D = 0.96$ (SEE ATTACHED)
$HW = (30\ IN)(0.96) = 28.8\ IN < 30.0\ IN$

USE 30" (D) x 10' (L)

NORTHWEST AREA

Q = 52 CFS
Q/B = 52 CFS / 10 FT = 5.2 SFS
ASSUME HEADWALL @ 30° TO 75°
TRY 30 INCHES DEPTH, $H_w/D = 0.575$ (SEE ATTACHED FIGURE)
$HW = (30\ IN)(0.575) = 17.3\ IN < 30\ IN$

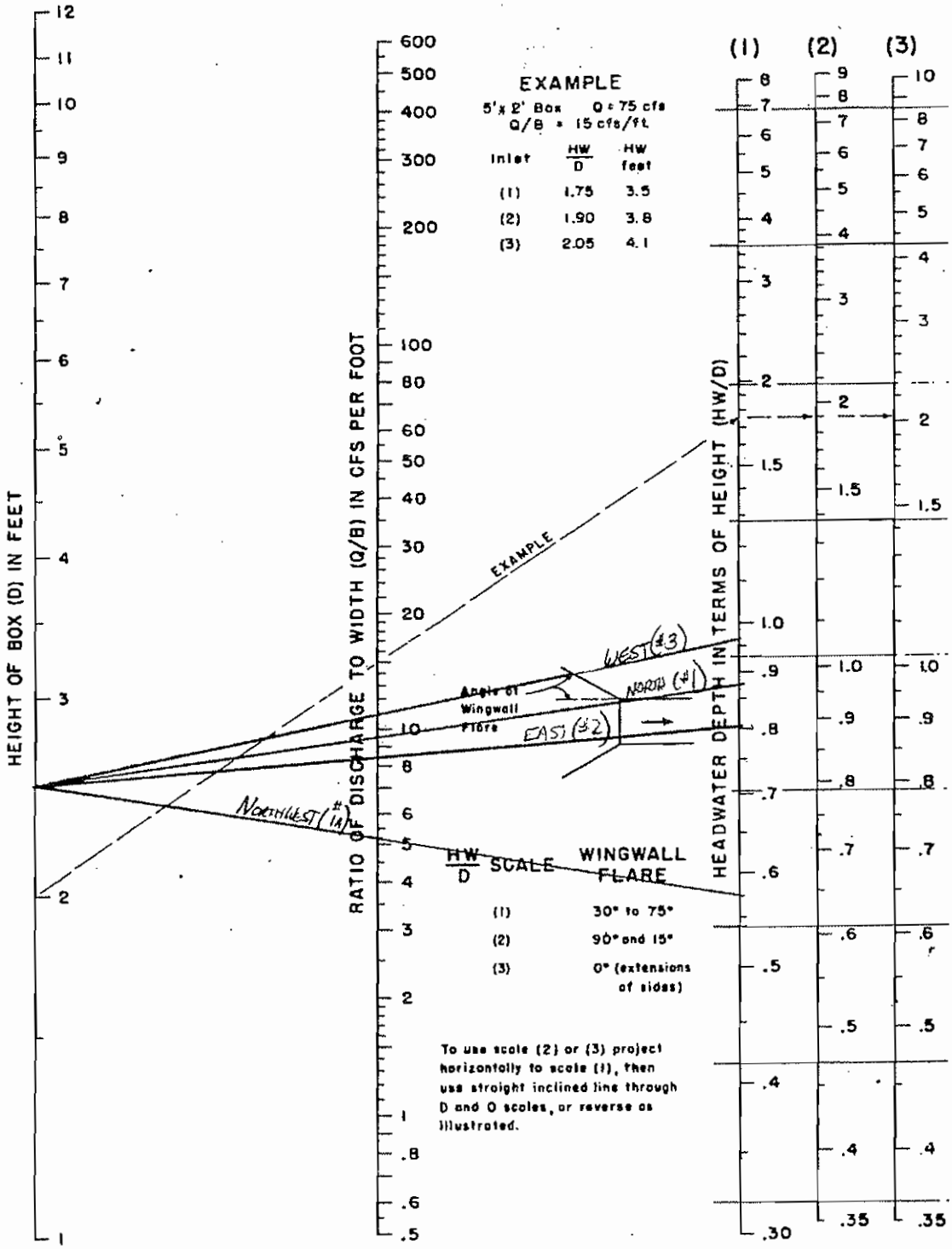
USE 30" (D) x 10' (L)

SUMMARY:

		D		L
NORTH AREA	(#1)	30 IN	x	10'
EAST AREA	(#2)	30 IN	x	10'
WEST AREA	(#3)	30 IN	x	10'
NORTHWEST AREA	(#1A)	30 IN	x	10'

* ASSUME CULVERTS DESIGNED WITH 30° TO 75° HEADWALLS

CHART I



HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

Attachment L8
Articulated Block Drainage Channel Design Calculations

DESIGN SHEET

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WEYERHAEUSER PLYMOUTH	SYK	6/3/99	EMT	6/7/99	05101.01

ARTICULATED BLOCK DRAINAGE CHANNEL DESIGN

PROBLEM: DETERMINE THE CAPACITY OF THE PROPOSED ARTICULATED BLOCK DRAINAGE CHANNELS

TRAPEZOIDAL CHANNELS
$Z = 4:1$
BASE = 10 FT WIDE
$n = 0.034$ (MANNING'S ROUGHNESS COEFFICIENT
$S = 0.27$ (AVG) $\rightsquigarrow [20' (V) / (60' + 15')$ Horiz. Terrace
MAX. DEPTH = 1.5 FT

BASED ON SEDIMOT II CALCS. Q_{DESIGN} (25 YR/24 HR) FOR EACH DRAINAGE AREA IS AS FOLLOWS.

NORTH AREA (#1) = 95 CFS
EAST AREA (#2) = 85 CFS
WEST AREA (#3) = 110 CFS
NORTHWEST AREA (#1A) = 52 CFS

USING THE FLOWMASTER PROGRAM, EVALUATE THE CHANNEL FOR THE GIVEN CONDITION AT 0.75 FEET DEPTH

FROM FLOWMASTER

Q_{MAX} @ 0.75' = 157.9 CFS > Q_{DESIGN} (25y/24h) = 95 CFS, 85 CFS, 110 CFS, 52 CFS (RESPECTIVELY)

CHANNELS ARE SATISFACTORY

2/2

WEYERHAEUSER PLYMOUTH - NO. 3 LANDFILL
Worksheet for Trapezoidal Channel

Project Description	
Project File	h:\data\common\civil\fmaster\wo_abdc.fm2
Worksheet	ARTICULATED BLOCK CHANNEL
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.034	
Channel Slope	0.270000	ft/ft
Depth	0.75	ft
Left Side Slope	4.00	H : V
Right Side Slope	4.00	H : V
Bottom Width	10.00	ft

Results		
Discharge	157.93	ft^3/s
Flow Area	9.75	ft^2
Wetted Perimeter	16.18	ft
Top Width	16.00	ft
Critical Depth	1.59	ft
Critical Slope	0.016472	ft/ft
Velocity	16.20	ft/s
Velocity Head	4.08	ft
Specific Energy	4.83	ft
Froude Number	3.66	
Flow is supercritical.		

Attachment L9
Steep Gradient Design Calculations

DESIGN SHEET

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WEYERHAEUSER - PLYMOUTH	SYK	6/5/99	EWT	7/7/99	05101.01

STEEP GRADIENT DESIGN OF ARTICULATED BLOCK DRAINAGE CHANNELS
(NICOLON - ARMORFLEX® DESIGN MANUAL)

MANNING'S RESISTANCE COEF, $n = 0.0369(q)^{0.305} \cdot (S)^{0.488}$

where: q = unit discharge per foot width, (Q/b)
S = slope of channel in direction of flow
$S = 0.333$ (MAX)
let channel base, b = 10-foot width
Q_{DESIGN} = 95 CFS, 85 CFS, 110 CFS, 52 CFS respectively for the North, East, West + Northwest Area.
25/24

$q = \frac{Q_{DESIGN}}{b}$ = 9.5 SFS, 8.5 SFS, 11.0 SFS, 5.2 SFS respectively for north, east, west + northwest areas.

then: $n_N = 0.043$
$n_E = 0.041$
$n_W = 0.045$
$n_{NW} = 0.036$

DEPTH OF UNIFORM FLOW, $y_0 = [q \cdot n / (1.49 S^{0.5})]^{0.6}$

$y_{0(N)} = [(9.5_{SFS})(0.043)/(1.49 \cdot (0.333)^{0.5})]^{0.6} \cong 0.64$ ft

$y_{0(E)} = [(8.5_{SFS})(0.041)/(1.49 \cdot (0.333)^{0.5})]^{0.6} \cong 0.59$ ft

$y_{0(W)} = [(11.0_{SFS})(0.045)/(1.49 \cdot (0.333)^{0.5})]^{0.6} \cong 0.72$ ft

$y_{0(NW)} = [(5.2_{SFS})(0.036)/((1.49)(0.333)^{0.5})]^{0.6} \cong 0.45$ ft

DESIGN SHEET

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VELOCITY OF UNIFORM FLOW, $V = q/y_o$

$V_{(NW)} = (5.2 \text{ SFS} / 0.45 \text{ ft}) = 11.5$ FPS

$V_{(N)} = (9.5 \text{ SFS} / 0.64 \text{ ft}) = 14.9$ FPS

$V_{(E)} = (8.5 \text{ SFS} / 0.59 \text{ ft}) = 14.5$ FPS

$V_{(W)} = (11 \text{ SFS} / 0.72 \text{ ft}) = 15.4$ FPS

NOTE:
FREEBOARD ALLOWANCE SHALL EQUAL OR EXCEED THE MEAN DEPTH OF FLOW SINCE THE WAVE HEIGHT WILL REACH APPROXIMATELY TWICE THE MEAN DEPTH. BOTH FLOW DEPTH AND FREEBOARD ARE TAKEN NORMAL TO THE PLANE OF THE CHANNEL BOTTOM

FOR SIDE SLOPES OF 4 HORIZONTAL TO 1 VERTICAL, CHANNEL SLOPE OF 0.333 FT/FT AND $q = 5.2; 9.5; 8.5;$ & 11.0 SFS (RESPECTIVELY) & CHART 4.3

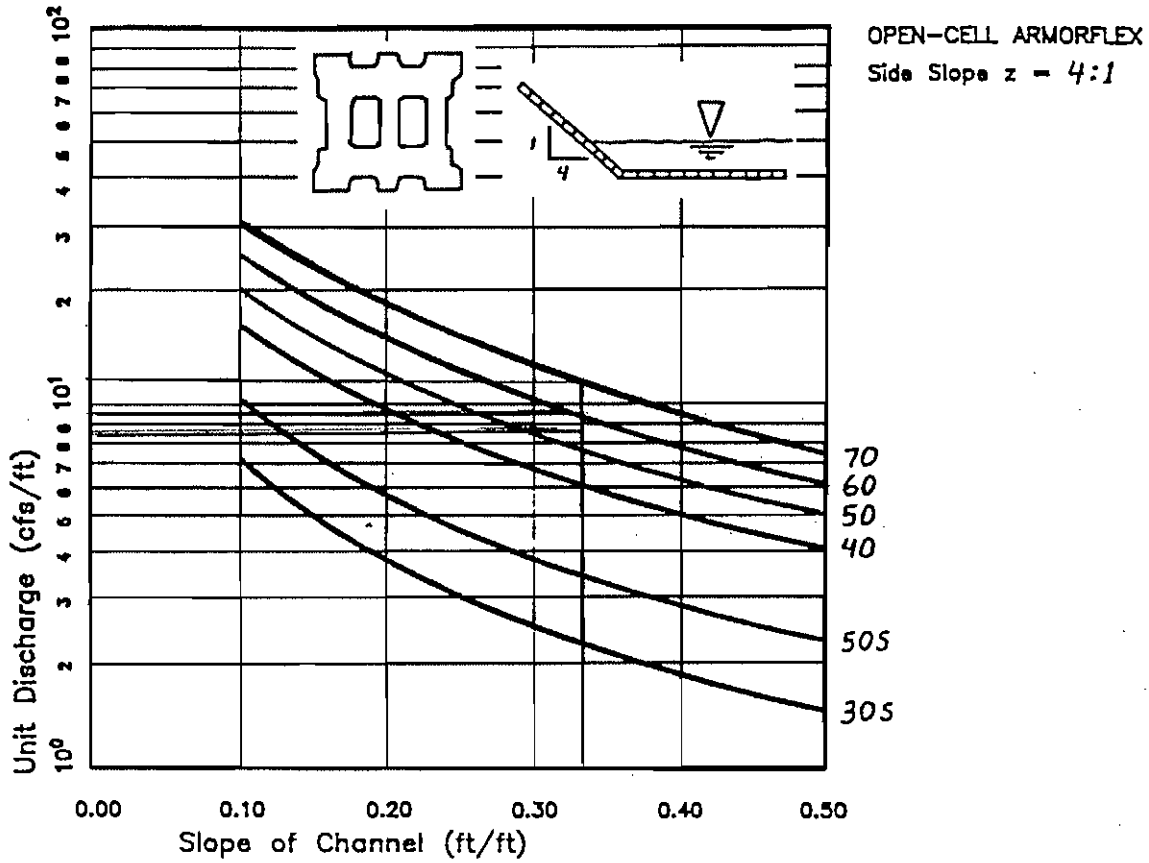
RECOMMEND USING THE FOLLOWING:

NORTH WEST AREA (#1A) — CLASS 45 - CLOSED CELL
CLASS 40 - OPEN CELL

NORTH AREA (#1) — CLASS 55 - CLOSED CELL OR
CLASS 60 - OPEN CELL

EAST AREA (#2) — CLASS 55 - CLOSED CELL OR
CLASS 60 - OPEN CELL

WEST AREA (#3) — CLASS 75 - CLOSED CELL OR
CLASS 70 - OPEN CELL


OPEN-CELL ARMORFLEX
Side Slope z = 4:1
Unit Discharge (cfs/ft)
Slope of Channel (ft/ft)
0.00
0.10
0.20
0.30
0.40
0.50
70
60
50
40
50S
30S

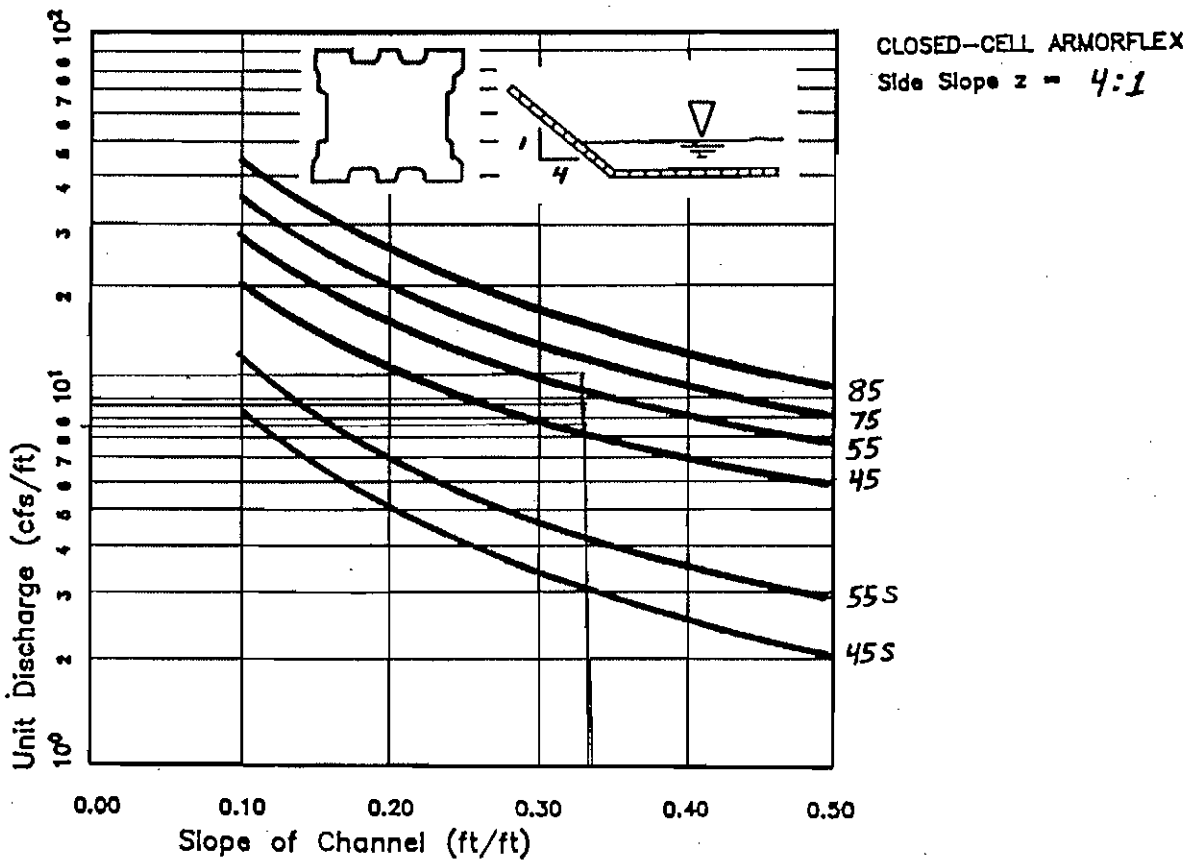

CLOSED-CELL ARMORFLEX
Side Slope z = 4:1
Unit Discharge (cfs/ft)
Slope of Channel (ft/ft)
0.00
0.10
0.20
0.30
0.40
0.50
85
75
55
45
55S
45S

CHART 4.3

Attachment L10
Sizing of Outlet Protection

DESIGN SHEET

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WEYERHAEUSER PLYMOUTH	DJC	9/22/99	RKN	9/24/99	05101.01

FROM NC DENR "EROSION AND SEDIMENT CONTROL PLANNING AND DESIGN MANUAL":

DESIGN RIPRAP OUTLET PROTECTION FOR OUTFALL CULVERT FOR EACH SEDIMENT BASIN

Q_{DESIGN} = DISCHARGE FLOW RATE WHEN THE WATER LEVEL IN THE BASIN REACHES THE BOTTOM OF THE EMERGENCY SPILLWAY

$d = D_o$ = DIAMETER OF THE PRINCIPAL SPILLWAY BARREL/OUTLET PIPE DIAMETER

ASSUME MAXIMUM TAILWATER CONDITION ($T_W \geq 0.5 D_o$)
THEREFORE USE FIGURE 8.06b

SEDIMENT BASIN OUTFALL	Q_{DESIGN} (CFS)	D_o (INCHES)	(MIN) $3D_o$ (FT)	(MIN) RIPRAP, d_{50} (INCHES)	(MIN) L_a (FT)	(MIN) $W = D_o + 0.4L_a$ (FT)
NORTH (#1)	43	24	6	7	48'	21.2
EAST (#2)	40	24	6	6	44'	19.6
WEST (#3)	43	24	6	7	48'	21.2
NORTHWEST (#1A)	40	24	6	6	44'	19.6

MAX. STONE DIAMETER = $1.5 \times d_{50}$ = 9 INCHES TO 10.5 INCHES = d_{MAX}

APRON THICKNESS = $1.5 \times d_{MAX}$ = 13.5 INCHES TO 15.75 INCHES

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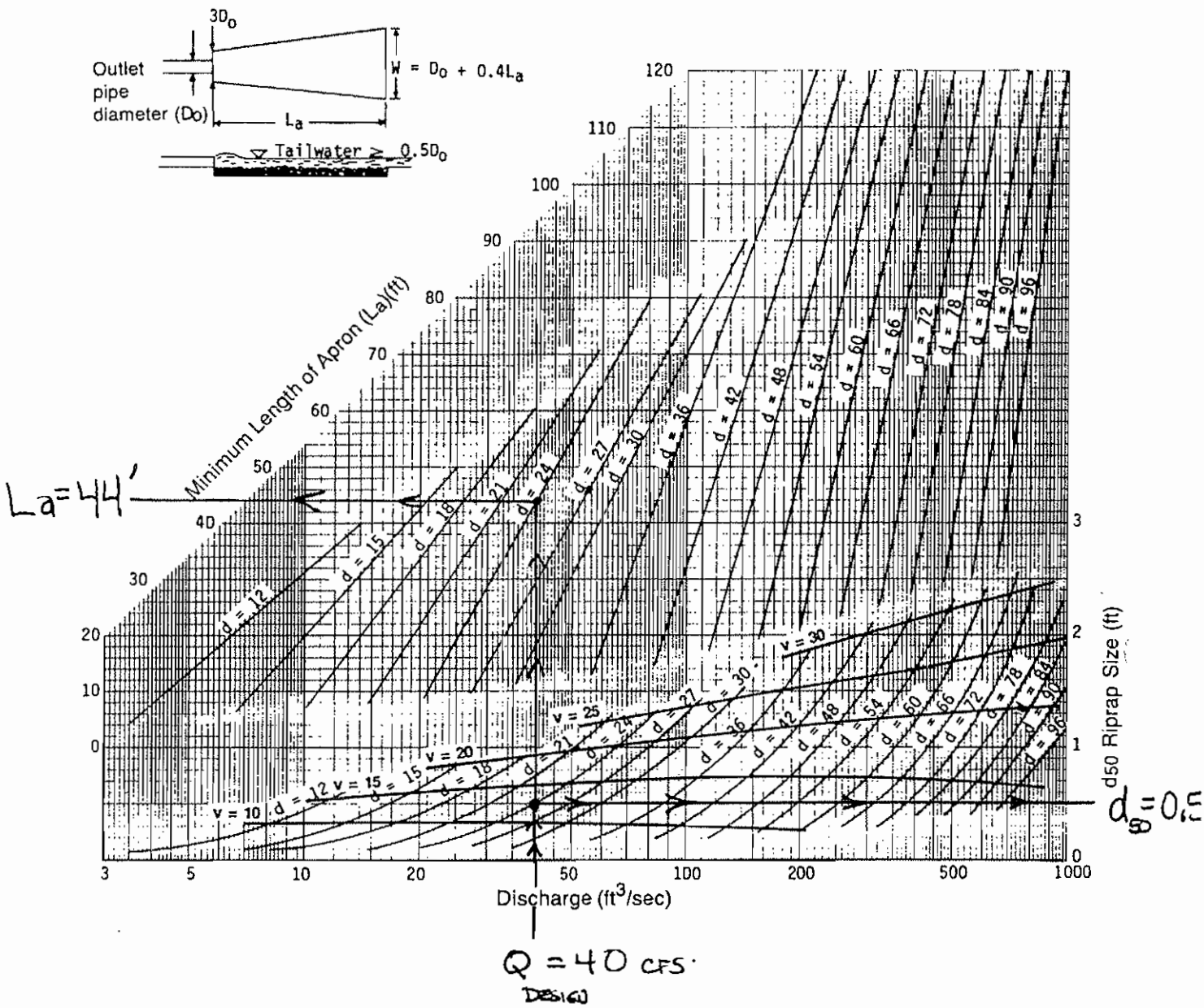
8

2/4



Curves may not be extrapolated.

Figure 8.06b Design of outlet protection from a round pipe flowing full, maximum tailwater condition ($T_w \geq 0.5$ diameter).

WEYERHAEUSER - PLYMOUTH NO. 3 LANDFILL
EAST (#2) AND NORTHWEST (#1A) SEDIMENT BASIN OUTFALLS

$Q_{DESIGN} = 40$ CFS

$D_o = 2$ FT

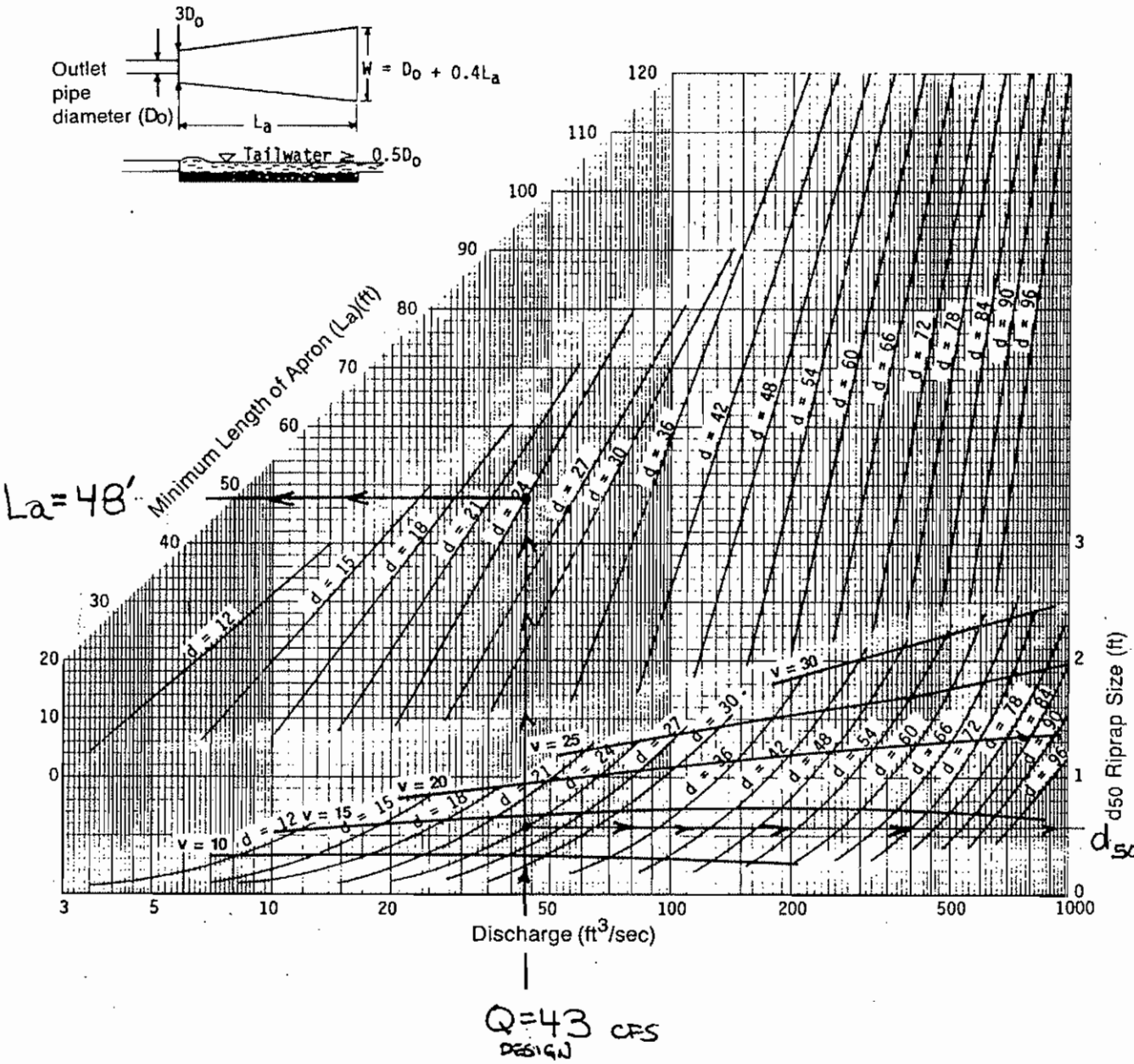
$L_a = 44$ FT (MIN)

d_{50} RIP RAP = 6 INCHES (MIN)

OS101.01

8

3/2



Curves may not be extrapolated.

Figure 8.06b Design of outlet protection from a round pipe flowing full, maximum tailwater condition ($T_w \geq 0.5$ diameter).

WEYERHAEUSER PLYMOUTH NO. 3 LANDFILL

NORTH (#1) AND WEST (#3) SEDIMENT BASIN OUTFALLS

Q_{DESIGN} = 43 CFS L_D = 48 FT (MIN)

D_o = 2 FT d_{50} = 7 INCHES (MIN)
RIPRAP

DESIGN SHEET

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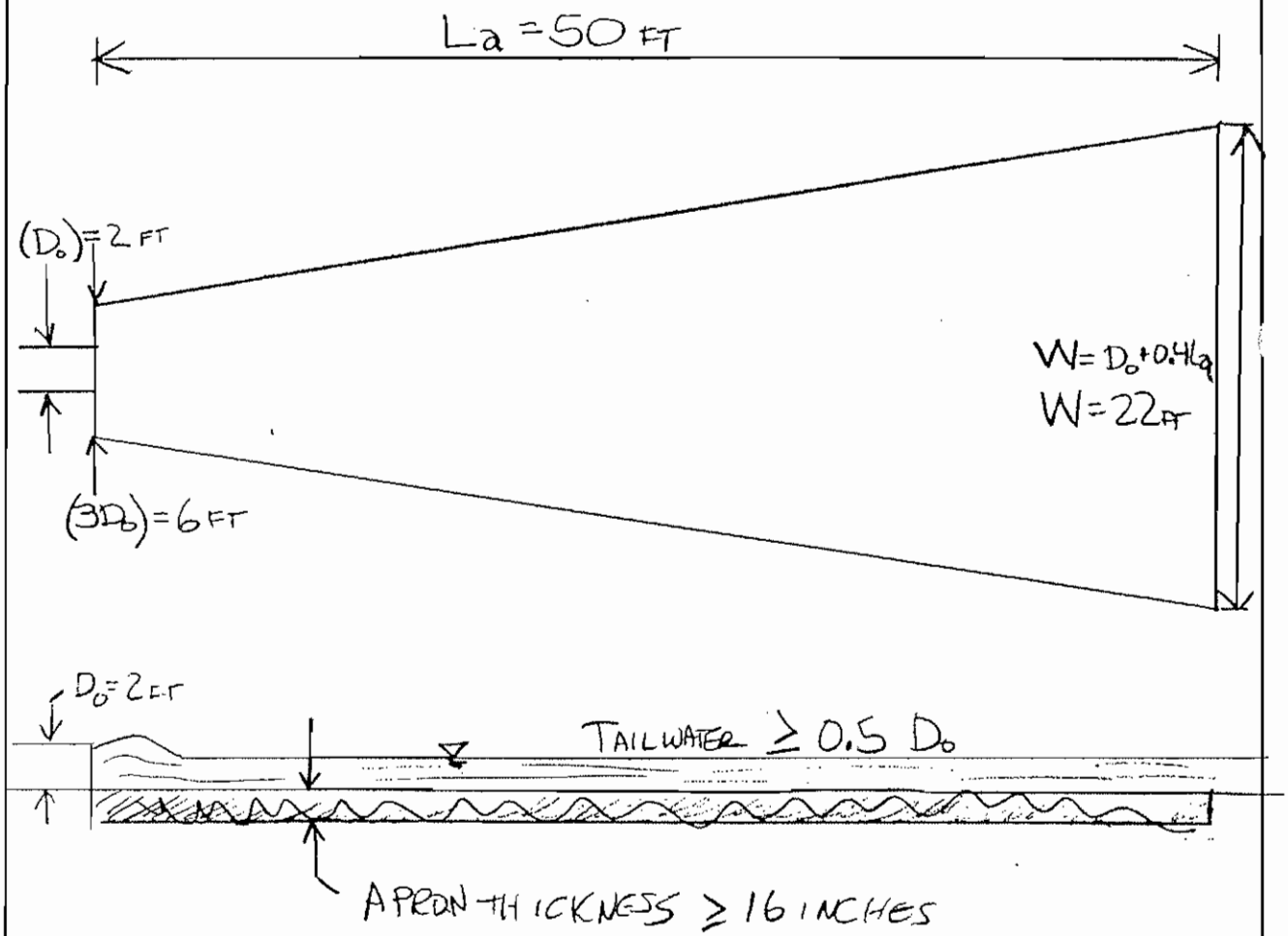
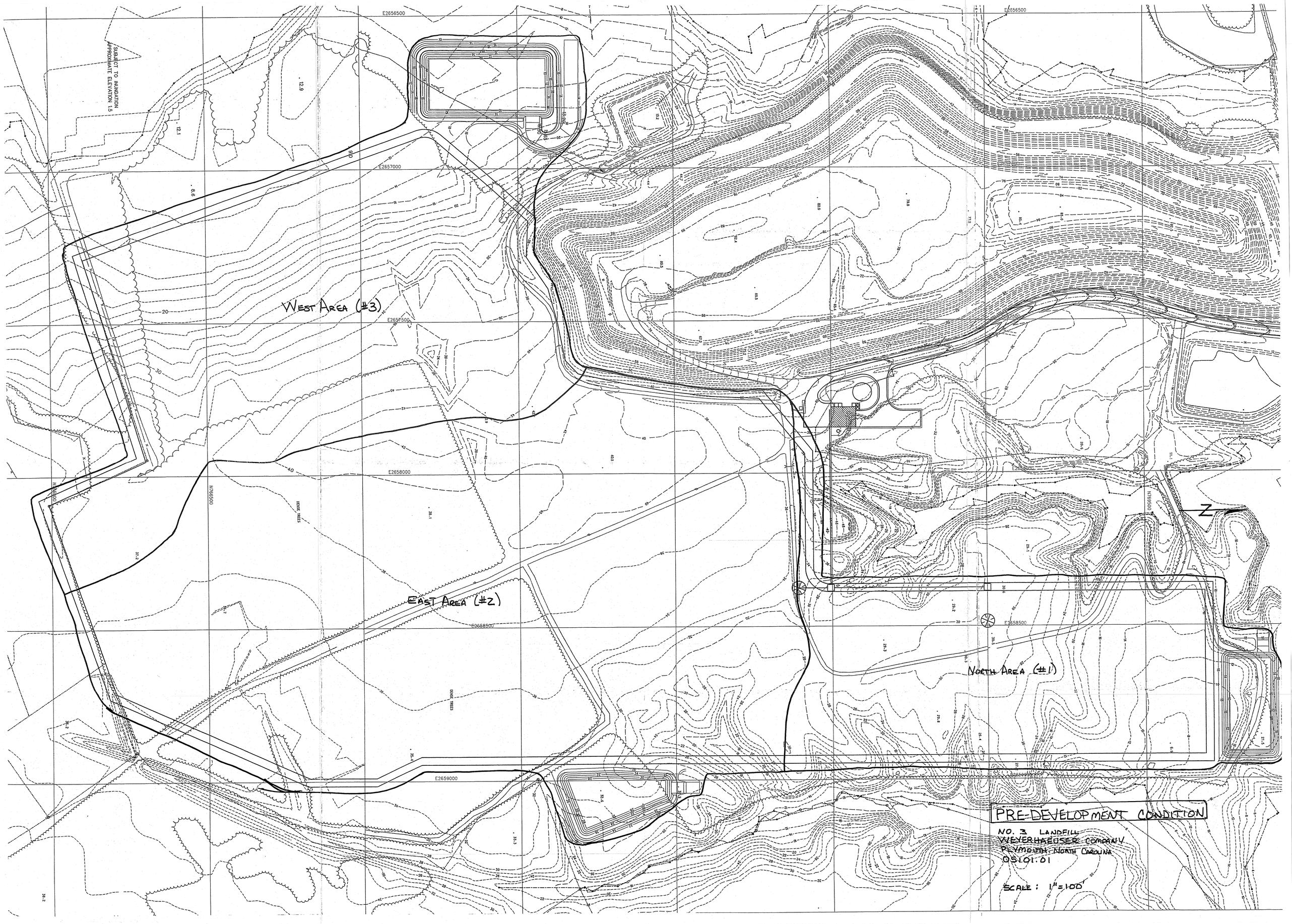
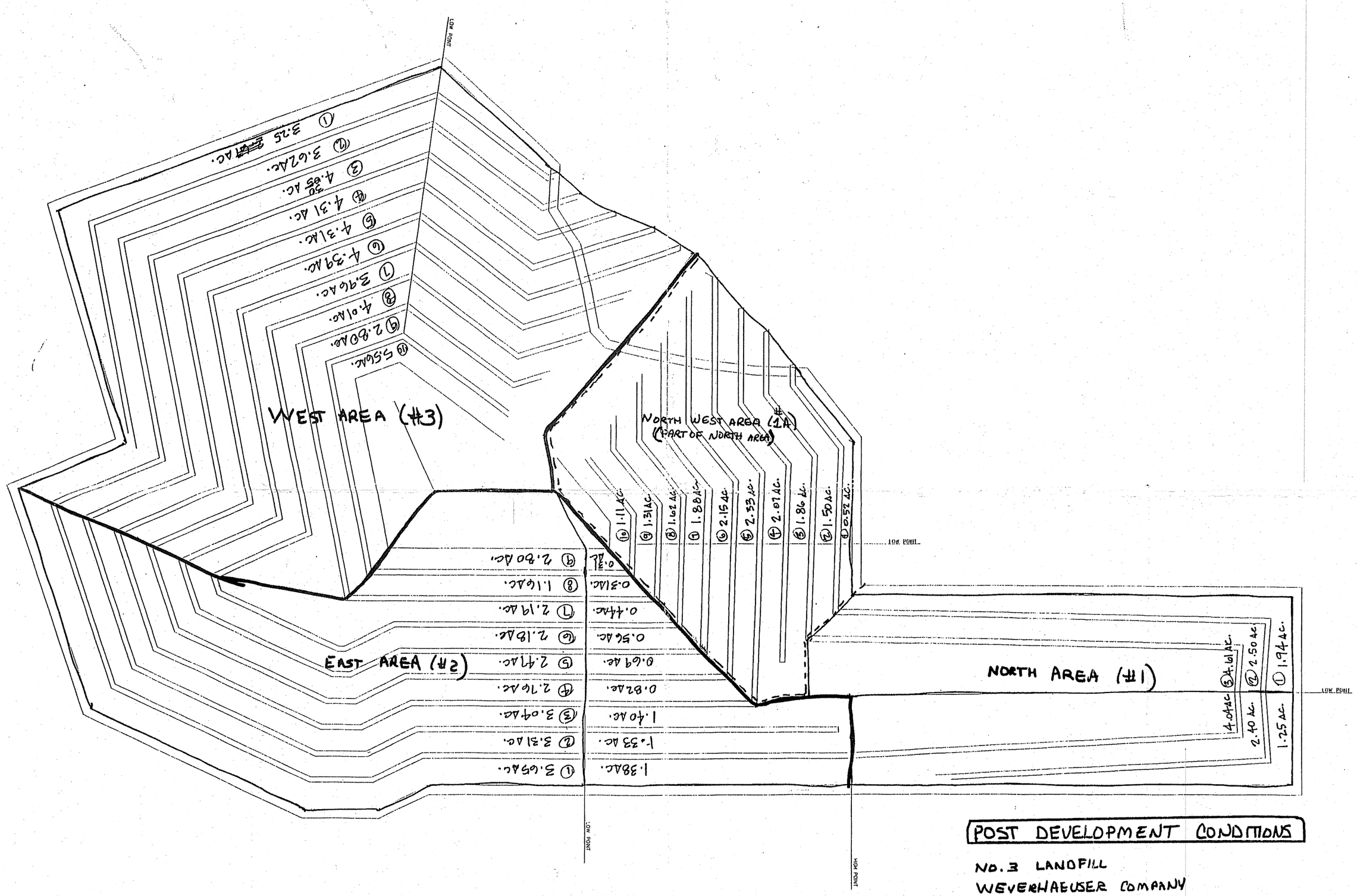
WEYER HAEUSER - PLYMOUTH	[illegible]	9/22/99	RKN	9/22/99	05101.01

SINCE ALL FOUR OUTFALL CULVERT REQUIRE SIMILAR SIZE RIP RAP OUTLET PROTECTION THE FOLLOWING DIMENSIONS ARE RECOMMENDED FOR OUTFALL PROTECTION FOR ALL FOUR BASINS



RIPRAP d_{50} = 7 INCHES
RIPRAP d_{MAX} = 10.5 INCHES


E2656500
E2657000
E2657500
E2658000
E2658500
E2659000
N766500
N767000
SUBJECT TO INUNDATION
APPROXIMATE ELEVATION 1.5
WEST AREA (#3)
EAST AREA (#2)
NORTH AREA (#1)
PRE-DEVELOPMENT CONDITION
NO. 3 LANDFILL
WEYERHAEUSER COMPANY
PLYMOUTH, NORTH CAROLINA
05101.01
SCALE: 1"=100'



POST DEVELOPMENT CONDITIONS

NO. 3 LANDFILL
WEYERHAEUSER COMPANY
PLYMOUTH, NC
05101.01

SCALE: 1" = 200'

Appendix M
Operations Plan

• ENVIRONMENT • ENERGY • ENGINEERING

Phase 3 and Phase 4 - Operations Plan

On-site Industrial Waste Landfill No. 3

Domtar Paper Company, LLC (Formerly Weyerhaeuser Company), Plymouth, North Carolina

June 2008, Revised August 2009, August 2010, November 2010

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CREATING BALANCE℠

Table of Contents

1. Overview 1-1

2. General Operating Requirements 2-1

3. Operating Equipment 3-1

4. Pumps 4-1

5. Dust Control 5-1

6. Litter Control 6-1

7. Stormwater Controls 7-1

8. Site Facilities 8-1

9. Final Cover 9-1

10. Inspections 10-1

11. Leachate Collection System Management Plan 11-1

List of Tables

Table 10-1 Sample Landfill Inspection Checklist 10-2

Section 1
Overview

Landfill No. 3 will be operated as an area fill. An operating area will be established on the waste surface where loads of waste will be dumped from transport and conveyor equipment. Landfill operating equipment will spread and compact waste materials into a working face that will slope downward from the operating area into the open cell bottom. The landfill operations described in the following sections will be conducted to accomplish the following objectives:

- Compact waste materials into a stable fill mass.
- Cover paper wastes that might present a blowing litter problem with soil-like waste materials such as dewatered wastewater treatment solids (fiber sludge), boiler ash, and woodyard waste (bark, grit, and reject wood chips).
- Cover any asbestos waste immediately.
- Grade all waste surfaces to promote drainage to the leachate collection drainage layer on the bottom and sides of the landfill.
- Maintain as small an operating area as possible.
- Minimize the area of operation generating leachate by using stormwater diversion berms and redirecting non-contact stormwater directly to surface drainage systems.

In addition, operations will be conducted in compliance with the provisions of NC DENR regulations Section .1626. Asbestos waste will be placed in the asbestos landfill located east of Landfill No. 2 and west of Phase 1 of Landfill No. 3.

Section 2
General Operating Requirements

Landfill operations will be conducted by a Domtar employee or a contract operator to Domtar.

Site control will be maintained at all times by a security fence and a manned guard station at the entrance to the Domtar mill. The landfill area will be accessible only to landfill operations personnel, Domtar supervisory personnel, and authorized visitors. The following activities are prohibited:

- Scavenging of waste materials
- Feeding of farm or domestic animals
- Waste fill in standing water
- Open burning

Access to the disposal area of the landfill will be established using temporary culverts and soil, ash waste or gravel as appropriate to construct ramps off the perimeter dike road into the lined fill area. Runon and runoff from waste-filled areas will be controlled at all times by the leachate collection system and the perimeter berm. Stormwater within open areas of the cell will be controlled by means of temporary stormwater diversion berms, which will allow stormwater to be discharged to the perimeter ditching rather than treated as leachate. Waste will be placed from the perimeter inward so that the side slopes may be capped as they reach final grades.

Salvage operations will not occur on a routine basis. Infrequently, the interior of the landfill might be used to store materials for recovery and use at a later date. Such materials include bark and wood waste, waste lime to be used for agricultural purposes, or dewatered fiber wastewater solids to be used as a soil amendment or other application. No hazardous wastes will be stored in the landfill. Recoverable materials will be segregated from the active waste disposal operation to the extent possible and stored temporarily in an area immediately west of Phase 2 and south of existing dewatering facility.

Daily inspections will be documented in a log, and will include actions taken or to be taken. Daily inspections should also be performed to evaluate leachate levels within the landfill. Impermeable waste streams, such as ash, should be concentrated within the cell as much as possible to allow direct runoff into the leachate collection layer. Care should be taken to place various waste streams in appropriate locations that assist the operation of the leachate system as well as the evolution of the cell. This includes leaving some freeboard along the edge of the perimeter berms. Waste should not be placed in such a manner as to spill on to the tops of these berms. The free board will leave access to the drainage layer against the wall of the berm allowing leachate runoff access to the collection system below.

Working faces should be kept as small as possible, and areas should be capped as they are completed to the designed grades. Placing waste from the edge of the cell inward will afford the opportunity to cap sections sooner. Stormwater that flows off the capped sections will be diverted to the perimeter drainage ditches and will not be collected as leachate. These common landfill operational practices will compliment a stormwater control berm.

The design features and operating procedures described in this application have been developed to minimize the potential for slope failure. However, the slope stability analysis has revealed that the potential for slope failure at this site increases under the following conditions:

- Steeper slopes than planned
- Waste placed much looser or wetter than in the existing landfill or that which was tested.
- Soil or waste not compacted as recommended
- A rise in the groundwater table
- Leachate not able to adequately drain
- Shear strength parameters less than those used in the analysis
- Subgrade soils destabilized due to poor drainage or construction equipment traffic

To minimize the potential occurrence of these conditions, the following operational procedures are recommended:

- Have the subgrade soils observed by a qualified geotechnical engineer immediately prior to construction of the liner to confirm that the subgrades are suitable for construction of the landfill.
- Have qualified geotechnical personnel monitor placement and test compaction of all controlled fill soil used to construct the landfill and sediment basins to verify that the recommended compaction has been attained.
- Control the equipment traffic and drainage throughout construction (especially during rainy weather) to prevent destabilization of the subgrade soils.
- Place soil used in construction of the sediment basins, perimeter dikes, or grading of the site in lifts no more than 8 inches thick (loose). Compact the soil to at least 95 percent of the Standard Proctor (ASTM D 698) maximum dry density at ±3 percent of the optimum moisture content.
- Dewater all dredge wastewater solids by plate and frame press immediately prior to placement in landfill.
- Place and compact the waste material in lifts no more than 3 feet thick. Waste material placed in the facility should be compacted by repeated passes of the bulldozer until firm.

- Keep all waste material well drained by sloping the surface of the waste material to allow for stormwater drainage.
- Conduct additional testing and slope stability analyses if there is a change in the waste material placed or the quality of waste material placed in the landfill.
- Maintain adequate drainage of any leachate generated during waste placement operations. RMT recommends that no more than 1 foot of head be allowed to build up within the solid waste facility.
- Construct side slopes no steeper than 3 horizontal to 1 vertical to a height not greater than 214 feet. Bench exterior side slopes inward 15 feet for every 20 feet rise in height.

In the event dewatered wastewater solids are subjected to precipitation prior to placement, blend it with ash to improve its shear strength and compaction. The shear strength of 60/40 dewatered wastewater solids to ash blend is significantly higher than for dewatered wastewater solids alone.

Section 3
Operating Equipment

Landfill No. 3 will be operated with a mid-size bulldozer. Support equipment will consist of over-the-road transport vehicles, including standard dump trucks and rolloff container trucks. A motor-grader will be used for road maintenance, but will not necessarily be dedicated to the landfill operations.

In general, a bulldozer will be used to spread waste and compact the working face. The bulldozer will be used to maintain access from the perimeter road to the operating area, and to spread soil-like waste materials over blowing waste.

Hauling equipment operating outside the landfill area will be washed in a wash down area located at the dewatering press building. Wash water will be collected and treated with the landfill leachate and the dewatering press filtrate.

Operating equipment will be included in Domtar's preventative maintenance program. Routine maintenance, such as oil and filter changes, as well as sampling and analysis of lubricating and hydraulic oils will be conducted on schedules set in the program. Spare parts will be carried in inventory. If extended service should be required on the landfill bulldozer, a substitute bulldozer will be provided by other operations at the Domtar mill or leased from a local contractor to ensure continuous operations.

Section 4
Pumps

Redundant submersible pump systems remove leachate from the bottom of the landfill and transfer it by force main to the storage tank/sump of the leachate transfer station, then to the mill wastewater treatment system. Maintenance of the pumps will be conducted in accordance with manufacturer's recommendations. Refer to Section 11 for a leachate system operational discussion and Appendix Q for pump information.

Maintaining a strict set of operational checks and balances is crucial to the success of all landfill operations. A daily record of flow rates and total volumes will be used in troubleshooting the system. If flow is lower than anticipated, the system should be thoroughly inspected and any problems should be repaired - a pump may be down, the line may be clogged, or the leachate collection layer may be impeded by an impermeable waste stream. The flow meter should be routinely monitored and placed on a preventative maintenance (PM) schedule. The pumps should also be placed on a PM schedule. This will allow water to be removed as designed and the overall storage capacity of the cell for the major storm events to be maintained.

Section 5
Dust Control

Due to the frequent use of ash as daily cover and the potential for dusting, dust control equipment will be used at the Landfill. This equipment will consist of a pump and piping system tied to the leachate transfer station storage tank or wet well. Leachate will be pumped from the storage tank or wet well to mobile sprinkler units located within the landfill. The ash will be sprayed as needed to control dust, and as frequently as on a daily basis.

Section 6
Litter Control

A portion of the waste disposed of in the landfill will be compacted and uncompacted paper from the Domtar Complex paper manufacturing operations. This waste type will be dumped at the edge of the operating area. The waste material will be compacted by repeated passes of the compactor or bulldozer. Each day, or more frequently if required by weather conditions, blowing waste will be covered with soil-like waste materials or soil if suitable wastes are unavailable. Cover material will be available from a stockpile area. If necessary, litter-control fencing will be used to prevent litter from blowing beyond the landfill area.

Section 7
Stormwater Controls

Landfill operations will be conducted in a manner to minimize infiltration into the waste fill for two reasons:

- Excess moisture will reduce the stability of the fill by lowering the shear strength of the waste materials.
- Excess moisture will result in the generation of unnecessary quantities of leachate and increase the hydraulic head on the landfill liner.

Surface water runon will be prevented by the perimeter ditch and berm around the landfill, and by the cell delineation berms at the south end of each construction stage. The waste fill will be graded to minimize infiltration of contact rainwater. The operating area must be nearly level to function as a turnaround and dumping area for waste transport vehicles. The working face and operating area will be kept as small as practical, and will be sloped or crowned so that water drains from the surface to the leachate collection sand layer at the toe of the waste fill. Ponding of water will not be allowed. Depressions in the operating area will be filled with waste materials to promote runoff. The working face of the fill will be maintained at a slope of 3 horizontal to 1 vertical up to 5 horizontal to 1 vertical to promote runoff to the leachate collection sand layer at the toe of the slope.

Temporary stormwater control berms will be constructed in unfilled areas of the active cell to divert clean stormwater away from the leachate collection system. The berm will be located to provide adequate storage space for waste as well as temporary storage of runoff from the working face. It will also be sited to maximize segregation of stormwater and leachate.

Leachate will be collected in a series of sumps equipped with both primary and secondary submersible pumps. It is anticipated that during normal landfill operations the pumps will cycle to minimize pump burnout. In the event of an extraordinary rainfall event, primary and secondary pumps will be active thereby minimizing the amount and holding time of leachate within the landfill.

The following stormwater and leachate management practices will be maintained at the landfill:

- Diversion of non-contact stormwater away from the leachate system and removal of surface water discharge outside the landfill boundary. This can be accomplished via temporary internal diversion berms within the landfill and the use of portable pumps, if necessary. Internal berms are most important in the initial time period after the landfill is opened

because extreme leachate generation rates are more likely. Although, the landfill system with internal stormwater diversion berms will allow for temporary storage/handling of the leachate generated from a 25-year, 24-hour storm event, it is crucial to separate and discharge non-contact stormwater before it is considered leachate. The pumps are sized to take up to 6 days to discharge leachate generated from the 25-year, 24-hour storm event.

- Limitation of the active filling area of the landfill to a small area to minimize the volume of leachate generated. This area is typically 5 acres or less depending on specific site conditions.
- Maintenance of a filling sequence that reaches final waste grades as soon as possible so that final cover soils can be placed to further divert surface water.
- Proper maintenance, operation, and monitoring of the leachate pumps, pump controls, discharge piping, leachate collection piping, and clean-outs.

Section 8
Site Facilities

Telephone, potable water, and toilets will be available in the dewatering press building. Back-up communication to and from the site will be provided by radio or cellular telephone. Since the dewatering press building is located in the area set aside for asbestos waste disposal, it will ultimately be demolished at closure of the landfill when it is no longer needed.

Section 9
Final Cover

Final cover will be progressively placed on areas of the landfill that have been graded to final contours. Cap construction will typically be performed in areas of 5 acres or less. Final grading and cap construction will proceed from north to south and west, as the fill reaches final grades. The cap for the Landfill includes GCL and a VFPE liner. These materials will be protected from the elements and operating equipment by a vegetative soil layer. Maintenance of the vegetative layer is critical to protect the integrity of the landfill cap system.

The cap will be sown according to approved seeding specifications for perennial vegetation. Vegetated cap areas will be mowed at least annually using equipment that will not damage the integrity of the soil cover layer. Vegetated areas will be inspected during the course of landfill operations. Conditions that may require repair include the following:

- Sparse or unhealthy vegetation
- Improper vegetation, such as trees or woody shrubs
- Erosion of the soil cover layer
- Slope failures, such as soil creep and sloughing
- Rutting from vehicular traffic or equipment operation

Damaged areas will be repaired as weather permits.

Section 10
Inspections

The landfill operator or designated inspector will conduct inspections of all landfill operating systems on a routine basis. Inspections will be conducted and documented using an inspection log. A typical example is included as Table 10-1.

Table 10-1
Sample Landfill Inspection Checklist

INSPECTION CHECKLIST	INSPECTION	INITIAL AND DATE THE APPROPRIATE BOX									
		S	M	T	W	T	F	S	STORMS	MONTHLY	QUARTERLY
Pumps											
1	Daily - check flashing light and standing water. Weekly - switch on and check current.										
2											
3											
4											
Ditches	Inspect monthly and after storms.										
Sediment Basin	Inspect monthly and after storms.										
Dikes and Berms	Inspect monthly and after storms.										
Fence and Gates											

Comments:

Work Orders Placed:

DATE	ORDER NUMBER	DESCRIPTION OF REQUEST

Section 11
Leachate Collection System Management Plan

The leachate collection and removal system (LCRS) will be comprised of the following components:

- A granular drainage layer
- Perforated leachate collection lines
- Dual submersible pumps in each leachate collection sump
- Leachate pump station manhole at each sump location
- A force main header pipe
- Wastewater solids dewatering facility

The lined area inside the landfill will be covered with an 18-inch thick drainage layer. The drainage layer will consist of a graded filter composed of a 6-inch thick layer of select clean sand above a 12-inch thick layer of select gravel. The select sand layer will contain less than 5 percent passing No. 200 sieve and will serve to filter out fines within the waste minimizing clogging of the select gravel layer. The select gravel layer will be sized to provide a lateral hydraulic conductivity of at least 0.3 cm/sec. The select gravel will also serve to provide bedding for the leachate collection piping and protection of the liner. The composite liner system below the drainage layer will be protected from the gravel layer, construction activities, and from operation activities with a 32-ounce geocushion.

The leachate collection lines within the landfill will consist of 6-inch diameter HDPE perforated pipes that provide chemical resistance and flexibility, and will be placed in v-notched trenches at a minimum slope of 0.5 percent. The base of the landfill will have a herringbone design consisting of a series of ridges and valleys with the maximum distance from a ridge to a valley of 100-feet. This design will direct the flow of leachate collected in the drainage layer towards collection pipes that will be located in each valley. The collection pipes will have a maximum spacing of 200 feet. The base of the landfill will slope from one side to the opposite side so leachate collected in the pipes will flow to sumps located in each phase at the low side of the landfill. This design is capable of maintaining leachate heads of less than 12-inches above the liner system. The leachate line hydraulic calculations for determining leachate head on the liner are provided in Appendix H of the *Construction Plan Application for On-Site Industrial Waste, Landfill No. 3* (RMT, 1999). To provide protection of pipes from being crushed during construction activities, operation activities, and under the anticipated waste loads in the landfill,

collection piping with a maximum Standard Dimension Ratio (SDR) of 17 will be used. Pipe strength calculations are presented in Appendix I in the *Construction Plan Application for On-Site Industrial Waste, Landfill No. 3* (RMT, 1999). The ends of the leachate collection lines will be fitted with 6-inch diameter SDR 17 solid wall cleanout pipe that will provide access for inspections and periodic cleaning. Remote camera inspections of the leachate collection lines will be performed after construction, after the removal of any blockage from a pipe, and at a minimum frequency of once every five years. Cleaning of the leachate collection lines will be performed if a blockage is discovered and at a minimum of once every year.

In each phase of the landfill, leachate will be collected through perforations in the collection pipes and will flow by gravity from the high end of the liner to the low end where it discharges into one or more collection sumps. Each sump will have 18-inch diameter perforated HDPE inclined riser pipes that will lay across the sump and perpendicular to the landfill perimeter berm. The pipes will run from the bottom of the sump and up the inside slope of the landfill perimeter berm where it will connect to a 6-foot diameter pumping station manhole located at the top of the perimeter berm. Leachate collected in the sump will be removed by using submersible pumps placed inside the 18-inch diameter pipes at the bottom of the sump. A level switch in the sump will automatically activate the dual submersible pump system that will pump the collected leachate up to the pumping station manhole through a 3-inch flexible hose. Inside the manhole the hose will connect to a 3-inch diameter solid wall HDPE force main pipe. Each wheeled submersible leachate collection pump will have a cable attached to allow for retrieval and maintenance of the pumps. See Drawing No. 510101-C17 of the *Construction Plan Application for On-Site Industrial Waste, Landfill No. 3* (RMT, 1999) for leachate collection system details. Maintenance of the submersible pumps will be conducted in accordance with the manufacturer's recommendations. Pump maintenance is also described in Section 4 of this document (Operations Plan).

Leachate in the 3-inch diameter HDPE force main pipe inside the pumping station manhole will exit the manhole through 3-inch diameter double wall pipe. The 3-inch diameter double -wall pipe runs for a short distance where it will connect to a 6-inch diameter double-wall force main header pipe. Leachate pipes located outside the manholes will consist of double-wall pipes and will be buried a minimum of 3-feet below the ground surface. The header pipe is buried inside the landfill perimeter berm and transports collected leachate around the outside perimeter of the landfill where it will discharge the leachate into a wet well located at the wastewater solids dewatering building located on the western side of the landfill. At this building the leachate will be mixed with filtrate from the wastewater solids press building The mixed leachate will either be taken to the landfill and used for dust control as needed or will be to transferred through another force main pipe to the mill's permitted wastewater treatment system located on Domtar's property.

Calculations for the design of the pumps and force main pipes are included in Appendix H of the *Construction Plan Application for On-Site Industrial Waste, Landfill No. 3* (RMT, 1999). Water balance modeling, including the Hydrologic Evaluation of Landfill Performance (HELP) model, was used for various landfill operational scenarios to determine leachate flow into the collection layers. The flow rate used for sizing the pumps and force main pipes includes the peak daily flow collected in the leachate collection layer.

Stormwater run-on and runoff will be controlled by means of the landfill's exterior perimeter berms and temporary interior stormwater control berms. The exterior berms are designed to contain, if necessary, precipitation falling within the landfill during a 24-hour, 25-year storm. The interior berms (shown on Drawing No. 510101-C19 of the *Construction Plan Application for On-Site Industrial Waste, Landfill No. 3* (RMT, 1999)) will allow segregation of stormwater and leachate within the landfill so that precipitation that has not come in contact with the waste will not require treatment as leachate. The temporary berms will be placed to allow for an adequate area for disposal of waste, while maximizing the area where noncontact precipitation can be diverted as stormwater. For Landfill No. 3, if temporary interior berms are not used, the leachate pumps have been sized to effectively pump collected precipitation as leachate within a period of 6 days.

Appendix N
Closure/Post-closure Plan

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Phase 3 and Phase 4 - Closure/Post-closure Plan

On-site Industrial Waste Landfill No. 3

Domtar Paper Company, LLC (Formerly Weyerhaeuser Company), Plymouth, North Carolina

June 2008, Revised August 2009, November 2010

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Table of Contents

1. Introduction 1-1
   1.1 Related Documents 1-1

2. Background and Location 2-1

3. Final Cover Design and Construction 3-1
   3.1 Permitted Final Cover Design 3-1
      3.1.1 Installation of Intermediate Cover 3-1
      3.1.2 Installation of the Cap System 3-1
   3.2 Construction Specifications 3-3
   3.3 Quality Assurance/Quality Control 3-3
   3.4 Erosion Control Measures 3-3

4. Closure Scenarios 4-1
   4.1 Routine and Premature Closure 4-1
   4.2 Closure Cost Estimate 4-1
      4.2.1 Control Grading 4-2
      4.2.2 Geosynthetic Clay Liner 4-2
      4.2.3 40-mil Textured Very Flexible Polyethylene Geomembrane 4-2
      4.2.4 Geonet Drainage Composite 4-2
      4.2.5 Vegetative Support Layer 4-2
      4.2.6 Topsoil 4-2
      4.2.7 Vegetation 4-2
      4.2.8 Closure Survey 4-3
      4.2.9 Administrative Costs 4-3
   4.3 Maximum Waste Inventory 4-3

5. Closure Schedule 5-1

6. Closure Certification and Deed Notation 6-1

7. Post-closure Monitoring and Maintenance 7-1
7.1 Final Cover Maintenance/Inspection Schedule 7-1
7.2 Leachate Collection System/Miscellaneous Maintenance 7-1
7.3 Groundwater Monitoring System 7-1
7.4 Gas Monitoring 7-2

8. Post-closure Cost Estimate 8-1
8.1 Routine Inspection 8-1
8.2 Maintenance of On-site Improvements 8-1
8.3 Maintaining Vegetation 8-1
8.4 Repair of Final Cover 8-1
8.5 Maintaining Surface Drainage Features 8-1
8.6 Groundwater Monitoring Well Sampling 8-2
8.7 Leachate Collection System Maintenance 8-2
8.8 Administrative Costs 8-2
8.9 Post-Closure Costs Not Included 8-2

9. Contact Persons 9-1

10. Landfill Property Use 10-1

11. Post-closure Certification 11-1

List of Attachments

Attachment 1 Opinion of Probable Costs Landfill No. 3 Closure, Phase 1a, 1b, 2, 3, and 4 Cost Estimate
Attachment 2 Opinion of Probable Costs Landfill No. 3 Post-closure, Phase 1a, 1b, 2, 3, and 4 Cost Estimate

Section 1
Introduction

This technical narrative addresses the closure and post-closure care requirements as identified in the NC DENR Solid Waste Management Rules, Section .1629 as related to closure/ post-closure activities for the Domtar Landfill No. 3 in Plymouth, North Carolina. The requirements have been addressed in the format suggested in Section .1629.

1.1 Related Documents

This closure plan and cost estimate are included as an appendix to the construction plan application for on-site industrial process waste Landfill No. 3. It is to be used in conjunction with the following:

- CQA plan (Appendix Q)
- Sheet No. 11 FINAL GRADING PLAN – PHASE 1A AND 1B
- Sheet No. 12 FINAL GRADING PLAN - OVERALL
- Sheet No. 13 PHASE PROGRESSION PLAN
- Sheet No. 16 LEACHATE COLLECTION AND REMOVAL SYSTEM DETAILS
- Sheet No. 20 EROSION CONTROL DETAILS
- Construction specifications (to be issued immediately prior to cap construction)

Section 2
Background and Location

Industrial solid waste generated from manufacturing operations at the Domtar Plymouth Complex will be disposed of in the landfill. The waste streams include, but are not limited to, boiler ash, grits, liquor dregs, lime mud, wood wastes, paper wastes, pulp rejects, general mill trash, and dewatered wastewater treatment plant solids. Off-site waste material will likely be accepted from other Domtar mills only. Waste streams from these mills will be limited to those listed above.

The proposed 96-acre site is located approximately 2 miles south of the Domtar Complex as shown on Sheet No. 1. The site is generally located west of Ken Trowbridge Road; south of the Domtar Complex and the Roanoke River; east of Welch Creek; and north of Highway 64.

Section 3
Final Cover Design and Construction

Closure activities for the Domtar landfill will include the following items:

- Installation of intermediate cover
- Installation of the cap system
- Establishment of the vegetative cover

3.1 Permitted Final Cover Design

3.1.1 Installation of Intermediate Cover

Intermediate cover will consist of 12 inches of select waste (ash). This layer will serve as a smooth support layer for the GCL. The intermediate cover will be placed at Domtar's discretion on the waste in areas that have reached final grade elevations, and may be removed and stockpiled for future use before capping activities begin.

3.1.2 Installation of the Cap System

The largest area of the landfill requiring cover at any time during the life of the landfill is for a premature closure condition and is estimated to be approximately 19 acres. The estimated total volume of the landfill is 10.7 million cy. Prior to beginning closure of the landfill, a notice of intent to close the unit will be submitted to NC DENR and placed in the site operating record.

The proposed cap system for final cover will consist of the following components (top to bottom) as shown on Sheet No. 17:

- 6-inch vegetative layer
- 12-inch vegetative support layer
- Geotextile/geonet/geotextile composite (drainage layer)
- 40-mil VFPE geomembrane
- GCL

The minimum slope of the final cap will be 5 percent with the exception of a small area at 3 percent. The maximum slope of the final cap will be 33 percent. Benches, 15 feet in width, will be graded into the final cap slope at vertical intervals of 20 feet. The benches will have a minimum slope of 0.5 percent to collect storm water from the cap and to provide equipment access along the face of the landfill for maintenance and inspections.

Prior to beginning capping activities, any remaining fine grading of the intermediate cover will be conducted. Gas collection trenches and vents will be placed at the crest of the landfill. Next, the GCL will be placed to provide an impermeable layer that will reduce storm water infiltration into the waste and thereby reduce leachate production.

A 40-mil, VFPE-textured liner will be placed on the GCL to enhance the barrier layer. Refer to the CQA plan for VFPE acceptance specifications (see Appendix Q). A drainage composite consisting of a geotextile/geonet/geotextile will be placed over the textured membrane. Refer to the CQA Plan for geonet and geotextile acceptance specifications. This drainage layer will collect infiltration and divert water to the drainage terraces.

The final component of the cover system will consist of general fill and topsoil. The general fill layer will consist of 12 inches of soil or a mixture of dewatered wastewater solids and ash, as previously approved by NC DENR. The topsoil will consist of 6 inches of soil capable of sustaining vegetative growth. The sedimentation pond will be cleaned of sediment build-up and the sediment, consisting of material eroded from the existing cover, may be blended into the vegetative layer. Final grading of this layer will be accomplished with tracked equipment.

Within 90 days after completion of final grading requirements of the landfill unit, a seed bed will be prepared in the vegetative layer prior to applying seed and mulch. The seed bed will be prepared with a disc harrow penetrating to a minimum depth of 2 inches. Large clods, rocks, or other foreign material brought to the surface during preparation of the seed bed will be removed prior to the application of fertilizer, seed, and mulch. Fertilizer will be evenly spread over the surface of the prepared seed bed and worked into the soil with one final light pass with a disk harrow or a chain harrow. Lime will be applied, if necessary, to enhance growth.

Permanent vegetation will be established by spreading seed with a mechanical device that ensures an even application rate of the seed mixture. The vegetative components may be applied simultaneously with a hydroseeder.

The following method is suggested for establishing the permanent vegetation:

1. Apply liming agent at recommended rate.
2. Apply fertilizer (10-10-10) at recommended rate.

3. Work lime and fertilizer into the soil.
4. Apply seed mixture at recommended rates.
5. Apply mulch to the seeded surface.
6. If final grading and surface preparation are delayed due to inclement weather, appropriate measures will be taken to remedy any effects of erosion.
7. Maintenance measures will be performed as necessary to achieve a thorough coverage of vegetation.

3.2 Construction Specifications

Prior to the commencement of closure activities, applicable construction specifications will be issued for NC DENR review. In the interim, the CQA plan located in Appendix Q of the permit application will provide any necessary information regarding the cap components and their required properties.

3.3 Quality Assurance/Quality Control

Construction quality assurance (QA) and quality control (QC) during all landfill closure activities will be performed according to the CQA plan (Appendix Q of the permit application). The CQA plan was written in accordance with Section .1621 of the NC DENR regulations and will form part of this document as referenced. Prior to closure, the CQA plan will be reviewed and modified as necessary and attached to this closure plan and cost estimate.

3.4 Erosion Control Measures

State and federal erosion control regulations will be followed during closure activities. Prior to establishing vegetation, areas left disturbed for a period greater than 14 days will be covered with jute mesh, temporary vegetation, or an equivalent cover. Other standard management practices for erosion control such as silt fencing, hay bale barriers, etc., will be employed as necessary. In addition, storm water from the cap areas will be routed through the sediment ponds located around the landfill, which will serve to remove suspended sediment.

Section 4
Closure Scenarios

4.1 Routine and Premature Closure

The disposal site will be developed in 18 phases as shown on Sheet No. 13. This operating scenario shown is based on utilizing the working face method of fill and allows for the lateral expansion of the facility in the future. As waste is placed in the active stage, it will be graded, spread, and compacted along the working face. As final subgrade elevations are reached, the working face will move to the south, into the next lined phase. Next, either the finished areas will be covered with a temporary cover, which will minimize the generation of leachate, or a final cover will be constructed.

Prior to construction of the final cap, surface water that comes into contact with waste will be managed as leachate. Surface water runoff from areas of vegetated intermediate cap will be discharged through appropriate sedimentation controls.

With the exception of Phase 1 and Phase 2, which occupy a footprint area of approximately 14 and 15 acres, respectively, each of the landfill's 18 phases covers approximately 5 acres. Phase 3 and Phase 4 have a combined life expectancy of approximately 5 years (*i.e.*, until other phases have to be opened to accommodate leachate generated by stormwater runoff).

Final cap construction will proceed from phase to phase. As Phase 3 and Phase 4 near capacity, the Phase 5 and Phase 6 cells will be constructed to provide temporary containment for leachate generated from stormwater runoff. Phase 3 and part of Phase 4 will then be capped as filling continues in Phase 4 to minimize the generation of leachate. Construction will proceed in this manner through the life of the landfill.

4.2 Closure Cost Estimate

For purposes of meeting NC DENR financial assurance requirements, the cost to close the intermediate 19-acre cell was calculated to be approximately $2.6 million (Attachment 1). This estimate includes the estimated cost for Domtar to hire an independent third party as general contractor (not a corporate subsidiary or parent, or affiliate of the permittee) to perform each task, including the costs of preparing and executing bid documents for the selection of a general contractor and supervising the general contractor's performance.

Unit costs are based on information from contractors in the southeastern United States, vendor estimates, published costs, or engineering estimates. Costs reflect a rate of return of 5 percent

and an inflation rate of 4 percent. Specific cost allowances are not included for interest during construction, legal fees, financial consultants, debt service, or equipment depreciation. Closure costs include an administrative allowance of 20 percent of the capital cost plus a general contingency of 40 percent.

The following is a description of those closure items in Attachment 1 that may require explanation.

4.2.1 Control Grading

This item includes relocating waste, surface preparation, and obtaining proper surface elevations. Erosion control measures are shown as separate line items.

4.2.2 Geosynthetic Clay Liner

This item includes placing GCL for the low permeability layer of the final cover.

4.2.3 40-mil Textured Very Flexible Polyethylene Geomembrane

This item includes obtaining and installing 40-mil textured VFPE geomembrane for the final cover.

4.2.4 Geonet Drainage Composite

This item includes obtaining and installing geonet drainage composite for the final cover.

4.2.5 Vegetative Support Layer

This item includes placing fill material for the vegetative support layer and assumes that all necessary material will be available from an on-site stockpile. The cost for this item is based on in-place volumes.

4.2.6 Topsoil

This item includes placing topsoil for the final cover and assumes that all necessary material will be available from an on-site stockpile. The cost for this item is based on in-place volumes.

4.2.7 Vegetation

Establishing a vegetative cover includes the following items:

- Soil testing

- Amending soil with lime, fertilizer, and organic matter
- Incorporating soil amendments, including disking, harrowing, sprigging, and herbicide application
- Spreading and disking surface thatch

4.2.8 Closure Survey

This item includes survey of the entire closure area to determine final elevations of the cap. The cost to prepare a drawing of the final elevations showing contour intervals at 2-foot contours is included as a separate item.

4.2.9 Administrative Costs

Administrative costs shown as 20 percent of the total capital cost include the following items:

- Redesigning final closure, if necessary, in accordance with existing site conditions and applicable regulations
- Contracting for technical consulting services
- Providing administrative overhead for oversight
- Preparing final closure certification
- The costs for an independent third-party consultant for all services associated with preparing and executing bid documents, selection of an independent third-party construction contractor, and supervision of the contractor's general performance

4.3 Maximum Waste Inventory

It is expected that over the entire life of the facility, the maximum waste inventory will be approximately 10.7 million cy. The maximum waste inventory in Phase 3 and Phase 4 will be approximately 506,000 cy.

Section 5
Closure Schedule

It is expected that closure for this scenario would not require longer than 180 days. However, if the project were to exceed this duration, Domtar would take the steps necessary to prevent threats to human health and the environment from the unclosed landfill unit. The closure period would be extended only with NC DENR approval. In addition, closure activities for the landfill unit would be completed in accordance with this plan.

Section 6
Closure Certification and Deed Notation

Following closure of the landfill unit, Domtar will submit to NC DENR a certification, signed by an independent registered professional engineer verifying that closure has been completed in accordance with the closure plan, and a copy placed in the site operating record. In addition, within 90 days after closure activities are complete, Domtar will record a notation onto the land deed and/or some other legal instrument that is normally examined during a title search stating that the property has been used as a solid waste disposal facility landfill unit. The notation will include the following information:

- The land has been used as a solid waste disposal facility landfill unit.
- The land use is restricted to ensure that the cap system integrity or other containment components are not compromised, and monitoring systems are not disturbed.
- That any re-use of the property will not increase the potential threat to human health or the environment.
- The name of the permittee, the type of disposal facility, and the beginning and closure dates of the disposal activities will be included.
- The locations and dimensions of the landfill unit with respect to permanently surveyed benchmarks and section corners on a plat prepared and sealed by a land surveyor will be included.
- The notation will be certified by an Engineer or Land Surveyor stating that all closure requirements have been completed as determined necessary by the Department.

Domtar will submit a certified copy of the recording instrument to NC DENR and place a copy in the operating record within 120 days after permit expiration, revocation, or as otherwise directed by NC DENR.

Section 7
Post-closure Monitoring and Maintenance

7.1 Final Cover Maintenance/Inspection Schedule

The finished cap and perimeter berm will receive a visual inspection on a weekly basis to check for and document evidence of settling, subsidence, erosion, and other potential failures of the final cover. These inspections will also encompass the perimeter berm, ditches, channels, and sediment basin to ensure storm water runoff and runon are being properly routed. These inspections, along with any repairs that were required, will be documented and maintained on file by Domtar.

In addition, the landfill will be mowed at least once per growing season, and fertilized and reseeded as necessary. This will protect the final cover against erosion and decrease the potential for leachate generation. Vegetation that poses a threat to the integrity of the final cover, such as deep-rooted shrubs and trees, will be removed.

7.2 Leachate Collection System/Miscellaneous Maintenance

Domtar will perform the following maintenance activities for the duration of the post-closure care period:

- **Pumps**. Proper maintenance of this equipment is critical to the operation of the leachate collection and transfer system. The manufacturer's recommendation for routine inspection and cleaning intervals will be followed for pumps and pump controls, with pump inspections occurring no less than once per week. The collection piping will be jet cleaned at least annually. In addition, all valves and flow measurement devices will be inspected and cleaned as necessary on a regular basis.
- **Leachate Treatment**. Leachate collected in the wet well of the leachate transfer station will continue to be treated in the mill wastewater treatment system for the duration of the post-closure period. Leachate collection may be discontinued if testing establishes that leachate treatment is no longer necessary and upon approval of NC DENR (see Subsection 5.6.2 of the permit application).
- **Access Control**. Access to the landfill facility will be controlled by secure fencing for the duration of the post-closure period.

7.3 Groundwater Monitoring System

Groundwater will continue to be monitored as described in Subsection 5.6.1 and in Appendix O, Sampling and Analysis Procedures for Groundwater, of the permit application for the duration of the post-closure period.

7.4 Gas Monitoring

Gas monitoring at the site will not be performed at the landfill due to the predominantly inorganic nature of the wastes, as discussed in Subsection 5.6.3 of the landfill permit application document.

Section 8
Post-closure Cost Estimate

The post-closure cost estimate was based on monitoring and maintaining Phase 3 and Phase 4 of the disposal facility for a period of 30 years after final closure. This estimate is included as Attachment 2. Unit costs are based on information from contractors in the southeastern United States, vendor estimates, published costs, or engineering estimates. Costs reflect current pricing. The present value of post-closure care for Phase 3 and Phase 4 is estimated to be $2.8 million (see Attachment 2), assuming a 5-year life for Phase 3 and Phase 4, a 30-year post-closure care duration, 4 percent inflation rate, and 5 percent interest rate. Specific cost allowances are not included for interest during construction, legal fees, financial consultants, debt service, or equipment depreciation. Post-closure costs include an administrative allowance of 20 percent of the capital cost plus a general contingency of 40 percent.

8.1 Routine Inspection

This item is for inspecting the site twice each year for 2 years to determine the necessary maintenance required.

8.2 Maintenance of On-site Improvements

This item is for repair and maintenance of all on-site permanent improvements and equipment including signs, gates, fences, roads, or other structures necessary to maintain closure of the site.

8.3 Maintaining Vegetation

The cost is included to mow the site two times per year, reseeding as necessary, and applying weed control measures.

8.4 Repair of Final Cover

This item is for controlling erosion, settlement, and ponding on the final cover.

8.5 Maintaining Surface Drainage Features

This item includes the cost of repairing erosion for 10 percent of the total ditch length per year.

8.6 Groundwater Monitoring Well Sampling

The cost is included to sample and analyze one sample per year for each of the 12 monitoring wells in accordance with the groundwater monitoring, sampling, and analysis plan for the duration of the post-closure period.

8.7 Leachate Collection System Maintenance

The cost is included to maintain the two additional leachate pumps in Phase 3 in accordance with manufacturer's recommendations. This cost was derived by multiplying the capital cost of the pumps by 10 percent representing the depreciation of each pump over its useful life.

8.8 Administrative Costs

Administrative costs shown as 20 percent of the total capital cost include the following items:

- Record keeping
- Contracting for technical consulting services
- Administrative overhead for oversight
- Preparing post-closure certification
- The costs for an independent third-party consultant for all services associated with preparing and executing bid documents, selection of an independent third-party construction contractor, and supervision of the contractor's general performance

8.9 Post-Closure Costs Not Included

No allowance has been made for the following items:

- Air sampling
- Soil sampling
- Surface water sampling
- Gas sampling
- Monitoring well abandonment
- Leachate treatment

Section 9
Contact Persons

The following office can be contacted during the post-closure period:

Environmental Manager
Domtar Paper Company, LLC
Plymouth Mill
West Main Street Extension
PO Box 747
Plymouth, North Carolina 27962
(252) 793-8111

Section 10
Landfill Property Use

Currently, there are no planned uses of the property during the post-closure period. In the event a use is realized, NC DENR will be contacted for approval. All proposed activities will be restricted to prevent damage to the integrity of the final cover, liner, and all other components of the containment system.

Section 11
Post-closure Certification

Following completion of post-closure care and verifying that post-closure care has been completed in accordance with this post-closure plan, Domtar will notify NC DENR that a certification, signed by a registered professional engineer, has been placed in the operating record.

Attachment 1
Opinion of Probable Costs
Landfill No. 3 Closure,
Phase 1a, 1b, 2, 3, and 4 Cost Estimate

OPINION OF PROBABLE COSTS					
CLOSURE OF LANDFILL NO. 3, PHASE 1a, 1b, 2, 3, and 4				By:	TWM
DOMTAR PAPER COMPANY, LLC, PLYMOUTH, NORTH CAROLINA				Checked:	DM
RMT PROJECT NO. 05794.41				Date:	8/11/2010

Footprint (acres):	34.30	Disposal Rate (cyds/year):	155,464
Volume (cyds):	1,737,063		
Waste Unit Weight (lbs/cf):	70		
Phase Operations (years):	11	Post-Closure Care (years):	30
Rate of Return:	7.1%	Inflation:	2.0%

DESCRIPTION: Closure of Phases 1 through 4 (approximately 34 acres)

ITEM NO.	*ITEM DESCRIPTION*	*QUANTITY*	*UNITS*	*UNIT COST*	*TOTAL COSTS*
1.00	**CONSTRUCT MULTILAYERED CAP**				
1.01	CONTROL GRADING	165,900	SY	$ 1.20	$ 199,080
1.02	SELECT ASH (1-FT THICK)	52,300	CY	$ 5.00	$ 261,500
1.03	GCL	1,493,000	SF	$ 0.74	$ 1,104,820
1.04	40-MIL TEXTURED LLDPE MEMBRANE	1,493,000	SF	$ 0.46	$ 686,780
1.05	GEONET COMPOSITE	1,368,000	SF	$ 0.73	$ 998,640
1.06	GEOCUSHION	124,600	SF	$ 0.56	$ 69,776
1.07	PASSIVE GAS SYSTEM	1,700	LF	$ 55.00	$ 93,500
1.08	VEGETATIVE SUPPORT LAYER	55,300	CY	$ 6.00	$ 331,800
1.09	TOPSOIL (6 INCHES THICK)	27,600	CY	$ 6.00	$ 165,600
1.10	FINAL GRADING	165,900	SY	$ 0.60	$ 99,540
1.11	SEEDING, FERTILIZING, & MULCHING	34	ACRE	$ 3,000.00	$ 102,000
1.12	BORROW AREA SEEDING, FERTILIZING, & MULCHING	10	ACRE	$ 3,000.00	$ 30,000
2.00	**STORMWATER CONTROLS**				
2.01	DOWNSLOPE FLUMES	2,850	LF	$ 90.00	$ 256,500
2.02	RIPRAP	590	CY	$ 60.00	$ 35,400
2.03	ENERGY DISSIPATERS	6	EA	$ 20,000.00	$ 120,000
2.04	4" DIA DRAINAGE LAYER COLLECTION PIPES	11,200	LF	$ 15.00	$ 168,000
3.00	**EROSION CONTROL**				
3.01	SILT FENCING	5,700	LF	$ 3.75	$ 21,375
3.02	TURF REINFORCEMENT MAT (TRM)	6,800	SY	$ 5.85	$ 39,780
3.03	EROSION CONTROL AND REVEGETATION MAT (ECRM)	23,600	SY	$ 1.80	$ 42,480
3.04	MISC. EROSION AND SEDIMENT CONTROLS	1	LS	$ 10,000.00	$ 10,000
4.00	**SURVEYING**	34	ACRE	$ 2,700.00	$ 91,800
	SUBTOTAL				***$ 4,928,371***
5.00	**ADMINISTRATION (2% OF CONSTRUCTION)**	1	LS	$ 98,567.42	$ 98,567
6.00	**MOBILIZATION (5 % OF CONSTRUCTION)**	1	LS	$ 246,418.55	$ 246,419
7.00	**DEMOBILIZATION (1% OF CONSTRUCTION)**	1	LS	$ 49,283.71	$ 49,284
8.00	**ENGINEERING SERVICES**	1	LS	$ 50,000.00	$ 50,000
9.00	**CONSTRUCT.MGMT. SVCS. & CERTIFIC. RPT. (10% OF CONSTRUCTION)**	1	LS	$ 492,837.10	$ 492,837
	SUBTOTAL				***$ 5,865,478***
	TOTAL CAPITAL COST ESTIMATE				***$ 5,865,478***
	PER ACRE CAPITAL COST ESTIMATE				*$ 171,005*
	TOTAL PRESENT VALUE CAPITAL COST ESTIMATE				**$ 3,393,701**

Attachment 2
Opinion of Probable Costs
Landfill No. 3 Post-closure,
Phase 1a, 1b, 2, 3, and 4 Cost Estimate

OPINION OF PROBABLE COSTS

POST-CLOSURE, LANDFILL NO. 3 PHASE 1a,1b, 2, 3, and 4

DOMTAR PAPER COMPANY, LLC, PLYMOUTH, NORTH CAROLINA

RMT PROJECT NO. 05794.41

By: TWM
Checked: DM
Date: 8/9/2010
Revision #1 9/16/2010

Footprint (acres):	34.30	Disposal Rate (cyds/year):	155,464
Volume (cyds):	1,231,063		
Waste Unit Weight (lbs/cf):	70		
Phase Operations (years):	8	Post-Closure Care (years):	30

DESCRIPTION: Post-Closure Care of Phases 1 through 4 (approximately 34 acres)

ITEM NO.	*ITEM DESCRIPTION*	*QUANTITY*	*UNITS*	*UNIT COST*	*TOTAL COSTS*
1.00	**ROUTINE INSPECTION (2 TRIPS PER YEAR)**	2	EACH	$ 3,000.00	$ 6,000
2.00	**MAINTENANCE OF ON-SITE IMPROVEMENTS**	1	YEAR	$ 7,500.00	$ 7,500
3.00	**MAINTAIN VEGETATION (34 ACRES AT $300/ACRE/YEAR)**	34	ACRE	$ 300.00	$ 10,290
4.00	**REPAIR FINAL COVER**	1	YEAR	$ 5,000.00	$ 5,000
5.00	**MAINTAIN SURFACE DRAINAGE FEATURES (1500 FT AT $4/LF/YR)**	1	YEAR	$ 6,000.00	$ 6,000
6.00	**MAINTAIN LEACHATE COLLECTION**				
6.01	MAINTENANCE OF LEACHATE PUMPS (10% OF CAPITAL COST/PUMP/YEAR)	5	PUMP	$ 2,700.00	$ 13,500
7.00	SUBTOTAL				$ 48,290
8.00	**TOTAL POST-CLOSURE CAPITAL COST ESTIMATE PER YEAR**				**$ 48,290**
8.01	TOTAL POST-CLOSURE CAPITAL COST ESTIMATE PER ACRE				$ 1,420
9.00	**TOTAL POST-CLOSURE CAPITAL COST ESTIMATE - 30 YEARS**				**$ 1,448,700**

Appendix O
Sampling and Analysis Procedures for Groundwater

Sampling and Analysis Procedures for Groundwater

General Information

Sample bottles will be shipped to the site in sturdy, durable shipping coolers.

Type 1 reagent grade water will be used that meets ASTM, CAP, and NCCLS standards.

Field activities will be documented in a bound field book or on a field collection sheet. The following information will appear on each page: project, date, time, sampler's initials, site contact, conductivity, well depth, temperature, water level, gallons purged, and pH.

Existing monitoring wells are fitted with dedicated QED low flow purge system bladder sampling pumps and water level meters (or equivalent). The dedicated pumps will be used to purge well volumes and collect groundwater samples. Proposed monitoring well MW-13 will also be fitted with a dedicated QED sampling pump (or equivalent) and an electric water level meter.

In most cases, a field team will consist of two technicians. The field team will check equipment before departing for the site. Water extracted from the wells that is not used for sample volume will be discarded on the land surface in the vicinity of the well.

Equipment Decontamination

Dedicated QED sampling pumps and water level meters (or equivalent) will remain in the wells. No equipment will require removal prior to measuring water levels and sampling. This equipment will be shipped to the site pre-cleaned. Therefore, decontamination of pump equipment at the site will not be necessary.

Though the wells are to be equipped with dedicated pumps, it may be necessary at times to use non-dedicated equipment (for example, dedicated pumps out of service) to purge and sample wells. Such groundwater sampling equipment that will come into contact with the sample will be cleaned according to a specific procedure. Equipment will be washed with laboratory detergent and water, followed by a tap water rinse. Stiff brushes may be used to remove gross debris. Cleaning procedures may be augmented with the use of a high-pressure sprayer to remove debris, assist with the detergent wash, and perform the tap water rinse. The equipment will then be rinsed three times with deionized, organic free (*i.e.*, Type 1 reagent grade) water, and allowed to air dry. After rinses with deionized, organic free water, equipment will be rinsed with isopropanol, and allowed to air dry. Any equipment that is not to be used

immediately after decontamination will be wrapped in aluminum foil, then stored in a manner and location that minimizes the risk of contamination.

Teflon® Bailer Cleaning Procedure

(This procedure is approved for use under both Solid Waste Section and Groundwater Section rules.)

1. Disassemble the bailers, and rinse the parts with tap water. Place the end caps and ball in a phosphate-free soap solution to soak.
2. Wash the bailer tubes with phosphate-free soap. Use a brush to scrub the insides of each tube.
3. Rinse all bailer parts with deionized water and reassemble.
4. Rinse the inside and outside of each bailer with a 10 percent solution of nitric acid in deionized water.
5. Rinse bailers with deionized water.
6. Rinse the inside and outside of each bailer with isopropyl alcohol.
7. Let bailers air dry for 24 hours on shelf.
8. Wrap completely in aluminum foil (shiny side out).
9. Place foil-wrapped bailer in plastic sleeve, and seal with tape.

Water Levels

A procedure for obtaining water levels will be used that maximizes accuracy of measurement, reduces the risk of exposure to potentially contaminated groundwater, and reduces the potential for cross contamination. The well cap will be removed and the well allowed to vent. Tightly sealed wells will not respond well to variation in the water table due to a "straw effect" caused by air trapped in the well casing. Venting the well will allow the water level in the well to equilibrate and become representative of the piezometric surface. Measurements will be made to the nearest hundredth of a foot.

The wells will be equipped with dedicated water level indicators. The dedicated water level indicators will be stored at least 5 feet above the mean seasonal high water level within the well. In the event that the dedicated water level indicator cannot be used, a portable water level indicator will be used. The operation of the portable electric water level indicator will be checked before introducing it into the well. The probe will be lowered slowly into the well until the buzzer sounds or a light illuminates to indicate the probe is in the water. Depth to water will be measured from the point on the cable touching the surveyed measuring point at the top of the well casing.

To reduce the possibility of cross contamination, the portable water level indicator probe and any cable that entered the well must be decontaminated as indicated by site-specific requirements before the next water level will be taken.

Pressure transducers and data loggers may also be used to record water levels over extended periods of time.

Purging Wells

Water that has remained in a well casing for a period of time may not be representative of the water contained in the surrounding formation that the well is intended to sample. To obtain samples that are representative of water in the formation, wells will be purged of the water in the casing and surrounding sand pack to allow water from the formation to enter the well casing for sampling. The wells will be purged slowly to reduce turbidity and the potential for suspended sediment in the sample.

Water will be purged slowly from a well until specific conductance, pH and temperature stabilize. A minimum of three well volumes will be purged from the well unless the well is bailed dry. In the latter case, no further purging is necessary. A "well volume" is the volume of water contained in the well at the time of sampling. A well volume will be purged using the dedicated sampling pump. As an alternative, the wells may be purged using a peristaltic pump with flexible tubing, or Groundfos® sampling pump (or equivalent), or using a clean bailer and cord. Unless otherwise specified, dedicated QED sampling pumps (or equivalent) will be used. The pump will be started at a low flow rate and the outflow will be directed into a bucket of known volume. The purpose of the low flow rate during well purging is to reduce turbidity resulting from disturbing sediment that may be present in the bottom of the well. Purge water will be measured based on the known volume of the bailer used or by pouring the contents into a container of known volume. Purge water will be discarded on the ground adjacent to the well.

As a second alternative to purging with the dedicated sampling pump, a bottom-filling Teflon® bailer may be used to purge the well. The bailer and cord should only touch the inside of the well or a clean surface provided specifically for that bailer and cord. Bailers will be gently lowered to the top of the water column and then gently removed to reduce turbidity.

The color, odor, turbidity, and any other comments pertaining to the purge water will be documented in the field log. After each well volume of water has been removed from the well, specific conductance, pH, and temperature of the water will be determined and recorded in the field log. After specific conductance, pH and temperature have stabilized, sample collection may begin.

Sampling of Wells

New monitoring well MW-13 will be sampled quarterly for four consecutive quarters beginning after the well has been installed. Following the fourth quarter, MW-13 will be sampled semiannually. Monitoring wells MW-2 through MW-6 and MW-6A and MW-7 will continue to be sampled at the frequency established for Landfill No. 2, and MW-9 through MW-12 will continue to be monitored at the frequency established for Landfill No. 3, Phase 1A.

Wells will be sampled using dedicated QED sampling pumps (or equivalent). The samples will be discharged directly to the sample containers. The sample bottles will be labeled with sample identification, date, and project number. Preservative will be added to the bottle prior to collecting the sample. Samples will be collected in the following order unless otherwise specified: volatile and organics; metals; sulfate and chloride; turbidity; and nitrate. This sequence is based on the preferred collection order listed in RCRA Groundwater Monitoring Technical Enforcement Guidance Document, September 1986.

In bottles where caustic preservative will be required (*i.e.*, samples for cyanide analysis), pH will be verified in the field by pouring some of the preserved sample over pH paper. If the proper pH has not been attained, more preservative will be added in the field. Samples requiring acid preservative will be checked with pH paper to determine if sufficient preservative has been added. More preservative will be added to the sample if necessary.

Well sampling sequence will be determined based upon available information about the site. The sequence will generally begin with background wells and wells upgradient of active and completed landfill phases, followed by wells downgradient of active or completed phases.

Sample Handling and Shipping

Immediately after sample collection, the sampler will check the label for completeness. Glass sample bottles will be wrapped in bubble wrap packaging to minimize the possibility of breakage. Samples will then be placed into a cooler containing ice. The chain-of-custody form will then be completed and stored with the samples inside the cooler in a plastic bag. Custody will be maintained by the sampler until the coolers are prepared for transport. The cooler will be filled with ice, sealed with tape, and shipped via overnight air freight or courier, or it will be delivered to the laboratory by field technicians.

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Appendix P
Construction Quality Assurance Plan Phase 3 and Phase 4 Construction – Landfill No. 3

• ENVIRONMENT • ENERGY • ENGINEERING

Phase 3 and Phase 4 - Construction Quality Assurance (CQA) Plan

On-site Industrial Waste Landfill No. 3

Domtar Paper Company, LLC (Formerly Weyerhaeuser Company), Plymouth, North Carolina

June 2008, Revised November 2010

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CREATING BALANCE℠

Table of Contents

1. Introduction 1-1
   - 1.1 Project Background 1-1
   - 1.2 Purpose and Scope 1-1

2. Roles, Responsibilities, and Qualifications 2-1
   - 2.1 Construction Quality Assurance Officer 2-1
   - 2.2 Resident Project Representative 2-1
   - 2.3 Soils Testing Laboratory 2-1
   - 2.4 Geosynthetics Testing Laboratory 2-2
   - 2.5 Construction Contractor 2-2
   - 2.6 Geosynthetic Installers 2-2

3. Preconstruction 3-1
   - 3.1 Preconstruction Meeting 3-1

4. General Construction Inspection and Documentation 4-1
   - 4.1 Daily Reports 4-1
   - 4.2 Forms, Checklists, and Data Sheets 4-2
   - 4.3 Problem/Deficiency Identification and Corrective Action 4-2
   - 4.4 Photographic Documentation 4-3
   - 4.5 Surveying 4-3

5. Compacted Select Clay Fill 5-1
   - 5.1 Procedures and Observation 5-1
   - 5.2 Sampling Requirements and Acceptance Criteria 5-2
   - 5.3 Field Testing and Sampling 5-3
     - 5.3.1 Field Testing Acceptance Criteria 5-3
     - 5.3.2 Laboratory Testing 5-4
     - 5.3.3 Undisturbed Sample Analysis 5-4
     - 5.3.4 Representative Sample Analysis 5-4
     - 5.3.5 Laboratory Testing Acceptance Criteria 5-5
     - 5.3.6 Typical Index Properties Recommended for Achieving Hydraulic Conductivities of $1x10^{-7}$ cm/s or Less 5-5
   - 5.4 Thickness Documentation 5-5

6. Granular Materials 6-1
6.1 Procedures and Observation 6-1
6.2 Sampling Requirements and Acceptance Criteria 6-2
6.2.1 Field Testing 6-2
6.2.2 Laboratory Testing 6-2
6.3 Thickness Documentation 6-3

7. Geotextiles and Geocushion™ 7-1
7.1 Pre-Installation 7-1
7.1.1 Manufacturing 7-1
7.1.2 Delivery, Handling, and Storage of Geotextile and Geocushion™ Rolls 7-2
7.2 Installation 7-4
7.2.1 Placement 7-4
7.2.2 Seams and Overlaps 7-4
7.3 Post-Installation 7-5
7.3.1 Final Examination 7-5
7.3.2 Placement of Soil or Granular Materials 7-5

8. Geomembranes 8-1
8.1 Pre-Installation 8-1
8.1.1 Manufacturing 8-2
8.1.2 Delivery, Handling, and Storage of Geomembrane Rolls 8-3
8.2 Installation 8-4
8.2.1 Testing Requirements 8-5
8.2.2 Earthwork 8-7
8.2.3 Placement 8-7
8.2.4 Defects and Repairs 8-9
8.3 Field Seaming 8-11
8.3.1 Seam Layout 8-11
8.3.2 Seaming Equipment 8-11
8.3.3 Initial Requirements 8-13
8.3.4 Nondestructive Testing 8-17
8.3.5 Destructive Seam Testing 8-20
8.4 Post-Construction 8-25

9. Geonets 9-1
9.1 Pre-installation 9-1
9.1.1 Manufacturing 9-1
9.1.2 Delivery, Handling, and Storage of Geonet Rolls 9-3

9.2 Installation 9-4
9.2.1 Placement 9-5
9.2.2 Stacking and Joining 9-5
9.2.3 Repairs 9-6
9.3 Post-Installation 9-6
9.3.1 Final Examination 9-6

10. Geosynthetic Clay Liner 10-1
10.1 Introduction 10-1
10.2 Pre-installation 10-1
10.2.1 Manufacturer's Quality Control Plan 10-1
10.2.2 Materials 10-2
10.2.3 Geosynthetic Clay Liner Delivery, Handling, and Storage 10-2
10.2.4 Submittals 10-4
10.3 Installation 10-5
10.3.1 Testing Requirements 10-5
10.3.2 Required Equipment 10-7
10.3.3 Surface/Subgrade Preparation 10-7
10.3.4 Deployment 10-8
10.3.5 Seaming 10-9
10.3.6 Patches/Repairs 10-9
10.3.7 Penetration Seals 10-10
10.3.8 Covering Geosynthetic Clay Liner 10-10
10.3.9 Construction Quality Assurance 10-11
10.3.10 Submittals 10-12
10.4 Post-installation 10-12
10.4.1 Final Examination 10-12
10.4.2 Submittals 10-12

11. Geocomposites 11-1
11.1 Pre-installation 11-1
11.1.1 Manufacturing 11-1
11.1.2 Delivery, Handling, and Storage of Geocomposite Rolls 11-2
11.2 Installation 11-3
11.2.1 Testing Requirements 11-3
11.2.2 Placement 11-5
11.2.3 Overlaps and Joining 11-5
11.2.4 Repairs 11-6
11.3 Post-Installation 11-6

11.3.1 Final Examination 11-6
11.3.2 Placement of Soil Materials 11-6

12. Select Waste Fill 12-1
12.1 Procedures and Observations 12-1
12.2 Field and Laboratory Testing 12-1
12.3 Thickness Documentation 12-1

13. Piping 13-1
13.1 Pre-installation 13-1
13.1.1 Manufacturing 13-1
13.1.2 Delivery, Handling, and Storage of Piping 13-2
13.2 Installation 13-3
13.2.1 Pipe Seams 13-4
13.2.2 Placement Requirements 13-4
13.2.3 Pipe Boots 13-5
13.2.4 Damages 13-5
13.3 Post-Installation 13-5

14. Compacted Prepared Subgrade Fill 14-1
14.1 Procedures and Observation 14-1
14.2 Sampling Requirements and Acceptance Criteria 14-2
14.3 Field Testing and Sampling 14-3
14.3.1 Field Testing Acceptance Criteria 14-3
14.3.2 Laboratory Testing 14-4
14.3.3 Undisturbed Sample Analysis 14-4
14.3.4 Representative Sample Analysis 14-4
14.3.5 Laboratory Testing Acceptance Criteria 14-5
14.4 Thickness Documentation 14-5

List of Tables

Table 5-1 Summary of Quality Assurance Testing for the Select Clay/Bentonite-Amended Soil Liner 5-6
Table 7-1 Geotextile Tests and Test Methods 7-6
Table 7-2 Geocushion™ Tests and Test Methods 7-6
Table 7-3 Geotextile Acceptance Specifications 7-7
Table 7-4 Geocushion™ Acceptance Specifications....7-7
Table 8-1 Number of Units to be Selected as Lot Sample—Specification Conformance 8-26
Table 8-2 High-Density Polyethylene Geomembrane Tests And Test Methods....8-26
Table 8-3 Very Flexible Polyethylene Geomembrane Tests and Test Methods....8-27
Table 8-4 High-Density Polyethylene Geomembrane 60-Mil Acceptance Specifications....8-28
Table 8-5 Very Flexible Polyethylene Geomembrane 40-Mil Acceptance Specifications....8-29
Table 8-6 60-Mil Smooth or Textured High-Density Polyethylene Geomembrane Seam Acceptable Specifications....8-29
Table 8-7 40-Mil Very Flexible Polyethylene Smooth or Textured Geomembrane Seam Acceptable Specifications....8-30
Table 9-1 Geonet Properties 9-7
Table 10-1 Summary of Specifications and Quality Control Testing 10-1
Table 10-2 Collection of Field Acceptance Samples....10-1
Table 11-1 Geocomposite Acceptance Specifications 11-8

Section 1
Introduction

1.1 Project Background

This report presents the CQA plan for specific components of the composite liner and final cover for the Domtar Plymouth Landfill. The liner and cover area cover approximately 95 acres and will be developed on Domtar property located in Plymouth, North Carolina.

This plan addresses CQA requirements for modified liner and cover components of the landfill. Design-related aspects of the components mentioned above are addressed in the construction plan application. This CQA plan is a "working" document, which will be updated as necessary to reflect changes in specific materials used, in installation practices, or in tests and test methods.

1.2 Purpose and Scope

The purpose of this CQA plan is to provide procedures that will confirm that the landfill liner and cover are constructed and documented consistent with the construction plan application approved by NC DENR, and the construction drawings and specifications.

The scope of this report includes general CQA requirements concerning roles, responsibilities, and qualifications of parties involved; the preconstruction meeting; and general inspection and documentation procedures. Specific CQA requirements for each liner component address construction procedures and observation, field and laboratory testing frequency and methods, and acceptance criteria. Geomembrane testing and acceptance criteria are based on ASTM and the Geosynthetics Research Institute (GRI).

The general CQA requirements (Sections 2, 3, and 4) pertain to all liner components. The following report sections pertain to the landfill components as shown:

REPORT SECTION		LANDFILL COMPONENT
Section 5	Compacted Select Clay Fill	Clay soil liner (sump areas)
Section 6	Granular Materials	Leachate drainage blanket Pipe bedding material
Section 7	Geotextiles and Geocushion™	Component of Geocomposites Leachate collection bedding cushion

REPORT SECTION		LANDFILL COMPONENT
Section 8	Geomembranes	Geomembrane liner (landfill base and cap)
Section 9	Geonets	Component of Geocomposite
Section 10	Geosynthetic Clay Liner	GCL liner (landfill base and cap)
Section 11	Geocomposites	Drainage layer (final cover and alternate leachate drainage layer)
Section 12	Select Ash Fill	Protection layer (landfill base) Leveling course (final cover)
Section 13	Piping	Leachate collection and transfer piping Gas Collection piping
Section 14	Compacted Prepared Subgrade Fill	Prepared subgrade for landfill base liner

Section 2
Roles, Responsibilities, and Qualifications

2.1 Construction Quality Assurance Officer

The CQA officer shall supervise and be responsible for all inspections, testing, and related construction documentation as described in this CQA plan. The CQA officer will be responsible for preparation of the construction documentation report to certify substantial compliance with the engineering design. The CQA officer shall be a North Carolina Registered Professional Engineer.

The CQA officer may delegate daily inspection, testing, and sampling duties to a qualified technician with experience in the assigned aspect of construction who will serve as the resident project representative (RPR). Although these duties may be delegated, the CQA officer will retain the responsibility for these activities.

When an RPR is designated, the CQA officer shall visit the construction site biweekly (every 2 weeks) at a minimum during active periods of construction to personally observe the construction and documentation procedures. Also, at a minimum, the CQA officer shall personally observe, on at least one occasion, each of the major elements of construction including the prepared subgrade, the GCL, the geomembrane liner, and the leachate drainage layer. The CQA officer shall be readily available for consultation, as needed.

2.2 Resident Project Representative

The RPR will carry out daily inspection, testing, and sampling duties under the direct supervision of the CQA officer. The RPR shall be a qualified technician with experience in the assigned aspect of construction. The RPR will observe and document construction and installation procedures. The RPR will prepare daily summary and inspection reports and transmit these routinely to the CQA officer. The RPR will immediately notify the CQA officer of problems or deviations from the CQA plan or design plans and specifications. Reporting, documentation, and resolution of problems and deficiencies shall be carried out as described in Subsection 4.3. The RPR will ***not*** have authority to approve design or specification changes without the consent of the CQA officer.

2.3 Soils Testing Laboratory

The Soils Testing Laboratory retained will be experienced in landfill construction soils testing in accordance with the ASTM standards and other applicable standards. The selected laboratory

will be required to be responsive to the project needs by providing test results within reasonable time frames. This shall include providing verbal communication on the status of ongoing tests and immediate communication of test results as needed to facilitate ongoing construction. Such information may include hydraulic conductivity test data, proctor values, and borrow source characterization data. Final laboratory reports will be certified by the soils testing laboratory and submitted to the CQA officer.

2.4 Geosynthetics Testing Laboratory

The Geosynthetics Testing Laboratory will have experience in testing geosynthetics in accordance with standards developed by ASTM, GRI, and other applicable test standards. The selected laboratory will be required to be responsive to the project needs by providing test results within reasonable time frames. Final laboratory reports will be certified by the geosynthetics testing laboratory and submitted to the CQA officer.

2.5 Construction Contractor

The construction contractor's role will be performed by a construction firm retained by the owner to furnish earthwork and piping construction. The construction contractor will be experienced in solid waste landfill construction, knowledgeable about clay liner construction techniques, and familiar with geosynthetic construction.

2.6 Geosynthetic Installers

The geosynthetic installers are the companies hired by the contractor to install the geosynthetic components referenced in this manual and to perform the nondestructive seam testing of the geomembranes required by this plan. The term "installer" is used throughout this plan when reference is made to the tasks and responsibilities of a geosynthetic installer.

The installer will be trained and qualified to install the various geosynthetic components covered by this plan. The installer of the geomembranes will be approved and/or licensed by the manufacturer. A copy of the approval letter or license will be submitted by the installer to the CQA officer.

Prior to confirmation of any contractual agreements, the contractor shall obtain from the installer of the geomembrane the following written information, which must be approved by the CQA officer:

1. Corporate background and information
2. Installation capabilities
    - Information on equipment and personnel

- Daily anticipated production
- QC manual for installation
- Samples of field seams and certified test results

3. A list of at least 10 completed facilities, totaling a minimum of 2,000,000 square feet (ft^2) for which the installer has completed the installation of a polyethylene geomembrane.

For each installation, the following information will be provided:

1. Name and purpose of facility, its location, and date of installation
2. Name of owner, project manager, designer, manufacturer, and fabricator (if any)
3. Name and qualifications of the supervisor(s) of the installer's crew(s)
4. Thickness of the geomembrane and the surface area of the installed geomembrane
5. Type of seaming and type of seaming apparatus used

All personnel performing geomembrane seaming operations will be qualified by experience or by successfully passing seaming tests for the seaming methods to be used. At least one seamer will have experience seaming a minimum of 1,000,000 ft^2 of polyethylene geomembrane using the same type of seaming apparatus in use at the site. The most experienced seamer, the "master seamer," will provide direct supervision, as required, over less experienced seamers. No field seaming will take place without an experienced seamer (meeting the seaming criteria stated above) being present.

The contractor shall require the installer to provide a list of proposed seaming personnel and their professional records. This document will be reviewed by the CQA officer. Any proposed seaming personnel deemed insufficiently experienced will not be accepted by the CQA officer or will be asked to pass a seaming test. Any changes in the list of seaming personnel shall be brought to the attention of the CQA officer.

The installer will designate one representative as the superintendent, who will represent the installer at all site meetings and be responsible for acting as the installer's spokesperson on site. This superintendent should be prequalified for this role, on the basis of experience, management ability, and authority. The appointment must be approved by the CQA officer.

Section 3
Preconstruction

3.1 Preconstruction Meeting

Prior to construction commencing at the landfill facility, a preconstruction meeting shall be held. This meeting will include the parties involved in the construction, including the CQA officer, RPR, construction and/or Installation contractor, and owner.

The objectives of this meeting include construction planning and coordination of tasks; identification of potential problems that might cause difficulties and delays in construction; and proper interpretation of design intent by contractor(s). It is important that the rules regarding testing, repair, etc., be known and accepted by each party to this plan.

Specific topics considered for this meeting include the following:

- Review general safety requirements of the owner and specific safety issues associated with the construction activities.
- Review critical design details of the project, including the plans and specifications.
- Review measures for surface water runoff and runon diversion control including sump locations, siltation control, and pumping requirements.
- Make appropriate modifications to the CQA plan; develop project-specific addendums (if necessary).
- Review the responsibilities of each party.
- Review lines of authority and communication.
- Review methods for documenting and reporting and for distributing documents and reports.
- Review requirements of the Soils Testing Laboratory and the Geosynthetics Testing Laboratory regarding sample sizes, methods of collection, and shipment. Also review turnaround times for sample data and implications on construction schedule pending receipt of acceptance data.
- Review the number and locations of the testing requirements for soils and geosynthetic components.
- Review precautions to be taken to maximize bonding between lifts of compacted clay.
- Review the method for splicing segments of compacted clay soil liner.
- Review precautions to be taken to minimize desiccation of clay soil surfaces.

- Review methods of subgrade surface preparation and approval prior to geosynthetic placement.
- Establish rules for writing on the geomembrane (*i.e.*, who is authorized to write, what can be written, and in which color); outline procedures for packaging and storing archive samples.
- Review the time schedule for all operations and workforce logistical issues.
- Establish procedures for deployment of materials over completed geomembranes emphasizing protection of the membrane. Specific discussion shall address deployment of select granular fill on sidewalls.
- Observe where the site survey benchmarks are located, and review methods for maintaining vertical and horizontal control.
- Review permit documentation requirements.
- Review the survey documentation tables and plans that identify the locations where survey documentation information is required.
- Conduct a site walk-around to review material storage locations and general conditions relative to construction.
- Review geomembrane panel and seam layout drawings and numbering systems.
- Establish procedures for use of the geomembrane welding apparatus, if applicable.
- Establish appropriate intervals for seamers to record operating and ambient data.
- Finalize field cutout sample sizes.
- Review liner penetration procedures.
- Review repair procedures.

The meeting will be documented by the CQA officer, and minutes will be distributed to all parties involved in the construction project.

Section 4
General Construction Inspection and Documentation

This section describes general documentation procedures to be implemented including use of forms, identification and resolution of problems or deficiencies, and photographic documentation.

4.1 Daily Reports

A daily summary report shall be prepared by the CQA officer or the RPR under direct supervision of the CQA officer, for each day of activity containing the following information:

1. Date, project name, location, and report preparer's name. Name of RPR on site performing CQA under the supervision of the CQA officer.
2. Time work starts and ends each construction work day. Also, the duration and reason for work stoppages (*i.e.*, weather delay, equipment shortage, labor shortage, unanticipated conditions encountered, *etc.*).
3. Data on weather conditions including temperature, humidity, wind speed and direction, cloud cover, and precipitation.
4. Construction contractor's work force, equipment in use, and materials delivered to or removed from job site.
5. Chronological description of work in progress including locations and type of work performed.
6. Summary of meetings held and attendees.
7. A description of materials used, and references or results of testing and documentation.
8. Discussion of problems/deficiencies identified and corrective actions taken as described in Subsection 4.3 (Problem/Deficiency Identification and Corrective Action).
9. Identification/list of laboratory samples collected, marked, and delivered to laboratories, or clear reference to the document containing such information if samples were obtained.
10. An accurate record of calibrations, recalibrations, or standardizations performed on field testing equipment, including actions taken as a result of recalibrations. In addition, the results of other data recording such as geomembrane seam barrel temperature, or a clear reference to the document containing such information, if applicable.
11. Copies of each RPR's daily field data sheets.

Field data sheets shall be prepared for each workday by each RPR containing the following information:

1. Test or sample location and elevation.
2. Type of inspection.
3. The procedures used.
4. Test data (*i.e.*, proctor value, *etc.*).
5. Results.
6. Personnel involved in the inspection and sampling activities.
7. Signature of the RPR.

4.2 Forms, Checklists, and Data Sheets

Additional forms may be developed during the course of the project to provide specific needs such as geomembrane inspections or simply to improve efficiency of data collection. New forms shall be approved by the CQA officer prior to their use.

4.3 Problem/Deficiency Identification and Corrective Action

Problem or deficiency identification and corrective action will be documented in the daily summary report when a construction material or activity is observed or tested that does not meet the requirements set forth in this plan and in the construction specifications. The summary report should clearly reference other reports, photographs, or forms that contain data or observations leading to the determination of a problem or deficiency. Problem/deficiency identification and corrective action documentation may include the following information:

1. A description of the problem or deficiency, including reference to supplemental data or observations responsible for determining the problem or deficiency.
2. Location of the problem or deficiency, including how and when the problem or deficiency was discovered. In addition, an estimate of how long the problem or deficiency has existed.
3. An opinion as to the probable cause of the problem or deficiency.
4. A recommended corrective action for resolving the problem or deficiency. If the corrective action has already been implemented, then the observations and documentation to show that the problem or deficiency has been resolved. If the problem or deficiency has not been resolved by the end of the day upon which it was discovered, then the report will clearly state that it is an unresolved problem or deficiency. Subsequent daily reports shall indicate the status of problems or deficiencies until resolved.

If the problem or deficiency has not been resolved, the CQA officer and the preparer will discuss the necessary corrective actions. The CQA officer will work with the owner and construction contractor to implement actions as necessary to resolve the problem or deficiency. A description of such problems or deficiencies and corrective actions implemented shall be provided in the construction documentation report.

The CQA officer, working with the owner and construction contractor, will determine if the problem or deficiency is an indication of a situation that might require changes to the plans and specifications and/or the CQA plan. Revisions to the plans or specifications or the CQA plan must be approved by the CQA officer and the site owner after consultation with NC DENR. Documentation of the Department's concurrence and/or conditions regarding proposed changes shall be incorporated into the construction documentation report.

4.4 Photographic Documentation

Photographs will be taken to document observations, problems, deficiencies, corrective actions, and work in progress. Photographs will be in 35-mm print format and will be filed in chronological order in a permanent protective file by the CQA officer, or the RPR.

The following information should be documented in the daily report or a log book for each photograph:

1. Date and time.
2. Location where photograph was taken, including information regarding the orientation of the photograph itself for proper viewing (*i.e.*, looking south).
3. Description of the subject matter.
4. Unique identifying number for reference in other reports.
5. Name and signature of photographer.

4.5 Surveying

Surveying documentation requirements for each liner component are described in their respective plan sections. Required surveying will be performed by a North Carolina registered surveyor experienced in construction surveying. Surveying will be conducted under the supervision of the CQA officer. Surveys will be based on survey control monuments shown on the drawings prepared as part of the construction plan application. Elevations will be based on msl datum, and coordinates will be based on the North Carolina State Plane Coordinate System. The location of field tests and samples will be recorded. Generally, these locations can be determined by reference to nearby construction stakes or markings; however, if such convenient

reference is not readily available, the CQA officer or the designated RPR is responsible to provide or request survey control.

Section 5
Compacted Select Clay Fill

Select clay fill refers to the compacted clay in the leachate sump area beneath the composite liner. The select clay fill shall be either bentonite-amended soil or a natural clay that can be compacted to a permeability of 1.0×10^{-7} cm/s or less. On-site clay soils are proposed. A clay borrow investigation report will be made available to the contractor. If clay soil from the on-site borrow source is not used, a bentonite-amended soil is proposed.

5.1 Procedures and Observation

The installer will be responsible for means and methods to implement the work. The RPR will observe the compacted clay liner and clay cover construction activities and document relevant observations to support certification of the following requirements:

1. The RPR will confirm the uniformity of the bentonite-amended soil/clay borrow soils. Soil excavation, proportioning, mixing, and placement will be monitored for segregation and removal of unsuitable material and for changes in soil type, color, texture, and moisture content.
2. The construction contractor will segregate and/or remove unsuitable materials such as soils not meeting acceptance criteria (boulders, cobbles, and organic material).
3. The RPR will measure field densities and moisture contents, using methods described in Subsection 5.2 (Sampling Requirements and Acceptance Criteria), to document that the compacted liner is in substantial conformance with the placement specifications and that soil placement has been conducted in a manner to achieve a uniform, homogeneous clay mass.
4. Voids created by nuclear density gauge testing or retrieval of Shelby tube samples will be backfilled with sodium bentonite.
5. The bentonite-amended soil/clay shall be placed in loose lift thicknesses not exceeding 8 inches. Each loose lift shall be compacted with multiple passes using appropriate compaction equipment. If the soil is deposited in thickness exceeding 8 inches, dozers will be used to spread the soil to an 8-inch thickness prior to compaction. This will ensure adequate reduction of clod size and provide a thin layer to achieve required compaction throughout the lift.
6. Areas of unacceptable hydraulic conductivity, compaction density, or moisture content, as defined by Subsection 5.2 (Sampling Requirements and Acceptance Criteria), will be documented by the RPR. Corrective action will consist of moisture conditioning of the soil

or additional compactive effort as necessary. Methods for moisture-conditioning soils are described in Item 7 below. Following corrective actions, such areas will be retested.

7. If necessary, surfaces of liner to receive successive lifts of bentonite-amended soil/clay will be moisture-conditioned either by scarification and addition of water where desiccated, or by disking and air drying where saturated to promote effective bonding of lifts. Following scarification, water will be applied with a spray bar applicator or equivalent methods to achieve uniform distribution.

8. Bentonite-amended soil/clay compaction will be performed in a manner to achieve continuous and complete keying together of soil liner construction areas. Stepped joints will be utilized to connect lateral segments of the soil liner construction.

9. No frozen soils will be used for clay liner construction. Frozen soils in the compaction work area will be removed.

10. Stones that are larger than 0.5 inch in diameter shall be removed from the surface of the final lift of the clay liner to avoid potential for puncturing the geosynthetic clay liner. The method to detect and remove stones requires an initial overfill of compacted clay liner soils approximately 1 inch above designed liner grades. A grader will then blade the liner surface to obtain uniform liner grades and design elevations. Stones present will be exposed and loosened by the grading. The RPR shall inspect the liner during this process and document removal of stones by the contractor. Voids made by removal of stones shall be filled with clay soil, and then the entire liner surface shall be rolled with a smooth drum compactor.

11. Preconstruction planning will be undertaken to sequence construction activities to minimize the length of time any completed clay liner surfaces are exposed prior to receiving protective cover. Protective cover will be provided by installation of the geosynthetic clay liner and the geomembrane.

12. Preconstruction planning will be undertaken to minimize the need for traffic over the completed bentonite-amended soil/clay surface. Heavy trucking of materials (ingress or egress) and cleated equipment will not be allowed directly on completed clay surfaces. If this is unavoidable, an evaluation will be made upon termination of the haul route to determine if the liner should be reconstructed or repaired in such areas. Flotation-type all-terrain vehicles will be used to assist in deployment of the geosynthetic clay liner to avoid disruption of the completed earth liner surface.

5.2 Sampling Requirements and Acceptance Criteria

Field and laboratory sampling frequencies are based on proportionate sampling of construction areas or volume of material placed as specified below. This section describes required analysis, methods, sample frequency, and acceptance limits. Table 5-1 summarizes the minimum QA

testing recommended in Subsection 5.3. The RPR will perform field tests and collect soil samples for laboratory analysis.

5.3 Field Testing and Sampling

The following field testing and sampling methods and frequencies will be used by the RPR during construction of the bentonite-amended soil/clay liner and final cover.

- One field density and as-placed moisture content test (ASTM D 3017 and ASTM D 2922 Method B) will be performed for each compacted lift on an approximate 100-foot grid pattern.
- Representative (grab) soil samples of the liner and cover soils will be collected from the initial clay borrow source or from the on-site amended source and submitted to the Soils Testing Laboratory for testing described in Subsection 5.3.4. Additional samples will be collected every 4,000 cy for each major soil type utilized. A sample will also be collected when changes in the physical appearance or soil characteristics are observed.
- A minimum of one undisturbed Shelby tube sample will be obtained for each acre (43,560 ft^2) or less for every lift of bentonite-amended soil/clay placed. A minimum of one test per lift will be performed in each of the leachate sump areas. Samples will be submitted to the Soils Testing Laboratory for testing described in Subsection 5.3.3.
- At a minimum, at least one field density/moisture content test will be conducted per lift and at least one test per day of compacted bentonite-amended soil/clay construction. In confined areas where compaction equipment is hindered or hand compaction is necessary, a minimum of two field density/moisture content tests will be performed for each lift of soil liner placed.

A nuclear density-moisture gauge (NDG) may be used for field moisture and density determination. The calibration of NDGs used for documentation shall be initially checked and adjusted (if necessary) according to the manufacturer's guidelines. Initial calibration shall be made with a one of the alternate test methods identified in the construction specifications for field density and moisture content.

5.3.1 Field Testing Acceptance Criteria

Acceptance criteria for field density will require soil compaction to a minimum of 95 percent of the Standard Proctor (ASTM D 698) maximum dry density. Specific moisture content requirements will be identified in the construction specifications. The acceptable range will be based on Proctor moisture-density relationships and compaction versus permeability relationships.

5.3.2 Laboratory Testing

Routine laboratory testing of the compacted liner soils will be performed on samples from the clay borrow area or samples from the disking operation and on the in-place soils collected by the RPR. Samples for determining in-place properties will be collected by pushing Shelby tubes. Soil characteristics will be determined from representative samples and from Shelby tube samples.

5.3.3 Undisturbed Sample Analysis

The following analysis will be performed on ***all*** undisturbed samples obtained:

PARAMETER	TEST METHOD
Hydraulic Conductivity	ASTM D 5084 or SW 846-USEPA Method 9100
Moisture Content and Dry Density	ASTM D 2216
Atterberg Limits	ASTM D 4318
Grain-size Analysis (P200)	ASTM D 422 (1)

(1) Percentage of soil finer than the No. 200 sieve (*i.e.*, soil finer than 0.075 mm).

5.3.4 Representative Sample Analysis

The following laboratory analyses will be performed on ***all*** representative samples obtained, except where noted:

PARAMETER	TEST METHOD
Moisture-Density Relationship using Standard Proctor Compaction	ASTM D 698 (1, 2)
Atterberg Limits	ASTM D 4318
Grain-size Analysis (sieve and hydrometer)	ASTM D 422 (3)
Moisture Content	ASTM D 2216
Hydraulic Conductivity (4)	ASTM D 5084 or SW 846-USEPA Method 9100

(1) A five-point Proctor analysis is required for first and second sampling criteria.
(2) A one-point Proctor analysis may be utilized for representative samples collected for the third sampling criteria (apparent changes in soil quality) to verify applicability of previously analyzed moisture-density relationships. If the result does not verify applicability, a five-point analysis will be performed in accordance with the first sampling criteria.
(3) Distribution shall be reported through the 0.002-mm particle size.
(4) For every 8,000 cy of soil extracted from the borrow source, perform one set of hydraulic conductivity tests. A set typically consists of four hydraulic conductivity tests run on a sample of soil remolded to four different moistures and dry densities.

5.3.5 Laboratory Testing Acceptance Criteria

1. A saturated hydraulic conductivity of 1×10^{-7} cm/s or less

5.3.6 Typical Index Properties Recommended for Achieving Hydraulic Conductivities of 1×10^{-7} cm/s or Less

1. A liquid limit of 30 percent or greater
2. A plasticity index of 15 percent or greater
3. A percentage of fines (*i.e.,* material finer than the No. 200 sieve or 0.075 mm) 60 percent or greater.
4. A percentage of clay (*i.e.,* material finer than 0.002 mm) 20 percent or greater.

5.4 Thickness Documentation

The top of clay liner grades will be surveyed at a minimum on the same 50-foot grid pattern, as other locations surveyed for subbase grades. Clay thickness at slope breaks will be surveyed. The clay liner thickness will be determined at surveyed locations and reported in table fashion. The minimum acceptable bentonite-amended soil/select clay liner thickness will be 2-foot vertical to the bottom or to the slope. The location and elevation of samples requiring surveying will be recorded.

Table 5-1
Summary of Quality Assurance Testing for the Select Clay/Bentonite-Amended Soil Liner

TEST	FREQUENCY	COMMENT
Atterberg Limits Test [ASTM D 4318]	One every 4,000 cy and material changes	Source material: clay/bentonite-amended soil
Grain-size analyses (sieve and hydrometer) [ASTM D 422]	One every 4,000 cy and material changes	Source material: clay/bentonite-amended soil
Moisture Content [ASTM D 2216]	One every 4,000 cy and material changes	Source material: clay/bentonite-amended soil
Density/Moisture (Standard Proctor) [ASTM D 698]	One every 4,000 cy and material changes	Source material: clay/bentonite-amended soil
Permability Testing (Falling Head) [ASTM D 5084 or SW846-USEPA Method 9100]	Four tests on one sample obtained every 8,000 cy and material changes	Source material: clay/bentonite-amended soil (on remolded source material)
Proofroll	All surfaces prior to liner placement	Subgrades for liner construction
Density/Moisture Content [ASTM D 2922 and ASTM D 3017] or [ASTM D 1556] or [ASTM D 2937]	One per 10,000 ft^2 per lift (approximate 100-foot grid pattern)	Liner: clay/bentonite-amended soil
Permability Testing (Falling Head) [ASTM D 5084 or SW 846-USEPA Method 9110]	One per acre (43,560 ft^2) per lift	Source material: clay/bentonite-amended soil (on tube samples obtained from the *in situ* liner)
Atterberg Limits Test [ASTM D 4318]	One per acre (43,560 ft^2) per lift	Source material: clay/bentonite-amended soil (on tube samples obtained from the *in situ* liner)
Grain-Size Analyses (P200) [ASTM D 422]	One per acre (43,560 ft^2) per lift	Source material: clay/bentonite-amended soil (on tube samples obtained from the *in situ* liner)
Density/Moisture [ASTM D 2216]	One per acre (43,560 ft^2) per lift	Source material: clay/bentonite-amended soil (on tube samples obtained from the *in situ* liner and subgrade)

Section 6
Granular Materials

Granular materials include "granular fill," "aggregate fill," and other granular materials shown or specified for pipe bedding and backfill material. The granular fill will function as the filtration layer between the protection layer of select waste (ash) and the aggregate fill. The aggregate fill will function as the leachate collection layer above the liner. It will be located between the geosynthetic protection layer and the granular fill layer. The granular fill covers the aggregate fill drainage layer and acts as a filtration layer. Granular materials refers to pipe-bedded material to be used for structural support of leachate collection pipes. Limestone and dolomite stone shall not be used in the leachate collection system unless no other suitable material is reasonably available. The aggregate fill should be rounded to subangular.

Refer to details on the drawings prepared as part of the construction plan application for specific details regarding the leachate drainage blanket and leachate collection pipe trench.

6.1 Procedures and Observation

The RPR will observe granular material placement activities and document relevant observations to support certification of the following requirements:

1. The RPR shall periodically observe aggregate fill material used for pipe bedding material, and granular fill for general conformance to material specifications and may randomly sample loads. The RPR will perform routine conformance sampling as defined in Subsection 6.2.
2. No trucks or heavy equipment shall travel directly on the geomembrane. Only low-contact-pressure equipment may operate over the geomembrane when there is a minimum 8-inch-thick layer of granular material in-place. Procedures for deployment of pipe, aggregate fill, and/or geotextiles overlying geomembranes will be planned at the preconstruction meeting. Special requirements for geomembrane protection and equipment necessary to deploy materials must be approved by the CQA officer.
3. Care shall be exercised during placement of pipe bedding material to prevent undue damage to pipes, geomembrane, and geotextiles. Stone shall not be dropped from a height greater than 3 feet above the bottom of the pipe trench.
4. A geotextile cushion (Geocushion™) or geocomposite shall be placed between the geomembrane and the leachate collection/pipe bedding material.

5. A minimum of 3 inches of bedding material shall be placed under leachate collection pipes prior to pipe placement, and a minimum of 6 inches of bedding material shall be placed over the top of leachate collection pipes.
6. A minimum 14-inch-thick granular material shall be placed between the top of the composite liner and the layer of select waste (ash).
7. If granular fill is stockpiled on site prior to use, measures should be taken to minimize contamination by fines such as wind-blown particles and surface soils during loading operations.

6.2 Sampling Requirements and Acceptance Criteria

Field sampling and laboratory testing frequencies are based on proportionate sampling of construction areas or volume of material placed as specified below. This section describes the required analysis, methods, sampling frequency, and acceptance limits. The RPR will collect granular material samples for laboratory analysis.

6.2.1 Field Testing

No field testing will be required for pipe bedding material or granular fill. However, as stated in Subsection 6.1 above, the RPR will perform visual inspection of these materials for conformance to material specifications and may randomly sample deliveries.

6.2.2 Laboratory Testing

Representative (grab) samples will be obtained from the proposed bedding material, and graded granular fill sources prior to delivery of the material. The source sampling frequency will be dependent on the apparent uniformity of the source and must be approved by the CQA officer.

Grab samples of pipe bedding material, and graded fill soils placed will be collected and analyzed as follows:

SOIL TYPE	FREQUENCY	PARAMETER	TEST METHOD
Granular fill	1/1,000 CY (1, 2)	Grain-size	ASTM D 422 (3)
Granular fill	1/2,500 CY (2, 4)	Remolded hydraulic conductivity	ASTM D 2434
Pipe bedding material	1/1,000 L.F. of trench (5)	Grain-size	ASTM D 422 (3)
Pipe bedding material	1/2,000 L.F. of trench	Remolded hydraulic conductivity	ASTM D 2434

(1) For lesser volumes, a minimum of four samples shall be tested.
(2) This frequency may be reduced for uniform sources. Proposed reductions will be submitted for NC DENR approval prior to implementation.
(3) Testing shall be required only to the #200 sieve.
(4) For lesser volumes, a minimum of two samples shall be tested.
(5) For documentation areas with less than 3,000 feet of pipe trench, a minimum of three samples shall be tested.

Laboratory Testing Acceptance Criteria

Pipe bedding material shall have a uniformity coefficient less than 4, contain no more than 5 percent by weight passing the #4 sieve, have a maximum particle diameter of ¾ inch, have a remolded hydraulic conductivity of 1 cm/s or greater, and have a rounded to subangular particle shape. Granular fill materials shall meet the grain-size distribution criteria specified in the construction plans and specifications.

6.3 Thickness Documentation

Granular fill in the leachate collection layer, and placed along collection pipe alignments will be surveyed for elevation. Granular materials in the leachate drainage blanket will be surveyed on a 50-foot grid. Pipe bedding material will also be surveyed prior to pipe placement and following pipe backfilling at 50-foot intervals to document the thickness of aggregate fill placed below pipe inverts and above the top of pipe. The minimum acceptable stone thickness will be 3 inches below and 6 inches above the leachate collection piping.

Section 7
Geotextiles and Geocushion™

This section of the CQA plan applies to non-woven geotextiles used for soil separation/ filtration in roadways and riprap channels, and for protection of the geomembrane. The geotextiles used in the geocomposites will meet the applicable requirements of this section. Geocomposites are discussed in Section 11. A Geocushion™ or geocomposite will be placed over the geomembrane liner. The Geocushion™ will meet the applicable requirements of this section.

This section is divided into three major subheadings, which cover the QA requirements for pre-installation (includes geotextile manufacturers), installation, and post-installation (includes the final examination of the geotextiles prior to placing the appropriate material above the geotextile). The terms pre-installation, installation, and post-installation are applicable only to the geotextile installation and do not apply to the overall construction of the landfill facility.

7.1 Pre-Installation

7.1.1 Manufacturing

Material Specifications

The geotextile or Geocushion™ will be supplied to the site in factory rolls.

Quality Control Requirements

Prior to the delivery of any geotextile or Geocushion™ rolls to the site, the geotextile or Geocushion™ manufacturer will provide to the CQA officer the manufacturer's QC plan used for production of the geotextile rolls.

Every roll of geotextile for delivery to the site must be manufactured and inspected by the geotextile or Geocushion™ manufacturer, according to the following requirements:

1. The geotextile or Geocushion™ must contain no needles used for punching.
2. The geotextile or Geocushion™ must be free of holes and any other sign of contamination by foreign matter.

Manufacturer's Certification

The geotextile manufacturer will provide certification, based on tests performed in accordance with the methods listed in Table 7-1, that the geotextile supplied under this plan will meet the material specifications listed in Table 7-3. The Geocushion™ manufacturer will provide certification based on tests performed in accordance with the methods and frequency listed in Table 7-2 that the Geocushion™ supplied under this plan will meet the material specifications listed in Table 7-4. These tests may be performed by the geotextile or Geocushion™ manufacturer's laboratory or a laboratory contracted by the manufacturer. Additionally, the manufacturer shall provide certification that the manufacturer's QC plan was fully implemented for the geotextile or Geocushion™ materials supplied under this plan. The manufacturer shall provide documentation to verify the results of the manufacturer's QC plan implementation if required by the CQA officer.

7.1.2 Delivery, Handling, and Storage of Geotextile and Geocushion™ Rolls

(Note: ASTM Standard D4873 titled *Standard Guide for Identification, Storage and Handling of geotextiles* was used in preparing these guidelines.)

Each geotextile or Geocushion™ roll, for use at the landfill facility, will be marked by the geotextile or Geocushion™ manufacturer with the following information and in the following manner:

1. When fabric is rolled on a core, identify each roll with a durable gummed label, or an equivalent, on the inside of the core and on the outside of the protective wrapping for the roll.
2. Each roll label will contain the following information at a minimum:
    - Name of manufacturer (or supplier)
    - Style and type number
    - Unit weight (ounces per square yard)
    - Roll length and width
    - Batch (or lot) number
    - Nominal product thickness
    - Date of manufacture
    - Direction for unrolling
    - Roll number

3. On the outside of the wrapping, all lettering should be a minimum ½ inch high, and on the inside of the core, the lettering should be at least ¼ inch high.

The geotextile or Geocushion™ manufacturer will use the following guidelines in packaging, wrapping, and preparing all geotextile rolls for shipment:

1. When cores are required, use those that have a crushing strength sufficient to avoid collapse or other damage while in use.
2. Cover each roll with a wrapping material that will protect the geotextile from damage due to shipment, water, sunlight, or contaminants.

The following practices should be used as a minimum in receiving and storing geotextile rolls in the designated storage area at the job site:

1. While unloading or transferring the geotextile rolls from one location to another, prevent damage to the wrapping or to the geotextile itself. If practicable, the installer may use forklift trucks fitted with poles that can be inserted into the cores of rolls. Be sure that the poles are at least two thirds the length of the rolls to avoid breaking the cores and possibly damaging the geotextile. Do not drag rolls.
2. Store the geotextile rolls to ensure that they are adequately protected from the following:
    - Precipitation
    - Ultraviolet radiation, including sunlight
    - Strong oxidizing chemicals, acids, or bases
    - Flames, including welding sparks
    - Temperatures in excess of 160°F
    - Soiling

The RPR will observe and document, throughout the pre-installation, installation, and post-installation periods, that the installer provides adequate handling equipment used for moving geotextile or Geocushion™ rolls and the equipment and that the handling methods used do not pose unnecessary risk of damage. The installer is responsible for means and methods to implement the work.

The installer will be responsible for ensuring that all materials installed meet specifications (*i.e.*, the roll marking label information indicates required specifications and properly represents materials). The RPR will maintain a log of geotextile or Geocushion™ roll deliveries. The following information, at a minimum, will be recorded on the log for each shipment received at the job site:

1. Date of shipment from geotextile or Geocushion™ manufacturer
2. Date of receipt of delivery at job site
3. For each geotextile roll, the following information will be noted:
    - Roll number
    - Batch (lot) number

7.2 Installation

This section describes the QA requirements applicable to the installation of geotextiles. This section describes installation, observation, and documentation of geotextiles or Geocushion™.

7.2.1 Placement

The installer will install all geotextiles or Geocushion™ in such a manner to ensure that they are not damaged and in a manner that complies with the following:

1. On sideslopes, the geotextiles will be securely anchored and then rolled down the slope in such a manner as to continually keep the geotextile or Geocushion™ in tension.
2. In the presence of winds, all geotextiles or Geocushion™ will be secured by other suitable methods. The temporary weighted material will be left in place until replaced with cover material as shown on the design plans and specifications.
3. In-place geotextiles or Geocushion™ will be cut with special care to protect other materials from damage that could be caused by the cutting of the geotextiles.
4. The installer will take necessary precautions to prevent damage to any underlying layers during placement of the geotextile or Geocushion™ .
5. During placement of geotextiles, care will be taken not to entrap in the geotextile or Geocushion™ any stones, excessive dust, or moisture that could damage the geotextile or Geocushion™, or generate clogging of drains or filters.
6. A visual examination of the geotextile or Geocushion™ will be carried out over the entire surface after installation by the installer to ensure that no potentially harmful foreign objects, such as needles, are present.

7.2.2 Seams and Overlaps

The Geocushion™ manufacturer's requirements for seaming and overlapping of Geocushion™ rolls will be met. The following requirements will be met with regard to seaming and overlapping of geotextile rolls:

1. A minimum 12-inch fabric overlap will be required to form geotextile seams.

2. No horizontal seams will be allowed on slopes steeper than 10-horizontal to 1-vertical (*i.e.*, seams will be along, not across, the slope), except as part of a geotextile repair. Horizontal repair seams on such slopes will be sewn or thermally bonded.
3. The installer will pay particular attention to seams to ensure that no earthen materials could be inadvertently trapped beneath the geotextile.
4. Sewing (if required per item 2 above) will be performed with thread made from the same base material as the geotextile, or suitable equivalent.

The RPR will be responsible for observing and documenting that the above provisions are performed by the installer in an acceptable manner.

7.3 Post-Installation

7.3.1 Final Examination

The RPR will perform a final geotextile or Geocushion™ examination after installation of each geotextile or Geocushion™ layer has been completed. The objectives of the final examination are as follows:

1. Examine for presence of holes, tears, or other deterioration.
2. Examine geotextile or Geocushion™ for excessive tension due to stretching of the fabric during installation.

If there will be an extended time delay between completion of the geotextile or Geocushion™ and the start of the installation of any overlying cover, then the installer will make provisions, by temporarily covering or using other suitable methods, to protect the geotextile against exposure to sunlight and ultraviolet radiation.

7.3.2 Placement of Soil or Granular Materials

The construction contractor will place all soil or granular materials located on top of a geotextile or Geocushion™ in such a manner as to minimize the following:

1. Damage of the geotextile or Geocushion™
2. Slippage of the geotextile or Geocushion™ on underlying layers
3. Excessive tensile stresses imposed on the geotextile or Geocushion™

Table 7-1
Geotextile Tests and Test Methods

PROPERTY	TEST METHODS	MINIMUM FREQUENCY OF TESTING
Apparent Opening Size	ASTM D 4751	1 per 100,000 ft^2
Grab Tensile Properties Tensile Strength Break Elongation	ASTM D 4632	1 per 100,000 ft^2
Mass Per Unit Area	ASTM D 5261	1 per 100,000 ft^2
Permitivity	ASTM D 4491	1 per 100,000 ft^2
Puncture Resistance	ASTM D 4833	1 per 100,000 ft^2
Trapezoidal Tear	ASTM D 4533	1 per 100,000 ft^2
Burst Strength	ASTM D 3786	1 per 100,000 ft^2

Table 7-2
Geocushion™ Tests and Test Methods

PROPERTY	TEST METHODS	MINIMUM FREQUENCY OF TESTING
Mass Per Unit Area	ASTM D 5261	1 per 100,000 ft^2
Thickness	ASTM D 1777	1 per 100,000 ft^2
Tapered Pin Puncture	FTM 101C-M2065	1 per 100,000 ft^2
Truncated Cone Puncture	GRI-GM3 2 inch (50 mm) cone height	1 per 100,000 ft^2

Table 7-3
Geotextile Acceptance Specifications

TEST	TYPE A UNDER RIPRAP AND FINAL COVER GEOCOMPOSITE	TYPE B USED UNDER ROADWAYS	TYPE C BOTTOM OF LEACHATE COLLECTION LAYER GEOCOMPOSITE	CRITERION
Apparent Opening Size (US Sieve Number)	70	70-100	100-140	Maximum
Grab Tensile Properties [1] Tensile Strength (lbs)	200	200	300	Minimum
Grab Tensile Properties [1] Break Elongation (%)	50	50	50	Minimum
Permitivity (1/sec)	1.2	1.2	1.0	Minimum
Puncture Resistance (lbs)	80	80	175	Minimum
Mullen Burst (psi)	400	360	580	Minimum
Trapezoidal Tear (lb)	65	65	115	Minimum

[1] These tests will be performed and results will be reported in both the machine and cross directions.

Table 7-4
Geocushion™ Acceptance Specifications

TEST	GEOCUSHION™ 32R	CRITERION
Mass/Area	32 oz/yd^2 (1,080 g/m^2)	Minimum
Thickness	0.3 in. (7.5 mm)	Minimum
Tapered Pin Puncture	400 lb. (1,780 N)	Minimum
Truncated Cone Puncture	32 psi (220 kPa)	Minimum

Section 8
Geomembranes

This section of the CQA plan applies to the HDPE geomembrane used in the landfill base composite liner and the VFPE geomembrane used in the cap composite liner.

The geomembrane will be supplied to the site in factory rolls. ***No factory seams will be used to prepare larger panels of geomembrane for delivery to the site.*** This plan, therefore, does not contain any QA/QC requirements for factory seaming.

This section is divided into four major subheadings, which cover the QA requirements for the pre-installation (includes resin manufacturers and geomembrane manufacturers), installation, field seaming, and post-installation (includes the final examination of the geomembranes prior to placing the appropriate material above the geomembrane). These terms pre-installation, installation, field seaming, and post-installation are applicable only to the geomembrane installation and do not apply to the overall construction of the landfill facility.

8.1 Pre-Installation

This section describes the QC measures that are applicable to the polyethylene (PE) resin manufacturers, geomembrane manufacturers, and finished geomembrane roll delivery to the site prior to installation.

The geomembranes must be fabricated from polyethylene resin, and the fabricated HDPE geomembrane must be classified as Type III, Class C, Category 4 or 5 as defined by ASTM D 1248. The fabricated VFPE membrane must be classified as Type III, Class C, Category 3 or 4 per ASTM D 1248. (Note: the classifications are based on tests performed on the finished product, ***not*** the polyethylene resin used to fabricate the geomembrane.)

In the event that during the course of construction, geomembrane materials are obtained from a different manufacturer or are made from different resins, seam samples formed by joining the original and the proposed geomembrane shall be tested to confirm the construction compatibility of the two geomembrane materials. Prior to the use of the new geomembrane material, a minimum of two seamed samples (as described above) shall be submitted to the geosynthetics laboratory for nondestructive and destructive seam testing as described in Subsections 8.3.4 and 8.3.5. The CQA officer shall review the testing results prior to authorizing the use of the new geomembrane material.

8.1.1 Manufacturing

Material Specifications

The following list specifies the required membrane materials for liner construction:

LINER	MEMBRANE MATERIALS
Base liner	60-mil HDPE (textured on slide slopes)
Final cover side slopes and cap	40-mil VFPE-textured

Quality Control Requirements

Prior to the delivery of any geomembrane rolls to the site, the geomembrane manufacturer will provide the CQA officer with the following information:

1. The resin supplier, location of supplier's production plant(s), and resin brand name and product number.
2. Any test results conducted by the geomembrane manufacturer and/or the resin manufacturer testing laboratories to document the quality of the resin used in fabricating the geomembrane.
3. The QC plan that the geomembrane manufacturer will be using for the geomembrane being supplied.

Every roll of geomembrane for delivery to the site must be manufactured and inspected by the geomembrane manufacturer according to the following requirements:

1. First quality polyethylene resin must be used.
2. The geomembrane must contain no more than a maximum of 1 percent by weight of additives, fillers, or extenders, excluding carbon black.
3. The geomembrane must have no striations, roughness (except for where the textured geomembrane is specified), or bubbles on the surface.
4. The geomembrane must be free of holes, blisters, undispersed raw materials, or any other sign of contamination by foreign matter.

The geomembrane manufacturer will routinely perform the following test program on the raw resin and will report the results on a periodic basis to the CQA officer:

1. Collect and test a minimum of one sample for the parameters in Item #2 below for every 50,000 pounds of resin received.

2. Perform carbon black content and carbon black dispersion. These test methods are listed in Table 8-2.

Manufacturer's Certification

The geomembrane manufacturer will provide certification, based on tests performed by either the geomembrane manufacturer's laboratory or other outside laboratory contracted by the geomembrane manufacturer, that the geomembrane supplied under this plan will meet the specifications of GRI-GM13 Standards, Table 1a and Table 2a. Additionally, the manufacturer shall provide certification that the manufacturer's QC plan was fully implemented for the geomembrane material supplied under this plan. The manufacturer shall provide documentation to verify results of the manufacturer's QC plan implementation if requested by the CQA officer.

8.1.2 Delivery, Handling, and Storage of Geomembrane Rolls

The geomembrane will be protected during shipment from excessive heat or cold, puncture, cutting, or other damaging or deleterious conditions. The geomembrane rolls will be stored on the site in a designated area and will be protected from long-term ultraviolet exposure prior to actual installation.

Each geomembrane roll will be marked by the geomembrane manufacturer with the following information (on a durable gummed label, or equivalent, on the inside of the core):

1. Name of manufacturer
2. Product type and identification number (if any)
3. Roll length and width
4. Batch (or lot) number
5. Nominal product thickness
6. Date of manufacture
7. Roll (or field panel) number

When cores are required for preparing geomembranes for shipment, the manufacturer shall use cores with sufficient crushing strength to avoid collapse or other damage while in use.

The following practices should be used as a minimum in receiving and storing geomembrane rolls in the designated storage area at the job site:

1. While unloading or transferring the geomembrane rolls from one location to another, prevent damage to the geomembrane itself. The preferred method involves use of a spreader-bar, straps, and a loader. Do not drag rolls.
2. Store the geomembrane rolls to ensure that they are adequately protected from the following:
    - Equipment damage
    - Strong oxidizing chemicals, acids, or bases
    - Flames including welding sparks
    - Temperatures in excess of 160°F
    - Soiling

The RPR will observe and document, throughout the pre-installation, installation, and post-installation periods that the installer provides adequate handling equipment for moving geomembrane rolls and that the equipment and the handling methods used do not pose unnecessary risk of damage. The installer is responsible for means and methods to implement the work.

The installer will be responsible for ensuring that all materials installed meet specifications (*i.e.*, that the roll marking label information indicates required specifications and properly represents materials). The RPR will maintain a log of geomembrane roll deliveries. The following information, at a minimum, will be recorded on the log for each shipment received at the job site:

1. Date of shipment from geomembrane manufacturer
2. Date of receipt of delivery at job site
3. For each geomembrane roll, the following information will be noted:
    - Roll number
    - Batch (lot) number

8.2 Installation

This subsection includes discussions of geomembrane roll testing requirements, earthwork required for geomembrane placement, placement of the geomembrane, defects and repairs of geomembranes, and requirements applicable to other materials in contact with the

geomembranes. Subsection 8.3 describes the installation and testing requirements for geomembrane seams.

All parties involved in the installation of the geomembrane should be familiar with geomembranes and should emphasize protection of the geomembrane from damage during construction activities.

8.2.1 Testing Requirements

This subsection describes the test methods, including sampling procedures and frequencies, and the role of the Geosynthetic Testing Laboratory in testing the geomembrane roll samples. Subsection 8.1.1, under QC requirements, describes the test methods that are performed on an infrequent basis to demonstrate the uniformity of resin used to fabricate geomembranes shipped to the job site. Seam testing is described in Subsections 8.3.4 and 8.3.5.

Test Methods

Geomembrane roll samples will be collected by the RPR. Sample frequency will be based on ASTM D 4354 procedure A where the number of units per lot is defined as the number of rolls for a specified lot (using batch or lot numbers) delivered to the job site in one shipment or one test per 100,000 square yards of material delivered to the site, whichever is less. Required sampling frequencies are shown in Table 8-1.

Samples will be 3 feet long by the full width of the roll and will not include the first 3 feet of any roll. Since machine direction for geomembrane rolls is the direction that the material comes off the roll, machine direction for any sample will always be along the 3-foot-length dimension of the sample.

Table 8-2 and Table 8-3 list the tests and the test methods to be performed on the HDPE and VFPE geomembrane roll samples, respectively. The specifications and methods used in evaluating the results are discussed below under procedures for determining geomembrane roll test failures. Unless specified otherwise, preparation of sample specimens will be performed in accordance with the referenced test method. Results for tear resistance and each of the tensile property tests will be reported for both the machine and cross direction.

Role of Testing Laboratory

The Geosynthetic Testing Laboratory will be responsible for performing the tests on samples submitted to them as described above under test methods. Results of tests performed will be reported to the CQA officer and the RPR.

Retesting of geomembrane rolls for QA purposes, because of failure to meet any or all of the acceptance specifications listed in Table 8-2 and Table 8-3, can only be authorized by the CQA officer.

The geomembrane manufacturer and/or installer may perform their own tests according to the methods and procedures defined in Table 8-2 and Table 8-3; however, the results will only be applicable to their own QC needs. These results will not be substituted for the QA testing described herein.

Procedures for Determining Geomembrane Roll Test Failures

Table 8-4 and Table 8-5 list the acceptance specifications for the HDPE and VFPE geomembranes, respectively. These tables apply to both textured and nontextured geomembranes. For those tests where results are reported for both machine and cross direction, each result will be compared to the listed specification to determine acceptance.

The HDPE membrane values listed in the acceptance specifications of Table 8-4 are from Table 1a and Table 2a of the GRI-GM13 standards. Currently, no industry-accepted standard specifications exist for textured geomembranes. Therefore, textured HDPE geomembranes will be required to meet the same specifications listed for nontextured geomembranes in Table 8-4.

The acceptance values for VFPE listed in Table 8-5 are based on current acceptable industry practice and manufacturer's minimum specifications for textured VFPE geomembranes.

The following procedure will be used for interpreting results:

1. If the test values meet the stated specifications in Table 8-4 and Table 8-5, then the roll and the lot will be accepted for use at the job site. If the sample represents all rolls from an entire shipment, then the entire shipment will also be considered accepted.
2. If the results do not meet the specifications, then the roll, the lot, and the entire shipment, if applicable, will be considered unsuitable for use in the liners at the site. The geomembrane manufacturer can request, however,

retesting of samples from either the original roll sample or another sample collected by the RPR and forwarded to the Geosynthetic Testing Laboratory. For retesting, *two* additional tests must be performed for the failed test procedure. If both of the retests are acceptable, then the roll and lot will be considered acceptable; if either of the two additional tests fail, then the roll and lot are unsuitable without further recourse and will be immediately marked for removal from the site.

8.2.2 Earthwork

The construction contractor will be responsible for preparing the supporting soil according to the plans and specifications and Section 5 and Section 14 of this plan. For installation of any of the geomembranes, the installer will certify in writing that the surface on which the geomembrane will be installed is acceptable. This certification of acceptance will be reported by the installer prior to the start of geomembrane installation in the area under consideration. Unacceptable areas noted by the installer will be immediately reported to the RPR.

The soil surface will also be examined by the RPR to evaluate any areas softened by precipitation or cracked due to desiccation. The daily observation will be documented in the daily report. Areas determined to be unacceptable will be reworked by the construction contractor until acceptable.

8.2.3 Placement

Location and Layout Drawing

A layout drawing for the geomembrane installation covered by this plan will be prepared by the installer prior to installation and submitted to the CQA officer, showing the location of geomembrane panels to be installed. Geomembrane panels will be identified by the RPR by the corresponding geomembrane roll number on the layout drawing as they are installed.

Installation Techniques

Geomembrane panels will be installed using one of the techniques described below. The installer will determine the method that best suits the conditions at the time of installation considering factors such as schedule and weather conditions.

1. All geomembrane panels are placed prior to field seaming, in order to protect the underlying soil from rain, *etc.* Seams may be tack-welded or

sand-bagged to prevent the geomembrane panels from shifting and to maintain proper overlap for eventual seaming.

2. Geomembrane rolls are placed one at a time, and each panel is seamed immediately after placement.
3. Any combination of the above two techniques.

If a decision is reached to place all panels prior to field seaming, care should be taken to facilitate drainage in the event of precipitation. Scheduling decisions must be made during placement in accordance with varying conditions. The RPR will evaluate changes in the schedule if proposed by the installer and will advise the CQA officer on the acceptability of the changes. The RPR will document that the condition of the supporting soil has not changed detrimentally during installation.

The RPR will record the roll number, location, and date of each geomembrane panel installed.

The installer shall take the following precautions while installing the geomembrane:

1. Equipment used does not damage the geomembrane by handling, excessive heat, leakage of hydrocarbons, or by other means.
2. Personnel working on the geomembrane do not smoke, wear damaging clothing, or engage in other activities that could damage the geomembrane.
3. Method used to unroll the geomembrane does not cause scratches or crimps in the geomembrane and does not damage the supporting soil.
4. Method used to place the rolls minimizes wrinkles (especially differential wrinkles between adjacent panels).
5. Adequate temporary loading or anchoring (continuously placed, if necessary), which will not damage the geomembrane, will be placed to prevent uplift by the wind.
6. Direct contact with the geomembrane will be minimized. The geomembrane will be protected by geotextiles, extra geomembrane, or other suitable materials, in areas where excessive traffic may be expected.

Weather Conditions

Geomembrane placement will not be performed in an area of ponded water, during precipitation events, or in the presence of excessive winds. The RPR

will document that this condition is fulfilled. The CQA officer will cause to cease or postpone the geomembrane placement when conditions are unacceptable.

Damages

The RPR will examine each panel for damage after placement and determine which panels, or panel portions, should be rejected, repaired, or accepted. Damaged panels or panel portions that have been rejected will be marked, and their removal from the site will be recorded by the RPR. Panel repairs will be made according to the procedures described in Subsection 8.2.4.

8.2.4 Defects and Repairs

This section applies to all defects and repairs resulting from examinations, tests, or visual observations performed on the geomembrane material itself and on the seams used in joining rolls in the field.

Identification

All seam and non-seam areas of the geomembranes will be examined and documented by the RPR for identification of defects, holes, blisters, undispersed raw materials, and any signs of contamination by any foreign matter. Because light reflected by the geomembrane helps to detect defects, the surface of the geomembrane will be clean at the time of examination. The smooth nonconductive geomembrane surface will be swept with a broom and/or washed by the installer if the amount of dust or mud inhibits examination. The textured conductive backed HDPE will be spark tested in accordance with technical specifications and manufacturer's recommended procedure. Spark testing will be performed in addition to destructive and nondestructive seam testing.

Evaluation

Each suspect area identified will be nondestructively tested using the vacuum box test method described in Subsection 8.3.4. Each location that fails the nondestructive tests will be marked by the RPR and repaired by the installer.

Repair Procedures

Any portion of the geomembrane exhibiting a flaw or failing a destructive or nondestructive test will be repaired. Several procedures exist for the repair of these areas. The procedures available include the following:

1. Patching—used to repair large holes, tears, undispersed raw materials, and contamination by foreign matter.
2. Grinding and rewelding—used to repair small sections of extruded seams.
3. Spot welding or seaming—used to repair small tears, pinholes, or other minor, localized flaws.
4. Capping—used to repair large lengths of failed seams.
5. Topping—used to repair areas of inadequate seams that have an exposed edge.
6. Removing the bad seam and replacing with a strip of new material welded into place—used for repairing large lengths of fusion seams.
7. Others may be used at the recommendation of the installer if agreed upon by the CQA officer and the RPR.

The repair procedures, materials, and techniques will be approved in advance of the specific repair by the CQA officer, RPR, and installer. At a minimum, the following provisions will be satisfied:

1. Patches or caps will extend at least 6 inches beyond the edge of the defect, and all corners of patches will be rounded with a radius of at least 3 inches.
2. The geomembrane below large caps should be appropriately cut to avoid water or gas collection between the two sheets.

Examination of Repairs

Each repair will be numbered and logged by the RPR. Each repair will be nondestructively tested according to Subsection 8.3.4. Repairs that pass the above testing will be considered to be adequately repaired, except that large caps may be of sufficient extent to require destructive seam sampling and testing, at the discretion of the RPR, according to the provisions of Subsection 8.3.5.

Failed tests indicate that the repair was inadequate and will be redone and retested until a passing result is obtained. The RPR will document that all

repairs have been subjected to nondestructive testing and will record the number of each repair, the date, and the test outcome.

Large Wrinkles

When seaming of the geomembrane is completed, the RPR will examine the geomembrane for wrinkles and determine which wrinkles should be cut and seamed by the installer. The wrinkle repair will be done in accordance with the equipment and procedures described in Subsections 8.3.2 and 8.3.3 (General Seaming Procedures), respectively, and it will be nondestructively tested using the vacuum box test method described in Section 8.3.4.

8.3 Field Seaming

This section covers the QA procedures on seams used to join the rolls of geomembrane into a continuous layer. The installation of each of the geomembranes at the landfill facility will include 100 percent nondestructive testing of all field seams for joining adjacent rolls of geomembranes to determine openings or gaps between geomembrane sheets. In addition, destructive testing will be performed at a routine interval for determining the strength and mode of failure of field seams in both the shear and peel modes.

The allowable field seam methods, equipment, personnel qualifications, and destructive and nondestructive testing methods are described in this section.

8.3.1 Seam Layout

The installer will provide the CQA officer and the RPR with seam layout drawings for each of the geomembrane installations covered by this plan showing each expected seam. The CQA officer will review the seam layout drawing and document that it is consistent with accepted practice and the design plans and specifications.

No horizontal seams will be allowed on slopes greater than 5- horizontal to 1- vertical. In corners and at other odd-shaped geometric intersections, the number of seams should be minimized. A seam numbering system comparable and compatible with the geomembrane roll numbering system will be agreed upon at the preconstruction meeting.

8.3.2 Seaming Equipment

The approved process for production field seaming (roll to roll) are the dual hot wedge (fusion-type) seam method and the extrusion fillet weld process. Specialty seams and repair seams (non-production) will be done by the extrusion fillet weld process. No

other processes can be used without prior written authorization from the CQA officer and the RPR. Only equipment that has been specifically approved by make and model will be used.

Dual Hot Wedge Process

The installer will meet the following requirements regarding the use, availability, and cleaning of the equipment to be used at the job site:

1. An automated self-propelled type of apparatus will be used.
2. The welding apparatus will be equipped to continuously monitor applicable temperatures.
3. One spare operable seaming device will be maintained on site at all times.
4. Equipment used for seaming should not damage the geomembrane.
5. The geomembrane should be protected in areas of heavy traffic to prevent damage as discussed in Subsection 8.2.3.
6. For cross seams, the edge of the cross seams will be ground to a smooth incline (top and bottom) prior to welding.
7. For cross seams, the intersecting dual hot wedge seam must be patched using the extrusion fillet process described below.
8. The electric generator for the equipment will be placed on a smooth base in such a way that no damage occurs to the geomembrane. Similarly, a smooth insulating plate or fabric will be placed beneath the hot equipment after usage.

The installer will keep records for each seamer performing dual hot wedge seaming, including welding machine I.D. number, ambient air temperature, geomembrane surface temperature, and machine operating pressures and temperatures. This data will be recorded at intervals as agreed to at the preconstruction meeting.

Extrusion Fillet Process

The installer will meet the following requirements regarding the use, availability, and cleaning of extrusion welding equipment to be used at the job site:

1. The welding apparatus will be equipped to continuously monitor temperature at the nozzle.
2. One spare operable seaming device will be maintained on site at all times.

3. Equipment used for seaming should not damage the geomembrane.
4. The geomembrane should be protected in areas of heavy traffic to prevent damage.
5. The extruder will be cleaned and purged prior to beginning seaming, and at any time that seaming operations are stopped, until all heat-degraded extrudate has been removed from the barrel.
6. The electric generator for the equipment will be placed on a smooth base in such a way that no damage occurs to the geomembrane. Similarly, a smooth insulating plate or fabric will be placed beneath the hot equipment after usage.
7. Grinding geomembrane surfaces for welding preparation shall not be performed more than 1 hour prior to seaming.

The installer and, if applicable, the geomembrane manufacturer will provide documentation to the CQA officer regarding the quality of the extrudate used in the welding apparatus. At a minimum, the extrudate should be compatible with the base liner material and contain the same grade and quality of polyethylene resin as used in the base material.

The installer will keep records for each seamer performing extrusion weld seaming, including welding machine I.D. number, extrudate, ambient air, and geomembrane surface temperatures. This data will be recorded at intervals as agreed to at the preconstruction meeting.

8.3.3 Initial Requirements

All personnel performing seaming operations will be qualified by experience or by successfully passing seaming tests for the type of seaming equipment to be used. At least one seamer will have experience seaming a minimum of 1,000,000 ft^2 of polyethylene geomembrane using the same type of seaming apparatus to be used at the landfill facility. The most experienced seamer, the "master seamer," will have direct supervisory responsibility at the job site over less experienced seamers.

The installer will provide a list of proposed seaming personnel and their experience records to the CQA officer and the RPR for their review and approval.

Weather Conditions

The range of weather conditions under which geomembrane seaming can be performed are as follows:

1. Unless otherwise authorized in writing by the CQA officer, no seaming will be attempted or performed at an ambient temperature below 32°F (0°C) or above 104°F (40°C).
2. Between ambient temperatures of 32°F (0°C) and 50°F (10°C), seaming will be performed only if the geomembrane is preheated by either sun or a hot air device to a temperature provided by the manufacturer, provided there is no excessive ambient cooling resulting from high winds.
3. Above 50°F (10°C), no preheating of the geomembrane is required.
4. Geomembrane will be dry and protected from the wind.
5. Seaming will not be performed during any precipitation event unless the installer erects satisfactory shelter to protect the geomembrane areas for seaming from water and/or moisture.
6. Seaming will not be performed in areas where ponded water has collected below the surface of the geomembrane.

If the installer wishes to use methods that may allow seaming at ambient temperatures below 32°F or above 104°F, the installer will demonstrate and certify that the methods and techniques used to perform the seaming produce seams that are entirely equivalent to seams produced at temperatures above 50°F and below 104°F, and that the overall quality of the geomembrane is not adversely affected.

The RPR will document the following items:

1. Ambient temperature at which seaming is performed.
2. Any precipitation events occurring at the site, including the time of such occurrences, the intensity, and the amount of the event.

The RPR will inform the CQA officer if any of the weather conditions are not being fulfilled. The CQA officer will cause to cease or postpone the geomembrane seaming when weather conditions are unacceptable.

Overlapping and Temporary Bond

The installer will be responsible for the following:

1. Panels of geomembranes have a finished overlap of a minimum of 3 inches for extrusion welding and 4 inches for fusion welding; but, in any event, sufficient overlap will be provided to allow peel tests to be performed on the seam.
2. No solvents or adhesives will be used on the geomembranes unless the product has been approved in writing by the CQA officer. Approval can only be obtained by submitting samples and data sheets to the CQA officer for testing and evaluation.
3. Procedures used to temporarily bond adjacent geomembrane rolls must not damage the geomembrane; in particular, the temperature of the hot air at the nozzle of any spot welding apparatus must be controlled such that the geomembrane is protected at all times against potential damage.

Trial Seams

Trial seams will be made on fragment pieces of geomembrane to document that seaming conditions are adequate. Such trial seams will be made at the beginning of each seaming period, and at least once every 4 hours thereafter, for each seaming apparatus used that day. Also, each seamer will make at least one trial seam each day. Trial seams will be made under the same conditions as actual seams.

The trial seams will be examined by the installer for squeeze-out, foot pressure applied by seaming equipment, and general appearance. If the seam fails any of these examinations, it will be repeated until satisfactory seams are obtained.

The trial seam samples will be at least 3 feet long by 1 foot wide after seaming, with the seam centered lengthwise. Seam overlap will be as indicated above, under overlapping and temporary bond.

Two specimens, each 1-inch wide, will be cut from opposite ends of the trial seam sample by the installer. The specimens will be tested respectively in shear and peel using a field tensiometer provided by the installer, and they should not fail in the seam. If a specimen fails, the entire test will be repeated using two additional specimens cut from the trial seam sample or a new trial seam sample shall be made (with or without adjustments in the seaming process) and specimens cut for testing. If the second set of specimens also fails, the seaming apparatus and seamer will not be accepted and will not be used for seaming

until the deficiencies are corrected and two consecutive successful trial seams are achieved.

The remainder of the trial seam sample will be identified and marked by the RPR as follows:

1. An assigned sample number, welding apparatus used, and seamer name
2. The date, time, applicable welding equipment operating temperatures, and ambient temperature at the time of seaming
3. Whether the sample passes or fails

The RPR may randomly select trial field samples for destructive testing by the Geosynthetic Testing Laboratory according to the test procedures described in Subsection 8.3.5 under field test methods. The frequency for trial seam laboratory testing will be at the discretion of the RPR.

If a trial seam sample fails a destructive test performed by the Geosynthetic Testing Laboratory according to the acceptance criteria stated in Subsection 8.3.5, then a destructive test seam sample(s) will be taken from each of the seams completed by the seamer during the shift related to the failed trial seam test. These samples will be forwarded by the RPR to the Geosynthetic Testing Laboratory and, if any of them fails the tests, the procedures described in Subsection 8.3.5 will apply. The conditions of this paragraph will be considered met if a destructive seam test sample, collected and tested according to the provisions under location and sampling frequency and sampling procedure of Subsection 8.3.5, has already been taken and passed.

Seam Preparation

The installer will meet the following conditions for each of the geomembrane installations covered by this plan:

1. Prior to seaming, the seam area is clean and free of moisture, dust, dirt, debris of any kind, and foreign material.
2. If seam overlap grinding is required, the grinding process will be completed according to the geomembrane manufacturer's instructions within 1 hour of the seaming operation, and in a way that will not damage the geomembrane or cause excessive striation of the geomembrane surface.
3. Seams will be aligned so as to minimize the number of wrinkles and "fishmouths."

General Seaming Procedures

Unless otherwise specified, the general seaming procedures to be used by the installer for each of the geomembrane installations covered by this plan, and observed by the RPR, will be as follows:

1. A firm substrate will be provided to achieve proper support for seaming.
2. Fishmouths or wrinkles at the seam overlaps will be cut along the ridge of the wrinkle in order to achieve a flat overlap. The cut fishmouths or wrinkles will be seamed, and any portion where the overlap is inadequate will then be patched with an oval or patch of the same geomembrane (including thickness) extending a minimum of 6 inches beyond the cut in all directions.
3. If seaming operations are to be conducted at night, adequate illumination will be provided.

8.3.4 Nondestructive Testing

Each field seam will be nondestructively tested over its full length using one of the methods described in this section. The purpose of nondestructive testing is to determine the continuity of the seams. Nondestructive testing, at this stage of development, does not provide any information on the strength of seams. Seam strengths will be determined by destructive testing methods that are described in Subsection 8.3.5. Failure of any of the nondestructive or destructive tests will require the repair of the failed section according to the procedures contained in Subsection 8.3.5.

Nondestructive testing as described in this section will be performed on seams for every geomembrane installation covered by this plan. The recommended test methods for conducting the nondestructive seam testing are the air pressure test for dual hot wedge seams and the vacuum box test for extrusion fillet welds. These two nondestructive testing methods are described below.

The RPR will perform the following:

1. Observe all nondestructive seam testing, and examine all seams for squeeze-out, foot pressure, and general appearance. Failure of these criteria based on the RPR's judgment will be considered as failure of the seam, and repair or reconstruction will be required.
2. Document location, date, test unit number, name of tester, and outcome of all testing.
3. Inform the installer and CQA officer of any required repairs.

4. Document that appropriate repairs are made and that the repairs are retested nondestructively with passing results.

Air Pressure Testing

The following test procedures are applicable only to dual hot wedge seams. The equipment for performing the test should meet the following minimum requirements:

1. An air compressor or hand pump equipped with a pressure gauge and regulator capable of producing and sustaining a pressure between 25 to 30 psig and mounted on a cushion to protect the geomembrane surface.
2. Fittings, rubber hose, valves, *etc.*, to operate the equipment, and a sharp hollow needle or other approved pressure feed device.

Air pressure testing will be performed according to the following procedure:

1. Seal both ends of the seam to be tested.
2. Insert needle or other approved pressure feed device into the air space at one end of the dual hot wedge seam.
3. Energize the air compressor or hand pump to a pressure of 25 to 30 psig. Close the valve and observe the pressure response in the seam air space for approximately 7 minutes. The pressure should stabilize within the first 2 minutes and then remain essentially constant.
4. Record the pressure in the seam at the end of 2 minutes and again at the end of 7 minutes.
5. If the subsequent pressure loss exceeds 2 psig over the last 5-minute period or if the pressure does not stabilize, then the seam fails, and the defect must be located, repaired, and retested nondestructively.
6. If pressure loss does not exceed 2 psig over the last 5-minute period, then the seam is considered to have passed the nondestructive test provided the installer has verified that the air channel tested was not obstructed by noting a release of air pressure at the end of the tested seam interval opposite the pressure gauge.

Vacuum Box Test

Vacuum box testing is to be used on those seams made by the extrusion fillet process, to locate precisely the defects identified from air pressure testing, or to evaluate suspect seam and non-seam areas as discussed in Subsection 8.2.4.

Vacuum box testing equipment must meet the following minimum standards:

1. A five-sided vacuum box with an open bottom, a clear viewing panel on top, and a pliable gasket attached to the bottom.
2. A steel vacuum tank and pump assembly equipped with a pressure controller and pipe connections capable of achieving a vacuum of 10 psig.
3. A vacuum gauge on the tank with an operating range of 0 to 10 psig, and a vacuum gauge on the vacuum box with an operating range from 0 to 10 psig.

The following procedures will be used in performing the vacuum box test:

1. Ensure seams to be tested are clean and relatively free from soil or foreign objects that might prohibit a good seal from being formed between the vacuum chamber and the geomembrane.
2. Energize the vacuum pump and create a vacuum in the tank of 5 to 10 psig.
3. Wet a strip of geomembrane approximately twice the size of the vacuum box with the soapy solution.
4. Place and center the vacuum box with the gasket in contact with the geomembrane surface over the wetted area of the seam.
5. Applying a normal force to the top of the vacuum box, close the bleed valve, and open the vacuum valve. Check to make certain that a tight seal is created between the geomembrane and the vacuum box. A minimum vacuum of 5 psig should be used for testing with the maximum allowable testing pressure never exceeding 10 psig of vacuum.
6. With the vacuum drawn, use the viewing panel to examine the geomembrane seam for bubbles resulting from the flow of air through the seam. Continue this examination for not less than 10 seconds.
7. Remove the vacuum box by first closing the vacuum valve and opening the bleed valve. Proceed to step 8 if bubbles appear in Step 6. If no bubbles appear in step 6, then proceed directly to Step 9.
8. If bubbles appear through the geomembrane, mark the defective area for repair according to the provisions of Subsection 8.2.4. All repairs must be tested with passing nondestructive results.
9. Move the vacuum box along the seam to be tested, overlapping the previously tested area by no less than 3 inches.

8.3.5 Destructive Seam Testing

Destructive seam testing will be performed on the geomembrane seams covered by this plan. Destructive seam testing is performed to determine the strength of the seam in both shear and peel failure modes. Destructive seam testing will be performed within 48 hours of sampling either in an on-site laboratory by personnel under the direction of the CQA officer or at the Geosynthetic Testing Laboratory.

Location and Sampling Frequency

The RPR will select locations where seam samples will be cut out for the destructive testing. Test locations will be determined during seaming at the RPR's discretion. Selection of such locations may be prompted by suspicion of excess crystallinity, contamination, offset welds, or any other potential causes of an imperfect seam. The installer will not be informed in advance of any location where seam samples will be taken.

The minimum frequency of sample collection will be one test location per every 500 linear feet of seam length. This minimum frequency is to be taken as an average for the entire installation area.

Sampling Procedure

Samples will be cut under the direction of the RPR as the seaming progresses. For each sample location, information will be documented as follows:

1. Assign a sample number and mark accordingly.
2. Record sample location on the layout drawing.
3. By sample number, record the reason for collecting the sample (*e.g.*, as part of statistical testing program, suspicious seam, *etc.*).
4. Note on the sample, for the peel test, which geomembrane is the top and which is the bottom with respect to seams performed using dual hot wedge (fusion) weld techniques.
5. Record pertinent information including date, time, seaming unit number, and name of seamer.

Specimens for qualitative field testing will be taken prior to removal of the laboratory sample. Samples for field tensiometer testing will be 1 inch wide by 16 inches long with the seam centered parallel to the width. The distance between the two samples should be 42 inches measured from inside edge to inside edge. If both samples pass the field tensiometer test described below

under field test methods, then the sample for laboratory testing will be taken according to the procedure described below.

The sample for laboratory testing will be located between the two samples used for field testing. Therefore, the laboratory sample will be 12 inches wide by 42 inches long with the seam centered lengthwise. The sample will be cut by the RPR into three parts and distributed as follows:

1. A 12-inch-by-16-inch sample will be given to the installer for testing if so desired.
2. A 12-inch-by-16-inch sample will be given to the owner for record storage.
3. An 8-inch-by-16-inch sample will be transmitted to the Geosynthetic Testing Laboratory or on-site testing laboratory by the RPR.

The RPR will make periodic reports to the installer detailing the locations of samples taken that must be repaired.

All holes cut into the geomembrane resulting from destructive seam sampling will be immediately repaired by the installer in accordance with the repair procedures described in Subsection 8.2.4. The repaired area will be nondestructively tested in accordance with the requirements of Subsection 8.3.4.

Field Test Methods

The two 1-inch-wide samples described above under sampling procedure will be field tested for both peel and shear. Testing will be performed using a field tensiometer or equivalent device to qualitatively determine the mode of failure. The seam will be considered as passing if the failure in both peel and shear does not occur with the seam. If the samples fail the field tensiometer test, then the repair procedures of Subsection 8.2.4 for the holes left by the cut-out samples, and seam reconstruction procedures for the repair of the defective seam, discussed later in this subsection, must be implemented.

Laboratory Test Methods

Laboratory testing of the destructive seam samples will be performed by the Geosynthetic Testing Laboratory or on-site testing laboratory under the direction of the CQA officer. All destructive seam tests, whether performed on trial seam samples (as described above) or on samples cut out from production seams, will be performed in general accordance with the methodology of

ASTM D 4437, which stipulates that at least five specimens should be tested in shear and five in peel. Samples will be cut in alternating order (*e.g.*, shear and peel, peel and shear) and should be tested in the order of cutting, to determine if any trend in seam quality along the length of the sample exists. All specimens will be cut as 1-inch-wide strips to ensure that the seam does not exceed the test gauge length of the specimen.

The following tests will be performed on each seam sample submitted for laboratory testing:

1. *Shear and peel maximum tension* is the maximum load per unit width of a 1-inch-wide specimen expressed in pounds per inch of width in both the shear and peel mode, according to ASTM D 4437.
2. *Shear elongation at break* is the extension at break expressed as a percentage of the initial distance between the edge of the fused track and the nearer grip. This distance should be the same on both sides of the seam and is usually 1 inch. No referenced ASTM test exists for this procedure as defined. The value that failure occurred will be noted on the results.
3. *Peel seam separation* estimates the area of seam interface separation expressed as a percentage of the original area.

Also, for both the seam shear and peel tension tests, an indication will be given for each specimen tested that defines the locus of the failure. The loci will be defined per ASTM 4437.

For the seam shear tests, specimens should be inserted in the test machine with minimum gauge lengths of ½ inch between each edge of the seam and the adjacent grip. The crosshead speed will be 2 inches per minute for HDPE and 20 inches per minute for VFPE. Parameters monitored during the test will be load and crosshead displacement.

For the peel tests, specimens will be inserted in the tensile machine so the grips are no closer than 1 inch to the edge of the seam. The grips may be closer than 1 inch only if there is insufficient material to allow insertion at this setting. Seam peel specimens will be tested at 2 inches per minute crosshead speed for HDPE and 20 inches per minute for VFPE.

For shear tests, the following values will be reported for each specimen tested:

1. Maximum tension in pounds per inch
2. Elongation at break indicating at what percentage the specimen failed

3. The locus of failure using the above designations

For peel tests, the following values will be reported for each specimen tested:

1. Maximum tension in pounds per inch
2. Seam separation expressed as percent of original seam area
3. Locus of failure

For each set of five specimens, the mean and standard deviation will be calculated and reported for shear maximum tension and peel maximum tension.

Role of Testing Laboratory

The Geosynthetic Testing Laboratory or on-site testing laboratory will be responsible for performing the tests on samples submitted to them as described above. Results of tests performed will be reported to the CQA officer and the RPR. Retesting of seams, because of failure to meet any or all of the specifications listed below, can only be authorized by the CQA officer.

The geomembrane manufacturer and/or installer may perform their own QC testing in accordance with the methods and procedures defined above under laboratory test methods; however, the results, if substantially different from those obtained by the Geosynthetic Testing Laboratory or on-site laboratory, may only be used to request a retesting by the Geosynthetic Testing Laboratory or on-site testing laboratory. All QA test results from the Geosynthetic Testing Laboratory or on-site laboratory govern, over any test results from the geomembrane manufacturer of installer. Only the CQA officer is authorized to approve a retesting request.

Procedures for Determining Destructive Seam Test Failures

The procedures described in this section apply to the destructive testing procedures defined above under field test methods and laboratory test methods. Specifications for destructive seam testing are shown in Table 8-7 and Table 8-8. Procedures for repairing failed seams are given in Subsection 8.2.4 of this plan.

Results from the shear and peel tests for the HDPE geomembrane will be evaluated by criteria, which are based on the values for material properties for yield stress (Note: yield stress of the base geomembrane is considered a more

representative criterion than bonded seam strength) from Table 1a and Table 2a of GRI-GM13 standards.

Results from the shear and peel tests for the VFPE will be evaluated by the following criteria:

1. Minimum acceptable individual specimen shear elongation values will be no less than 50 percent.
2. Maximum allowable individual specimen peel separation value will be 10 percent.
3. Failure type in peel must be film-tear bond (FTB) for 4 out of 5 test specimens.

The installer has the following two options in determining the repair boundary whenever a seam has failed: either the field tensiometer testing or laboratory destructive testing:

1. The seam can be reconstructed between any two previously tested and passed destructive seam test locations.
2. The installer can trace the welding path to an intermediate location (at a 10-foot minimum from the point of the failed test in each direction) and request that field tensiometer tests be performed at these intermediate locations. If the field tensiometer sample results are acceptable, then full laboratory samples are taken and tested. If the laboratory tests are acceptable, then the seam is reconstructed between these intermediate locations. If either sample fails, then the process is repeated until acceptable destructive seam tests have been performed in both directions away from the original failed sample location. All retesting of seams, according to this procedure, will use the sampling methodology described above under Sampling Procedure.

For all seams reconstructed due to a failing destructive seam sample, an additional sample taken from the reconstructed zone must pass destructive seam testing.

The RPR will be responsible for documenting all actions, including test results submitted by the Geosynthetic Testing Laboratory, taken in conjunction with seam testing. The RPR will also be responsible for keeping the CQA officer informed on seam testing results and seaming progress.

8.4 Post-Construction

Each geomembrane covered by this plan will be examined by the RPR. Any defects, whether due to failed seams, pinholes, or other penetrations, will be repaired. In addition, a stress crack examination will be performed along the seams of all the geomembrane installations covered by the plan.

This examination, by experienced personnel, will utilize the procedures described in the USEPA Field Inspector's Manual titled *Stress Cracking of Flexible Membrane Liner Seams*. This document identifies three levels of stress crack development with Level #1 being those that can be observed only under a microscope, Level #2 being those that are barely visible to the eye, and Level #3 being those that are complete fractures.

The geomembranes covered by this plan will be examined for Level #2 and Level #3 stress cracks according to the procedure described in the Field Inspector's Manual under the heading "Field Inspection Recommendations." This examination will be performed by experienced personnel only. Any Level #2 or Level #3 stress cracks found will be immediately marked by the RPR and will be repaired according to the provisions of Subsection 8.2.4.

Placement of the Geocushion™ drainage layer material shall proceed as soon as practical following the RPR's testing and acceptance of completed geomembrane areas. The granular layer will provide ultraviolet protection, thermal insulation, and protection from physical damage.

Table 8-1
Number of Units to be Selected as Lot Sample—Specification Conformance

NUMBER OF UNITS IN LOT	NUMBER OF UNITS SELECTED
1 to 2	1
3 to 8	2
9 to 27	3
28 to 64	4
65 to 125	5
126 to 216	6
217 to 343	7
344 to 512	8
513 to 729	9
730 to 1,000	10
1,001 or more	11

Table 8-2
High-Density Polyethylene Geomembrane Tests And Test Methods

PROPERTY	TEST METHOD
Carbon Black Content	ASTM D 4218
Carbon Black Dispersion	ASTM D 5596
Density	ASTM D 792 or D1505
Tear Resistance [1]	ASTM D 1004
Puncture Resistance	ASTM D 4833
Tensile Properties[1] Yield Stress Yield Elongation Break Stress Break Elongation	ASTM D 638, Type IV specimen at 2 inches/minute
Single-Point Notched Constant Tensile Load (SP-NCTL)	ASTM D 5397
Thickness	ASTM D 5199 (smooth) ASTM D 5994 (textured)

[1] These tests will be performed and results reported for both machine and cross direction.

Table 8-3
Very Flexible Polyethylene Geomembrane Tests and Test Methods

PROPERTY	TEST METHOD
Carbon Black Content	ASTM D 4218
Carbon Black Dispersion	ASTM D 5596
Density	ASTM D 792, Method A; or ASTM D 1505
Tear Resistance [1]	ASTM D 1004
Puncture Resistance	ASTM D 4833
Tensile Properties [1] Yield Stress Yield Elongation Break Stress Break Elongation	ASTM D 638, Type IV specimen at 2 inches/minute
Single-Point Notched Constant Tensile Load (SP-NCTL)	ASTM D 5397
Thickness	ASTM D 5199 (smooth) ASTM D 5994 (textured)

[1] These tests will be performed and results reported for both machine and cross direction.

Table 8-4
High-Density Polyethylene Geomembrane 60-Mil Acceptance Specifications

PROPERTY	UNITS	TYPE OF CRITERION	ACCEPTABLE VALUE [1]
Carbon Black Content	% by weight	Range	2 – 3
Carbon Black Dispersion	N/A	Range	Category 1, 2, or 3 [2]
Density	g/cc	Minimum	0.940
Tear Resistance [3]	lb	Minimum	42
Puncture Resistance	lb	Minimum	90
Tensile Properties [4]			
Yield Stress	ppi	Minimum	126
Yield Elongation	%	Minimum	12
Break Stress	ppi	Minimum	228 (90) [4]
Break Elongation	%	Minimum	700 (100)
SP-NCTL	hours	Minimum	200
Thickness [5] (lowest individual)	mils	Minimum	54 (51) [6]
Thickness (minimum average)	mils	Average	60

(1) Values are from Table 1a and Table 2a of GRI-GM13 standards
(2) Eight of 10 views Category 1 or 2, and 10 of 10 views Category 1, 2, or 3.
(3) Test is performed in both machine and cross direction.
(4) Parenthetical values are for textured geomembranes.
(5) For smooth geomembrane, lowest individual value of 10 values; for textured geomembrane, lowest individual value for 8 of 10 values.
(6) For textured geomembrane, lowest individual value of any 10 values.

Table 8-5
Very Flexible Polyethylene Geomembrane 40-Mil Acceptance Specifications

PROPERTY	UNITS	TYPE OF CRITERION	ACCEPTABLE VALUE [1]
Carbon Black Content	% by weight	Range	2 - 3
Carbon Black Dispersion	N/A	Range	Category 1, 2, or 3 [2]
Density	g/cc	Minimum	0.910 – 0.935
Tear Resistance [3]	lb	Minimum	22
Puncture Resistance	lb	Minimum	52
Tensile Properties [3] Break Stress Break Elongation	 ppi %	 Minimum Minimum	 152 (72) [4] 625 (200) [4]
SP-NCTL	hours	Minimum	1,500
Thickness [5] (lowest individual)	mils	Minimum	36 (34) [6]
Thickness (minimum average)	mils	Average	40

(1) Values based on representative manufacturer's product data.
(2) Eight of 10 views Category 1 or 2, and 10 of 10 views Category 1, 2, or 3
(3) Test performed in both machine and cross direction.
(4) Parenthetical values are for textured geomembrane.
(5) For smooth geomembrane, lowest individual value of 10 values; for textured geomembrane, lowest individual value for 8 of 10 values.
(6) For textured geomembrane, lowest individual value for any of the 10 values.

Table 8-6
60-Mil Smooth or Textured High-Density Polyethylene Geomembrane Seam Acceptable Specifications

PROPERTY	TEST METHOD	UNITS	TYPE OF CRITERION	MINIMUM AVERAGE VALUE [1]	
				NONTEXTURED	TEXTURED
Shear Strength [2]	ASTM D 4437	ppi	Minimum	126	113
Shear Elongation	--	percent	Minimum	50	50
Peel Strength [2] Fusion	ASTM D 4437	ppi	Minimum	90	82
Peel Strength [2] Extrusion	ASTM D 4437	ppi	Minimum	78	70
Peel Separation [3]	--	percent	Maximum	10	10

(1) The average of all five specimen test results must meet these requirements. In addition, five out of the five test results must meet these requirements.
(2) Failure type in peel must be film-tear bond (FTB) for four out of five test specimens.
(3) Maximum acceptable value.

Table 8-7
40-Mil Very Flexible Polyethylene Smooth or Textured Geomembrane Seam Acceptable Specifications

PROPERTY	TEST METHOD	UNITS	MINIMUM AVERAGE VALUE [1]	
			NONTEXTURED	TEXTURED
Shear Strength [2]	ASTM D 4437	ppi	44	40
Shear Elongation [2]	—	percent	50	50
Peel Strength [3, 4] Fusion	ASTM D 4437	ppi	40	36
Peel Strength [3,4] Extrusion	ASTM D 4437	ppi	36	36
Peel Separation [5]	—	percent	10	10

(1) If the lengthwise edges of the textured geomembrane panels are nontextured, then the nontextured specifications shall apply for the testing of seams made along these edges.
(2) Five out of the five test specimens must meet these requirements. In addition, failure type must be FTB for all five specimens.
(3) Four out of the five specimens must meet the three requirements. The fifth specimen shall achieve 90 percent of the listed peel strength.
(4) Failure type must be FTB for four out of five test specimens.
(5) Maximum Acceptance Value for four out of five test specimens. The fifth specimen shall have no more than 50 percent peel separation.

Section 9
Geonets

Geonets will be part of a geocomposite consisting of a non-woven geotextile heat bonded to the geonet. The geonets used in the geocomposites will meet the applicable requirements of this section. Geocomposites are discussed in Section 11.

As geonets will not be used independently (*i.e.*, only used as a component of the geocomposite), portions of this section are not applicable. Section 9 (Geonets) is included to provide a reference source for geonet material specifications and testing requirements as called for in Section 11.

This section is divided into three major subheadings that cover the QA requirements for pre-installation (includes geonet manufacturers), installation, and post-installation (includes the final examination of the geonets prior to placing the appropriate material above the geonet). The terms pre-installation, installation, and post-installation are applicable only to the geonet installation and do not apply to the overall construction of the landfill facility.

9.1 Pre-installation

9.1.1 Manufacturing

Material Specifications

The geonets used must be fabricated from polyethylene resin, and the fabricated geonet must be classified as Type III, Class C, Category 4 or 5 as defined by ASTM D 1248 (Note: this classification is based on tests performed on the finished product, ***not*** the polyethylene resin used to fabricate the geonet).

Quality Control Requirements

Prior to the delivery of any geonet rolls to the site, the geonet manufacturer will provide the CQA officer with the following information:

1. The resin supplier, location of supplier's production plant(s), and resin brand name and product number.
2. Test results obtained by the geonet manufacturer and/or the resin manufacturer's testing laboratories to document the quality of the resin used in fabricating the geonet.

3. The QC plan that the geonet manufacturer will be using for the geonet being supplied.

Every roll of geonet for delivery to the site must be manufactured and inspected by the geonet manufacturer, according to the following requirements:

1. First-quality polyethylene resin must be used.
2. The geonet must contain no more than a maximum of 1 percent by weight of additives, fillers, or extenders, excluding carbon black.
3. The geonet must have no striations, roughness, or cuts on the surface.
4. The geonet must be free of blisters, undispersed raw materials, or any other sign of contamination by foreign matter.

The geonet manufacturer will routinely perform the following tests on the raw resin, at the stated frequencies, and will report the results on a periodic basis to the CQA officer:

1. Collect and test a minimum of one sample for the parameters in Item #2 below for every 50,000 pounds of resin received.
2. Perform carbon black content by ASTM D 4218, carbon black dispersion by ASTM D 2663 Method B, specific gravity by ASTM D 792 Method A, melt flow index by ASTM D 1238 with a load of 2.16 kg and at 190°C, and moisture content by any approved method.

Manufacturer's Certification

The geonet manufacturer will provide certification, based on tests performed in accordance with the methods listed in Table 9-1 that the geonet supplied under this plan will meet the material specifications listed in Table 9-1. These tests may be performed at a minimum frequency of 1 per 100,000 square yards of material delivered to the site by the geonet manufacturer's laboratory or by a laboratory contracted by the manufacturer. Additionally, the manufacturer shall provide certification that the manufacturer's QC plan was fully implemented for the geonet materials supplied under this plan. The manufacturer shall provide documentation to verify the results of the manufacturer's CQA plan implementation if requested by the CQA officer.

9.1.2 Delivery, Handling, and Storage of Geonet Rolls

Each geonet roll for use at the landfill facility will be marked by the geonet manufacturer with the following information and in the following manner:

1. When the net is rolled on a core, identify each roll with a durable gummed label, or an equivalent, on the inside of the core and on the outside of the protective wrapping for the roll.
2. Each roll label will contain the following information at a minimum:
    - Name of manufacturer (or supplier)
    - Style and type number
    - Roll length and width
    - Batch (or lot) number
    - Nominal product thickness
    - Date of manufacture
    - Direction for unrolling
    - Roll number
3. On the outside of the roll, all lettering should be a minimum ½ inch high; and on the inside of the core, the lettering should be at least ¼ inch high.

The geonet manufacturer will use the following guidelines in packaging and preparing all geonet rolls for shipment:

1. When cores are required, use those that have a crushing strength sufficient to avoid collapse or other damage while in use.
2. Geonets must be rolled on the cores so that they will unroll in the machine direction. The machine direction is defined as the direction parallel with the longest diagonal in the diamond pattern of the geonet.

The following practices should be used as a minimum in receiving and storing geonet rolls in the designated storage area at the job site:

1. While unloading or transferring the geonet rolls from one location to another, prevent damage to the geonet. If practicable, the installer may use forklift trucks fitted with poles that can be inserted into the cores of rolls. Be sure that the poles are at least ⅔ the length of the rolls to avoid breaking the cores and possibly damaging the geonet. Do not drag the rolls.

2. Store the geonet rolls to ensure that they are adequately covered to protect the geonet from the following:
    - Precipitation
    - Ultraviolet radiation, including sunlight
    - Strong oxidizing chemicals, acids or bases
    - Flames, including welding sparks
    - Temperatures in excess of 160°F
    - Soiling

The RPR will observe and document throughout the pre-installation, installation, and post-installation periods that the installer provides adequate handling equipment used for moving geonet rolls and that the equipment and handling methods used do not pose unnecessary risk of damage. The installer is responsible for means and methods to implement the work.

The installer will be responsible for ensuring that materials installed meet specifications (*i.e.*, the roll marking label information indicates required specifications and properly represents materials). The RPR will maintain a log of geonet roll deliveries. The following information, at a minimum, will be recorded on the log for each shipment received at the job site:

1. Date of shipment from geonet manufacturer
2. Date of receipt of delivery at job site
3. For each geonet roll the following information will be noted:
    - Roll number
    - Batch (lot) number

9.2 Installation

This section describes the QA requirements applicable to the installation of geonets. This section includes installation, observations, and documentation of geonets.

9.2.1 Placement

The installer will install all geonets in such a manner as to ensure that they are not damaged in any way and in a manner that complies with the following:

1. On sideslopes, the geonets will be securely anchored, then rolled down the slope in such a manner as to continually keep the geonet in tension. If necessary, the geonet will be positioned by hand after being unrolled to minimize wrinkles.
2. In the presence of winds, all geonets will be secured by suitable methods. The temporary weighted material will be left in place until replaced with cover material as shown on the design plans and specifications.
3. Cutting should be done according to manufacturer's recommendations.
4. The installer will take necessary precautions to prevent damage to underlying layers during placement of the geonet.
5. During placement of geonets, care will be taken not to entrap in the geonet any stones, excessive dust, or moisture that could cause clogging of the drainage system, and/or stones that could damage the adjacent geomembrane. If dirt or excessive dust is entrapped in the geonet, the geonet will be cleaned prior to placement of the next material on top of the geonet.
6. Unless otherwise approved by the CQA officer, geonets will not be welded or tack welded to the underlying geomembranes.

9.2.2 Stacking and Joining

When several layers of geonets are stacked, care should be taken to prevent strands from one layer from penetrating the channels of the adjacent layer, thereby significantly reducing the transmissivity. This cannot happen if stacked geonets are placed in the same direction. A stacked geonet should not be laid in a perpendicular direction to the underlying layer.

The following guidelines should be used in stacking and joining geonets:

1. Adjacent rolls will be overlapped by a minimum of four inches.
2. These overlaps will be secured by spot-welding to each other or tying.
3. Tying can be achieved by strings, plastic fasteners, or polymer braid. Tying devices will be white or brightly colored for easy identification. Metallic devices will not be used in any circumstances.

9.2.3 Repairs

Any tears or other defects in the geonet will be repaired by placing a patch extending a minimum of 2 feet beyond the edges of the hole or tear. The patch will be secured to the original geonet by spot-welding or tying every 6 inches. If the tear or other defect width is more than 50 percent of the roll width, the damaged area will be cut out and replaced with new geonet. Tying devices as indicated in Subsection 9.2.2 will be used. The RPR will examine and document that the repair of any geonets is performed according to the above procedure.

9.3 Post-Installation

9.3.1 Final Examination

The RPR will perform a final geonet examination after installation of each geonet layer has been completed. The objectives of this step are as follows:

1. Examine for presence of tears or defects.
2. Examine overlaps and tying or spot-welding.

If any portion of the geonet requires repairs due to the above examination, they will be performed according to the procedures in Subsection 9.2.3. The RPR will document the result of the final examination, including any subsequent repairs.

Table 9-1
Geonet Properties

PROPERTY	UNITS	FINAL COVER VALUE	LEACHATE COLLECTION LAYER VALUE	TEST METHOD	CRITERION
Thickness	mils	225	300	ASTM D 5199	Minimum
Density	g/cu cm	0.94	0.94	ASTM D 1505	Minimum
Melt Flow Index	g/10 min	1.0	1.0	ASTM D 1238	Maximum
Carbon Black Content	Percent	2 - 3	2 - 3	ASTM D 4218	Range

Section 10
Geosynthetic Clay Liner

10.1 Introduction

This section of the CQA plan applies to the geosynthetic clay liner used in the landfill base composite liner and in the composite final cover. This section is divided into three major subheadings, which cover the quality assurance requirements for pre-installation (includes the GCL manufacturer), installation, and post-installation (includes the final examination of GCL prior to the placement of the geomembrane). The terms pre-installation, installation, and post-installation are applicable only to the GCL installation and do not apply to the overall construction of the landfill facility.

10.2 Pre-installation

Pre-installation activities are designed to help ensure that a high-quality product is being manufactured and that it is properly delivered, handled, and stored to maintain its quality.

10.2.1 Manufacturer's Quality Control Plan

The manufacturer of each component of the GCL and the GCL itself will have a manufacturer's quality control plan (MQCP) to ensure that their product meets all of the stated minimum properties. These manufacturers include the bentonite supplier, the geotextile manufacturer, and the GCL manufacturer.

Bentonite Supplier

The bentonite supplier will have a MQCP that will be adhered to in the manufacturing process. This plan will include the following information:

1. Documentation that the bentonite is sodium bentonite
2. Testing that demonstrates that the bentonite meets specified gradation requirements
3. Testing that demonstrates that the bentonite meets specified index test requirements
4. Testing that demonstrates that the bentonite has not been treated with synthetic chemicals or polymers

Geotextile Manufacturer

The geotextile manufacturer will have a MQCP that will be adhered to in their manufacturing process. This plan will include the following provisions:

1. Testing that demonstrates that the product is made of specified polymers
2. Testing that demonstrates that the product meets certain minimum average roll values for geotextiles

GCL Manufacturer

The GCL manufacturer will have a MQCP that describes the procedures for accomplishing quality in the final product. At a minimum, the tests shown in Table 10-1 shall be performed by the manufacturer.

This MQCP will also dictate the following requirements:

- Overlap alignment lines are to be marked on the edges.
- Completed rolls are to be securely wrapped in plastic.
- Completed rolls are to be stored indoors, and provisions are to be in place to prevent rolls from being stacked too high, to ensure that they are kept dry, and to prevent damage during handling.
- QC certificates are to be provided.

10.2.2 Materials

The GCL will consist of a layer of pure sodium bentonite clay encapsulated between two geotextiles, and will comply with all of the manufacturing processes and physical/chemical criteria listed in this subsection.

The bentonite clay utilized in the manufacture of the GCL, as well as any accessory bentonite clay (*i.e.*, Volclay® granular sodium bentonite or approved equivalent) provided for seaming and detail work, will meet the manufacturer's minimum requirements, as specified in the MQCP.

The geotextile components of the GCL, and the GCL itself, will meet the minimum requirements of the respective MQCPs.

10.2.3 Geosynthetic Clay Liner Delivery, Handling, and Storage

The GCL panels will be supplied to the site in factory-produced rolls, which are of standard factory roll dimensions.

Each roll of GCL supplied to the site will be labeled with the following information:

1. Name of manufacturer
2. Product type and identification number (if any)
3. Lot (Batch) number
4. Date of manufacture
5. Roll number and dimensions

The GCL manufacturer will ensure that the crushing strength of all GCL roll cores will be sufficient to avoid collapse or other damage while in use.

The rolls of GCL will be carefully unloaded by the contractor upon arrival at the site. At a minimum, the following practices will be followed in receiving and storing GCL rolls in the covered storage area at the job site:

1. While unloading or transferring the GCL rolls from one location to another, precautions will be taken to prevent damage to the GCL.
2. For standard rolls, a 3-inch Schedule 120 steel support pipe will be inserted through the cardboard roll core. The slings or lifting chains will be attached at one end to the support pipe and at the other end to the bucket of a front-end loader or lifting device. A spreader bar will be used to support and spread the slings. The bar and support pipe must be long enough to prevent damage to the edges of the GCL during hoisting.
3. Alternatively, forklift trucks can be modified to lift the rolls with a 3-inch Schedule 120 steel bar, securely attached to the forklift and inserted into the roll core. At no time will the rolls be lifted by sliding the forks under the roll.
4. The rolls of GCL will be stored in their original, unopened, wrapped cover in a clean, dry area. The material will be stored off the ground on pallets or by other suitable techniques that provide continuous support over the entire length of the roll. It will be covered with a heavy, protective tarpaulin or stored beneath a roof. Care will be used to protect the GCL from the following:
    - Precipitation
    - Ultraviolet radiation, including sunlight
    - Strong oxidizing chemicals, acids or bases
    - Flames, including welding sparks
    - Temperatures in excess of 160°F

The RPR will be responsible throughout the pre-installation, installation, and post-installation periods, for observing and documenting that the installer provides adequate handling equipment used for moving GCL rolls and that the equipment and handling methods used do not pose any risk of damage.

The RPR will be responsible for making certain that the name of the manufacturer, the type, and the thickness of each roll (as noted on the roll marking label described above) are correct. The RPR will also maintain a log of GCL roll deliveries. The following information, at a minimum, will be recorded on the log for each shipment received at the job site:

1. Date of receipt of delivery at job site
2. For each GCL roll, the following information will be noted:
    - Roll number
    - Batch (lot) number

10.2.4 Submittals

Submittals will be made prior to installation of the GCL concerning the GCL manufacturer/production information and the GCL installer information.

The GCL manufacturer/production information will include the following:

1. Corporate background and information.
2. MQCP for bentonite, geotextile, and GCL manufacturers.
3. Project reference list consisting of the principal details of at least 10 projects totaling at least 8 million ft^2 of GCL installation.
4. Results of tests conducted by the bentonite supplier and geotextile suppliers to document the quality of the materials used to manufacture the GCL rolls assigned to the project.
5. Copy of QC certificates, signed by a responsible entity of the manufacturer. Each quality control certificate will include roll identification numbers, and the results of quality control tests (refer to Subsection 10.2.1 above for minimum testing requirements).
6. Manufacturer's written certification that the GCL meets the project specifications, that the GCL has been continuously inspected and found to be needle-free, that the bentonite will not shift during transportation or installation, and that the bentonite and geotextile materials meet the manufacturer's specifications

GCL installer information will include the following:

1. Corporate background information
2. Project reference list consisting of the principal details of at least five projects totaling at least 1 million ft^2
3. List of personnel performing field operations, along with pertinent experience information, if required by the RPR or CQA officer

The proposed panel layout diagram identifying placement of the GCL panels and seams, as well as any variances or additional details that deviate from the engineering drawings will also be submitted prior to installation. The layout will be drawn to scale, will include information such as dimensions and details, and will be adequate for use as a construction plan.

10.3 Installation

The following installation procedures are designed to ensure the effectiveness of the GCL in meeting its design requirements and to simplify the deployment procedures. These procedures are to be followed by the installer, unless the installer proposes alternative procedures in writing and the CQA officer approves them in writing prior to installation.

10.3.1 Testing Requirements

This subsection describes the test methods, including sampling procedures and frequencies, and the role of the Geosynthetic Testing Laboratory in testing the GCL roll samples. Unless specified otherwise, all sampling procedures will be performed in accordance with the referenced test method defined in this section.

GCL roll samples will be collected by the contractor at the discretion of, and under the direction of, the RPR, at a rate specified by the RPR.

Samples will be 3 feet long by the full width of the roll and will not include the first 3 feet of any roll.

Table 10-1 lists the tests and the test methods that may be performed on GCL roll samples. The specifications and methods used in evaluating the results are discussed later in this subsection.

Role of Testing Laboratory

The Geosynthetic Testing Laboratory will be responsible for performing the tests on samples submitted to them. The results of tests performed will be reported to the RPR and CQA officer.

Retesting of GCL rolls for quality assurance purposes, because of failure to meet any or all of the acceptance specifications in this section, can only be authorized by the CQA officer.

The GCL manufacturer and/or installer may perform their own tests according to the methods and procedures defined in Table 10-1; however, the results will only be applicable to their own quality control needs. These results will not be substituted for the quality assurance testing described herein.

Procedure for Determining GCL Roll Test Failures

Table 10-1 lists the specifications that are applicable to the GCL. For any referenced test method that requires the testing of multiple specimens, the criteria in Table 10-1 will be met based on the average results of the multiple specimen tests.

The following procedure will be used for interpreting the results relative to acceptance or rejection of rolls, lots, and shipments of GCL to the site:

1. If the test values meet the stated specifications, then the roll and batch will be accepted for use at the job site. If the sample represents all rolls from an entire shipment, then the entire shipment will also be considered accepted.
2. If the results do not meet the specification, then the roll and the batch will be retested at the contractor's expense using specimens either from the original roll sample or from another sample collected by the RPR. For retesting, two additional tests will be performed for the failed test procedure. (Each additional test will consist of multiple specimen tests if multiple specimens are called for in the failed test procedure.) If both of the retests are acceptable, then the roll and batch will be considered as having passed this particular acceptance test; if either of the two additional tests fail, then the roll and batch will be considered as being unsuitable without further recourse. The RPR may obtain samples from other rolls in the batch. On the basis of testing these samples, the CQA officer may choose to accept a portion of the batch while rejecting the remainder.

   If retesting does not result in passing test results as defined in the preceding paragraph, or if there is any other nonconformity with the

material specifications, then the contractor will withdraw the rolls from use in the project at contractor's sole risk, cost, and expense. Once withdrawn, the same rolls will not be resubmitted for use. Expenses for removing this GCL from the site and replacing it with acceptable GCL will be the sole risk and responsibility of the contractor.

10.3.2 Required Equipment

The following installation equipment is required on site:

1. Front-end loader, crane, or other similar equipment. The selected piece of equipment will not cause damage to the subgrade, such as rutting. The installer will verify in the presence of the RPR that the selected piece of equipment does not damage the subgrade
2. A spreader bar to prevent slings from damaging the ends of the rolls.
3. 3-inch–diameter Schedule 120 steel pipes to be inserted into the roll's core for lifting.
4. Wooden pallets for aboveground storage of the GCL rolls.
5. Heavy waterproof tarps for protecting all GCL rolls.
6. Sandbags for securing the GCL during installation and for securing the tarps.
7. Adhesive or tape for securing patches.
8. Granular bentonite for seams and patches, and for securing around penetrations and structures as shown on the drawings.

10.3.3 Surface/Subgrade Preparation

GCL liner installation will not begin until a proper subbase has been prepared to accept the bentonite liner. Base material will be fine-grained soil free from angular rocks, roots, grass, and vegetation. Foreign materials and protrusions will be removed; all cracks and voids will be filled; and the surface will be made smooth and uniformly sloping. Unless otherwise required by the contract specifications, the prepared surface will be free from excessive moisture, loose earth, rocks or clay clods larger than ½ inch in diameter, rubble, and other foreign matter. The subgrade will be uniformly compacted to ensure against localized settlement and rutting under wheel loads and will be smoothed with a smooth drum roller.

The surface on which the liner is to be placed will be maintained in a firm, clean, and smooth condition, free of standing water, during liner installation.

10.3.4 Deployment

As each roll is moved from the storage area, the labels will be removed by the installer's Superintendent or RPR for storage in the project file.

The rolls of GCL will be brought to the area to be lined with a front-end loader, and support pipe will be set up such that the roll of liner is fully supported across its length. A spreader bar or similar device will be used to prevent the lifting chains or slings from damaging the edges. Dragging of the GCL liner will be minimized.

The contractor will ensure, and the RPR will verify, that the following criteria are being met:

1. The equipment used does not damage the GCL by handling, excessive heat, leakage of hydrocarbons, or by other means.
2. The prepared surface underlying the GCL has not deteriorated since previous acceptance, and it is still acceptable at the time of GCL placement.
3. Personnel working on the GCL do not smoke, wear damaging clothing, or engage in other activities that could damage the GCL.
4. The method used to unroll the GCL does not cause damage to the GCL, and/or the subgrade.
5. The method used to place the rolls minimizes wrinkles (especially wrinkles between adjacent panels).

GCL must not be placed during precipitation events, in the presence of excessive moisture, in any area of ponded water, or during excessive winds. The GCL must be dry when installed and must be dry when covered with soil.

The proper side of the GCL, as per the manufacturer's recommendation, will face upward (unless otherwise dictated by project requirements). The liner will be placed over the prepared surface such that material handling will be minimized.

The GCL panels will be placed in a manner that ensures sufficient overlap as described in Subsection 10.3.5. Horizontal seams will not occur on slopes steeper than 7 horizontal: 1 vertical.

The cover material (*i.e.*, geocomposite and soil) will be placed over the bentonite liner during the same day as the placement of the GCL. Only those GCL rolls that can be covered that same day will be unpacked and placed in position.

When wind conditions could affect installation, the GCL liner installation will be started at the upwind side of the project and will proceed downwind. The leading edge of the liner will be secured at all times with sandbags or other means sufficient to hold it down during high winds.

The GCL will be installed in a relaxed condition and will be free of tension or stress upon completion of the installation. Stretching of the liner to fit will not be allowed. Deployed rolls (panels) will be straightened by the installation personnel to smooth out creases or irregularities.

The RPR will visually inspect the geotextile's quality, the bentonite uniformity, and the degree of hydration, if any, of the GCL. Any areas in need of repair will be marked.

10.3.5 Seaming

Once the first panel has been deployed, adjoining panels will be laid with a 6-inch minimum overlap on longitudinal seams, and 24 inches on the panel end seams. Six-inch and 12-inch overlap lines will be marked on the liner to assist in obtaining the proper overlap. All dirt, gravel, or other debris will be removed from the overlap area of the GCL.

Seam overlaps, whenever possible, will be placed such that the direction of flow is from the top panel to the underlying panel to form a shingle effect.

If the GCL requires a granular bentonite seam, then the overlapping panel edge will be pulled back and granular Volclay® (or approved equivalent) sodium bentonite will be poured continuously along all seams and lap areas from the panel edge to the 6-inch lapline, at a minimum application rate of ¼ pound per linear foot.

10.3.6 Patches/Repairs

Irregular shapes, cuts, or tears in the installed GCL will be covered with sufficient liner to provide a 12-inch overlap in all directions beyond the damaged area. A layer of granular bentonite will be placed in the overlap zone in accordance with the manufacturer's recommendations. An epoxy-based adhesive, or other approved method, will be used to secure the patch during backfill operations. Alternatively, the patch can be placed underneath the defective liner.

Patch repairs should not be allowed on slopes greater than 7 horizontal: 1 vertical, unless a water-soluble adhesive, or other approved method, is used to secure the patch.

10.3.7 Penetration Seals

The GCL will be sealed around penetrations, pipes, and structures in accordance with the recommendations of the GCL manufacturer.

Pipe penetrations will incorporate a collar of GCL wrapped around the pipe and securely fastened. A bentonite or mastic grout will be placed around the corners for additional protection.

Depending on the location of the pipe penetration, an additional GCL skirt placed over the bentonite grout may be required by the GCL manufacturer to provide a third level of protection and to prevent the bentonite grout from being displaced.

If the seal requires granular bentonite, then a 1-inch to 2-inch cut will be excavated around the circumference of the pipe, into the subgrade at least 12 inches out from the pipe. Volclay® sodium bentonite (or approved equivalent) will then be packed around the pipe in the subgrade excavation and on adjacent areas so that the pipe is surrounded with granular bentonite.

The GCL panel will then be placed over the pipe by penetrating the GCL with slits in a "pie" configuration where the pipe is to protrude in a manner that will create a snug fit between the GCL and the pipe.

More sodium bentonite will then be spread around the cut edges of the GCL against the pipe and over adjacent areas.

To complete the pipe penetration seal, a collar of GCL will be cut in a manner similar to that made on the main panel and will be fit around the pipe, with additional Volclay® sodium bentonite being applied into any gaps that may remain.

10.3.8 Covering Geosynthetic Clay Liner

Only the amount of GCL that can be inspected, repaired, and covered in the same day will be installed. The GCL must be covered the same day on which it is installed.

Geosynthetics

When covering the GCL, precautions will be taken to prevent damage to the GCL by restricting heavy equipment traffic. The following requirements apply to material placement over the GCLs:

1. Equipment used for placing the material must not be driven directly on the GCL.

2. A minimum thickness of 0.6 feet of fill is specified between a light dozer (*i.e.*, maximum contact pressure of 5 lb/sq. inch) and the geocomposite or Geocushion™ on top of the composite liner (*i.e.*, geomembrane overlying a GCL).
3. A minimum thickness of 3 feet of fill is specified between rubber-tired vehicles and the composite liner.

Any leading edge or panels of GCL left unprotected must be covered with a heavy, waterproofing tarp that is secured and protected with sandbags or other ballast.

10.3.9 Construction Quality Assurance

Installer

The installer will maintain documentation in the daily installation records, and will provide such documentation to the RPR that the above conditions are fulfilled. The RPR will be informed if any of the above conditions are not met.

The GCL will be installed according to the manufacturer's guidelines, the CQA plan, and the project specifications.

Resident Project Representative

The RPR will be responsible for the following quality assurance duties:

1. Observation of the installation of the GCL for compliance with the manufacturer's guidelines, the CQA plan, and the project specifications.
2. Collection of the field acceptance samples to be tested as indicated in Table 10-2.
3. Visual inspection of the geotextile quality, bentonite uniformity, and degree of hydration, if any, on the GCL. Any areas in need of repair will be marked.
4. Recording each roll number and lot number as panels are deployed, along with a general description of the location of each panel.
5. Inspection of the overlaps.
6. Inspection of the anchoring and sealing around penetrations.

10.3.10 Submittals

The following will be submitted during installation:

1. Daily records/logs prepared by the installer documenting work performed, personnel involved, general working conditions, and any problems encountered or expected on the project. These records will be submitted on a weekly basis.
2. Copy of subgrade acceptance forms by the installer.
3. QC documentation.

10.4 Post-installation

10.4.1 Final Examination

The RPR will perform a final GCL examination after portions of installation have been completed. The RPR will examine the GCL for the following:

1. Tears or defects
2. Proper overlaps
3. If any portion of the GCL requires repairs based on the above examination, it will be repaired in accordance with the procedures in Subsection 10.3.6.

10.4.2 Submittals

The following will be submitted after installation is completed:

1. Installation certification prepared by the installer certifying that the GCL was installed in substantial accordance with the specifications and the CQA plan.
2. An as-built panel layout diagram prepared by the installer identifying the placement of panels and seams. The numbering sequence will be as agreed upon between the RPR and the installer prior to commencing installation.
3. A copy of the warranty obtained from the manufacturer/installer.

Table 10-1
Summary of Specifications and Quality Control Testing

	PROPERTY	TEST METHOD[5]	UNITS	VALUE	MIN. TESTING FREQUENCY	TESTED BY
Bentonite properties (bentonite removed from finished product)	Free swell Fluid loss	USP-NF-XVII API 13 A	mL/2g mL	24 (MARV) [1] 18 (MAX.A.R.V.)	1/20,000 SF	Manufacturer or independent laboratory hired by the manufacturer
Physical GCL properties	Mass per unit area	ASTM D 5993	lb/sqf	0.75 (MARV)	1/20,000 SF	Manufacturer or independent laboratory hired by the manufacturer
Hydraulic Properties	Flux [2, 3]	ASTM D 5886	m/s	1×10^{-8} (MAX)	1/750,000 SF	Manufacturer or independent laboratory hired by the manufacturer

(1) Minimum average roll value (MARV).
(2) Flux is defined as "flow rate/unit area" which can be converted to permeability using the equation: permeability = flux/hydraulic gradient.
(3) Report results at a maximum confining stress of 34 Kpa (5 PSI) and 14 Kpa (2 PSI) head pressure.

Table 10-2
Collection of Field Acceptance Samples

PROPERTY	METHOD	MINIMUM ACCEPTABLE VALUE
Fluid loss	API 13 A	15 mL[1]
Free swell	USP-NF-XVII	24 mL at 24 hours[2]
Liquid limit	ASTM D 4318	500%[2]

(1) Maximum Average Roll Value (Max.A.R.V.)
(2) Minimum Average Roll Value (M.A.R.V.)

Section 11
Geocomposites

A geocomposite will be installed over the barrier layer in the final cover to provide drainage. A geocomposite will also be installed over the composite liner on the 3 (horizontal): 1 (vertical) sideslopes to function as the leachate collection layer. A geocomposite may also be installed above the composite liner on the bottom of the facility in lieu of the Geocushion™ and some of the aggregate fill in the leachate collection layer.

This section is divided into three major subheadings, which cover the QA requirements for pre-installation, installation, and post-installation. The terms pre-installation, installation, and post-installation are applicable only to the geocomposite installation and do not apply to the overall construction.

11.1 Pre-installation

11.1.1 Manufacturing

Material Specifications

Geotextile and geonet suitable for producing the geocomposite to be used in the landfill final cover and leachate collection layer are based on the material specifications of the geotextile and geonet listed in Subsection 7.1.1 and Subsection 9.1.1, respectively.

Quality Control Requirements/Manufacturer's Certification

The geocomposite manufacturer (fabricator) will provide the CQA officer with certification of geotextile and geonet materials used in the fabrication of the geocomposite rolls delivered to the job site. The geocomposite manufacturer will also provide the CQA officer with representative samples of the geotextile used in the fabrication of the geocomposite rolls for conformance testing. Requirements for the manufacturer's certification for geonets are described in Subsection 9.1.1. Requirements for the manufacturer's certification of geotextiles are shown in Table 11-1.

11.1.2 Delivery, Handling, and Storage of Geocomposite Rolls

Each geocomposite roll, for use at the landfill facility, will be marked by the geocomposite manufacturer with the following information and in the following manner:

1. When fabric is rolled on a core, identify each roll with a durable gummed label, or an equivalent, on the inside of the core and on the outside of the protective wrapping for the roll.
2. Each roll label will contain the following information at a minimum:
    - Name of manufacturer (or fabricator)
    - Style and type number
    - Roll length and width
    - Batch (or lot) number, if applicable
    - Date of manufacture
    - Direction for unrolling
    - Roll number
3. On the outside of the roll, all lettering should be a minimum of ½ inch high, and on the inside of the core, the lettering should be at least ¼ inch high.

The geocomposite manufacturer will use the following guidelines in packaging, wrapping, and preparing all geocomposite rolls for shipment:

1. When cores are required, use those that have a crushing strength sufficient to avoid collapse or other damage while in use.
2. Cover each roll with a wrapping material that will protect the geotextile from damage due to shipment, water, sunlight, or contaminants.

The following practices should be used as a minimum in receiving and storing geocomposite rolls in the designated storage area at the job site:

1. While unloading or transferring the geocomposite rolls from one location to another, prevent damage to the geocomposite. If practicable, the installer may use forklift trucks fitted with poles that can be inserted into the cores of rolls. Be sure that the poles are at least ⅔ the length of the rolls to avoid breaking the cores and possibly damaging the geocomposite. Do not drag the rolls.
2. Store the geocomposite rolls to ensure that they are adequately covered to protect the geocomposite from the following:
    - Precipitation

- Ultraviolet radiation, including sunlight
- Strong oxidizing chemicals, acids or bases
- Flames, including welding sparks
- Temperatures in excess of 160°F
- Soiling

The RPR will observe and document throughout the pre-installation, installation, and post-installation periods for observing and documenting that the installer provides adequate handling equipment used for moving geocomposite rolls and that the equipment and handling methods used do not pose unnecessary risk of damage. The installer is responsible for means and methods to implement the work.

The installer will be responsible for ensuring that materials installed meet specifications (*i.e.,* the roll marking label information indicates required specifications and properly represents materials). The RPR will maintain a log of geocomposite roll deliveries. The following information, at a minimum, will be recorded on the log for each shipment received at the job site:

1. Date of shipment from geocomposite manufacturer
2. Date of receipt of delivery at job site
3. For each geocomposite roll, the following information will be noted:
    - Roll number
    - Batch (lot) number, if applicable

11.2 Installation

This section describes the QA requirements applicable to the installation and testing of geocomposites. This section includes roll sample testing, installation, observations, and documentation of geocomposites.

11.2.1 Testing Requirements

This subsection describes the test method, including sampling procedures and frequencies, and the role of the Geosynthetic Testing Laboratory in testing the geocomposite roll samples.

Test Method

Unless specified otherwise, all sampling procedures will be performed in accordance with the referenced test method defined in this section.

Geocomposite roll samples will be collected by the RPR. Sample frequency will be based on ASTM D 4354, Procedure A, where the number of units per lot is defined as the number of rolls for a specified lot (using batch or lot numbers) delivered to the job site in one shipment. Required sampling frequencies are shown in Table 8-1.

Samples will be 3 feet long by the full width of the roll and will not include the first 3 feet of any roll. Since machine direction for the geocomposite rolls is the direction that the material comes off the roll, machine direction for any sample will always be along the 3-foot-length dimension of the sample.

Table 11-1 lists the test and the test method to be performed on geocomposite roll samples. The specifications and methods in evaluating the results are discussed below under procedures for determining geocomposite roll test failures.

Results for ply adhesion will be reported for both the machine and cross direction (machine direction will be taken as the direction the geonet is taken off of the rolls).

Role of Testing Laboratory

The Geosynthetic Testing Laboratory will be responsible for performing the test on samples submitted to them as described above. Results of tests performed will be reported to the CQA officer and the RPR.

Retesting of geocomposite rolls for QA purposes, because of failure to meet any or all of the specifications listed below, can only be authorized by the CQA officer.

The geocomposite manufacturer (fabricator) and/or installer may perform their own tests according to the methods and procedures defined in Table 11-1; however, the results will only be applicable to their own QC needs. These results will not be substituted for the QA testing described herein.

Procedures for Determining Geocomposite Roll Test Failures

Table 11-1 lists the accepted values that are applicable to geotextile component the geocomposite. The values in Table 11-1 are based on minimum values.

The following procedure will be used for interpreting results relative to acceptance or rejection of rolls and shipments of geocomposites to the site:

1. Test results for the stated specifications in Table 11-1 will be evaluated in accordance with ASTM D 4759 for determining acceptance of roll shipments.
2. The RPR will coordinate and document the conformance testing and the determination of material acceptance or rejection.

11.2.2 Placement

The installer will install all geocomposites in such a manner as to ensure that they are not damaged in any way and in a manner that complies with the following:

1. On sideslopes, the geocomposites will be securely anchored, then rolled down the slope in such a manner as to continually keep the geocomposite in tension. If necessary, the geocomposite will be positioned by hand after being unrolled to minimize wrinkles.
2. In the presence of winds, all geocomposites will be secured by suitable methods. The temporary weighted material will be left in place until replaced with cover material as shown on the design plans and specifications.
3. Cutting should be done according to manufacturer's recommendations.
4. The installer will take necessary precautions to prevent damage to underlying layers during placement of the geocomposite.
5. During placement of geocomposites, care will be taken not to entrap any stones, excessive dust, or moisture that could cause clogging of the drainage system.

11.2.3 Overlaps and Joining

The following requirements will be used with regard to overlapping and joining of geocomposite rolls:

1. Adjacent rolls will be overlapped by a minimum of 4 inches.
2. These overlaps may be secured by tying to each other.
3. Tying can be achieved by strings, plastic fasteners, or polymer braid. Tying devices will be black or brightly colored for easy identification. Metallic devices will not be used in any circumstances.

4. No horizontal joints or overlaps will be allowed on slopes greater than 5 horizontal to 1 vertical (*i.e.*, seams will be along, not across, the slope), except as part of a patch.

11.2.4 Repairs

Any tears or other defects in the geocomposite will be repaired by placing a patch extending a minimum of 2 feet beyond the edges of the hole or tear. The patch will be secured to the original geocomposite by tying every 6 inches. If the tear or other defect width is more than 50 percent of the roll width, the damaged area will be cut out and replaced with new geocomposite material. Tying devices will be as indicated in Subsection 11.2.3. The RPR will examine and document that the repair of any geonets is performed according to the above procedure.

11.3 Post-Installation

11.3.1 Final Examination

The RPR will perform a final geocomposite examination after installation of each geocomposite layer has been completed. The objectives of this step are as follows:

1. Examine for presence of tears or defects
2. Examine overlaps to make certain that they are in conformance with the requirements of Subsection 11.2.3.

If any portion of the geocomposite requires repairs due to the above examination, they will be performed according to the procedures in Subsection 11.2.4.

If there will be an extended time delay between completion of the geocomposite and the start of the installation of any overlying cover, the installer will make provisions by using a temporary covering or other suitable methods, to protect the upper geotextile component against exposure to sunlight and ultraviolet radiation.

11.3.2 Placement of Soil Materials

The construction contractor will place all soil materials located on top of the geocomposite in such a manner as to minimize the following:

1. Damage of the geocomposite
2. Slippage of the geocomposite on underlying layers
3. Excessive tensile stresses imposed on the geocomposite

If portions of the geocomposite are exposed, the RPR will periodically place two (or more, at his discretion) marks on the geocomposite 10 feet apart along the slope and measure the elongation of the geocomposite during the placement of soil.

Table 11-1
Geocomposite Acceptance Specifications

PROPERTY	UNITS	FINAL COVER VALUE	LEACHATE COLLECTION LAYER VALUE	TEST METHOD	TYPE OF CRITERION
Ply Adhesion - Machine Direction	ppi	1.0	1.0	ASTM F904	Minimum
Ply Adhesion - Cross Direction	ppi	1.0	1.0	ASTM F904	Minimum
Geotextile Apparent Opening Size	NA	No. 70	100 – 140	ASTM D 4751	Maximum
Geotextile Grab Strength	lb	200	300	ASTM D 4632	Minimum
Geotextile Grab Strength Elongation	Percent	50	50	ASTM D 4632	Minimum
Geotextile Trapezoidal Tear	lb	65	115	ASTM D 4533	Minimum
Geotextile Puncture Strength	lb	80	175	ASTM D 4833	Minimum
Geotextile Mullen Burst Strength	lb/sq in.	400	580	ASTM D 2210	Minimum
Geocomposite Transmissivity	m^2/sec	1.0×10^{-3} (1)	1.8×10^{-3} (2)	ASTM D 4716	Minimum

(1) Transmissivity of the geocomposite subjected to a load of 10,000 psf and a gradient of 0.1.
(2) Transmissivity of the geocomposite subjected to a load of 15,000 psf and a gradient of 0.1.

Section 12
Select Waste Fill

Select waste fill refers to select ash or waste material that will be placed as a protective layer over the granular drainage material, and on the waste as it approaches final grade to provide a leveling course prior to placement of the final cover.

12.1 Procedures and Observations

The RPR will observe select waste fill placement activities and document relevant observations to support certification of the following requirements:

1. Select waste fill material shall be free of cinders and solid impurities capable of puncturing the GCL or the geomembrane.
2. Select waste fill shall be placed in 8-inch loose depth maximum lifts and compacted with a minimum of two passes of the compaction equipment.
3. The completed select waste fill layer shall have a uniform surface.

12.2 Field and Laboratory Testing

Field and laboratory testing of select waste fill material is not required; however, as discussed in Subsection 12.1 above, the RPR will observe and document the consistency of the fill material and placement procedures.

12.3 Thickness Documentation

The top and bottom of the select waste fill layer will be surveyed on a 50-foot grid pattern for application of select waste fill over the liner granular drainage layer. The top of the select waste fill layer beneath the final cover will be surveyed on a 50-foot grid pattern. The minimum acceptable compacted thickness will be 12 inches vertical in the liner and 12 inches vertical in the cap.

Section 13
Piping

This section of the CQA plan applies to piping used in the leachate collection and removal system in the landfill liner and in the gas removal system. This section is divided into three major subheadings, which cover the QA requirements for the pre-installation (which includes resin manufacturers, piping manufacturers, and fabricators), installation, and post-installation (which includes the final observation and documentation of piping installations prior to installation of other materials over and around the pipe). These terms pre-installation, installation, and post-installation are applicable only to the piping installation and do not apply to the overall construction.

Individual pipe sizes and SDRs to be used for each individual pipe installation are not detailed in this section; rather, the plans and specifications should be used for the determination of correct size and wall thickness.

13.1 Pre-installation

This section describes the QA measures that are applicable to the PE resin manufacturers, piping manufacturers, piping fabricator used to perforate the pipe, and finished piping delivery to the site, prior to installation.

13.1.1 Manufacturing

Material Specifications

Any pipe used must be made from extra high molecular weight (EHMW) PE resin, and the manufactured piping must be classified as Type III, Class C, Category 5, Grade P34 material according to ASTM D 1248 and also have a cell classification of 345434C as defined by ASTM D 3350. Pipe shall be free of paint or other surface treatments.

Quality Control Requirements

Prior to the delivery of any piping to the site, the piping manufacturer will provide the CQA officer with the following information:

1. The resin supplier, location of supplier's production plant(s) and resin brand name and product number.

2. Any test results obtained by the piping manufacturer and/or the pipe manufacturer's testing laboratories to document the quality of the resin used in manufacturing the piping.
3. The QC plan that the piping manufacturer will be using for the pipe being supplied.

Fabricator

The piping fabricator will be responsible for perforating the pipe, delivered by the piping manufacturer, according to the plans and specifications. The piping fabricator will be responsible for preparing and shipping the perforated pipe to the job site. Marking of the pipe must be performed in accordance with Subsection 13.1.2.

Manufacturer's Certification

The piping manufacturer will provide certification, based on tests performed by either the piping manufacturer's laboratory or other outside laboratory contracted by the piping manufacturer, that the pipe supplied under this plan will meet the following specifications:

1. The finished pipe is classified as Type III, Class C, Category 5, Grade P34 according to the provisions of ASTM D 1248.
2. The finished pipe meets the cell classification of 345434C according to the provisions of ASTM D 3350.
3. The finished pipe has the SDR value specified.

13.1.2 Delivery, Handling, and Storage of Piping

Each bundle of pipe prepared for shipment by the Piping Fabricator will be marked with the following information:

1. Nominal Size
2. Dimension Ratio
3. Pressure Rating
4. Type (manufacturer)
5. Material Classification
6. Certification Bases
7. Blank Position for GRI Use

8. Pipe Test Category
9. Plant
10. Extruder Number
11. Date
12. Operator Number
13. Shift Letter
14. Resin Supplier Code

Example: 10" IPS SDR 15.5 110 psi (Trade Name) PE 3408 ASTM F-714 GRI C3 P5 06FEB89 55A P

The pipe will be protected, during shipment, from excessive heat or cold, puncture, or other damaging or deleterious conditions. The pipe will be stored on site in a manner suitable to protect it from long-term ultraviolet exposure, prior to actual installation.

The RPR will observe and document throughout the preconstruction, construction, and post-construction periods that the installer provides adequate handling equipment for moving pipe and that the equipment and handling methods used do not pose unnecessary risk of damage. The installer is responsible for means and methods to implement the work.

The installer will be responsible for making certain that the manufacturer, type and size of each pipe is correct. The RPR will maintain a log of pipe deliveries throughout the installation. The following information at a minimum will be recorded on the log for each shipment received at the job site:

1. Date of shipment from piping manufacturer
2. Date of receipt of delivery at job site
3. For each pipe, the following information will be noted:
    - Pipe size and type
    - Batch (lot) number

13.2 Installation

This section describes the requirements applicable to pipe installation. This subsection includes installation, observations, and documentation of piping installations.

13.2.1 Pipe Seams

Unless approved otherwise by the CQA officer, all pipe seams will be made by the butt fusion procedure as defined by Phillips Driscopipe, Inc. and Plexco Piping Company. Sections of polyethylene pipe should be joined into continuous lengths on the job site above ground. The joining method shall be the butt fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements of 400°F, alignment, and 75 psi interfacial fusion pressure. Butt fusion joining shall be 100 percent efficient offering a joint weld strength equal to or greater than the tensile strength of the pipe. Socket fusion shall not be used. Extrusion welding or hot gas welding of HDPE shall not be used for pressure pipe applications nor in fabrications where shear or structural strength is important. Flanges, unions, grooved-couplers, transition fittings, and some mechanical couplers may be used to mechanically connect HDPE pipe without butt fusion. Refer to the manufacturer's recommendations. The following procedures will be used regarding butt fusion seams:

1. Seams should be made at the pipe manufacturer's recommended heater plate temperature of approximately 400°F for fusing pipe and fittings.
2. For pipe diameter sizes 4 inches (nominal) and larger seams will be made using the hydraulic fusion machines. For pipe diameters of less than 4 inches, manual fusion equipment can be used.
3. Care will be taken to make certain that adequate pressures are used for fusing pipes and that sufficient cooling periods are allowed prior to testing, bending, or backfilling of pipe sections.

13.2.2 Placement Requirements

Pipe placement will be done in accordance with the following procedures and requirements:

1. Piping placement will not be performed in the presence of excessive moisture. The RPR will document that this condition is fulfilled. Additionally, the RPR will document that the supporting backfill has not been damaged by weather conditions. The RPR will inform the CQA officer if any of the above conditions are not fulfilled for evaluation of the necessity of corrective action.
2. The prepared surface underlying the piping has not deteriorated since previous acceptance, and it is still acceptable immediately prior to piping placement.
3. Method used to place the piping does not cause damage to the piping and does not disturb the supporting backfill.

4. The RPR will observe and document all pipe installation. Deviations from the plans and specifications will be brought to the attention of the CQA officer for evaluation of the necessity of corrective action.
5. The RPR will observe and document the placement of geotextile filter to line the trenches and placement of pipe bedding stone around collector pipes according to the plans and specifications and the procedures described in Subsection 7.2.1.
6. Observations and measurements should be made to ensure that the pipes are the specified size, manufactured of the specified material, and that pipe perforations are sized and spaced as specified.
7. All piping should be located as noted in the plans and specifications. Locations, grades, and size requirements are specified on the details of the plan set. Observations and surveying measurements should be made to ensure the pipes are placed at the specified locations and grades, and in the specified configuration. Observations should be made throughout the construction to ensure that backfilling is completed as specified in the plans and specifications and that, in the process, the pipe network is not damaged.

13.2.3 Pipe Boots

Pipe boots shall be installed as shown on approved shop drawings with a continuous extrusion weld joining the pipe to the geomembrane liner. The RPR shall observe all pipe boot installations.

13.2.4 Damages

The RPR will examine each pipe after placement for damage. Damaged pipes or portions of pipes that have been rejected will be marked and removed from the installation area and documented by the RPR.

13.3 Post-Installation

Pipe inverts (or top of pipe elevations) and coordinate locations shall be surveyed at 50-foot intervals and at all tee connection locations. Additional surveying requirements regarding granular soil backfill placement are discussed in Subsection 6.3.

Section 14
Compacted Prepared Subgrade Fill

Prepared subgrade fill refers to the 1-foot thick compacted subgrade soil beneath the composite liner with permeability of 4.2×10^{-4} cm/s or less. The existing on-site subgrade soils if appropriate and soil from the owner's on-site borrow source are proposed for the prepared fill subgrade layer. Existing soil data, cross sections, and borrow investigation reports will be made available to the contractor.

14.1 Procedures and Observation

The installer will be responsible for means and methods to implement the work. The RPR will observe the compacted prepared subgrade construction activities and will document relevant observations to support certification of the following requirements:

1. The RPR will confirm the uniformity of the prepared subgrade fill. Soil excavation, proportioning, mixing, and placement will be monitored for segregation and removal of unsuitable material and for changes in soil type, color, texture, and moisture content.
2. The construction contractor will segregate and/or remove unsuitable materials such as soils not meeting acceptance criteria (boulders, cobbles, and organic material).
3. The RPR will measure field densities and moisture contents, using methods described in Subsection 14.2 (Sampling Requirements and Acceptance Criteria), to document that the compacted prepared subgrade is in substantial conformance with the placement specifications and that soil placement has been conducted in a manner to achieve a uniform, homogeneous mass meeting the permeability requirement.
4. Voids created by nuclear density gauge testing or retrieval of Shelby tube samples will be backfilled with sodium bentonite.
5. The prepared subgrade fill shall be placed in two loose lift thicknesses not exceeding 8 inches. Each loose lift shall be compacted with multiple passes using appropriate compaction equipment. If the soil is deposited in thickness exceeding 8 inches, dozers will be used to spread the soil to an 8-inch thickness prior to compaction. This will ensure adequate reduction of clod size and provide a thin layer to achieve required compaction throughout the lift.
6. Areas of unacceptable hydraulic conductivity, compaction density, or moisture content, as defined by Subsection 14.2 (Sampling Requirements and Acceptance Criteria), will be documented by the RPR. Corrective action will consist of moisture conditioning of the soil or additional compactive effort as necessary. Methods for moisture-conditioning soils are described in Item 7 below. Following corrective actions, such areas will be retested.

7. If necessary, surfaces of the prepared subgrade to receive successive lifts of prepared subgrade fill will be moisture-conditioned either by scarification and addition of water where desiccated, or by disking and air drying where saturated to promote effective bonding of lifts. Following scarification, water will be applied with a spray bar applicator or equivalent methods to achieve uniform distribution.
8. Soil compaction will be performed in a manner to achieve continuous and complete keying together of the prepared subgrade construction areas. Stepped joints will be utilized to connect lateral segments of the prepared subgrade construction.
9. No frozen soils will be used for prepared subgrade construction. Frozen soils in the compaction work area will be removed.
10. Stones that are larger than 0.5-inch in diameter shall be removed from the surface of the final lift of the prepared subgrade to avoid potential for puncturing the geosynthetic clay liner. The method to detect and remove stones requires an initial overfill of compacted prepared subgrade soils approximately 1 inch above design grades. A grader will then blade the prepared subgrade surface to obtain uniform subgrades and design elevations. Stones present will be exposed and loosened by the grading. The RPR shall inspect the prepared subgrade during this process and document removal of stones by the contractor. Voids made by removal of stones shall be filled with prepared subgrade soil, and then the entire prepared subgrade surface shall be rolled with a smooth drum compactor.
11. The prepared subgrade surface on which the composite liner will be placed shall be maintained in a firm, clean, and smooth condition, free of standing water, during liner installation.
12. Preconstruction planning will be undertaken to sequence construction activities to minimize the length of time any completed prepared subgrade surfaces are exposed prior to receiving protective cover. Protective cover will be provided by installation of the geosynthetic clay liner and the geomembrane.
13. Preconstruction planning will be undertaken to minimize the need for traffic over the completed prepared subgrade surface. Heavy trucking of materials (ingress or egress) and cleated equipment will not be allowed directly on completed prepared subgrade surfaces. If this is unavoidable, an evaluation will be made upon termination of the haul route to determine if the prepared subgrade should be reconstructed or repaired in such areas. Flotation-type all-terrain vehicles will be used to assist in deployment of the geosynthetic clay liner to avoid disruption of the completed prepared subgrade surface.

14.2 Sampling Requirements and Acceptance Criteria

Field and laboratory sampling frequencies are based on proportionate sampling of construction areas or volume of material placed as specified below. This section describes required analysis, methods, sample frequency, and acceptance limits. Table 14-1 summarizes the minimum QA

testing recommended in Subsection 14.3. The RPR will perform field tests and collect soil samples for laboratory analysis.

14.3 Field Testing and Sampling

The following field testing and sampling methods and frequencies will be used by the RPR during construction of the prepared subgrade.

- One field density and as-placed moisture content test (ASTM D 3017 and ASTM D 2922 Method B) will be performed for each compacted lift on an approximate 100-foot grid pattern.
- Initially, a representative (grab) soil sample of the prepared subgrade soils will be collected from the borrow source and submitted to the Soils Testing Laboratory for testing described in Subsection 14.3.4. Additional samples will be collected every 4,000 cy for each major soil type utilized. A sample will also be collected when changes in the physical appearance or soil characteristics are observed.
- A minimum of one undisturbed Shelby tube sample will be obtained for each acre or less for every lift of prepared subgrade placed. Samples will be submitted to the Soils Testing Laboratory for testing described in Subsection 14.3.3.
- At a minimum, at least one field density/moisture content test will be conducted per lift and at least one test per day of compacted prepared subgrade construction.

A NDG may be used for field moisture and density determination. The calibration of NDGs used for documentation shall be initially checked and adjusted (if necessary) according to the manufacturer's guidelines. Initial calibration of the NDG shall be made with one of the alternate test methods identified in Construction Specifications for determining field density and moisture content.

14.3.1 Field Testing Acceptance Criteria

Acceptance criteria for field density will require soil compaction to a minimum of 95 percent of the Standard Proctor (ASTM D 698) maximum dry density. Specific moisture content requirements will be identified in the construction specifications. The acceptable range will be based on Proctor moisture-density relationships and compaction versus permeability relationships.

14.3.2 Laboratory Testing

Routine laboratory testing of the compacted prepared subgrade soils will be performed on samples from the borrow area or samples from the disking operation and on the in-place soils collected by the RPR. Samples for determining in-place properties will be collected by pushing Shelby tubes. Soil characteristics will be determined from representative samples and from Shelby tube samples.

14.3.3 Undisturbed Sample Analysis

The following analysis will be performed on ***all*** undisturbed samples obtained:

PARAMETER	TEST METHOD
Hydraulic Conductivity	ASTM D 5084 or SW 846-USEPA Method 9100
Moisture Content and Dry Density	ASTM D 2216
Atterberg Limits	ASTM D 4318
Grain-size Analysis (P200)	ASTM D 422 (1)

(1) Percentage of soil finer than the No. 200 sieve (*i.e.*, soil finer than 0.075 mm).

14.3.4 Representative Sample Analysis

The following laboratory analyses will be performed on ***all*** representative samples obtained, except where noted:

PARAMETER	TEST METHOD
Moisture-Density Relationship using Standard Proctor Compaction	ASTM D 698 (1, 2)
Atterberg Limits	ASTM D 4318
Grain-size Analysis (sieve and hydrometer)	ASTM D 422 (3)
Moisture Content	ASTM D 2216
Hydraulic Conductivity (4)	ASTM D 5084 or SW 846-USEPA Method 9100

(1) A five-point Proctor analysis is required for first and second sampling criteria.
(2) A one-point Proctor analysis may be utilized for representative samples collected for the third sampling criteria (apparent changes in soil quality) to verify applicability of previously analyzed moisture-density relationships. If the result does not verify applicability, a five-point analysis will be performed in accordance with the first sampling criteria.
(3) Distribution shall be reported through the 0.002-mm particle size.
(4) For every 8,000 cy of soil extracted from the borrow source, perform one hydraulic conductivity test. The hydraulic conductivity test will be run on a sample of soil remolded to 95 percent of its Standard Proctor (ASTM D 698) maximum dry density at 2 percent over its optimum moisture content.

14.3.5 Laboratory Testing Acceptance Criteria

- A saturated hydraulic conductivity of 4.2×10^{-4} cm/s or less

14.4 Thickness Documentation

The top of the prepared subgrade layer will be surveyed at a minimum on the same 50-foot grid pattern as other locations surveyed for bottom of the prepared subgrade layers. Prepared subgrade thicknesses at slope breaks will be surveyed. The prepared subgrade thickness will be determined at surveyed locations and reported in table fashion. The minimum acceptable prepared subgrade liner thickness will be 1-foot vertical to the bottom. The location and elevation of samples requiring surveying will be recorded.

Appendix Q
EPG Pump Maintenance Information

EPG Companies Inc.

Operations & Maintenance Manual

FOR

Domtar Paper

EPG Job #09-9274

EPG Companies Inc.

Operations and Maintenance Index

Domtar Paper

EPG Job # 09-9274

Bulletin	1055	List of Equipment
Drawing	05775-0000	Series 12 SurePump™
Drawing	05775-0010	Series 12 Size 5 Sump Drainer
Bulletin	0335g	Engineer's Specification EPG WSDPT SurePump™ Wheeled Sump Drainer for side slope riser installations with built-in level sensor
Bulletin	0480e	Materials of Construction
Bulletin	0130c	EPG Sump Drainer Vent Tube / Check Valve Installation Instructions
Bulletin	0680a	EPG SurePump™ with LevelMaster™ Level Sensor Disassembly / Assembly Operation & Maintenance Instructions
Bulletin	0691	EPG SurePump™ with LevelMaster™ Level Sensor Replacement Instructions for Level Sensor in Wheeled Sump Drainer
Bulletin	0790	Test Equipment
Bulletin	0780a	Troubleshooting Guide
Bulletin	6090a	Wire Cable Clamp Installation Instructions
Bulletin	0370a	Storage Information
Bulletin	0380d	SurePump™ Installation Record
Bulletin	0200c	Limited Warranty

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List of Equipment

Domtar Paper

EPG Job # 09-9274

2 each	WSDPT 12-8 EPG SurePump, patented, stainless steel Wheeled Sump Drainer, 5 HP, 460 V, 3PH motor, 100' of jacketed 12-4 CP motor lead, 0-5 PSI level sensor with 100' of polypropylene lead, 3"X2" stainless steel discharge reducer bushing, and 100' of 3/16" stainless steel suspension cable and clamps.

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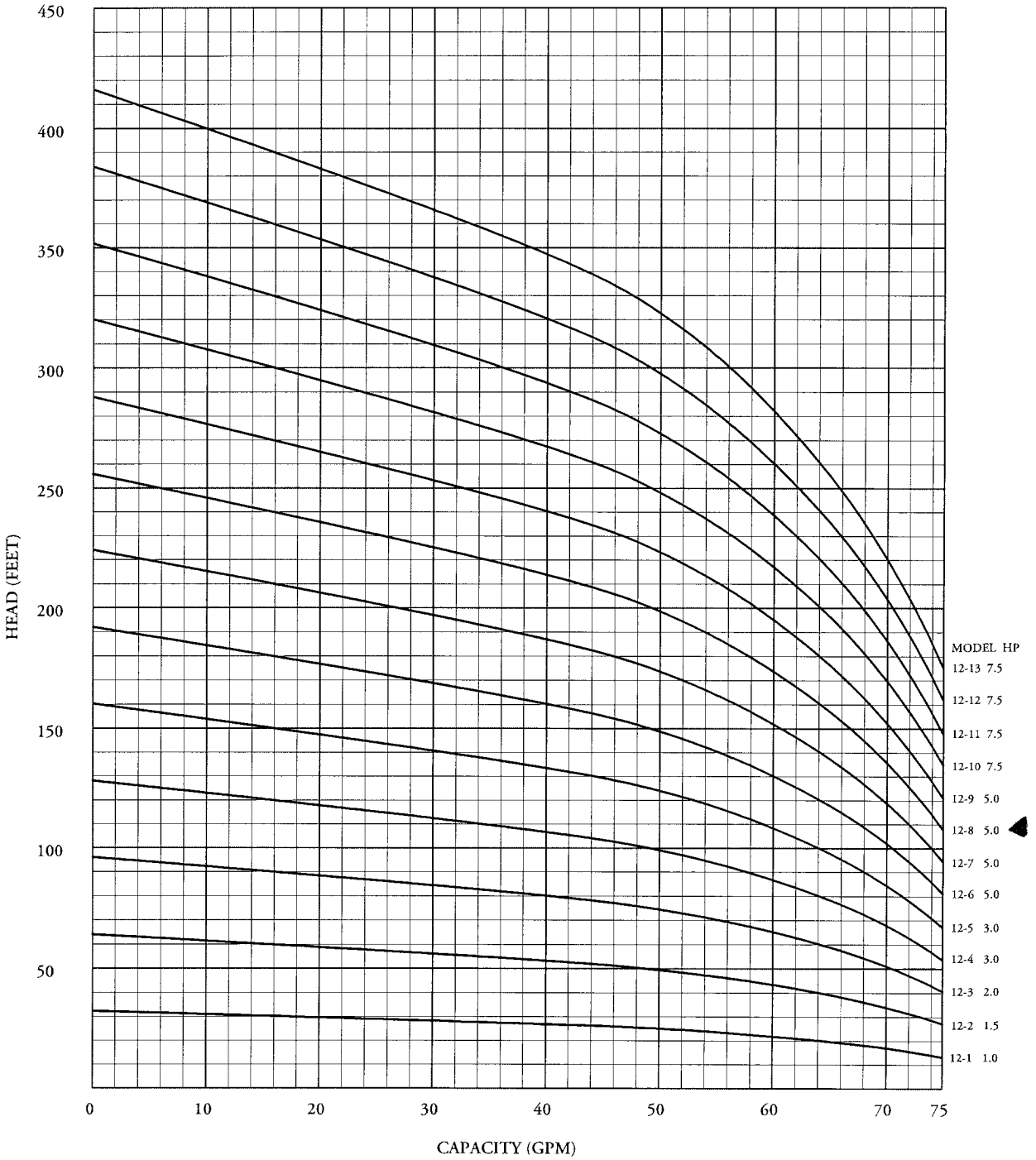
SERIES 12 SurePump™

Flow Range 35-75 GPM

60 Hz



DATA SUBJECT TO CHANGE WITHOUT NOTICE

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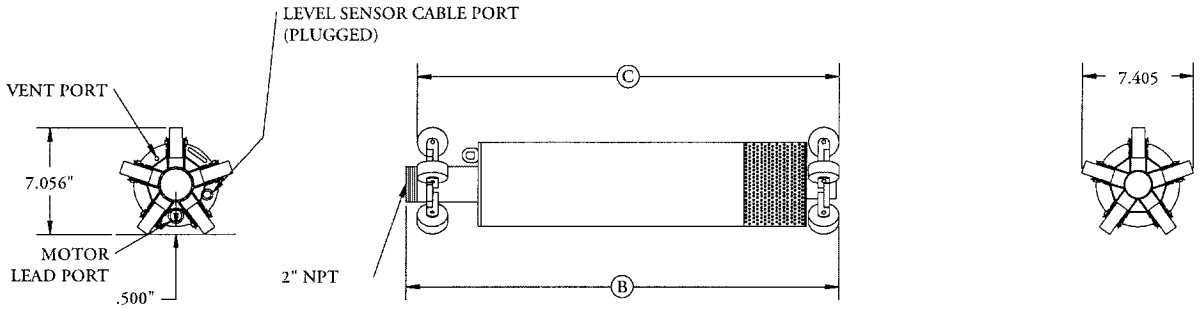
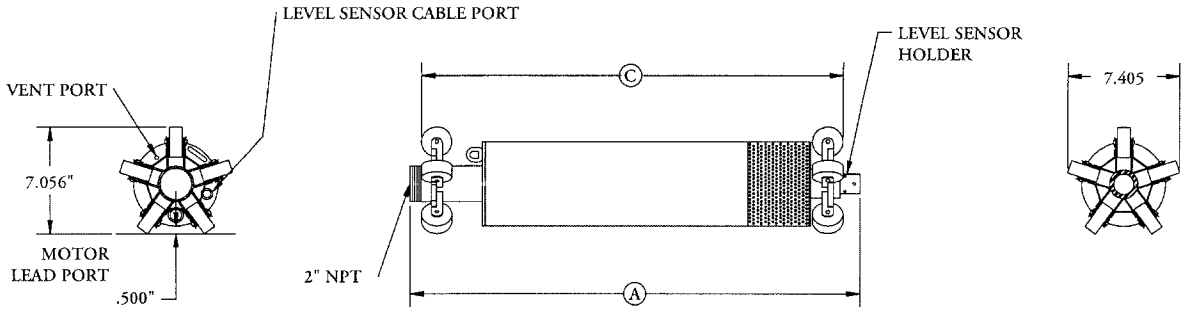
SERIES 12 SIZE 5 WHEELED SUMP DRAINER



WSD



WSDPT

MODEL	HP	PHASE	A	B	C	*APPROX. SHIPPING WEIGHT	
						WSD	WSDPT
12-1	1.00	1	36.01	34.89	34.14	77.26	82.26
12-1	1.00	3	36.01	34.89	34.14	77.26	82.26
12-2	1.50	1	40.48	39.36	38.61	87.64	92.64
12-2	1.50	3	38.61	37.49	36.74	80.80	85.80
12-3	2.00	1	44.58	43.46	42.71	95.65	100.65
12-3	2.00	3	43.08	41.96	41.21	91.18	96.18
12-4	3.00	1	55.68	54.56	53.81	130.52	135.52
12-4	3.00	3	52.68	51.56	50.81	116.58	121.58
12-5	3.00	1	58.28	57.16	56.41	149.06	154.06
12-5	3.00	3	55.28	54.16	53.41	131.12	136.12
12-6	5.00	1	66.88	65.76	65.01	158.48	163.48
12-6	5.00	3	60.88	59.76	59.01	137.61	142.61

MODEL	HP	PHASE	A	B	C	*APPROX. SHIPPING WEIGHT	
						WSD	WSDPT
12-7	5.00	1	69.48	68.36	67.61	162.03	167.03
12-7	5.00	3	63.48	62.36	61.61	141.15	146.15
12-8	5.00	1	72.08	70.96	70.21	165.57	170.57
12-8	5.00	3	66.08	64.96	64.21	144.70	149.70
12-9	5.00	1	74.68	73.56	72.81	169.12	174.12
12-9	5.00	3	68.68	67.56	66.81	148.24	153.24

NOTE: ALL DIMENSIONS ARE IN INCHES.

*SHIPPING WEIGHT INCLUDES
WSD: CRATE, 50' OF 12-4 MOTOR LEAD, 50' OF 3/16" SS CABLE.
WSDPT: CRATE, 50' OF 12-4 MOTOR LEAD, 50' OF 3/16" SS CABLE,
LEVEL SENSOR AND CABLE.

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ENGINEER'S SPECIFICATION

EPG WSDPT SurePump™ Wheeled Sump Drainer

for side slope riser installations
with built-in level sensor

Furnish __2__ centrifugal submersible EPG WSDPT SurePump Wheeled Sump Drainer(s) (U.S. patented), Model WSDPT __12__ - __8__ with __8__ impeller stages. Each unit shall be suitable for side slope riser installation. Each unit shall be equipped with a __5__ HP, submersible electric motor for operation on __460__ Volts, __3__ phase, 60 Hertz service with __100__ feet of power cable. Each SurePump Wheeled Sump Drainer shall have a __2__ inch MNPT threaded discharge nozzle and be capable of delivering __60__ GPM at __172__ feet of TDH. Each SurePump will be fitted with __100__ feet of stainless steel lifting cable of sufficient strength to permit removal of the unit.

DESIGN
Each SurePump Wheeled Sump Drainer shall be capable of pumping contaminated ground water for spill recovery, leachate, condensate, and purge applications. A removable transmitter mount (patent pending) shall be installed at the center bottom of the Sump Drainer for liquid level control. The Sump Drainer shall permit the unit to "pump down" to within __9__ inches of the sump bottom without any loss of performance or damage to the pump. External "priming" shall not be required nor allowed. The Sump Drainer shall be equipped with a vent valve to assist with the evacuation of air from the Sump Drainer.

MATERIALS
Major components shall be made of 304 stainless steel, seal rings are to be made of E-Glide™, and bearings are to be E-Glide. In addition, all fasteners shall be 304 stainless steel.

CHECK VALVE
Each unit shall include a built-in check valve with non-metallic seat, and housing and disc of 304 stainless steel.

SHAFT
The shaft shall be of 304 stainless steel and rotate on E-Glide bearings that are fluid lubricated.

DIFFUSER CHAMBER
The diffuser chambers for each impeller shall be 304 stainless steel and fitted with E-Glide impeller seal rings.

IMPELLERS
The impeller(s) shall be closed and consist of 304 stainless steel.

MOTOR
The motor shall be a submersible, hermetically sealed Franklin motor in __Sand Fighter__ construction. The motor shall be designed for continuous duty, capable of sustaining up to __100__ starts per day. The motor shall be connected to the pump via a motor adaptor and coupling in 304 stainless steel. Single phase motors in ½ HP to 1 HP only shall have thermal protection in the motor windings to protect the windings from overload. The unit will restart automatically after the motor cools down. Larger horsepower single phase motors and three phase motors shall have thermal protection located in the control panel that is manually reset.

MOTOR LEAD WIRE
The lead wire shall be no-splice with EPG's "CP" waterproof and chemically resistant jacket over 600 Volt insulation and be of the length specified.

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Materials of Construction

EPG SurePump™

	STANDARD
Check Valve Housing	304 Stainless Steel
Check Valve	304 Stainless Steel
Check Valve Seat	E-Glide™
Diffuser Chamber	304 Stainless Steel
Impeller Seal Ring	E-Glide™
Impeller	304 Stainless Steel
Motor Adapter	304 Stainless Steel
Inlet Screen	304 Stainless Steel
Pump Shaft	304 Stainless Steel
Coupling	329/420/431 Stainless Steel
Fasteners	304 Stainless Steel
Bearings	E-Glide™

FRANKLIN ELECTRIC MOTORS

	1/3 to 2 HORSEPOWER	3 to 5 HORSEPOWER	5 to 10 HORSEPOWER
End Bell Castings	304 Stainless Steel over Iron	304 Stainless Steel over Iron	304 Stainless Steel over Iron
Stator Shell	301 Stainless Steel	301 Stainless Steel	301 Stainless Steel
Shaft Extension	303 Stainless Steel	303 Stainless steel	303 Stainless Steel
Fasteners	316 Stainless Steel	300 Stainless Steel	316 Stainless Steel
Seal Cover	Tefzel	Sintered Bronze	Tefzel
Shaft Seal	Viton	Viton, Carbon, Ceramic Face Seal	Viton
Diaphragm	Viton	Nitrile Rubber	Viton
Diaphragm Plate	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
Diaphragm Spring	302 Stainless Steel	302 Stainless Steel	302 Stainless Steel
Diaphragm Cover	316 Stainless Steel	304 Stainless Steel	316 Stainless Steel
Slinger	Viton	Nitrile Rubber	Viton
Lead Sleeve	316 Stainless Steel	316 Stainless Steel	316 Stainless Steel
Lead Jam Nut	316 Stainless Steel	N/A	316 Stainless Steel
Lead Jam Clamp	N/A	300 Stainless Steel	N/A
Lead Potting	Epoxy	Epoxy	Epoxy
Lead Bushing	Viton	Viton	Viton

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EPG Sump Drainer Vent Tube / Check Valve

INSTALLATION INSTRUCTIONS

EPG's patented sump drainer* enables a submersible pump to pump down and restart in applications that would normally cause the pump to air lock.

Critical to the operation of the sump drainer is the installation of the vent tube and air check valve. The vent tube / check valve assembly has two functions. First, as the sump drainer fills with fluid the vent tube assembly allows air trapped inside of the sump drainer to escape, allowing the sump drainer to completely fill with fluid. When the sump drainer pump starts the vent assembly then closes, allowing the pump to draw liquid through the screen at the opposite end of the sump drainer. The closed check valve enables the pump to continue pumping even though the fluid level in the sump is below the normal intake of the pump.

The vent tube may be tied off to the pump discharge line. The vent check valve will operate correctly even if submerged.

INSTALLATION

Refer to Figure 1 for help in completing this procedure.

1. Slip the free end of the plastic vent tube onto the adapter on the top of the sump drainer.

2. Verify the open end of the check valve is labeled "VAC".

3. As you lower the sump drainer into the sump, uncoil the vent tube and fasten it to the discharge pipe. We recommend you keep the check valve above the fluid level. The check valve will work if it is submerged, but can foul with particles in the fluid.

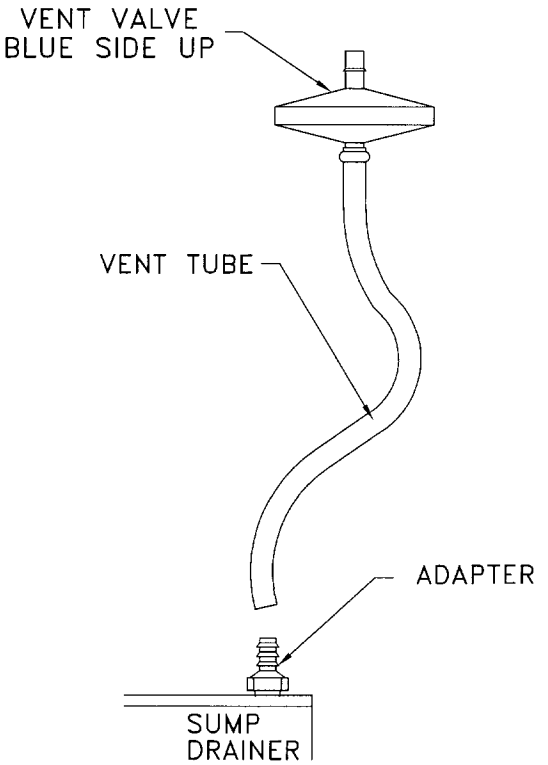

Figure 1. Vent Tube / Check Valve Assembly

* U.S. Patent #4,966,534 and 4,992,030

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EPG SurePump™ with LevelMaster™ Level Sensor Disassembly / Assembly

OPERATION & MAINTENANCE INSTRUCTIONS

NOTE: Refer to Table B for list of tools needed for disassembly, assembly, and testing.

1. Place the pump on a suitable work surface with blocks to prevent the pump from rolling. Remove the vent tube by pulling straight out from the top. In cold weather it is better to unscrew the vent hose barb adaptor with tube attached rather than trying to pull the tube off the hose barb.

2. Unscrew the cord restraint nuts and pull inserts out about two (2) feet along the motor lead and level sensor lead. Loosen the insert from the wires so they are free to move through the cord restraint.

3. Mark the alignment of the tube and top (check for factory alignment marks). Center punch new marks in top and tube if factory marks can not be found. The alignment marks will make reassembly easier.

4. Remove the three (3) cap screws that secure the tube to the top and carefully pull the top, with pump and motor attached, out of the tube. Do not hammer, pry, or pound on tube or top. Allow the sensor lead wire to slide through the cord restraint.

5. Remove the three (3) socket head setscrews from the level sensor housing on the bottom of the tube. Carefully pull the level sensor up and out from the bottom of the tube. Carefully remove the sensor lead wire by pulling the controller end back through the top. Cover the end of the sensor lead wire with tape to prevent moisture and dirt from entering. If the sensor is unused or put into storage, remove the dryer from the controller and install on end of vent tube during storage period.

6. Remove the nuts (4) that secure the motor to the pump and pull the motor from the pump. Do not remove the motor lead from the motor unless it will be replaced with a new lead. It is recommended that a new motor lead be used whenever the old lead is removed from the motor because of possible damage to the lead or distortion of the rubber seal that may prevent resealing.

7. Unscrew the motor lead nut from the motor. Work the lead back and forth to loosen seal and unplug the lead from the motor connector. Remove the lead by pulling the controller end back through the top.

8. Unscrew the pump assembly from the top using cloth strap wrenches to prevent damage to the metal surfaces.

CAUTION

Do not attempt to disassemble level sensor or pump motor. Any disassembly will void the warranty.

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ASSEMBLY

1. Apply pipe sealing compound to the top threads and screw the pump to the top. To prevent damage to the top sealing surface or the pump bowls, tighten pump to top using cloth strap wrenches.

2. Slide motor and pump together and align motor shaft splines to pump splines by turning the motor shaft. Align the motor lead connector with the cutaway in the pump flange. Secure motor to pump with four (4) nuts.

3. Slide the long end of the motor lead through the cord restraint cap and nut in the top. Insert plug into the motor connector. Tighten motor lead connector nut to secure lead to motor.

4. Inspect upper and inside surface of tube and remove any sharp edges or burrs. Wipe surface of tube and top to remove any dirt, sand, or metal filings. Remove the O-ring and clean sealing groove in the top. If original O-ring installation used a spacer / shim between the top and O-ring, clean the shim and reinstall into the sealing groove in the top.

5. Carefully slide level sensor lead wire through the top cord restraint and nut.

> **CAUTION**
> Use care while handling the level sensor lead wire to prevent damage to the conductors and center vent tube.

6. Slide the level sensor and center it within the sensor housing at the bottom of the tube. Secure it with the three (3) socket head setscrews. To prevent damage to the sensor case, do not over tighten the setscrews.

7. Position the tube vertically and carefully slide the pump and motor assembly into the tube. Guide the assembly past the sensor lead wire to prevent crushing or cutting the lead wire. Remove slack from the sensor lead wire by pulling the lead wire out through the top.

8. Install a new top O-ring and liberally apply white petroleum jelly (Vaseline or equivalent) to the O-ring and cover sealing surfaces. Align the screw holes in the top with the holes in the tube and carefully slide the top into the tube making sure that the O-ring is not damaged.

9. Remove the slack from the motor lead and sensor lead wire. Secure the top to the tube with three (3) cap screws. Tighten cap screws until sealing grease starts to bead out from the top-to-tube joint. Do not over tighten.

10. Secure motor lead and sensor lead wire with the cord restraint nuts. Tighten the nut until the edge of the insert can be seen on the inside edge. Install vent hose.

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SEAL TEST PROCEDURE

NOTE: Refer to Figure 2.

1. Install mechanical plug into the discharge pipe connection located in pump top. Tighten to recommended specifications. Refer to Table A.

2. Connect gage tubing to vent fitting.

3. Connect magnehelic gage to gage tubing.

4. Fill five gallon pail with water to the rim.

5. Place pump assembly, as depicted on Figure 2, in the filled five gallon pail.

6. Observe the magnehelic gage. The pressure should read about 5" W.C. and hold steady.
   a. If the pressure holds steady, the pump is ready to be installed. Remove the gauge tubing and the mechanical plug.
   b. If the gauge pressure does not hold steady, there is an air leak in the top assembly.
      b.1. Remove the pump assembly from the five gallon pail and refill the pail with water.
      b.2. Mix a solution of soap and water in a hand pump spray application bottle and spray the top assembly.
      b.3. Place the pump assembly in the five gallon pail and observe the top assembly for bubbles to determine point of the seal leak.
      b.4. Make necessary adjustments to the pump assembly and repeat items b.1. through b.3. until the leak has been corrected and the gauge pressure holds steady.

INSTALLATION

1. Remove the gage tubing and the mechanical plug and install the vent tube with vent valve.

2. Run the level sensor lead wire to the PumpMaster™ control panel or breakout box and connect the sensor RED wire to the (-) terminal and BLACK wire to the (+) terminal. Connect the level sensor vent tube to the dryer and check for kinks and crushed areas in the tube connection area. The vent tube must be open to allow atmospheric pressure change compensation in the sensor.

3. Repeat bucket test to verify level sensor operation.

4. Install pump into place.

5. Check the level sensor readings before running pump. The LevelMaster meter should indicate the proper depth of the sensor when immersed in liquid. If the meter shows -34.7 the lead wires connections are reversed, not connected or damaged. Be certain to check correct voltages at the controller and measure the resistance of the motor lead and motor to assure proper wiring.

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Table A

MECHANICAL PLUG SPECIFICATION

Nominal Pipe Size	Maximum Allowable Back Pressure PSIG		Tightening Torque
	Air	Water	
1"	5	110	20 in. lbs.
1.25"	5	100	30 in. lbs.
1.5"	5	70	5 ft. lbs.
2"	5	40	10 ft. lbs.
3"	5	30	12 ft. lbs.

Table B

TOOLS AND ITEMS REQUIRED FOR MAINTENANCE OF EPG SUREPUMP

* 0-32 Screw with 5/16" hex head
* 5/16" Nut driver
* 10-32 x 5/16" long stainless steel set screw
* 3/32" Allen wrench
* .0005" Shim stock (blue)
* O-ring set 4, 5, and 6
* White petroleum jelly (Vaseline)
* Anti-seize compound
* Small channel lock pliers
* Magnehelic gage (Model 2010)
* Scissors to cut shim stock
* Flat blade screwdriver
* 1/2" Open end wrench
* 24" of 1/4" OD nylon tubing
* Mechanical plug set -- 1", 1.25", 1.5", 2", and 3"
* Torque wrench

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Figure 1

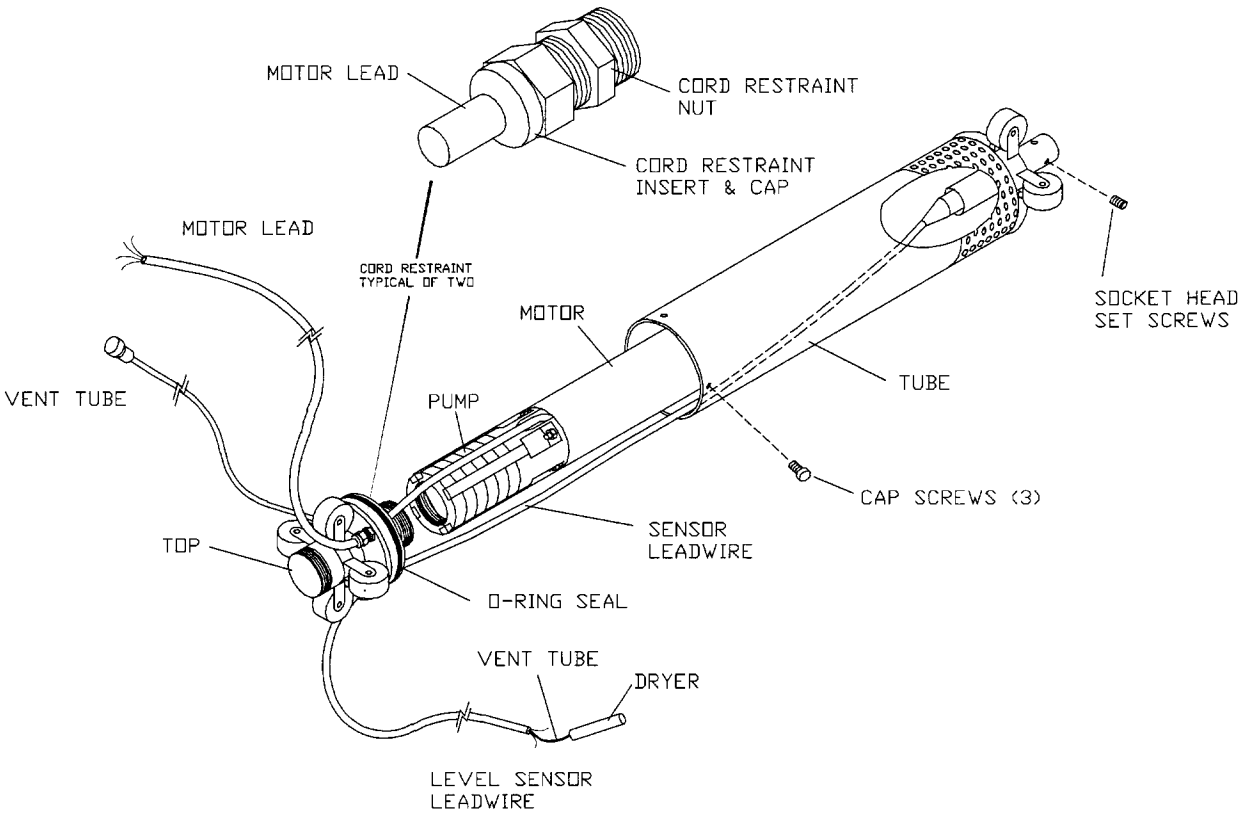

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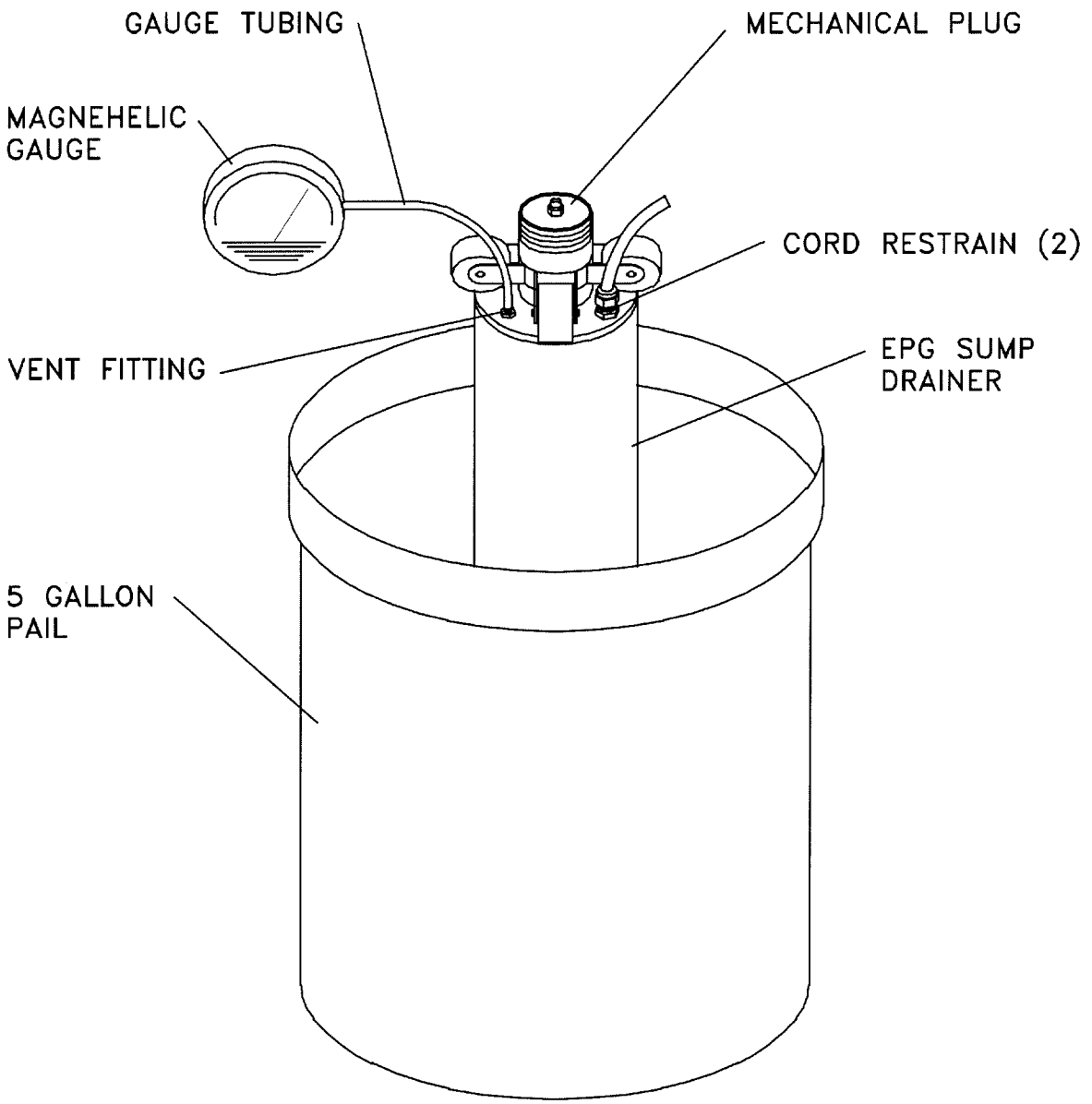
Figure 2



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EPG SurePump™ with LevelMaster™ Level Sensor

REPLACEMENT INSTRUCTIONS FOR LEVEL SENSOR IN WHEELED SUMP DRAINER

1. Use a 15/16 open end wrench to loosen and then remove the cord restraint nut (2).
2. Slide the cord restraint nut (2) and the grommet (3) off of the level sensor cable (1).
3. Use a 3/32" hex key to loosen the three set screws (4) from the locking collar.
4. Tie a string to the top end of the level sensor cable (1) and use electrician's tape to secure the string. Remove desiccant dryer from vent tube and close vent tube with tape.
5. Push several inches of the level sensor cable (1) into the sump drainer. Pull the level sensor holder (8) and the level sensor (6) out of the locking collar (5).
6. Pull the level sensor cable (1) through the sump drainer to a point where the electrician's tape can be removed.

   CAUTION: Do not pull the string through the sump drainer, it will be used to assist installation of the new level sensor.
7. Use the 3/32" hex key to loosen the four set screws (7) in the level sensor holder (8) and remove the level sensor.
8. Remove the string from the level sensor cable (1).
9. Remove the foam protective cover from the new level sensor.

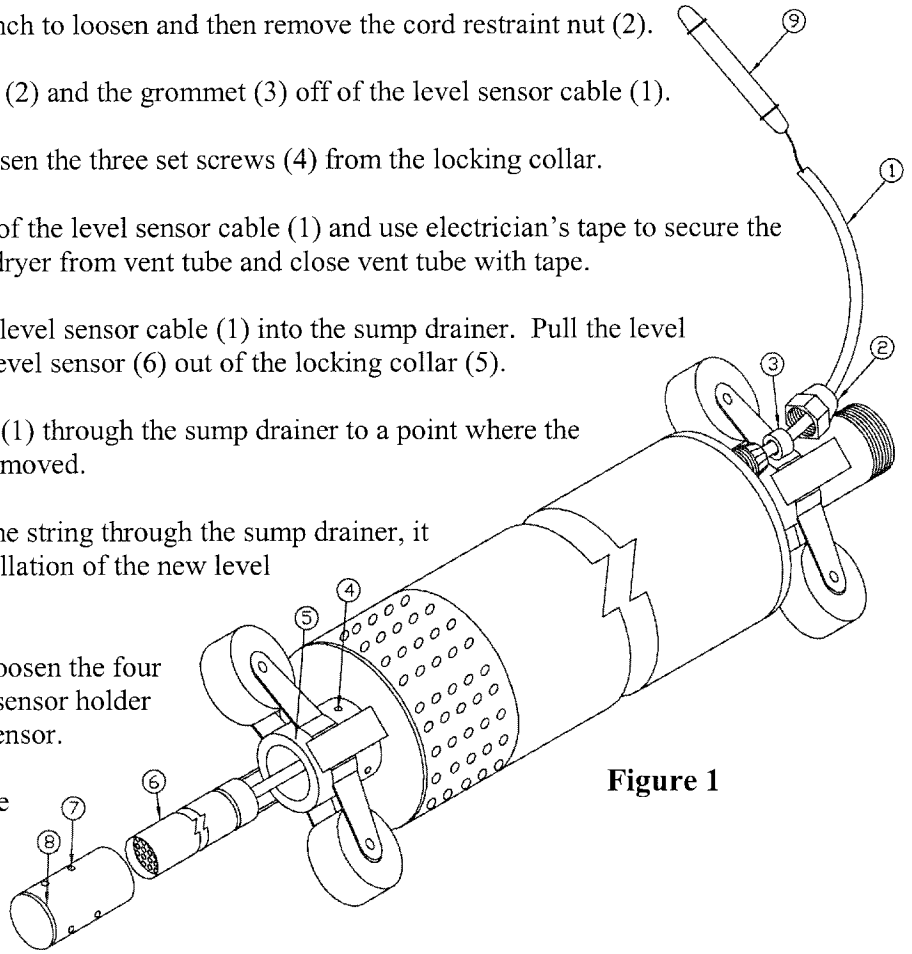

Figure 1

10. Remove the desiccant dryer tube (9) and seal the vent tube with electrician's tape.

    CAUTION: The vent tube must have a dessicant dryer installed at all times or be sealed with electrician's tape. It is very important not to allow any dirt or moisture to enter the vent tube.
11. Place the new level sensor (6) in the level sensor holder (8). Secure the two setscrews with the 3/32 hex key and torque to a maximum of seven-inch pounds.

    CAUTION: Do not over tighten the setscrews. Over tightening can damage the level sensor. Seven-inch pounds torque will secure the level sensor (6) in place.

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12. Tie the string to the new level sensor cable end (1) and use electrician's tape to secure the string.

13. At the sump drainer's discharge end, pull the string and level sensor cable (1) through the sump drainer until the level sensor holder (8) is seated in the locking collar (5).

    CAUTION: Do not pull the cable tight. Allow two to three inches of slack in the sump drainer.

14. Insure the level sensor holder (8) is securely seated in the locking collar (5) and tighten the three set screws (4). Torque to 15-inch pounds.

15. Remove the electrician's tape and string from the level sensor cable.

16. Reinstall the grommet (3) and the cord restraint nut (2). Tighten with the 15/16 open end wrench

17. Remove the tape from the vent tube and reinstall the dryer (9).

Tools/Equipment needed:

- 15/16 open end wrench
- 3/32 hex key
- String-2 or 3 feet longer than the sump drainer
- Electrician's tape
- Torque wrench with inch pound scale

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TEST EQUIPMENT

To insure proper installation, EPG recommends the following instruments. When working with electrical circuits, use caution to avoid electrical shock.

Megohmmeter:	To measure insulation value of motor and motor leads to ground. The higher the reading, the better.
Ohmmeter:	(Must be able to read less than 1 ohm) To measure resistance winding to winding in motor, check quality of any connections made in motor circuit to test coils of relays and continuity of circuits.
Volt Meter:	To verify correct supply voltage and measure system requirements when running.
Clamp on Amp Meter:	To measure current draw in system.

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TROUBLESHOOTING GUIDE

FAULT	POSSIBLE CAUSE	HOW TO CHECK	HOW TO CORRECT
Pump or blower does not run.	No electricity at controller.	Check for voltage at controller.	If no voltage at controller, check for cause. Contact power company if voltage is incorrect.
	Fuses are blown or circuit breakers are tripped.	Check fuses for correct size and check for loose, dirty, or corroded connections in fuse receptacle, terminal strip and at splice points.	Replace with proper fuse or reset circuit breaker. If new fuses blow or circuit breaker trips, the electrical installation, motor and leads must be checked.
	Motor starter overloads have tripped out.	Check for voltage on line and load side of starter. Check megohm value of motor and lead.	Reset heaters or replace. Inspect starter for other damage. If heater trips again, check the supply voltage. Replace motor or lead as needed.
	Motor and/or cable are defective.	Turn off voltage, disconnect drop leads from controller to the motor. Measure the lead-to-lead resistances with ohmeter (RX-1). Measure lead-to-ground values with megohm meter. Record measured values.	If open winding or ground is found, remove pump and recheck values at the surface. Repair or replace motor or cable.

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FAULT	POSSIBLE CAUSE	HOW TO CHECK	HOW TO CORRECT
	Starter does not energize.	Energize control circuit and check for voltage at the holding coil.	If no voltage, check control circuit. If voltage, check holding coil for shorts. Replace bad coil.
	Defective controls.	Check all sensors and safety switches for operation. Inspect contact in control devices.	Replace worn or defective parts.
	Defective capacitor. (Single phase only.)	Turn off voltage, discharge capacitor. Check with megohm meter. Record measured values.	Replace if defective.
Pump runs but does not deliver liquid.	Liquid level in sump is too low or sump infiltration rate is reduced or intranded gas.	Check sump draw down.	See pump data sheet for minimum submergence values.
	Vent valve not installed or improperly installed.	Make sure valve is attached to the to of the sump drainer and that it is not installed backward.	Replace valve if missing. Reverse valve if installed upside down.
	Inlet strainer is clogged.	Install pressure gauge, start pump, gradually close the discharge valve and read pressure at shutoff.	Remove pump and inspect for blockage. Clean screen as needed. Inspect check valve for blockage. Rinse out pump and reinstall.

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FAULT	POSSIBLE CAUSE	HOW TO CHECK	HOW TO CORRECT
	Pump is defective or worn.	Same as description above.	Convert PSI to feet (PSI x 2.31 ft/PSI = ___ ft.), add elevation from pressure gauge to liquid level to the converted pressure reading. Refer to specific pump curve for shutoff head for that pump model. If calculated value is close to curve, pump is probably OK. If not, remove pump & inspect.
Pump runs continuously.	Leak in system.	Check system for leaks.	Replace damaged pipes or repair leaks.
	Worn pump.	Install pressure gauge, start pump, gradually close the discharge valve and read pressure at shut-off.	Pull pump and inspect. Replace worn impellers, bearings or other close fitting parts.
	Loose or broken motor shaft.	Little or no liquid will be delivered if the pump/motor coupling is loose or if the motor shaft has sheared off.	Check for damaged shafts if coupling is loose and replace worn or defective units.
	Pump intake or impellers blocked.	Restricted flow may indicate a clogged intake screen or partially blocked impellers. Pump may be installed in mud or sand.	Clean screen and reset pump. It may be necessary to clean impellers.

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FAULT	POSSIBLE CAUSE	HOW TO CHECK	HOW TO CORRECT
Pump runs but at reduced capacity.	Wrong rotation.	Check for proper electrical connection in control box.	Correct wiring and change leads as required.
	Leak in system.	Check system for leaks.	Replace damaged pipes or repair leaks.
	Pump strainer or check valve is clogged.	Remove pump and inspect.	Clean, repair, rinse out and re-install pump. It may be necessary to take pump apart and clean impellers. Check discharge line for any obstructions.

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Wire Cable Clamp

INSTALLATION INSTRUCTIONS

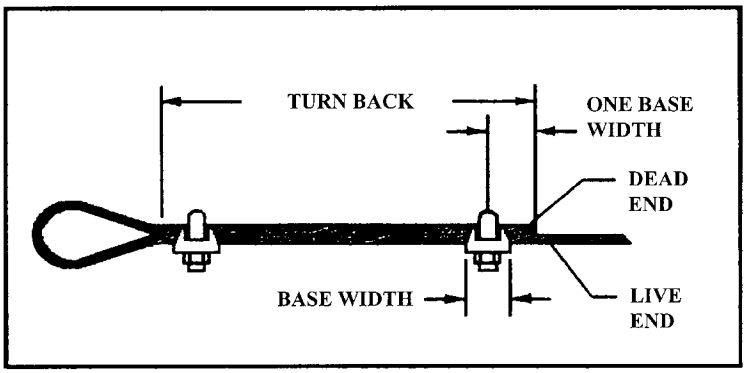
Recommended Method of Applying Clamps to get Maximum Holding Power

1. *Turn back* the specified amount of cable from the loop. Apply the first clamp one base width from the dead end of the wire cable (U-bolt over dead end - live end rests in clamp saddle). Tighten nuts evenly to recommended torque.

2. *Apply the next clamp* as near the loop as possible. Turn on nuts firm, take up rope slack, and tighten nuts evenly to recommended torque.

3. Do not use clamps on plastic coated wire rope.

4. Never use clamps to connect two straight lengths of wire rope.



Attaching Clamps

A termination made in accordance with instruction and using the number of clamps shown has an approximate 80% efficiency rating. This rating is based upon the catalog breaking strength of wire rope.

Number of Clamps Recommended

Clamp Size Inches	Minimum No. of Clamps	Amount of Cable to Turn Back in Inches	Breaking Strength FT/LBS	Clamp Torque FT/LBS	Cable Strength with Clamps FT/LBS
1/8	2	3 1/4	1,760	4.5	1400
3/16	2	3 3/4	3,700	7.5	2960
1/4	2	4 3/4	6,400	15	5120

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STORAGE INFORMATION

SUREPUMP™

1. The ideal storage condition for SurePump is in a warm dry location. Although SurePump will tolerate a light freeze, temperatures should not fall below -3°C (27°F). Repeated freezing and thawing should be avoided to prevent possible loss of motor fluid.

2. Limit storage time to less than two years if storage area temperatures exceed 100°F. Limit storage time to one year or less if storage area temperatures exceed 130°F.

3. To prevent motor seal damage and/or fluid loss, always store SurePump vertically.

LEVELMASTER™

1. IMPORTANT: During any short or long term storage, to prevent moisture damage to internal components, the desiccant dryer must be installed on the vent tube of the submersible level sensor signal cable. Store in a warm dry location to prevent internal condensation in the meter enclosure.

2. If the level sensor is installed in a SurePump, pump must be stored in a vertical position. Coil the sensor signal cable and place in a box or protected area to prevent damage to the signal cable. Do not stack heavy items on top of level sensor signal cable.

3. Make certain that the desiccant dryer is attached to the end of the level sensor vent tube. Inspect dryer periodically and replace if crystals are pink or white.

PUMPMASTER™ CONTROLS

1. To prevent condensation/moisture damage within the control cabinet, store the PumpMaster in a warm dry location.

2. Check that the corrosion inhibitor cartridge is installed in the interior of the cabinet. If the PumpMaster control will be stored for over six months, contact EPG Companies Inc. for additional corrosion inhibitor cartridges

NOTE

The non-volatile memory of level and flow meters may deteriorate if left without power for periods greater than one year. If storage times are expected to exceed one year contact EPG Companies Inc. for special precautions.

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EPG Companies Inc.

SurePump™ Installation Record

Form Completed by: _____ Installation Date: _____

Company: _____ EPG Serial #: _____

PUMPS, CONTROLS AND POWER SUPPLY

Installer:	Address:	Installation Location:
Motor Model HP	Volts: Max Amps Rating:	Pump Model:
Power Supply Transformers: Number Used: KVA Each:	Hertz: Comments:	
Pump Control Panel: Mfg. & Model #:	Motor Starter Size: Overload Heater Part or setting range:	IEC Starters:
Lightning Arrestors: Mfg. & Model:	Surge Capacitors: Yes _____ No _____	Disconnect Fuse or Circuit Breaker Amp Rating:
Primary Flow Control Devices: (Low Level Control, Flow Control, Valve, System Back Pressure, etc.)		

OPERATING DATA (Measurements at Control Panel)

PUMP CONDITIONS: GPM	VOLTS	AMPS
Pump Not Running 0	R-Y _____ R-B _____ B-Y _____	
Open Discharge	R-Y _____ R-B _____ B-Y _____	R _____ Y _____ B _____
Normal Operation Run Time _____ Off Time _____	R-Y _____ R-B _____ B-Y _____	R _____ Y _____ B _____

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INSTALLATION DATA

Discharge Line Size:	Discharge Pressure:	Pump Submergence:	Fluid Temp: _____°F _____°C
External Check Valve Used?	Location:	Cable Length & Size:	Ground Resistance
Insulation Megohm Readings:	Before Installation:	After Installation:	After 30 min. Run:

SENSORS

Type of Level Sensor: Pressure Transmitter _____ Load Monitor _____ Floats _____ Other _____	Transmitter Serial Number:
Length of Sensor Lead:	Ohm Readings Across I.S. Barrier:
mA Readings on Transmitter Lead:	Voltage Reading Entering Level Meter: ____VAC Voltage Leaving Level Meter: _____VAC
Are Flow Sensors Used: Yes _____ No _____	Flow Spool Made of: PVC _____ Stainless Steel _____

Comments: _____

_____

_____

_____

_____

_____

Place one copy of this record in the control panel, return one copy to EPG, and retain original for your records.

In case of problems or questions, contact EPG Companies Inc., 19900 County Road 81, Maple Grove, MN 55311. Phone: 800-762-8418 FAX: 763-493-4812

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LIMITED WARRANTY

This agreement shall be deemed to have been entered into in the State of Minnesota, and shall be construed in accordance with the laws of the State of Minnesota, including Minnesota's enactment of the Uniform Commercial Code. Buyer hereby stipulates and agrees that Hennepin County, Minnesota shall be the proper jurisdiction for adjudicating all claims and controversies arising from this agreement.

Products manufactured by EPG Companies Inc. are warranted for a period of 12 months from date of installation or eighteen (18) months from date of manufacture* to be free from defects of materials and workmanship. It is expressly agreed that the exclusive remedy under this warranty is limited solely to the repair or replacement, at the sole discretion of EPG, of the part that failed. The cost of labor for any field repairs is not covered by this warranty. EPG Companies will not be liable for any damage or wear due to abnormal conditions or improper installation.

Products not manufactured by EPG Companies Inc. are covered by the original manufacturer's warranty, which EPG Companies passes through to the purchaser. The actual manufacturer will make warranty determination.

To have a defective part repaired or replaced, you must return the defective product to EPG Companies. Please call (800) 443-7426 or (763) 424-2613 to obtain a Return Goods Authorization (RGA) number. Send defective product (freight prepaid) with RGA #, description of installation, installation data and failure date to EPG Companies Inc., 19900 County Rd. 81, Maple Grove, MN 55311.

EPG Companies will not be held liable for any incidental or consequential damages, losses or expenses incurred from installation, use or any other reason. THERE ARE NO OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING IMPLIED WARRANTIES OF EITHER FITNESS FOR A PARTICULAR PURPOSE OR OF MERCHANTABILITY, WHICH EXTEND BEYOND THOSE SPECIFICALLY LISTED HERE.

If equipment is to be stored for a period greater than six months, proper storage precautions must be taken if the warranty is to be maintained. Please call EPG Companies for specific requirements regarding product storage.

The following is a partial list of items, which will void the warranty:

- Opening the motor for any reason.
- Using undersized electrical wire.
- Making unauthorized circuit changes. Please call EPG Companies before making any changes.
- Operating a three phase submersible motor from single phase power through a phase converter unless 3-leg ambient-compensated quick trip overload protectors are used and complete details are sent in writing to EPG Companies.

* To qualify for the delayed installation warranty you must contact EPG Companies Inc., at (800) 443-7426 or (763) 424-2613 within 60 days of purchase.

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Appendix R
NPDES Permit

wastewater

William G. Ross Jr., Secretary
North Carolina Department of Environment and Natural Resources

Alan W. Klimek, P.E. Director
Division of Water Quality

March 14, 2007

Jack Bray
Domtar Paper Company, LLC
P.O. Box 747
Plymouth, NC 27962

Subject: NPDES Permit Modification
Permit NC0000680
Domtar Paper Company, LLC
formerly Weyerhauser Co.
Martin County

Dear Mr. Bray:

Division personnel have reviewed and approved your request to transfer ownership of the subject permit, received on March 14 2007. This permit modification documents the change in ownership.

Please find enclosed the revised permit. All other terms and conditions contained in the original permit remain unchanged and in full effect. This permit modification is issued under the requirements of North Carolina General Statutes 143-215.1 and the Memorandum of Agreement between North Carolina and the U.S. Environmental Protection Agency.

If you have any questions concerning this permit modification, please contact the Point Source Branch at (919) 733-5083 extension 363.

Sincerely,

Phil Vinzani

for: Alan W. Klimek, P.E.

cc: Central Files
Washington Regional Office, Surface Water Protection
Aquatic Toxicology Unit
Mr. Roosevelt Childress, EPA Region IV
NPDES Unit File

STATE OF NORTH CAROLINA
DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF WATER QUALITY

PERMIT

TO DISCHARGE WASTEWATER UNDER THE

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provision of North Carolina General Statute 143-215.1, other lawful standards and regulations promulgated and adopted by the North Carolina Environmental Management Commission, and the Federal Water Pollution Control Act, as amended,

Domtar Paper Company, LLC

is hereby authorized to discharge wastewater from a facility located at the

Domtar Paper Company, LLC
NCSR 1565
Martin County

to receiving waters designated as the Roanoke River in the Roanoke River Basin in accordance with effluent limitations, monitoring requirements, and other conditions set forth in Parts I, II, III and IV hereof.

This permit shall become effective March 15, 2007.

This permit and authorization to discharge shall expire at midnight on February 28, 2011.

Signed this day March 15, 2007.

for: Alan Klimek, P.E., Director
Division of Water Quality
By Authority of the Environmental Management Commission

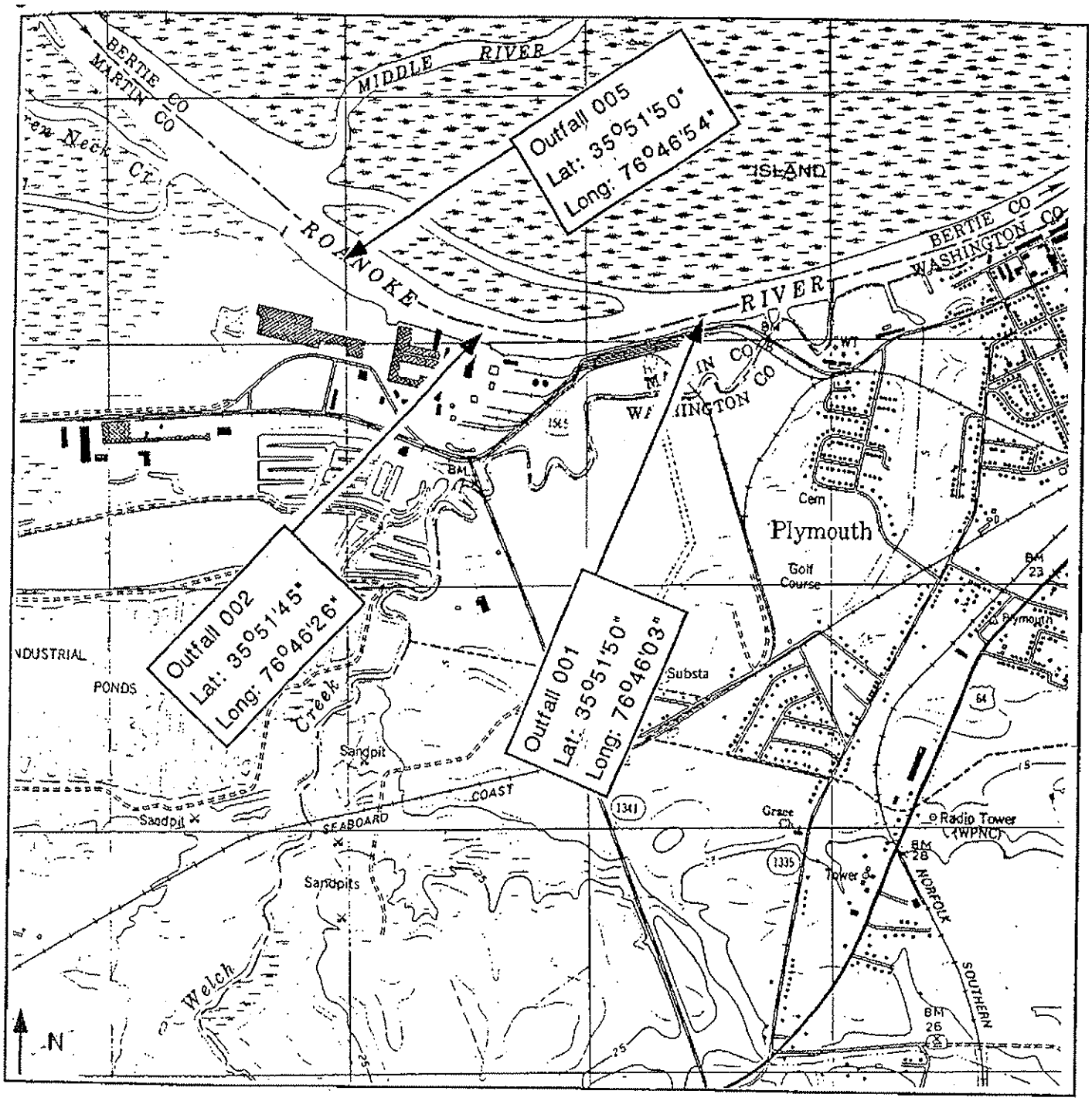
SUPPLEMENT TO PERMIT COVER SHEET

All previous NPDES Permits issued to this facility, whether for operation or discharge are hereby revoked. As of this permit issuance, any previously issued permit bearing this number is no longer effective. Therefore, the exclusive authority to operate and discharge from this facility arises under the permit conditions, requirements, terms, and provisions included herein.

The Domtar Paper Company, LLC is hereby authorized to:

1. Continue to operate existing treatment facilities (outfall 001) consisting of two primary settling ponds with a total area of 71.3 acres, a 72 acre aeration pond, two retention ponds containing a total of 292.5 acres and sludge ponds, discharge non-contact turbine cooling water (outfall 002) and discharge stormwater runoff and, during rain events exceeding 3.8"/day (0.16"/hr), ice maker drain water, non-contact air conditioning cooling water, and non-contact drip pan water (outfall 005), from the Domtar Paper Company, LLC Facility located on NCSR 1565, Martin County, and

2. Discharge from said treatment works at the locations specified on the attached map into the Roanoke River which is classified C-Swamp waters in the Roanoke River Basin.



Latitude: see above
Longitude: see above
Design Q 55.0 MGD
Discharge Class: 100% Industrial
Stream Class: C-Swamp
Receiving Stream: The Roanoke River
Sub-Basin: 03-02-09
Permitted Flow: 0.0053 MGD

NC0000680
Domtar Paper Company, LLC

North

Facility Location

SCALE 1:24000

A. (1) EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

ıring the period beginning on the effective date of the permit and lasting until expiration, the Permittee is authorized to 'scharge from outfall(s) serial number 001. Such discharges shall be limited and monitored by the Permittee as specified belo

EFFLUENT CHARACTERISTICS	LIMITS			MONITORING REQUIREMENTS		
	Monthly Average	Weekly Average	Daily Maximum	Measurement Frequency	Sample Type	Sample Location[1]
Flow (MGD)	55.0		82.5	Continuous	Recording	E
BOD, 5-day, 20°C (Summer)	9340 lbs/day		18119 lbs/day	Daily	Composite	E
BOD, 5-day, 20°C (Winter)	18680 lbs/day		36239 lbs/day	Daily	Composite	E
Total Suspended Residue	40793 lbs/day		77218 lbs/day	Daily	Composite	E
NH_3-N (Summer)	1600 lbs/day		2400 lbs/day	Daily	Composite	E
NH_3-N (Winter)	3200 lbs/day		4800 lbs/day	Daily	Composite	E
Temperature (°C)				Daily	Grab	E
Dissolved Oxygen				Daily	Grab	E
pH[2]				Daily	Grab	E
Total Phosphorus (lbs/day)				Monthly	Composite	E
Total Nitrogen (NO_2+NO_3+TKN) (lbs/day)				Monthly	Composite	E
Chronic Toxicity[3]				Quarterly	Composite	E
Dioxin[4]			1.3 pg/L	Quarterly	Composite	E
AOX[5]	2,167.2 lb/day		3,308.2 lb/day	Daily	Composite	E
Trichlorophenol[6]			31.2 lb/day	Suspended	Composite	E
Pentachlorophenol[6]			6.5 lb/day	Suspended	Composite	E
Temperature (°C)				See A. (8)	Grab	U, D
Dissolved Oxygen				See A. (8)	Grab	U, D
Conductivity				See A. (8)	Grab	U, D

Notes:

1. Sample Locations: E - Effluent. For instream monitoring information, see item A (9) of the *Supplement to Effluent Limitations and Monitoring* page.

2. The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units.

3. Chronic Toxicity (Ceriodaphnia) P/F at 6.8%; February, May, August and November; see item A. (5) of the *Supplement to Effluent Limitations and Monitoring* page.

4. For compliance purposes, the dioxin "effluent" sample shall be collected at the combined inlet to the wastewater treatment plant; see item A (9) of the *Supplement to Effluent Limitations and Monitoring* page.

5. AOX monitoring shall be in accordance with the Weyerhaeuser Cluster Rule Sampling Plan (dated 8/11/2000) or subsequent modifications approved by the Division. AOX data shall be submitted on a quarterly basis along with other Cluster Rule chemical data; refer to A. (11) Effluent Guideline Sampling Plan Special Condition.

6. Monitoring is suspended for these compounds as long as chlorophenolic-containing biocides are not used at the facility.

'here shall be no discharge of floating solids or visible foam in other than trace amounts.

ummer shall mean April 1 - October 31, while winter shall mean November 1 - March 31.

A (2) EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

L ..ng the period beginning on the effective date of the permit and lasting until expiration, the Permittee is authorized to discharge from outfall(s) serial number 002. Such discharges shall be limited and monitored by the Permittee as specified below:

EFFLUENT CHARACTERISTICS	LIMITS			MONITORING REQUIREMENTS		
	Monthly Average	Weekly Average	Daily Maximum	Measurement Frequency	Sample Type	Sample Location[1]
Flow (MGD)				Monthly	Instantaneous	E
Temperature (°C)[2]				Monthly	Grab	E
Total Residual Chlorine[3]				Monthly	Grab	E
pH[4]				Monthly	Grab	E

Notes:

THERE SHALL BE NO CHROMIUM, ZINC OR COPPER ADDED TO THE TREATMENT SYSTEM EXCEPT AS PRE-APPROVED ADDITIVES TO BIOCIDAL COMPOUNDS.

1. Sample Locations: E - Effluent.

2. The temperature of the effluent shall be such as not to cause an increase in the temperature of the receiving stream of more than 2.80°C and in no case cause the ambient water temperature to exceed 32.0°C.

3. Monitoring requirements only apply if chlorine is added to the cooling water.

4. The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units.

The permittee shall obtain authorization from the Division of Water Quality prior to utilizing any biocide in the cooling water; see item A (5) of the *Supplement to Effluent Limitations and Monitoring* page.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

(3) EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning on the effective date of the permit and lasting until expiration, the Permittee is authorized to discharge from outfall(s) serial number 005. Such discharges shall be limited and monitored by the Permittee as specified below:

EFFLUENT CHARACTERISTICS	LIMITS			MONITORING REQUIREMENTS		
	Monthly Average	Weekly Average	Daily Maximum	Measurement Frequency	Sample Type	Sample Location[1]
Flow (MGD)				Annually	Instantaneous	E
Temperature (°C)[2]				Annually	Grab	E
Total Residual Chlorine[3]				Annually	Grab	E
pH[4]				Annually	Grab	E

Notes:

THERE SHALL BE NO CHROMIUM, ZINC OR COPPER ADDED TO THE TREATMENT SYSTEM EXCEPT AS PRE-APPROVED ADDITIVES TO BIOCIDAL COMPOUNDS.

1. Sample Locations: E - Effluent.

2. The temperature of the effluent shall be such as not to cause an increase in the temperature of the receiving stream of more than 2.8°C and in no case cause the ambient water temperature to exceed 32.0°C.

3. Monitoring requirements only apply if chlorine is added to the cooling water.

4. The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units.

The permittee shall obtain authorization from the Division of Water Quality prior to utilizing any biocide in the cooling water; see item A (5) of the *Supplement to Effluent Limitations and Monitoring* page.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

.. (4) EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning upon the effective date of the permit and lasting until expiration, the discharge of **wastewater from the bleach plant 6 and bleach plant 7** through outfall(s) **006,** shall be limited and monitored by the Permittee as specified below and in A. (12) Effluent Guideline Sampling Plan Special Condition:

Effluent Characteristics	LIMITS		MONITORING REQUIREMENTS[2]		
	Monthly Average	Daily Maximum	Measurement Frequency	Sample Type[3]	Sample Location[1]
Flow[2]			Weekly	Calculated	E
Chloroform[4]	14.4 lb/day	24.1 lb/day	Weekly	Grab	E
2,3,7,8 Tetrachloro-dibenzo-p-dioxin (TCDD)		< 10 pg/L	Monthly	Composite	E
2,3,7,8 Tetrachloro-dibenzo-p-furan (TCDF)		31.9 pg/L	Monthly	Composite	E
Trichlorosyringol		< 2.5 µg/L[5]	Monthly	Composite	E
3,4,5-Trichlorocatechol		< 5.0 µg/L[5]	Monthly	Composite	E
3,4,6-Trichlorocatechol		< 5.0 µg/L[5]	Monthly	Composite	E
3,4,5-Trichloroguaiacol		< 2.5 µg/L[5]	Monthly	Composite	E
3,4,6-Trichloroguaiacol		< 2.5 µg/L[5]	Monthly	Composite	E
4,5,6-Trichloroguaiacol		< 2.5 µg/L[5]	Monthly	Composite	E
2,4,5-Trichlorophenol		< 2.5 µg/L[5]	Monthly	Composite	E
2,4,6-Trichlorophenol		< 2.5 µg/L[5]	Monthly	Composite	E
Tetrachlorocatechol		< 5.0 µg/L[5]	Monthly	Composite	E
Tetrachloroguaiacol		< 5.0 µg/L[5]	Monthly	Composite	E
2,3,4,6-Tetrachlorophenol		< 2.5 µg/L[5]	Monthly	Composite	E
Pentachlorophenol		< 5.0 µg/L[5]	Monthly	Composite	E
pH of the first ClO_2 bleaching stage[6]		3.22	Weekly	Grab	E
Kappa factor of the first ClO_2 bleaching stage[6]		0.80	Weekly	Calculated	E
Total bleach line ClO_2 application rate (lb/ADT)[6]		8.50	Weekly	Calculated	E

Footnotes:

1. Sample Location: E – Discharge point of where the combined bleach plant effluent sewer enters the wastewater treatment system. Effluent is composed of **Bleach Plant 6 Effluent and Bleach Plant 7 effluent**. See A. (12) Effluent Guideline Sampling Plan Special Condition.

2. Monitoring and flow calculations monitoring shall be in accordance with the Weyerhaeuser Cluster Rule Sampling Plan (dated 8/11/2000) or subsequent modifications approved by the Division. Chemical results for Cluster Rule parameters (Internall Outfall 006 + AOX from Outfall 001) shall be reported on a quarterly basis; refer to A. (12).

3. Sample Type: **Calculated**- calculate separate flows for Bleach Plant 6 and Bleach Plant 7 by water balance or flow meters, and report total bleach plants flow (acid + alkaline waste streams) in DMRs. **Grab**- collect separate automated grab samples over a 24-hour period from sampling point using the ISCO Cluster Rule Volatile Organic Compound sampler (or similar sampler), which will then be composited separately by the lab and analyzed as 24-hr

composite sample. **Composite-** collect separate automated composite samples over a 24-hour period from sampling point, then prepare and analyze a single flow-proportioned composite sample.

4. Per 40 CFR 430.02 (f) chloroform monitoring is suspended due to the submission of "Certification in lieu of monitoring". If conditions of certification are violated and chloroform sampling is performed, then for compliance purposes, the permittee must report the total chloroform mass loading.

5. Limits are based on Minimum Levels (ML) specified in 40 CFR 430.01.

6. If limit is exceeded the permittee will be in violation unless:
   a) DWQ is notified within 30 days of the exceedence, and
   b) Compliance with the chloroform limit is demonstrated by taking one sample to monitor effluent for chloroform within 7 days of exceeding the value. If the sample demonstrates compliance, process monitoring will resume in lieu of monitoring for chloroform.

   Compliance with the chloroform effluent limit can be demonstrated by either sampling each fiberline for chloroform or by monitoring process parameters.
   In order to continue exemption from the chloroform monitoring requirements the permittee must meet conditions specified in 40 CFR 430.02 (f)(6)(2). Periods of start-up, shutdown, or instrumental malfunction will not be considered for the purposes of demonstrating compliance.

Definitions:

"b/day – Pounds per day
g/L – Picograms per liter
µg/L – Micrograms per liter
ADT – air dried ton of pulp product

SUPPLEMENT TO EFFLUENT LIMITATIONS
AND MONITORING REQUIREMENTS
SPECIAL CONDITIONS

A. (5) CHRONIC TOXICITY PASS/FAIL PERMIT LIMIT (QUARTERLY)

The effluent discharge shall at no time exhibit observable inhibition of reproduction or significant mortality to Ceriodaphnia dubia at an effluent concentration of **6.8%.**

The permit holder shall perform at a minimum, quarterly monitoring using test procedures outlined in the "North Carolina Ceriodaphnia Chronic Effluent Bioassay Procedure," Revised February 1998, or subsequent versions or "North Carolina Phase II Chronic Whole Effluent Toxicity Test Procedure" (Revised-February 1998) or subsequent versions. The tests will be performed during the months of February, May, August and November. Effluent sampling for this testing shall be performed at the NPDES permitted final effluent discharge below all treatment processes.

If the test procedure performed as the first test of any single quarter results in a failure or ChV below the permit limit, then multiple-concentration testing shall be performed at a minimum, in each of the two following months as described in "North Carolina Phase II Chronic Whole Effluent Toxicity Test Procedure" (Revised-February 1998) or subsequent versions.

The chronic value for multiple concentration tests will be determined using the geometric mean of the highest concentration having no detectable impairment of reproduction or survival and the lowest concentration that does have a detectable impairment of reproduction or survival. The definition of "detectable impairment," collection methods, exposure regimes, and further statistical methods are specified in the "North Carolina Phase II Chronic Whole Effluent Toxicity Test Procedure" (Revised-February 1998) or subsequent versions.

All toxicity testing results required as part of this permit condition will be entered on the Effluent Discharge Monitoring Form (MR-1) for the months in which tests were performed, using the parameter code TGP3B for the pass/fail results and THP3B for the Chronic Value. Additionally, DWQ Form AT-3 (original) is to be sent to the following address:

Attention: NC DENR / DWQ / Environmental Sciences Section
1621 Mail Service Center
Raleigh, North Carolina 27699-1621

Completed Aquatic Toxicity Test Forms shall be filed with the Environmental Sciences Branch no later than 30 days after the end of the reporting period for which the report is made.

Test data shall be complete, accurate, include all supporting chemical/physical measurements and all concentration/response data, and be certified by laboratory supervisor and ORC or approved designate signature. Total residual chlorine of the effluent toxicity sample must be measured and reported if chlorine is employed for disinfection of the waste stream.

Should there be no discharge of flow from the facility during a month in which toxicity monitoring is required, the permittee will complete the information located at the top of the aquatic toxicity (AT) test form indicating the facility name, permit number, pipe number, county, and the month/year of the report with the notation of "No Flow" in the comment area of the form. The report shall be submitted to the Environmental Sciences Branch at the address cited above.

Should the permittee fail to monitor during a month in which toxicity monitoring is required, monitoring will be required during the following month.

Should any test data from this monitoring requirement or tests performed by the North Carolina Division of Water Quality indicate potential impacts to the receiving stream, this permit may be re-opened and modified to include alternate monitoring requirements or limits.

NOTE: Failure to achieve test conditions as specified in the cited document, such as minimum control organism survival, minimum control organism reproduction, and appropriate environmental controls, shall constitute an invalid test and will require immediate follow-up testing to be completed no later than the last day of the month following the month of the initial monitoring.

SUPPLEMENT TO EFFLUENT LIMITATIONS
AND MONITORING REQUIREMENTS
SPECIAL CONDITIONS (Continued)

A. (6) BIOCIDE CONDITION

The Permittee shall obtain authorization from the Division of Water Quality prior to utilizing any biocide in the cooling water. The Permittee shall notify the Director in writing not later than ninety (90) days prior to instituting use of any additional biocide used in cooling systems which may be toxic to aquatic life or other than those previously reported to the Division of Water Quality. Such notification shall include completion of Biocide Worksheet Form 101 and a map locating the discharge point and receiving stream. Concentrations of chromium, copper or zinc added to biocides shall not exceed applicable water quality standards or action levels in the receiving stream, as determined by calculations from the Biocide Worksheet From 101 with Supplemental Metals Analysis worksheet.

A. (7) NUTRIENT CONDITION FOR PERMITS WITHOUR PHOSPHORUS LIMITS

This permit may be modified, or revoked and reissued to include an effluent limitation on nutrients for this discharge depending upon the following:

1. The findings of a study by the Division of Water Quality determining that nutrient control is necessary.

2. Local actions do not successfully reduce the nutrient loading on the receiving waters.

3. The onset of problem conditions in the receiving waters

A (7). The Permittee may not discharge any wastewater if the dissolved oxygen concentration in the Roanoke River is below 4.0 mg/L for more than 24 hours, unless such discharge is authorized by the Director or his/her designee.

A. (8) STREAM SAMPLING

Upstream samples shall be taken at a point in-line with the access road to the old pumphouse at a location near the center of the Roanoke River. Downstream samples shall be taken at river marker 17.

Stream sampling shall be conducted three (3) times per week during the months of June, July, August and September as water column profile samples at the surface and at one meter depth increments to, but not including, the river bottom. Stream samples during the remaining months of the year shall be taken once per week at the surface only. During events of instream dissolved oxygen levels at or below 4.0 mg/L, the facility will monitor instream at the above locations, the NC 45 bridge, Conaby Creek and River Marker #10. The instream monitoring during these events shall be water column profiles as described above.

SUPPLEMENT TO EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS SPECIAL CONDITIONS (Continued)

A. (9) DIOXIN MONITORING

For compliance purposes, the point of compliance shall be defined as the influent before the wastewater treatment facility. Compliance with the daily maximum permit limit shall be demonstrated by determining the TCDD concentration at the influent to the wastewater treatment facility.

Adequate sample volume shall be collected to perform the analysis. The total sample volume shall be collected and preserved in accordance with Part II, Section C Monitoring and Records. The sample shall be analyzed in accordance with the appropriate method of analysis specified in Analytical Procedures and Quality Assurance for Multimedia Analysis of Polychlorinated Dibenzo-para-dioxins and Polychlorinated Dibenzofurans by High Resolution Gas Chromatography/High Resolution Mass Spectrometry, EPA, 1987 (EPA Method 1613), or another equivalent analytical protocol approved by DWQ. A single sample may be analyzed to determine compliance with the daily maximum effluent limitation. Alternatively, a sample volume may be collected to enable the sample to be split (duplicate analysis). If the analysis of either split sample is below the detection limit, the quantity, for the purposes of compliance evaluation, is considered to be zero. If both splits are positive, the results of the two analyses shall be averaged to determine compliance with the daily maximum effluent limitation. If the measurement is below detection limits, the quantity for the purposes of compliance evaluation is considered to be zero. The detection limit using these methods for the purpose of compliance evaluation is considered to be 10 picograms per liter. The dioxin isomer to be monitored and limited by this permit is 2, 3, 7, 8, TCDD.

Fish tissue analysis will be performed, as a minimum, at one station established upstream of the discharge and at two stations downstream in accordance with the Division of Water Quality approved monitoring plan. The monitoring plan is an enforceable part of this permit. All dioxin data collected as part of this monitoring requirement will be reported within three months of receiving the finalized analyses from the data collection.

The Permittee shall perform the following analysis for dioxin in addition to the monitoring as specified on the effluent pages:

1. Fish tissue analysis	Annually (TCDD and TCDF)

A. (10) CLUSTER RULE BMPs

The permittee must implement the BMPs specified in Section A below. The primary BMP objective is to prevent leaks and spills of spent pulping liquors, soap, and turpentine. A secondary objective is to contain, collect, and recover at the immediate process area, or otherwise control, those leaks, spills, and intentional diversions of spent pulping liquor, soap, and turpentine that do occur. BMPs must be developed according to best engineering practices and must be implemented in a manner that takes into account the specific circumstances at the mill.

SUPPLEMENT TO EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS SPECIAL CONDITIONS (Continued)

Section A. BMP Implementation Requirements

1. The permittee must return spilled or diverted spent pulping liquors, soap, and turpentine to the process to the maximum extent practicable as determined by the mill, recover such materials outside the process, or discharge spilled or diverted material at a rate that does not disrupt the receiving wastewater treatment system.
2. The permittee must establish a program to identify and repair leaking equipment items. This program must include: (i) Regular daily visual inspections of process area with equipment items in spent pulping liquor, soap, and turpentine service; (ii) Immediate repair of leaking equipment items, when possible. Leaking equipment items that cannot be repaired during normal operations must be identified, temporary means for mitigating the leaks must be provided, and the leaking equipment items repaired during the next maintenance outage; (iii) Identification of conditions under which production will be curtailed or halted to repair leaking equipment items or to prevent pulping liquor, soap, and turpentine leaks and spills; and (iv) A means for tracking repairs over time to identify those equipment items where upgrade or replacement may be warranted based on frequency and severity of leaks, spills, or failures.
3. The permittee must operate continuous, automatic monitoring systems that the mill determines are necessary to detect and control leaks, spills, and intentional diversions of spent pulping liquor, soap, and turpentine. These monitoring systems should be integrated with the mill process control system and may include, e.g., high level monitors and alarms on storage tanks; process area conductivity (or pH) monitors and alarms; and process area sewer, process wastewater, and wastewater treatment plant conductivity (or pH) monitors and alarms.
4. The permittee must establish a program of initial and refresher training of operators, maintenance personnel, and other technical and supervisory personnel who have responsibility for operating, maintaining, or supervising the operation and maintenance of equipment items in spent pulping liquor, soap, and turpentine service. The refresher training must be conducted at least annually and the training program must be documented.
5. The permittee must prepare a brief report that evaluates each spill of spent pulping liquor, soap, or turpentine that is not contained at the immediate process area and any intentional diversion of spent pulping liquor, soap, or turpentine that is not contained at the immediate process area. The report must describe the equipment items involved, the circumstances leading to the incident, the effectiveness of the corrective actions taken to contain and recover the spill or intentional diversion, and plans to develop changes to equipment and operating and maintenance practices as necessary to prevent recurrence. Discussion of the reports must be included as part of the annual refresher training.
6. The permittee must establish a program to review any planned modifications to the pulping and chemical recovery facilities and any construction activities in the pulping and chemical recovery areas before these activities commence. The purpose of such review is to prevent leaks and spills of spent pulping liquor, soap, and turpentine during the planned modifications, and to ensure that construction and supervisory personnel are aware of possible liquor diversions and of the requirement to prevent leaks and spills of spent pulping liquors, soap, and turpentine during construction.
7. The permittee must install and maintain secondary containment (i.e., containment constructed of materials impervious to pulping liquors) for spent pulping liquor bulk storage tanks equivalent to the volume of the largest tank plus sufficient freeboard for precipitation. An annual tank integrity testing

SUPPLEMENT TO EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS SPECIAL CONDITIONS (Continued)

program, if coupled with other containment or diversion structures, may be substituted for secondary containment for spent pulping liquor bulk storage tanks.

8. The permittee must install and maintain secondary containment for turpentine bulk storage tanks.
9. The permittee must install and maintain curbing, diking or other means of isolating soap and turpentine processing and loading areas from the wastewater treatment facilities.
10. The permittee must conduct wastewater monitoring to detect leaks and spills, to track the effectiveness of the BMPs, and to detect trends in spent pulping liquor losses. Such monitoring must be performed in accordance with Section E.

Section B. BMP Plan Requirements

1. The permittee must prepare and implement a BMP Plan. The BMP Plan must be based on a detailed engineering review as described in this section. The BMP Plan must specify the procedures and the practices required for the mill to meet the requirements of Section A, the construction the mill determines is necessary to meet those requirements including a schedule for such construction, and the monitoring program (including the statistically derived action levels) that will be used to meet the requirements of Section E. The BMP Plan also must specify the period of time that the mill determines the action levels established under Section D may be exceeded without triggering the responses specified in Section E.
2. The permittee must conduct a detailed engineering review of the pulping and chemical recovery operations--including but not limited to process equipment, storage tanks, pipelines and pumping systems, loading and unloading facilities, and other appurtenant pulping and chemical recovery equipment items in spent pulping liquor, soap, and turpentine service--for the purpose of determining the magnitude and routing of potential leaks, spills, and intentional diversions of spent pulping liquors, soap, and turpentine during the following periods of operation: (i) Process start-ups and shut downs; (ii) Maintenance; (iii) Production grade changes; (iv) Storm or other weather events; (v) Power failures; and (vi) Normal operations.
3. As part of the engineering review, the permittee must determine whether existing spent pulping liquor containment facilities are of adequate capacity for collection and storage of anticipated intentional liquor diversions with sufficient contingency for collection and containment of spills. The engineering review must also consider: (i) The need for continuous, automatic monitoring systems to detect and control leaks and spills of spent pulping liquor, soap, and turpentine; (ii) The need for process wastewater diversion facilities to protect end-of-pipe wastewater treatment facilities from adverse effects of spills and diversions of spent pulping liquors, soap, and turpentine; (iii) The potential for contamination of storm water from the immediate process areas; and (iv) The extent to which segregation and/or collection and treatment of contaminated storm water from the immediate process areas is appropriate.
4. The permittee must amend its BMP Plan whenever there is a change in mill design, construction, operation, or maintenance that materially affects the potential for leaks or spills of spent pulping liquor, turpentine, or soap from the immediate process areas.
5. The permittee must complete a review and evaluation of the BMP Plan five years after the first BMP Plan is prepared and, except as provided in Section B.4., once every five years thereafter. As a result of this review and evaluation, the permittee must amend the BMP Plan within three months of the review if

SUPPLEMENT TO EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS SPECIAL CONDITIONS (Continued)

the mill determines that any new or modified management practices and engineered controls are necessary to reduce significantly the likelihood of spent pulping liquor, soap, and turpentine leaks, spills, or intentional diversions from the immediate process areas, including a schedule for implementation of such practices and controls.

6. The BMP Plan, and any amendments thereto, must be reviewed by the senior technical manager at the mill and approved and signed by the mill manager. Any person signing the BMP Plan or its amendments must certify to the Division under penalty of law that the BMP Plan (or its amendments) has been prepared in accordance with good engineering practices and in accordance with this regulation. The permittee is not required to obtain approval from the Division of the BMP Plan or any amendments thereto.

Section C. BMP Recordkeeping Requirements

1. The permittee must maintain on its premises a complete copy of the current BMP Plan and the records specified in Section C.2 and must make such BMP Plan and records available to the Division for review upon request.
2. The permittee must maintain the following records for three years from the date they are created: (i) Records tracking the repairs performed in accordance with the repair program described in Section A; (ii) Records of initial and refresher training conducted in accordance with Section A; (iii) Reports prepared in accordance with Section A; and (iv) Records of monitoring required by Sections A and E.

Section D. Establishment of Wastewater Treatment System Influent Action Levels

1. The permittee must conduct a monitoring program per Section D.2, for the purpose of defining wastewater treatment system influent characteristics (or action levels), described in Section D.3, that will trigger requirements to initiate investigations on BMP effectiveness and to take corrective action.
2. The permittee must employ the following procedures in order to develop the action levels required by Section D:

- Monitoring parameters. The permittee must collect 24-hour composite samples and analyze the samples for a measure of organic content (e.g., Chemical Oxygen Demand (COD) or Total Organic Carbon (TOC)). Alternatively, the mill may use a measure related to spent pulping liquor losses measured continuously and averaged over 24 hours (e.g., specific conductivity or color).
- Monitoring locations. The permittee must conduct monitoring at the point influent enters the wastewater treatment system. For the purposes of this requirement, the permittee may select alternate monitoring point(s) in order to isolate possible sources of spent pulping liquor, soap, or turpentine from other possible sources of organic wastewaters that are tributary to the wastewater treatment facilities (e.g., bleach plants, paper machines and secondary fiber operations).

3. By April 15, 1999 or permit effective date, the permittee must complete an initial six-month monitoring program using the procedures specified in Section D and must establish initial action levels based on the results of that program. A wastewater treatment influent action level is a statistically determined

SUPPLEMENT TO EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS SPECIAL CONDITIONS (Continued)

pollutant loading determined by a statistical analysis of six months of daily measurements. The action levels must consist of a lower action level, which if exceeded will trigger the investigation requirements described in Section E, and an upper action level, which if exceeded will trigger the corrective action requirements described in Section E.

4. By January 15, 2002, the permittee must complete a second six-month monitoring program using the procedures specified in Section D and must establish revised action levels based on the results of that program. The initial action levels shall remain in effect until replaced by revised action levels.
5. Action levels developed under this Section must be revised using six months of monitoring data after any change in mill design, construction, operation, or maintenance that materially affects the potential for leaks or spills of spent pulping liquor, soap, or turpentine from the immediate process areas.

Section E. BMP Monitoring, Corrective Action, and Reporting Requirements

1. The permittee must conduct daily monitoring of the influent to the wastewater treatment system in accordance with the procedures described in Section D for the purpose of detecting leaks and spills, tracking the effectiveness of the BMPs, and detecting trends in spent pulping liquor losses.
2. Whenever monitoring results exceed the lower action level for the period of time specified in the BMP Plan, the permittee must conduct an investigation to determine the cause of such exceedance. Whenever monitoring results exceed the upper action level for the period of time specified in the BMP Plan, the permittee must complete corrective action to bring the wastewater treatment system influent mass loading below the lower action level as soon as practicable.
3. Although exceedances of the action levels will not constitute violations of an NPDES permit, failure to take the actions required by Section E.2 as soon as practicable will be a permit violation.
4. The permittee must report to the Division the results of the daily monitoring conducted pursuant to Section E.1. Such reports must include a summary of the monitoring results, the number and dates of exceedances of the applicable action levels, and brief descriptions of any corrective actions taken to respond to such exceedances. Submission of such reports shall be annually, by March 31st of the following year.

Section F. BMP Compliance Deadlines

1. The permittee is subject to the following BMP deadlines:

- Prepare BMP Plans and certify to the Division that the BMP Plan has been prepared in accordance with this regulation not later than April 15, 1999 or permit effective date.
- Implement all BMPs specified in Section A that do not require the construction of containment or diversion structures or the installation of monitoring and alarm systems not later than April 15, 1999, or permit effective date.
- Establish initial action levels required by Section D not later than April 15, 1999, or permit effective date.
- Commence operation of any new or upgraded continuous, automatic monitoring systems that the mill determines to be necessary under Section A (other than those associated with construction of containment or diversion structures) not later than April 17, 2000, or permit effective date.

SUPPLEMENT TO EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS SPECIAL CONDITIONS (Continued)

- Complete construction and commence operation of any spent pulping liquor, collection, containment, diversion, or other facilities, including any associated continuous monitoring systems, necessary to fully implement BMPs specified in Section A not later than April 16, 2001.
- Establish revised action levels required by Section D as soon as possible after fully implementing the BMPs specified in Section A, but not later than January 15, 2002.
- Submit Annual Reports required by Section E.4 to the Division by March 31st of the following year.

Section G. BMP Definitions

1. Action Level: A daily pollutant loading that when exceeded triggers investigative or corrective action. Mills determine action levels by a statistical analysis of six months of daily measurements collected at the mill. For example, the lower action level may be the 75th percentile of the running seven-day averages (that value exceeded by 25 percent of the running seven-day averages) and the upper action level may be the 90th percentile of the running seven-day averages (that value exceeded by 10 percent of the running seven-day averages).
2. Division: North Carolina DENR, Division of Water Quality, 1617 Mail Service Center, Raleigh, North Carolina 27699-1617.
3. Equipment Items in Spent Pulping Liquor, Soap, and Turpentine Service: Any process vessel, storage tank, pumping system, evaporator, heat exchanger, recovery furnace or boiler, pipeline, valve, fitting, or other device that contains, processes, transports, or comes into contact with spent pulping liquor, soap, or turpentine. Sometimes referred to as ``equipment items."
4. Immediate Process Area: The location at the mill where pulping, screening, knotting, pulp washing, pulping liquor concentration, pulping liquor processing, and chemical recovery facilities are located, generally the battery limits of the aforementioned processes. ``Immediate process area" includes spent pulping liquor storage and spill control tanks located at the mill, whether or not they are located in the immediate process area.
5. Intentional Diversion: The planned removal of spent pulping liquor, soap, or turpentine from equipment items in spent pulping liquor, soap, or turpentine service by the mill for any purpose including, but not limited to, maintenance, grade changes, or process shutdowns.
6. Mill: The owner or operator of a direct or indirect discharging pulp, paper, or paperboard manufacturing facility subject to this section.
7. Senior Technical Manager: The person designated by the mill manager to review the BMP Plan. The senior technical manager shall be the chief engineer at the mill, the manager of pulping and chemical recovery operations, or other such responsible person designated by the mill manager who has knowledge of and responsibility for pulping and chemical recovery operations.
8. Soap: The product of reaction between the alkali in kraft pulping liquor and fatty acid portions of the wood, which precipitate out when water is evaporated from the spent pulping liquor.
9. Spent Pulping Liquor: For kraft and soda mills ``spent pulping liquor" means black liquor that is used, generated, stored, or processed at any point in the pulping and chemical recovery processes.
10. Turpentine: A mixture of terpenes, principally pinene, obtained by the steam distillation of pine gum recovered from the condensation of digester relief gases from the cooking of softwoods by the kraft pulping process. Sometimes referred to as sulfate turpentine.

SUPPLEMENT TO EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS SPECIAL CONDITIONS (Continued)

A. (11) EFFLUENT GUIDELINE SAMPLING PLAN SPECIAL CONDITION

The bleach plant effluent sample (Outfall 006 located at the confluence of the effluent lines for Bleach Plant 6 and Bleach Plant 7) shall be analyzed for 2,3,7,8-TCDD in accordance with EPA Method 1613. A single sample may be analyzed to determine compliance with the daily maximum effluent limitation. Alternatively, a sample volume may be collected to enable the sample to be split (duplicate analysis). If the analysis of either split sample is below the Minimum Level (ML), the quantity is considered to be zero for compliance evaluation. If both splits are positive, the results of two analyses shall be averaged to determine compliance. The Minimum Level for 2,3,7,8-TCDD by EPA Method 1613 is 10 pg/l.

The bleach plants effluent sample (Outfall 006) shall be analyzed for the 12 chlorinated phenolic compounds in Part I, A(2) in accordance with EPA Method 1653. A single sample may be analyzed to determine compliance with the daily maximum effluent limitation. Alternatively, a sample volume may be collected to enable the sample to be split (duplicate analysis). If the analysis of either split sample is below the Minimum Level (ML), the quantity is considered to be zero for compliance evaluation. If both splits are positive, the results of two analyses shall be averaged to determine compliance. The Minimum Levels for each of the 12 chlorinated compounds are the same as the Daily Maximum concentrations listed in Part I, A(2).

The final wastewater treatment plant effluent sample (Outfall 001) shall be analyzed for AOX in accordance with EPA Method 1650, or subsequent test methods approved by the Division.

The permittee may request future monitoring modifications to the Cluster Rule requirements, including 1) use of ECF certification in lieu of monitoring for chloroform in the bleach plant effluent (Outfall 006) when this rule is promulgated by EPA; 2) demonstrating compliance using samples collected less frequently than every four hours; 3) using automated composite volatile samplers for chloroform sampling; and 4) using automated composite samplers for chlorophenolic and TCDD/DF sampling. Such future requests will be evaluated in accordance with 15A NCAC 2H.0114.

The flow calculations for internal Outfall 006 shall not be subject to accuracy requirements specified under Part II, Section D.3. This exclusion is similar to that provided for pump log flow calculations.

Chemical data for Cluster Rule parameters (all Outfall 006 parameters + AOX from Outfall 001) shall be submitted to the Division on a quarterly basis (January- March, April- June, July- September, October- December). Quarterly submissions shall be due 60 days following the last day of each quarter (Due dates = May 31, August 31, November 30, February 28). Chemical data shall be submitted on Division-approved DMR forms, with a separate form provided for each month.

SUPPLEMENT TO EFFLUENT LIMITATIONS
AND MONITORING REQUIREMENTS
SPECIAL CONDITIONS (Continued)

A. (12) SLUDGE RESIDUALS FROM PLYMOUTH WWTP

Weyerhaeuser Plymouth is authorized to accept wastewater sludge residuals from the Town of Plymouth Municipal Wastewater Treatment Plant in situations deemed an emergency by both the Division and the POTW (situations such as abnormally prolonged rainfall). Sludge residuals shall be added into the influent of the Weyerhaeuser wastewater treatment system.

A. (13) VARIANCE TO 24-HOUR STAFFING BY CERTIFIED OPERATOR

The request by Weyerhaeuser for the variance to 24-hour staffing coverage at your WWTP by certified operators is hereby granted with the following conditions:

1. The facility shall maintain at least all current systems, operating strategies, monitoring and operator training as outlined in your letter dated January 30, 2006 (Review comments to Draft NPDES Permit).
2. Maintain and have available for review by Division staff the documentation of the Wastewater Treatment Operator's Training.
3. Failure of the monitoring system to detect and report a malfunction, or the failure of an appropriate person in responding to a problem must be documented and reported to the Washington Regional Office. Failure of a monitoring device or failure to respond to a problem will not be a mitigating factor in any enforcement action.
4. This variance shall remain in effect until February 28, 2011, and will be reviewed with the renewal of the NPDES permit for this facility. A request for renewal of this variance should be submitted with the permit renewal request.
5. The remote alarm system must be a polling SCADA alarm. If the existing alarm system is different from the required, the upgrade must be completed before this variance can be considered valid.
6. Security guards must conduct surveillance routes around entire wastewater system every 4 hours when ORC is not on site. Security guards must be trained to recognize potential problems at the site and report them immediately to the member of the environmental team who is currently on call.
7. 48-hours before, during and after (until operation of the WWTP is stabilized) a major storm event the facility must keep a certified operator on site 24 hours per day.
8. The variance may be rescinded at the discretion of the Director in the event that the compliance status or the conditions at the facility change.

PART II
STANDARD CONDITIONS FOR NPDES PERMITS

Section A. Definitions

2/Month
Samples are collected twice per month with at least ten calendar days between sampling events.

3/Week
Samples are collected three times per week on three separate calendar days.

Act or "the Act"
The Federal Water Pollution Control Act, also known as the Clean Water Act, as amended, 33 USC 1251, et. seq.

Annual Average
The arithmetic mean of all "daily discharges" of a pollutant measured during the calendar year. In the case of fecal coliform, the geometric mean of such discharges.

Arithmetic Mean
The summation of the individual values divided by the number of individual values.

Bypass
The known diversion of waste streams from any portion of a treatment facility including the collection system, which is not a designed or established or operating mode for the facility.

Calendar Day
The period from midnight of one day until midnight of the next day. However, for purposes of this permit, any consecutive 24-hour period that reasonably represents the calendar day may be used for sampling.

Calendar Quarter
One of the following distinct periods: January through March, April through June, July through September, and October through December.

Composite Sample
A sample collected over a 24-hour period by continuous sampling or combining grab samples of at least 100 ml in such a manner as to result in a total sample representative of the wastewater discharge during the sample period. The Director may designate the most appropriate method (specific number and size of aliquots necessary, the time interval between grab samples, etc.) on a case-by-case basis. Samples may be collected manually or automatically. Composite samples may be obtained by the following methods:

(1) Continuous: a single, continuous sample collected over a 24-hour period proportional to the rate of flow.
(2) Constant time/variable volume: a series of grab samples collected at equal time intervals over a 24 hour period of discharge and combined proportional to the rate of flow measured at the time of individual sample collection, or
(3) Variable time/constant volume: a series of grab samples of equal volume collected over a 24 hour period with the time intervals between samples determined by a preset number of gallons passing the sampling point. Flow measurement between sample intervals shall be determined by use of a flow recorder and totalizer, and the preset gallon interval between sample collection fixed at no greater than 1/24 of the expected total daily flow at the treatment system, or
(4) Constant time/constant volume: a series of grab samples of equal volume collected over a 24-hour period at a constant time interval. **This method may only be used in situations where effluent flow rates vary less than 15 percent.** The grab samples shall be taken at intervals of no greater than 20 minutes apart during any 24-hour period and must be of equal size and of no less than 100 milliliters. **Use of this method requires prior approval by the Director.**

In accordance with (4) above, influent grab samples shall not be collected more than once per hour. Effluent grab samples shall not be collected more than once per hour except at wastewater treatment system. having a detention time of greater than 24 hours. In such cases, effluent grab samples may be collected at intervals evenly spaced over the 24-hour period that are equal in number of hours to the detention time of the system in number of days. However, the interval between effluent grab samples may not exceed six hours nor the number of samples less than four during a 24-hour sampling period.

Continuous flow measurement
Flow monitoring that occurs without interruption throughout the operating hours of the facility. Flow shall be monitored continually except for the infrequent times when there may be no flow or for infrequent maintenance activities on the flow device.

Daily Discharge
The discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants measured in units of mass, the "daily discharge" is calculated as the total mass of the pollutant discharged over the day. The "daily discharge" concentration comprises the mean concentration for a 24-hour sampling period as either a composite sample concentration or the arithmetic mean of all grab samples collected during that period. (40 CFR 122.3)

Daily Maximum
The highest "daily discharge" during the calendar month.

Daily Sampling
Parameters requiring daily sampling shall be sampled 5 out of every 7 days per week unless otherwise specified in the permit. The Division expects that sampling shall be conducted on weekdays except where holidays or other disruptions of normal operations prevent weekday sampling. If sampling is required for all seven days of the week for any permit parameter(s), that requirement will be so noted on the Effluent Limitations and Monitoring Page(s).

DWQ or "the Division"
The Division of Water Quality, Department of Environment and Natural Resources.

EMC
The North Carolina Environmental Management Commission.

Facility Closure
The cessation of wastewater treatment at a permitted facility, or the cessation of all activities that require coverage under the NPDES. Completion of facility closure will allow this permit to be rescinded.

Geometric Mean
The Nth root of the product of the individual values where N = the number of individual values. For purposes of calculating the geometric mean, values of "0" (or "< [detection level]") shall be considered = 1.

Grab Sample
Individual samples of at least 100 ml collected over a period of time not exceeding 15 minutes. Grab samples can be collected manually. Grab samples must be representative of the discharge (or the receiving stream, for instream samples).

Hazardous Substance
Any substance designated under 40 CFR Part 116 pursuant to Section 311 of the Clean Water Act.

Instantaneous flow measurement
A measure of flow taken at the time of sampling, when both the sample and flow will be representative of the total discharge.

Monthly Average (concentration limit)
The arithmetic mean of all "daily discharges" of a pollutant measured during the calendar month. In the case of fecal coliform, the geometric mean of such discharges.

Permit Issuing Authority
The Director of the Division of Water Quality.

Quarterly Average (concentration limit)
The average of all samples taken over a calendar quarter.

Severe property damage
Substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage excludes economic loss caused by delays in production.

Toxic Pollutant:
Any pollutant listed as toxic under Section 307(a)(l) of the Clean Water Act.

Upset
An incident beyond the reasonable control of the Permittee causing unintentional and temporary noncompliance with permit effluent limitations and/or monitoring requirements. An upset does not include noncompliance caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

Weekly Average (concentration limit)
The arithmetic mean of all "daily discharges" of a pollutant measured during the calendar week. In the case of fecal coliform, the geometric mean of such discharges.

Section B. General Conditions

1. Duty to Comply
   The Permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or denial of a permit renewal application [40 CFR 122.41].

   a. The Permittee shall comply with effluent standards or prohibitions established under section 307(a) of the Clean Water Act for toxic pollutants and with standards for sewage sludge use or disposal established under section 405(d) of the Clean Water Act within the time provided in the regulations that establish these standards or prohibitions or standards for sewage sludge use or disposal, even if the permit has not yet been modified to incorporate the requirement.

   b. The Clean Water Act provides that any person who violates section 301, 302, 306, 307, 308, 318 or 405 of the Act, or any permit condition or limitation implementing any such sections in a permit issued under section 402, or any requirement imposed in a pretreatment program approved under sections 402(a)(3) or 402(b)(8) of the Act, is subject to a civil penalty not to exceed $25,000 per day for each violation. [40 CFR 122.41 (a) (2)]

   c. The Clean Water Act provides that any person who *negligently* violates sections 301, 302, 306, 307, 308, 318, or 405 of the Act, or any condition or limitation implementing any of such sections in a permit issued under section 402 of the Act, or any requirement imposed in a pretreatment program approved under section 402(a)(3) or 402(b)(8) of the Act, is subject to criminal penalties of $2,500 to $25,000 per day of violation, or imprisonment of not more than 1 year, or both. In the case of a second or subsequent conviction for a negligent violation, a person shall be subject to criminal penalties of not more than $50,000 per day of violation, or by imprisonment of not more than 2 years, or both. [40 CFR 122.41 (a) (2)]

d. Any person who *knowingly* violates such sections, or such conditions or limitations is subject to crimir penalties of $5,000 to $50,000 per day of violation, or imprisonment for not more than 3 years, or both. i.. the case of a second or subsequent conviction for a knowing violation, a person shall be subject to criminal penalties of not more than $100,000 per day of violation, or imprisonment of not more than 6 years, or both. [40 CFR 122.41 (a) (2)]

e. Any person who knowingly violates section 301, 302, 303, 306, 307, 308, 318 or 405 of the Act, or any permit condition or limitation implementing any of such sections in a permit issued under section 402 of the Act, and who knows at that time that he thereby places another person in imminent danger of death or serious bodily injury, shall, upon conviction, be subject to a fine of not more than $250,000 or imprisonment of not more than 15 years, or both. In the case of a second or subsequent conviction for a knowing endangerment violation, a person shall be subject to a fine of not more than $500,000 or by imprisonment of not more than 30 years, or both. An organization, as defined in section 309(c)(3)(B)(iii) of the CWA, shall, upon conviction of violating the imminent danger provision, be subject to a fine of not more than $1,000,000 and can be fined up to $2,000,000 for second or subsequent convictions. [40 CFR 122.41 (a) (2)]

f. Under state law, a civil penalty of not more than $25,000 per violation may be assessed against any person who violates or fails to act in accordance with the terms, conditions, or requirements of a permit. [North Carolina General Statutes § 143-215.6A]

g. Any person may be assessed an administrative penalty by the Administrator for violating section 301, 302, 306, 307, 308, 318 or 405 of this Act, or any permit condition or limitation implementing any of such sections in a permit issued under section 402 of this Act. Administrative penalties for Class I violations are not to exceed $10,000 per violation, with the maximum amount of any Class I penalty assessed not to exceed $25,000. Penalties for Class II violations are not to exceed $10,000 per day for each day during which the violation continues, with the maximum amount of any Class II penalty not to exceed $125,000. [40 CF 122.41 (a) (3)]

2. Duty to Mitigate
The Permittee shall take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment [40 CFR 122.41 (d)].

3. Civil and Criminal Liability
Except as provided in permit conditions on "Bypassing" (Part II. C. 4), "Upsets" (Part II. C. 5) and "Power Failures" (Part II. C. 7), nothing in this permit shall be construed to relieve the Permittee from any responsibilities, liabilities, or penalties for noncompliance pursuant to NCGS 143-215.3, 143-215.6 or Section 309 of the Federal Act, 33 USC 1319. Furthermore, the Permittee is responsible for consequential damages, such as fish kills, even though the responsibility for effective compliance may be temporarily suspended.

4. Oil and Hazardous Substance Liability
Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the Permittee from any responsibilities, liabilities, or penalties to which the Permittee is or may be subject to under NCGS 143-215.75 et seq. or Section 311 of the Federal Act, 33 USG 1321. Furthermore, the Permittee is responsible for consequential damages, such as fish kills, even though the responsibility for effective compliance may be temporarily suspended.

5. Property Rights
The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, State or local laws or regulations [40 CFR 122.41 (g)].

6. Onshore or Offshore Construction
This permit does not authorize or approve the construction of any onshore or offshore physical structures or facilities or the undertaking of any work in any navigable waters.

7. Severability
The provisions of this permit are severable. If any provision of this permit, or the application of any provision of t permit to any circumstances, is held invalid, the application of such provision to other circumstances, and the remain of this permit, shall not be affected thereby [NCGS 150B-23].

8. Duty to Provide Information
The Permittee shall furnish to the Permit Issuing Authority, within a reasonable time, any information which the Permit Issuing Authority may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The Permittee shall also furnish to the Permit Issuing Authority upon request, copies of records required by this permit [40 CFR 122.41 (h)].

9. Duty to Reapply
If the Permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the Permittee must apply for and obtain a new permit [40 CFR 122.41 (b)].

10. Expiration of Permit
The Permittee is not authorized to discharge after the expiration date. In order to receive automatic authorization to discharge beyond the expiration date, the Permittee shall submit such information, forms, and fees as are required by the agency authorized to issue permits no later than 180 days prior to the expiration date. Any Permittee that has not requested renewal at least 180 days prior to expiration, or any Permittee that does not have a permit after the expiration and has not requested renewal at least 180 days prior to expiration, will subject the Permittee to enforcement procedures as provided in NCGS 143-215.6 and 33 USC 1251 et. seq.

11. Signatory Requirements
All applications, reports, or information submitted to the Permit Issuing Authority shall be signed and certified [40 CFR 122.41 (k)].

a. **All permit applications shall be signed as follows:**
   (1) For a corporation: by a responsible corporate officer. For the purpose of this Section, a responsible corporate officer means: (a) a president, secretary, treasurer or vice president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision making functions for the corporation, or (b) the manager of one or more manufacturing, production, or operating facilities, provided, the manager is authorized to make management decisions which govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations, and initiating and directing other comprehensive measures to assure long term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures .
   (2) For a partnership or sole proprietorship: by a general partner or the proprietor, respectively; or
   (3) For a municipality, State, Federal, or other public agency: by either a principal executive officer or ranking elected official [40 CFR 122.22].

b. All reports required by the permit and other information requested by the Permit Issuing Authority shall be signed by a person described in paragraph a. above or by a duly authorized representative of that person. A person is a duly authorized representative only if:
   1. The authorization is made in writing by a person described above;
   2. The authorization specified either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, operator of a well or well field, superintendent, a position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.); and
   3. The written authorization is submitted to the Permit Issuing Authority [40 CFR 122.22]

c. Changes to authorization: If an authorization under paragraph (b) of this section is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of paragraph (b) of this section must be submitted to the Director prior to or together with any reports, information, or applications to be signed by an authorized representative [40 CFR 122.22]

d. Certification. Any person signing a document under paragraphs a. or b. of this section shall make the following certification [40 CFR 122.22]:
"I certify, under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations."

12. Permit Actions
This permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the Permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not stay any permit condition [40 CFR 122.41 (f)].

13. Permit Modification, Revocation and Reissuance, or Termination
The issuance of this permit does not prohibit the permit issuing authority from reopening and modifying the permit, revoking and reissuing the permit, or terminating the permit as allowed by the laws, rules, and regulations contained in Title 40, Code of Federal Regulations, Parts 122 and 123; Title 15A of the North Carolina Administrative Code, Subchapter 2H .0100; and North Carolina General Statute 143-215.1 et. al.

14. Annual Administering and Compliance Monitoring Fee Requirements
The Permittee must pay the annual administering and compliance monitoring fee within thirty days after being billed by the Division. Failure to pay the fee in a timely manner in accordance with 15A NCAC 2H.0105 (b) (4) may cause this Division to initiate action to revoke the permit.

Section C. Operation and Maintenance of Pollution Controls

1. Certified Operator
Upon classification of the permitted facility by the Certification Commission, the Permittee shall employ a certified water pollution control treatment system operator in responsible charge (ORC) of the water pollution control treatment system. Such operator must hold a certification of the grade equivalent to or greater than the classification assigned to the water pollution control treatment system by the Certification Commission. The Permittee must also employ one or more certified Back-up ORCs who possess a currently valid certificate of the type of the system. Back-up ORCs must possess a grade equal to (or no more than one grade less than) the grade of the system [15A NCAC 8G.0201].

The ORC of each Class I facility must:
- Visit the facility at least weekly
- Comply with all other conditions of 15A NCAC 8G.0204.

The ORC of each Class II, III and IV facility must:
- Visit the facility at least daily, excluding weekends and holidays
- Properly manage and document daily operation and maintenance of the facility
- Comply with all other conditions of 15A NCAC 8G.0204.

Once the facility is classified, the Permittee shall submit a letter to the Certification Commission designating the operator in responsible charge:
a. Within 60 calendar days prior to wastewater being introduced into a new system

b. Within 120 calendar days of:
   - Receiving notification of a change in the classification of the system requiring the designation of a new ORC and back-up ORC
   - A vacancy in the position of ORC or back-up ORC.

2. Proper Operation and Maintenance
The Permittee shall at all times provide the operation and maintenance resources necessary to operate the existing facilities at optimum efficiency. The Permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the Permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the Permittee to install and operate backup or auxiliary facilities only when necessary to achieve compliance with the conditions of the permit [40 CFR 122.41 (e)].

3. Need to Halt or Reduce not a Defense
It shall not be a defense for a Permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the condition of this permit [40 CFR 122.41 (c)].

4. Bypassing of Treatment Facilities
a. Bypass not exceeding limitations [40 CFR 122.41 (m) (2)]
The Permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to the provisions of Paragraphs b. and c. of this section.

b. Notice [40 CFR 122.41 (m) (3)]
(1) Anticipated bypass. If the Permittee knows in advance of the need for a bypass, it shall submit prior notice, if possible at least ten days before the date of the bypass; including an evaluation of the anticipated quality and effect of the bypass.
(2) Unanticipated bypass. The Permittee shall submit notice of an unanticipated bypass as required in Part II. E. 6. (24-hour notice).

c. Prohibition of Bypass
(1) Bypass from the treatment facility is prohibited and the Permit Issuing Authority may take enforcement action against a Permittee for bypass, unless:
(A) Bypass was unavoidable to prevent loss of life, personal injury or severe property damage;
(B) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate backup equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and
(C) The Permittee submitted notices as required under Paragraph b. of this section.

(2) Bypass from the collection system is prohibited and the Permit Issuing Authority may take enforcement action against a Permittee for a bypass as provided in any current or future system-wide collection system permit associated with the treatment facility.

(3) The Permit Issuing Authority may approve an anticipated bypass, after considering its adverse effects, if the Permit Issuing Authority determines that it will meet the three conditions listed above in Paragraph c. (1) of this section.

5. Upsets
a. Effect of an upset [40 CFR 122.41 (n) (2)]: An upset constitutes an affirmative defense to an action brought for noncompliance with such technology based permit effluent limitations if the requirements of paragraph b. of this condition are met. No determination made during administrative review of claims that

noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.

b. Conditions necessary for a demonstration of upset: A Permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:
(1) An upset occurred and that the Permittee can identify the cause(s) of the upset;
(2) The Permittee facility was at the time being properly operated; and
(3) The Permittee submitted notice of the upset as required in Part II. E. 6. (b) (B) of this permit.
(4) The Permittee complied with any remedial measures required under Part II. B. 2. of this permit.

d. Burden of proof [40 CFR 122.41 (n) (4)]: The Permittee seeking to establish the occurrence of an upset has the burden of proof in any enforcement proceeding.

6. Removed Substances
Solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters shall be utilized/disposed of in accordance with NCGS 143-215.1 and in a manner such as to prevent any pollutant from such materials from entering waters of the State or navigable waters of the United States. The Permittee shall comply with all existing Federal regulations governing the disposal of sewage sludge. Upon promulgation of 40 CFR Part 503, any permit issued by the Permit Issuing Authority for the utilization/disposal of sludge may be reopened and modified, or revoked and reissued, to incorporate applicable requirements at 40 CFR 503. The Permittee shall comply with applicable 40 CFR 503 Standards for the Use and Disposal of Sewage Sludge (when promulgated) within the time provided in the regulation, even if the permit is not modified to incorporate the requirement. The Permittee shall notify the Permit Issuing Authority of any significant change in its sludge use or disposal practices.

7. Power Failures
The Permittee is responsible for maintaining adequate safeguards (as required by 15A NCAC 2H.0124 – Reliability) to prevent the discharge of untreated or inadequately treated wastes during electrical power failures either by means of alternate power sources, standby generators or retention of inadequately treated effluent.

Section D. Monitoring and Records

1. Representative Sampling
Samples collected and measurements taken, as required herein, shall be characteristic of the volume and nature of the permitted discharge. Samples collected at a frequency less than daily shall be taken on a day and time that is characteristic of the discharge over the entire period the sample represents. All samples shall be taken at the monitoring points specified in this permit and, unless otherwise specified, before the effluent joins or is diluted by any other wastestream, body of water, or substance. Monitoring points shall not be changed without notification to and the approval of the Permit Issuing Authority [40 CFR 122.41 (j)].

2. Reporting
Monitoring results obtained during the previous month(s) shall be summarized for each month and reported on a monthly Discharge Monitoring Report (DMR) Form (MR 1, 1.1, 2, 3) or alternative forms approved by the Director, postmarked no later than the 28th day following the completed reporting period.

The first DMR is due on the last day of the month following the issuance of the permit or in the case of a new facility, on the last day of the month following the commencement of discharge. Duplicate signed copies of these, and all other reports required herein, shall be submitted to the following address:

NC DENR / Division of Water Quality / Water Quality Section
ATTENTION: Central Files
1617 Mail Service Center
Raleigh, North Carolina 27699-1617

3. Flow Measurements
Appropriate flow measurement devices and methods consistent with accepted scientific practices shall be selected and used to ensure the accuracy and reliability of measurements of the volume of monitored discharges. The devices shall be installed, calibrated and maintained to ensure that the accuracy of the measurements is consistent with the accepted capability of that type of device. Devices selected shall be capable of measuring flows with a maximum deviation of less than 10% from the true discharge rates throughout the range of expected discharge volumes. Flow measurement devices shall be accurately calibrated at a minimum of once per year and maintained to ensure that the accuracy of the measurements is consistent with the accepted capability of that type of device. The Director shall approve the flow measurement device and monitoring location prior to installation.

Once-through condenser cooling water flow monitored by pump logs, or pump hour meters as specified in Part I of this permit and based on the manufacturer's pump curves shall not be subject to this requirement.

4. Test Procedures
Test procedures for the analysis of pollutants shall conform to the EMC regulations (published pursuant to NCGS 143-215.63 et. seq.), the Water and Air Quality Reporting Acts, and to regulations published pursuant to Section 304(g), 33 USC 1314, of the Federal Water Pollution Control Act (as Amended), and 40 CFR 136; or in the case of sludge use or disposal, approved under 40 CFR 136, unless otherwise specified in 40 CFR 503, unless other test procedures have been specified in this permit [40 CFR 122.41].

To meet the intent of the monitoring required by this permit, all test procedures must produce minimum detection and reporting levels that are below the permit discharge requirements and all data generated must be reported down to the minimum detection or lower reporting level of the procedure. If no approved methods are determined capable of achieving minimum detection and reporting levels below permit discharge requirements, then the most sensitive (method with the lowest possible detection and reporting level) approved method must be used.

5. Penalties for Tampering
The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate, any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than two years per violation, or by both. If a conviction of a person is for a violation committed after a first conviction of such person under this paragraph, punishment is a fine of not more than $20,000 per day of violation, or by imprisonment of not more than 4 years, or both [40 CFR 122.41].

6. Records Retention
Except for records of monitoring information required by this permit related to the Permittee's sewage sludge use and disposal activities, which shall be retained for a period of at least five years (or longer as required by 40 CFR 503), the Permittee shall retain records of all monitoring information, including:
- all calibration and maintenance records
- all original strip chart recordings for continuous monitoring instrumentation
- copies of all reports required by this permit
- copies of all data used to complete the application for this permit

These records or copies shall be maintained for a period of at least 3 years from the date of the sample, measurement, report or application. This period may be extended by request of the Director at any time [40 CFR 122.41].

7. Recording Results
For each measurement or sample taken pursuant to the requirements of this permit, the Permittee shall record the following information [40 CFR 122.41]:

a. The date, exact place, and time of sampling or measurements;
b. The individual(s) who performed the sampling or measurements;
c. The date(s) analyses were performed;
d. The individual(s) who performed the analyses;

e. The analytical techniques or methods used; and
f. The results of such analyses.

8. Inspection and Entry
The Permittee shall allow the Director, or an authorized representative (including an authorized contractor acting as a representative of the Director), upon the presentation of credentials and other documents as may be required by law, to;

a. Enter upon the Permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;
b. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;
c. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and
d. Sample or monitor at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act, any substances or parameters at any location [40 CFR 122.41 (i)].

Section E. Reporting Requirements

1. Change in Discharge
All discharges authorized herein shall be consistent with the terms and conditions of this permit. The discharge of any pollutant identified in this permit more frequently than or at a level in excess of that authorized shall constitute a violation of the permit.

2. Planned Changes
The Permittee shall give notice to the Director as soon as possible of any planned physical alterations or additions to the permitted facility [40 CFR 122.41 (l)]. Notice is required only when:

a. The alteration or addition to a permitted facility may meet one of the criteria for new sources at 40 CFR 122.29 (b); or
b. The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants subject neither to effluent limitations in the permit, nor to notification requirements under 40 CFR 122.42 (a) (l).
c. The alteration or addition results in a significant change in the Permittee's sludge use or disposal practices, and such alternation, addition or change may justify the application of permit conditions that are different from or absent in the existing permit, including notification of additional use or disposal sites not reported during the permit application process or not reported pursuant to an approved land application plan.

3. Anticipated Noncompliance
The Permittee shall give advance notice to the Director of any planned changes to the permitted facility or other activities that might result in noncompliance with the permit [40 CFR 122.41 (l) (2)].

4. Transfers
This permit is not transferable to any person except after notice to the Director. The Director may require modification or revocation and reissuance of the permit to document the change of ownership. Any such action may incorporate other requirements as may be necessary under the Clean Water Act [40 CFR 122.41 (l) (3)].

5. Monitoring Reports
Monitoring results shall be reported at the intervals specified elsewhere in this permit [40 CFR 122.41 (l) (4)].

a. Monitoring results must be reported on a Discharge Monitoring Report (DMR) (See Part II. D. 2) or forms provided by the Director for reporting results of monitoring of sludge use or disposal practices.
b. If the Permittee monitors any pollutant more frequently than required by this permit, the results of such monitoring shall be included in the calculation and reporting of the data submitted on the DMR.

6. Twenty-four Hour Reporting
   a. The Permittee shall report to the Director or the appropriate Regional Office any noncompliance that potentially threatens public health or the environment. Any information shall be provided orally within 24 hours from the time the Permittee became aware of the circumstances. A written submission shall also be provided within 5 days of the time the Permittee becomes aware of the circumstances. The written submission shall contain a description of the noncompliance, and its cause; the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance [40 CFR 122.41 (l) (6)].

   b. The Director may waive the written report on a case-by-case basis for reports under this section if the oral report has been received within 24 hours.

   c. Occurrences outside normal business hours may also be reported to the Division's Emergency Response personnel at (800) 662-7956, (800) 858-0368 or (919) 733-3300.

7. Other Noncompliance
   The Permittee shall report all instances of noncompliance not reported under Part II. E. 5 and 6. of this permit at the time monitoring reports are submitted. The reports shall contain the information listed in Part II. E. 6. of this permit [40 CFR 122.41 (l) (7)].

8. Other Information
   Where the Permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the Director, it shall promptly submit such facts or information [40 CFR 122.41 (l) (8)].

9. Noncompliance Notification
   The Permittee shall report by telephone to either the central office or the appropriate regional office of the Division as soon as possible, but in no case more than 24 hours or on the next working day following the occurrence or first knowledge of the occurrence of any of the following:

   a. Any occurrence at the water pollution control facility which results in the discharge of significant amounts of wastes which are abnormal in quantity or characteristic, such as the dumping of the contents of a sludge digester; the known passage of a slug of hazardous substance through the facility; or any other unusual circumstances.
   b. Any process unit failure, due to known or unknown reasons, that render the facility incapable of adequate wastewater treatment such as mechanical or electrical failures of pumps, aerators, compressors, etc.
   c. Any failure of a pumping station, sewer line, or treatment facility resulting in a by-pass directly to receiving waters without treatment of all or any portion of the influent to such station or facility.

   Persons reporting such occurrences by telephone shall also file a written report within 5 days following first knowledge of the occurrence.

10. Availability of Reports
    Except for data determined to be confidential under NCGS 143-215.3 (a)(2) or Section 308 of the Federal Act, 33 USC 1318, all reports prepared in accordance with the terms shall be available for public inspection at the offices of the Division of Water Quality. As required by the Act, effluent data shall not be considered confidential. Knowingly making any false statement on any such report may result in the imposition of criminal penalties as provided for in NCGS 143-215.1 (b)(2) or in Section 309 of the Federal Act.

11. Penalties for Falsification of Reports
    The Clean Water Act provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance shall, upon conviction, be punished by a fine of

not more than $25,000 per violation, or by imprisonment for not more than two years per violation, or by both [40 CFR 122.41].

12. Annual Performance Reports
Permittees who own or operate facilities that collect or treat municipal or domestic waste shall provide an annual report to the Permit Issuing Authority and to the users/customers served by the Permittee (NCGS 143-215.1C). The report shall summarize the performance of the collection or treatment system, as well as the extent to which the facility was compliant with applicable Federal or State laws, regulations and rules pertaining to water quality. The report shall be provided no later than sixty days after the end of the calendar or fiscal year, depending upon which annual period is used for evaluation.

PART III
OTHER REQUIREMENTS

Section A. Construction
The Permittee shall not commence construction of wastewater treatment facilities, nor add to the plant's treatment capacity, nor change the treatment process(es) utilized at the treatment plant unless the Division has issued an Authorization to Construct (AtC) permit. Issuance of an AtC will not occur until Final Plans and Specifications for the proposed construction have been submitted by the Permittee and approved by the Division.

Section B. Groundwater Monitoring
The Permittee shall, upon written notice from the Director of the Division of Water Quality, conduct groundwater monitoring as may be required to determine the compliance of this NPDES permitted facility with the current groundwater standards.

Section C. Changes in Discharges of Toxic Substances
The Permittee shall notify the Permit Issuing Authority as soon as it knows or has reason to believe (40 CFR 122.42):

a. That any activity has occurred or will occur which would result in the discharge, on a routine or frequent basis, of any toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels";
   (1) One hundred micrograms per liter (100 µg/L);
   (2) Two hundred micrograms per liter (200 µg/L) for acrolein and acrylonitrile; five hundred micrograms per liter (500 µg/L) for 2.4-dinitrophenol and for 2-methyl-4.6-dinitrophenol; and one milligram per liter (1 mg/L) for antimony;
   (3) Five times the maximum concentration value reported for that pollutant in the permit application.

b. That any activity has occurred or will occur which would result in any discharge, on a non-routine or infrequent basis, of a toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels";
   (1) Five hundred micrograms per liter (500 µg/L);
   (2) One milligram per liter (1 mg/L) for antimony;
   (3) Ten times the maximum concentration value reported for that pollutant in the permit application.

Section D. Evaluation of Wastewater Discharge Alternatives
The Permittee shall evaluate all wastewater disposal alternatives and pursue the most environmentally sound alternative of the reasonably cost effective alternatives. If the facility is in substantial non-compliance with the terms and conditions of the NPDES permit or governing rules, regulations or laws, the Permittee shall submit a report in such form and detail as required by the Division evaluating these alternatives and a plan of action within 60 days of notification by the Division.

Section E. Facility Closure Requirements
The Permittee must notify the Division at least 90 days prior to the closure of any wastewater treatment system covered by this permit. The Division may require specific measures during deactivation of the system to prevent

adverse impacts to waters of the State. This permit cannot be rescinded while any activities requiring this permit continue at the permitted facility.

PART IV
SPECIAL CONDITIONS FOR MUNCIPAL FACILITIES

Section A. Publicly Owned Treatment Works (POTWs)

All POTWs must provide adequate notice to the Director of the following:

1. Any new introduction of pollutants into the POTW from an indirect discharger which would be subject to section 301 or 306 of CWA if it were directly discharging those pollutants; and
2. Any substantial change in the volume or character of pollutants being introduced by an indirect discharger as influent to that POTW at the time of issuance of the permit.
3. For purposes of this paragraph, adequate notice shall include information on (1) the quality and quantity of effluent introduced into the POTW, and (2) any anticipated impact of the change on the quantity or quality of effluent to be discharged from the POTW.

Section B. Municipal Control of Pollutants from Industrial Users.

1. Effluent limitations are listed in Part I of this permit. Other pollutants attributable to inputs from industries using the municipal system may be present in the Permittee's discharge. At such time as sufficient information becomes available to establish limitations for such pollutants, this permit may be revised to specify effluent limitations for any or all of such other pollutants in accordance with best practicable technology or water quality standards.

2. Under no circumstances shall the Permittee allow introduction of the following wastes in the waste treatment system:
   a. Pollutants which create a fire or explosion hazard in the POTW, including, but not limited to, wastestreams with a closed cup flashpoint of less than 140 degrees Fahrenheit or 60 degrees Centigrade using the test methods specified in 40 CFR 261.21;
   b. Pollutants which will cause corrosive structural damage to the POTW, but in no case Discharges with pH lower than 5.0, unless the works is specifically designed to accommodate such Discharges;
   c. Solid or viscous pollutants in amounts which will cause obstruction to the flow in the POTW resulting in Interference;
   d. Any pollutant, including oxygen demanding pollutants (BOD, etc.) released in a Discharge at a flow rate and/or pollutant concentration which will cause Interference with the POTW;
   e. Heat in amounts which will inhibit biological activity in the POTW resulting in Interference, but in no case heat in such quantities that the temperature at the POTW Treatment Plant exceeds 40°C (104°F) unless the Division, upon request of the POTW, approves alternate temperature limits;
   f. Petroleum oil, nonbiodegradable cutting oil, or products of mineral oil origin in amounts that will cause interference or pass through;
   g. Pollutants which result in the presence of toxic gases, vapors, or fumes within the POTW in a quantity that may cause acute worker health and safety problems;
   h. Any trucked or hauled pollutants, except at discharge points designated by the POTW.

3. With regard to the effluent requirements listed in Part I of this permit, it may be necessary for the Permittee to supplement the requirements of the Federal Pretreatment Standards (40 CFR, Part 403) to ensure compliance by the Permittee with all applicable effluent limitations. Such actions by the Permittee may be necessary regarding some or all of the industries discharging to the municipal system.

4. The Permittee shall require any industrial discharges sending influent to the permitted system to meet Federal Pretreatment Standards promulgated in response to Section 307(b) of the Act. Prior to accepting wastewater from any significant industrial user, the Permittee shall either develop and submit to the

Division a Pretreatment Program for approval per 15A NCAC 2H .0907(a) or modify an existing Pretreatment Program per 15A NCAC 2H .0907(b).

5. This permit shall be modified, or alternatively, revoked and reissued, to incorporate or modify an approved POTW Pretreatment Program or to include a compliance schedule for the development of a POTW Pretreatment Program as required under Section 402(b)(8) of the Clean Water Act and implementing regulations or by the requirements of the approved State pretreatment program, as appropriate.

Section C. Pretreatment Programs

Under authority of sections 307(b) and (c) and 402(b)(8) of the Clean Water Act and implementing regulations 40 CFR Part 403, North Carolina General Statute 143-215.3 (14) and implementing regulations 15A NCAC 2H .0900, and in accordance with the approved pretreatment program, all provisions and regulations contained and referenced in the Pretreatment Program Submittal are an enforceable part of this permit.

The Permittee shall operate its approved pretreatment program in accordance with Section 402(b)(8) of the Clean Water Act, the Federal Pretreatment Regulations 40 CFR Part 403, the State Pretreatment Regulations 15A NCAC 2H .0900, and the legal authorities, policies, procedures, and financial provisions contained in its pretreatment program submission and Division approved modifications there of. Such operation shall include but is not limited to the implementation of the following conditions and requirements:

1. Sewer Use Ordinance (SUO)
   The Permittee shall maintain adequate legal authority to implement its approved pretreatment program.

2. Industrial Waste Survey (IWS)
   The Permittee shall update its Industrial Waste Survey (IWS) to include all users of the sewer collection system at least once every five years.

3. Monitoring Plan
   The Permittee shall implement a Division approved Monitoring Plan for the collection of facility specific data to be used in a wastewater treatment plant Headworks Analysis (HWA) for the development of specific pretreatment local limits. Effluent data from the Plan shall be reported on the DMRs (as required by Part II, Section D, and Section E.5.).

4. Headworks Analysis (HWA) and Local Limits
   The Permittee shall obtain Division approval of a Headworks Analysis (HWA) at least once every five years, and as required by the Division. Within 180 days of the effective date of this permit (or any subsequent permit modification) the Permittee shall submit to the Division a written technical evaluation of the need to revise local limits (i.e., an updated HWA or documentation of why one is not needed) [40 CFR 122.42]. The Permittee shall develop, in accordance with 40 CFR 403.5(c) and 15A NCAC 2H .0909, specific Local Limits to implement the prohibitions listed in 40 CFR 403.5(a) and (b) and 15A NCAC 2H .0909.

5. Industrial User Pretreatment Permits (IUP) & Allocation Tables
   In accordance with NCGS 143-215.1, the Permittee shall issue to all significant industrial users, permits for operation of pretreatment equipment and discharge to the Permittee's treatment works. These permits shall contain limitations, sampling protocols, reporting requirements, appropriate standard and special conditions, and compliance schedules as necessary for the installation of treatment and control technologies to assure that their wastewater discharge will meet all applicable pretreatment standards and requirements. The Permittee shall maintain a current Allocation Table (AT) which summarizes the results of the Headworks Analysis (HWA) and the limits from all Industrial User Pretreatment Permits (IUP). Permitted IUP loadings for each parameter cannot exceed the treatment capacity of the POTW as determined by the HWA.

6. Authorization to Construct (A to C)
The Permittee shall ensure that an Authorization to Construct permit (AtC) is issued to all applicable industrial users for the construction or modification of any pretreatment facility. Prior to the issuance of an AtC, the proposed pretreatment facility and treatment process must be evaluated for its capacity to comply with all Industrial User Pretreatment Permit (IUP) limitations.

7. POTW Inspection & Monitoring of their SIUs
The Permittee shall conduct inspection, surveillance, and monitoring activities as described in its Division approved pretreatment program in order to determine, independent of information supplied by industrial users, compliance with applicable pretreatment standards. The Permittee must:
   a. Inspect all Significant Industrial Users (SIUs) at least once per calendar year; and
   b. Sample all Significant Industrial Users (SIUs) at least twice per calendar year for all permit-limited pollutants, once during the period from January 1 through June 30 and once during the period from July 1 through December 31, except for organic compounds which shall be sampled once per calendar year;

8. SIU Self Monitoring and Reporting
The Permittee shall require all industrial users to comply with the applicable monitoring and reporting requirements outlined in the Division approved pretreatment program, the industry's pretreatment permit, or in 15A NCAC 2H .0908.

9. Enforcement Response Plan (ERP)
The Permittee shall enforce and obtain appropriate remedies for violations of all pretreatment standards promulgated pursuant to section 307(b) and (c) of the Clean Water Act (40 CFR 405 et. seq.), prohibitive discharge standards as set forth in 40 CFR 403.5 and 15A NCAC 2H .0909, and specific local limitations. All enforcement actions shall be consistent with the Enforcement Response Plan (ERP) approved by the Division.

10. Pretreatment Annual Reports (PAR)
The Permittee shall report to the Division in accordance with 15A NCAC 2H .0908. In lieu of submitting annual reports, Modified Pretreatment Programs developed under 15A NCAC 2H .0904 (b) may be required to meet with Division personnel periodically to discuss enforcement of pretreatment requirements and other pretreatment implementation issues.

For all other active pretreatment programs, the Permittee shall submit two copies of a Pretreatment Annual Report (PAR) describing its pretreatment activities over the previous twelve months to the Division at the following address:

NC DENR / DWQ / Pretreatment Unit
1617 Mail Service Center
Raleigh, NC 27699-1617

These reports shall be submitted according to a schedule established by the Director and shall contain the following:

a.) Narrative
A brief discussion of reasons for, status of, and actions taken for all Significant Industrial Users (SIUs) in Significant Non-Compliance (SNC);

b.) Pretreatment Program Summary (PPS)
A pretreatment program summary (PPS) on specific forms approved by the Division;

c.) Significant Non-Compliance Report (SNCR)
The nature of the violations and the actions taken or proposed to correct the violations on specific forms approved by the Division;

d.) Industrial Data Summary Forms (IDSF)

Monitoring data from samples collected by both the POTW and the Significant Industrial User (SIU). These analytical results must be reported on Industrial Data Summary Forms (IDSF) or other specific format approved by the Division;

e.) Other Information

Copies of the POTW's allocation table, new or modified enforcement compliance schedules, public notice of SIUs in SNC, and any other information, upon request, which in the opinion of the Director is needed to determine compliance with the pretreatment implementation requirements of this permit;

11. Public Notice

The Permittee shall publish annually a list of Significant Industrial Users (SIUs) that were in Significant Non-Compliance (SNC) as defined in the Permittee's Division approved Sewer Use Ordinance with applicable pretreatment requirements and standards during the previous twelve month period. This list shall be published within four months of the applicable twelve-month period.

12. Record Keeping

The Permittee shall retain for a minimum of three years records of monitoring activities and results, along with support information including general records, water quality records, and records of industrial impact on the POTW.

13. Funding and Financial Report

The Permittee shall maintain adequate funding and staffing levels to accomplish the objectives of its approved pretreatment program.

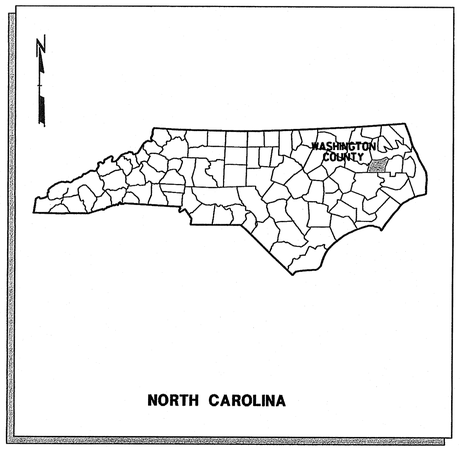
14. Modification to Pretreatment Programs

Modifications to the approved pretreatment program including but not limited to local limits modifications, POTW monitoring of their Significant Industrial Users (SIUs), and Monitoring Plan modifications, shall be considered a permit modification and shall be governed by 15 NCAC 2H .0114 and 15A NCAC 2H .0907.

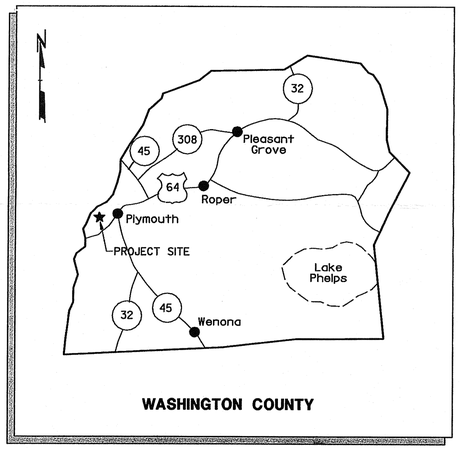
NEW LANDFILL No. 3
PHASE 3 & 4
CONSTRUCTION PLAN APPLICATION
DOMTAR COMPANY
PLYMOUTH, NORTH CAROLINA

PREPARED BY RMT NORTH CAROLINA INC.

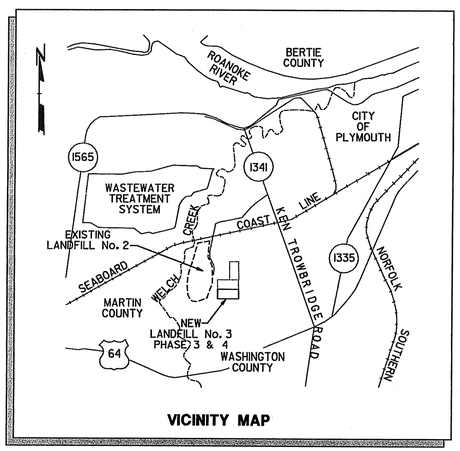
JANUARY 2008



NORTH CAROLINA



WASHINGTON COUNTY



VICINITY MAP

DRAWING LIST

SHEET NO.	TITLE
1	TITLE SHEET
2	DATA POINT LOCATION MAP
3	HISTORICAL HIGH WATER TABLE CONFIGURATION (APRIL 2, 1993)*
4	(NOT USED)
5	GEOLOGIC CROSS SECTIONS - SHEET 1
6	GEOLOGIC CROSS SECTIONS - SHEET 2
7	OVERALL SITE PLAN
8	LINER GRADING PLAN
9	LEACHATE PIPING PLAN
10	FINAL GRADING PLAN PHASE 3 & 4
11	FINAL GRADING PLAN OVERALL
12	PHASE PROGRESSION PLAN
13	BORROW AREA SITE PLAN
14	LANDFILL DETAILS SHEET 1
15	LANDFILL DETAILS - SHEET 2
16	LEACHATE COLLECTION AND REMOVAL SYSTEM DETAILS
17	ENGINEERING CROSS SECTIONS
18	MISCELLANEOUS DETAILS
19	EROSION CONTROL DETAILS

GENERAL NOTES

1. EXISTING PLANNIMETRIC AND TOPOGRAPHIC INFORMATION THAT LIES WITHIN THE FOOTPRINT OF PHASES 1A, 1B, 2, 3 AND 4 OF LANDFILL No. 3 WAS TAKEN FROM A SURVEY PREPARED BY McKIM & CREED ENGINEERING, INC, CAREY, NORTH CAROLINA DATED APRIL 13, 2007. THIS SURVEY IS BASED ON NCGS CONTROL MONUMENTS "ADVISOR" AND "BENNETT" (SEE NOTE 2). NO PERMANENT SURVEY CONTROL SET ON SITE AT THE TIME OF THIS SURVEY.

2. CONTROL MONUMENT INFORMATION:

NCGS MONUMENT "ADVISOR"	NCGS MONUMENT "BENNETT"
GRID COORDINATES	GRID COORDINATES
N=765,198.28'	N=764,433.87'
E=2,659,512.73'	E=2,658,436.50'
(NAD 83)	(NAD 83)
ELEV=39.12'	ELEV=37.71'
(NGVD 29)	(NGVD 29)

3. ALL PLANNIMETRIC AND TOPOGRAPHIC INFORMATION THAT FALLS OUTSIDE THE LIMITS AS DESCRIBED IN NOTE 1 WAS TAKEN FROM A SURVEY MADE BY McKIM & CREED ENGINEERING, INC., CAREY, NORTH CAROLINA, DATED APRIL 26, 2001. ALL COORDINATES AND BEARINGS ARE BASED ON THE NORTH CAROLINA STATE PLANE COODINATE SYSTEM, NAD 83. ALL ELEVATIONS SHOWN ARE IN FEET AND ARE BASED ON NGVD 1929 DATUM. PROPERTY LINES BASED ON SURVEY PROVIDED BY McKIM & CREED AND INFORMATION PROVIDED BY WEYERHAEUSER COMPANY. ELEVATIONS SHOWN IN THE EXISTING LANDFILL No. 2, THE ASBESTOS LANDFILL, AND THE BORROW AREAS SHOWN ON SHEET 13 HAVE BEEN ALTERED BY NEW CONSTRUCTION.

4. THE PROPOSED SITE IS LOCATED IN WASHINGTON COUNTY, SOUTHWEST OF THE CITY OF PLYMOUTH, NORTH CAROLINA, AS SHOWN ON THE VICINITY MAP.

5. THE GEOTECHNICAL INVESTIGATION FOR THIS PROJECT WAS PERFORMED BY RMT, INC. DATED DECEMBER 1990.

6. ALL EROSION AND SEDIMENTARY CONTROL MEASURES SHALL BE IMPLEMENTED, MONITORED AND MAINTAINED ON A REGULAR BASIS TO ASSURE MAXIMUM EFFICIENCY IN CONTAINING SEDIMENTS WITHIN THE PROPERTY DURING AND AFTER LANDFILL/EARTHWORK OPERATIONS UNTIL THE DISTURBED AREAS ARE REVEGETATED OR OTHERWISE STABILIZED.

7. UNLESS NOTED OTHERWISE, NEW CONTOURS AND/OR NEW SPOT ELEVATIONS REPRESENT FINISH GRADE. ALLOWANCE SHALL BE MADE FOR TOPSOIL, ROAD SURFACES, AND LINER CONSTRUCTION.

10. BOUNDARIES OF THE EXISTING ASBESTOS LANDFILL SHOWN ON SHEET 7 WERE LOCATED BY McKIM AND CREED ENGINEERS, NEW BERN, NORTH CAROLINA.

11. WETLANDS DELINEATION BOUNDARYS ARE SHOWN ON THE SITE PLANS. SEE APPENDIX "A" OF THE REPORT FOR DELINEATION MAP.

LEGEND

	EXISTING	NEW
ACCESS ROAD		
BUILDING		
CONTOUR	34	34
WATER TABLE SURFACE		6
WETLAND DELINEATION		
ASBESTOS LANDFILL WASTE LIMITS		
DRAINAGE FLOW DIRECTION		
HEADWALL		
MONITORING WELL WATER ELEVATION	MW-1 30.43	MW-9
OBSERVATION WELL WATER ELEVATION	OW-2 29.92	
SOIL BORING	SB-5	
HAND AUGER	HA-10	
TEST PIT	TP-1	
BENCH MARK (CONTROL POINT)		
CLEANOUT		CO
MANHOLE		
MONUMENT		
POWER POLE (LIGHT POLE)	PP	PP
POWER LINE	P	P
RIP RAP OR CRUSHED STONE		
SPOT ELEVATION	34.2	34.2
TREE LINE		
PROPERTY LINE		
PERMITTED LANDFILL BOUNDARY		
LEACHATE COLLECTION LINE		LC
LEACHATE FORCE MAIN		LFM
STORM DRAIN		SD
SANITARY SEWER		SS
GAS VENT PIPING		GVP
CATCH BASIN		
RAILROAD		
GAS VENT		

ABBREVIATIONS

APPROX	APPROXIMATELY	I. E.	INVERT ELEVATION
ASTM	AMERICAN SOCIETY FOR TESTING MATERIALS	INV EL	INVERT ELEVATION
BM	BENCH MARK	LF	LINEAR FEET
℄	CENTERLINE	LC	LEACHATE COLLECTION
CHDPE	CORRUGATED HIGH DENSITY	LP	LIGHT POLE
CONC	CONCRETE	LFM	LEACHATE FORCE MAIN
CS	CARBON STEEL	MAX	MAXIMUM
CSP	CORRUGATED STEEL PIPE	MH	MANHOLE
DIA	DIAMETER	MIN	MINIMUM
DET	DETAIL	MISC	MISCELLANEOUS
DI	DROP INLET	N	NORTH
DWG	DRAWING	NO.	NUMBER
E	EAST	NTS	NOT TO SCALE
EA	EACH	OD	OUTSIDE DIAMETER
EL,ELEV	ELEVATION	PERF	PERFORATED
EXIST	EXISTING	PI	POINT OF INTERSECTION
FT	FEET	PC	POINT OF CURVATURE
FUT	FUTURE	PL	PROPERTY LINE
FM	FORCE MAIN	PSF	POUNDS PER SQUARE
GA	GAGE, GAUGE	PSI	POUNDS PER SQUARE
GALV	GALVANIZED	R	RADIUS
GR	GRADE	REV	REVISION
HDPE	HIGH DENSITY	REQ'D	REQUIRED
HORIZ	HORIZONTAL	RR	RAILROAD
HP	HIGH POINT	SAN	SANITARY SEWER
HW	HEADWALL	SECT	SECTION
ID	INSIDE DIAMETER	STA	STATION
		STD	STANDARD
		T/CONC	TOP OF CONCRETE
		TYP	TYPICAL
		W/	WITH

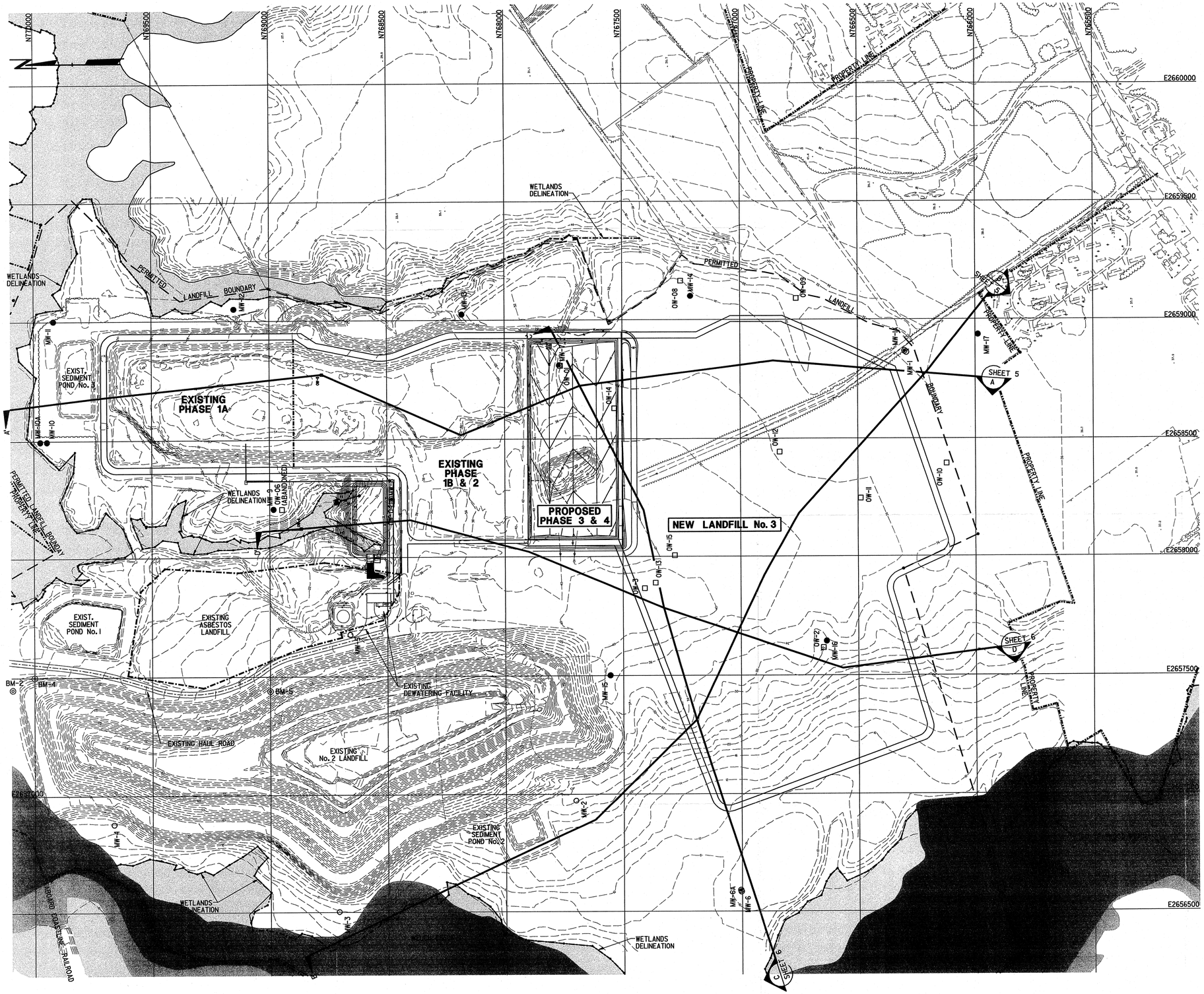
NORTH CAROLINA PROFESSIONAL SEAL 17543 ENGINEER RICHARD K. WILKINSON

RMT

RMT North Carolina, Inc.

NOTES

REFER TO SHEET 1 FOR STANDARD LEGEND, ABBREVIATIONS AND GENERAL NOTES.



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A	DMC	1-11-08	ISSUED FOR CLIENT REVIEW	RKN

Domtar

NEW LANDFILL No. 3 - PHASE 3 & 4
CONSTRUCTION PLAN APPLICATION
DOMTAR COMPANY
PLYMOUTH, NORTH CAROLINA

SHEET TITLE:
DATA POINT LOCATION MAP

DRAWN BY: DMC	SCALE: AS NOTED	PROJ. NO. 71717.01	
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APPROVED BY: MBP	DATE PRINTED:	SHEET 2 OF 19	
DATE: OCTOBER 2007			

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NORTH CAROLINA PROFESSIONAL SEAL 17543 ENGINEER R. KENT NELSON

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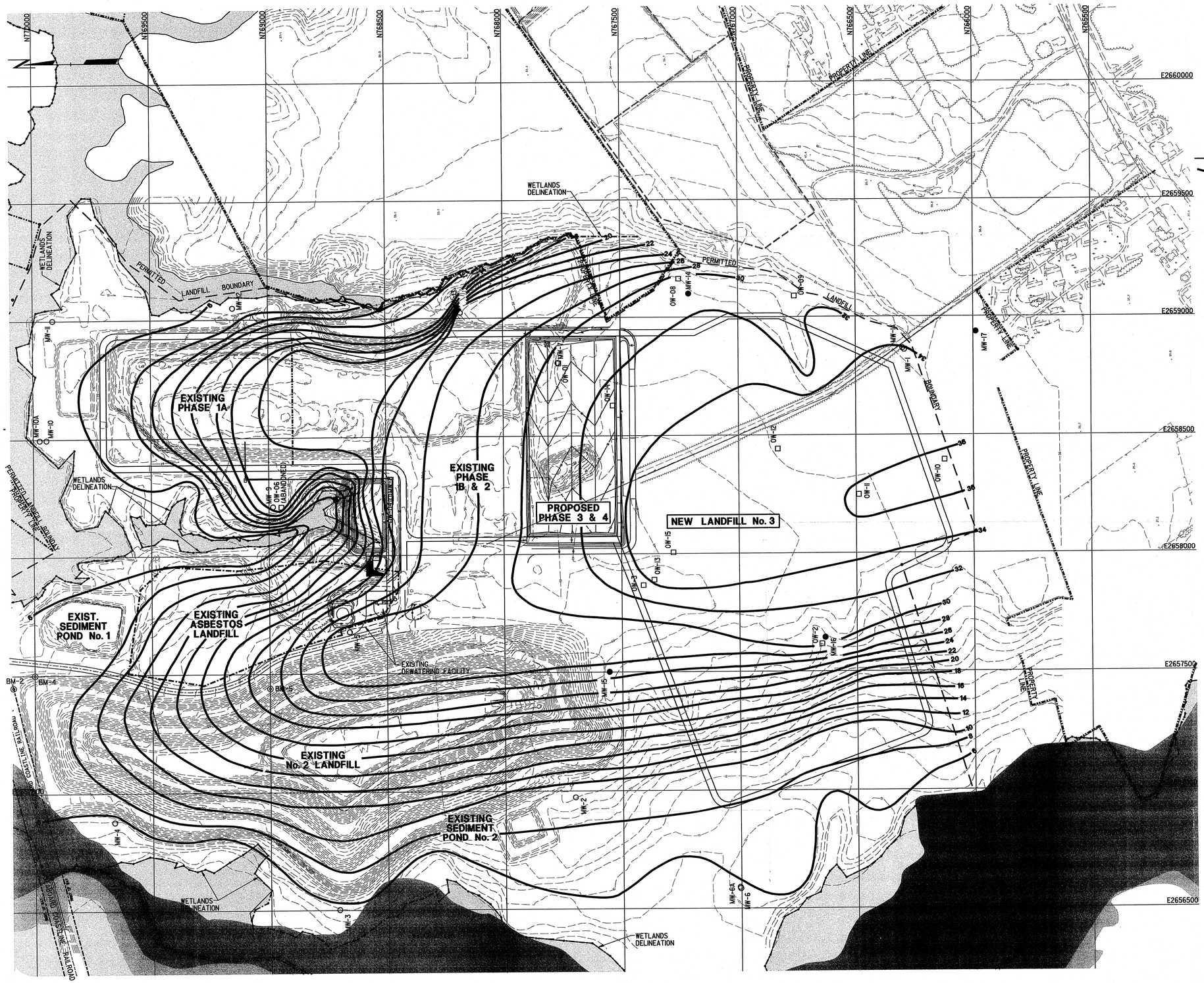

NOTES

1. REFER TO SHEET 2 FOR STANDARD LEGEND, ABBREVIATIONS GENERAL NOTES.
2. WATER TABLE CONFIGURATION BASED ON WATER TABLE MAP FOR APRIL 2, 1993 (HIGHEST ON RECORD)*.

LEGEND

22	HISTORICAL HIGH WATER TABLE ELEVATION IN FEET ABOVE MEAN SEA LEVEL CONTOUR INTERVAL IS TWO FEET (MEASURED APRIL 2, 1993*)
○ MW-1	EXISTING MONITORING WELL
□ OW-2	EXISTING OBSERVATION WELL (* INDICATES INSTALLATION AFTER APRIL, 1993)
● MW-9	PROPOSED MONITORING WELL

* WATER TABLE CONTOURS ADJUSTED TO REFLECT HISTORICAL HIGH WATER LEVELS MEASURED IN WELLS MW-5 AND MW-13 ON MAY 16, 2003 AND WELL MW-7 ON DECEMBER 1, 2005.

MONITORING WELL INSTALLATION AND ABANDONMENT SCHEDULE

PHASE	WELLS
3 & 4	ABANDON MW-7, OW-14, OW-01
5 & 6	INSTALL MW-14, MW-15
LATER PHASES	INSTALL MW-16, MW-17 ABANDON MW-16

THE HYDROGEOLOGY WORK FOR DOMTAR IN PLYMOUTH, NORTH CAROLINA WAS PERFORMED BY RMT, INC. CONSULTING HYDROGEOLOGIST IN SUPPORT OF RMT NORTH CAROLINA, INC.

NORTH CAROLINA LICENSED SEAL 249 GEOLOGIST DAN O. MADISON, JR. 6/3/08

NORTH CAROLINA PROFESSIONAL SEAL 17543 ENGINEER R. KENT KLASSON 6/3/08

0 200' 400' 600' 800'
SCALE: 1" = 200'

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NEW LANDFILL No. 3 - PHASE 3 & 4
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DOMTAR COMPANY
PLYMOUTH, NORTH CAROLINA

SHEET TITLE: HISTORICAL HIGH WATER TABLE CONFIGURATION (APRIL 2, 1993)x

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DATE: OCTOBER 2007			

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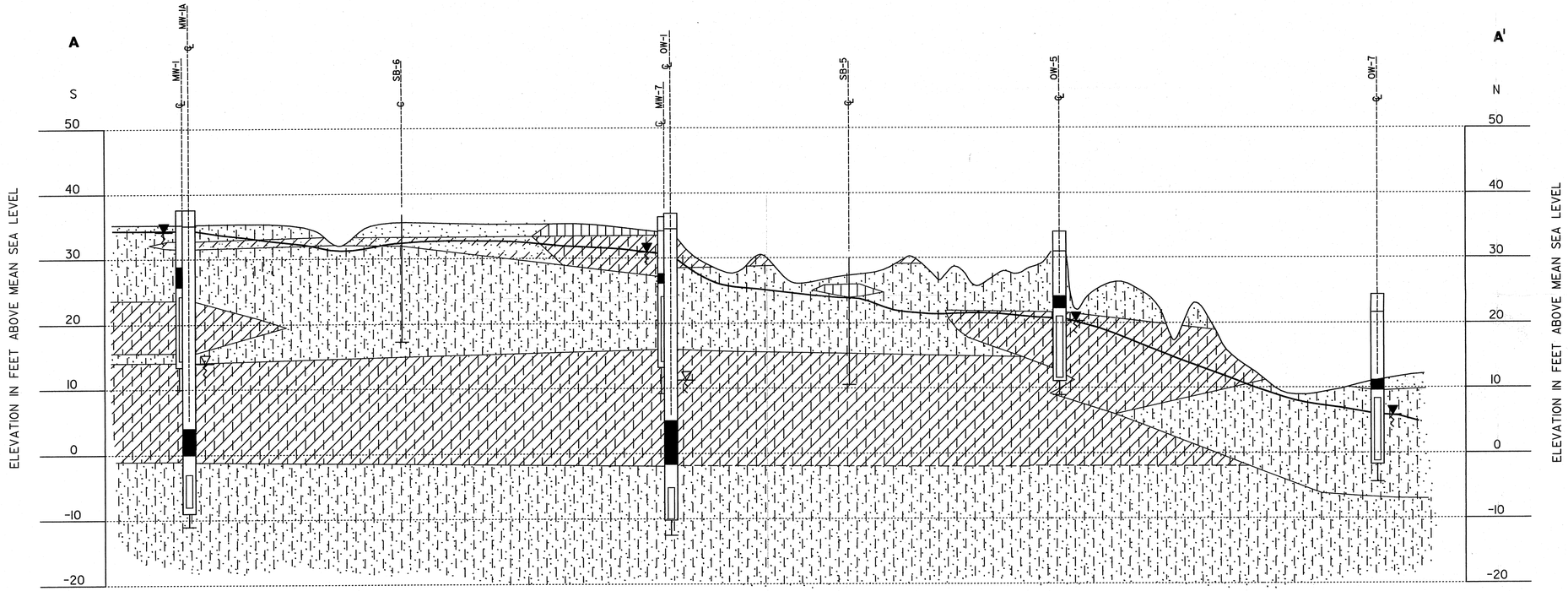
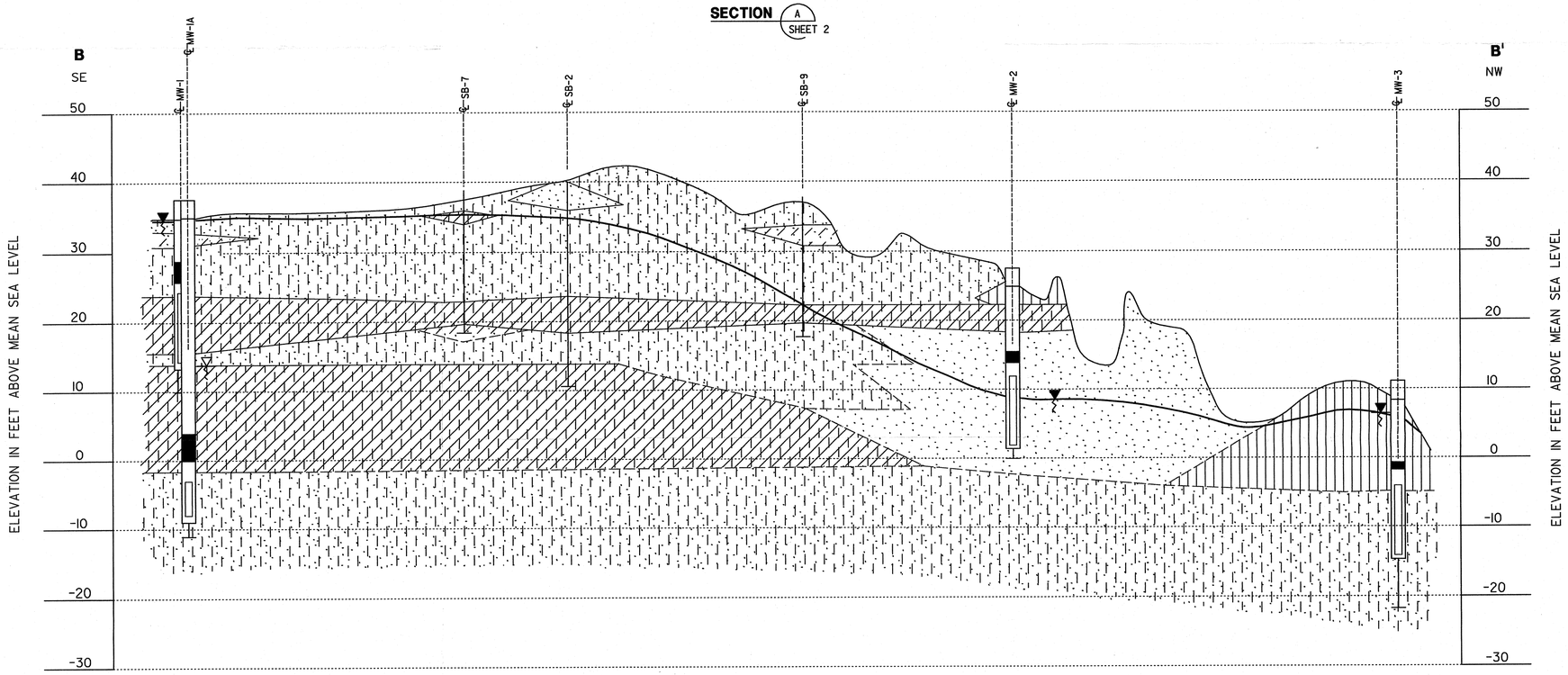


GEOLOGIC CROSS SECTION A-A'

SECTION A / SHEET 2



GEOLOGIC CROSS SECTION B-B'

SECTION B / SHEET 2

NOTES

1. REFER TO SHEET 1 FOR LEGEND, ABBREVIATIONS AND GENERAL NOTES.
2. HISTORICAL HIGH WATER TABLE SURFACE FOR MW-7 WAS RECORDED ON DECEMBER 1, 2005.

LEGEND

- WELL SCREEN AND BENTONITE SEAL
- WATER TABLE SURFACE HISTORIC HIGH (APRIL, 1993) (SEE NOTE 2)
- POTENTIOMETRIC SURFACE HISTORIC HIGH (APRIL, 1993)
- SILTY CLAY - SOFT TO STIFF; OCCASIONAL TRACE FINE TO MEDIUM GRAINED SAND. DEEP CLAYS ARE USUALLY MICACEOUS WITH SOME SAMPLES TESTED AS CLAYEY SILTS
- SILT - OFTEN CLAYEY; OCCASIONAL ORGANIC MATERIAL
- CLAYEY SAND - MOST FINE GRAINED; OFTEN SILTY
- SILTY SAND - MOST FINE GRAINED; OCCASIONAL CLAY WITH FRAGMENTED SHELL ZONES AND POORLY GRADED SAND ZONES
- POORLY GRADED SAND

THE HYDROGEOLOGY WORK FOR DOMTAR IN PLYMOUTH, NORTH CAROLINA WAS PERFORMED BY RMT, INC. CONSULTING HYDROGEOLOGIST IN SUPPORT OF RMT NORTH CAROLINA, INC.

0 200 400
HORIZONTAL SCALE: 1" = 200'

0 10 20
VERTICAL SCALE: 1" = 10'
VERTICAL EXAGGERATION: 20x

NORTH CAROLINA LICENSED GEOLOGIST SEAL 249 6/3/08 DAN Q. MADISON, JR.

NORTH CAROLINA PROFESSIONAL SEAL 17543 ENGINEER R. KENT NILSSON

NO.	BY	DATE	REVISION	APP'D.
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NEW LANDFILL No. 3 - PHASE 3 & 4
CONSTRUCTION PLAN APPLICATION
DOMTAR COMPANY
PLYMOUTH, NORTH CAROLINA

SHEET TITLE:
GEOLOGIC CROSS SECTIONS - SHEET 1

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DATE: OCTOBER 2007			

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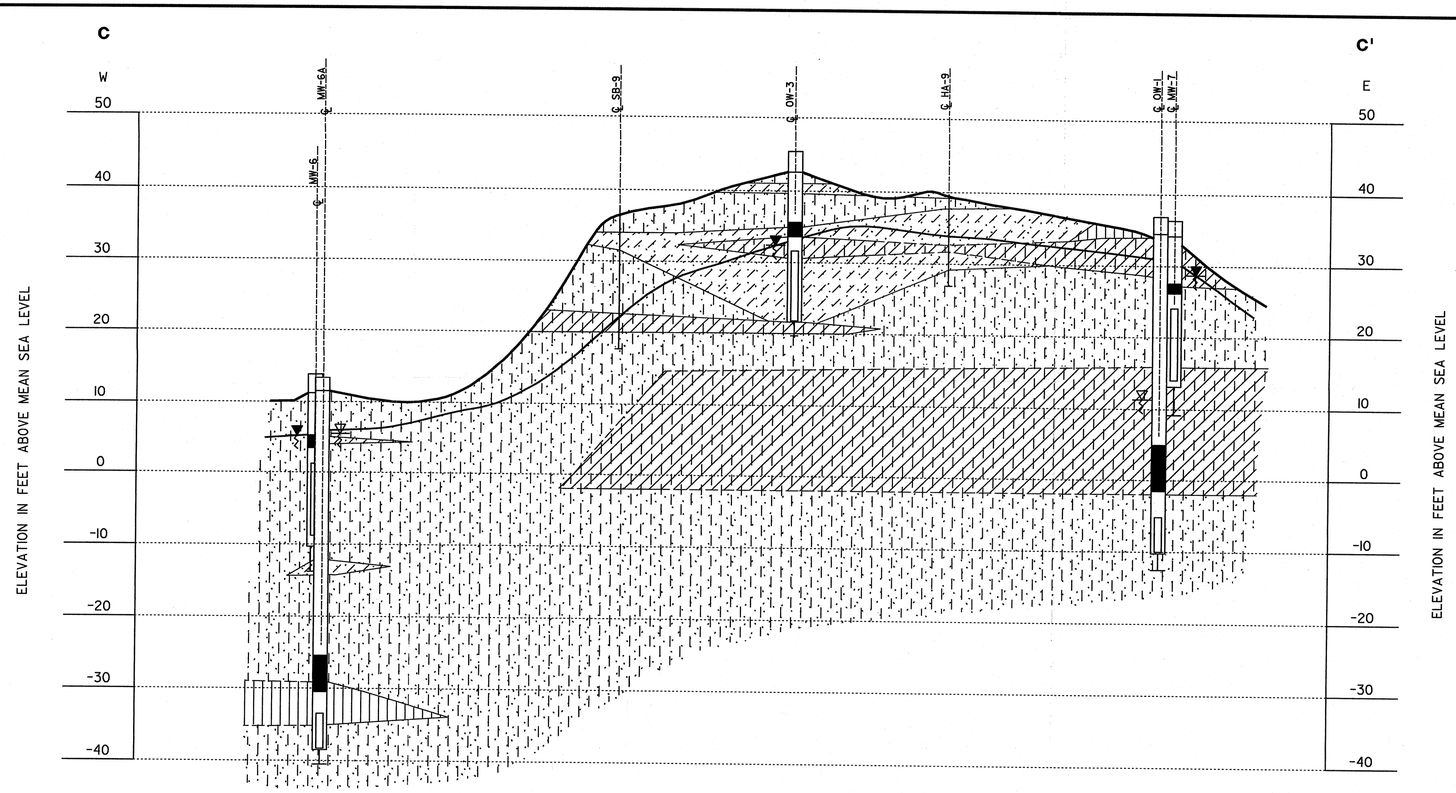
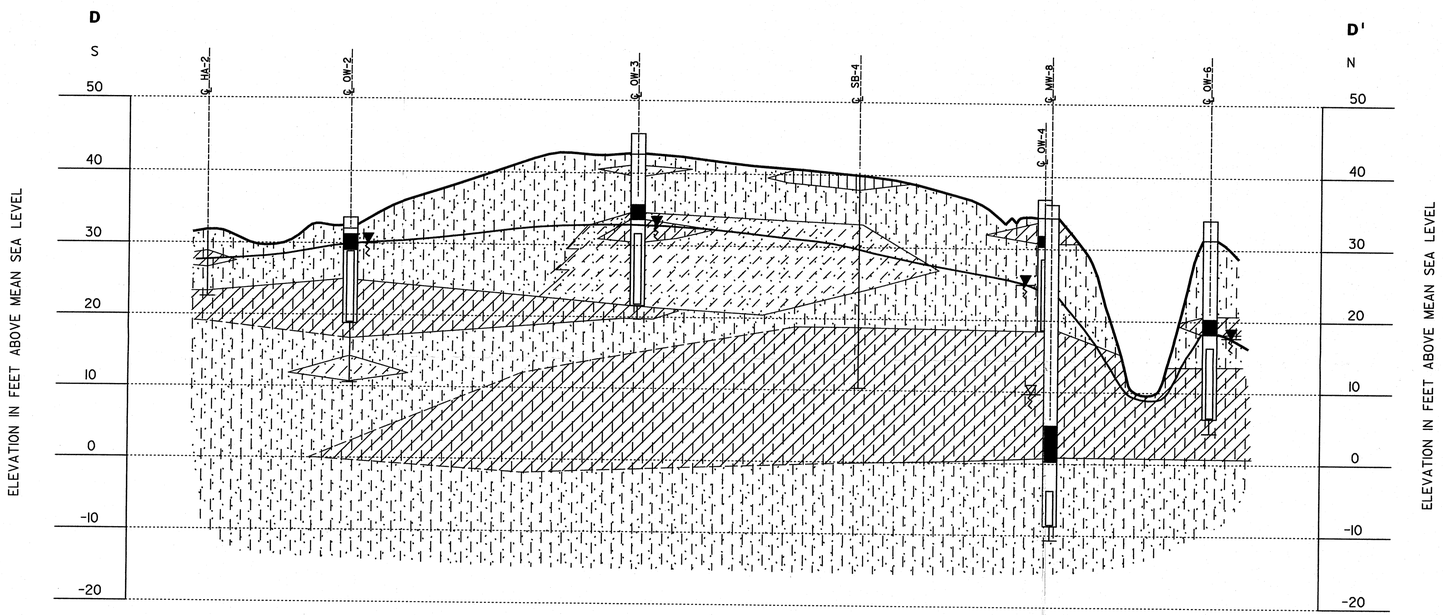


GEOLOGIC CROSS SECTION C-C'

SECTION C SHEET 2



GEOLOGIC CROSS SECTION D-D'

SECTION D SHEET 2

NOTES

1. REFER TO SHEET 1 FOR LEGEND, ABBREVIATIONS AND GENERAL NOTES.
2. HISTORICAL HIGH WATER TABLE SURFACE FOR MW-7 WAS RECORDED ON DECEMBER 1, 2005.

LEGEND

- WELL SCREEN AND BENTONITE SEAL
- WATER TABLE SURFACE HISTORIC HIGH (APRIL, 1993) (SEE NOTE 2)
- POTENTIOMETRIC SURFACE HISTORIC HIGH (APRIL, 1993)
- SILTY CLAY - SOFT TO STIFF; OCCASIONAL TRACE FINE TO MEDIUM GRAINED SAND. DEEP CLAYS ARE USUALLY MICACEOUS WITH SOME SAMPLES TESTED AS CLAYEY SILTS
- SILT - OFTEN CLAYEY; OCCASIONAL ORGANIC MATERIAL
- CLAYEY SAND - MOST FINE GRAINED; OFTEN SILTY
- SILTY SAND - MOST FINE GRAINED; OCCASIONAL CLAY WITH FRAGMENTED SHELL ZONES AND POORLY GRADED SAND ZONES
- POORLY GRADED SAND

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0 200 400
HORIZONTAL SCALE: 1" = 200'

0 10 20
VERTICAL SCALE: 1" = 10'
VERTICAL EXAGGERATION: 20x

NORTH CAROLINA LICENSED SEAL 249 GEOLOGIST DAN Q. MADISON, JR.

NORTH CAROLINA PROFESSIONAL SEAL 17543 ENGINEER R. KENT WILSON

NO.	BY	DATE	REVISION	APP'D.
A	DMC	1-11-08	ISSUED FOR CLIENT REVIEW	RKN

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NEW LANDFILL No. 3 - PHASE 3 & 4
CONSTRUCTION PLAN APPLICATION
DOMTAR COMPANY
PLYMOUTH, NORTH CAROLINA

SHEET TITLE:
GEOLOGIC CROSS SECTIONS - SHEET 2

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DATE: OCTOBER 2007			

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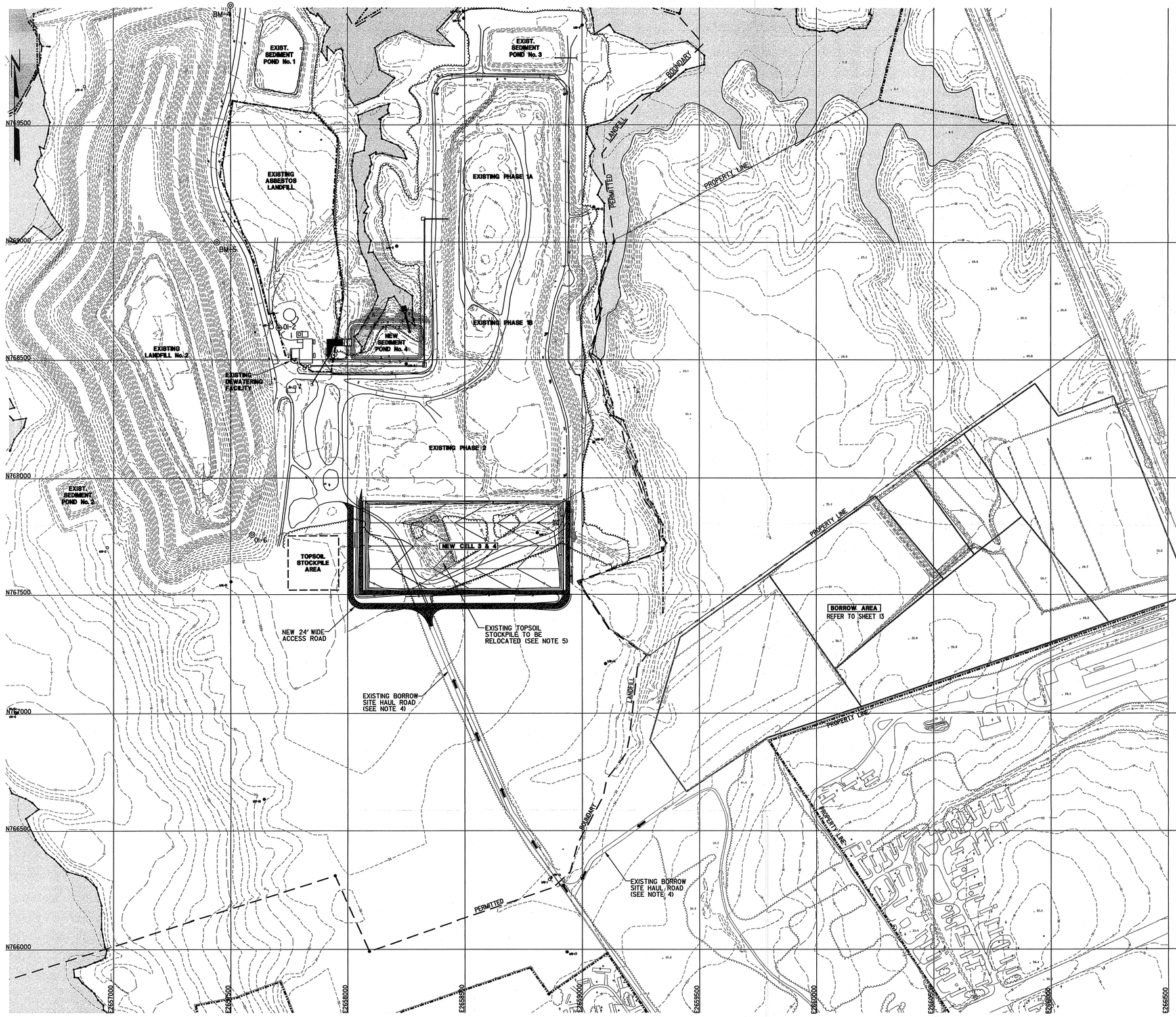

NOTES

1. REFER TO SHEET 1 FOR LEGEND, ABBREVIATIONS AND GENERAL NOTES.
2. UNLESS NOTED OTHERWISE, NEW CONTOURS AND/OR NEW SPOT ELEVATIONS REPRESENT FINISHED GRADE. ALLOWANCES SHALL BE MADE FOR TOPSOIL, ROAD SURFACES AND LINER CONSTRUCTION.
3. CLEARING AND GRUBBING LIMITS SHALL BE 10' OUTSIDE THE GRADING LIMITS REFER TO SHEET 4.
4. BORROW SITE HAUL ROAD MAY BE UPGRADED AT THE CONTRACTOR'S DISCRETION.
5. EXISTING TOPSOIL STOCKPILE SHALL BE REMOVED PRIOR TO LINER CONSTRUCTION AND USED FOR CELLS 3 & 4 WHERE TOPSOIL IS INDICATED ON THE PLANS. ANY EXISTING TOPSOIL NOT USED SHALL BE STOCKPILED IN THE AREA INDICATED.

HORIZONTAL/VERTICAL CONTROL POINTS

REFER TO NOTE 3 OF THE GENERAL NOTES ON SHEET 1

POINT I.D.	NORTH COORDINATE	EAST COORDINATE	COMMENT
BM-1	N768316.38	E2657674.09	CONCRETE MONUMENT NEAR REFUELING FACILITY - ELEV. 39.55 MSL
BM-2	N770092.49	E2657448.66	PK NAIL AT INTERSECTION OF SEABOARD COASTLINE RAILROAD AND SITE ACCESS ROAD - ELEV. 11.51MSL
BM-3	N770174.35	E2657809.01	PK NAIL IN CROSS TIE AT INTERSECTION OF SEABOARD COASTLINE RAILROAD AND LITTLE MILL CREEK
BM-4	N770000.00	E2657500.00	CONCRETE MONUMENT
BM-5	N769000.00	E2657440.00	CONCRETE MONUMENT
BM-6	N767500.00	E2657500.00	CONCRETE MONUMENT
BM-7	N767500.00	E2656500.00	CONCRETE MONUMENT
OI-1	N770103.15	E2657619.83	ELEV. 12.03 MSL
OI-2	N768634.57	E2657705.36	ELEV. 36.94 MSL
OI-6	N767759.89	E2657590.77	ELEV. 59.00 MSL

0 200' 400' 600' 800'

SCALE: 1" = 200'

NO.	BY	DATE	REVISION	APPD.
A	DMC	1-11-08	ISSUED FOR CLIENT REVIEW	RKN

NORTH CAROLINA PROFESSIONAL SEAL 17543 ENGINEER R. KENT ANDERSON 6/3/08

Domtar

NEW LANDFILL No. 3 - PHASE 3 & 4
CONSTRUCTION PLAN APPLICATION
DOMTAR COMPANY
PLYMOUTH, NORTH CAROLINA

SHEET TITLE: **OVERALL SITE PLAN**

DRAWN BY: DMC	SCALE: AS NOTED	PROJ. NO.	71717.01
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APPROVED BY: MBP	DATE PRINTED:	SHEET	7 OF 19
DATE: OCTOBER 2007			

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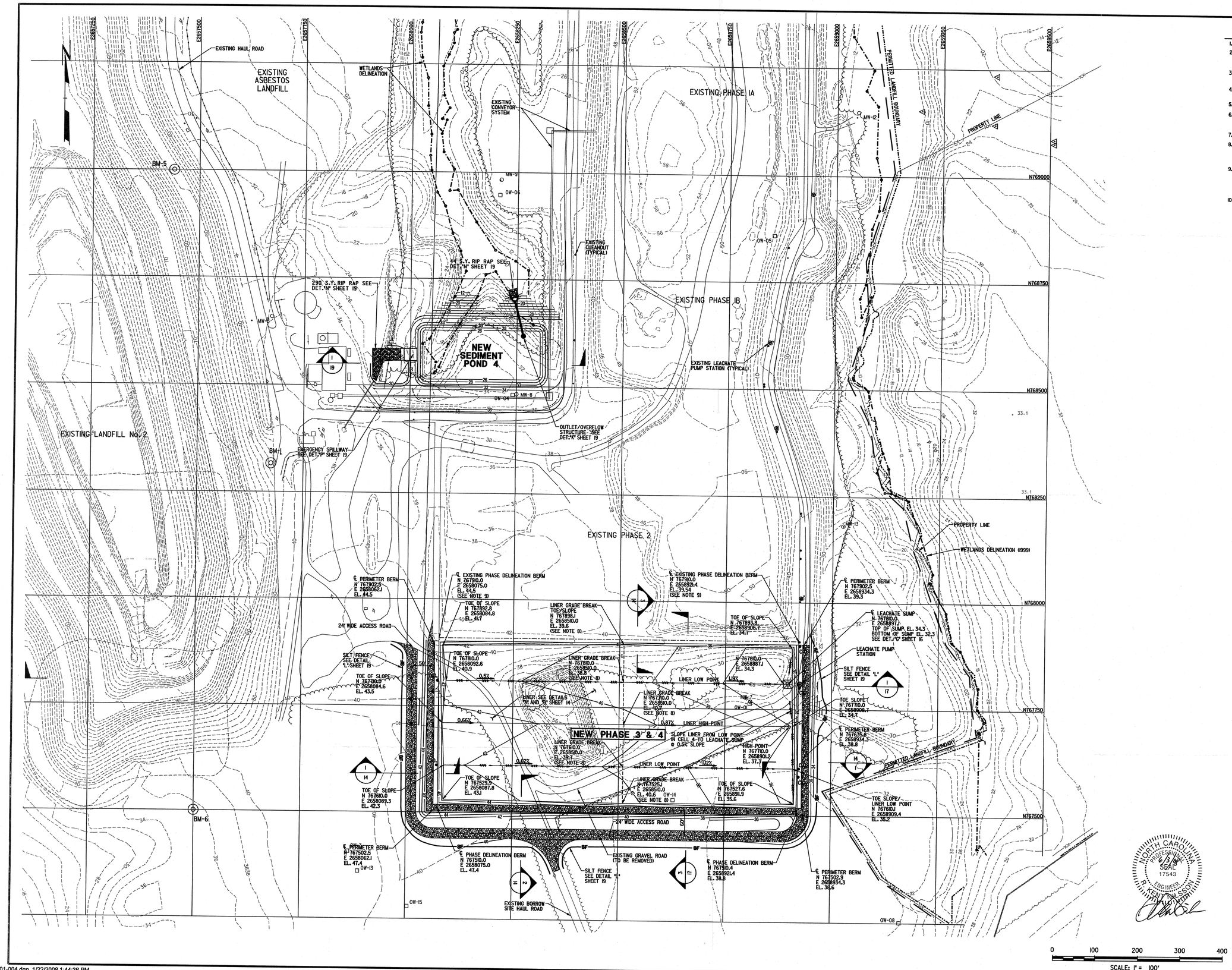

NOTES

1. REFER TO SHEET 1 FOR STANDARD LEGEND, ABBREVIATIONS AND GENERAL NOTES.
2. NEW CONTOURS INSIDE THE PERIMETER BERM AND PHASE DELINEATION BERM ARE TOP OF PREPARED SUBGRADE ELEVATIONS. ALL OTHER NEW CONTOURS ARE FINISHED GRADE ELEVATIONS.
3. RIP RAP IS TO BE PLACED (SIZE AND THICKNESS) AS PER DETAIL "K" DRAWING SHEET 11.
4. ALL NEW SIDE SLOPES ARE TO BE 3' (HORIZONTAL) TO 1' (VERTICAL) UNLESS NOTED OTHERWISE.
5. FOR DETAIL OF LEACHATE SUMP REFER TO DETAIL "F" SHEET 16.
6. ALL AREAS NOT COVERED WITH RIP RAP, CRUSHED STONE SURFACING OR LINER SYSTEM, SHALL BE GRASSED IN ACCORDANCE WITH SECTIONS 02921 AND 02923 OF THE SPECIFICATIONS.
7. ALL EXISTING MONITORING WELLS ARE TO BE PROTECTED DURING CONSTRUCTION.
8. THE LINER GRADE BREAKS TO A STEEPER SLOPE AT THE GRADE BREAK TO ALLOW FOR LONG-TERM SETTLEMENT OF THE SUBGRADE. THE GRADES SHOWN WERE ESTABLISHED TO PROVIDE CAMBER FOR THE LEACHATE PIPE TO HAVE A MINIMUM SLOPE OF 0.5% AFTER PREDICTED SETTLEMENT.
9. CONTRACTOR SHALL FIELD DETERMINE THE CENTERLINE LOCATION OF EXISTING PHASE DELINEATION BERM FOR CELL 2. REMOVE EXISTING CRUSHED STONE ON TOP OF BERM AS REQUIRED TO LOCATE TIE-IN LOCATION FOR NEW LINER IN CELL 3. EXISTING LINER SHALL BE CLEAN AND UNDAMAGED FOR TIE-IN. REFER TO DETAIL "B" SHEET 14 AND SECTION "3" SHEET 14.
10. REFER TO DETAILS "A" AND "B" SHEET 14 FOR LINER CONSTRUCTION DETAILS.

NO.	BY	DATE	REVISION	APPD.
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NORTH CAROLINA PROFESSIONAL SEAL 17543 ENGINEER RICHARD K. NILSSON

Domtar

NEW LANDFILL No. 3 - PHASE 3 & 4
CONSTRUCTION PLAN APPLICATION
DOMTAR COMPANY
PLYMOUTH, NORTH CAROLINA

SHEET TITLE: **LINER GRADING PLAN**

DRAWN BY: DMC	SCALE: AS NOTED	PROJ. NO. 71717.01	
CHECKED BY: RKN		FILE NO.	
APPROVED BY: MBP	DATE PRINTED:	SHEET 8 OF 19	
DATE: OCTOBER 2007			

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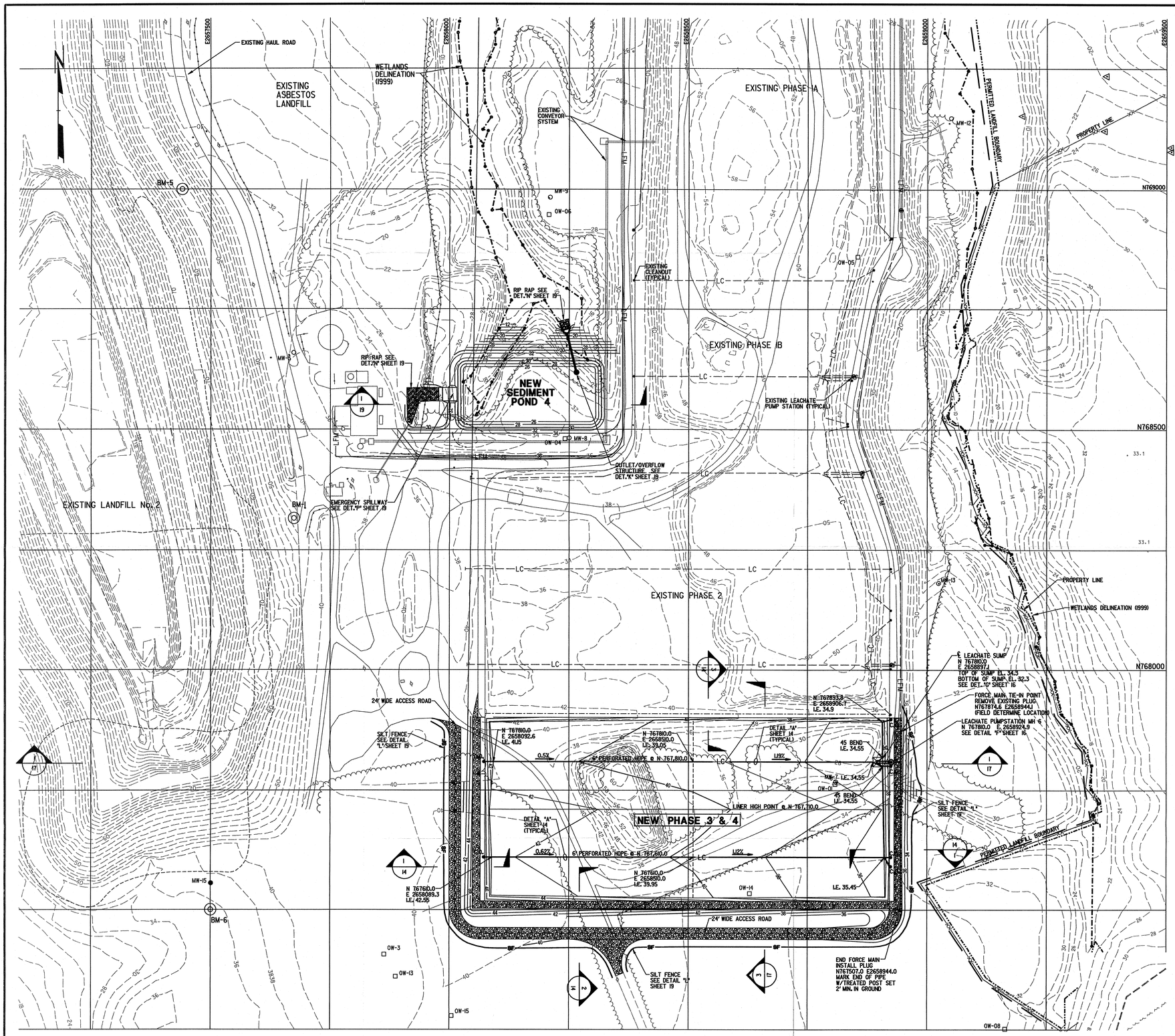

NOTES

1. REFER TO SHEET 1 FOR STANDARD LEGEND, ABBREVIATIONS AND GENERAL NOTES.
2. THRUST BLOCKS SHALL BE INSTALLED ON FORCE MAIN AT ALL PLUGS, BENDS, TEES AN Y-BRANCHES. REFER DETAIL "J" SHEET 18.
3. ALL 6" AND 18" HDPE PIPE SHALL BE SDR 17.
4. THE LEACHATE COLLECTION SYSTEM DRAINAGE LAYER CONSISTS OF 12" OF No. 67 STONE AND OVERLAIN BY 6" OF SELECT GRADED SAND. THE No. 67 STONE SHALL BE PLACED OVER THE ENTIRE LINED FOOTPRINT. DURING INITIAL CONSTRUCTION THE SAND SHALL BE PLACED 5' UP THE SLOPES. DURING OPERATIONS THE SAND LAYER WILL BE RAISED AS THE WASTE LEVEL IS RAISED.
5. FORCE MAIN SHALL BE A DUAL CONTAINMENT PIPING SYSTEM THAT CONSISTS OF A 6" HDPE FORCE MAIN IN A 10" HDPE CARRIER PIPE.
6. REFER TO SECTION "I" SHEET 14 FOR CLEANOUT DETAIL.
7. REFER TO DETAIL "A" SHEET 14 FOR LEACHATE COLLECTION AND LINER DETAILS.

0 100 200 300 400
SCALE: 1" = 100'

NORTH CAROLINA PROFESSIONAL SEAL 17543 ENGINEER R. KENT NIXSON 6/3/08

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NEW LANDFILL No. 3 - PHASE 3 & 4
CONSTRUCTION PLAN APPLICATION
DOMTAR COMPANY
PLYMOUTH, NORTH CAROLINA

SHEET TITLE:
LEACHATE PIPING PLAN

DRAWN BY: DMC	SCALE: AS NOTED	PROJ. NO. 71717.01	
CHECKED BY: RKN		FILE NO.	
APPROVED BY: MBP	DATE PRINTED:	SHEET 9 OF 19	
DATE: OCTOBER 2007			

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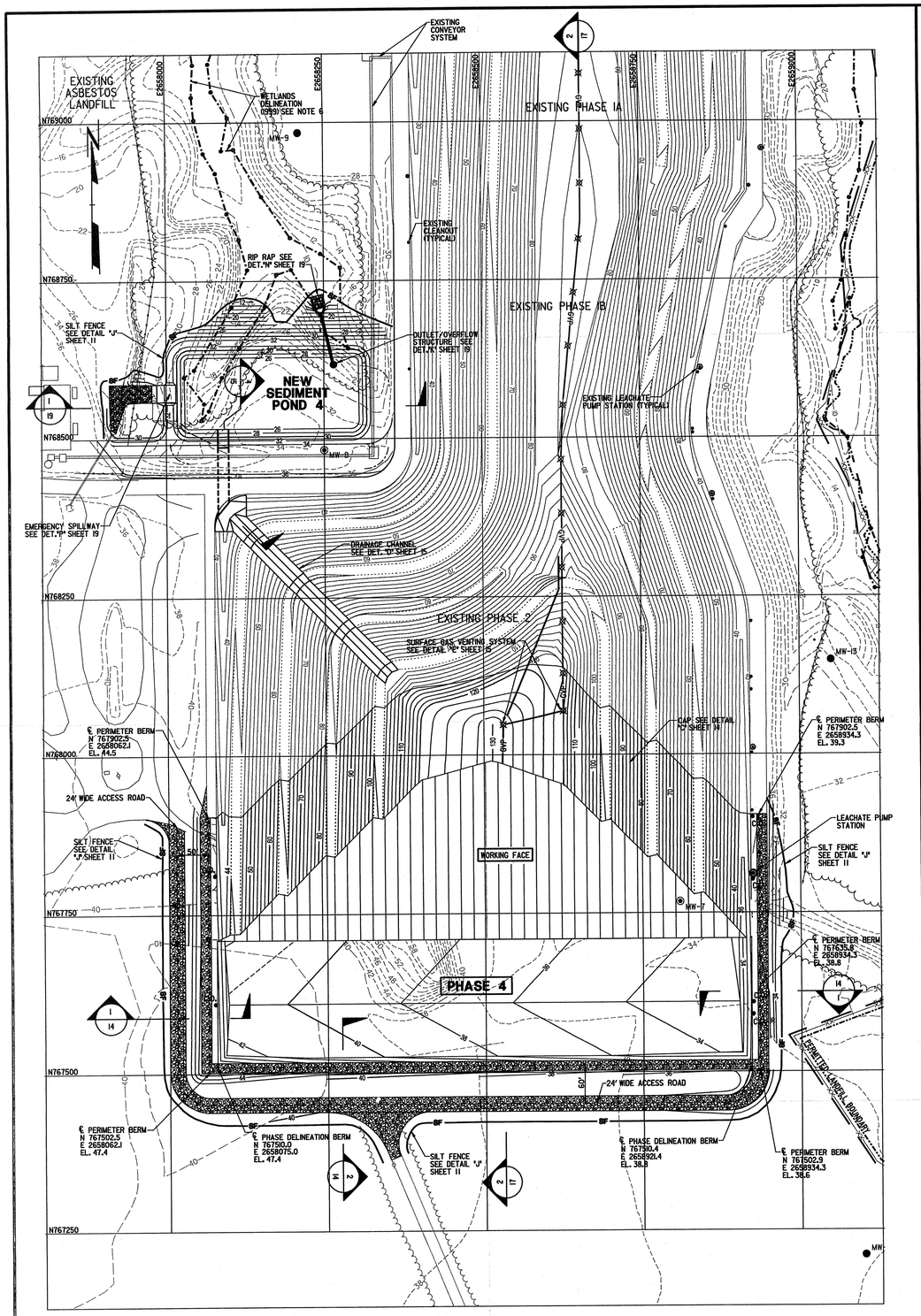
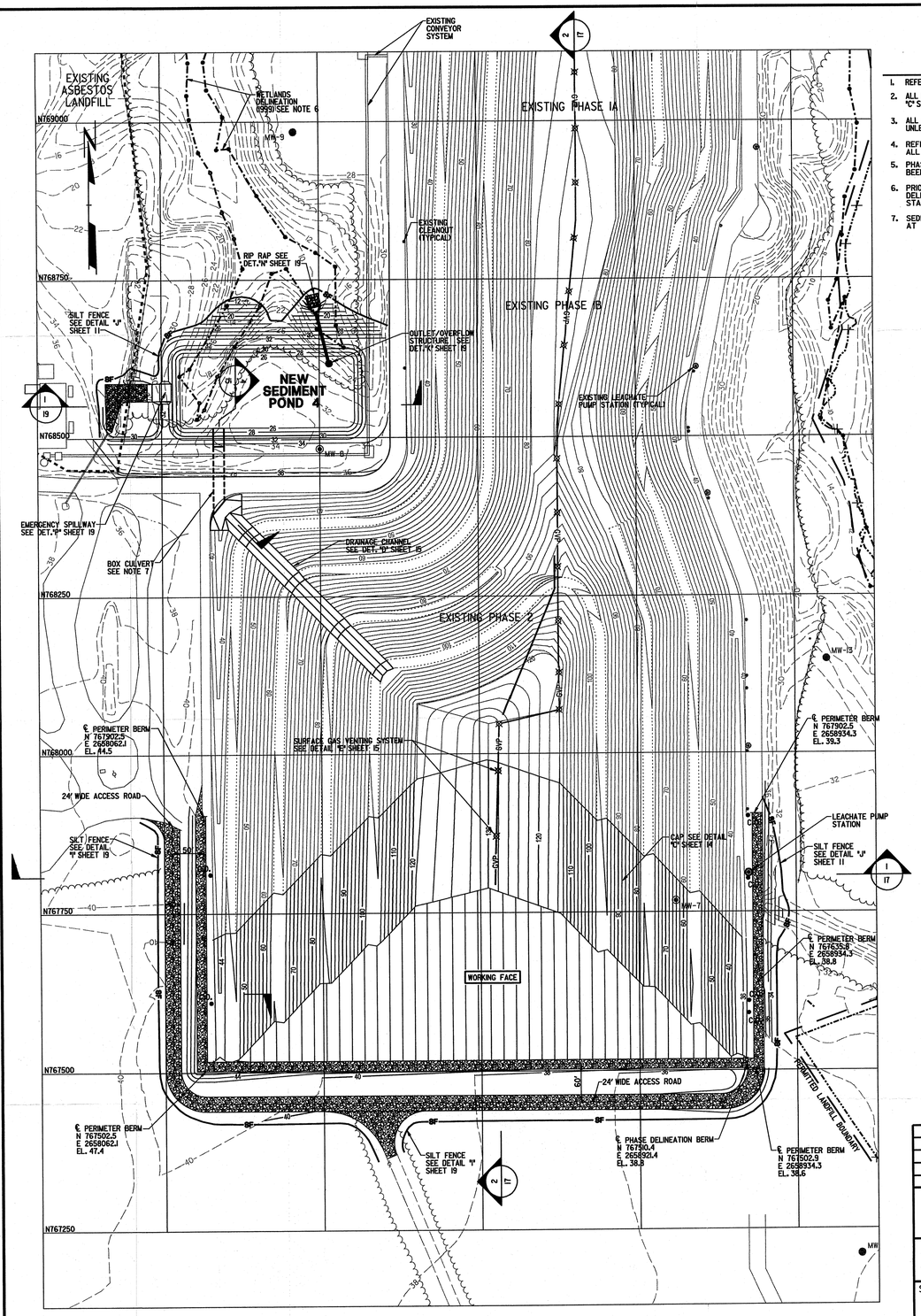


FINAL GRADING PLAN PHASE 3



FINAL GRADING PLAN PHASE 4

NOTES

1. REFER TO SHEET 1 FOR STANDARD LEGEND, ABBREVIATIONS AND GENERAL NOTES.
2. ALL FINAL GRADE ELEVATIONS SHOWN ARE FINISHED ELEVATIONS. REFER TO DETAIL "C" SHEET 14 FOR CAP THICKNESS.
3. ALL FINAL GRADE SLOPES ARE TO BE 3' (HORIZONTAL) TO 1' (VERTICAL) UNLESS NOTED OTHERWISE.
4. REFER TO SHEET 11 FOR THE OVERALL GRADING PLAN FOR ALL PHASES.
5. PHASE 3 AND 4 SHALL NOT BE CLOSED UNTIL PHASES 5 AND 6 HAVE BEEN CONSTRUCTED. SEE SHEET 12 FOR PHASE PROGRESSION.
6. PRIOR TO CONSTRUCTION OF SEDIMENT POND No. 4 THE WETLAND DELINEATION SHALL BE VERIFIED, AND IF NECESSARY, THE APPROPRIATE STATE AND FEDERAL PERMITS SHALL BE OBTAINED.
7. SEDIMENT POND No. 4 AND BOX CULVERT SHALL BE CONSTRUCTED AT THE TIME OF PHASE 2 CAPPING.

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 17543 R. KENT NILSSON

NO.	BY	DATE	REVISION	APP'D.
A	DMC	1-11-08	ISSUED FOR CLIENT REVIEW	RKN

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NEW LANDFILL No. 3 - PHASE 3 & 4
CONSTRUCTION PLAN APPLICATION
DOMTAR COMPANY
PLYMOUTH, NORTH CAROLINA

SHEET TITLE: FINAL GRADING PLAN PHASE 3 & 4

DRAWN BY: DMC	SCALE: AS NOTED	PROJ. NO. 71717.01	
CHECKED BY: RKN		FILE NO.	
APPROVED BY: MBP	DATE PRINTED:	SHEET 10 OF 19	
DATE: OCTOBER 2007			

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0 100 200 300 400
SCALE: 1" = 100'

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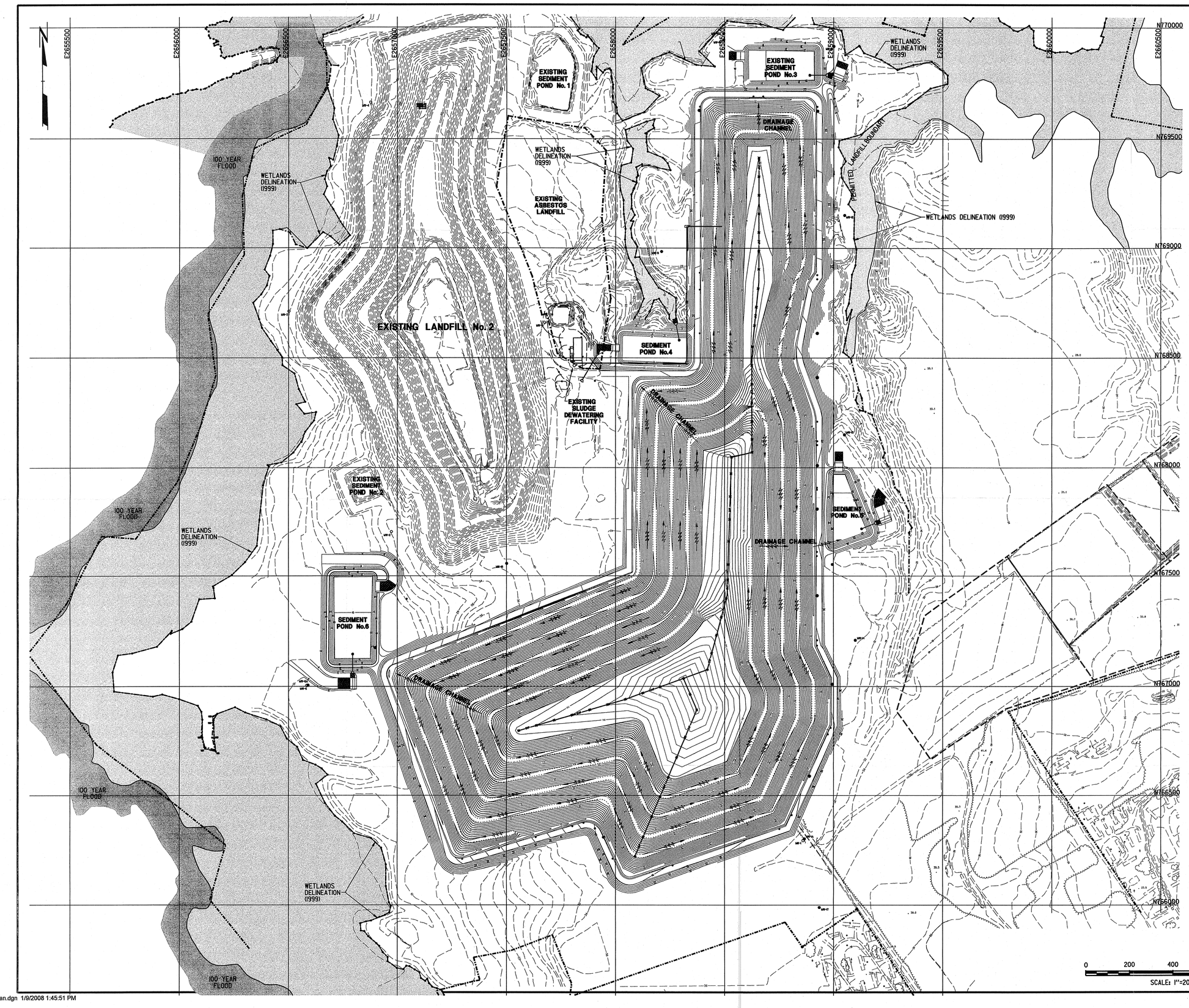

NOTES

1. REFER TO SHEET 2 FOR STANDARD LEGEND, ABBREVIATIONS AND GENERAL NOTES.
2. ALL NEW SLOPES ARE TO BE 3' (HORIZONTAL) TO 1' (VERTICAL) UNLESS NOTED OTHERWISE.
3. REFER TO DETAIL "C" SHEET 14 FOR CAP THICKNESS AND CONSTRUCTION.

NORTH CAROLINA PROFESSIONAL SEAL 17543 ENGINEER R. KENT WILSON

NO.	BY	DATE	REVISION	APP'D.
A	DMC	1-11-08	ISSUED FOR CLIENT REVIEW	RKN

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NEW LANDFILL No. 3 - PHASE 3 & 4
CONSTRUCTION PLAN APPLICATION
DOMTAR COMPANY
PLYMOUTH, NORTH CAROLINA

SHEET TITLE:
FINAL GRADING PLAN - OVERALL

DRAWN BY: DMC	SCALE: AS NOTED	PROJ. NO. 71717.01	
CHECKED BY: RKN		FILE NO.	
APPROVED BY: MBP	DATE PRINTED:	SHEET 11 OF 19	
DATE: OCTOBER 2007			

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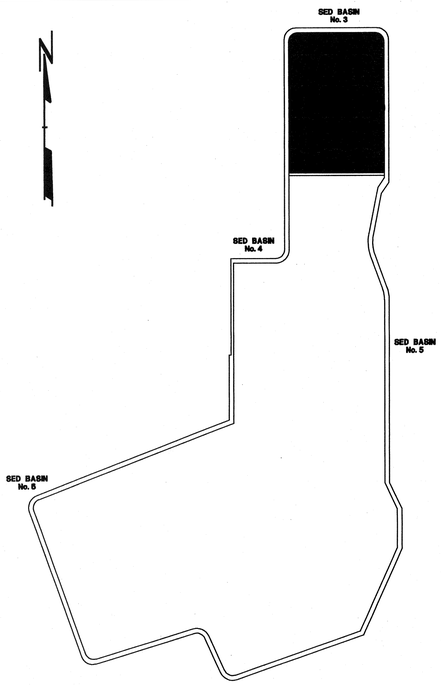
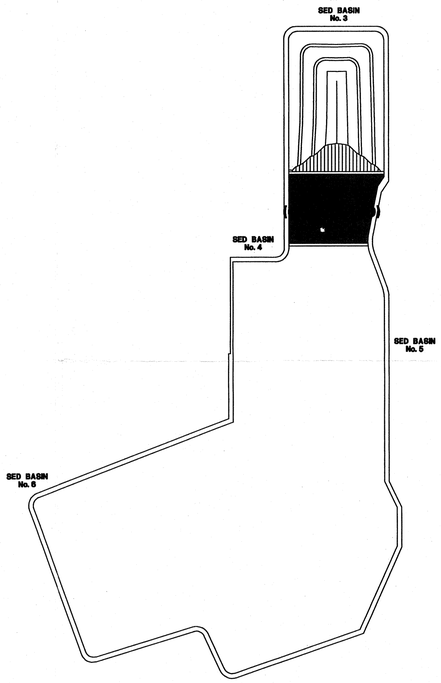


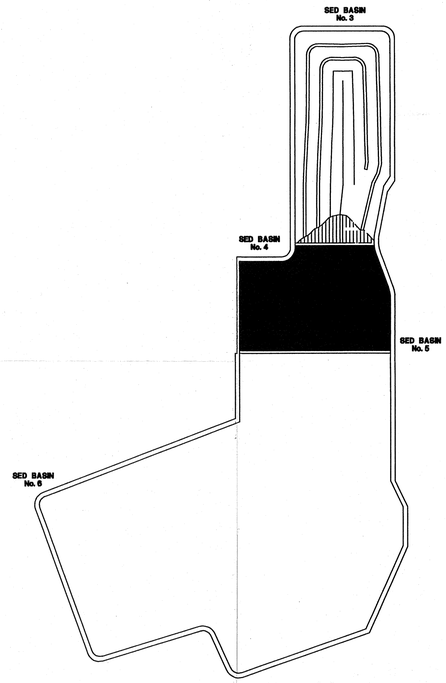
PHASE 1A CONSTRUCTION SEQUENCE (COMPLETED)

- INSTALL NEW MONITORING WELLS MW-9 THROUGH MW-16 PRIOR TO CONSTRUCTION OF PHASE IA
- ABANDON MW-8, MW-14, MW-15 AND ABANDON OW-1 THROUGH OW-15
- CONSTRUCT PHASE IA LINER AND LEACHATE COLLECTION SYSTEM
- CONSTRUCT LEACHATE PUMP STATIONS 1 AND 2
- CONSTRUCT NEW SEDIMENTATION POND NO. 3
- CONSTRUCT PARTIAL FINAL CAP OF PHASE IA FROM NORTH TO SOUTH AS FILL IS COMPLETED



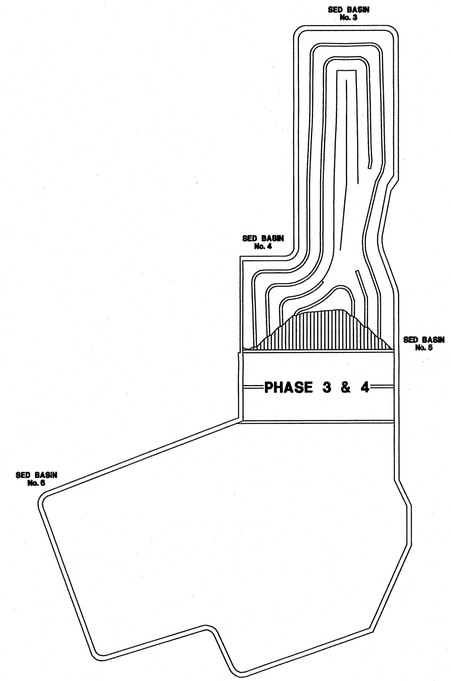
PHASE 1B CONSTRUCTION SEQUENCE (COMPLETED)

- CONSTRUCT PHASE IB LINER AND LEACHATE COLLECTION SYSTEM
- CONSTRUCT LEACHATE PUMP STATIONS 3
- COMPLETE PHASE IA CAP EXCEPT WORKING FACE
- CONSTRUCT PARTIAL FINAL CAP OF PHASE IB FROM NORTH TO SOUTH AS FILL IS COMPLETED



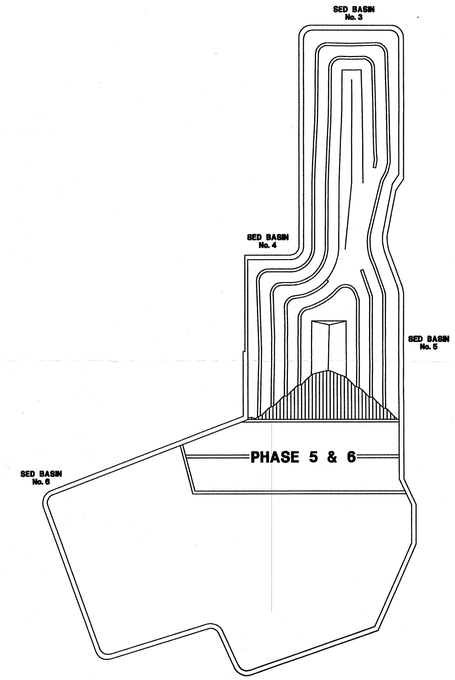
PHASE 2 CONSTRUCTION SEQUENCE (COMPLETED)

- CONSTRUCT PHASE 2 LINER AND LEACHATE COLLECTION SYSTEM
- CONSTRUCT LEACHATE PUMP STATIONS 4 AND 5
- COMPLETE PHASE IB CAP EXCEPT WORKING FACE
- CONSTRUCT PARTIAL FINAL CAP OF PHASE 2 FROM NORTH TO SOUTH AS FILL IS COMPLETED



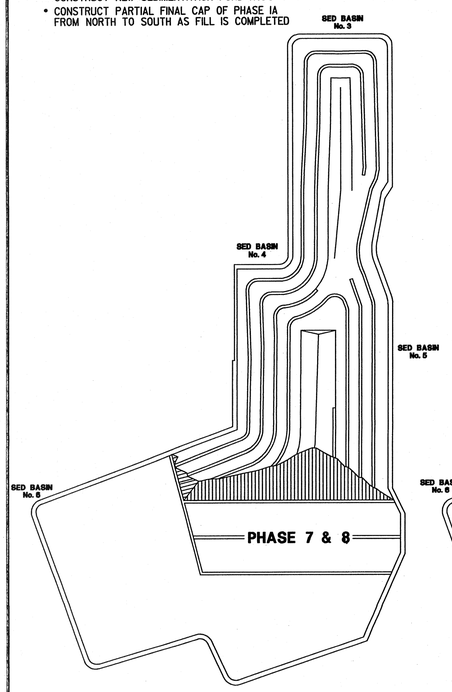
PHASE 3 & 4 CONSTRUCTION SEQUENCE

- CONSTRUCT PHASE 3 & 4 LINER AND LEACHATE COLLECTION SYSTEM
- CONSTRUCT LEACHATE PUMP STATION 6
- CONSTRUCT NEW SEDIMENTATION POND NO. 4
- COMPLETE PHASE 2 CAP EXCEPT WORKING FACE
- CONSTRUCT PARTIAL FINAL CAP OF PHASE 3 & 4 FROM NORTH TO SOUTH AS FILL IS COMPLETED



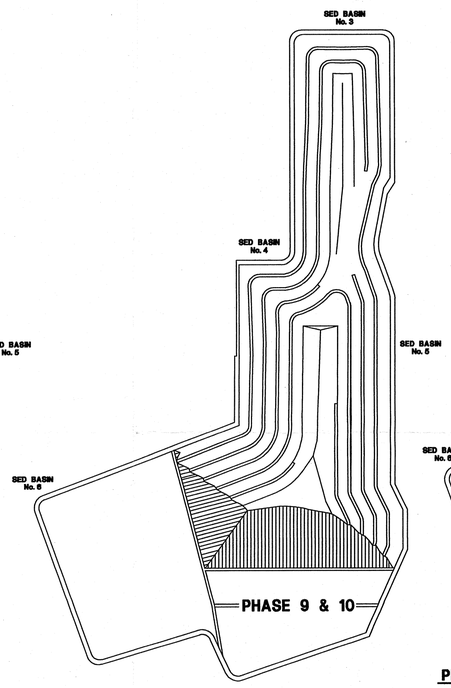
PHASE 5 & 6 CONSTRUCTION SEQUENCE

- CONSTRUCT PHASE 5 & 6 LINER AND LEACHATE COLLECTION SYSTEM
- CONSTRUCT NEW SEDIMENTATION POND No. 5
- CONSTRUCT LEACHATE PUMP STATION 7
- COMPLETE PHASE 3 & 4 CAP EXCEPT WORKING FACE
- CONSTRUCT PARTIAL FINAL CAP OF PHASE 5 & 6 FROM NORTH TO SOUTH AS FILL IS COMPLETED



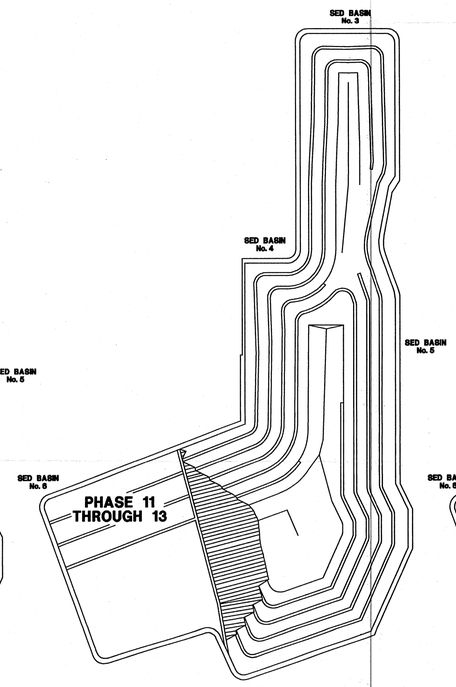
PHASE 7 & 8 CONSTRUCTION SEQUENCE

- CONSTRUCT PHASE 7 & 8 LINER AND LEACHATE COLLECTION SYSTEM
- CONSTRUCT LEACHATE PUMP STATION 8
- COMPLETE PHASE 5 & 6 CAP EXCEPT FOR WORKING FACE
- CONSTRUCT PARTIAL FINAL CAP OF PHASE 7 & 8 FROM NORTH TO SOUTH AS FILL IS COMPLETED



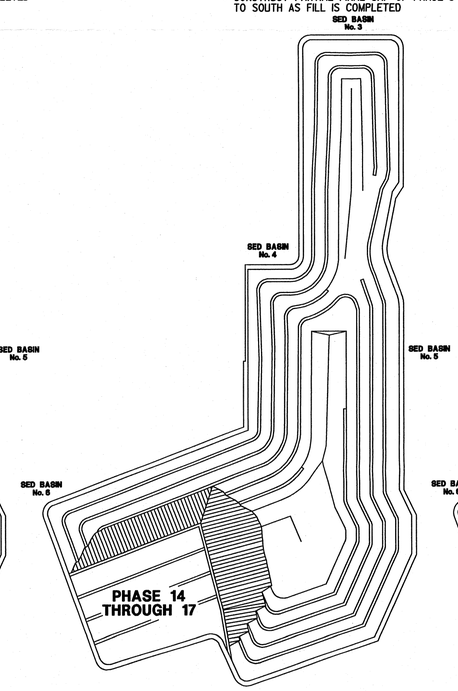
PHASE 9 & 10 CONSTRUCTION SEQUENCE

- CONSRUCT PHASE 9 & 10 LINER AND LEACHATE COLLECTION SYSTEM
- CONSTRUCT LEACHATE PUMP STATION 9
- COMPLETE PHASE 7 & 8 CAP EXCEPT FOR WORKING FACE
- CONSTRUCT PARTIAL FINAL CAP OF PHASE 9 & 10 FROM NORTH TO SOUTH AS FILL IS COMPLETED



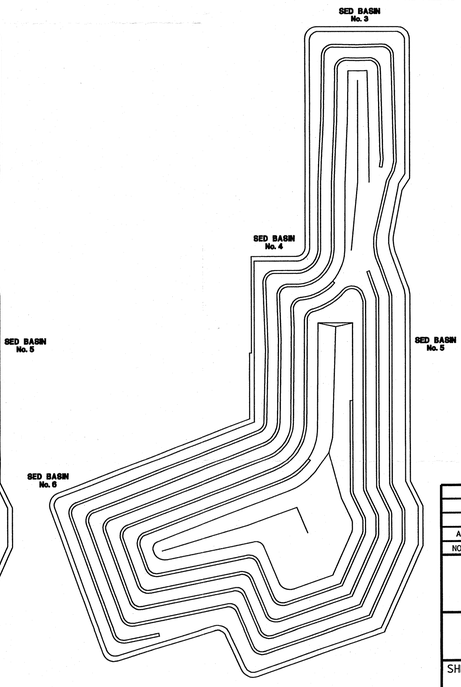
PHASE 11 THROUGH 13 CONSTRUCTION SEQUENCE

- CONSTRUCT PHASE 11 THROUGH 13 LINER AND LEACHATE COLLECTION SYSTEM
- CONSTRUCT NEW SEDIMENTATION POND NO. 6
- CONSTRUCT LEACHATE PUMP STATION 10
- CAP PHASE 3 THROUGH 6 WORKING FACE AS FILL IS COMPLETED
- CAP PHASE 7 & 8 WORKING FACE AS FILL IS COMPLETED
- CAP PHASE 9 & 10 WORKING FACE AS FILL IS COMPLETED
- CAP PHASE 11 THROUGH 13 WORKING FACE AS FILL IS COMPLETED



PHASE 14 THROUGH 17 CONSTRUCTION SEQUENCE

- CONSTRUCT PHASE 14 THROUGH 17 LINER AND LEACHATE COLLECTION SYSTEM
- CAP PHASE 7 & 8 WORKING FACE AS FILL IS COMPLETED
- CAP PHASE 9 & 10 WORKING FACE AS FILL IS COMPLETED
- CAP PHASE 11 THROUGH 17 WORKING FACE AS FILL IS COMPLETED



FINISHED LANDFILL

0 400 800 1200 1600

SCALE: 1"= 400'

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 17543 R. KEVIN KASSON 6/3/08

NO.	BY	DATE	REVISION	APP'D.
A	DMC	1-11-08	ISSUED FOR CLIENT REVIEW	RKN

Domtar

NEW LANDFILL No. 3 - PHASE 3 & 4
CONSTRUCTION PLAN APPLICATION
DOMTAR COMPANY
PLYMOUTH, NORTH CAROLINA

SHEET TITLE:
PHASE PROGRESSION PLAN

DRAWN BY: DMC	SCALE: AS NOTED	PROJ. NO. 71717.01	
CHECKED BY: RKN		FILE NO.	
APPROVED BY: MBP	DATE PRINTED:	SHEET 12 OF 19	
DATE: OCTOBER 2007			

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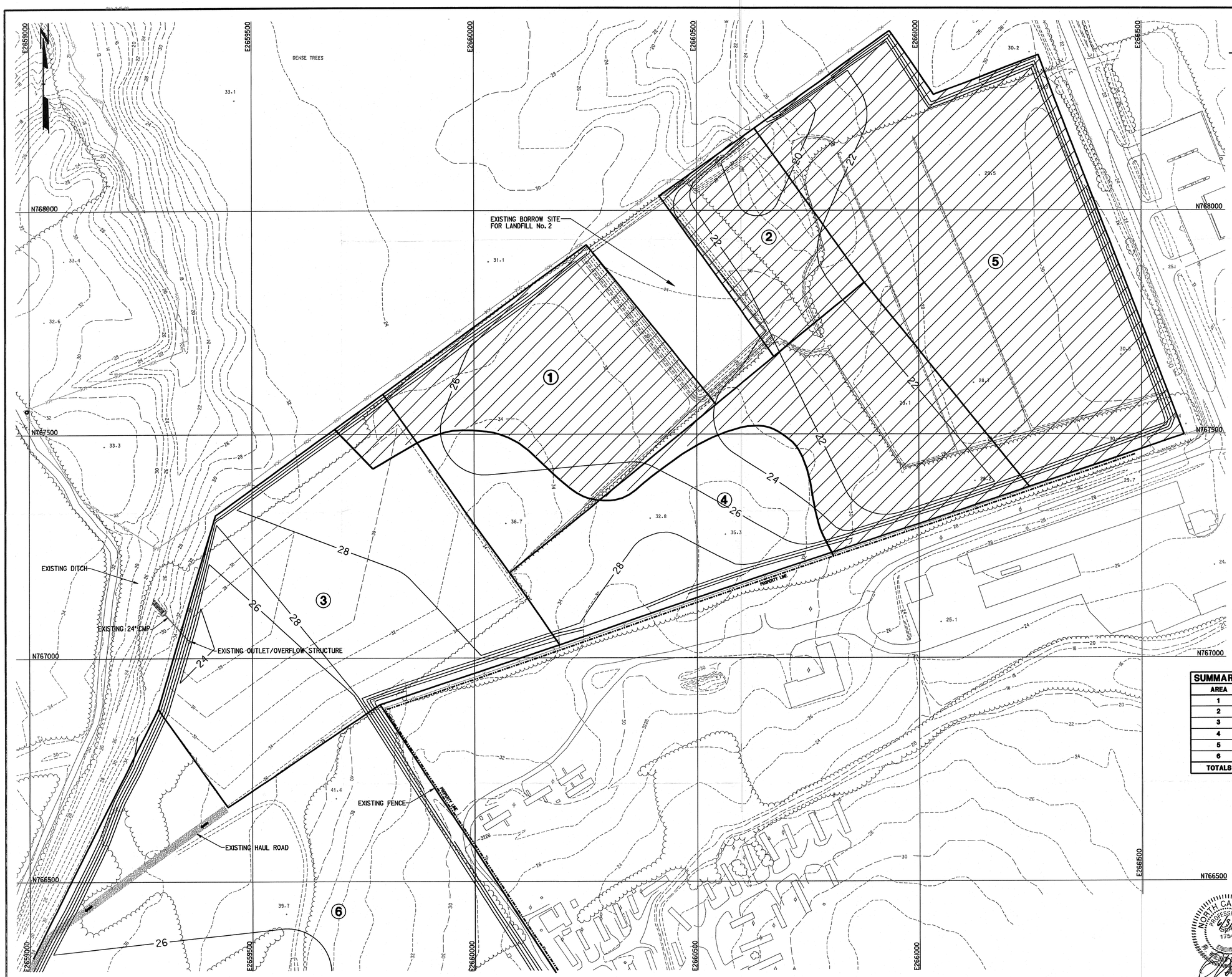

NOTES

1. REFER TO SHEET 1OF FOR STANDARD LEGEND, ABBREVIATIONS AND GENERAL NOTES.
2. CLEARING AND GRUBBING LIMITS SHALL BE 10' OUTSIDE THE CONSTRUCTION LIMITS.
3. BORROW OPERATIONS SHALL BEGIN AT THE OUTLET/OVERFLOW STRUCTURE AND PROGRESS TO THE EAST AND SOUTH.
4. AFTER BORROW OPERATION IS COMPLETE, ALL DISTURBED AREAS SHALL BE GRASSED IN ACCORDANCE WITH SECTIONS 02921 AND 02923 OF THE SPECIFICATIONS.
5. PROPOSED GRADES SHOWN IN BORROW AREA ARE FOR GENERAL INFORMATION. CONTRACTOR IS TO BORROW MATERIAL IN A LOGICAL SEQUENCE AND INSURE POSITIVE DRAINAGE TO THE OUTLET OVERFLOW STRUCTURE AT ALL TIMES.
6. TOPSOIL AND CLAY THAT IS EXCAVATED FROM THE BORROW SITE IS TO BE STOCKPILED IN THE AREAS DESIGNATED ON SHEET 7.
7. ESTIMATED BORROW MATERIAL VOLUMES (AS SHOWN IN TABLE ON THIS SHEET) WERE AS OF 1-18-02. PRESENT IN-PLACE BORROW MATERIAL VOLUMES MAY BE LESS.

LEGEND

MOST ABUNDANT CLAY DEPOSITS (SUITABLE FOR LINER AND CAP CONSTRUCTION)

SUMMARY OF ESTIMATED BORROW MATERIAL AVAILABLE

AREA	TOPSOIL	CLAY AND GENERAL FILL
1	5,000 C.Y.	65,500 C.Y.
2	2,000 C.Y.	21,400 C.Y.
3	6,800 C.Y.	48,700 C.Y.
4	7,500 C.Y.	98,600 C.Y.
5	9,300 C.Y.	58,000 C.Y.
6	25,200 C.Y.	328,400 C.Y.
TOTALS	55,800 C.Y.	620,600 C.Y.

NO.	BY	DATE	REVISION	APP'D.
A	DMC	1-11-08	ISSUED FOR CLIENT REVIEW	RKN

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NEW LANDFILL No. 3 - PHASE 3 & 4
CONSTRUCTION PLAN APPLICATION
DOMTAR COMPANY
PLYMOUTH, NORTH CAROLINA

SHEET TITLE:
BORROW AREA SITE PLAN

DRAWN BY: DMC	SCALE: AS NOTED	PROJ. NO. 71717.01	
CHECKED BY: RKN		FILE NO.	
APPROVED BY: MBP	DATE PRINTED:	SHEET 13 OF 19	
DATE: OCTOBER 2007			

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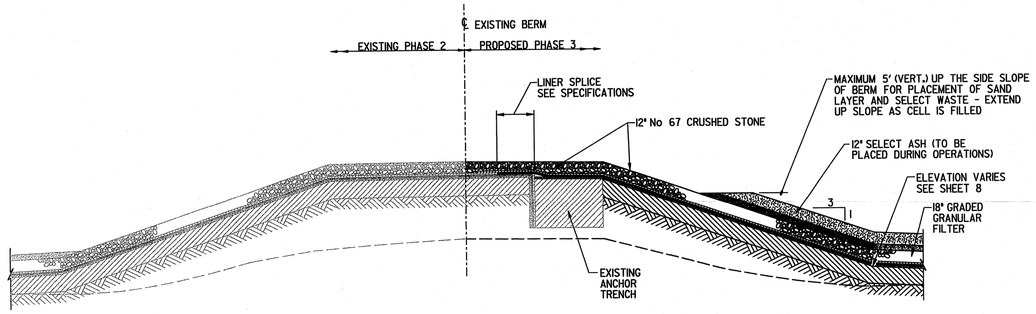
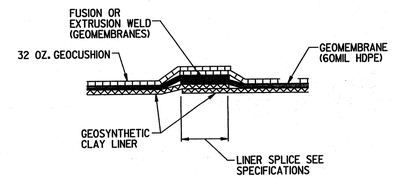
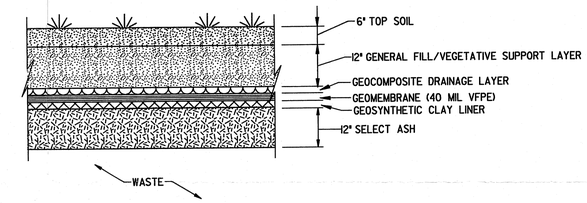


3 / 8,9 **SECTION - PHASE DELINEATION BERM**
NOT TO SCALE

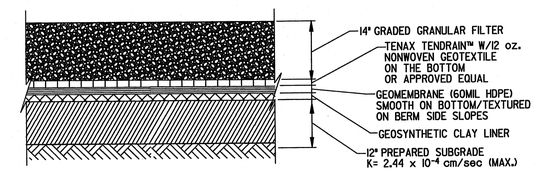


NOTE
VERTICAL SCALE EXAGGERATED FOR CLARITY

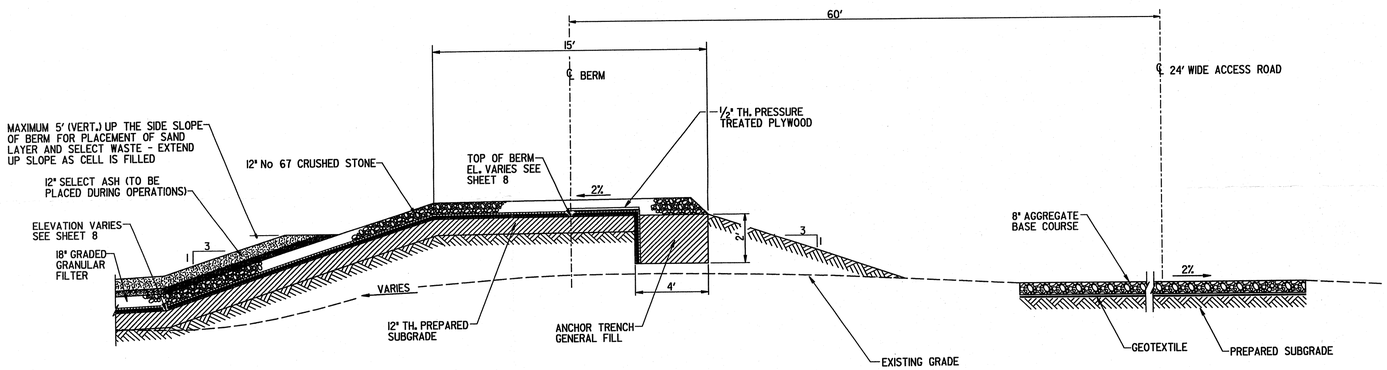
B / 15 **TYPICAL LINER SPLICE DETAIL**
NOT TO SCALE



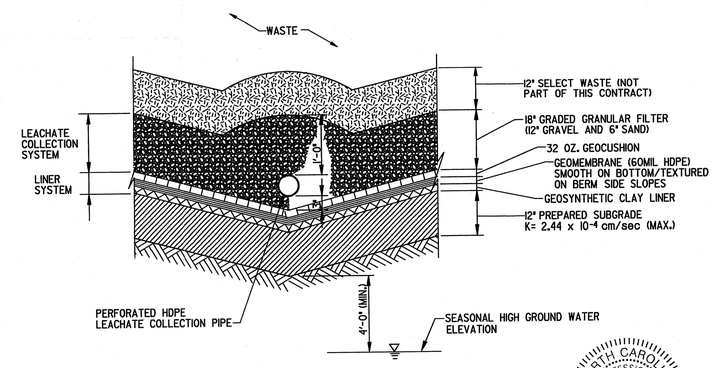
C / 10,11 **CAP DETAIL**
NOT TO SCALE



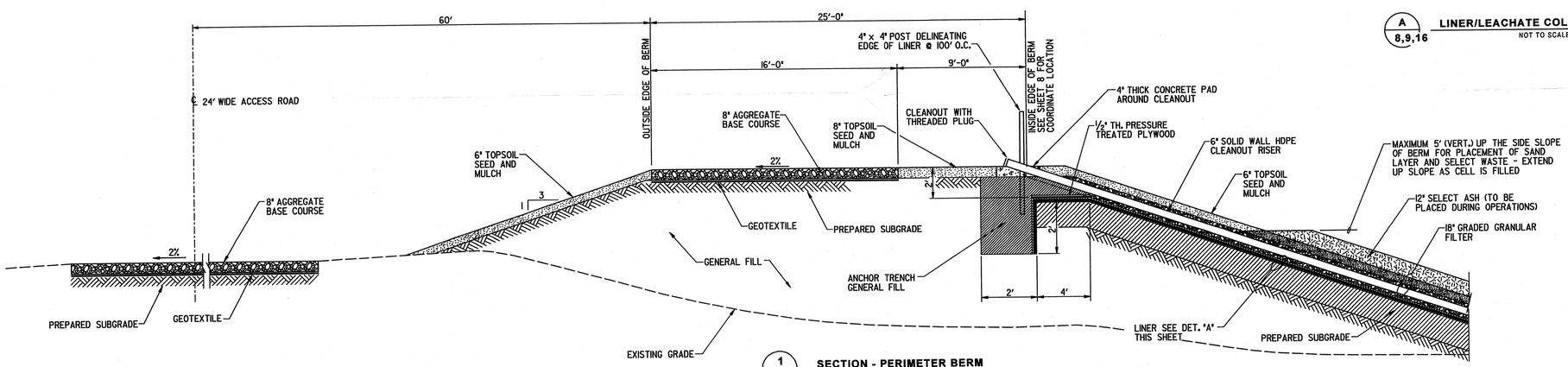
ALTERNATE LINER DETAIL
NTS



2 / 8,9,10 **SECTION - PHASE DELINEATION BERM**
NOT TO SCALE



A / 8,9,16 **LINER/LEACHATE COLLECTION DETAIL**
NOT TO SCALE



1 / 8,9,10 **SECTION - PERIMETER BERM**
NOT TO SCALE

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 17543 R. KEVIN NIXSON 6/3/08

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A	DMC	1-11-08	ISSUED FOR CLIENT REVIEW	RKN

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NEW LANDFILL No. 3 - PHASE 3 & 4
CONSTRUCTION PLAN APPLICATION
DOMTAR COMPANY
PLYMOUTH, NORTH CAROLINA

SHEET TITLE:
LANDFILL DETAILS - SHEET 1

DRAWN BY: DMC	SCALE: AS NOTED	PROJ. NO. 71717.01	
CHECKED BY: RKN		FILE NO.	
APPROVED BY: MBP	DATE PRINTED:	SHEET 14 OF 19	
DATE: OCTOBER 2007			

RMT NORTH CAROLINA, INC.

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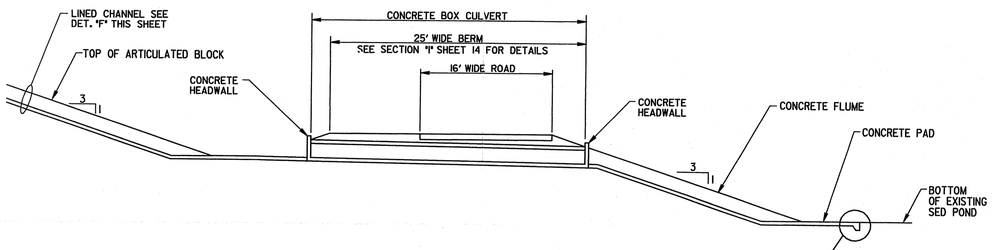
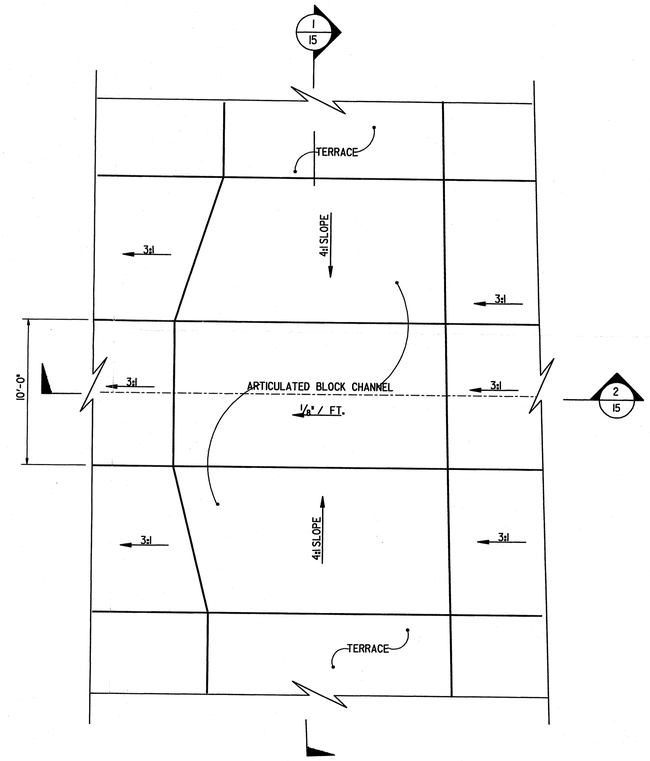
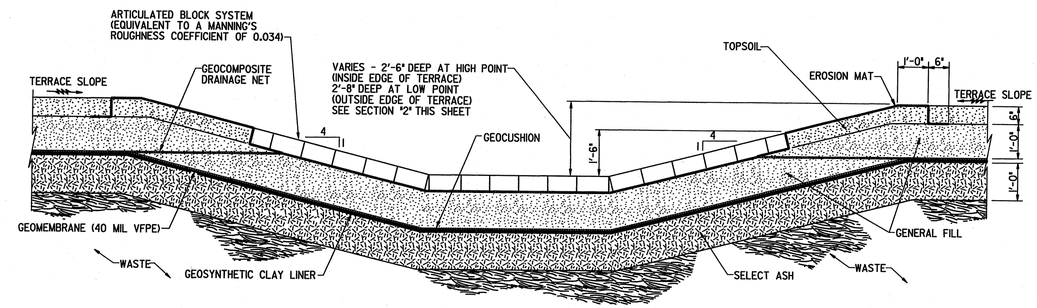


4/10 SECTION
NOT TO SCALE



ENLARGED CHANNEL PLAN AT TERRACE
NOT TO SCALE



1/15 SECTION
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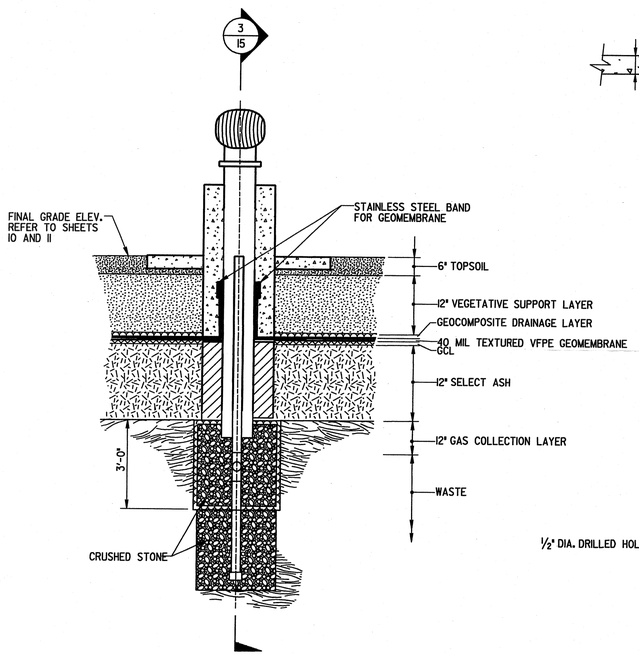
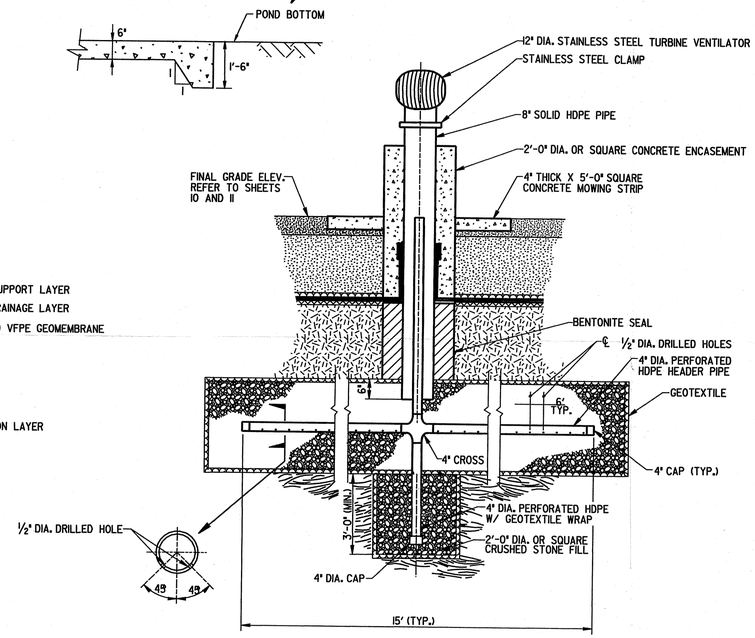
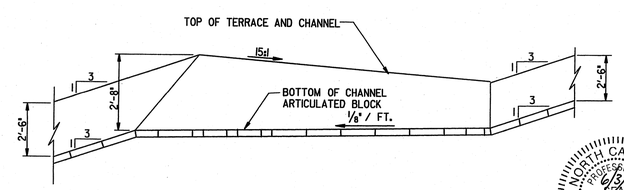


E/10,11 SURFACE GAS VENTING SYSTEM DETAIL
NOT TO SCALE



3/15 SECTION
NOT TO SCALE

D/10,11 LINED CHANNEL DETAIL
NOT TO SCALE



2/15 SECTION
NOT TO SCALE

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A	DMC	1-11-08	ISSUED FOR CLIENT REVIEW	RKN

Domtar

NEW LANDFILL No. 3 - PHASE 3 & 4
CONSTRUCTION PLAN APPLICATION
DOMTAR COMPANY
PLYMOUTH, NORTH CAROLINA

SHEET TITLE:
LANDFILL DETAILS - SHEET 2

DRAWN BY: DMC	SCALE: AS NOTED	PROJ. NO. 71717.01	
CHECKED BY: RKN		FILE NO.	
APPROVED BY: MBP	DATE PRINTED:	SHEET 15 OF 19	
DATE: OCTOBER 2007			

RMT NORTH CAROLINA, INC.

NORTH CAROLINA PROFESSIONAL SEAL 17543 ENGINEER KENT R. NELSON

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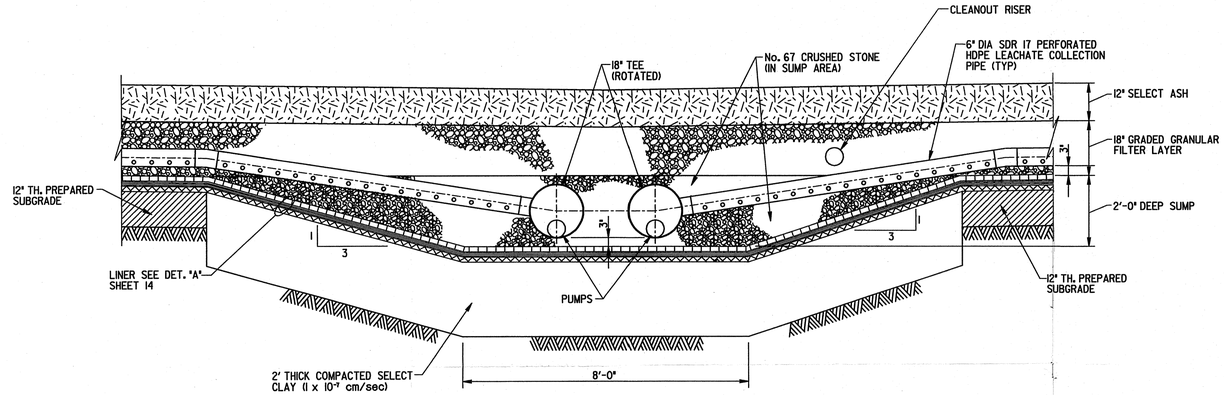
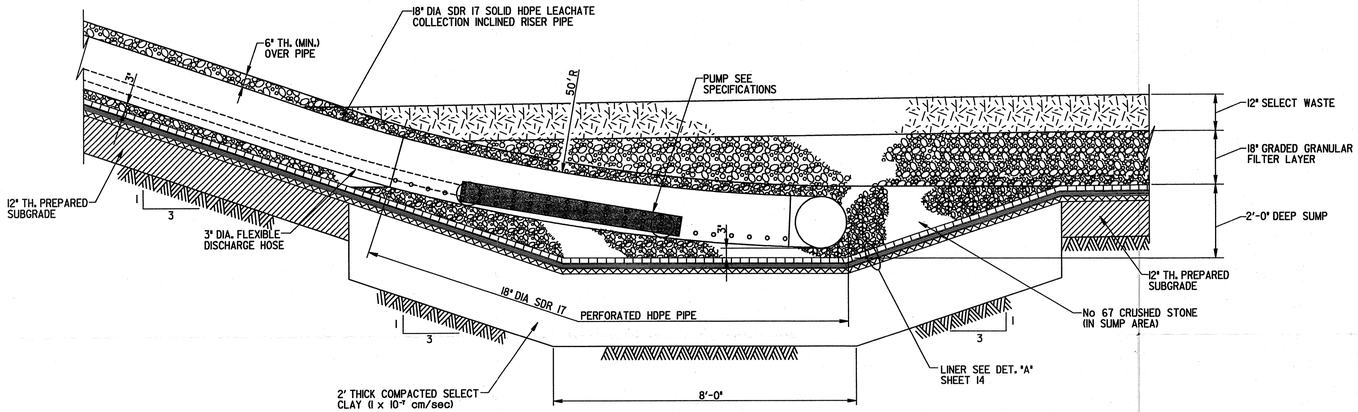
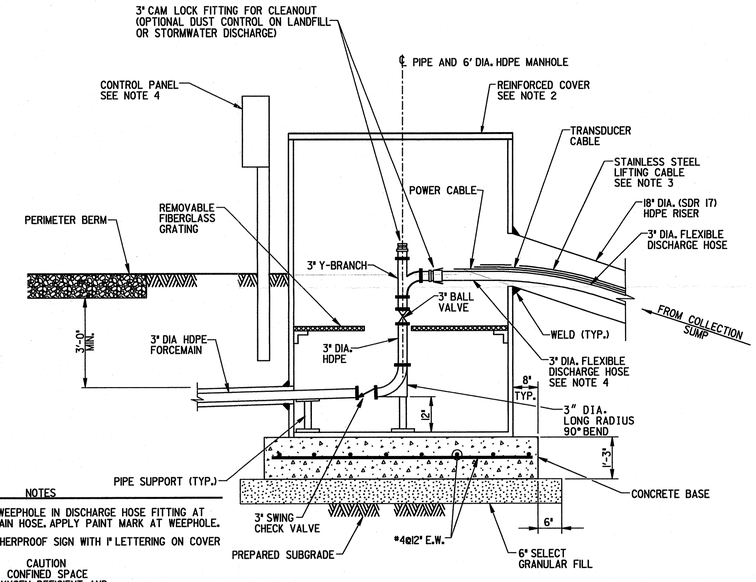


3/16 SECTION
1/2"=1'-0"



2/16 SECTION
1/2"=1'-0"

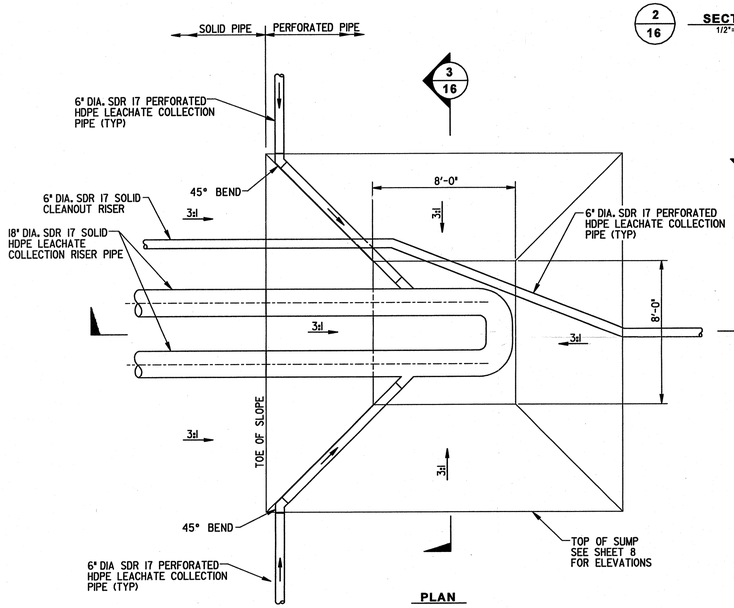


NOTES

1. PROVIDE 1/8" WEEPHOLE IN DISCHARGE HOSE FITTING AT PUMP TO DRAIN HOSE. APPLY PAINT MARK AT WEEPHOLE.
2. MOUNT WEATHERPROOF SIGN WITH 1" LETTERING ON COVER STATING:

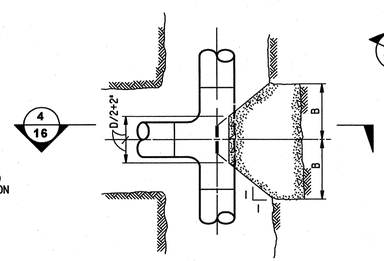
   CAUTION
   CONFINED SPACE
   OXYGEN DEFICIENT AND
   EXPLOSIVE HAZARDS PRESENT
   ENTRY BY PERMIT ONLY
3. PUMP LIFT CABLE TO BE FASTENED TO INSIDE OF MANHOLE.
4. CONTROL PANEL, PUMP AND DISCHARGE HOSE (TO QUICK CONNECT FITTING) TO BE PROVIDED BY LEACHATOR PUMPING SYSTEMS. ELECRICAL JUNCTION BOX TO BE INSTALLED BETWEEN MANHOLE AND CONTROL PANEL TO PREVENT MIGRATION OF GAS THROUGH CONDUIT.
5. ALL FORCE MAIN PIPING TO BE DUAL CONTAINMENT PIPING. 3" FORCE MAIN TO HAVE 6" CARRIER PIPE, 6" FORCE MAIN TO HAVE 10" CARRIER PIPE.
6. ALL 3" HDPE PIPE TO BE SDR 11. ALL 6" HDPE PIPE TO BE SDR 17.

1/16 SECTION
1/2"=1'-0"

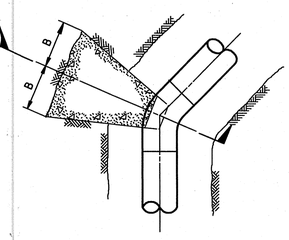


PLAN

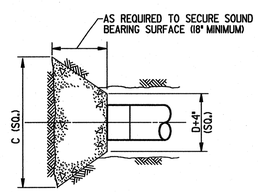
G/8,9 LEACHATE COLLECTION SUMP DETAIL
1/4"=1'-0"



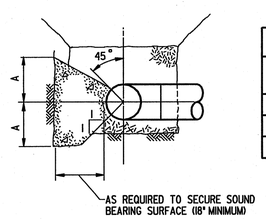
PLAN - TEES



PLAN - BENDS

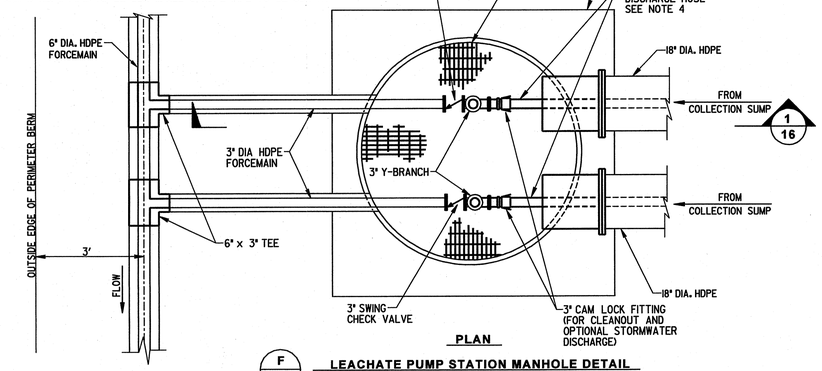


PLAN & ELEVATION - PLUGS



4/16 SECTION
NOT TO SCALE

H/9 TYPICAL THRUST BLOCK DETAIL
NOT TO SCALE



PLAN

F/9 LEACHATE PUMP STATION MANHOLE DETAIL
1/2"=1'-0"

***THRUST BLOCK DIMENSION TABLE**

PIPE SIZE	90° ELLS		45° ELLS		22½° ELLS 11¼° ELLS		TEES		PLUGS
D	A	B	A	B	A	B	A	B	C
3"	0'-9"	1'-0"	0'6"	0'-9"	0'-6"	0'-6"	0'-9"	1'-0"	1'-6"
6"	1'-0"	2'-7"	1'-0"	1'-6"	0'-9"	1'-0"	1'-0"	2'-7"	2'-9"

* DIMENSIONS SHOWN ARE MINIMUM AND ARE BASED ON A TEST PRESSURE OF 225 PSI AND A SOIL BEARING CAPACITY OF 2000 PSF

NO.	BY	DATE	REVISION	APP'D.
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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 17543 RICHARD KENNETH NELSON 6/9/08

Domtar

NEW LANDFILL No. 3 - PHASE 3 & 4
CONSTRUCTION PLAN APPLICATION
DOMTAR COMPANY
PLYMOUTH, NORTH CAROLINA

SHEET TITLE:
LEACHATE COLLECTION AND REMOVAL SYSTEM DETAILS

DRAWN BY: DMC	SCALE: AS NOTED	PROJ. NO. 71717.01	
CHECKED BY: RKN		FILE NO.	
APPROVED BY: MBP	DATE PRINTED:	SHEET 16 OF 19	
DATE: OCTOBER 2007			

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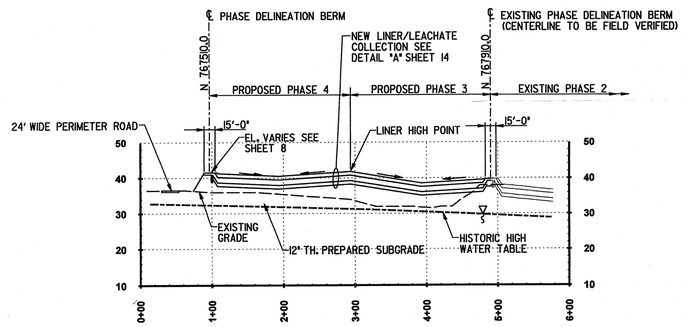
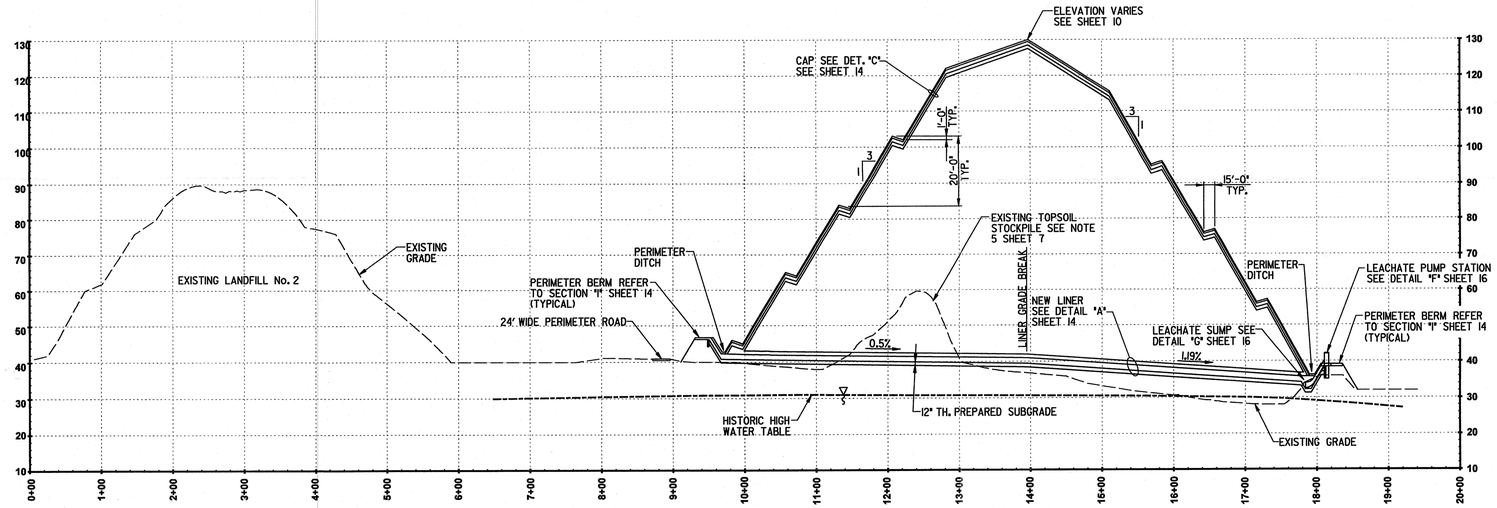
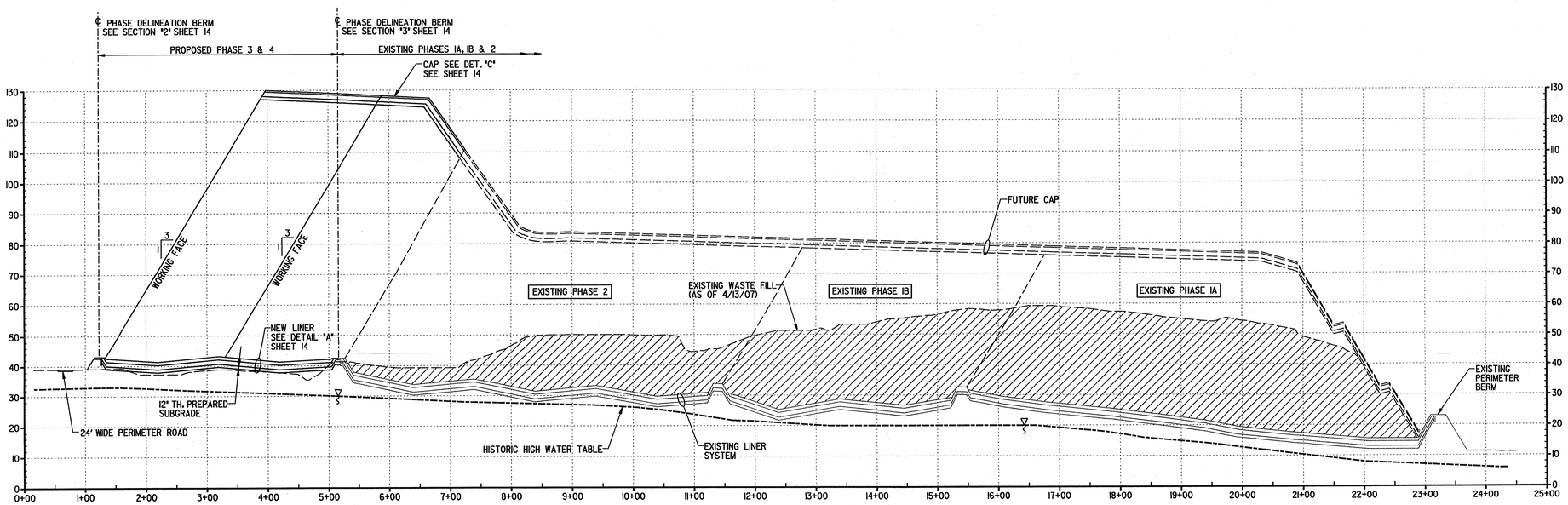


3 / 8,9 **SECTION**
1"=100' HORIZ.
1"=20' VERT.



1 / 8,9,10 **SECTION**
1"=100' HORIZ.
1"=20' VERT.



2 / 10 **SECTION**
1"=100' HORIZ.
1"=20' VERT.

0 20 40 60 80
SCALE: 1"= 20' (VERT.)

0 100 200 300 400
SCALE: 1"= 100' (HORIZ.)

THE HYDROGEOLOGY WORK FOR DOMTAR IN PLYMOUTH, NORTH CAROLINA WAS PERFORMED BY RMT, INC. CONSULTING HYDROGEOLOGIST IN SUPPORT OF RMT NORTH CAROLINA, INC.

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A	DMC	1-11-08	ISSUED FOR CLIENT REVIEW	RKN

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NEW LANDFILL No. 3 - PHASE 3 & 4
CONSTRUCTION PLAN APPLICATION
DOMTAR COMPANY
PLYMOUTH, NORTH CAROLINA

SHEET TITLE:
ENGINEERING CROSS SECTIONS

DRAWN BY: DMC	SCALE: AS NOTED	PROJ. NO. 71717.01	
CHECKED BY: RKN		FILE NO.	
APPROVED BY: MBP	DATE PRINTED:	SHEET 17 OF 19	
DATE: OCTOBER 2007			

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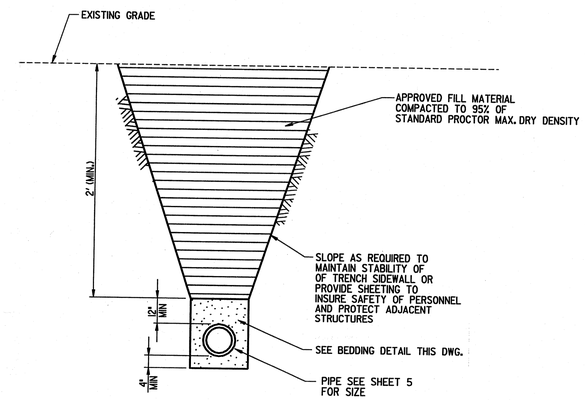
NOTES

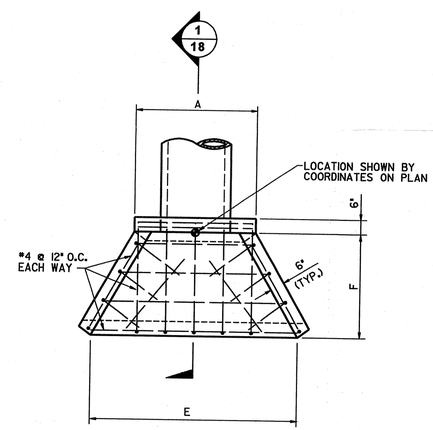
1. REFER TO SHEET 1 FOR LEGEND, ABBREVIATIONS AND GENERAL NOTES.
2. ALL CONCRETE SHALL DEVELOP A MINIMUM COMPRESSIVE STRENGTH OF 4000 PSI IN 28 DAYS. SLUMP SHALL BE BETWEEN 2 AND 4 INCHES IN ACCORDANCE WITH ASTM C143.

CAST-IN-PLACE CONCRETE REQUIREMENTS

1. ALL REINFORCING STEEL SHALL BE GRADE 60, DEFORMED BARS, CONFORMING TO ASTM A615.
2. ALL DETAILING, FABRICATION, AND PLACING OF REINFORCED STEEL SHALL CONFORM TO THE MANUAL OF STANDARD PRACTICE FOR DETAILING REINFORCED CONCRETE STRUCTURES (ACI-SP-66, LATEST EDITION).
3. DO NOT PLACE CONCRETE WHEN WEATHER CONDITIONS PREVENT PROPER PLACEMENT AND CONSOLIDATION.
4. COLD WEATHER: ACI306R. PROVIDE AND MAINTAIN 50 DEGREES F MINIMUM, CONCRETE TEMPERATURE. DO NOT PLACE CONCRETE WHEN THE AMBIENT TEMPERATURE IS BELOW 40 DEGREES F. COVER CONCRETE AND PROVIDE WITH A SOURCE OF HEAT SUFFICIENT TO MAINTAIN 50 DEGREES F MINIMUM WHILE CURING.
5. HOT WEATHER: ACI305R. CONCRETE TEMPERATURE FROM INITIAL MIXING THROUGH FINAL CURE SHALL NOT EXCEED 90 DEGREES F. COOL INGREDIENTS BEFORE MIXING, OR SUBSTITUTE CHIP ICE FOR PART OF REQUIRED MIXING WATER OR USE OTHER SUITABLE MEANS TO CONTROL CONCRETE TEMPERATURE TO PREVENT RAPID DRYING OF NEWLY PLACED CONCRETE. SHADE THE FRESH CONCRETE AND START CURING AS SOON AS THE SURFACE OF THE FRESH CONCRETE IS SUFFICIENTLY HARD TO PERMIT CURING WITHOUT DAMAGE.
6. ALL EXPOSED EDGES OF CONCRETE SHALL BE CHAMFERED ¾"× 45°.
7. ALL CONCRETE CONSTRUCTION SHALL BE IN ACCORDANCE WITH ACI-318-99.

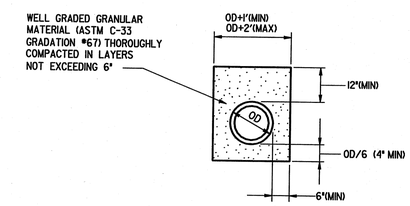


TYPICAL TRENCHING DETAIL
NOT TO SCALE

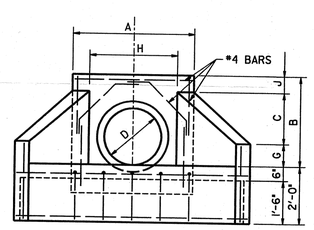


PLAN

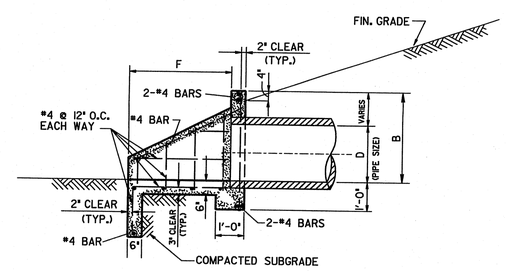
DIMENSION TABLE								
D	A	B	C	E	F	G	H	J
12"	3'-2"	2'-0"	0'-11"	4'-0"	1'-9"	6"	2'-0"	7"
18"	3'-8"	2'-7½"	1'-4½"	5'-8½"	2'-9"	8"	2'-6"	7"
24"	4'-3"	3'-2"	1'-9½"	7'-3"	3'-7"	0'-9½"	3'-1"	7"
30"	4'-10½"	3'-8½"	2'-1½"	8'-7½"	4'-3"	1'-0"	3'-8½"	7"



TYPICAL PIPE BEDDING DETAIL
NOT TO SCALE



ELEVATION



1/18 **SECTION**

J/10,11 **TYPICAL CONCRETE HEADWALL DETAIL (0°-30° SKEW)**
NOT TO SCALE

NO.	BY	DATE	REVISION	APP'D.
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NEW LANDFILL No. 3 - PHASE 3 & 4
CONSTRUCTION PLAN APPLICATION
DOMTAR COMPANY
PLYMOUTH, NORTH CAROLINA

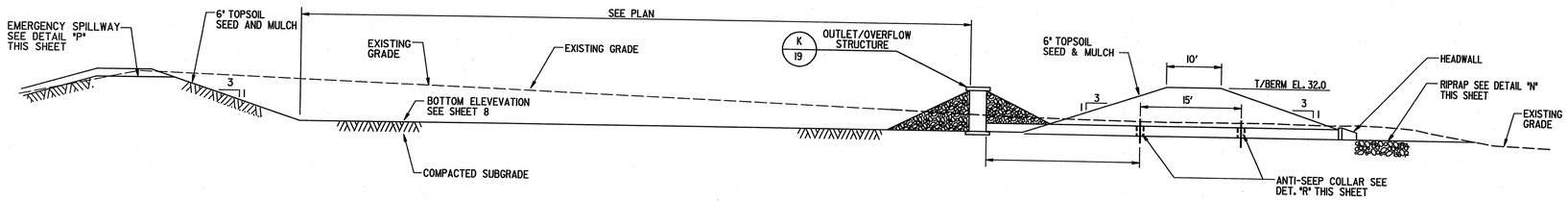
SHEET TITLE: **MISCELLANEOUS DETAILS**

DRAWN BY: DMC	SCALE: AS NOTED	PROJ. NO. 71717.01	
CHECKED BY: RKN		FILE NO.	
APPROVED BY: MBP	DATE PRINTED:	SHEET 18 OF 19	
DATE: OCTOBER 2007			

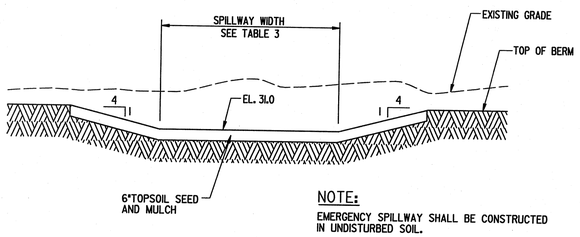
RMT NORTH CAROLINA, INC.

NOTES

1. REFER TO SHEET 1 FOR STANDARD LEGEND, ABBREVIATIONS AND GENERAL NOTES.

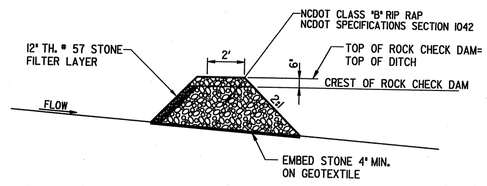


1/8 SECTION - SEDIMENT POND No. 4
NOT TO SCALE

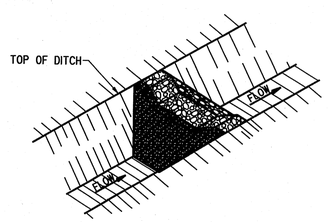


NOTE:
EMERGENCY SPILLWAY SHALL BE CONSTRUCTED IN UNDISTURBED SOIL.

P 8,9,10 EMERGENCY SPILLWAY DETAIL
NOT TO SCALE

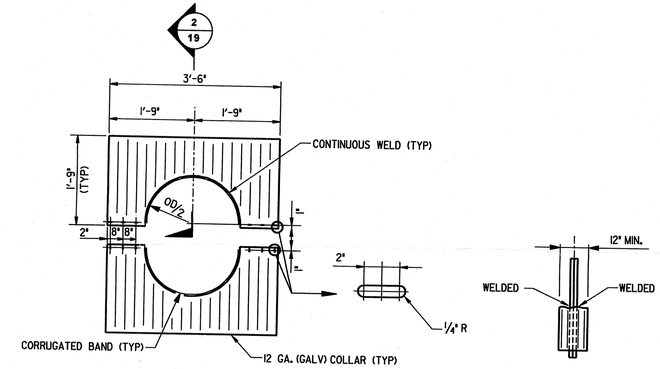


SECTION



ISOMETRIC VIEW

TYPICAL ROCK CHECK DAM DETAIL
NOT TO SCALE



ELEVATION
NOT TO SCALE

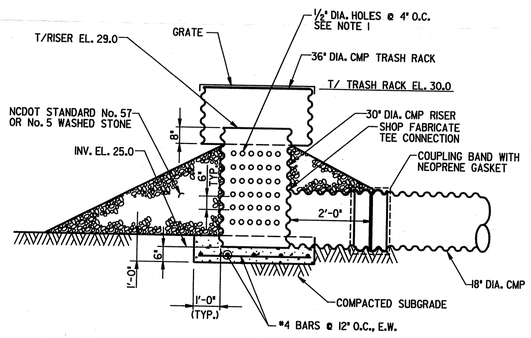
2/19 SECTION
NOT TO SCALE

NOTE:
THE LAP BETWEEN THE TWO HALF SECTIONS AND BETWEEN THE PIPE AND CONNECTING BAND SHALL BE CAULKED WITH ASPHALT MASTIC AT TIME OF INSTALLATION. CONNECT COLLAR TO PIPE WITH 1/2" DIA. RODS WITH STANDARD TANK LUGS

R 19 ANTI-SEEP COLLAR DETAIL
NOT TO SCALE

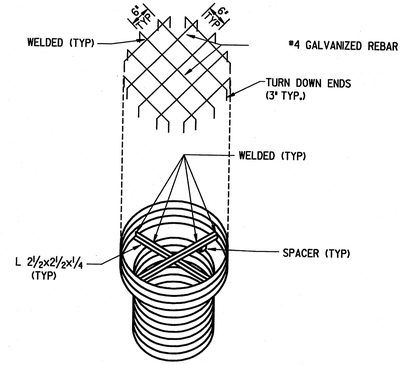
TABLE - 4
OUTLET PROTECTION SUMMARY

OUTLET	Q (CFS)	V (FPS)	D (IN.)	Dx (FT.)	Dy (FT.)
HW-1			18	50	22



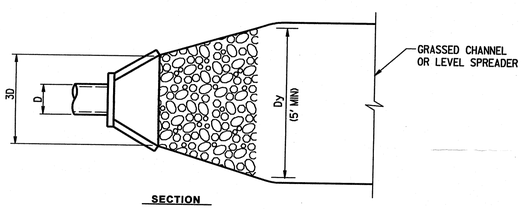
SECTION

NOTE
1. HOLES IN OUTLET/OVERFLOW STRUCTURE SHALL BE MACHINE DRILLED. FIELD CUTTING WITH TORCH IS NOT ACCEPTABLE.

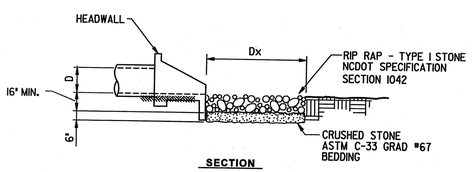


ISOMETRIC

K 8,9,10,19 OUTLET/OVERFLOW STRUCTURE DETAIL
NOT TO SCALE

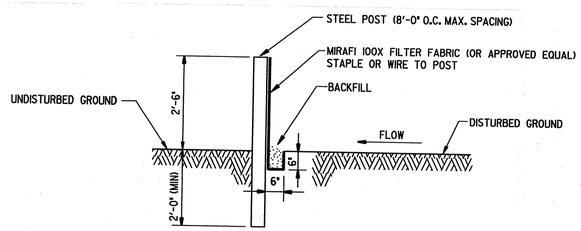


SECTION

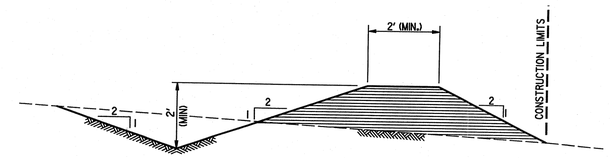


SECTION

N 8,9,10 RIP RAP DETAIL
NOT TO SCALE



L 8,9,10 TYPICAL SILT FENCE DETAIL
NOT TO SCALE



TYPICAL DIVERSION DITCH DETAIL
NOT TO SCALE

NO.	BY	DATE	REVISION	APPD.
A	DMC	1-11-08	ISSUED FOR CLIENT REVIEW	RKN

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NEW LANDFILL No. 3 - PHASE 3 & 4
CONSTRUCTION PLAN APPLICATION
DOMTAR COMPANY
PLYMOUTH, NORTH CAROLINA

SHEET TITLE:
EROSION CONTROL DETAILS

DRAWN BY: DMC	SCALE: AS NOTED	PROJ. NO. 71717.01	
CHECKED BY: RKN		FILE NO.	
APPROVED BY: MBP	DATE PRINTED:	SHEET 19 OF 19	
DATE: OCTOBER 2007			

NORTH CAROLINA PROFESSIONAL SEAL 17543 ENGINEER R. KENT NILSSON 6/3/08

RMT NORTH CAROLINA, INC.

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