Permit No.	Date	DIN
11-07	September 3, 2015	24948

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August 26, 2015
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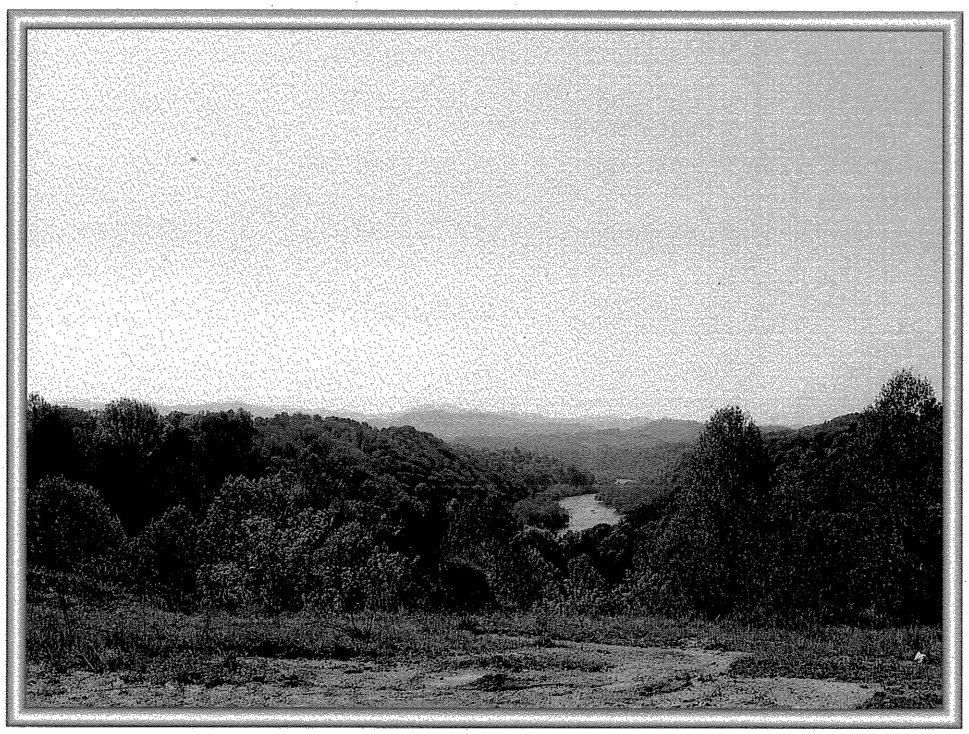
Buncombe County

Buncombe County Solid Waste Management Facility

C&D Landfill Substantial Amendment and Phase 5 Permit to Construction Application

Volume 2 of 2

April 2009
REVISED AUGUST 2015 BY MCGILL ASSOCIATES P.A.



Buncombe County
North Carolina

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Buncombe County Solid Waste Management Facility
C&D Landfill
Substantial Amendment and
Phase 5 Permit to Construct Application
Volume 2 of 2

April 2009

04/30/2009

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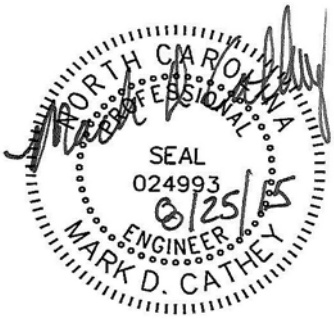
PHASE 5 EXPANSION PERMIT TO CONSTRUCT APPLICATION

BUNCOMBE COUNTY SOLID WASTE MANAGEMENT FACILITY

BUNCOMBE COUNTY, NORTH CAROLINA

MARK D. CATHEY, PE



McGill ASSOCIATES

Engineering • Planning • Finance
Asheville, North Carolina

Note: This seal only applies to the Phase 5 expansion revisions noted as footnotes throughout the document.

August 2015

14.00713

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Buncombe County, North Carolina

Buncombe County Solid Waste Management Facility

C&D Landfill Expansion Part 5: Engineering Plan

April 2009
REVISED AUGUST 2015 BY MCGILL ASSOCIATES, P.A.

Part 5: Engineering Plan
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Section 1
Purpose

The purpose of this Engineering Plan is to provide details relative to the design and performance of the Buncombe County C&D landfill proposed Phase 5 expansion containment and environmental control systems. This Engineering Plan has been prepared in accordance with the North Carolina Solid Waste Rule 15A NCAC 13B .0539, Engineering Plan for C&DLF Facilities.

Section 1.1 Engineering Report

The Engineering Report has been prepared in accordance with Rule .0539(d) and is presented in the following sections. An analysis of the facility design and calculations are provided.

Section 1.2 Engineering Drawings

The Engineering Drawings have been prepared in accordance with Rule .0539(e) and are included as Sheets EP-1 through EP-9 in Appendix D.

[1]The 0.48 acre lateral expansion as prepared by McGill Associates, April 2015, are included as sheets C-101, C-102, C-103, C-104 & C-501.

[1] Revision for Phase 5 Expansion prepared by McGill Associates, P.A. in August 2015.

Section 2
Analysis of the Facility Design – Overview

The purpose of this section is to provide a brief description of the landfill subgrade and final cover for Phase 5 of the Buncombe County C&D landfill.

2.1 Landfill Subgrade

The proposed landfill subgrade for Phase 5 is designed in conformance with Title 15A of the North Carolina Administrative Code, Subchapter 13B, Section .0540 (2) and will be constructed according to the following:

- Post-settlement bottom elevations of waste will be a minimum four feet above the seasonal high ground-water table and the bedrock datum plane contours as established in the Appendix C – Design Hydrogeological Report; and

- In-situ or modified soils making up the upper two feet of separation will consist of the SC, SM, ML, CL, MH, or CH soils per Unified Soil Classification System.

2.2 Final Cap System

The final cap system has been designed to minimize the amount of stormwater infiltration into the landfill and to resist erosive forces. The final cap system consists of the following layers (listed from top to bottom), which meet the requirements of Rule 0.543(c)(1):

- An 18-inch erosion layer consisting of earthen material that is capable of sustaining native plant growth; and
- An 18-inch low permeability barrier of earthen material with a permeability no greater than 1.0×10^{-5} cm per second.

The post-settlement grades of the top surface slopes will not be less than 5 percent (to prevent ponding).

Closure side slopes are designed at 3:1(Horizontal:Vertical) slopes for Phase 5 as provided in Section 4: Engineering Report, Appendix B – Design Geotechnical Evaluation. Post-settlement slopes are expected to be less than 3:1. Rule 0.543(c)(3)(C) allows for alternative side slopes (those greater than 25%) to be approved by the North Carolina Department of Environment and Natural Resources Solid Waste Section (NCDENR SWS) if the design is certified (by a licensed professional engineer in the State of North Carolina) to be stable, encourage runoff, and be safe to construct, operate and maintain.

Design drawings are included in Appendix D as Sheets EP-6 and EP-9. Closure cap calculations are included in Appendix A.

[1]McGill Associates and Bunnell-Lammons Engineering have reviewed the Design Geotechnical Evaluation prepared by CDM dated April 27, 2009. The proposed 0.48 acre Phase 5 expansion falls within the design parameters included in the evaluation. No additional evaluation is required. A supporting letter from Bunnell-Lammons Engineering is included.

2.3 Stormwater Control

The Phase 5 expansion will include construction of drainage ditches and Sediment Pond 12 and modifications to existing Sediment Ponds 10 and 11. The drainage ditches convey stormwater to the existing and proposed sediment ponds as shown on Sheet EP-2 in Appendix D. Design calculations for the stormwater control devices were calculated based on the 25-year, 24-hour storm event. The design calculations are provided in Appendix A.

Temporary stormwater control devices such as silt fencing, etc. will be used during construction to control sediment laden stormwater runoff. These devices will remain in use until construction has been completed, areas have been stabilized, and all stormwater is diverted into and controlled by the permanent stormwater control devices. Prior to construction, the engineer will submit for approval a Sedimentation and Erosion Control Permit Application to NCDENR Division of Land Resources, Land Quality Section prepared in accordance with the North Carolina Erosion and Sediment Control Planning and Design Manual, which will include all temporary stormwater control devices.

[1]McGill Associates has provided a grading plan that will add approximately 30,000 SF (.69 Acres) to the drainage area of sediment basin 11. A hydrocad model using the SCS TR-20 method was created of sediment basin 11 to ensure that it contained sufficient storage volume, and that the primary & emergency spillway could adequately pass a 25 year 24 hour storm.

[1]A Proposed Ditch 11.3 was added around the additional landfill footprint in order to convey stormwater to sediment basin 11. Ditch 11.2 was analyzed to ensure that the provided geometry and shear stress resistance was sufficient to carry the stormwater added by Proposed Ditch 11.3.

[1] Revision for Phase 5 Expansion prepared by McGill Associates, P.A. in August 2015.

Section 3
Analysis of the Facility Design - Summary

3.1 Analytical Methods Used to Evaluate the Design

The stormwater erosion and sedimentation controls and structures are designed in accordance with the North Carolina Erosion and Sediment Control Planning and Design Manual. The entire set of design calculations for the erosion and sedimentation control system is contained in Appendix A of this Engineering Plan. The County will apply for an erosion and sediment control permit prior to construction.

Soil loss calculations are included in Appendix A of this report addressing the vegetative cover soil layer's resistance to erosion of the final cap system.

The design geotechnical report is included in Appendix B and contains descriptions of the geotechnical methods used to analyze the design of the facility and associated calculations. Calculations include cap component (slope) stability for the final cap system.

3.2 Critical Conditions Evaluated and Assumptions Made

The following assumptions and critical conditions were made to design the various landfill components:

- A maximum horizontal acceleration of 0.10 g was used to perform the seismic slope stability analysis.
- The 25-year, 24-hour storm event was assumed in the design of site drainage structures and sediment ponds.

3.3 Technical References

The following references were used for the design and evaluation of the different landfill components.

- North Carolina Erosion and Sediment Control Planning and Design Manual
- AutoCAD Civil 3D Design Software
- Driscopipe Design Manual

3.4 Location Restrictions

Rule .0539(d)(1)(D) requires that a report be prepared and submitted demonstrating compliance with the location restrictions in Rule .0536. Rule .0536(c)(4) through (10) requires documentation or approvals by agencies other than the Division of Solid

Waste Management that demonstrate compliance with specific location criteria. Pertinent documentation is included in Part 3: Facility Plan, Appendix B: Location Restrictions for the entire proposed C&D landfill expansion.

Section 4
Description of Materials and Construction Practices

A detailed description of the materials and construction practices that will be used during the construction of the Buncombe County C&D landfill is provided in the Construction Quality Assurance (CQA) Plan, which is Part 6 of this permit application. The design calculations and evaluations used in determining material specifications are located in Appendices A through C of the Engineering Plan.

Part 5
Engineering Report

Appendix A
Calculations

CDM	CLIENT	Buncombe County	COMPUTED BY / DATE	MKS 04/27/09
	PROJECT	Phase 5 Landfill Operation	CHECKED BY / DATE	- -
	DETAIL	Peak Runoff	REVISION NO. / DATE	- -
	PROJECT NO.	6447-65973	REVIEWED BY / DATE	- -

Calculation Brief Title: Peak Runoff for Channels

1.0 Objective

The purpose of this calculations is to determine the peak runoff rate contributing to each of the proposed channels/swales for the 2-. 10-, and 25-year, 24-hour design storm events.

2.0 Procedure

1. Determine the drainage areas.
2. Determine the time of concentration and associated rainfall intensity.
3. Determine the runoff coefficient.
4. Calculate the peak runoff rate.

3.0 References / Data Sources

1. Department of Environment and Natural Resources (NCDENR), June 1, 2006, Revised March 2009. Erosion and Sediment Control Planning and Design Manual.

4.0 Assumptions / Limitations

1. Use the SCS TR-55 Method for calculating the time of concentration.
2. Use the Rational Method for calculating the peak runoff rate.

5.0 Calculations

5.1 Determine the Drainage Area

-- Refer to **Attachment # 1** for the drainage basin delineations. **Table 1** below summarizes the contributing drainage a

Table 1 - Drainage Areas

Channel	Drainage Area	
	square-feet	acres
10.1	226,169	5.19
11.1	41,602	0.96
11.2	89,296	2.05
12.1	135,166	3.10
12.2	25,321	0.58
12.3	23,871	0.55
12.4	24,127	0.55
12.5	7,387	0.17
13.1	82,299	1.89

5.2 Determine the Time of Concentration and Associated Rainfall Intensity

-- The drainage basins are relatively small and/or have steep slopes and channels. Assume a time of concentration of 5 minutes for all drainage areas. The corresponding rainfall intensities from the NC E&S Design Manual Table 8.03c for the 2-, 10-, and 25-year design storms are 5.21, 7.06, and 8.09 inches per hour.

5.0 Calculations [continued]

5.3 Determine the Runoff Coefficients

-- Use Table 8.03b in the NC E&S Design Manual to identify the appropriate runoff coefficients for the land use types representative of the existing land use, shown in **Table 2**.

Table 2 - Runoff Coefficients

Land Use Type	Runoff Coefficient
Newly Graded	0.60
Grassed, Fair Condition	0.35
Wooded	0.20

-- Calculate the weighted runoff coefficient using the various land use types for each drainage area, shown in **Table 3**. The areas are approximated using 2006 aeiral photography obtained from the Buncombe County website.

Table 3 - Weighted Runoff Coefficient

Channel	Area by Runoff Coefficient			Weighted Runoff Coefficient
	0.60	0.35	0.20	
10.1	2.00	1.60	1.60	0.40
11.1	0.00	0.96	0.00	0.35
11.2	2.05	0.00	0.00	0.60
12.1	3.10	0.00	0.00	0.60
12.2	0.00	0.00	0.58	0.20
12.3	0.00	0.00	0.55	0.20
12.4	0.00	0.00	0.55	0.20
12.5	0.00	0.00	0.17	0.20
13.1	1.29	0.60	0.00	0.52

5.4 Calculate the Peak Runoff Rate

-- Use the Rational Method to calculate the peak runoff rate for each of the three design storm events, shown in

Rational Method Q = CIA

Q = Peak Runoff Rate (cfs)
C = Rational Coefficient
I = Intensity (in/hr)
A = Drainage Area (acres)

Table 4 - Peak Runoff Rate

Channel	Peak Runoff Rate (cfs)		
	2-year	10-year	25-year
10.1	11	15	17
11.1	1.7	2.4	2.7
11.2	6.4	8.7	10
12.1	10	13	15
12.2	0.6	0.8	0.9
12.3	0.6	0.8	0.9
12.4	0.6	0.8	0.9
12.5	0.2	0.2	0.3
13.1	5.1	7.0	8.0

6.0 Conclusions

Table 4 in Task 5.4 summarizes the peak runoff rates for the 2-, 10-, and 25-year, 24-hour design storm events for the channels/swales.

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: K. YANG
DRAWN BY: J. KILLINGSWORTH
SHEET CHK'D BY: K. YANG
CROSS CHK'D BY: C. GABEL
APPROVED BY: K. YANG
DATE: APRIL 2009

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BUNCOMBE COUNTY
NORTH CAROLINA

BUNCOMBE COUNTY C&D LANDFILL
ENGINEERING PLAN

STORMWATER CHANNELS
DRAINAGE AREAS

PROJECT NO. 6447-65973
FILE NAME: EP-2.DWG
SHEET NO.
ATTACHMENT-1

CLIENT	Buncombe County	COMPUTED BY / DATE	MKS 04/30/09
PROJECT	Landfill Closure	CHECKED BY / DATE	- -
DETAIL	Stormwater Channel Design	REVISION NO. / DATE	- -
PROJECT NO.	1278-58730	REVIEWED BY / DATE	- -

Calculation Brief Title: Summary of Stormwater Channel Recommendations

1.0 Objective

The purpose of this spreadsheet is to summarize the recommended channel characteristics and erosion control lining requirements.

2.0 Procedure

1. Summarize the required channel characteristics and erosion control lining.
2. Develop recommendations for channel characteristics and erosion control lining.

3.0 References / Data Sources

1. Seet **Attachment 1** for a map showing the channels and associated identifiers.
2. See **Attachments 2** through **14** for the channel design calculation spredsheets.

4.0 Assumptions / Limitations

1. Channel locations are approximate.
2. Assume a minmum six (6) inch freeboard

5.0 Calculations

5.1 Minimum Channel Dimension and Erosion Control Lining Requirements

-- See **Table 1** below for a summary of the calculated channel characteristics and minimum allowable temporary and permanent channel linings.

Table 1: Minimum Channel Requirements

Channel ID	Status	Bottom Width (ft)	Flow Depth[1] (ft)	Side Slopes		Channel Lining	
				M_1	M_2	Temporary	Permanent
10.1 (1)	Permanent	3	1.04	3	3	grass	Straw with Net
10.1 (2)	Permanent	3	0.73	3	3	N/A	Class I Riprap
10.1 (3)	Permanent	3	0.41	3	3	N/A	Recylex TRM
11.1	Temporary	0	1.11	2	4	grass	Straw with Net
11.2 (1)	Temporary	0	1.05	2	3	grass	Curlex I (.98)
11.2 (2)	Temporary	3	0.47	3	3	N/A	Class I Riprap
12.1 (1)	Permanent	3	0.69	3	3	N/A	Class I Riprap
12.1 (2)	Permanent	3	0.41	3	3	N/A	Recylex TRM
12.2	Permanent	0	0.91	2	5	grass	Straw with Net
12.3	Permanent	0	0.54	2	5	grass	Curlex II
12.4	Temporary	0	0.52	2	5	grass	Curlex II
13.1 (1)	Temporary	0	1.63	2	3	grass	Straw with Net
13.1 (2)	Temporary	3	0.55	2	3	grass	Straw w/ Coconut

5.0 Calculations [continued]

5.2 Recommended Channel Dimension and Erosion Control Lining Requirements

-- See **Table 2** for a summary of the recommended channel dimensions and erosion control liners. In general, the goal is to try and limit the amount of variation in dimensions and channel liners. The minimum requirements presented in Table 1 above will be met for all cases.

Table 1: Minimum Channel Requirements

Channel ID	Bottom Width (ft)	Channel Depth (ft)	Freeboard	Side Slopes		Channel Lining	
				M_1	M_2	Temporary	Permanent
10.1 (1)	3	1.5	0.46	3	3	grass	Straw with Net
10.1 (2)	3	1.5	0.77	3	3	N/A	Class I Riprap
10.1 (3)	3	1.5	1.09	3	3	N/A	Fabriform
11.1	0	1.5	0.39	2	4	grass	Straw with Net
11.2 (1)	0	1.5	0.45	2	3	grass	Curlex II
11.2 (2)	3	1.5	1.03	3	3	N/A	Class I Riprap
12.1 (1)	3	1.5	0.81	3	3	N/A	Class I Riprap
12.1 (2)	3	1.5	1.09	3	3	N/A	Fabriform
12.2	0	1.5	0.59	2	5	grass	Straw with Net
12.3	0	1.5	0.97	2	5	grass	Curlex II
12.4	0	1.5	0.98	2	5	grass	Curlex II
13.1 (1)	0	2	0.37	2	3	grass	Curlex II
13.1 (2)	3	2	1.46	2	3	grass	Curlex II

6.0 Conclusions

Table 2 above summarizes the recommended channel dimenions and erosion control linings.

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: K. YANG
DRAWN BY: J. KILLINGSWORTH
SHEET CHK'D BY: K. YANG
CROSS CHK'D BY: C. GABEL
APPROVED BY: K. YANG
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BUNCOMBE COUNTY
NORTH CAROLINA

BUNCOMBE COUNTY C&D LANDFILL
ENGINEERING PLAN

STORMWATER CHANNELS

PROJECT NO. 6447-65973
FILE NAME: EP-2.DWG
SHEET NO.
ATTACHMENT-1

CLIENT	Cabarrus County	COMPUTED BY / DATE	MKS 04/06/09
PROJECT	Landfill Closure	CHECKED BY / DATE	- -
DETAIL	Stormwater Channel Design	REVISION NO. / DATE	- -
PROJECT NO.	1278-58730	REVIEWED BY / DATE	- -

Calculation Brief Title: Channel Sizing and Lining Calculation

1.0 Objective

Determine the appropriate channel dimensions and temporary/permanent erosion control protection for section of the Channel 10.1 that breaks off the road and discharges into the existing fabriform-lined channel, contributing to Pond 10.

2.0 Procedure

1. Identify the desired channel characteristics including bottom width, side slopes, longitudinal slope, Manning's 'n', and required flow.
2. Calculate the normal depth and velocity for the pre- and post-vegetative conditions by adjusting the flow depth.
3. Calculate the shear stress.
4. Determine the need for pre- and post-vegetation erosion control measures.

3.0 References / Data Sources

1. Department of Environment and Natural Resources (NCDENR), June 1, 2006, Revised March 2009. Erosion and Sediment Control Planning and Design Manual.

4.0 Assumptions / Limitations

1. Calculate the normal depth based on the steepest section of the channel.
2. Assume unit weight of water is 62.5 lbs/ft^3.
3. Assume unit weight of concrete is 150 lbs/ft^3.

5.0 Calculations

5.1 Input Preliminary Channel Dimensions and Required Flow Capacity

- See **Attachment 1** for the channel location

Channel Characteristics

B =	3	M_1 =	3	$Q_{25\text{-}YR}$ =	17.0	Inputs
		M_2 =	3	s =	0.019	

B - Channel width (ft) M - Channel sideslope
Q - Design discharge (cfs) s - Channel longitudinal slope

5.2 Determine Permissible Velocity for Established Grass-Lined Channel

- Input the desired grass seed mix

Bahiagrass Desired Grass Lining (ref WMB)

- Identify the permissible velocity (NCDENR, Table 8.05a)

4.5 feet/second

5.0 Calculations [continued]

5.3 Calculate Normal Depth and Check Channel Velocity for Established Grass-Lined Channel -

- Identify vegetation retardness classification for a well maintained condition (NCDENR, Table 8.05c)

D — Vegetation Retardance Classification - Maintained Condition

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y - Depth of flow (ft) A - Channel area (sf) n - Manning's Coefficient
R - Hydraulic radius (ft) P - Wetted perimeter (ft)

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}	Velocity (ft/s)	VR
0.743	0.03	3.89	7.70	0.50	2.46	2.46	4.4	2.2
0.899	0.044	5.12	8.69	0.59	3.60	3.60	3.3	2.0
0.918	0.046	5.28	8.81	0.60	3.76	3.76	3.2	1.9
0.921	0.046	5.31	8.82	0.60	3.78	3.78	3.2	1.9

0.92 = Calculated normal depth (ft)
3.2 = Calculated velocity at normal depth (ft/s)

- Check that calculated velocity does not exceed permissible velocity

Actual		Permissible	
3.2	<	4.5	ok

5.4 Calculate Normal Depth and Check Channel Velocity for Established Grass-Lined Channel -

- Identify vegetation retardness classification for an unmaintained condition (NCDENR, Table 8.05c)

C — Vegetation Retardance Classification - Maintained Condition

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}	Velocity (ft/s)	VR
0.602	0.02	2.89	6.81	0.43	1.64	1.64	5.9	2.5
0.972	0.052	5.75	9.15	0.63	4.22	4.22	3.0	1.9
1.033	0.058	6.30	9.53	0.66	4.78	4.78	2.7	1.8
1.044	0.060	6.40	9.60	0.67	4.89	4.89	2.7	1.8

1.04 = Calculated normal depth (ft)
2.7 = Calculated velocity at normal depth (ft/s)

- Check that calculated velocity does not exceed permissible velocity

Calculated		Permissible	
2.7	<	4.5	ok

5.5 Calculate Normal Depth and Check Channel Velocity to Determine Need for Temporary Liner

- Input soil type

Sand Loam — Desired Grass Lining (ref WMB)

- Identify the permissible velocity (NCDENR, Table 8.05d)

2.5 feet/second

5.0 Calculations [continued]

- Identify the appropriate Manning's n coefficient (NCDENR, Table 8.05f)

0.02

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}
0.602	0.02	2.89	6.81	0.43	1.64	1.64

Velocity (ft/s)	V/R
5.9	13.8

- Check that calculated velocity does not exceed permissible velocity

Calculated		Permissible	
5.9	<	2.5	**inadequate**

- If a temporary liner is required, move to Step 5.6, else move to Step 6

5.6 Calculate Shear Stress to Determine Required Temporary Liner

- Input the desired temporary liner

Straw with Net — Desired Grass Lining

- Identify the permissible shear stress (NCDENR, Table 8.05g)

1.45 pound per square foot

- Identify the appropriate Manning's n coefficient based on approximate flow depth (provided by Excelsior)

0.035

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}
0.803	0.035	4.34	8.08	0.54	2.87	2.87

Velocity (ft/s)	V/R
3.9	7.3

- Calculate shear stress and compare to permissible shear stress for the desired temporary liner

Shear Stress T = yds

T = shear stress in lb/sf
y = U.W. of H_2O (62.4 lb/cf)
d = flow depth (ft)
s = channel gradient

Calculated		Permissible	
1.0	<	1.45	**ok**

6.0 Recommendations and Conclusions

- Summarize calculations and recommended channel characteristics

1.0	= Maximum Flow Depth (Y, feet)
5.9	= Maximum Velocity (feet per second)
3.0	= Channel Bottom Width (B, feet)
3.0	= Channel Side Slope (M_1)
3.0	= Channel Side Slope (M_2)
1.5	= Recommended Channel Depth (feet)
grass	= Recommended Permanent Channel Lining
Straw with Net	= Recommended Temporary Channel Lining

CLIENT	Cabarrus County	COMPUTED BY / DATE	MKS 04/06/09
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DETAIL	Stormwater Channel Design	REVISION NO. / DATE	- -
PROJECT NO.	1278-58730	REVIEWED BY / DATE	- -

Calculation Brief Title: Channel Sizing and Riprap Lining Calculation

1.0 Objective

Determine the appropriate channel dimensions and temporary/permanent erosion control protection for section of the Channel 10.1 that parallels the road and discharges into the proposed channel, which eventually discharges into Pond 10.

2.0 Procedure

1. Identify the desired channel characteristics, riprap characteristics, and required flow.
2. Calculate the normal depth and velocity.
3. Adjust channel dimensions and/or recommended riprap d_{50} until the four requirements are met.
4. Summarize recommended channel dimensions and riprap d_{50} and thickness.

3.0 References / Data Sources

1. US Department of Transportation - Federal Highway Administration, *Hydraulic Engineering Circular Number 15, Third Edition* . http://www.fhwa.dot.gov/engineering/hydraulics/pubs/05114/index.cfm#_Toc115781580
1. Department of Environment and Natural Resources (NCDENR), June 1, 2006, Revised March 2009. Erosion and Sediment Control Planning and Design Manual.

4.0 Assumptions / Limitations

3. Assume unit weight of water is 62.4 lbs/ft^3.
4. Assume unit weight of riprap is 165 lbs/ft^3.
5. Assume no prominent bends in the channel that could affect wave height.

5.0 Calculations

5.1 Input Preliminary Channel Dimensions, Required Flow Capacity, and Preliminary Riprap Characterist

- See **Attachment 1** for the channel location

B - Channel width (ft)
Q - Design discharge (cfs)
M - Channel sideslope
s - Channel longitudinal slope

Channel Characteristics

B =	3	M_1 =	3	$Q_{10\text{-}YR}$ =	17.0	Inputs
		M_2 =	3	s =	0.112	

- Input the desired riprap shape: Crushed Stone
- Input a recommended riprap d_{50}: 10 inches
- Identify permissible shear stress: 7.54 lb/ft^2

5.0 Calculations [continued]

5.2 Calculate Normal Depth and Check Required Riprap d_{50} and Shear Stress

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y - Depth of flow (ft) | A - Channel area (sf) | n - Manning's Coefficient
R - Hydraulic radius (ft) | P - Wetted perimeter (ft) | d_a = Average Flow Depth (ft)

Y	Manning's n	A	P	R	d_a	Vel (ft/s)	Z_{REQ}	Z_{AV}
0.703	0.065	3.59	7.45	0.48	0.50	4.7	2.21	2.21
0.723	0.069	3.74	7.57	0.49	0.51	4.5	2.33	2.33
0.730	0.070	3.79	7.62	0.50	0.51	4.5	2.38	2.38
0.732	0.070	3.80	7.63	0.50	0.51	4.5	2.39	2.39

0.73	= Calculated normal depth (ft)
4.5	= Calculated velocity at normal depth (ft/s)

- Check that calculated riprap d_{50} does not exceed recommended riprap d_{50}

	Recommended		Required	
d_{50} (inches)	10	>	9.9	ok

- Check that calculated shear stress does not exceed permissible shear stress

	Actual w/ SF		Permissible	
lb/ft^2	6.21	<	7.54	ok

- Check that calculated side slope riprap d_{50} does not exceed recommended riprap d_{50}

	Recommended		Required	
d_{50} (inches)	10	>	9.7	ok

- Check that calculated side slope shear stress does not exceed permissible side slope shear stress

	Actual w/ SF		Permissible	
lb/ft^2	6.21	<	7.54	ok

6.0 Recommendations and Conclusions

- Summarize calculations and recommended channel characteristics

0.7	= Maximum Flow Depth (Y, feet)
4.5	= Maximum Velocity (feet per second)
3.0	= Channel Bottom Width (B, feet)
3.0	= Channel Side Slope (M_1)
3.0	= Channel Side Slope (M_2)
1.25	= Recommended Channel Depth (feet)
10	= Recommended Riprap d_{50} (inches)
23	= Recommended Riprap thickness (inches)

CLIENT	Cabarrus County	COMPUTED BY / DATE	MKS 04/06/09
PROJECT	Landfill Closure	CHECKED BY / DATE	- -
DETAIL	Stormwater Channel Design	REVISION NO. / DATE	- -
PROJECT NO.	1278-58730	REVIEWED BY / DATE	- -

Calculation Brief Title: Channel Sizing and Lining Calculation

1.0 Objective

Determine the appropriate channel dimensions and temporary/permanent erosion control protection for section of the Channel 10.1 that breaks off the road and discharges into the existing fabriform-lined channel, contributing to Pond 10.

2.0 Procedure

1. Identify the desired channel characteristics including bottom width, side slopes, longitudinal slope, Manning's 'n', and required flow.
2. Calculate the normal depth and velocity for the pre- and post-vegetative conditions by adjusting the flow depth.
3. Calculate the shear stress.
4. Determine the need for pre- and post-vegetation erosion control measures.

3.0 References / Data Sources

1. Department of Environment and Natural Resources (NCDENR), June 1, 2006, Revised March 2009. Erosion and Sediment Control Planning and Design Manual.

4.0 Assumptions / Limitations

1. Calculate the normal depth based on the steepest section of the channel.
2. Assume unit weight of water is 62.5 lbs/ft^3.
3. Assume unit weight of concrete is 150 lbs/ft^3.

5.0 Calculations

5.1 Input Preliminary Channel Dimensions and Required Flow Capacity

- See **Attachment 1** for the channel location

Channel Characteristics

B =	3	M_1 =	3	$Q_{25\text{-}YR}$ =	17.0	Inputs
		M_2 =	3	s =	0.260	

B - Channel width (ft) M - Channel sideslope
Q - Design discharge (cfs) s - Channel longitudinal slope

5.2 Determine Permissible Velocity for Established Grass-Lined Channel

- Input the desired grass seed mix

Recyclex TRM Desired Grass Lining (ref WMB)

- Identify the permissible velocity (NCDENR, Table 8.05a)

17 feet/second

5.0 Calculations [continued]

5.3 Calculate Normal Depth and Check Channel Velocity for Established Grass-Lined Channel -

- Identify vegetation retardness classification for a well maintained condition (NCDENR, Table 8.05c)

D Vegetation Retardance Classification - Maintained Condition

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y - Depth of flow (ft) A - Channel area (sf) n - Manning's Coefficient
R - Hydraulic radius (ft) P - Wetted perimeter (ft)

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}	Velocity (ft/s)	VR
	0.03	0.00	3.00	0.00	0.67	0.00	#DIV/0!	#DIV/0!
	#DIV/0!	0.00	3.00	0.00	#DIV/0!	0.00	#DIV/0!	#DIV/0!
	#DIV/0!	0.00	3.00	0.00	#DIV/0!	0.00	#DIV/0!	#DIV/0!
	#DIV/0!	0.00	3.00	0.00	#DIV/0!	0.00	#DIV/0!	#DIV/0!

= Calculated normal depth (ft)
#N/A = Calculated velocity at normal depth (ft/s)

- Check that calculated velocity does not exceed permissible velocity

Actual		Permissible	
#N/A	<	17	#N/A

5.4 Calculate Normal Depth and Check Channel Velocity for Established Grass-Lined Channel -

- Identify vegetation retardness classification for an unmaintained condition (NCDENR, Table 8.05c)

C Vegetation Retardance Classification - Maintained Condition

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}	Velocity (ft/s)	VR
	0.02	0.00	3.00	0.00	0.45	0.00	#DIV/0!	#DIV/0!
	#DIV/0!	0.00	3.00	0.00	#DIV/0!	0.00	#DIV/0!	#DIV/0!
	#DIV/0!	0.00	3.00	0.00	#DIV/0!	0.00	#DIV/0!	#DIV/0!
	#DIV/0!	0.00	3.00	0.00	#DIV/0!	0.00	#DIV/0!	#DIV/0!

= Calculated normal depth (ft)
#N/A = Calculated velocity at normal depth (ft/s)

- Check that calculated velocity does not exceed permissible velocity

Calculated		Permissible	
#N/A	<	17	#N/A

5.5 Calculate Normal Depth and Check Channel Velocity to Determine Need for Temporary Liner

- Input soil type

Sand Loam Desired Grass Lining (ref WMB)

- Identify the permissible velocity (NCDENR, Table 8.05d)

2.5 feet/second

5.0 Calculations [continued]

- Identify the appropriate Manning's n coefficient (NCDENR, Table 8.05f)

0.02

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}
	0.02	0.00	3.00	0.00	0.45	0.00

Velocity (ft/s)	V/R
#DIV/0!	#DIV/0!

- Check that calculated velocity does not exceed permissible velocity

Calculated		Permissible	
#DIV/0!	<	2.5	**#DIV/0!**

- If a temporary liner is required, move to Step 5.6, else move to Step 6

5.6 Calculate Shear Stress to Determine Required Temporary Liner

- Input the desired temporary liner

Recyclex TRM Desired Grass Lining

- Identify the permissible shear stress (NCDENR, Table 8.05g)

10 pound per square foot

- Identify the appropriate Manning's n coefficient based on approximate flow depth (provided by Excelsior)

0.035

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}
0.407	0.035	1.72	5.57	0.31	0.78	0.78

Velocity (ft/s)	V/R
9.9	32.1

- Calculate shear stress and compare to permissible shear stress for the desired temporary liner

Shear Stress T = yds T = shear stress in lb/sf d = flow depth (ft)
y = U.W. of H_2O (62.4 lb/cf) s = channel gradient

Calculated		Permissible	
6.6	<	10	**ok**

6.0 Recommendations and Conclusions

- Summarize calculations and recommended channel characteristics

0.4	= Maximum Flow Depth (Y, feet)
#DIV/0!	= Maximum Velocity (feet per second)
3.0	= Channel Bottom Width (B, feet)
3.0	= Channel Side Slope (M_1)
3.0	= Channel Side Slope (M_2)
1.0	= Recommended Channel Depth (feet)
Recyclex TRM	= Recommended Permanent Channel Lining
N/A	= Recommended Temporary Channel Lining

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PROJECT NO.	1278-58730	REVIEWED BY / DATE	- -

Calculation Brief Title: Channel Sizing and Lining Calculation

1.0 Objective

Determine the appropriate channel dimensions and temporary/permanent erosion control protection for Channel 11.1.

2.0 Procedure

1. Identify the desired channel characteristics including bottom width, side slopes, longitudinal slope, Manning's 'n', and required flow.
2. Calculate the normal depth and velocity for the pre- and post-vegetative conditions by adjusting the flow depth.
3. Calculate the shear stress.
4. Determine the need for pre- and post-vegetation erosion control measures.

3.0 References / Data Sources

1. Department of Environment and Natural Resources (NCDENR), June 1, 2006, Revised March 2009. Erosion and Sediment Control Planning and Design Manual.

4.0 Assumptions / Limitations

1. The flow contributing to the channel along the steep slope is considered insignificant. This design is for the diversion berm at a 1.5% slope.
2. Assume unit weight of water is 62.5 lbs/ft^3.
3. Assume unit weight of concrete is 150 lbs/ft^3.

5.0 Calculations

5.1 Input Preliminary Channel Dimensions and Required Flow Capacity

- See **Attachment 1** for the channel location

Channel Characteristics

B =	0	M_1 =	2	$Q_{25\text{-}YR}$ =	3.0	Inputs
		M_2 =	4	s =	0.015	

B - Channel width (ft) M - Channel sideslope
Q - Design discharge (cfs) s - Channel longitudinal slope

5.2 Determine Permissible Velocity for Established Grass-Lined Channel

- Input the desired grass seed mix

Bahiagrass Desired Grass Lining (ref WMB)

- Identify the permissible velocity (NCDENR, Table 8.05a)

4.5 feet/second

5.0 Calculations [continued]

5.3 Calculate Normal Depth and Check Channel Velocity for Established Grass-Lined Channel -

- Identify vegetation retardness classification for a well maintained condition (NCDENR, Table 8.05c)

D — Vegetation Retardance Classification - Maintained Condition

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y - Depth of flow (ft) A - Channel area (sf) n - Manning's Coefficient
R - Hydraulic radius (ft) P - Wetted perimeter (ft)

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}	Velocity (ft/s)	VR
0.610	0.03	1.12	3.88	0.29	0.49	0.49	2.7	0.8
0.820	0.065	2.02	5.21	0.39	1.07	1.07	1.5	0.6
0.870	0.076	2.27	5.53	0.41	1.25	1.25	1.3	0.5
0.882	0.079	2.33	5.61	0.42	1.30	1.30	1.3	0.5

0.88 = Calculated normal depth (ft)
1.3 = Calculated velocity at normal depth (ft/s)

- Check that calculated velocity does not exceed permissible velocity

Actual		Permissible	
1.3	<	4.5	ok

5.4 Calculate Normal Depth and Check Channel Velocity for Established Grass-Lined Channel -

- Identify vegetation retardness classification for an unmaintained condition (NCDENR, Table 8.05c)

C — Vegetation Retardance Classification - Maintained Condition

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}	Velocity (ft/s)	VR
0.530	0.02	0.84	3.37	0.25	0.33	0.33	3.6	0.9
0.920	0.089	2.54	5.85	0.43	1.46	1.46	1.2	0.5
1.065	0.131	3.40	6.77	0.50	2.15	2.15	0.9	0.4
1.108	0.145	3.68	7.05	0.52	2.39	2.39	0.8	0.4

1.11 = Calculated normal depth (ft)
0.8 = Calculated velocity at normal depth (ft/s)

- Check that calculated velocity does not exceed permissible velocity

Calculated		Permissible	
0.8	<	4.5	ok

5.5 Calculate Normal Depth and Check Channel Velocity to Determine Need for Temporary Liner

- Input soil type

Sand Loam — Desired Grass Lining (ref WMB)

- Identify the permissible velocity (NCDENR, Table 8.05d)

2.5 feet/second

5.0 Calculations [continued]

- Identify the appropriate Manning's n coefficient (NCDENR, Table 8.05f)

0.02

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}
0.630	0.02	1.19	4.01	0.30	0.33	0.53

Velocity (ft/s)	V/R
2.5	8.5

- Check that calculated velocity does not exceed permissible velocity

Calculated		Permissible	
2.5	<	2.5	**inadequate**

- If a temporary liner is required, move to Step 5.6, else move to Step 6

5.6 Calculate Shear Stress to Determine Required Temporary Liner

- Input the desired temporary liner

Straw with Net — Desired Grass Lining

- Identify the permissible shear stress (NCDENR, Table 8.05g)

1.45 pound per square foot

- Identify the appropriate Manning's n coefficient based on approximate flow depth (NCDENR, Table 8.05e)

0.065

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}
0.820	0.065	2.02	5.21	0.39	1.07	1.07

Velocity (ft/s)	V/R
1.5	3.8

- Calculate shear stress and compare to permissible shear stress for the desired temporary liner

Shear Stress T = yds

T = shear stress in lb/sf
y = U.W. of H_2O (62.4 lb/cf)
d = flow depth (ft)
s = channel gradient

Calculated		Permissible	
0.8	<	1.45	**ok**

6.0 Recommendations and Conclusions

- Summarize calculations and recommended channel characteristics

1.1	= Maximum Flow Depth (Y, feet)
2.5	= Maximum Velocity (feet per second)
0.0	= Channel Bottom Width (B, feet)
2.0	= Channel Side Slope (M_1)
4.0	= Channel Side Slope (M_2)
1.5	= Recommended Channel Depth (feet)
grass	= Recommended Permanent Channel Lining
straw with net	= Recommended Temporary Channel Lining

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PROJECT NO.	1278-58730	REVIEWED BY / DATE	- -

Calculation Brief Title: Channel Sizing and Lining Calculation

1.0 Objective

Determine the appropriate channel dimensions and temporary/permanent erosion control protection for Channel 11.2.

2.0 Procedure

1. Identify the desired channel characteristics including bottom width, side slopes, longitudinal slope, Manning's 'n', and required flow.
2. Calculate the normal depth and velocity for the pre- and post-vegetative conditions by adjusting the flow depth.
3. Calculate the shear stress.
4. Determine the need for pre- and post-vegetation erosion control measures.

3.0 References / Data Sources

1. Department of Environment and Natural Resources (NCDENR), June 1, 2006, Revised March 2009. Erosion and Sediment Control Planning and Design Manual.

4.0 Assumptions / Limitations

1. The flow contributing to the channel along the steep slope is considered insignificant. This design is for the diversion berm at a 1.5% slope.
2. Assume unit weight of water is 62.5 lbs/ft^3.
3. Assume unit weight of concrete is 150 lbs/ft^3.
4. The total flow for the drainage area is calculated as 10 cfs. The section of channel being evaluated in this calculation includes 1.3 acres of the entire drainage area of 2.05 acres. The flow for this drainage area is weighted based on area.

5.0 Calculations

5.1 Input Preliminary Channel Dimensions and Required Flow Capacity

- See **Attachment 1** for the channel location

Channel Characteristics

B =	0	M_1 =	2	$Q_{25\text{-}YR}$ =	6.3
		M_2 =	3	s =	0.036

Inputs

B - Channel width (ft)
M - Channel sideslope
Q - Design discharge (cfs)
s - Channel longitudinal slope

5.2 Determine Permissible Velocity for Established Grass-Lined Channel

- Input the desired grass seed mix

Bahiagrass Desired Grass Lining (ref WMB)

- Identify the permissible velocity (NCDENR, Table 8.05a)

4.5 feet/second

5.0 Calculations [continued]

5.3 Calculate Normal Depth and Check Channel Velocity for Established Grass-Lined Channel -

- Identify vegetation retardness classification for a well maintained condition (NCDENR, Table 8.05c)

D — Vegetation Retardance Classification - Maintained Condition

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y - Depth of flow (ft) A - Channel area (sf) n - Manning's Coefficient
R - Hydraulic radius (ft) P - Wetted perimeter (ft)

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}	Velocity (ft/s)	VR
0.740	0.03	1.37	3.99	0.34	0.67	0.67	4.6	1.6
0.890	0.049	1.98	4.80	0.41	1.10	1.10	3.2	1.3
0.915	0.053	2.09	4.94	0.42	1.18	1.18	3.0	1.3
0.917	0.053	2.10	4.95	0.42	1.19	1.19	3.0	1.3

0.92 = Calculated normal depth (ft)
3.0 = Calculated velocity at normal depth (ft/s)

- Check that calculated velocity does not exceed permissible velocity

Actual		Permissible	
3.0	<	4.5	ok

5.4 Calculate Normal Depth and Check Channel Velocity for Established Grass-Lined Channel -

- Identify vegetation retardness classification for an unmaintained condition (NCDENR, Table 8.05c)

C — Vegetation Retardance Classification - Maintained Condition

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}	Velocity (ft/s)	VR
0.635	0.02	1.01	3.43	0.29	0.45	0.45	6.3	1.8
0.950	0.059	2.26	5.13	0.44	1.31	1.31	2.8	1.2
1.035	0.074	2.68	5.59	0.48	1.64	1.64	2.4	1.1
1.053	0.077	2.77	5.68	0.49	1.72	1.72	2.3	1.1

1.05 = Calculated normal depth (ft)
2.3 = Calculated velocity at normal depth (ft/s)

- Check that calculated velocity does not exceed permissible velocity

Calculated		Permissible	
2.3	<	4.5	ok

5.5 Calculate Normal Depth and Check Channel Velocity to Determine Need for Temporary Liner

- Input soil type

Sand Loam — Desired Grass Lining (ref WMB)

- Identify the permissible velocity (NCDENR, Table 8.05d)

2.5 feet/second

5.0 Calculations [continued]

- Identify the appropriate Manning's n coefficient (NCDENR, Table 8.05f)

0.02

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}
0.635	0.02	1.01	3.43	0.29	0.45	0.45

Velocity (ft/s)	V/R
6.3	21.4

- Check that calculated velocity does not exceed permissible velocity

Calculated		Permissible	
6.3	<	2.5	**inadequate**

- If a temporary liner is required, move to Step 5.6, else move to Step 6

5.6 Calculate Shear Stress to Determine Required Temporary Liner

- Input the desired temporary liner

Curlex I (.98) Desired Grass Lining

- Identify the permissible shear stress (NCDENR, Table 8.05g)

2 pound per square foot

- Identify the appropriate Manning's n coefficient based on approximate flow depth (NCDENR, Table 8.05e)

0.035

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}
0.785	0.035	1.54	4.24	0.36	0.78	0.78

Velocity (ft/s)	V/R
4.1	11.3

- Calculate shear stress and compare to permissible shear stress for the desired temporary liner

Shear Stress T = yds T = shear stress in lb/sf; y = U.W. of H_2O (62.4 lb/cf); d = flow depth (ft); s = channel gradient

Calculated		Permissible	
1.8	<	2	**ok**

6.0 Recommendations and Conclusions

- Summarize calculations and recommended channel characteristics

1.1	= Maximum Flow Depth (Y, feet)
6.3	= Maximum Velocity (feet per second)
0.0	= Channel Bottom Width (B, feet)
2.0	= Channel Side Slope (M_1)
3.0	= Channel Side Slope (M_2)
1.5	= Recommended Channel Depth (feet)
grass	= Recommended Permanent Channel Lining
Curlex I (.98)	= Recommended Temporary Channel Lining

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Calculation Brief Title: Channel Sizing and Riprap Lining Calculation

1.0 Objective

Determine the appropriate channel dimensions and temporary/permanent erosion control protection for section of the Channel 11.2 that breaks off the road and discharges into the proposed Pond 11.

2.0 Procedure

1. Identify the desired channel characteristics, riprap characteristics, and required flow.
2. Calculate the normal depth and velocity.
3. Adjust channel dimensions and/or recommended riprap d_{50} until the four requirements are met.
4. Summarize recommended channel dimensions and riprap d_{50} and thickness.

3.0 References / Data Sources

1. US Department of Transportation - Federal Highway Administration, *Hydraulic Engineering Circular Number 15, Third Edition* . http://www.fhwa.dot.gov/engineering/hydraulics/pubs/05114/index.cfm#_Toc115781580
1. Department of Environment and Natural Resources (NCDENR), June 1, 2006, Revised March 2009. Erosion and Sediment Control Planning and Design Manual.

4.0 Assumptions / Limitations

3. Assume unit weight of water is 62.4 lbs/ft^3.
4. Assume unit weight of riprap is 165 lbs/ft^3.
5. Assume no prominent bends in the channel that could affect wave height.

5.0 Calculations

5.1 Input Preliminary Channel Dimensions, Required Flow Capacity, and Preliminary Riprap Characterist

- See **Attachment 1** for the channel location

B - Channel width (ft)
Q - Design discharge (cfs)
M - Channel sideslope
s - Channel longitudinal slope

Channel Characteristics

B =	3	M_1 =	3	$Q_{10\text{-}YR}$ =	10.0	Inputs
		M_2 =	3	s =	0.182	

- Input the desired riprap shape: Crushed Stone
- Input a recommended riprap d_{50}: 10 inches
- Identify permissible shear stress: 7.65 lb/ft^2

5.0 Calculations [continued]

5.2 Calculate Normal Depth and Check Required Riprap d_{50} and Shear Stress

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y - Depth of flow (ft) | A - Channel area (sf) | n - Manning's Coefficient
R - Hydraulic radius (ft) | P - Wetted perimeter (ft) | d_a = Average Flow Depth (ft)

Y	Manning's n	A	P	R	d_a	Vel (ft/s)	Z_{REQ}	Z_{AV}
0.470	0.065	2.07	5.97	0.35	0.36	4.8	1.02	1.02
0.470	0.065	2.07	5.97	0.35	0.36	4.8	1.02	1.02
0.470	0.065	2.07	5.97	0.35	0.36	4.8	1.02	1.02
0.470	0.065	2.07	5.97	0.35	0.36	4.8	1.02	1.02

0.47	= Calculated normal depth (ft)
4.8	= Calculated velocity at normal depth (ft/s)

- Check that calculated riprap d_{50} does not exceed recommended riprap d_{50}

	Recommended		Required	
d_{50} (inches)	10	>	10.5	**inadequate**

- Check that calculated shear stress does not exceed permissible shear stress

	Actual w/ SF		Permissible	
lb/ft^2	6.48	<	7.65	**ok**

- Check that calculated side slope riprap d_{50} does not exceed recommended riprap d_{50}

	Recommended		Required	
d_{50} (inches)	10	>	10.3	**inadequate**

- Check that calculated side slope shear stress does not exceed permissible side slope shear stress

	Actual w/ SF		Permissible	
lb/ft^2	6.48	<	7.65	**ok**

6.0 Recommendations and Conclusions

- Summarize calculations and recommended channel characteristics

0.5	= Maximum Flow Depth (Y, feet)
4.8	= Maximum Velocity (feet per second)
3.0	= Channel Bottom Width (B, feet)
3.0	= Channel Side Slope (M_1)
3.0	= Channel Side Slope (M_2)
1.25	= Recommended Channel Depth (feet)
10	= Recommended Riprap d_{50} (inches)
23	= Recommended Riprap thickness (inches)

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Calculation Brief Title: Channel Sizing and Riprap Lining Calculation

1.0 Objective

Determine the appropriate channel dimensions and temporary/permanent erosion control protection for section of the Channel 12.1 that breaks off the road and discharges into the proposed Pond 12.

2.0 Procedure

1. Identify the desired channel characteristics, riprap characteristics, and required flow.
2. Calculate the normal depth and velocity.
3. Adjust channel dimensions and/or recommended riprap d_{50} until the four requirements are met.
4. Summarize recommended channel dimensions and riprap d_{50} and thickness.

3.0 References / Data Sources

1. US Department of Transportation - Federal Highway Administration, *Hydraulic Engineering Circular Number 15, Third Edition* . http://www.fhwa.dot.gov/engineering/hydraulics/pubs/05114/index.cfm#_Toc115781580
1. Department of Environment and Natural Resources (NCDENR), June 1, 2006, Revised March 2009. Erosion and Sediment Control Planning and Design Manual.

4.0 Assumptions / Limitations

3. Assume unit weight of water is 62.4 lbs/ft^3.
4. Assume unit weight of riprap is 165 lbs/ft^3.
5. Assume no prominent bends in the channel that could affect wave height.

5.0 Calculations

5.1 Input Preliminary Channel Dimensions, Required Flow Capacity, and Preliminary Riprap Characterist

- See **Attachment 1** for the channel location

B - Channel width (ft)
Q - Design discharge (cfs)
M - Channel sideslope
s - Channel longitudinal slope

Channel Characteristics

B =	3	M_1 =	3	$Q_{10\text{-}YR}$ =	15.0	Inputs
		M_2 =	3	s =	0.112	

- Input the desired riprap shape: Crushed Stone
- Input a recommended riprap d_{50}: 10 inches
- Identify permissible shear stress: 7.38 lb/ft^2

5.0 Calculations [continued]

5.2 Calculate Normal Depth and Check Required Riprap d_{50} and Shear Stress

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y - Depth of flow (ft) | A - Channel area (sf) | n - Manning's Coefficient
R - Hydraulic radius (ft) | P - Wetted perimeter (ft) | d_a = Average Flow Depth (ft)

Y	Manning's n	A	P	R	d_a	Vel (ft/s)	Z_{REQ}	Z_{AV}
0.660	0.065	3.29	7.17	0.46	0.47	4.6	1.95	1.95
0.682	0.069	3.44	7.31	0.47	0.49	4.4	2.08	2.08
0.690	0.071	3.50	7.36	0.48	0.49	4.3	2.13	2.13
0.693	0.071	3.52	7.38	0.48	0.49	4.3	2.15	2.15

0.69	= Calculated normal depth (ft)
4.3	= Calculated velocity at normal depth (ft/s)

- Check that calculated riprap d_{50} does not exceed recommended riprap d_{50}

	Recommended		Required	
d_{50} (inches)	10	>	9.4	ok

- Check that calculated shear stress does not exceed permissible shear stress

	Actual w/ SF		Permissible	
lb/ft^2	5.83	<	7.38	ok

- Check that calculated side slope riprap d_{50} does not exceed recommended riprap d_{50}

	Recommended		Required	
d_{50} (inches)	10	>	9.3	ok

- Check that calculated side slope shear stress does not exceed permissible side slope shear stress

	Actual w/ SF		Permissible	
lb/ft^2	5.83	<	7.38	ok

6.0 Recommendations and Conclusions

- Summarize calculations and recommended channel characteristics

0.7	= Maximum Flow Depth (Y, feet)
4.3	= Maximum Velocity (feet per second)
3.0	= Channel Bottom Width (B, feet)
3.0	= Channel Side Slope (M_1)
3.0	= Channel Side Slope (M_2)
1.25	= Recommended Channel Depth (feet)
10	= Recommended Riprap d_{50} (inches)
23	= Recommended Riprap thickness (inches)

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Calculation Brief Title: Channel Sizing and Lining Calculation

1.0 Objective

Determine the appropriate channel dimensions and temporary/permanent erosion control protection for section of the Channel 12.1 that parallels the road and eventually discharges into proposed Pond 12.

2.0 Procedure

1. Identify the desired channel characteristics including bottom width, side slopes, longitudinal slope, Manning's 'n', and required flow.
2. Calculate the normal depth and velocity for the pre- and post-vegetative conditions by adjusting the flow depth.
3. Calculate the shear stress.
4. Determine the need for pre- and post-vegetation erosion control measures.

3.0 References / Data Sources

1. Department of Environment and Natural Resources (NCDENR), June 1, 2006, Revised March 2009. Erosion and Sediment Control Planning and Design Manual.

4.0 Assumptions / Limitations

1. The flow contributing to the channel along the steep slope is considered insignificant. This design is for the diversion berm at a 1.5% slope.
2. Assume unit weight of water is 62.5 lbs/ft^3.
3. Assume unit weight of concrete is 150 lbs/ft^3.

5.0 Calculations

5.1 Input Preliminary Channel Dimensions and Required Flow Capacity

- See **Attachment 1** for the channel location

Channel Characteristics

B =	3	M_1 =	3	$Q_{25\text{-}YR}$ =	15.0	Inputs
		M_2 =	3	s =	0.385	

B - Channel width (ft) M - Channel sideslope
Q - Design discharge (cfs) s - Channel longitudinal slope

5.2 Determine Permissible Velocity for Established Grass-Lined Channel

- Input the desired grass seed mix

[ ] Desired Grass Lining (ref WMB)

- Identify the permissible velocity (NCDENR, Table 8.05a)

[ ] feet/second

5.0 Calculations [continued]

5.3 Calculate Normal Depth and Check Channel Velocity for Established Grass-Lined Channel -

- Identify vegetation retardness classification for a well maintained condition (NCDENR, Table 8.05c)

D Vegetation Retardance Classification - Maintained Condition

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y - Depth of flow (ft) A - Channel area (sf) n - Manning's Coefficient
R - Hydraulic radius (ft) P - Wetted perimeter (ft)

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}	Velocity (ft/s)	VR
0.313	0.03	1.23	4.98	0.25	0.49	0.49	12.2	3.0
0.367	0.040	1.51	5.32	0.28	0.65	0.65	10.0	2.8
0.370	0.040	1.52	5.34	0.28	0.66	0.66	9.9	2.8
0.370	0.040	1.52	5.34	0.28	0.66	0.66	9.9	2.8

0.37 = Calculated normal depth (ft)
9.9 = Calculated velocity at normal depth (ft/s)

- Check that calculated velocity does not exceed permissible velocity

Actual		Permissible	
9.9	<	0	inadequate

5.4 Calculate Normal Depth and Check Channel Velocity for Established Grass-Lined Channel -

- Identify vegetation retardness classification for an unmaintained condition (NCDENR, Table 8.05c)

C Vegetation Retardance Classification - Maintained Condition

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}	Velocity (ft/s)	VR
0.247	0.02	0.92	4.56	0.20	0.32	0.32	16.2	3.3
0.395	0.046	1.65	5.50	0.30	0.74	0.74	9.1	2.7
0.413	0.050	1.75	5.61	0.31	0.81	0.81	8.6	2.7
0.413	0.050	1.75	5.61	0.31	0.81	0.81	8.6	2.7

0.41 = Calculated normal depth (ft)
8.6 = Calculated velocity at normal depth (ft/s)

- Check that calculated velocity does not exceed permissible velocity

Calculated		Permissible	
8.6	<	0	inadequate

5.5 Calculate Normal Depth and Check Channel Velocity to Determine Need for Temporary Liner

- Input soil type

Sand Loam Desired Grass Lining (ref WMB)

- Identify the permissible velocity (NCDENR, Table 8.05d)

2.5 feet/second

5.0 Calculations [continued]

- Identify the appropriate Manning's n coefficient (NCDENR, Table 8.05f)

0.02

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}
0.247	0.02	0.92	4.56	0.20	0.32	0.32

Velocity (ft/s)	V/R
16.2	80.1

- Check that calculated velocity does not exceed permissible velocity

Calculated		Permissible	
16.2	<	2.5	inadequate

- If a temporary liner is required, move to Step 5.6, else move to Step 6

5.6 Calculate Shear Stress to Determine Required Temporary Liner

- Input the desired temporary liner

Recyclex TRM Desired Grass Lining

- Identify the permissible shear stress (NCDENR, Table 8.05g)

10 pound per square foot

- Identify the appropriate Manning's n coefficient based on approximate flow depth (NCDENR, Table 8.05e)

0.04

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}
0.367	0.04	1.51	5.32	0.28	0.65	0.65

Velocity (ft/s)	V/R
10.0	35.2

- Calculate shear stress and compare to permissible shear stress for the desired temporary liner

Shear Stress T = yds T = shear stress in lb/sf d = flow depth (ft)
y = U.W. of H_2O (62.4 lb/cf) s = channel gradient

Calculated		Permissible	
8.8	<	10	ok

6.0 Recommendations and Conclusions

- Summarize calculations and recommended channel characteristics

0.4	= Maximum Flow Depth (Y, feet)
16.2	= Maximum Velocity (feet per second)
3.0	= Channel Bottom Width (B, feet)
3.0	= Channel Side Slope (M_1)
3.0	= Channel Side Slope (M_2)
1.0	= Recommended Channel Depth (feet)
Recyclex	= Recommended Permanent Channel Lining
N/A	= Recommended Temporary Channel Lining

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Calculation Brief Title: Channel Sizing and Lining Calculation

1.0 Objective

Determine the appropriate channel dimensions and temporary/permanent erosion control protection for Channel 12.2.

2.0 Procedure

1. Identify the desired channel characteristics including bottom width, side slopes, longitudinal slope, Manning's 'n', and required flow.
2. Calculate the normal depth and velocity for the pre- and post-vegetative conditions by adjusting the flow depth.
3. Calculate the shear stress.
4. Determine the need for pre- and post-vegetation erosion control measures.

3.0 References / Data Sources

1. Department of Environment and Natural Resources (NCDENR), June 1, 2006, Revised March 2009. Erosion and Sediment Control Planning and Design Manual.

4.0 Assumptions / Limitations

1. The flow contributing to the channel along the steep slope is considered insignificant. This design is for the diversion berm at a 1.5% slope.
2. Assume unit weight of water is 62.5 lbs/ft^3.
3. Assume unit weight of concrete is 150 lbs/ft^3.

5.0 Calculations

5.1 Input Preliminary Channel Dimensions and Required Flow Capacity

- See **Attachment 1** for the channel location

Channel Characteristics

B =	0	M_1 =	2	$Q_{25\text{-}YR}$ =	1.0	Inputs
		M_2 =	5	s =	0.015	

B - Channel width (ft) M - Channel sideslope
Q - Design discharge (cfs) s - Channel longitudinal slope

5.2 Determine Permissible Velocity for Established Grass-Lined Channel

- Input the desired grass seed mix

Bahiagrass Desired Grass Lining (ref WMB)

- Identify the permissible velocity (NCDENR, Table 8.05a)

4.5 feet/second

5.0 Calculations [continued]

5.3 Calculate Normal Depth and Check Channel Velocity for Established Grass-Lined Channel -

- Identify vegetation retardness classification for a well maintained condition (NCDENR, Table 8.05c)

D — Vegetation Retardance Classification - Maintained Condition

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y - Depth of flow (ft) A - Channel area (sf) n - Manning's Coefficient
R - Hydraulic radius (ft) P - Wetted perimeter (ft)

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}	Velocity (ft/s)	VR
0.380	0.03	0.51	2.79	0.18	0.16	0.16	2.0	0.4
0.595	0.098	1.24	4.36	0.28	0.54	0.54	0.8	0.2
0.653	0.125	1.49	4.79	0.31	0.69	0.69	0.7	0.2
0.665	0.132	1.55	4.88	0.32	0.72	0.72	0.6	0.2

0.67 = Calculated normal depth (ft)
0.6 = Calculated velocity at normal depth (ft/s)

- Check that calculated velocity does not exceed permissible velocity

Actual		Permissible	
0.6	<	4.5	ok

5.4 Calculate Normal Depth and Check Channel Velocity for Established Grass-Lined Channel -

- Identify vegetation retardness classification for an unmaintained condition (NCDENR, Table 8.05c)

C — Vegetation Retardance Classification - Maintained Condition

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}	Velocity (ft/s)	VR
0.330	0.02	0.38	2.42	0.16	0.11	0.11	2.6	0.4
0.703	0.153	1.73	5.16	0.34	0.84	0.84	0.6	0.2
0.860	0.262	2.59	6.31	0.41	1.43	1.43	0.4	0.2
0.907	0.302	2.88	6.65	0.43	1.65	1.65	0.3	0.2

0.91 = Calculated normal depth (ft)
0.3 = Calculated velocity at normal depth (ft/s)

- Check that calculated velocity does not exceed permissible velocity

Calculated		Permissible	
0.3	<	4.5	ok

5.5 Calculate Normal Depth and Check Channel Velocity to Determine Need for Temporary Liner

- Input soil type

Sand Loam — Desired Grass Lining (ref WMB)

- Identify the permissible velocity (NCDENR, Table 8.05d)

2.5 feet/second

5.0 Calculations [continued]

- Identify the appropriate Manning's n coefficient (NCDENR, Table 8.05f)

0.02

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}
0.330	0.02	0.38	2.42	0.16	0.11	0.11

Velocity (ft/s)	V/R
2.6	16.7

- Check that calculated velocity does not exceed permissible velocity

Calculated		Permissible	
2.6	<	2.5	inadequate

- If a temporary liner is required, move to Step 5.6, else move to Step 6

5.6 Calculate Shear Stress to Determine Required Temporary Liner

- Input the desired temporary liner

Straw with Net — Desired Grass Lining

- Identify the permissible shear stress (NCDENR, Table 8.05g)

1.45 pound per square foot

- Identify the appropriate Manning's n coefficient based on approximate flow depth (NCDENR, Table 8.05e)

0.065

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}
0.515	0.065	0.93	3.78	0.25	0.36	0.36

Velocity (ft/s)	V/R
1.1	4.4

- Calculate shear stress and compare to permissible shear stress for the desired temporary liner

Shear Stress T = yds

T = shear stress in lb/sf
y = U.W. of H_2O (62.4 lb/cf)
d = flow depth (ft)
s = channel gradient

Calculated		Permissible	
0.5	<	1.45	ok

6.0 Recommendations and Conclusions

- Summarize calculations and recommended channel characteristics

0.9	= Maximum Flow Depth (Y, feet)
2.6	= Maximum Velocity (feet per second)
0.0	= Channel Bottom Width (B, feet)
2.0	= Channel Side Slope (M_1)
5.0	= Channel Side Slope (M_2)
1.5	= Recommended Channel Depth (feet)
grass	= Recommended Permanent Channel Lining
straw with net	= Recommended Temporary Channel Lining

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Calculation Brief Title: Channel Sizing and Lining Calculation

1.0 Objective

Determine the appropriate channel dimensions and temporary/permanent erosion control protection for Channel 12.3.

2.0 Procedure

1. Identify the desired channel characteristics including bottom width, side slopes, longitudinal slope, Manning's 'n', and required flow.
2. Calculate the normal depth and velocity for the pre- and post-vegetative conditions by adjusting the flow depth.
3. Calculate the shear stress.
4. Determine the need for pre- and post-vegetation erosion control measures.

3.0 References / Data Sources

1. Department of Environment and Natural Resources (NCDENR), June 1, 2006, Revised March 2009. Erosion and Sediment Control Planning and Design Manual.

4.0 Assumptions / Limitations

1. Calculate the normal depth based on the steepest section of the channel.
2. Assume unit weight of water is 62.5 lbs/ft^3.
3. Assume unit weight of concrete is 150 lbs/ft^3.

5.0 Calculations

5.1 Input Preliminary Channel Dimensions and Required Flow Capacity

- See **Attachment 1** for the channel location

Channel Characteristics

B =	0	M_1 =	2	$Q_{25\text{-}YR}$ =	1.0	Inputs
		M_2 =	5	s =	0.123	

B - Channel width (ft) M - Channel sideslope
Q - Design discharge (cfs) s - Channel longitudinal slope

5.2 Determine Permissible Velocity for Established Grass-Lined Channel

- Input the desired grass seed mix

Bahiagrass Desired Grass Lining (ref WMB)

- Identify the permissible velocity (NCDENR, Table 8.05a)

4.5 feet/second

5.0 Calculations [continued]

5.3 Calculate Normal Depth and Check Channel Velocity for Established Grass-Lined Channel -

- Identify vegetation retardness classification for a well maintained condition (NCDENR, Table 8.05c)

D — Vegetation Retardance Classification - Maintained Condition

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y - Depth of flow (ft) A - Channel area (sf) n - Manning's Coefficient
R - Hydraulic radius (ft) P - Wetted perimeter (ft)

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}	Velocity (ft/s)	VR
0.260	0.03	0.24	1.91	0.12	0.06	0.06	4.2	0.5
0.370	0.080	0.48	2.71	0.18	0.15	0.15	2.1	0.4
0.400	0.097	0.56	2.93	0.19	0.19	0.19	1.8	0.3
0.400	0.101	0.56	2.93	0.19	0.19	0.19	1.8	0.3

0.40 = Calculated normal depth (ft)
1.8 = Calculated velocity at normal depth (ft/s)

- Check that calculated velocity does not exceed permissible velocity

Actual		Permissible	
1.8	<	4.5	ok

5.4 Calculate Normal Depth and Check Channel Velocity for Established Grass-Lined Channel -

- Identify vegetation retardness classification for an unmaintained condition (NCDENR, Table 8.05c)

C — Vegetation Retardance Classification - Maintained Condition

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}	Velocity (ft/s)	VR
0.230	0.02	0.19	1.69	0.11	0.04	0.04	5.4	0.6
0.430	0.118	0.65	3.15	0.21	0.23	0.23	1.5	0.3
0.510	0.184	0.91	3.74	0.24	0.35	0.35	1.1	0.3
0.535	0.208	1.00	3.92	0.26	0.40	0.40	1.0	0.3

0.54 = Calculated normal depth (ft)
1.0 = Calculated velocity at normal depth (ft/s)

- Check that calculated velocity does not exceed permissible velocity

Calculated		Permissible	
1.0	<	4.5	ok

5.5 Calculate Normal Depth and Check Channel Velocity to Determine Need for Temporary Liner

- Input soil type

Sand Loam — Desired Grass Lining (ref WMB)

- Identify the permissible velocity (NCDENR, Table 8.05d)

2.5 feet/second

5.0 Calculations [continued]

- Identify the appropriate Manning's n coefficient (NCDENR, Table 8.05f)

0.02

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}
0.230	0.02	0.19	1.69	0.11	0.04	0.04

Velocity (ft/s)	V/R
5.4	49.2

- Check that calculated velocity does not exceed permissible velocity

Calculated		Permissible	
5.4	<	2.5	**inadequate**

- If a temporary liner is required, move to Step 5.6, else move to Step 6

5.6 Calculate Shear Stress to Determine Required Temporary Liner

- Input the desired temporary liner

Curlex II — Desired Grass Lining

- Identify the permissible shear stress (NCDENR, Table 8.05g)

2.25 pound per square foot

- Identify the appropriate Manning's n coefficient based on approximate flow depth (provided by Excelsior)

0.035

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}
0.270	0.035	0.26	1.98	0.13	0.07	0.07

Velocity (ft/s)	V/R
3.9	30.4

- Calculate shear stress and compare to permissible shear stress for the desired temporary liner

Shear Stress T = yds

T = shear stress in lb/sf
y = U.W. of H_2O (62.4 lb/cf)
d = flow depth (ft)
s = channel gradient

Calculated		Permissible	
2.1	<	2.25	**ok**

6.0 Recommendations and Conclusions

- Summarize calculations and recommended channel characteristics

0.5	= Maximum Flow Depth (Y, feet)
5.4	= Maximum Velocity (feet per second)
0.0	= Channel Bottom Width (B, feet)
2.0	= Channel Side Slope (M_1)
5.0	= Channel Side Slope (M_2)
1.0	= Recommended Channel Depth (feet)
grass	= Recommended Permanent Channel Lining
Curlex II	= Recommended Temporary Channel Lining

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Calculation Brief Title: Channel Sizing and Lining Calculation

1.0 Objective

Determine the appropriate channel dimensions and temporary/permanent erosion control protection for Channel 12.4.

2.0 Procedure

1. Identify the desired channel characteristics including bottom width, side slopes, longitudinal slope, Manning's 'n', and required flow.
2. Calculate the normal depth and velocity for the pre- and post-vegetative conditions by adjusting the flow depth.
3. Calculate the shear stress.
4. Determine the need for pre- and post-vegetation erosion control measures.

3.0 References / Data Sources

1. Department of Environment and Natural Resources (NCDENR), June 1, 2006, Revised March 2009. Erosion and Sediment Control Planning and Design Manual.

4.0 Assumptions / Limitations

1. Calculate the normal depth based on the steepest section of the channel.
2. Assume unit weight of water is 62.5 lbs/ft^3.
3. Assume unit weight of concrete is 150 lbs/ft^3.

5.0 Calculations

5.1 Input Preliminary Channel Dimensions and Required Flow Capacity

- See **Attachment 1** for the channel location

Channel Characteristics

B =	0	M_1 =	2	$Q_{25\text{-}YR}$ =	1.0	Inputs
		M_2 =	5	s =	0.137	

B - Channel width (ft) M - Channel sideslope
Q - Design discharge (cfs) s - Channel longitudinal slope

5.2 Determine Permissible Velocity for Established Grass-Lined Channel

- Input the desired grass seed mix

Bahiagrass Desired Grass Lining (ref WMB)

- Identify the permissible velocity (NCDENR, Table 8.05a)

4.5 feet/second

5.0 Calculations [continued]

5.3 Calculate Normal Depth and Check Channel Velocity for Established Grass-Lined Channel -

- Identify vegetation retardness classification for a well maintained condition (NCDENR, Table 8.05c)

D — Vegetation Retardance Classification - Maintained Condition

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y - Depth of flow (ft) A - Channel area (sf) n - Manning's Coefficient
R - Hydraulic radius (ft) P - Wetted perimeter (ft)

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}	Velocity (ft/s)	VR
0.240	0.03	0.20	1.76	0.11	0.05	0.05	5.0	0.6
0.360	0.077	0.45	2.64	0.17	0.14	0.14	2.2	0.4
0.390	0.096	0.53	2.86	0.19	0.17	0.17	1.9	0.3
0.395	0.100	0.55	2.90	0.19	0.18	0.18	1.8	0.3

0.40 = Calculated normal depth (ft)
1.8 = Calculated velocity at normal depth (ft/s)

- Check that calculated velocity does not exceed permissible velocity

Actual		Permissible	
1.8	<	4.5	ok

5.4 Calculate Normal Depth and Check Channel Velocity for Established Grass-Lined Channel -

- Identify vegetation retardness classification for an unmaintained condition (NCDENR, Table 8.05c)

C — Vegetation Retardance Classification - Maintained Condition

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}	Velocity (ft/s)	VR
0.230	0.02	0.19	1.69	0.11	0.04	0.04	5.4	0.6
0.420	0.118	0.62	3.08	0.20	0.21	0.21	1.6	0.3
0.495	0.181	0.86	3.63	0.24	0.33	0.33	1.2	0.3
0.520	0.204	0.95	3.81	0.25	0.37	0.37	1.1	0.3

0.52 = Calculated normal depth (ft)
1.1 = Calculated velocity at normal depth (ft/s)

- Check that calculated velocity does not exceed permissible velocity

Calculated		Permissible	
1.1	<	4.5	ok

5.5 Calculate Normal Depth and Check Channel Velocity to Determine Need for Temporary Liner

- Input soil type

Sand Loam — Desired Grass Lining (ref WMB)

- Identify the permissible velocity (NCDENR, Table 8.05d)

2.5 feet/second

5.0 Calculations [continued]

- Identify the appropriate Manning's n coefficient (NCDENR, Table 8.05f)

0.02

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}
0.230	0.02	0.19	1.69	0.11	0.04	0.04

Velocity (ft/s)	V/R
5.4	49.2

- Check that calculated velocity does not exceed permissible velocity

Calculated		Permissible	
5.4	<	2.5	**inadequate**

- If a temporary liner is required, move to Step 5.6, else move to Step 6

5.6 Calculate Shear Stress to Determine Required Temporary Liner

- Input the desired temporary liner

Curlex II Desired Grass Lining

- Identify the permissible shear stress (NCDENR, Table 8.05g)

2.25 pound per square foot

- Identify the appropriate Manning's n coefficient based on approximate flow depth (provided by Excelsior)

0.035

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}
0.260	0.035	0.24	1.91	0.12	0.06	0.06

Velocity (ft/s)	V/R
4.2	34.1

- Calculate shear stress and compare to permissible shear stress for the desired temporary liner

Shear Stress T = yds T = shear stress in lb/sf d = flow depth (ft)
y = U.W. of H_2O (62.4 lb/cf) s = channel gradient

Calculated		Permissible	
2.2	<	2.25	**ok**

6.0 Recommendations and Conclusions

- Summarize calculations and recommended channel characteristics

0.5	= Maximum Flow Depth (Y, feet)
5.4	= Maximum Velocity (feet per second)
0.0	= Channel Bottom Width (B, feet)
2.0	= Channel Side Slope (M_1)
5.0	= Channel Side Slope (M_2)
1.5	= Recommended Channel Depth (feet)
grass	= Recommended Permanent Channel Lining
Curlex II	= Recommended Temporary Channel Lining

-- A one-foot freeboard was provided due to the significant channel bend.

CLIENT	Cabarrus County	COMPUTED BY / DATE	MKS 04/06/09
PROJECT	Landfill Closure	CHECKED BY / DATE	- -
DETAIL	Stormwater Channel Design	REVISION NO. / DATE	- -
PROJECT NO.	1278-58730	REVIEWED BY / DATE	- -

Calculation Brief Title: Channel Sizing and Lining Calculation

1.0 Objective

Determine the appropriate channel dimensions and temporary/permanent erosion control protection for the section of Channel 13.1 that is at a 0.5% slope.

2.0 Procedure

1. Identify the desired channel characteristics including bottom width, side slopes, longitudinal slope, Manning's 'n', and required flow.
2. Calculate the normal depth and velocity for the pre- and post-vegetative conditions by adjusting the flow depth.
3. Calculate the shear stress.
4. Determine the need for pre- and post-vegetation erosion control measures.

3.0 References / Data Sources

1. Department of Environment and Natural Resources (NCDENR), June 1, 2006, Revised March 2009. Erosion and Sediment Control Planning and Design Manual.

4.0 Assumptions / Limitations

1. Calculate the normal depth based on the steepest section of the channel.
2. Assume unit weight of water is 62.5 lbs/ft^3.
3. Assume unit weight of concrete is 150 lbs/ft^3.

5.0 Calculations

5.1 Input Preliminary Channel Dimensions and Required Flow Capacity

- See **Attachment 1** for the channel location

Channel Characteristics

B =	0	M_1 =	2	$Q_{25\text{-}YR}$ =	8.0	Inputs
		M_2 =	3	s =	0.007	

B - Channel width (ft) M - Channel sideslope
Q - Design discharge (cfs) s - Channel longitudinal slope

5.2 Determine Permissible Velocity for Established Grass-Lined Channel

- Input the desired grass seed mix

Bahiagrass Desired Grass Lining (ref WMB)

- Identify the permissible velocity (NCDENR, Table 8.05a)

4.5 feet/second

5.0 Calculations [continued]

5.3 Calculate Normal Depth and Check Channel Velocity for Established Grass-Lined Channel -

- Identify vegetation retardness classification for a well maintained condition (NCDENR, Table 8.05c)

D Vegetation Retardance Classification - Maintained Condition

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y - Depth of flow (ft) A - Channel area (sf) n - Manning's Coefficient
R - Hydraulic radius (ft) P - Wetted perimeter (ft)

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}	Velocity (ft/s)	VR
1.100	0.03	3.03	5.94	0.51	1.93	1.93	2.6	1.3
1.356	0.052	4.60	7.32	0.63	3.37	3.37	1.7	1.1
1.394	0.056	4.86	7.53	0.65	3.63	3.63	1.6	1.1
1.398	0.057	4.89	7.55	0.65	3.66	3.66	1.6	1.1

1.40 = Calculated normal depth (ft)
1.6 = Calculated velocity at normal depth (ft/s)

- Check that calculated velocity does not exceed permissible velocity

Actual		Permissible	
1.6	<	4.5	ok

5.4 Calculate Normal Depth and Check Channel Velocity for Established Grass-Lined Channel -

- Identify vegetation retardness classification for an unmaintained condition (NCDENR, Table 8.05c)

C Vegetation Retardance Classification - Maintained Condition

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}	Velocity (ft/s)	VR
0.942	0.02	2.22	5.09	0.44	1.28	1.28	3.6	1.6
1.462	0.064	5.34	7.89	0.68	4.12	4.12	1.5	1.0
1.606	0.082	6.45	8.67	0.74	5.29	5.29	1.2	0.9
1.634	0.086	6.67	8.82	0.76	5.54	5.54	1.2	0.9

1.63 = Calculated normal depth (ft)
1.2 = Calculated velocity at normal depth (ft/s)

- Check that calculated velocity does not exceed permissible velocity

Calculated		Permissible	
1.2	<	4.5	ok

5.5 Calculate Normal Depth and Check Channel Velocity to Determine Need for Temporary Liner

- Input soil type

Sand Loam Desired Grass Lining (ref WMB)

- Identify the permissible velocity (NCDENR, Table 8.05d)

2.5 feet/second

5.0 Calculations [continued]

- Identify the appropriate Manning's n coefficient (NCDENR, Table 8.05f)

0.02

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}
0.943	0.02	2.22	5.09	0.44	1.28	1.28

Velocity (ft/s)	V/R
3.6	8.2

- Check that calculated velocity does not exceed permissible velocity

Calculated		Permissible	
3.6	<	2.5	**inadequate**

- If a temporary liner is required, move to Step 5.6, else move to Step 6

5.6 Calculate Shear Stress to Determine Required Temporary Liner

- Input the desired temporary liner

Straw with Net — Desired Grass Lining

- Identify the permissible shear stress (NCDENR, Table 8.05g)

1.45 pound per square foot

- Identify the appropriate Manning's n coefficient based on approximate flow depth (provided by Excelsior)

0.035

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}
1.165	0.035	3.39	6.29	0.54	2.25	2.25

Velocity (ft/s)	V/R
2.4	4.4

- Calculate shear stress and compare to permissible shear stress for the desired temporary liner

Shear Stress T = yds

T = shear stress in lb/sf
y = U.W. of H_2O (62.4 lb/cf)
d = flow depth (ft)
s = channel gradient

Calculated		Permissible	
0.5	<	1.45	**ok**

6.0 Recommendations and Conclusions

- Summarize calculations and recommended channel characteristics

1.6	= Maximum Flow Depth (Y, feet)
3.6	= Maximum Velocity (feet per second)
0.0	= Channel Bottom Width (B, feet)
2.0	= Channel Side Slope (M_1)
3.0	= Channel Side Slope (M_2)
2.0	= Recommended Channel Depth (feet)
grass	= Recommended Permanent Channel Lining
Straw with Net	= Recommended Temporary Channel Lining

CLIENT	Cabarrus County	COMPUTED BY / DATE	MKS 04/06/09
PROJECT	Landfill Closure	CHECKED BY / DATE	- -
DETAIL	Stormwater Channel Design	REVISION NO. / DATE	- -
PROJECT NO.	1278-58730	REVIEWED BY / DATE	- -

Calculation Brief Title: Channel Sizing and Lining Calculation

1.0 Objective

Determine the appropriate channel dimensions and temporary/permanent erosion control protection for the most downstream section of Channel 13.1, which is at a 8.5% slope opposed to the flatter section which is at a 0.5% slope.

2.0 Procedure

1. Identify the desired channel characteristics including bottom width, side slopes, longitudinal slope, Manning's 'n', and required flow.
2. Calculate the normal depth and velocity for the pre- and post-vegetative conditions by adjusting the flow depth.
3. Calculate the shear stress.
4. Determine the need for pre- and post-vegetation erosion control measures.

3.0 References / Data Sources

1. Department of Environment and Natural Resources (NCDENR), June 1, 2006, Revised March 2009. Erosion and Sediment Control Planning and Design Manual.

4.0 Assumptions / Limitations

1. Calculate the normal depth based on the steepest section of the channel.
2. Assume unit weight of water is 62.5 lbs/ft^3.
3. Assume unit weight of concrete is 150 lbs/ft^3.

5.0 Calculations

5.1 Input Preliminary Channel Dimensions and Required Flow Capacity

- See **Attachment 1** for the channel location

Channel Characteristics

B =	3	M_1 =	2	$Q_{25\text{-}YR}$ =	8.0	Inputs
		M_2 =	3	s =	0.085	

B - Channel width (ft) M - Channel sideslope
Q - Design discharge (cfs) s - Channel longitudinal slope

5.2 Determine Permissible Velocity for Established Grass-Lined Channel

- Input the desired grass seed mix

Bahiagrass Desired Grass Lining (ref WMB)

- Identify the permissible velocity (NCDENR, Table 8.05a)

4.5 feet/second

5.0 Calculations [continued]

5.3 Calculate Normal Depth and Check Channel Velocity for Established Grass-Lined Channel -

- Identify vegetation retardness classification for a well maintained condition (NCDENR, Table 8.05c)

D — Vegetation Retardance Classification - Maintained Condition

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y - Depth of flow (ft) A - Channel area (sf) n - Manning's Coefficient
R - Hydraulic radius (ft) P - Wetted perimeter (ft)

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}	Velocity (ft/s)	VR
0.340	0.03	1.31	4.84	0.27	0.55	0.55	6.1	1.7
0.447	0.049	1.84	5.41	0.34	0.90	0.90	4.3	1.5
0.455	0.051	1.88	5.46	0.35	0.93	0.93	4.2	1.5
0.460	0.051	1.91	5.48	0.35	0.94	0.94	4.2	1.5

0.46 = Calculated normal depth (ft)
4.2 = Calculated velocity at normal depth (ft/s)

- Check that calculated velocity does not exceed permissible velocity

Actual		Permissible	
4.2	<	4.5	ok

5.4 Calculate Normal Depth and Check Channel Velocity for Established Grass-Lined Channel -

- Identify vegetation retardness classification for an unmaintained condition (NCDENR, Table 8.05c)

C — Vegetation Retardance Classification - Maintained Condition

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}	Velocity (ft/s)	VR
0.273	0.02	1.01	4.47	0.22	0.37	0.37	8.0	1.8
0.500	0.060	2.13	5.70	0.37	1.10	1.10	3.8	1.4
0.537	0.068	2.33	5.90	0.40	1.26	1.26	3.4	1.4
0.545	0.070	2.38	5.94	0.40	1.29	1.29	3.4	1.3

0.55 = Calculated normal depth (ft)
3.4 = Calculated velocity at normal depth (ft/s)

- Check that calculated velocity does not exceed permissible velocity

Calculated		Permissible	
3.4	<	4.5	ok

5.5 Calculate Normal Depth and Check Channel Velocity to Determine Need for Temporary Liner

- Input soil type

Sand Loam — Desired Grass Lining (ref WMB)

- Identify the permissible velocity (NCDENR, Table 8.05d)

2.5 feet/second

5.0 Calculations [continued]

- Identify the appropriate Manning's n coefficient (NCDENR, Table 8.05f)

0.02

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}
0.273	0.02	1.01	4.47	0.22	0.37	0.37

Velocity (ft/s)	V/R
8.0	35.4

- Check that calculated velocity does not exceed permissible velocity

Calculated		Permissible	
8.0	<	2.5	**inadequate**

- If a temporary liner is required, move to Step 5.6, else move to Step 6

5.6 Calculate Shear Stress to Determine Required Temporary Liner

- Input the desired temporary liner

Premier Straw/Coconut Desired Grass Lining

- Identify the permissible shear stress (NCDENR, Table 8.05g)

2 pound per square foot

- Identify the appropriate Manning's n coefficient based on approximate flow depth (provided by Excelsior)

0.03

- Calculate the normal depth and velocity (adjust depth [Y] so that Z_{REQ} and Z_{AV} are equal).

Y	Manning's n	A	P	R	Z_{REQ}	Z_{AV}
0.340	0.03	1.31	4.84	0.27	0.55	0.55

Velocity (ft/s)	V/R
6.1	22.6

- Calculate shear stress and compare to permissible shear stress for the desired temporary liner

Shear Stress T = yds T = shear stress in lb/sf; y = U.W. of H_2O (62.4 lb/cf); d = flow depth (ft); s = channel gradient

Calculated		Permissible	
1.8	<	2	**ok**

6.0 Recommendations and Conclusions

- Summarize calculations and recommended channel characteristics

0.5	= Maximum Flow Depth (Y, feet)
8.0	= Maximum Velocity (feet per second)
3.0	= Channel Bottom Width (B, feet)
2.0	= Channel Side Slope (M_1)
3.0	= Channel Side Slope (M_2)
1.0	= Recommended Channel Depth (feet)
grass	= Recommended Permanent Channel Lining
Premier Straw/Coconut	= Recommended Temporary Channel Lining

CLIENT	Buncombe County	COMPUTED BY / DATE	MKS 04/27/09
PROJECT	Phase 5 Landfill Operation	CHECKED BY / DATE	- -
DETAIL	Peak Runoff	REVISION NO. / DATE	- -
PROJECT NO.	6447-65973	REVIEWED BY / DATE	- -

Calculation Brief Title: Peak Runoff Calculation

1.0 Objective

The purpose of this calculations is to determine the peak runoff rate for Ponds 10 through 13 for the 25-year, 24-hour design storm event.

2.0 Procedure

1. Determine the drainage areas.
2. Determine the time of concentration and associated rainfall intensity.
3. Determine the runoff coefficient.
4. Calculate the peak runoff rate.

3.0 References / Data Sources

1. Department of Environment and Natural Resources (NCDENR), June 1, 2006, Revised March 2009. Erosion and Sediment Control Planning and Design Manual.

4.0 Assumptions / Limitations

1. Use the SCS TR-55 Method for calculating the time of concentration.
2. Use the Rational Method for calculating the peak runoff rate.

5.0 Calculations

5.1 Determine the Drainage Area

-- Refer to **Attachment # 1** for the drainage basin delineations. **Table 1** below summarizes the contributing drainage a

Table 1 - Drainage Areas

Pond	Drainage Area	
	square-feet	acres
10	983,384	22.58
11	530,177	12.17
12	210,785	4.84
13	1,184,506	27.19

5.2 Determine the Time of Concentration and Associated Rainfall Intensity

-- Refer to **AttachmentS #2** through **#5** for the time of concentration calculations.

-- Identify the corresponding rainfall intensity using the NC E&S Design Manual Table 8.03c.

-- Summarize the times of concentration and corresponding rainfall intensities for each drainage area, shown in

Table 2 - Tc and I

Pond	Time of Concentration (min)	Intensity (in/hr)
10	10.8	6.44
11	7.5	8.09
12	6.8	8.09
13	14.4	6.44

5.0 Calculations [continued]

5.3 Determine the Runoff Coefficients

-- Use Table 8.03b in the NC E&S Design Manual to identify the appropriate runoff coefficients for the land use types representative of the existing land use, shown in **Table 3**.

Table 3 - Runoff Coefficients

Land Use Type	Runoff Coefficient
Newly Graded	0.60
Grassed, Fair Condition	0.35
Wooded	0.20

-- Calculate the weighted runoff coefficient using the various land use types for each drainage area, shown in **Table 4**. Assume that no more than two (2) acres can have waste application without grassed stabilization.

Table 4 - Weighted Runoff Coefficient

Pond	Area by Runoff Coefficient			Weighted Runoff Coefficient
	0.60	0.35	0.20	
10	2	16.7	3.9	0.35
11	2	10.2	0	0.39
12	2	2.8	0	0.45
13	2	21.3	3.9	0.35

5.4 Calculate the Peak Runoff Rate

-- Use the Rational Method to calculate the peak runoff rate for each of the three design storm events, shown in

Rational Method Q = CIA

Q = Peak Runoff Rate (cfs)
C = Rational Coefficient
I = Intensity (in/hr)
A = Drainage Area (acres)

Table 5 - Peak Runoff Rate

Pond	25-year Peak Runoff Rate (cfs)
10	50
11	39
12	18
13	61

6.0 Conclusions

Table 5 in Task 5.4 summarizes the peak runoff rates for the 25-year, 24-hour design storm events for the existing ponds 10 and 11 and proposed ponds 12 and 13.

DRAINAGE AREA DELINEATIONS

CDM Camp Dresser & McKee

DATE _____

SHEET NO.	LOCATION		ATTACHMENT
			1

Client: Buncombe County Project: Solid Waste Facility Task: Stormwater Drainage Plan	Computed By: M. Sloop Date: 3/10/2009 Checked By:

OBJECTIVE

Determine the time of concentration for Pond 10 for existing conditions.

BACKGROUND

Determine the time of concentration using the SCS TR-55 Method. Also included is the Kirpich Method for comparison purposes only. See the attached spreadsheet for the calculation data used for this analysis

Reference: Department of Environment and Natural Resources, Department of Natural Resource Conservation Service (NCDENR-NRCS). June 1986. *Urban Hydrology for Small Watersheds*.

DEVELOPMENT

SCS TR-55 Method

Tc = Sheet + Shallow + Channel + Reservoir + Pipe

Flow Type	Included	Time (min)
Sheet Flow =	yes	6.0
Shallow Flow #1 =	no	0.0
Shallow Flow #2 =	no	0.0
Channel Flow #1 =	yes	1.3
Channel Flow #2 =	yes	2.1
Channel Flow #3 =	yes	1.1
Reservoir Flow =	yes	0.2
Pipe Flow =	yes	0.0
	Tc =	10.8 min

Kirpich Method

	Tc =	7.3 min

RESULTS

Based on the TR-55 method:

Time of Concentration (T_C) = 10.8 min

Client: Buncombe County Project: Solid Waste Facility Task: Stormwater Drainage Plan	Computed By: M. Sloop Date: 3/10/2009 Checked By:

DEVELOPMENT ***(continued)***

INPUT
OUTPUT

Sheet Flow included -> yes

$$T_t = \frac{0.42(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$$

Term			
Mannings n	n =	0.15	
Change in Elevation	H_1 =	2123	ft
	H_2 =	2060	ft
	ΔH =	63	ft
Hydraulic Length	L =	270	ft
Precipitation	P =	5.79	in
Land slope	s =	0.233	ft/ft
	T_t =	6.04	min

Note: Hydraulic Length should be 300 feet or less

Pipe Flow included -> yes

$$T_t = \frac{AL}{Q}$$

Term			
Pipe Diameter:	D =	24	in
Number of Pipes:	N =	1	
Flow Area:	A =	3.14	ft^2
Pipe Lenth:	L =	57	ft
Pipe Flow	Q =	103	ft^3/s
	T_t =	0.03	min

Note: For Q assume full pipe flow

Shallow Concentrated Flow #1 included -> no

$$T_t = \frac{L}{60V}$$

Term			
Change in Elevation	H_1 =		ft
	H_2 =		ft
	ΔH =	0	ft
Hydraulic Length	L =		ft
Watercourse slope	s =	0.000	ft/ft
Average Velocity	V =		ft/s
	T_t =	0.00	min

Velocity may be attained by using the Watercourse slope vs. Average velocity chart

Shallow Concentrated Flow #2 included -> no

$$T_t = \frac{L}{60V}$$

Term			
Change in Elevation	H_1 =		ft
	H_2 =		ft
	ΔH =	0	ft
Hydraulic Length	L =		ft
Watercourse slope	s =	0.000	ft/ft
Average Velocity	V =		ft/s
	T_t =	0.00	min

Velocity may be attained by using the Watercourse slope vs. Average velocity chart

Reservoir flow included -> yes

$$T_t = \frac{L}{60V}$$

Term			
Avg. Reservoir Depth	D_M =	4	ft
Average Velocity	V_W =	11.35	ft/s
Hydraulic Length	L =	156	ft
	T_t =	0.23	min

Note: $V_W = \sqrt{gDM}$

Client: Buncombe County Project: Solid Waste Facility Task: Stormwater Drainage Plan	Computed By: M. Sloop Date: 3/10/2009 Checked By:

DEVELOPMENT ***(continued)***

INPUT
OUTPUT

Channel Flow #1		included ->	yes
	$T_t =$	$\frac{L}{60V}$	
Term			
Change in Elevation	$H_1 =$	2060	ft
	$H_2 =$	2053	ft
	$\Delta H =$	7	ft
Hydraulic Length	L =	336	ft
Watercourse slope	s =	0.02	ft/ft
Average Velocity	V =	4.19	ft/s
	$T_t =$	1.34	min

Velocity may be attained by using mannings equation

Channel Flow #2		included ->	yes
	$T_t =$	$\frac{L}{60V}$	
Term			
Change in Elevation	$H_1 =$	2052	ft
	$H_2 =$	2012	ft
	$\Delta H =$	40	ft
Hydraulic Length	L =	803	ft
Watercourse slope	s =	0.05	ft/ft
Average Velocity	V =	6.48	ft/s
	$T_t =$	2.06	min

Velocity may be attained by using mannings equation

Channel Flow #3		included ->	yes
	$T_t =$	$\frac{L}{60V}$	
Term			
Change in Elevation	$H_1 =$	2012	ft
	$H_2 =$	1938	ft
	$\Delta H =$	74	ft
Hydraulic Length	L =	495	ft
Watercourse slope	s =	0.15	ft/ft
Average Velocity	V =	7.35	ft/s
	$T_t =$	1.12	min

Velocity may be attained by using mannings equation

Client: Buncombe County Project: Solid Waste Facility Task: Stormwater Drainage Plan	Computed By: M. Sloop Date: 3/10/2009 Checked By:

DEVELOPMENT ***(continued)***

INPUT
OUTPUT

Mannings -- Channel #1 Velocity

$$V = \frac{1.49 r^{2/3} s^{1/2}}{n}$$

Term			
Mannings	n =	0.03	
Channel Bottom Wid	B =	0	ft
Channel Depth	Y =	1.0	ft
Channel Slope	M_1 =	2	ft/ft
Channel Slope	M_2 =	2	ft/ft
Watercourse Slope	s =	0.02	ft/ft
Hydraulic Radius	R =	0.45	ft
Cross-Sectional Area	A =	2	ft^2
Wetted Perimeter	P =	4.47	ft
Channel Velocity	V =	4.19	ft/s

Note: Hydraulic Radius R = A/P

Mannings -- Channel #2 Velocity

$$V = \frac{1.49 r^{2/3} s^{1/2}}{n}$$

Term			
Mannings	n =	0.03	
Channel Bottom Wid	B =	0	ft
Channel Depth	Y =	1.0	ft
Channel Slope	M_1 =	2	ft/ft
Channel Slope	M_2 =	2	ft/ft
Watercourse Slope	s =	0.05	ft/ft
Hydraulic Radius	R =	0.45	ft
Cross-Sectional Area	A =	2	ft^2
Wetted Perimeter	P =	4.47	ft
Channel Velocity	V =	6.48	ft/s

Note: Hydraulic Radius R = A/P

Mannings -- Channel #3 Velocity

$$V = \frac{1.49 r^{2/3} s^{1/2}}{n}$$

Term			
Mannings	n =	0.06	
Channel Bottom Wid	B =	3	ft
Channel Depth	Y =	1.0	ft
Channel Slope	M_1 =	2	ft/ft
Channel Slope	M_2 =	2	ft/ft
Watercourse Slope	s =	0.15	ft/ft
Hydraulic Radius	R =	0.67	ft
Cross-Sectional Area	A =	5	ft^2
Wetted Perimeter	P =	7.47	ft
Channel Velocity	V =	7.35	ft/s

Note: Hydraulic Radius R = A/P

Kirpich Equation

$$T_c = \frac{(L^3/H)^{.385}}{128}$$

Term			
Hydraulic Length	L=	2117	ft
Change in Elevation	ΔH =	185	ft
Flow Factor	K=	1	factor
	T_c =	7.3	min

Client: Buncombe County Project: Solid Waste Facility Task: Stormwater Drainage Plan	Computed By: M. Sloop Date: 3/10/2009 Checked By:

OBJECTIVE

Determine the time of concentration for Pond 11 for existing conditions.

BACKGROUND

Determine the time of concentration using the SCS TR-55 Method. Also included is the Kirpich Method for comparison purposes only. See the attached spreadsheet for the calculation data used for this analysis

Reference: Department of Environment and Natural Resources, Department of Natural Resource Conservation Service (NCDENR-NRCS). June 1986. *Urban Hydrology for Small Watersheds*.

DEVELOPMENT

SCS TR-55 Method

Tc = Sheet + Shallow + Channel + Reservoir + Pipe

Flow Type	Included	Time (min)
Sheet Flow =	yes	5.6
Shallow Flow #1 =	no	0.0
Shallow Flow #2 =	no	0.0
Channel Flow #1 =	yes	1.1
Channel Flow #2 =	yes	0.6
Channel Flow #3 =	no	0.0
Reservoir Flow =	yes	0.2
Pipe Flow =	no	0.0

Tc =	7.5	min

Kirpich Method

Tc =	1.3	min

RESULTS

Based on the TR-55 method:

Time of Concentration (T_C) = 7.5 min

Client: Buncombe County Project: Solid Waste Facility Task: Stormwater Drainage Plan	Computed By: M. Sloop Date: 3/10/2009 Checked By:

DEVELOPMENT ***(continued)***

INPUT
OUTPUT

Sheet Flow included -> yes

$$T_t = \frac{0.42(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$$

Term			
Mannings n	n =	0.15	
Change in Elevation	H_1 =	2123	ft
	H_2 =	2066	ft
	ΔH =	57	ft
Hydraulic Length	L =	244	ft
Precipitation	P =	5.79	in
Land slope	s =	0.234	ft/ft
	T_t =	5.56	min

Note: Hydraulic Length should be 300 feet or less

Pipe Flow included -> no

$$T_t = \frac{AL}{Q}$$

Term			
Pipe Diameter:	D =		in
Number of Pipes:	N =		
Flow Area:	A =	0.00	ft^2
Pipe Lenth:	L =		ft
Pipe Flow	Q =	#DIV/0!	ft^3/s
	T_t =	0.00	min

Note: For Q assume full pipe flow

Shallow Concentrated Flow #1 included -> no

$$T_t = \frac{L}{60V}$$

Term			
Change in Elevation	H_1 =		ft
	H_2 =		ft
	ΔH =	0	ft
Hydraulic Length	L =		ft
Watercourse slope	s =	0.000	ft/ft
Average Velocity	V =		ft/s
	T_t =	0.00	min

Velocity may be attained by using the Watercourse slope vs. Average velocity chart

Shallow Concentrated Flow #2 included -> no

$$T_t = \frac{L}{60V}$$

Term			
Change in Elevation	H_1 =		ft
	H_2 =		ft
	ΔH =	0	ft
Hydraulic Length	L =		ft
Watercourse slope	s =	0.000	ft/ft
Average Velocity	V =		ft/s
	T_t =	0.00	min

Velocity may be attained by using the Watercourse slope vs. Average velocity chart

Reservoir flow included -> yes

$$T_t = \frac{L}{60V}$$

Term			
Avg. Reservoir Dept	D_M =	4	ft
Average Velocity	V_W =	11.35	ft/s
Hydraulic Length	L =	156	ft
	T_t =	0.23	min

Note: $V_W = \sqrt{gDM}$

Client: Buncombe County Project: Solid Waste Facility Task: Stormwater Drainage Plan	Computed By: M. Sloop Date: 3/10/2009 Checked By:

DEVELOPMENT ***(continued)***

INPUT
OUTPUT

Channel Flow #1		included ->	yes
	$T_t =$	$\frac{L}{60V}$	
Term			
Change in Elevation	$H_1 =$	2066	ft
	$H_2 =$	2052	ft
	$\Delta H =$	14	ft
Hydraulic Length	L =	365	ft
Watercourse slope	s =	0.04	ft/ft
Average Velocity	V =	5.69	ft/s
	$T_t =$	1.07	min

Velocity may be attained by using mannings equation

Channel Flow #2		included ->	yes
	$T_t =$	$\frac{L}{60V}$	
Term			
Change in Elevation	$H_1 =$	2052	ft
	$H_2 =$	1946	ft
	$\Delta H =$	106	ft
Hydraulic Length	L =	318	ft
Watercourse slope	s =	0.33	ft/ft
Average Velocity	V =	8.91	ft/s
	$T_t =$	0.59	min

Velocity may be attained by using mannings equation

Channel Flow #3		included ->	no
	$T_t =$	$\frac{L}{60V}$	
Term			
Change in Elevation	$H_1 =$		ft
	$H_2 =$		ft
	$\Delta H =$	0	ft
Hydraulic Length	L =		ft
Watercourse slope	s =	#DIV/0!	ft/ft
Average Velocity	V =	#DIV/0!	ft/s
	$T_t =$	0.00	min

Velocity may be attained by using mannings equation

Client: Buncombe County Project: Solid Waste Facility Task: Stormwater Drainage Plan	Computed By: M. Sloop Date: 3/10/2009 Checked By:

DEVELOPMENT ***(continued)***

INPUT
OUTPUT

Mannings -- Channel #1 Velocity

$$V = \frac{1.49 r^{2/3} s^{1/2}}{n}$$

Term			
Mannings	n =	0.03	
Channel Bottom Wid	B =	0	ft
Channel Depth	Y =	1.0	ft
Channel Slope	M_1 =	2	ft/ft
Channel Slope	M_2 =	2	ft/ft
Watercourse Slope	s =	0.04	ft/ft
Hydraulic Radius	R =	0.45	ft
Cross-Sectional Area	A =	2	ft^2
Wetted Perimeter	P =	4.47	ft
Channel Velocity	V =	5.69	ft/s

Note: Hydraulic Radius R = A/P

Mannings -- Channel #2 Velocity

$$V = \frac{1.49 r^{2/3} s^{1/2}}{n}$$

Term			
Mannings	n =	0.06	
Channel Bottom Wid	B =	0	ft
Channel Depth	Y =	1.0	ft
Channel Slope	M_1 =	5	ft/ft
Channel Slope	M_2 =	5	ft/ft
Watercourse Slope	s =	0.33	ft/ft
Hydraulic Radius	R =	0.49	ft
Cross-Sectional Area	A =	5	ft^2
Wetted Perimeter	P =	10.20	ft
Channel Velocity	V =	8.91	ft/s

Note: Hydraulic Radius R = A/P

Mannings -- Channel #3 Velocity

$$V = \frac{1.49 r^{2/3} s^{1/2}}{n}$$

Term			
Mannings	n =		
Channel Bottom Wid	B =		ft
Channel Depth	Y =		ft
Channel Slope	M_1 =		ft/ft
Channel Slope	M_2 =		ft/ft
Watercourse Slope	s =	#DIV/0!	ft/ft
Hydraulic Radius	R =	#DIV/0!	ft
Cross-Sectional Area	A =	0	ft^2
Wetted Perimeter	P =	0.00	ft
Channel Velocity	V =	#DIV/0!	ft/s

Note: Hydraulic Radius R = A/P

Kirpich Equation

$$T_c = \frac{(L^3/H)^{.385}}{128}$$

Term			
Hydraulic Length	L=	1083	ft
Change in Elevation	ΔH =	2123	ft
Flow Factor	K=	1	factor
	T_c =	1.3	min

Client: Buncombe County Project: Solid Waste Facility Task: Stormwater Drainage Plan	Computed By: M. Sloop Date: 3/10/2009 Checked By:

OBJECTIVE

Determine the time of concentration for Pond 12 for existing conditions.

BACKGROUND

Determine the time of concentration using the SCS TR-55 Method. Also included is the Kirpich Method for comparison purposes only. See the attached spreadsheet for the calculation data used for this analysis

Reference: Department of Environment and Natural Resources, Department of Natural Resource Conservation Service (NCDENR-NRCS). June 1986. *Urban Hydrology for Small Watershed*

DEVELOPMENT

SCS TR-55 Method

Tc = Sheet + Shallow + Channel + Reservoir + Pipe

Flow Type	Included	Time (min)
Sheet Flow =	yes	4.7
Shallow Flow #1 =	no	0.0
Shallow Flow #2 =	no	0.0
Channel Flow #1 =	yes	1.7
Channel Flow #2 =	yes	0.3
Channel Flow #3 =	no	0.0
Reservoir Flow =	yes	0.1
Pipe Flow =	no	0.0
	Tc =	6.8 min

Kirpich Method

	Tc =	1.3 min

RESULTS

Based on the TR-55 method:

Time of Concentration (T_C) = 6.8 min

Client: Buncombe County Project: Solid Waste Facility Task: Stormwater Drainage Plan	Computed By: M. Sloop Date: 3/10/2009 Checked By:

DEVELOPMENT ***(continued)***

INPUT
OUTPUT

Sheet Flow included -> yes

$$T_t = \frac{0.42(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$$

Term			
Mannings n	n =	0.15	
Change in Elevation	H_1 =	2120.5	ft
	H_2 =	2050	ft
	ΔH =	70.5	ft
Hydraulic Length	L =	229	ft
Precipitation	P =	5.79	in
Land slope	s =	0.308	ft/ft
	T_t =	4.73	min

Note: Hydraulic Length should be 300 feet or less

Pipe Flow included -> no

$$T_t = \frac{AL}{Q}$$

Term			
Pipe Diameter:	D =		in
Number of Pipes:	N =		
Flow Area:	A =	0.00	ft^2
Pipe Lenth:	L =		ft
Pipe Flow	Q =	#DIV/0!	ft^3/s
	T_t =	0.00	min

Note: For Q assume full pipe flow

Shallow Concentrated Flow #1 included -> no

$$T_t = \frac{L}{60V}$$

Term			
Change in Elevation	H_1 =		ft
	H_2 =		ft
	ΔH =	0	ft
Hydraulic Length	L =		ft
Watercourse slope	s =	0.000	ft/ft
Average Velocity	V =		ft/s
	T_t =	0.00	min

Velocity may be attained by using the Watercourse slope vs. Average velocity chart

Shallow Concentrated Flow #2 included -> no

$$T_t = \frac{L}{60V}$$

Term			
Change in Elevation	H_1 =		ft
	H_2 =		ft
	ΔH =	0	ft
Hydraulic Length	L =		ft
Watercourse slope	s =	0.000	ft/ft
Average Velocity	V =		ft/s
	T_t =	0.00	min

Velocity may be attained by using the Watercourse slope vs. Average velocity chart

Reservoir flow included -> yes

$$T_t = \frac{L}{60V}$$

Term			
Avg. Reservoir Depth	D_M =	4	ft
Average Velocity	V_W =	11.35	ft/s
Hydraulic Length	L =	59	ft
	T_t =	0.09	min

Note: $V_W = \sqrt{gDM}$

Client: Buncombe County Project: Solid Waste Facility Task: Stormwater Drainage Plan	Computed By: M. Sloop Date: 3/10/2009 Checked By:

DEVELOPMENT ***(continued)***

INPUT
OUTPUT

Channel Flow #1		included ->	yes
	$T_t =$	$\frac{L}{60V}$	
Term			
Change in Elevation	$H_1 =$	2050	ft
	$H_2 =$	2020	ft
	$\Delta H =$	30	ft
Hydraulic Length	L =	638	ft
Watercourse slope	s =	0.05	ft/ft
Average Velocity	V =	6.30	ft/s
	$T_t =$	1.69	min

Velocity may be attained by using mannings equation

Channel Flow #2		included ->	yes
	$T_t =$	$\frac{L}{60V}$	
Term			
Change in Elevation	$H_1 =$	2020	ft
	$H_2 =$	1968	ft
	$\Delta H =$	52	ft
Hydraulic Length	L =	180	ft
Watercourse slope	s =	0.29	ft/ft
Average Velocity	V =	10.21	ft/s
	$T_t =$	0.29	min

Velocity may be attained by using mannings equation

Channel Flow #3		included ->	no
	$T_t =$	$\frac{L}{60V}$	
Term			
Change in Elevation	$H_1 =$		ft
	$H_2 =$		ft
	$\Delta H =$	0	ft
Hydraulic Length	L =		ft
Watercourse slope	s =	#DIV/0!	ft/ft
Average Velocity	V =	#DIV/0!	ft/s
	$T_t =$	0.00	min

Velocity may be attained by using mannings equation

Client: Buncombe County Project: Solid Waste Facility Task: Stormwater Drainage Plan	Computed By: M. Sloop Date: 3/10/2009 Checked By:

DEVELOPMENT ***(continued)***

INPUT
OUTPUT

Mannings -- Channel #1 Velocity

$$V = \frac{1.49 r^{2/3} s^{1/2}}{n}$$

Term			
Mannings	n =	0.03	
Channel Bottom Wid	B =	0	ft
Channel Depth	Y =	1.0	ft
Channel Slope	M_1 =	2	ft/ft
Channel Slope	M_2 =	2	ft/ft
Watercourse Slope	s =	0.05	ft/ft
Hydraulic Radius	R =	0.45	ft
Cross-Sectional Area	A =	2	ft^2
Wetted Perimeter	P =	4.47	ft
Channel Velocity	V =	6.30	ft/s

Note: Hydraulic Radius R = A/P

Mannings -- Channel #2 Velocity

$$V = \frac{1.49 r^{2/3} s^{1/2}}{n}$$

Term			
Mannings	n =	0.06	
Channel Bottom Wid	B =	3	ft
Channel Depth	Y =	1.0	ft
Channel Slope	M_1 =	2	ft/ft
Channel Slope	M_2 =	2	ft/ft
Watercourse Slope	s =	0.29	ft/ft
Hydraulic Radius	R =	0.67	ft
Cross-Sectional Area	A =	5	ft^2
Wetted Perimeter	P =	7.47	ft
Channel Velocity	V =	10.21	ft/s

Note: Hydraulic Radius R = A/P

Mannings -- Channel #3 Velocity

$$V = \frac{1.49 r^{2/3} s^{1/2}}{n}$$

Term			
Mannings	n =		
Channel Bottom Wid	B =		ft
Channel Depth	Y =		ft
Channel Slope	M_1 =		ft/ft
Channel Slope	M_2 =		ft/ft
Watercourse Slope	s =	#DIV/0!	ft/ft
Hydraulic Radius	R =	#DIV/0!	ft
Cross-Sectional Area	A =	0	ft^2
Wetted Perimeter	P =	0.00	ft
Channel Velocity	V =	#DIV/0!	ft/s

Note: Hydraulic Radius R = A/P

Kirpich Equation

$$T_c = \frac{(L^3/H)^{.385}}{128}$$

Term			
Hydraulic Length	L=	1106	ft
Change in Elevation	ΔH =	2120.5	ft
Flow Factor	K=	1	factor
	T_c =	1.3	min

/s .

Client: Buncombe County Project: Solid Waste Facility Task: Stormwater Drainage Plan	Computed By: M. Sloop Date: 3/10/2009 Checked By:

OBJECTIVE

Determine the time of concentration for Pond 13 for existing conditions.

BACKGROUND

Determine the time of concentration using the SCS TR-55 Method. Also included is the Kirpich Method for comparison purposes only. See the attached spreadsheet for the calculation data used for this analysis

Reference: Department of Environment and Natural Resources, Department of Natural Resource Conservation Service (NCDENR-NRCS). June 1986. *Urban Hydrology for Small Watershed*

DEVELOPMENT

SCS TR-55 Method

Tc = Sheet + Shallow + Channel + Reservoir + Pipe

Flow Type	Included	Time (min)
Sheet Flow =	yes	11.0
Shallow Flow #1 =	yes	1.8
Shallow Flow #2 =	no	0.0
Channel Flow #1 =	yes	1.0
Channel Flow #2 =	yes	0.3
Channel Flow #3 =	no	0.0
Reservoir Flow =	yes	0.3
Pipe Flow =	no	0.0
	Tc =	14.4 min

Kirpich Method

Tc = 2.1 min

RESULTS

Based on the TR-55 method:

Time of Concentration (T_C) = 14.4 min

Client: Buncombe County Project: Solid Waste Facility Task: Stormwater Drainage Plan	Computed By: M. Sloop Date: 3/10/2009 Checked By:

DEVELOPMENT ***(continued)***

INPUT
OUTPUT

Sheet Flow included -> yes

$$T_t = \frac{0.42(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$$

Term			
Mannings n	n =	0.35	
Change in Elevation	H_1 =	2120.5	ft
	H_2 =	2060	ft
	ΔH =	60.5	ft
Hydraulic Length	L =	250	ft
Precipitation	P =	5.79	in
Land slope	s =	0.242	ft/ft
	T_t =	11.02	min

Note: Hydraulic Length should be 300 feet or less

Pipe Flow included -> no

$$T_t = \frac{AL}{Q}$$

Term			
Pipe Diameter:	D =		in
Number of Pipes:	N =		
Flow Area:	A =	0.00	ft^2
Pipe Lenth:	L =		ft
Pipe Flow	Q =	#DIV/0!	ft^3/s
	T_t =	0.00	min

Note: For Q assume full pipe flow

Shallow Concentrated Flow #1 included -> yes

$$T_t = \frac{L}{60V}$$

Term			
Change in Elevation	H_1 =	2060	ft
	H_2 =	1978	ft
	ΔH =	82	ft
Hydraulic Length	L =	533	ft
Watercourse slope	s =	0.154	ft/ft
Average Velocity	V =	5	ft/s
	T_t =	1.78	min

Velocity may be attained by using the Watercourse slope vs. Average velocity chart

Shallow Concentrated Flow #2 included -> no

$$T_t = \frac{L}{60V}$$

Term			
Change in Elevation	H_1 =		ft
	H_2 =		ft
	ΔH =	0	ft
Hydraulic Length	L =		ft
Watercourse slope	s =	0.000	ft/ft
Average Velocity	V =		ft/s
	T_t =	0.00	min

Velocity may be attained by using the Watercourse slope vs. Average velocity chart

Reservoir flow included -> yes

$$T_t = \frac{L}{60V}$$

Term			
Avg. Reservoir Dept	D_M =	4	ft
Average Velocity	V_W =	11.35	ft/s
Hydraulic Length	L =	183	ft
	T_t =	0.27	min

Note: $V_W = \sqrt{gDM}$

Client: Buncombe County Project: Solid Waste Facility Task: Stormwater Drainage Plan	Computed By: M. Sloop Date: 3/10/2009 Checked By:

DEVELOPMENT ***(continued)***

INPUT
OUTPUT

Channel Flow #1		included ->	yes
	T_t =	$\frac{L}{60V}$	
Term			
Change in Elevation	H_1 =	1978	ft
	H_2 =	1890	ft
	ΔH =	88	ft
Hydraulic Length	L =	511	ft
Watercourse slope	s =	0.17	ft/ft
Average Velocity	V =	8.15	ft/s
	T_t =	1.04	min

Velocity may be attained by using mannings equation

Channel Flow #2		included ->	yes
	T_t =	$\frac{L}{60V}$	
Term			
Change in Elevation	H_1 =	2020	ft
	H_2 =	1968	ft
	ΔH =	52	ft
Hydraulic Length	L =	180	ft
Watercourse slope	s =	0.29	ft/ft
Average Velocity	V =	10.21	ft/s
	T_t =	0.29	min

Velocity may be attained by using mannings equation

Channel Flow #3		included ->	no
	T_t =	$\frac{L}{60V}$	
Term			
Change in Elevation	H_1 =		ft
	H_2 =		ft
	ΔH =	0	ft
Hydraulic Length	L =		ft
Watercourse slope	s =	#DIV/0!	ft/ft
Average Velocity	V =	#DIV/0!	ft/s
	T_t =	0.00	min

Velocity may be attained by using mannings equation

Client: Buncombe County Project: Solid Waste Facility Task: Stormwater Drainage Plan	Computed By: M. Sloop Date: 3/10/2009 Checked By:

DEVELOPMENT ***(continued)***

INPUT
OUTPUT

Mannings -- Channel #1 Velocity

$$V = \frac{1.49 r^{2/3} s^{1/2}}{n}$$

Term			
Mannings	n =	0.03	
Channel Bottom Wid	B =	3	ft
Channel Depth	Y =	0.3	ft
Channel Slope	M_1 =	2	ft/ft
Channel Slope	M_2 =	2	ft/ft
Watercourse Slope	s =	0.17	ft/ft
Hydraulic Radius	R =	0.25	ft
Cross-Sectional Area	A =	1.08	ft^2
Wetted Perimeter	P =	4.34	ft
Channel Velocity	V =	8.15	ft/s

Note: Hydraulic Radius R = A/P

Mannings -- Channel #2 Velocity

$$V = \frac{1.49 r^{2/3} s^{1/2}}{n}$$

Term			
Mannings	n =	0.06	
Channel Bottom Wid	B =	3	ft
Channel Depth	Y =	1.0	ft
Channel Slope	M_1 =	2	ft/ft
Channel Slope	M_2 =	2	ft/ft
Watercourse Slope	s =	0.29	ft/ft
Hydraulic Radius	R =	0.67	ft
Cross-Sectional Area	A =	5	ft^2
Wetted Perimeter	P =	7.47	ft
Channel Velocity	V =	10.21	ft/s

Note: Hydraulic Radius R = A/P

Mannings -- Channel #3 Velocity

$$V = \frac{1.49 r^{2/3} s^{1/2}}{n}$$

Term			
Mannings	n =		
Channel Bottom Wid	B =		ft
Channel Depth	Y =		ft
Channel Slope	M_1 =		ft/ft
Channel Slope	M_2 =		ft/ft
Watercourse Slope	s =	#DIV/0!	ft/ft
Hydraulic Radius	R =	#DIV/0!	ft
Cross-Sectional Area	A =	0	ft^2
Wetted Perimeter	P =	0.00	ft
Channel Velocity	V =	#DIV/0!	ft/s

Note: Hydraulic Radius R = A/P

Kirpich Equation

$$T_c = \frac{(L^3/H)^{.385}}{128}$$

Term			
Hydraulic Length	L=	1657	ft
Change in Elevation	ΔH =	2120.5	ft
Flow Factor	K=	1	factor
	T_c =	2.1	min

/s .

CDM	CLIENT	Buncombe County	COMPUTED BY / DATE	MKS 04/30/09
	PROJECT	Landfill Operation	CHECKED BY / DATE	- -
	DETAIL	Pond Routing Summary	REVISION NO. / DATE	- -
	PROJECT NO.	6447-65973	REVIEWED BY / DATE	- -

Calculation Brief Title: Pond Routing Summary

1.0 Objective

The purpose of this calculation spreadsheet is to summarize the results of the pond routings for the two existing ponds 10 and 11 and two proposed ponds 12 and 13 for the 25-year, 24-hour design storm events

2.0 Procedure

1. Summarize the results of the pond routings.

3.0 References / Data Sources

1. See **Attachment #1** for the drainage basin delineations.
2. See **Attachments #2** through **#4** for the detailed pond routing calculations

4.0 Assumptions / Limitations

1. Evaluate the 25-year, 24-hour design storm event.
2.

5.0 Calculations

5.1 Calculations/Sketch:

- Refer to **Attachments # 2** through **#4**.

6.0 Conclusions

Pond	Drainage Area (acres)	Peak Flow (cfs)	Principal Spillway Elevation (ft)	Emergency Spillway Elevation (ft)	Dam Crest Elevation (ft)	Peak Discharge (cfs)	Design Storm Elevation (ft)	Freeboard (ft)
10	22.6	50	1936	1940	1942	31	1939.1	2.9
11	12.2	39	1946	1950	1952	13	1947.9	4.1
12	4.8	18	1967	1968	1970	16	1968.1	1.9
13	27.2	61	1887.75	1888.75	1890	51	1889	1.0

DRAINAGE AREA DELINEATIONS

CDM Camp Dresser & McKee

DATE _____

SHEET NO.	LOCATION		ATTACHMENT
			1

Client:	Buncombe County
Project:	Landfill Operation
Task:	Pond Routing

Computed By:	M. Sloop
Date:	4/30/2009
Checked By:	

OBJECTIVE

Check the Pond 10 design for the 25-year, 24-hour design storm event.

BACKGROUND

Routing perfomed by the chainsaw method as outlined by HR Malcom, PE, Ph.D, NCSU

Parameters input by the user.

DEVELOPMENT

SYSTEM PARAMETERS

Time Step (minutes)	1.0

Riser Barrel Spillway

Weir Configuration:	CMP Riser
Weir Diameter (inches):	36
Weir Length (feet):	9.42
Weir Area (square feet):	7.07
Weir Coefficient	3.00
Discharge Coefficient:	0.60
Crest Elevation:	1936.0
Barrel Configuration:	CMP Barrel
Barrel Diameter (inches):	18
Discharge Coefficient	0.59
Number of Barrels	1
Barrel Invert In	1924.9

Emergency Spillway

Weir Configuration:	Concrete
Weir Length (feet):	80.0
ES Crest Elevation:	1940.00
Weir Coefficient:	3.00

Sharp Crested Weir Spillway

Weir Configuration:	Sharp Crested
Weir Length (feet):	0.0
Crest Elevation:	0.0
Weir Coefficient:	0.00

Circular Culvert / Low Level Outlet

Conduit Configuration:	CMP Barrel
Conduit Diameter (inches):	0
Number of Conduits:	0
Discharge Coefficient:	0
Effective Flow Area (ratio):	0
Conduit Invert In	0

Design Settling Particle

D_{15} (Microns) =	40
Specific Gravity	2.6
Number of effective cells	2
V_{SET} (fps) =	4.01E-03

ROUTING CONTROL & RESULTS

Return Period	25	years	Pond Invert EL	1930.0	feet	Max principal flow	31	cfs
Peak Runoff	50.4	cfs	Pond Crest EL	1942.0	feet	ES Max Discharge	0	cfs
Precipitation	5.79	inches	Initial WS EL	1930.0	feet	ES Depth of Flow	0.00	feet
Drainage Area	22.6	acres	Max Stage EL	1939.1	feet	ES Max Velocity	0.00	fps
Min Sett Eff		percent	Max Storage	3.7	acre-feet			
Ks =	11244		Max Stage	9.08	feet			
b =	1.21							

TIME	INFLOW	STORAGE	STAGE	OUTFLOW	CULVERT/ LOW LEVEL	RISER WEIR	RISER ORIFICE	BARREL ORIFICE	OVERFLOW WEIR	ES WEIR
(min)	(cfs)	(cf)	(ft)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
0	0.0	0	0.00	0.0	0.0	0.0	0.0	17.4	0.0	0.0
1.0	0.0	0	0.00	0.0	0.0	0.0	0.0	17.4	0.0	0.0
2.0	0.1	1	0.00	0.0	0.0	0.0	0.0	17.4	0.0	0.0
3.0	0.1	4	0.00	0.0	0.0	0.0	0.0	17.4	0.0	0.0
4.0	0.2	12	0.00	0.0	0.0	0.0	0.0	17.4	0.0	0.0
5.0	0.4	25	0.01	0.0	0.0	0.0	0.0	17.4	0.0	0.0
6.0	0.5	46	0.01	0.0	0.0	0.0	0.0	17.4	0.0	0.0
7.0	0.7	77	0.02	0.0	0.0	0.0	0.0	17.5	0.0	0.0
8.0	0.9	118	0.02	0.0	0.0	0.0	0.0	17.5	0.0	0.0
9.0	1.1	172	0.03	0.0	0.0	0.0	0.0	17.5	0.0	0.0
10.0	1.4	240	0.04	0.0	0.0	0.0	0.0	17.5	0.0	0.0
11.0	1.7	323	0.05	0.0	0.0	0.0	0.0	17.5	0.0	0.0
12.0	2.0	424	0.07	0.0	0.0	0.0	0.0	17.6	0.0	0.0
13.0	2.3	544	0.08	0.0	0.0	0.0	0.0	17.6	0.0	0.0
14.0	2.7	685	0.10	0.0	0.0	0.0	0.0	17.6	0.0	0.0

TIME	INFLOW	STORAGE	STAGE	OUTFLOW	CULVERT/ LOW LEVEL	RISER WEIR	RISER ORIFICE	BARREL ORIFICE	OVERFLOW WEIR	ES WEIR
(min)	(cfs)	(cf)	(ft)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
15.0	3.1	848	0.12	0.0	0.0	0.0	0.0	17.7	0.0	0.0
16.0	3.5	1034	0.14	0.0	0.0	0.0	0.0	17.7	0.0	0.0
17.0	4.0	1245	0.16	0.0	0.0	0.0	0.0	17.7	0.0	0.0
18.0	4.4	1483	0.19	0.0	0.0	0.0	0.0	17.8	0.0	0.0
19.0	4.9	1748	0.21	0.0	0.0	0.0	0.0	17.8	0.0	0.0
20.0	5.4	2043	0.24	0.0	0.0	0.0	0.0	17.9	0.0	0.0
21.0	6.0	2369	0.27	0.0	0.0	0.0	0.0	18.0	0.0	0.0
22.0	6.5	2726	0.31	0.0	0.0	0.0	0.0	18.0	0.0	0.0
23.0	7.1	3117	0.34	0.0	0.0	0.0	0.0	18.1	0.0	0.0
24.0	7.7	3542	0.38	0.0	0.0	0.0	0.0	18.2	0.0	0.0
25.0	8.3	4004	0.42	0.0	0.0	0.0	0.0	18.3	0.0	0.0
26.0	8.9	4502	0.47	0.0	0.0	0.0	0.0	18.3	0.0	0.0
27.0	9.6	5038	0.51	0.0	0.0	0.0	0.0	18.4	0.0	0.0
28.0	10.3	5613	0.56	0.0	0.0	0.0	0.0	18.5	0.0	0.0
29.0	10.9	6229	0.61	0.0	0.0	0.0	0.0	18.6	0.0	0.0
30.0	11.6	6885	0.67	0.0	0.0	0.0	0.0	18.7	0.0	0.0
31.0	12.4	7584	0.72	0.0	0.0	0.0	0.0	18.8	0.0	0.0
32.0	13.1	8326	0.78	0.0	0.0	0.0	0.0	18.9	0.0	0.0
33.0	13.8	9112	0.84	0.0	0.0	0.0	0.0	19.0	0.0	0.0
34.0	14.6	9942	0.90	0.0	0.0	0.0	0.0	19.1	0.0	0.0
35.0	15.4	10818	0.97	0.0	0.0	0.0	0.0	19.3	0.0	0.0
36.0	16.2	11740	1.04	0.0	0.0	0.0	0.0	19.4	0.0	0.0
37.0	16.9	12710	1.11	0.0	0.0	0.0	0.0	19.5	0.0	0.0
38.0	17.7	13726	1.18	0.0	0.0	0.0	0.0	19.6	0.0	0.0
39.0	18.6	14791	1.26	0.0	0.0	0.0	0.0	19.8	0.0	0.0
40.0	19.4	15904	1.33	0.0	0.0	0.0	0.0	19.9	0.0	0.0
41.0	20.2	17066	1.41	0.0	0.0	0.0	0.0	20.1	0.0	0.0
42.0	21.0	18278	1.50	0.0	0.0	0.0	0.0	20.2	0.0	0.0
43.0	21.9	19539	1.58	0.0	0.0	0.0	0.0	20.3	0.0	0.0
44.0	22.7	20850	1.67	0.0	0.0	0.0	0.0	20.5	0.0	0.0
45.0	23.5	22212	1.76	0.0	0.0	0.0	0.0	20.6	0.0	0.0
46.0	24.4	23623	1.85	0.0	0.0	0.0	0.0	20.8	0.0	0.0
47.0	25.2	25086	1.95	0.0	0.0	0.0	0.0	21.0	0.0	0.0
48.0	26.1	26599	2.04	0.0	0.0	0.0	0.0	21.1	0.0	0.0
49.0	26.9	28162	2.14	0.0	0.0	0.0	0.0	21.3	0.0	0.0
50.0	27.7	29776	2.24	0.0	0.0	0.0	0.0	21.5	0.0	0.0
51.0	28.6	31440	2.35	0.0	0.0	0.0	0.0	21.6	0.0	0.0
52.0	29.4	33155	2.45	0.0	0.0	0.0	0.0	21.8	0.0	0.0
53.0	30.2	34919	2.56	0.0	0.0	0.0	0.0	22.0	0.0	0.0
54.0	31.1	36733	2.67	0.0	0.0	0.0	0.0	22.1	0.0	0.0
55.0	31.9	38597	2.78	0.0	0.0	0.0	0.0	22.3	0.0	0.0
56.0	32.7	40509	2.90	0.0	0.0	0.0	0.0	22.5	0.0	0.0
57.0	33.5	42470	3.01	0.0	0.0	0.0	0.0	22.7	0.0	0.0
58.0	34.3	44480	3.13	0.0	0.0	0.0	0.0	22.8	0.0	0.0
59.0	35.1	46536	3.25	0.0	0.0	0.0	0.0	23.0	0.0	0.0
60.0	35.8	48640	3.37	0.0	0.0	0.0	0.0	23.2	0.0	0.0
61.0	36.6	50789	3.49	0.0	0.0	0.0	0.0	23.4	0.0	0.0
62.0	37.3	52984	3.62	0.0	0.0	0.0	0.0	23.6	0.0	0.0
63.0	38.1	55224	3.75	0.0	0.0	0.0	0.0	23.8	0.0	0.0
64.0	38.8	57508	3.87	0.0	0.0	0.0	0.0	24.0	0.0	0.0
65.0	39.5	59835	4.00	0.0	0.0	0.0	0.0	24.1	0.0	0.0
66.0	40.2	62204	4.13	0.0	0.0	0.0	0.0	24.3	0.0	0.0
67.0	40.8	64614	4.27	0.0	0.0	0.0	0.0	24.5	0.0	0.0
68.0	41.5	67065	4.40	0.0	0.0	0.0	0.0	24.7	0.0	0.0
69.0	42.1	69554	4.54	0.0	0.0	0.0	0.0	24.9	0.0	0.0
70.0	42.7	72082	4.67	0.0	0.0	0.0	0.0	25.1	0.0	0.0
71.0	43.3	74647	4.81	0.0	0.0	0.0	0.0	25.3	0.0	0.0
72.0	43.9	77247	4.95	0.0	0.0	0.0	0.0	25.5	0.0	0.0
73.0	44.5	79882	5.09	0.0	0.0	0.0	0.0	25.7	0.0	0.0
74.0	45.0	82550	5.23	0.0	0.0	0.0	0.0	25.9	0.0	0.0
75.0	45.5	85250	5.37	0.0	0.0	0.0	0.0	26.0	0.0	0.0
76.0	46.0	87981	5.51	0.0	0.0	0.0	0.0	26.2	0.0	0.0
77.0	46.5	90741	5.65	0.0	0.0	0.0	0.0	26.4	0.0	0.0
78.0	46.9	93529	5.80	0.0	0.0	0.0	0.0	26.6	0.0	0.0
79.0	47.3	96344	5.94	0.0	0.0	0.0	0.0	26.8	0.0	0.0

TIME	INFLOW	STORAGE	STAGE	OUTFLOW	CULVERT/ LOW LEVEL	RISER WEIR	RISER ORIFICE	BARREL ORIFICE	OVERFLOW WEIR	ES WEIR
(min)	(cfs)	(cf)	(ft)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
80.0	47.7	99183	6.09	0.7	0.0	0.7	10.1	27.0	0.0	0.0
81.0	48.1	102002	6.23	3.1	0.0	3.1	16.4	27.2	0.0	0.0
82.0	48.4	104699	6.37	6.3	0.0	6.3	20.6	27.3	0.0	0.0
83.0	48.7	107227	6.49	9.8	0.0	9.8	23.9	27.5	0.0	0.0
84.0	49.0	109561	6.61	13.5	0.0	13.5	26.6	27.7	0.0	0.0
85.0	49.3	111691	6.72	17.2	0.0	17.2	28.8	27.8	0.0	0.0
86.0	49.5	113616	6.81	20.8	0.0	20.8	30.7	27.9	0.0	0.0
87.0	49.7	115342	6.90	24.1	0.0	24.1	32.3	28.0	0.0	0.0
88.0	49.9	116878	6.98	27.3	0.0	27.3	33.6	28.1	0.0	0.0
89.0	50.1	118237	7.04	28.2	0.0	30.1	34.8	28.2	0.0	0.0
90.0	50.2	119550	7.11	28.3	0.0	33.0	35.8	28.3	0.0	0.0
91.0	50.3	120865	7.17	28.4	0.0	35.9	36.9	28.4	0.0	0.0
92.0	50.4	122182	7.24	28.4	0.0	38.9	37.9	28.4	0.0	0.0
93.0	50.4	123498	7.30	28.5	0.0	42.0	38.8	28.5	0.0	0.0
94.0	50.4	124812	7.37	28.6	0.0	45.2	39.8	28.6	0.0	0.0
95.0	50.4	126122	7.43	28.7	0.0	48.4	40.7	28.7	0.0	0.0
96.0	50.4	127427	7.49	28.8	0.0	51.7	41.6	28.8	0.0	0.0
97.0	50.3	128724	7.56	28.8	0.0	55.0	42.5	28.8	0.0	0.0
98.0	50.2	130013	7.62	28.9	0.0	58.3	43.3	28.9	0.0	0.0
99.0	50.1	131291	7.68	29.0	0.0	61.7	44.1	29.0	0.0	0.0
100.0	49.9	132557	7.74	29.1	0.0	65.1	44.9	29.1	0.0	0.0
101.0	49.7	133809	7.80	29.1	0.0	68.6	45.7	29.1	0.0	0.0
102.0	49.5	135046	7.86	29.2	0.0	72.0	46.5	29.2	0.0	0.0
103.0	49.3	136266	7.92	29.3	0.0	75.4	47.2	29.3	0.0	0.0
104.0	49.0	137468	7.98	29.3	0.0	78.9	47.9	29.3	0.0	0.0
105.0	48.7	138650	8.04	29.4	0.0	82.3	48.6	29.4	0.0	0.0
106.0	48.4	139810	8.09	29.5	0.0	85.7	49.3	29.5	0.0	0.0
107.0	48.1	140948	8.15	29.5	0.0	89.1	49.9	29.5	0.0	0.0
108.0	47.7	142061	8.20	29.6	0.0	92.4	50.5	29.6	0.0	0.0
109.0	47.3	143148	8.25	29.7	0.0	95.7	51.1	29.7	0.0	0.0
110.0	46.9	144209	8.30	29.7	0.0	98.9	51.7	29.7	0.0	0.0
111.0	46.5	145240	8.35	29.8	0.0	102.1	52.2	29.8	0.0	0.0
112.0	46.0	146242	8.40	29.8	0.0	105.2	52.7	29.8	0.0	0.0
113.0	45.5	147212	8.45	29.9	0.0	108.3	53.3	29.9	0.0	0.0
114.0	45.0	148150	8.49	29.9	0.0	111.3	53.7	29.9	0.0	0.0
115.0	44.5	149054	8.54	30.0	0.0	114.2	54.2	30.0	0.0	0.0
116.0	43.9	149922	8.58	30.0	0.0	117.0	54.6	30.0	0.0	0.0
117.0	43.3	150755	8.62	30.1	0.0	119.7	55.1	30.1	0.0	0.0
118.0	42.8	151551	8.65	30.1	0.0	122.3	55.4	30.1	0.0	0.0
119.0	42.2	152311	8.69	30.2	0.0	124.8	55.8	30.2	0.0	0.0
120.0	41.6	153034	8.72	30.2	0.0	127.1	56.2	30.2	0.0	0.0
121.0	41.1	153719	8.76	30.2	0.0	129.4	56.5	30.2	0.0	0.0
122.0	40.5	154368	8.79	30.3	0.0	131.6	56.8	30.3	0.0	0.0
123.0	39.9	154981	8.82	30.3	0.0	133.6	57.1	30.3	0.0	0.0
124.0	39.4	155559	8.84	30.3	0.0	135.6	57.4	30.3	0.0	0.0
125.0	38.9	156102	8.87	30.4	0.0	137.4	57.6	30.4	0.0	0.0
126.0	38.3	156611	8.89	30.4	0.0	139.1	57.9	30.4	0.0	0.0
127.0	37.8	157086	8.92	30.4	0.0	140.8	58.1	30.4	0.0	0.0
128.0	37.3	157528	8.94	30.4	0.0	142.3	58.3	30.4	0.0	0.0
129.0	36.8	157937	8.96	30.5	0.0	143.7	58.5	30.5	0.0	0.0
130.0	36.3	158314	8.97	30.5	0.0	145.0	58.7	30.5	0.0	0.0
131.0	35.8	158660	8.99	30.5	0.0	146.2	58.8	30.5	0.0	0.0
132.0	35.3	158975	9.00	30.5	0.0	147.2	59.0	30.5	0.0	0.0
133.0	34.8	159259	9.02	30.5	0.0	148.2	59.1	30.5	0.0	0.0
134.0	34.3	159513	9.03	30.6	0.0	149.1	59.2	30.6	0.0	0.0
135.0	33.8	159738	9.04	30.6	0.0	149.9	59.3	30.6	0.0	0.0
136.0	33.4	159934	9.05	30.6	0.0	150.6	59.4	30.6	0.0	0.0
137.0	32.9	160101	9.06	30.6	0.0	151.1	59.5	30.6	0.0	0.0
138.0	32.5	160240	9.06	30.6	0.0	151.6	59.6	30.6	0.0	0.0
139.0	32.0	160352	9.07	30.6	0.0	152.0	59.6	30.6	0.0	0.0
140.0	31.6	160437	9.07	30.6	0.0	152.3	59.7	30.6	0.0	0.0
141.0	31.1	160495	9.08	30.6	0.0	152.5	59.7	30.6	0.0	0.0
142.0	30.7	160526	9.08	30.6	0.0	152.6	59.7	30.6	0.0	0.0
143.0	30.3	160532	9.08	30.6	0.0	152.6	59.7	30.6	0.0	0.0
144.0	29.9	160513	9.08	30.6	0.0	152.6	59.7	30.6	0.0	0.0

TIME	INFLOW	STORAGE	STAGE	OUTFLOW	CULVERT/ LOW LEVEL	RISER WEIR	RISER ORIFICE	BARREL ORIFICE	OVERFLOW WEIR	ES WEIR
(min)	(cfs)	(cf)	(ft)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
145.0	29.5	160469	9.07	30.6	0.0	152.4	59.7	30.6	0.0	0.0
146.0	29.1	160400	9.07	30.6	0.0	152.2	59.6	30.6	0.0	0.0
147.0	28.7	160307	9.07	30.6	0.0	151.9	59.6	30.6	0.0	0.0
148.0	28.3	160191	9.06	30.6	0.0	151.5	59.6	30.6	0.0	0.0
149.0	27.9	160051	9.05	30.6	0.0	151.0	59.5	30.6	0.0	0.0
150.0	27.5	159889	9.05	30.6	0.0	150.4	59.4	30.6	0.0	0.0
151.0	27.1	159704	9.04	30.6	0.0	149.8	59.3	30.6	0.0	0.0
152.0	26.7	159497	9.03	30.6	0.0	149.0	59.2	30.6	0.0	0.0
153.0	26.4	159268	9.02	30.5	0.0	148.3	59.1	30.5	0.0	0.0
154.0	26.0	159018	9.01	30.5	0.0	147.4	59.0	30.5	0.0	0.0
155.0	25.7	158747	8.99	30.5	0.0	146.5	58.9	30.5	0.0	0.0
156.0	25.3	158456	8.98	30.5	0.0	145.4	58.8	30.5	0.0	0.0
157.0	25.0	158144	8.97	30.5	0.0	144.4	58.6	30.5	0.0	0.0
158.0	24.6	157812	8.95	30.5	0.0	143.2	58.5	30.5	0.0	0.0
159.0	24.3	157461	8.93	30.4	0.0	142.0	58.3	30.4	0.0	0.0
160.0	23.9	157091	8.92	30.4	0.0	140.8	58.1	30.4	0.0	0.0
161.0	23.6	156702	8.90	30.4	0.0	139.4	57.9	30.4	0.0	0.0
162.0	23.3	156295	8.88	30.4	0.0	138.1	57.7	30.4	0.0	0.0
163.0	23.0	155869	8.86	30.4	0.0	136.6	57.5	30.4	0.0	0.0
164.0	22.7	155426	8.84	30.3	0.0	135.1	57.3	30.3	0.0	0.0
165.0	22.3	154965	8.82	30.3	0.0	133.6	57.1	30.3	0.0	0.0
166.0	22.0	154487	8.79	30.3	0.0	132.0	56.9	30.3	0.0	0.0
167.0	21.7	153992	8.77	30.3	0.0	130.3	56.6	30.3	0.0	0.0
168.0	21.4	153480	8.75	30.2	0.0	128.6	56.4	30.2	0.0	0.0
169.0	21.1	152953	8.72	30.2	0.0	126.9	56.1	30.2	0.0	0.0
170.0	20.9	152409	8.69	30.2	0.0	125.1	55.9	30.2	0.0	0.0
171.0	20.6	151850	8.67	30.1	0.0	123.2	55.6	30.1	0.0	0.0
172.0	20.3	151275	8.64	30.1	0.0	121.4	55.3	30.1	0.0	0.0
173.0	20.0	150685	8.61	30.1	0.0	119.4	55.0	30.1	0.0	0.0
174.0	19.7	150081	8.58	30.0	0.0	117.5	54.7	30.0	0.0	0.0
175.0	19.5	149462	8.56	30.0	0.0	115.5	54.4	30.0	0.0	0.0
176.0	19.2	148829	8.52	30.0	0.0	113.4	54.1	30.0	0.0	0.0
177.0	18.9	148182	8.49	29.9	0.0	111.4	53.8	29.9	0.0	0.0
178.0	18.7	147521	8.46	29.9	0.0	109.3	53.4	29.9	0.0	0.0
179.0	18.4	146847	8.43	29.9	0.0	107.1	53.1	29.9	0.0	0.0
180.0	18.2	146160	8.40	29.8	0.0	105.0	52.7	29.8	0.0	0.0
181.0	17.9	145460	8.36	29.8	0.0	102.8	52.3	29.8	0.0	0.0
182.0	17.7	144747	8.33	29.7	0.0	100.6	52.0	29.7	0.0	0.0
183.0	17.4	144022	8.30	29.7	0.0	98.4	51.6	29.7	0.0	0.0
184.0	17.2	143284	8.26	29.7	0.0	96.1	51.2	29.7	0.0	0.0
185.0	16.9	142535	8.22	29.6	0.0	93.8	50.8	29.6	0.0	0.0
186.0	16.7	141775	8.19	29.6	0.0	91.5	50.3	29.6	0.0	0.0
187.0	16.5	141002	8.15	29.5	0.0	89.2	49.9	29.5	0.0	0.0
188.0	16.3	140219	8.11	29.5	0.0	86.9	49.5	29.5	0.0	0.0
189.0	16.0	139425	8.08	29.4	0.0	84.5	49.0	29.4	0.0	0.0
190.0	15.8	138620	8.04	29.4	0.0	82.2	48.6	29.4	0.0	0.0
191.0	15.6	137805	8.00	29.4	0.0	79.8	48.1	29.4	0.0	0.0
192.0	15.4	136979	7.96	29.3	0.0	77.5	47.6	29.3	0.0	0.0
193.0	15.2	136144	7.92	29.3	0.0	75.1	47.1	29.3	0.0	0.0
194.0	15.0	135298	7.88	29.2	0.0	72.7	46.6	29.2	0.0	0.0
195.0	14.8	134443	7.84	29.2	0.0	70.3	46.1	29.2	0.0	0.0
196.0	14.6	133579	7.79	29.1	0.0	67.9	45.6	29.1	0.0	0.0
197.0	14.4	132706	7.75	29.1	0.0	65.5	45.0	29.1	0.0	0.0
198.0	14.2	131823	7.71	29.0	0.0	63.1	44.5	29.0	0.0	0.0
199.0	14.0	130932	7.67	29.0	0.0	60.8	43.9	29.0	0.0	0.0
200.0	13.8	130032	7.62	28.9	0.0	58.4	43.3	28.9	0.0	0.0

Client:	Buncombe County
Project:	Landfill Operation
Task:	Pond Routing

Computed By:	M. Sloop
Date:	4/30/2009
Checked By:	

SMALL WATERSHED HYDROGRAPH FORMULATION

Return Period	25	years	NOAA g:	
Duration	24	hours	NOAA h:	
Precipitation	5.79	in		
SCS CN	85			

Watershed Flow Characteristics

Watershed Area	22.58	acres
Hydraulic Length:		feet
Maximum Elevation:		
Minimum Elevation:		
Total Relief:	0	feet
Kirpich K:	1	
Time of Concentration	0.0	minutes
Use T_C =	10.8	minutes

Composite C Determination

Land Use	Ci		Ai	Ci*Ai
Wooded	0.2		3.9	0.78
Undisturbed	0.35		20.58	7.203
Disturbed	0.60		2.00	1.2
Pond				0
		Σ	26.48	9.183
			Cc	**0.35**

CALCULATED:

				Calculated	Estimated	Use	
Soil Storage	1.76	inches	Intensity	0.0	6.44	6.4	inches/hour
Runoff Depth	4.10	inches	Discharge	50		50	cfs
Volume of Runoff	108.7	acre-inches					
Time to Peak	94	minutes	Method of Discharge Estimate:			Rational Method	
Use T_P =	94	minutes					

HYDROGRAPH FORMULATION : By step function developed by H.R. Malcom, Ph.D., P.E., North Carolina State University
(Patterned after SCS dimensionless unit hydrograph)

Time (min)	Q (cfs)	Time (min)	Q (cfs)	Time (min)	Q (cfs)	Time (min)	Q (cfs)	Time (min)	Q (cfs)	Time (min)	Q (cfs)
0	0.0	36	16.2	72	43.9	108	47.7	144	29.9	180	18.2
1	0.0	37	16.9	73	44.5	109	47.3	145	29.5	181	17.9
2	0.1	38	17.7	74	45.0	110	46.9	146	29.1	182	17.7
3	0.1	39	18.6	75	45.5	111	46.5	147	28.7	183	17.4
4	0.2	40	19.4	76	46.0	112	46.0	148	28.3	184	17.2
5	0.4	41	20.2	77	46.5	113	45.5	149	27.9	185	16.9
6	0.5	42	21.0	78	46.9	114	45.0	150	27.5	186	16.7
7	0.7	43	21.9	79	47.3	115	44.5	151	27.1	187	16.5
8	0.9	44	22.7	80	47.7	116	43.9	152	26.7	188	16.3
9	1.1	45	23.5	81	48.1	117	43.3	153	26.4	189	16.0
10	1.4	46	24.4	82	48.4	118	42.8	154	26.0	190	15.8
11	1.7	47	25.2	83	48.7	119	42.2	155	25.7	191	15.6
12	2.0	48	26.1	84	49.0	120	41.6	156	25.3	192	15.4
13	2.3	49	26.9	85	49.3	121	41.1	157	25.0	193	15.2
14	2.7	50	27.7	86	49.5	122	40.5	158	24.6	194	15.0
15	3.1	51	28.6	87	49.7	123	39.9	159	24.3	195	14.8
16	3.5	52	29.4	88	49.9	124	39.4	160	23.9	196	14.6
17	4.0	53	30.2	89	50.1	125	38.9	161	23.6	197	14.4
18	4.4	54	31.1	90	50.2	126	38.3	162	23.3	198	14.2
19	4.9	55	31.9	91	50.3	127	37.8	163	23.0	199	14.0
20	5.4	56	32.7	92	50.4	128	37.3	164	22.7	200	13.8
21	6.0	57	33.5	93	50.4	129	36.8	165	22.3		
22	6.5	58	34.3	94	50.4	130	36.3	166	22.0		
23	7.1	59	35.1	95	50.4	131	35.8	167	21.7		
24	7.7	60	35.8	96	50.4	132	35.3	168	21.4		
25	8.3	61	36.6	97	50.3	133	34.8	169	21.1		
26	8.9	62	37.3	98	50.2	134	34.3	170	20.9		
27	9.6	63	38.1	99	50.1	135	33.8	171	20.6		
28	10.3	64	38.8	100	49.9	136	33.4	172	20.3		
29	10.9	65	39.5	101	49.7	137	32.9	173	20.0		
30	11.6	66	40.2	102	49.5	138	32.5	174	19.7		
31	12.4	67	40.8	103	49.3	139	32.0	175	19.5		
32	13.1	68	41.5	104	49.0	140	31.6	176	19.2		
33	13.8	69	42.1	105	48.7	141	31.1	177	18.9		
34	14.6	70	42.7	106	48.4	142	30.7	178	18.7		
35	15.4	71	43.3	107	48.1	143	30.3	179	18.4		

Client:	Buncombe County
Project:	Landfill Operation
Task:	Stage-Storage

Computed By:	M. Sloop
Date:	4/30/2009
Checked By:	

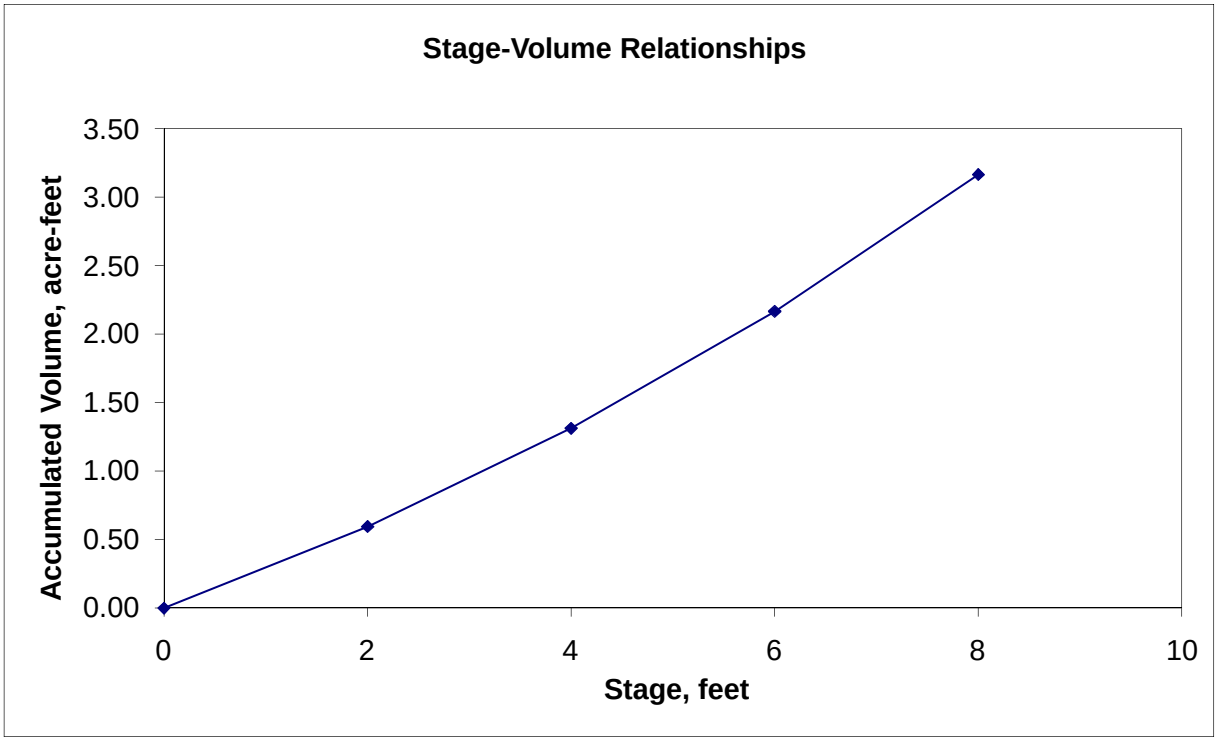
OBJECTIVE
Determine the stage-storage and associated Ks and b values

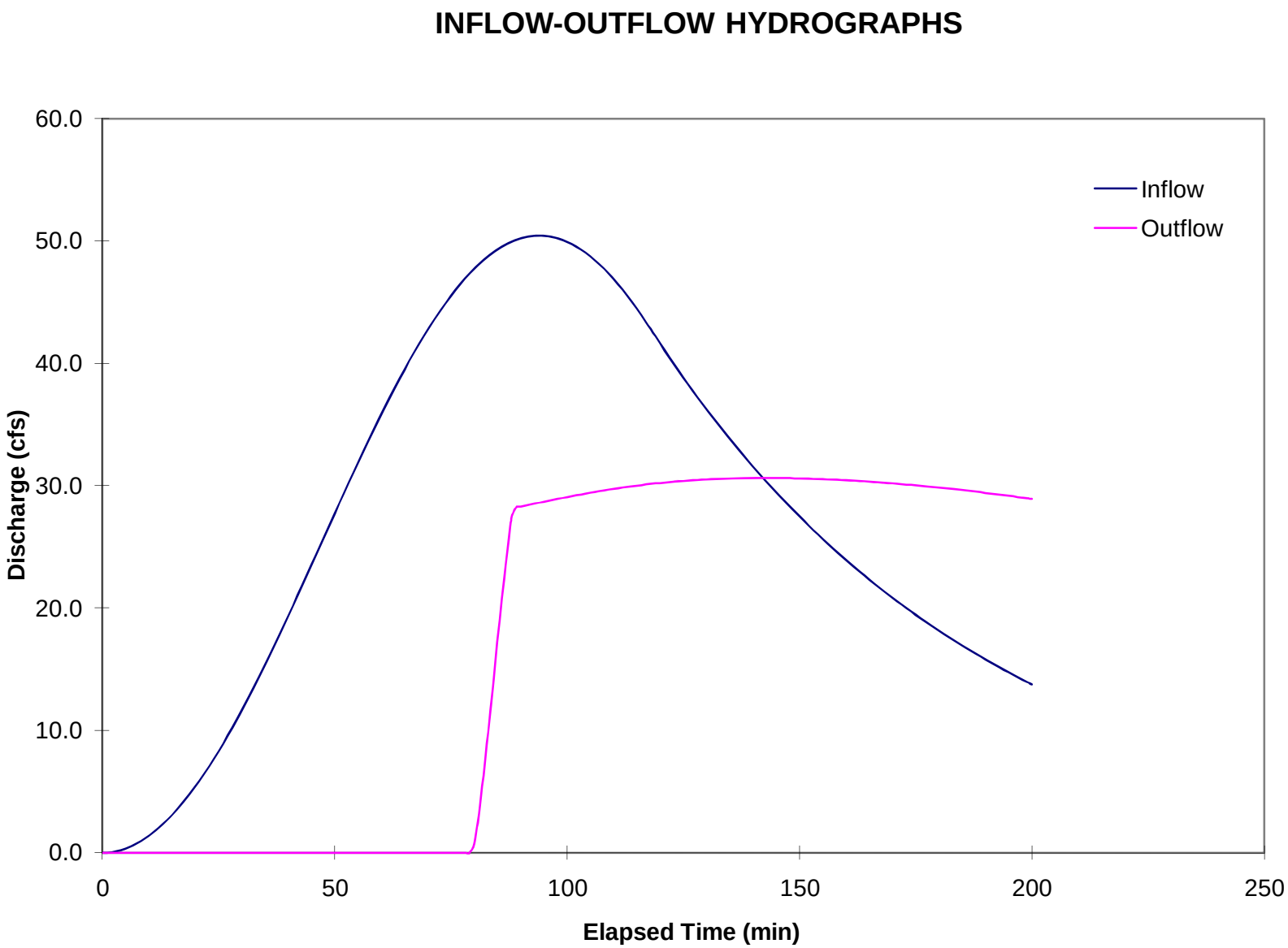
BACKGROUND
Stage-Storage Function obtained from H.R. Malcom CE785 course pack.

DEVELOPMENT

Elevation (ft)	Stage (ft)	Area (sf)	Incr. Vol (cf)	Acc. Vol (cf)	LN S	LN Z	Z est (ft)	Acc. Vol (ac-ft)
1930	0	11,698	0	0	---	---	---	0.00
1932	2	14,229	25,927	25,927	10.2	0.7	2.0	0.60
1934	4	17,040	31,269	57,196	11.0	1.4	3.9	1.31
1936	6	20,107	37,147	94,343	11.5	1.8	5.8	2.17
1938	8	23,403	43,510	137,853	11.8	2.1	8.0	3.16

b=	**1.21**
Ks=	**11244**





CDM

Attachment #2
Inflow-Outflow Hydrograph - Pond 10
Page 1

Client:	Buncombe County	Computed By:	M. Sloop
Project:	Landfill Operation	Date:	4/30/2009
Task:	Pond Routing	Checked By:	

OBJECTIVE

Check the Pond 11 design for the 25-year, 24-hour design storm event.

BACKGROUND

Routing perfomed by the chainsaw method as outlined by HR Malcom, PE, Ph.D, NCSU

Parameters input by the user.

DEVELOPMENT

SYSTEM PARAMETERS

Time Step (minutes)	1.0

Riser Barrel Spillway

Weir Configuration:	CMP Riser
Weir Diameter (inches):	36
Weir Length (feet):	9.42
Weir Area (square feet):	7.07
Weir Coefficient	3.00
Discharge Coefficient:	0.60
Crest Elevation:	1946.0
Barrel Configuration:	CMP Barrel
Barrel Diameter (inches):	12
Discharge Coefficient	0.59
Number of Barrels	1
Barrel Invert In	1935.0

Emergency Spillway

Weir Configuration:	Concrete
Weir Length (feet):	80.0
ES Crest Elevation:	1950.00
Weir Coefficient:	3.00

Sharp Crested Weir Spillway

Weir Configuration:	Sharp Crested
Weir Length (feet):	0.0
Crest Elevation:	0.0
Weir Coefficient:	0.00

Circular Culvert / Low Level Outlet

Conduit Configuration:	CMP Barrel
Conduit Diameter (inches):	0
Number of Conduits:	0
Discharge Coefficient:	0
Effective Flow Area (ratio):	0
Conduit Invert In	0

Design Settling Particle

D_{15} (Microns) =	40
Specific Gravity	2.6
Number of effective cells	2
V_{SET} (fps) =	4.01E-03

ROUTING CONTROL & RESULTS

Return Period	25	years	Pond Invert EL	1936.0	feet	Max principal flow	13	cfs
Peak Runoff	38.5	cfs	Pond Crest EL	1952.0	feet	ES Max Discharge	0	cfs
Precipitation	5.79	inches	Initial WS EL	1938.0	feet	ES Depth of Flow	0.00	feet
Drainage Area	12.2	acres	Max Stage EL	1947.9	feet	ES Max Velocity	0.00	fps
Min Sett Eff	#REF!	percent	Max Storage	2.9	acre-feet			
Ks =	3396		Max Stage	11.89	feet			
b =	1.46							

TIME	INFLOW	STORAGE	STAGE	OUTFLOW	CULVERT/ LOW LEVEL	RISER WEIR	RISER ORIFICE	BARREL ORIFICE	OVERFLOW WEIR	ES WEIR
(min)	(cfs)	(cf)	(ft)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
0	0.0	9316	2.00	0.0	0.0	0.0	0.0	5.9	0.0	0.0
1.0	0.0	9316	2.00	0.0	0.0	0.0	0.0	5.9	0.0	0.0
2.0	0.1	9318	2.00	0.0	0.0	0.0	0.0	5.9	0.0	0.0
3.0	0.3	9325	2.00	0.0	0.0	0.0	0.0	5.9	0.0	0.0
4.0	0.5	9341	2.00	0.0	0.0	0.0	0.0	5.9	0.0	0.0
5.0	0.8	9370	2.01	0.0	0.0	0.0	0.0	5.9	0.0	0.0
6.0	1.1	9416	2.01	0.0	0.0	0.0	0.0	5.9	0.0	0.0
7.0	1.5	9480	2.02	0.0	0.0	0.0	0.0	5.9	0.0	0.0
8.0	1.9	9568	2.04	0.0	0.0	0.0	0.0	5.9	0.0	0.0
9.0	2.4	9683	2.05	0.0	0.0	0.0	0.0	5.9	0.0	0.0
10.0	3.0	9827	2.07	0.0	0.0	0.0	0.0	6.0	0.0	0.0
11.0	3.6	10004	2.10	0.0	0.0	0.0	0.0	6.0	0.0	0.0
12.0	4.2	10217	2.13	0.0	0.0	0.0	0.0	6.0	0.0	0.0
13.0	4.9	10469	2.17	0.0	0.0	0.0	0.0	6.1	0.0	0.0
14.0	5.6	10763	2.21	0.0	0.0	0.0	0.0	6.1	0.0	0.0

CDM

TIME	INFLOW	STORAGE	STAGE	OUTFLOW	CULVERT/ LOW LEVEL	RISER WEIR	RISER ORIFICE	BARREL ORIFICE	OVERFLOW WEIR	ES WEIR
(min)	(cfs)	(cf)	(ft)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
15.0	6.4	11101	2.26	0.0	0.0	0.0	0.0	6.2	0.0	0.0
16.0	7.2	11486	2.31	0.0	0.0	0.0	0.0	6.2	0.0	0.0
17.0	8.1	11921	2.37	0.0	0.0	0.0	0.0	6.3	0.0	0.0
18.0	9.0	12408	2.44	0.0	0.0	0.0	0.0	6.4	0.0	0.0
19.0	9.9	12949	2.51	0.0	0.0	0.0	0.0	6.4	0.0	0.0
20.0	10.9	13545	2.59	0.0	0.0	0.0	0.0	6.5	0.0	0.0
21.0	11.9	14199	2.67	0.0	0.0	0.0	0.0	6.6	0.0	0.0
22.0	12.9	14912	2.76	0.0	0.0	0.0	0.0	6.7	0.0	0.0
23.0	13.9	15686	2.86	0.0	0.0	0.0	0.0	6.8	0.0	0.0
24.0	15.0	16521	2.96	0.0	0.0	0.0	0.0	6.9	0.0	0.0
25.0	16.0	17419	3.07	0.0	0.0	0.0	0.0	7.0	0.0	0.0
26.0	17.1	18381	3.19	0.0	0.0	0.0	0.0	7.1	0.0	0.0
27.0	18.2	19407	3.31	0.0	0.0	0.0	0.0	7.2	0.0	0.0
28.0	19.3	20497	3.44	0.0	0.0	0.0	0.0	7.4	0.0	0.0
29.0	20.3	21652	3.57	0.0	0.0	0.0	0.0	7.5	0.0	0.0
30.0	21.4	22872	3.71	0.0	0.0	0.0	0.0	7.6	0.0	0.0
31.0	22.5	24156	3.85	0.0	0.0	0.0	0.0	7.7	0.0	0.0
32.0	23.5	25505	3.99	0.0	0.0	0.0	0.0	7.9	0.0	0.0
33.0	24.6	26917	4.15	0.0	0.0	0.0	0.0	8.0	0.0	0.0
34.0	25.6	28392	4.30	0.0	0.0	0.0	0.0	8.1	0.0	0.0
35.0	26.6	29929	4.46	0.0	0.0	0.0	0.0	8.3	0.0	0.0
36.0	27.6	31526	4.62	0.0	0.0	0.0	0.0	8.4	0.0	0.0
37.0	28.6	33182	4.79	0.0	0.0	0.0	0.0	8.5	0.0	0.0
38.0	29.5	34896	4.95	0.0	0.0	0.0	0.0	8.7	0.0	0.0
39.0	30.4	36666	5.13	0.0	0.0	0.0	0.0	8.8	0.0	0.0
40.0	31.3	38489	5.30	0.0	0.0	0.0	0.0	8.9	0.0	0.0
41.0	32.1	40365	5.48	0.0	0.0	0.0	0.0	9.1	0.0	0.0
42.0	32.9	42290	5.65	0.0	0.0	0.0	0.0	9.2	0.0	0.0
43.0	33.6	44262	5.83	0.0	0.0	0.0	0.0	9.3	0.0	0.0
44.0	34.3	46278	6.01	0.0	0.0	0.0	0.0	9.5	0.0	0.0
45.0	35.0	48336	6.20	0.0	0.0	0.0	0.0	9.6	0.0	0.0
46.0	35.6	50433	6.38	0.0	0.0	0.0	0.0	9.7	0.0	0.0
47.0	36.1	52567	6.56	0.0	0.0	0.0	0.0	9.9	0.0	0.0
48.0	36.6	54733	6.75	0.0	0.0	0.0	0.0	10.0	0.0	0.0
49.0	37.0	56929	6.93	0.0	0.0	0.0	0.0	10.1	0.0	0.0
50.0	37.4	59151	7.12	0.0	0.0	0.0	0.0	10.2	0.0	0.0
51.0	37.8	61396	7.30	0.0	0.0	0.0	0.0	10.4	0.0	0.0
52.0	38.0	63662	7.49	0.0	0.0	0.0	0.0	10.5	0.0	0.0
53.0	38.2	65943	7.67	0.0	0.0	0.0	0.0	10.6	0.0	0.0
54.0	38.4	68237	7.85	0.0	0.0	0.0	0.0	10.7	0.0	0.0
55.0	38.5	70540	8.03	0.0	0.0	0.0	0.0	10.8	0.0	0.0
56.0	38.5	72848	8.21	0.0	0.0	0.0	0.0	11.0	0.0	0.0
57.0	38.5	75158	8.39	0.0	0.0	0.0	0.0	11.1	0.0	0.0
58.0	38.4	77467	8.57	0.0	0.0	0.0	0.0	11.2	0.0	0.0
59.0	38.2	79770	8.74	0.0	0.0	0.0	0.0	11.3	0.0	0.0
60.0	38.0	82064	8.91	0.0	0.0	0.0	0.0	11.4	0.0	0.0
61.0	37.8	84345	9.08	0.0	0.0	0.0	0.0	11.5	0.0	0.0
62.0	37.4	86610	9.25	0.0	0.0	0.0	0.0	11.6	0.0	0.0
63.0	37.0	88856	9.41	0.0	0.0	0.0	0.0	11.7	0.0	0.0
64.0	36.6	91078	9.58	0.0	0.0	0.0	0.0	11.8	0.0	0.0
65.0	36.1	93274	9.73	0.0	0.0	0.0	0.0	11.9	0.0	0.0
66.0	35.6	95440	9.89	0.0	0.0	0.0	0.0	12.0	0.0	0.0
67.0	35.0	97573	10.04	0.2	0.0	0.2	6.8	12.1	0.0	0.0
68.0	34.3	99657	10.19	2.3	0.0	2.3	14.7	12.1	0.0	0.0
69.0	33.6	101578	10.32	5.1	0.0	5.1	19.3	12.2	0.0	0.0
70.0	32.9	103286	10.44	8.3	0.0	8.3	22.6	12.3	0.0	0.0
71.0	32.2	104763	10.54	11.3	0.0	11.3	25.1	12.3	0.0	0.0
72.0	31.4	106014	10.63	12.4	0.0	14.1	27.0	12.4	0.0	0.0
73.0	30.7	107156	10.71	12.4	0.0	16.8	28.6	12.4	0.0	0.0
74.0	30.0	108252	10.78	12.5	0.0	19.6	30.1	12.5	0.0	0.0
75.0	29.3	109303	10.85	12.5	0.0	22.3	31.5	12.5	0.0	0.0
76.0	28.6	110310	10.92	12.5	0.0	25.1	32.7	12.5	0.0	0.0
77.0	28.0	111275	10.99	12.6	0.0	27.8	33.8	12.6	0.0	0.0
78.0	27.3	112198	11.05	12.6	0.0	30.5	34.9	12.6	0.0	0.0
79.0	26.7	113081	11.11	12.7	0.0	33.1	35.9	12.7	0.0	0.0

CDM

TIME	INFLOW	STORAGE	STAGE	OUTFLOW	CULVERT/ LOW LEVEL	RISER WEIR	RISER ORIFICE	BARREL ORIFICE	OVERFLOW WEIR	ES WEIR
(min)	(cfs)	(cf)	(ft)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
80.0	26.1	113924	11.17	12.7	0.0	35.7	36.8	12.7	0.0	0.0
81.0	25.5	114728	11.22	12.7	0.0	38.2	37.6	12.7	0.0	0.0
82.0	24.9	115495	11.27	12.7	0.0	40.6	38.4	12.7	0.0	0.0
83.0	24.3	116225	11.32	12.8	0.0	43.0	39.1	12.8	0.0	0.0
84.0	23.8	116919	11.37	12.8	0.0	45.2	39.8	12.8	0.0	0.0
85.0	23.2	117578	11.41	12.8	0.0	47.4	40.4	12.8	0.0	0.0
86.0	22.7	118203	11.45	12.8	0.0	49.6	41.0	12.8	0.0	0.0
87.0	22.2	118795	11.49	12.9	0.0	51.6	41.6	12.9	0.0	0.0
88.0	21.7	119354	11.53	12.9	0.0	53.5	42.1	12.9	0.0	0.0
89.0	21.2	119881	11.57	12.9	0.0	55.4	42.6	12.9	0.0	0.0
90.0	20.7	120377	11.60	12.9	0.0	57.1	43.0	12.9	0.0	0.0
91.0	20.2	120844	11.63	12.9	0.0	58.8	43.4	12.9	0.0	0.0
92.0	19.7	121280	11.66	12.9	0.0	60.3	43.8	12.9	0.0	0.0
93.0	19.3	121688	11.68	13.0	0.0	61.8	44.2	13.0	0.0	0.0
94.0	18.8	122068	11.71	13.0	0.0	63.2	44.5	13.0	0.0	0.0
95.0	18.4	122421	11.73	13.0	0.0	64.5	44.8	13.0	0.0	0.0
96.0	18.0	122747	11.75	13.0	0.0	65.7	45.1	13.0	0.0	0.0
97.0	17.6	123047	11.77	13.0	0.0	66.8	45.3	13.0	0.0	0.0
98.0	17.2	123321	11.79	13.0	0.0	67.8	45.6	13.0	0.0	0.0
99.0	16.8	123571	11.81	13.0	0.0	68.8	45.8	13.0	0.0	0.0
100.0	16.4	123796	11.82	13.0	0.0	69.6	46.0	13.0	0.0	0.0
101.0	16.0	123998	11.84	13.0	0.0	70.4	46.1	13.0	0.0	0.0
102.0	15.7	124177	11.85	13.0	0.0	71.0	46.3	13.0	0.0	0.0
103.0	15.3	124334	11.86	13.1	0.0	71.6	46.4	13.1	0.0	0.0
104.0	14.9	124468	11.87	13.1	0.0	72.1	46.5	13.1	0.0	0.0
105.0	14.6	124582	11.87	13.1	0.0	72.6	46.6	13.1	0.0	0.0
106.0	14.3	124674	11.88	13.1	0.0	72.9	46.7	13.1	0.0	0.0
107.0	13.9	124746	11.89	13.1	0.0	73.2	46.7	13.1	0.0	0.0
108.0	13.6	124799	11.89	13.1	0.0	73.4	46.8	13.1	0.0	0.0
109.0	13.3	124832	11.89	13.1	0.0	73.5	46.8	13.1	0.0	0.0
110.0	13.0	124846	11.89	13.1	0.0	73.6	46.8	13.1	0.0	0.0
111.0	12.7	124842	11.89	13.1	0.0	73.6	46.8	13.1	0.0	0.0
112.0	12.4	124820	11.89	13.1	0.0	73.5	46.8	13.1	0.0	0.0
113.0	12.1	124781	11.89	13.1	0.0	73.3	46.8	13.1	0.0	0.0
114.0	11.8	124724	11.88	13.1	0.0	73.1	46.7	13.1	0.0	0.0
115.0	11.6	124651	11.88	13.1	0.0	72.8	46.7	13.1	0.0	0.0
116.0	11.3	124562	11.87	13.1	0.0	72.5	46.6	13.1	0.0	0.0
117.0	11.1	124457	11.87	13.1	0.0	72.1	46.5	13.1	0.0	0.0
118.0	10.8	124337	11.86	13.1	0.0	71.6	46.4	13.1	0.0	0.0
119.0	10.6	124201	11.85	13.0	0.0	71.1	46.3	13.0	0.0	0.0
120.0	10.3	124052	11.84	13.0	0.0	70.6	46.2	13.0	0.0	0.0
121.0	10.1	123888	11.83	13.0	0.0	69.9	46.0	13.0	0.0	0.0
122.0	9.8	123710	11.82	13.0	0.0	69.3	45.9	13.0	0.0	0.0
123.0	9.6	123518	11.80	13.0	0.0	68.6	45.7	13.0	0.0	0.0
124.0	9.4	123314	11.79	13.0	0.0	67.8	45.6	13.0	0.0	0.0
125.0	9.2	123096	11.78	13.0	0.0	67.0	45.4	13.0	0.0	0.0
126.0	9.0	122867	11.76	13.0	0.0	66.1	45.2	13.0	0.0	0.0
127.0	8.8	122625	11.75	13.0	0.0	65.2	45.0	13.0	0.0	0.0
128.0	8.6	122371	11.73	13.0	0.0	64.3	44.8	13.0	0.0	0.0
129.0	8.4	122105	11.71	13.0	0.0	63.3	44.5	13.0	0.0	0.0
130.0	8.2	121829	11.69	13.0	0.0	62.3	44.3	13.0	0.0	0.0
131.0	8.0	121541	11.67	13.0	0.0	61.3	44.0	13.0	0.0	0.0
132.0	7.8	121243	11.66	12.9	0.0	60.2	43.8	12.9	0.0	0.0
133.0	7.6	120935	11.63	12.9	0.0	59.1	43.5	12.9	0.0	0.0
134.0	7.4	120616	11.61	12.9	0.0	58.0	43.2	12.9	0.0	0.0
135.0	7.3	120287	11.59	12.9	0.0	56.8	42.9	12.9	0.0	0.0
136.0	7.1	119949	11.57	12.9	0.0	55.6	42.6	12.9	0.0	0.0
137.0	6.9	119602	11.55	12.9	0.0	54.4	42.3	12.9	0.0	0.0
138.0	6.8	119246	11.52	12.9	0.0	53.1	42.0	12.9	0.0	0.0
139.0	6.6	118881	11.50	12.9	0.0	51.9	41.7	12.9	0.0	0.0
140.0	6.5	118507	11.47	12.8	0.0	50.6	41.3	12.8	0.0	0.0
141.0	6.3	118125	11.45	12.8	0.0	49.3	41.0	12.8	0.0	0.0
142.0	6.2	117735	11.42	12.8	0.0	48.0	40.6	12.8	0.0	0.0
143.0	6.0	117337	11.40	12.8	0.0	46.6	40.2	12.8	0.0	0.0
144.0	5.9	116931	11.37	12.8	0.0	45.3	39.8	12.8	0.0	0.0

CDM

TIME	INFLOW	STORAGE	STAGE	OUTFLOW	CULVERT/ LOW LEVEL	RISER WEIR	RISER ORIFICE	BARREL ORIFICE	OVERFLOW WEIR	ES WEIR
(min)	(cfs)	(cf)	(ft)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
145.0	5.8	116518	11.34	12.8	0.0	43.9	39.4	12.8	0.0	0.0
146.0	5.6	116097	11.31	12.8	0.0	42.5	39.0	12.8	0.0	0.0
147.0	5.5	115670	11.28	12.7	0.0	41.2	38.6	12.7	0.0	0.0
148.0	5.4	115236	11.26	12.7	0.0	39.8	38.1	12.7	0.0	0.0
149.0	5.3	114795	11.23	12.7	0.0	38.4	37.7	12.7	0.0	0.0
150.0	5.1	114347	11.20	12.7	0.0	37.0	37.2	12.7	0.0	0.0
151.0	5.0	113894	11.17	12.7	0.0	35.6	36.7	12.7	0.0	0.0
152.0	4.9	113434	11.13	12.7	0.0	34.2	36.2	12.7	0.0	0.0
153.0	4.8	112968	11.10	12.6	0.0	32.7	35.7	12.6	0.0	0.0
154.0	4.7	112497	11.07	12.6	0.0	31.3	35.2	12.6	0.0	0.0
155.0	4.6	112020	11.04	12.6	0.0	29.9	34.7	12.6	0.0	0.0
156.0	4.5	111538	11.01	12.6	0.0	28.5	34.1	12.6	0.0	0.0
157.0	4.4	111051	10.97	12.6	0.0	27.1	33.6	12.6	0.0	0.0
158.0	4.3	110558	10.94	12.6	0.0	25.7	33.0	12.6	0.0	0.0
159.0	4.2	110061	10.91	12.5	0.0	24.4	32.4	12.5	0.0	0.0
160.0	4.1	109558	10.87	12.5	0.0	23.0	31.8	12.5	0.0	0.0
161.0	4.0	109052	10.84	12.5	0.0	21.6	31.1	12.5	0.0	0.0
162.0	3.9	108540	10.80	12.5	0.0	20.3	30.5	12.5	0.0	0.0
163.0	3.8	108025	10.77	12.5	0.0	19.0	29.8	12.5	0.0	0.0
164.0	3.7	107505	10.73	12.4	0.0	17.7	29.1	12.4	0.0	0.0
165.0	3.6	106981	10.70	12.4	0.0	16.4	28.4	12.4	0.0	0.0
166.0	3.5	106453	10.66	12.4	0.0	15.1	27.6	12.4	0.0	0.0
167.0	3.5	105922	10.62	12.4	0.0	13.9	26.8	12.4	0.0	0.0
168.0	3.4	105387	10.59	12.4	0.0	12.7	26.0	12.4	0.0	0.0
169.0	3.3	104848	10.55	11.5	0.0	11.5	25.2	12.3	0.0	0.0
170.0	3.2	104358	10.51	10.4	0.0	10.4	24.4	12.3	0.0	0.0
171.0	3.2	103926	10.48	9.5	0.0	9.5	23.7	12.3	0.0	0.0
172.0	3.1	103543	10.46	8.8	0.0	8.8	23.0	12.3	0.0	0.0
173.0	3.0	103202	10.43	8.1	0.0	8.1	22.4	12.3	0.0	0.0
174.0	2.9	102898	10.41	7.5	0.0	7.5	21.9	12.3	0.0	0.0
175.0	2.9	102624	10.39	7.0	0.0	7.0	21.4	12.3	0.0	0.0
176.0	2.8	102377	10.38	6.5	0.0	6.5	20.9	12.2	0.0	0.0
177.0	2.7	102153	10.36	6.1	0.0	6.1	20.5	12.2	0.0	0.0
178.0	2.7	101950	10.35	5.8	0.0	5.8	20.0	12.2	0.0	0.0
179.0	2.6	101764	10.33	5.5	0.0	5.5	19.7	12.2	0.0	0.0
180.0	2.6	101593	10.32	5.2	0.0	5.2	19.3	12.2	0.0	0.0
181.0	2.5	101437	10.31	4.9	0.0	4.9	19.0	12.2	0.0	0.0
182.0	2.4	101292	10.30	4.7	0.0	4.7	18.7	12.2	0.0	0.0
183.0	2.4	101158	10.29	4.5	0.0	4.5	18.4	12.2	0.0	0.0
184.0	2.3	101034	10.28	4.3	0.0	4.3	18.1	12.2	0.0	0.0
185.0	2.3	100919	10.28	4.1	0.0	4.1	17.8	12.2	0.0	0.0
186.0	2.2	100811	10.27	3.9	0.0	3.9	17.6	12.2	0.0	0.0
187.0	2.2	100710	10.26	3.8	0.0	3.8	17.4	12.2	0.0	0.0
188.0	2.1	100615	10.25	3.6	0.0	3.6	17.1	12.2	0.0	0.0
189.0	2.1	100525	10.25	3.5	0.0	3.5	16.9	12.2	0.0	0.0
190.0	2.0	100441	10.24	3.4	0.0	3.4	16.7	12.2	0.0	0.0
191.0	2.0	100361	10.24	3.2	0.0	3.2	16.5	12.2	0.0	0.0
192.0	1.9	100286	10.23	3.1	0.0	3.1	16.3	12.2	0.0	0.0
193.0	1.9	100214	10.23	3.0	0.0	3.0	16.2	12.2	0.0	0.0
194.0	1.8	100146	10.22	2.9	0.0	2.9	16.0	12.2	0.0	0.0
195.0	1.8	100081	10.22	2.8	0.0	2.8	15.8	12.2	0.0	0.0
196.0	1.8	100018	10.21	2.8	0.0	2.8	15.7	12.2	0.0	0.0
197.0	1.7	99959	10.21	2.7	0.0	2.7	15.5	12.1	0.0	0.0
198.0	1.7	99901	10.20	2.6	0.0	2.6	15.4	12.1	0.0	0.0
199.0	1.6	99847	10.20	2.5	0.0	2.5	15.2	12.1	0.0	0.0
200.0	1.6	99794	10.20	2.5	0.0	2.5	15.1	12.1	0.0	0.0

Client:	Buncombe County
Project:	Landfill Operation
Task:	Pond Routing

Computed By:	M. Sloop
Date:	4/30/2009
Checked By:	

SMALL WATERSHED HYDROGRAPH FORMULATION

Return Period	25	years	NOAA g:	
Duration	24	hours	NOAA h:	
Precipitation	5.79	in		
SCS CN	85			

Watershed Flow Characteristics

Watershed Area	12.17	acres
Hydraulic Length:		feet
Maximum Elevation:		
Minimum Elevation:		
Total Relief:	0	feet
Kirpich K:	1	
Time of Concentration	0.0	minutes
Use T_C =	5.0	minutes

Composite C Determination

Land Use	Ci		Ai	Ci*Ai
Impervious				0
Undisturbed	0.35		10.17	3.5595
Disturbed	0.60		2.00	1.2
Pond				0
		Σ	12.17	4.7595
			Cc	**0.39**

CALCULATED:

				Calculated	Estimated	Use	
Soil Storage	1.76	inches	Intensity	0.0	8.09	8.1	inches/hour
Runoff Depth	4.10	inches	Discharge	39		39	cfs
Volume of Runoff	50.0	acre-inches					
Time to Peak	56	minutes	Method of Discharge Estimate:			Rational Method	
Use T_P =	56	minutes					

HYDROGRAPH FORMULATION : By step function developed by H.R. Malcom, Ph.D., P.E., North Carolina State University
(Patterned after SCS dimensionless unit hydrograph)

Time (min)	Q (cfs)	Time (min)	Q (cfs)	Time (min)	Q (cfs)	Time (min)	Q (cfs)	Time (min)	Q (cfs)	Time (min)	Q (cfs)
0	0.0	36	27.6	72	31.4	108	13.6	144	5.9	180	2.6
1	0.0	37	28.6	73	30.7	109	13.3	145	5.8	181	2.5
2	0.1	38	29.5	74	30.0	110	13.0	146	5.6	182	2.4
3	0.3	39	30.4	75	29.3	111	12.7	147	5.5	183	2.4
4	0.5	40	31.3	76	28.6	112	12.4	148	5.4	184	2.3
5	0.8	41	32.1	77	28.0	113	12.1	149	5.3	185	2.3
6	1.1	42	32.9	78	27.3	114	11.8	150	5.1	186	2.2
7	1.5	43	33.6	79	26.7	115	11.6	151	5.0	187	2.2
8	1.9	44	34.3	80	26.1	116	11.3	152	4.9	188	2.1
9	2.4	45	35.0	81	25.5	117	11.1	153	4.8	189	2.1
10	3.0	46	35.6	82	24.9	118	10.8	154	4.7	190	2.0
11	3.6	47	36.1	83	24.3	119	10.6	155	4.6	191	2.0
12	4.2	48	36.6	84	23.8	120	10.3	156	4.5	192	1.9
13	4.9	49	37.0	85	23.2	121	10.1	157	4.4	193	1.9
14	5.6	50	37.4	86	22.7	122	9.8	158	4.3	194	1.8
15	6.4	51	37.8	87	22.2	123	9.6	159	4.2	195	1.8
16	7.2	52	38.0	88	21.7	124	9.4	160	4.1	196	1.8
17	8.1	53	38.2	89	21.2	125	9.2	161	4.0	197	1.7
18	9.0	54	38.4	90	20.7	126	9.0	162	3.9	198	1.7
19	9.9	55	38.5	91	20.2	127	8.8	163	3.8	199	1.6
20	10.9	56	38.5	92	19.7	128	8.6	164	3.7	200	1.6
21	11.9	57	38.5	93	19.3	129	8.4	165	3.6		
22	12.9	58	38.4	94	18.8	130	8.2	166	3.5		
23	13.9	59	38.2	95	18.4	131	8.0	167	3.5		
24	15.0	60	38.0	96	18.0	132	7.8	168	3.4		
25	16.0	61	37.8	97	17.6	133	7.6	169	3.3		
26	17.1	62	37.4	98	17.2	134	7.4	170	3.2		
27	18.2	63	37.0	99	16.8	135	7.3	171	3.2		
28	19.3	64	36.6	100	16.4	136	7.1	172	3.1		
29	20.3	65	36.1	101	16.0	137	6.9	173	3.0		
30	21.4	66	35.6	102	15.7	138	6.8	174	2.9		
31	22.5	67	35.0	103	15.3	139	6.6	175	2.9		
32	23.5	68	34.3	104	14.9	140	6.5	176	2.8		
33	24.6	69	33.6	105	14.6	141	6.3	177	2.7		
34	25.6	70	32.9	106	14.3	142	6.2	178	2.7		
35	26.6	71	32.2	107	13.9	143	6.0	179	2.6		

Client:	Buncombe County
Project:	Landfill Operation
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Computed By:	M. Sloop
Date:	4/30/2009
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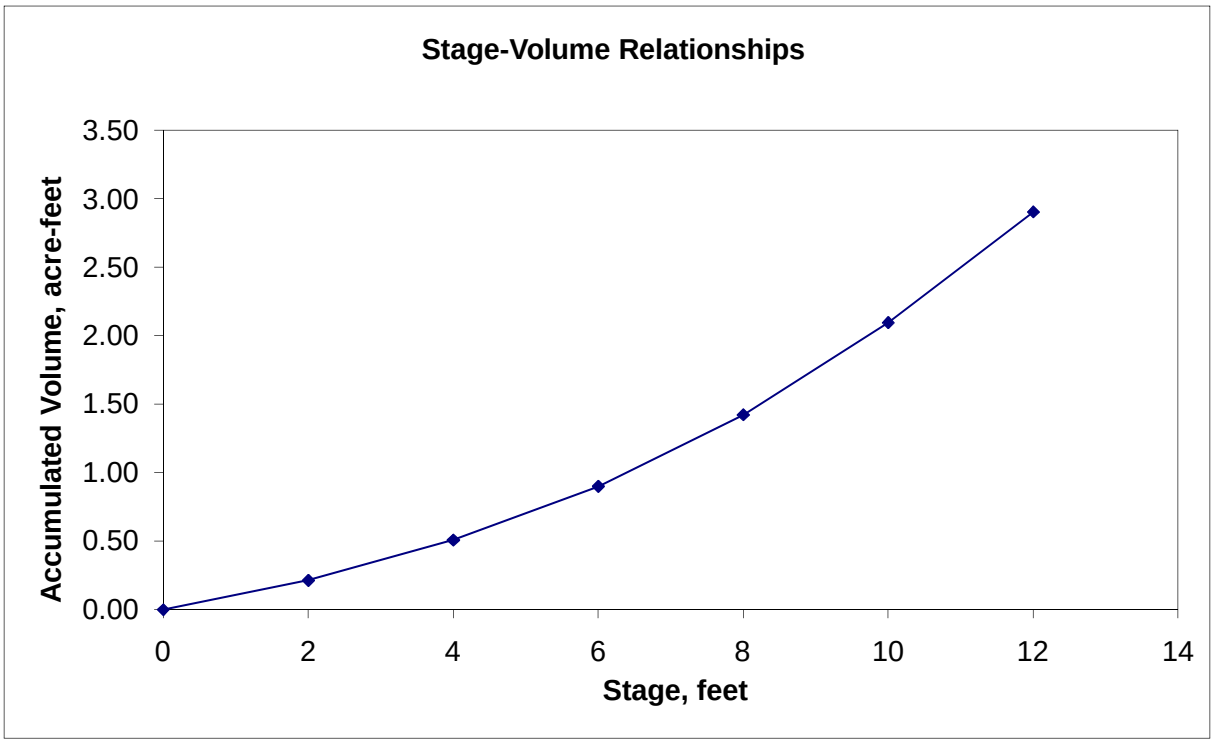
OBJECTIVE
Determine the stage-storage and associated Ks and b values

BACKGROUND
Stage-Storage Function obtained from H.R. Malcom CE785 course pack.

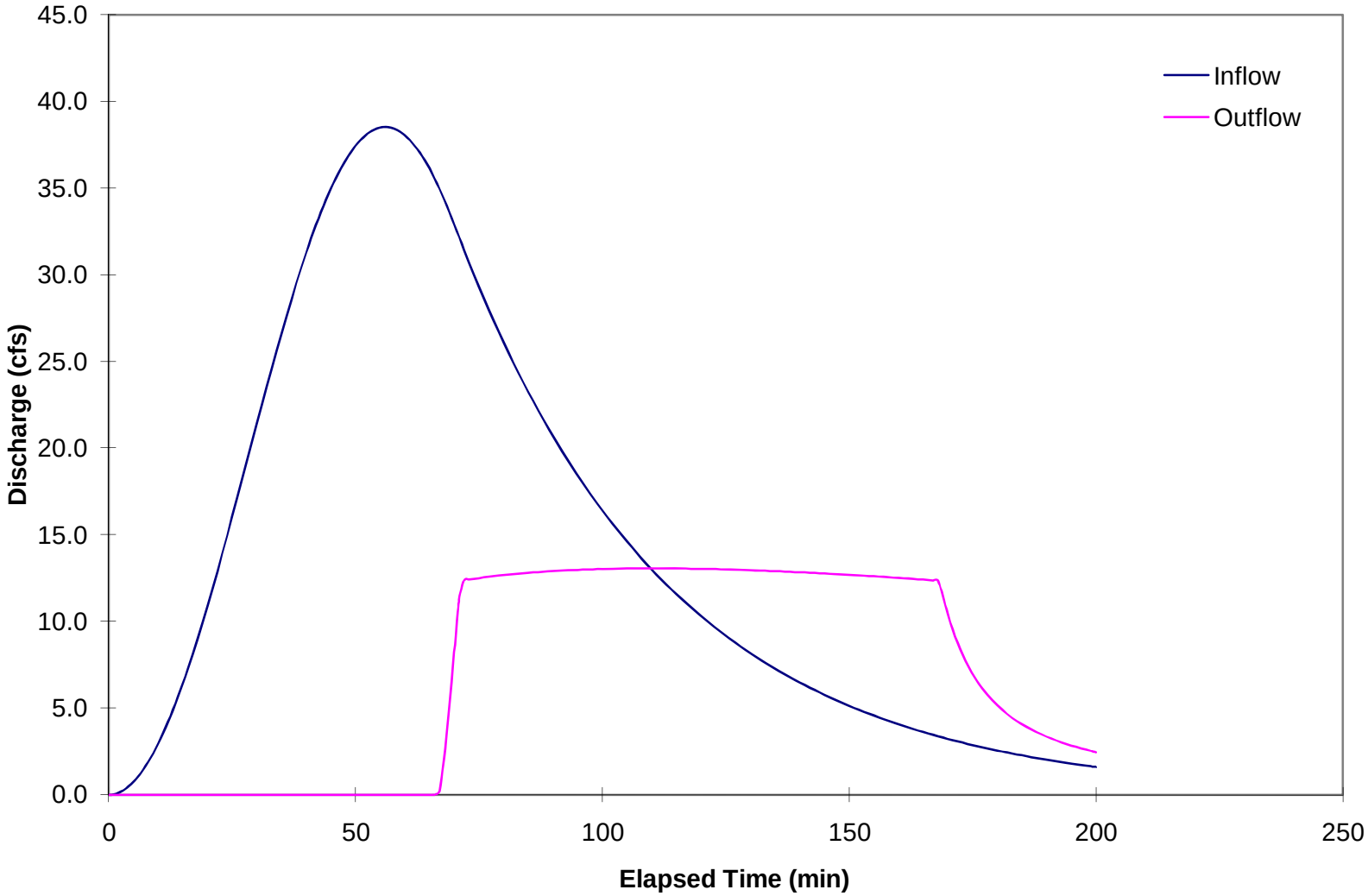
DEVELOPMENT

Elevation (ft)	Stage (ft)	Area (sf)	Incr. Vol (cf)	Acc. Vol (cf)	LN S	LN Z	Z est (ft)	Acc. Vol (ac-ft)
1936	0	3,886	0	0	---	---	---	0.00
1938	2	5,430	9,316	9,316	9.1	0.7	2.0	0.21
1940	4	7,410	12,840	22,156	10.0	1.4	3.6	0.51
1942	6	9,617	17,027	39,183	10.6	1.8	5.4	0.90
1944	8	13,173	22,790	61,973	11.0	2.1	7.4	1.42
1946	10	16,131	29,304	91,277	11.4	2.3	9.6	2.10
1948	12	19,092	35,223	126,500	11.7	2.5	12.0	2.90

b=	**1.46**
Ks=	**3396**



INFLOW-OUTFLOW HYDROGRAPHS



CDM

Attachment #3
Inflow/Outflow Hydrograph - Pond 11
Page 1

Client:	Buncombe County	Computed By:	M. Sloop
Project:	Landfill Operation	Date:	4/30/2009
Task:	Pond Routing	Checked By:	

OBJECTIVE

Check the Pond 12 design for the 25-year, 24-hour design storm event.

BACKGROUND

Routing perfomed by the chainsaw method as outlined by HR Malcom, PE, Ph.D, NCSU

Parameters input by the user.

DEVELOPMENT

SYSTEM PARAMETERS

Time Step (minutes)	1.0

Riser Barrel Spillway

Weir Configuration:	CMP Riser
Weir Diameter (inches):	24
Weir Length (feet):	6.28
Weir Area (square feet):	3.14
Weir Coefficient	3.00
Discharge Coefficient:	0.60
Crest Elevation:	1967.0
Barrel Configuration:	CMP Barrel
Barrel Diameter (inches):	12
Discharge Coefficient	0.59
Number of Barrels	1
Barrel Invert In	1962.0

Emergency Spillway

Weir Configuration:	Concrete
Weir Length (feet):	80.0
ES Crest Elevation:	1968.00
Weir Coefficient:	3.00

Sharp Crested Weir Spillway

Weir Configuration:	Sharp Crested
Weir Length (feet):	0.0
Crest Elevation:	0.0
Weir Coefficient:	0.00

Circular Culvert / Low Level Outlet

Conduit Configuration:	CMP Barrel
Conduit Diameter (inches):	0
Number of Conduits:	0
Discharge Coefficient:	0
Effective Flow Area (ratio):	0
Conduit Invert In	0

Design Settling Particle

D_{15} (Microns) =	40
Specific Gravity	2.6
Number of effective cells	2
V_{SET} (fps) =	4.01E-03

ROUTING CONTROL & RESULTS

Return Period	25	years	Pond Invert EL	1962.0	feet	Max principal flow	9	cfs
Peak Runoff	17.7	cfs	Pond Crest EL	1970.0	feet	ES Max Discharge	7	cfs
Precipitation	5.79	inches	Initial WS EL	1962.0	feet	ES Depth of Flow	0.06	feet
Drainage Area	4.8	acres	Max Stage EL	1968.1	feet	ES Max Velocity	1.36	fps
Min Sett Eff	#REF!	percent	Max Storage	0.7	acre-feet			
Ks =	2444		Max Stage	6.09	feet			
b =	1.43							

TIME	INFLOW	STORAGE	STAGE	OUTFLOW	CULVERT/ LOW LEVEL	RISER WEIR	RISER ORIFICE	BARREL ORIFICE	OVERFLOW WEIR	ES WEIR
(min)	(cfs)	(cf)	(ft)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
0	0.0	0	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.0	0.0	0	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.0	0.1	1	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.0	0.2	5	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.0	0.3	15	0.03	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.0	0.5	33	0.05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.0	0.6	60	0.07	0.0	0.0	0.0	0.0	0.1	0.0	0.0
7.0	0.9	99	0.11	0.0	0.0	0.0	0.0	0.1	0.0	0.0
8.0	1.1	151	0.14	0.0	0.0	0.0	0.0	0.1	0.0	0.0
9.0	1.4	220	0.19	0.0	0.0	0.0	0.0	0.2	0.0	0.0
10.0	1.8	306	0.23	0.0	0.0	0.0	0.0	0.3	0.0	0.0
11.0	2.1	412	0.29	0.0	0.0	0.0	0.0	0.4	0.0	0.0
12.0	2.5	539	0.35	0.0	0.0	0.0	0.0	0.5	0.0	0.0
13.0	2.9	689	0.41	0.0	0.0	0.0	0.0	0.7	0.0	0.0
14.0	3.3	863	0.48	0.0	0.0	0.0	0.0	0.9	0.0	0.0

TIME	INFLOW	STORAGE	STAGE	OUTFLOW	CULVERT/ LOW LEVEL	RISER WEIR	RISER ORIFICE	BARREL ORIFICE	OVERFLOW WEIR	ES WEIR
(min)	(cfs)	(cf)	(ft)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
15.0	3.8	1064	0.56	0.0	0.0	0.0	0.0	1.1	0.0	0.0
16.0	4.3	1292	0.64	0.0	0.0	0.0	0.0	1.3	0.0	0.0
17.0	4.8	1548	0.73	0.0	0.0	0.0	0.0	1.6	0.0	0.0
18.0	5.3	1834	0.82	0.0	0.0	0.0	0.0	1.9	0.0	0.0
19.0	5.8	2151	0.91	0.0	0.0	0.0	0.0	2.3	0.0	0.0
20.0	6.3	2500	1.02	0.0	0.0	0.0	0.0	2.7	0.0	0.0
21.0	6.9	2881	1.12	0.0	0.0	0.0	0.0	2.9	0.0	0.0
22.0	7.5	3295	1.23	0.0	0.0	0.0	0.0	3.2	0.0	0.0
23.0	8.0	3742	1.35	0.0	0.0	0.0	0.0	3.4	0.0	0.0
24.0	8.6	4224	1.47	0.0	0.0	0.0	0.0	3.7	0.0	0.0
25.0	9.2	4739	1.59	0.0	0.0	0.0	0.0	3.9	0.0	0.0
26.0	9.7	5289	1.72	0.0	0.0	0.0	0.0	4.1	0.0	0.0
27.0	10.3	5872	1.85	0.0	0.0	0.0	0.0	4.3	0.0	0.0
28.0	10.8	6490	1.98	0.0	0.0	0.0	0.0	4.5	0.0	0.0
29.0	11.4	7141	2.12	0.0	0.0	0.0	0.0	4.7	0.0	0.0
30.0	11.9	7825	2.26	0.0	0.0	0.0	0.0	4.9	0.0	0.0
31.0	12.5	8541	2.40	0.0	0.0	0.0	0.0	5.1	0.0	0.0
32.0	13.0	9289	2.55	0.0	0.0	0.0	0.0	5.3	0.0	0.0
33.0	13.5	10068	2.70	0.0	0.0	0.0	0.0	5.5	0.0	0.0
34.0	14.0	10876	2.85	0.0	0.0	0.0	0.0	5.7	0.0	0.0
35.0	14.4	11714	3.00	0.0	0.0	0.0	0.0	5.9	0.0	0.0
36.0	14.8	12578	3.15	0.0	0.0	0.0	0.0	6.0	0.0	0.0
37.0	15.2	13469	3.31	0.0	0.0	0.0	0.0	6.2	0.0	0.0
38.0	15.6	14384	3.46	0.0	0.0	0.0	0.0	6.4	0.0	0.0
39.0	16.0	15322	3.62	0.0	0.0	0.0	0.0	6.6	0.0	0.0
40.0	16.3	16281	3.78	0.0	0.0	0.0	0.0	6.7	0.0	0.0
41.0	16.6	17259	3.93	0.0	0.0	0.0	0.0	6.9	0.0	0.0
42.0	16.9	18256	4.09	0.0	0.0	0.0	0.0	7.0	0.0	0.0
43.0	17.1	19268	4.25	0.0	0.0	0.0	0.0	7.2	0.0	0.0
44.0	17.3	20294	4.41	0.0	0.0	0.0	0.0	7.3	0.0	0.0
45.0	17.5	21332	4.56	0.0	0.0	0.0	0.0	7.5	0.0	0.0
46.0	17.6	22380	4.72	0.0	0.0	0.0	0.0	7.6	0.0	0.0
47.0	17.7	23435	4.87	0.0	0.0	0.0	0.0	7.8	0.0	0.0
48.0	17.7	24495	5.03	0.1	0.0	0.1	2.4	7.9	0.0	0.0
49.0	17.7	25554	5.18	1.4	0.0	1.4	6.4	8.0	0.0	0.0
50.0	17.7	26535	5.32	3.3	0.0	3.3	8.5	8.1	0.0	0.0
51.0	17.7	27398	5.44	5.4	0.0	5.4	10.0	8.2	0.0	0.0
52.0	17.6	28133	5.54	7.4	0.0	7.4	11.1	8.3	0.0	0.0
53.0	17.5	28742	5.62	8.4	0.0	9.2	11.9	8.4	0.0	0.0
54.0	17.3	29286	5.70	8.5	0.0	10.9	12.6	8.5	0.0	0.0
55.0	17.1	29816	5.77	8.5	0.0	12.7	13.3	8.5	0.0	0.0
56.0	16.9	30331	5.84	8.6	0.0	14.4	13.8	8.6	0.0	0.0
57.0	16.6	30828	5.90	8.6	0.0	16.2	14.4	8.6	0.0	0.0
58.0	16.3	31307	5.97	8.7	0.0	18.0	14.9	8.7	0.0	0.0
59.0	16.0	31764	6.03	9.9	0.0	19.7	15.3	8.7	0.0	1.2
60.0	15.6	32127	6.08	14.0	0.0	21.1	15.7	8.8	0.0	5.2
61.0	15.2	32228	6.09	15.4	0.0	21.5	15.8	8.8	0.0	6.6
62.0	14.9	32221	6.09	15.3	0.0	21.5	15.8	8.8	0.0	6.5
63.0	14.5	32197	6.09	14.9	0.0	21.4	15.8	8.8	0.0	6.2
64.0	14.1	32171	6.08	14.6	0.0	21.3	15.7	8.8	0.0	5.8
65.0	13.7	32144	6.08	14.2	0.0	21.1	15.7	8.8	0.0	5.4
66.0	13.4	32117	6.08	13.8	0.0	21.0	15.7	8.8	0.0	5.1
67.0	13.0	32090	6.07	13.5	0.0	20.9	15.7	8.8	0.0	4.7
68.0	12.7	32063	6.07	13.1	0.0	20.8	15.6	8.8	0.0	4.4
69.0	12.3	32037	6.07	12.8	0.0	20.7	15.6	8.8	0.0	4.0
70.0	12.0	32010	6.06	12.5	0.0	20.6	15.6	8.8	0.0	3.7
71.0	11.7	31984	6.06	12.2	0.0	20.5	15.6	8.8	0.0	3.4
72.0	11.4	31957	6.06	11.8	0.0	20.4	15.5	8.8	0.0	3.1
73.0	11.1	31930	6.05	11.6	0.0	20.3	15.5	8.7	0.0	2.8
74.0	10.8	31904	6.05	11.3	0.0	20.2	15.5	8.7	0.0	2.5
75.0	10.5	31877	6.04	11.0	0.0	20.1	15.5	8.7	0.0	2.2
76.0	10.3	31849	6.04	10.7	0.0	20.0	15.4	8.7	0.0	2.0
77.0	10.0	31822	6.04	10.5	0.0	19.9	15.4	8.7	0.0	1.7
78.0	9.7	31794	6.03	10.2	0.0	19.8	15.4	8.7	0.0	1.5
79.0	9.5	31766	6.03	10.0	0.0	19.7	15.3	8.7	0.0	1.2

CDM

TIME	INFLOW	STORAGE	STAGE	OUTFLOW	CULVERT/ LOW LEVEL	RISER WEIR	RISER ORIFICE	BARREL ORIFICE	OVERFLOW WEIR	ES WEIR
(min)	(cfs)	(cf)	(ft)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
80.0	9.2	31737	6.03	9.7	0.0	19.6	15.3	8.7	0.0	1.0
81.0	9.0	31707	6.02	9.5	0.0	19.5	15.3	8.7	0.0	0.8
82.0	8.7	31676	6.02	9.3	0.0	19.4	15.3	8.7	0.0	0.6
83.0	8.5	31644	6.01	9.1	0.0	19.2	15.2	8.7	0.0	0.4
84.0	8.3	31609	6.01	8.9	0.0	19.1	15.2	8.7	0.0	0.2
85.0	8.1	31572	6.00	8.8	0.0	19.0	15.2	8.7	0.0	0.1
86.0	7.9	31531	6.00	8.7	0.0	18.8	15.1	8.7	0.0	0.0
87.0	7.7	31481	5.99	8.7	0.0	18.6	15.1	8.7	0.0	0.0
88.0	7.5	31418	5.98	8.7	0.0	18.4	15.0	8.7	0.0	0.0
89.0	7.3	31344	5.97	8.7	0.0	18.1	14.9	8.7	0.0	0.0
90.0	7.1	31259	5.96	8.7	0.0	17.8	14.8	8.7	0.0	0.0
91.0	6.9	31163	5.95	8.7	0.0	17.4	14.7	8.7	0.0	0.0
92.0	6.7	31056	5.93	8.7	0.0	17.0	14.6	8.7	0.0	0.0
93.0	6.5	30939	5.92	8.6	0.0	16.6	14.5	8.6	0.0	0.0
94.0	6.4	30813	5.90	8.6	0.0	16.2	14.4	8.6	0.0	0.0
95.0	6.2	30676	5.88	8.6	0.0	15.7	14.2	8.6	0.0	0.0
96.0	6.0	30531	5.86	8.6	0.0	15.2	14.1	8.6	0.0	0.0
97.0	5.9	30377	5.84	8.6	0.0	14.6	13.9	8.6	0.0	0.0
98.0	5.7	30215	5.82	8.6	0.0	14.0	13.7	8.6	0.0	0.0
99.0	5.6	30044	5.80	8.5	0.0	13.5	13.5	8.5	0.0	0.0
100.0	5.4	29866	5.77	8.5	0.0	12.9	13.3	8.5	0.0	0.0
101.0	5.3	29680	5.75	8.5	0.0	12.2	13.1	8.5	0.0	0.0
102.0	5.1	29486	5.72	8.5	0.0	11.6	12.9	8.5	0.0	0.0
103.0	5.0	29286	5.70	8.5	0.0	10.9	12.6	8.5	0.0	0.0
104.0	4.9	29079	5.67	8.4	0.0	10.3	12.4	8.4	0.0	0.0
105.0	4.8	28865	5.64	8.4	0.0	9.6	12.1	8.4	0.0	0.0
106.0	4.6	28645	5.61	8.4	0.0	8.9	11.8	8.4	0.0	0.0
107.0	4.5	28420	5.58	8.3	0.0	8.3	11.5	8.4	0.0	0.0
108.0	4.4	28194	5.55	7.6	0.0	7.6	11.2	8.3	0.0	0.0
109.0	4.3	28001	5.52	7.1	0.0	7.1	10.9	8.3	0.0	0.0
110.0	4.2	27833	5.50	6.6	0.0	6.6	10.7	8.3	0.0	0.0
111.0	4.1	27687	5.48	6.2	0.0	6.2	10.4	8.3	0.0	0.0
112.0	3.9	27559	5.46	5.9	0.0	5.9	10.2	8.3	0.0	0.0
113.0	3.8	27445	5.44	5.5	0.0	5.5	10.1	8.3	0.0	0.0
114.0	3.7	27342	5.43	5.3	0.0	5.3	9.9	8.2	0.0	0.0
115.0	3.6	27250	5.42	5.0	0.0	5.0	9.7	8.2	0.0	0.0
116.0	3.5	27165	5.40	4.8	0.0	4.8	9.6	8.2	0.0	0.0
117.0	3.5	27088	5.39	4.6	0.0	4.6	9.5	8.2	0.0	0.0
118.0	3.4	27017	5.38	4.5	0.0	4.5	9.4	8.2	0.0	0.0
119.0	3.3	26951	5.37	4.3	0.0	4.3	9.2	8.2	0.0	0.0
120.0	3.2	26889	5.37	4.2	0.0	4.2	9.1	8.2	0.0	0.0
121.0	3.1	26831	5.36	4.0	0.0	4.0	9.0	8.2	0.0	0.0
122.0	3.0	26776	5.35	3.9	0.0	3.9	8.9	8.2	0.0	0.0
123.0	2.9	26724	5.34	3.8	0.0	3.8	8.8	8.2	0.0	0.0
124.0	2.9	26675	5.34	3.7	0.0	3.7	8.8	8.2	0.0	0.0
125.0	2.8	26628	5.33	3.5	0.0	3.5	8.7	8.2	0.0	0.0
126.0	2.7	26582	5.32	3.4	0.0	3.4	8.6	8.2	0.0	0.0
127.0	2.7	26539	5.32	3.3	0.0	3.3	8.5	8.1	0.0	0.0
128.0	2.6	26497	5.31	3.3	0.0	3.3	8.4	8.1	0.0	0.0
129.0	2.5	26456	5.30	3.2	0.0	3.2	8.3	8.1	0.0	0.0
130.0	2.4	26417	5.30	3.1	0.0	3.1	8.3	8.1	0.0	0.0
131.0	2.4	26379	5.29	3.0	0.0	3.0	8.2	8.1	0.0	0.0
132.0	2.3	26342	5.29	2.9	0.0	2.9	8.1	8.1	0.0	0.0
133.0	2.3	26306	5.28	2.8	0.0	2.8	8.1	8.1	0.0	0.0
134.0	2.2	26271	5.28	2.8	0.0	2.8	8.0	8.1	0.0	0.0
135.0	2.1	26237	5.27	2.7	0.0	2.7	7.9	8.1	0.0	0.0
136.0	2.1	26204	5.27	2.6	0.0	2.6	7.8	8.1	0.0	0.0
137.0	2.0	26171	5.26	2.6	0.0	2.6	7.8	8.1	0.0	0.0
138.0	2.0	26139	5.26	2.5	0.0	2.5	7.7	8.1	0.0	0.0
139.0	1.9	26108	5.26	2.4	0.0	2.4	7.6	8.1	0.0	0.0
140.0	1.9	26078	5.25	2.4	0.0	2.4	7.6	8.1	0.0	0.0
141.0	1.8	26048	5.25	2.3	0.0	2.3	7.5	8.1	0.0	0.0
142.0	1.8	26019	5.24	2.3	0.0	2.3	7.5	8.1	0.0	0.0
143.0	1.7	25990	5.24	2.2	0.0	2.2	7.4	8.1	0.0	0.0
144.0	1.7	25962	5.23	2.1	0.0	2.1	7.3	8.1	0.0	0.0

CDM

TIME	INFLOW	STORAGE	STAGE	OUTFLOW	CULVERT/ LOW LEVEL	RISER WEIR	RISER ORIFICE	BARREL ORIFICE	OVERFLOW WEIR	ES WEIR
(min)	(cfs)	(cf)	(ft)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
145.0	1.6	25935	5.23	2.1	0.0	2.1	7.3	8.1	0.0	0.0
146.0	1.6	25908	5.23	2.0	0.0	2.0	7.2	8.1	0.0	0.0
147.0	1.6	25881	5.22	2.0	0.0	2.0	7.2	8.1	0.0	0.0
148.0	1.5	25855	5.22	1.9	0.0	1.9	7.1	8.1	0.0	0.0
149.0	1.5	25830	5.22	1.9	0.0	1.9	7.0	8.1	0.0	0.0
150.0	1.4	25805	5.21	1.8	0.0	1.8	7.0	8.1	0.0	0.0
151.0	1.4	25780	5.21	1.8	0.0	1.8	6.9	8.1	0.0	0.0
152.0	1.4	25756	5.21	1.8	0.0	1.8	6.9	8.1	0.0	0.0
153.0	1.3	25733	5.20	1.7	0.0	1.7	6.8	8.1	0.0	0.0
154.0	1.3	25709	5.20	1.7	0.0	1.7	6.8	8.0	0.0	0.0
155.0	1.3	25687	5.20	1.6	0.0	1.6	6.7	8.0	0.0	0.0
156.0	1.2	25664	5.19	1.6	0.0	1.6	6.6	8.0	0.0	0.0
157.0	1.2	25642	5.19	1.6	0.0	1.6	6.6	8.0	0.0	0.0
158.0	1.2	25621	5.19	1.5	0.0	1.5	6.5	8.0	0.0	0.0
159.0	1.1	25599	5.18	1.5	0.0	1.5	6.5	8.0	0.0	0.0
160.0	1.1	25578	5.18	1.4	0.0	1.4	6.4	8.0	0.0	0.0
161.0	1.1	25558	5.18	1.4	0.0	1.4	6.4	8.0	0.0	0.0
162.0	1.0	25538	5.17	1.4	0.0	1.4	6.3	8.0	0.0	0.0
163.0	1.0	25518	5.17	1.3	0.0	1.3	6.3	8.0	0.0	0.0
164.0	1.0	25498	5.17	1.3	0.0	1.3	6.2	8.0	0.0	0.0
165.0	1.0	25479	5.17	1.3	0.0	1.3	6.2	8.0	0.0	0.0
166.0	0.9	25460	5.16	1.3	0.0	1.3	6.1	8.0	0.0	0.0
167.0	0.9	25442	5.16	1.2	0.0	1.2	6.1	8.0	0.0	0.0
168.0	0.9	25424	5.16	1.2	0.0	1.2	6.0	8.0	0.0	0.0
169.0	0.9	25406	5.16	1.2	0.0	1.2	6.0	8.0	0.0	0.0
170.0	0.8	25388	5.15	1.1	0.0	1.1	5.9	8.0	0.0	0.0
171.0	0.8	25371	5.15	1.1	0.0	1.1	5.9	8.0	0.0	0.0
172.0	0.8	25354	5.15	1.1	0.0	1.1	5.8	8.0	0.0	0.0
173.0	0.8	25337	5.15	1.1	0.0	1.1	5.8	8.0	0.0	0.0
174.0	0.8	25321	5.14	1.0	0.0	1.0	5.7	8.0	0.0	0.0
175.0	0.7	25305	5.14	1.0	0.0	1.0	5.7	8.0	0.0	0.0
176.0	0.7	25289	5.14	1.0	0.0	1.0	5.6	8.0	0.0	0.0
177.0	0.7	25274	5.14	1.0	0.0	1.0	5.6	8.0	0.0	0.0
178.0	0.7	25258	5.14	0.9	0.0	0.9	5.6	8.0	0.0	0.0
179.0	0.7	25243	5.13	0.9	0.0	0.9	5.5	8.0	0.0	0.0
180.0	0.6	25228	5.13	0.9	0.0	0.9	5.5	8.0	0.0	0.0
181.0	0.6	25214	5.13	0.9	0.0	0.9	5.4	8.0	0.0	0.0
182.0	0.6	25200	5.13	0.9	0.0	0.9	5.4	8.0	0.0	0.0
183.0	0.6	25186	5.12	0.8	0.0	0.8	5.3	8.0	0.0	0.0
184.0	0.6	25172	5.12	0.8	0.0	0.8	5.3	8.0	0.0	0.0
185.0	0.6	25158	5.12	0.8	0.0	0.8	5.3	8.0	0.0	0.0
186.0	0.6	25145	5.12	0.8	0.0	0.8	5.2	8.0	0.0	0.0
187.0	0.5	25132	5.12	0.8	0.0	0.8	5.2	8.0	0.0	0.0
188.0	0.5	25119	5.12	0.7	0.0	0.7	5.1	8.0	0.0	0.0
189.0	0.5	25106	5.11	0.7	0.0	0.7	5.1	8.0	0.0	0.0
190.0	0.5	25094	5.11	0.7	0.0	0.7	5.1	8.0	0.0	0.0
191.0	0.5	25081	5.11	0.7	0.0	0.7	5.0	8.0	0.0	0.0
192.0	0.5	25069	5.11	0.7	0.0	0.7	5.0	8.0	0.0	0.0
193.0	0.5	25057	5.11	0.7	0.0	0.7	4.9	8.0	0.0	0.0
194.0	0.4	25046	5.10	0.6	0.0	0.6	4.9	8.0	0.0	0.0
195.0	0.4	25034	5.10	0.6	0.0	0.6	4.9	8.0	0.0	0.0
196.0	0.4	25023	5.10	0.6	0.0	0.6	4.8	8.0	0.0	0.0
197.0	0.4	25012	5.10	0.6	0.0	0.6	4.8	8.0	0.0	0.0
198.0	0.4	25001	5.10	0.6	0.0	0.6	4.7	8.0	0.0	0.0
199.0	0.4	24990	5.10	0.6	0.0	0.6	4.7	8.0	0.0	0.0
200.0	0.4	24980	5.10	0.6	0.0	0.6	4.7	8.0	0.0	0.0

Client:	Buncombe County
Project:	Landfill Operation
Task:	Pond Routing

Computed By:	M. Sloop
Date:	4/30/2009
Checked By:	

SMALL WATERSHED HYDROGRAPH FORMULATION

Return Period	25	years	NOAA g:	
Duration	24	hours	NOAA h:	
Precipitation	5.79	in		
SCS CN	85			

Watershed Flow Characteristics

Watershed Area	4.84	acres
Hydraulic Length:		feet
Maximum Elevation:		
Minimum Elevation:		
Total Relief:	0	feet
Kirpich K:	1	
Time of Concentration	0.0	minutes
Use T_C =	6.8	minutes

Composite C Determination

Land Use	Ci		Ai	Ci*Ai
Impervious				0
Undisturbed	0.35		2.84	0.994
Disturbed	0.60		2.00	1.2
Pond				0
		Σ	4.84	2.194
			Cc	**0.45**

CALCULATED:

				Calculated	Estimated	Use	
Soil Storage	1.76	inches	Intensity	0.0	8.09	8.1	inches/hour
Runoff Depth	4.10	inches	Discharge	18		18	cfs
Volume of Runoff	19.9	acre-inches					
Time to Peak	49	minutes	Method of Discharge Estimate:			Rational Method	
Use T_P =	49	minutes					

HYDROGRAPH FORMULATION : By step function developed by H.R. Malcom, Ph.D., P.E., North Carolina State University
(Patterned after SCS dimensionless unit hydrograph)

Time (min)	Q (cfs)	Time (min)	Q (cfs)	Time (min)	Q (cfs)	Time (min)	Q (cfs)	Time (min)	Q (cfs)	Time (min)	Q (cfs)
0	0.0	36	14.8	72	11.4	108	4.4	144	1.7	180	0.6
1	0.0	37	15.2	73	11.1	109	4.3	145	1.6	181	0.6
2	0.1	38	15.6	74	10.8	110	4.2	146	1.6	182	0.6
3	0.2	39	16.0	75	10.5	111	4.1	147	1.6	183	0.6
4	0.3	40	16.3	76	10.3	112	3.9	148	1.5	184	0.6
5	0.5	41	16.6	77	10.0	113	3.8	149	1.5	185	0.6
6	0.6	42	16.9	78	9.7	114	3.7	150	1.4	186	0.6
7	0.9	43	17.1	79	9.5	115	3.6	151	1.4	187	0.5
8	1.1	44	17.3	80	9.2	116	3.5	152	1.4	188	0.5
9	1.4	45	17.5	81	9.0	117	3.5	153	1.3	189	0.5
10	1.8	46	17.6	82	8.7	118	3.4	154	1.3	190	0.5
11	2.1	47	17.7	83	8.5	119	3.3	155	1.3	191	0.5
12	2.5	48	17.7	84	8.3	120	3.2	156	1.2	192	0.5
13	2.9	49	17.7	85	8.1	121	3.1	157	1.2	193	0.5
14	3.3	50	17.7	86	7.9	122	3.0	158	1.2	194	0.4
15	3.8	51	17.7	87	7.7	123	2.9	159	1.1	195	0.4
16	4.3	52	17.6	88	7.5	124	2.9	160	1.1	196	0.4
17	4.8	53	17.5	89	7.3	125	2.8	161	1.1	197	0.4
18	5.3	54	17.3	90	7.1	126	2.7	162	1.0	198	0.4
19	5.8	55	17.1	91	6.9	127	2.7	163	1.0	199	0.4
20	6.3	56	16.9	92	6.7	128	2.6	164	1.0	200	0.4
21	6.9	57	16.6	93	6.5	129	2.5	165	1.0		
22	7.5	58	16.3	94	6.4	130	2.4	166	0.9		
23	8.0	59	16.0	95	6.2	131	2.4	167	0.9		
24	8.6	60	15.6	96	6.0	132	2.3	168	0.9		
25	9.2	61	15.2	97	5.9	133	2.3	169	0.9		
26	9.7	62	14.9	98	5.7	134	2.2	170	0.8		
27	10.3	63	14.5	99	5.6	135	2.1	171	0.8		
28	10.8	64	14.1	100	5.4	136	2.1	172	0.8		
29	11.4	65	13.7	101	5.3	137	2.0	173	0.8		
30	11.9	66	13.4	102	5.1	138	2.0	174	0.8		
31	12.5	67	13.0	103	5.0	139	1.9	175	0.7		
32	13.0	68	12.7	104	4.9	140	1.9	176	0.7		
33	13.5	69	12.3	105	4.8	141	1.8	177	0.7		
34	14.0	70	12.0	106	4.6	142	1.8	178	0.7		
35	14.4	71	11.7	107	4.5	143	1.7	179	0.7		

Client:	Buncombe County
Project:	Landfill Operation
Task:	Pond Routing

Computed By:	M. Sloop
Date:	4/30/2009
Checked By:	

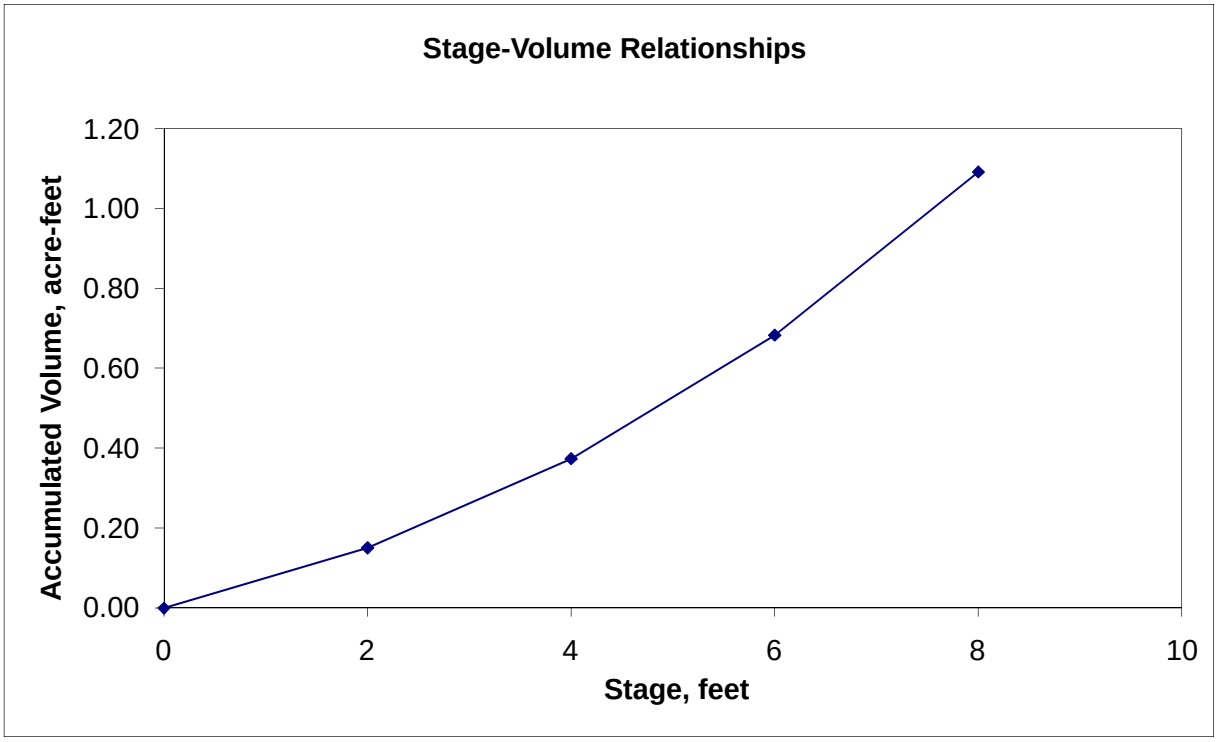
OBJECTIVE
Determine the stage-storage and associated Ks and b values

BACKGROUND
Stage-Storage Function obtained from H.R. Malcom CE785 course pack.

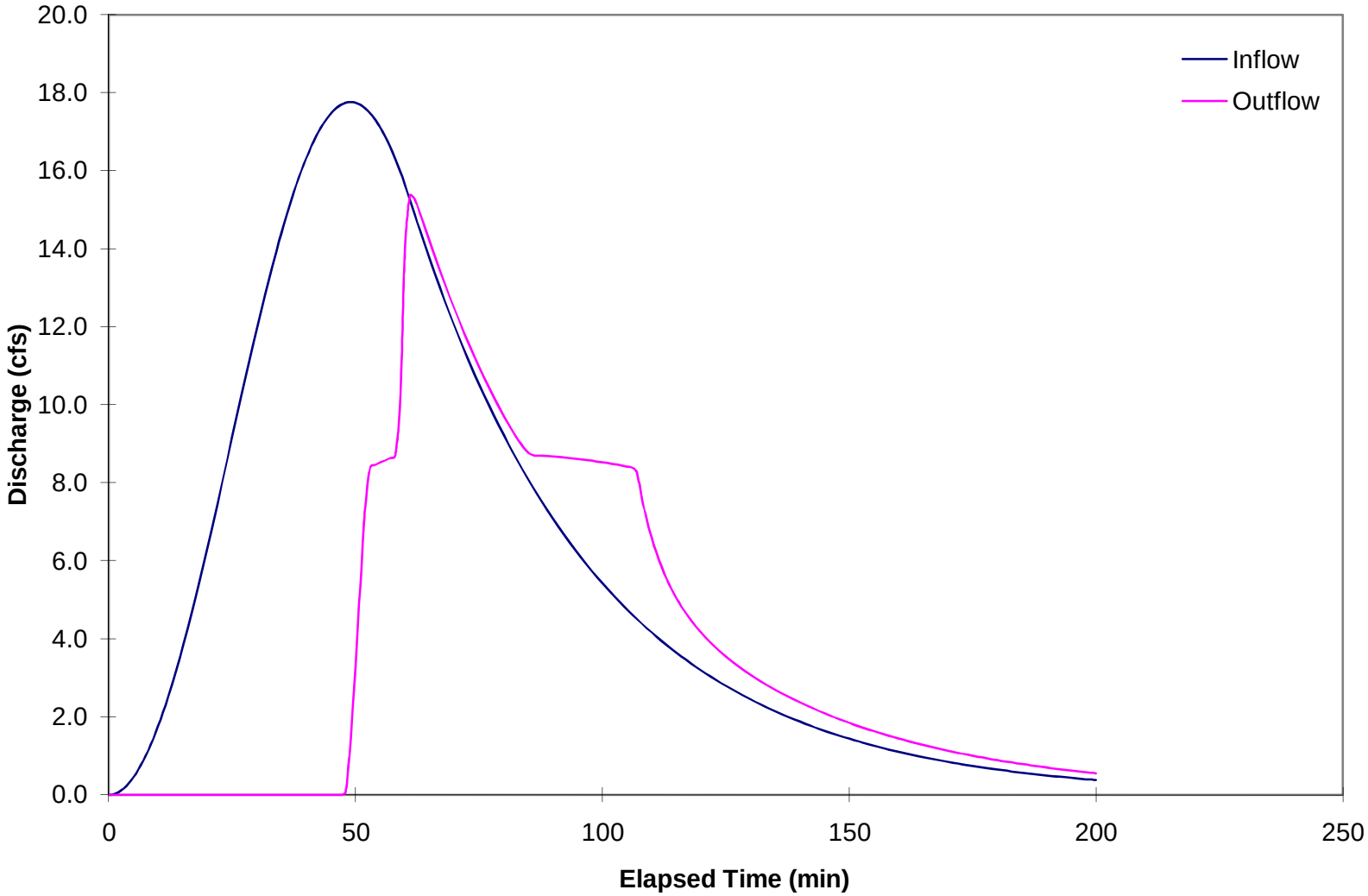
DEVELOPMENT

Elevation (ft)	Stage (ft)	Area (sf)	Incr. Vol (cf)	Acc. Vol (cf)	LN S	LN Z	Z est (ft)	Acc. Vol (ac-ft)
1962	0	2,574	0	0	---	---	---	0.00
1964	2	4,000	6,574	6,574	8.8	0.7	2.0	0.15
1966	4	5,721	9,721	16,295	9.7	1.4	3.8	0.37
1968	6	7,743	13,464	29,759	10.3	1.8	5.8	0.68
1970	8	10,059	17,802	47,561	10.8	2.1	8.0	1.09

b=	**1.43**
Ks=	**2444**



INFLOW-OUTFLOW HYDROGRAPHS



CDM

Attachment #4
Inflow/Outflow Hydrograph - Pond 12
Page 1

Client:	Buncombe County	Computed By:	M. Sloop
Project:	Landfill Operation	Date:	4/30/2009
Task:	Pond Routing	Checked By:	

OBJECTIVE

Check the Pond 13 design for the 25-year, 24-hour design storm event.

BACKGROUND

Routing perfomed by the chainsaw method as outlined by HR Malcom, PE, Ph.D, NCSU

Parameters input by the user.

DEVELOPMENT

SYSTEM PARAMETERS

Time Step (minutes)	1.0

Riser Barrel Spillway

Weir Configuration:	CMP Riser
Weir Diameter (inches):	36
Weir Length (feet):	9.42
Weir Area (square feet):	7.07
Weir Coefficient	3.00
Discharge Coefficient:	0.60
Crest Elevation:	1887.75
Barrel Configuration:	CMP Barrel
Barrel Diameter (inches):	18
Discharge Coefficient	0.59
Number of Barrels	1
Barrel Invert In	1880.0

Emergency Spillway

Weir Configuration:	Concrete
Weir Length (feet):	80.0
ES Crest Elevation:	1888.75
Weir Coefficient:	3.00

Sharp Crested Weir Spillway

Weir Configuration:	Sharp Crested
Weir Length (feet):	0.0
Crest Elevation:	0.0
Weir Coefficient:	0.00

Circular Culvert / Low Level Outlet

Conduit Configuration:	CMP Barrel
Conduit Diameter (inches):	0
Number of Conduits:	0
Discharge Coefficient:	0
Effective Flow Area (ratio):	0
Conduit Invert In	0

Design Settling Particle

D_{15} (Microns) =	40
Specific Gravity	2.6
Number of effective cells	2
V_{SET} (fps) =	4.01E-03

ROUTING CONTROL & RESULTS

Return Period	25	years	Pond Invert EL	1882.0	feet	Max principal flow	24	cfs
Peak Runoff	54.9	cfs	Pond Crest EL	1890.0	feet	ES Max Discharge	27	cfs
Precipitation	5.79	inches	Initial WS EL	1882.0	feet	ES Depth of Flow	0.16	feet
Drainage Area	24.6	acres	Max Stage EL	1889.0	feet	ES Max Velocity	2.18	fps
Min Sett Eff		percent	Max Storage	3.4	acre-feet			
Ks =	13753		Max Stage	6.99	feet			
b =	1.22							

TIME	INFLOW	STORAGE	STAGE	OUTFLOW	CULVERT/ LOW LEVEL	RISER WEIR	RISER ORIFICE	BARREL ORIFICE	OVERFLOW WEIR	ES WEIR
(min)	(cfs)	(cf)	(ft)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
0	0.0	0	0.00	0.0	0.0	0.0	0.0	9.3	0.0	0.0
1.0	0.0	0	0.00	0.0	0.0	0.0	0.0	9.3	0.0	0.0
2.0	0.1	1	0.00	0.0	0.0	0.0	0.0	9.3	0.0	0.0
3.0	0.2	6	0.00	0.0	0.0	0.0	0.0	9.3	0.0	0.0
4.0	0.3	18	0.00	0.0	0.0	0.0	0.0	9.4	0.0	0.0
5.0	0.5	38	0.01	0.0	0.0	0.0	0.0	9.4	0.0	0.0
6.0	0.8	70	0.01	0.0	0.0	0.0	0.0	9.4	0.0	0.0
7.0	1.0	115	0.02	0.0	0.0	0.0	0.0	9.4	0.0	0.0
8.0	1.3	177	0.03	0.0	0.0	0.0	0.0	9.4	0.0	0.0
9.0	1.7	257	0.04	0.0	0.0	0.0	0.0	9.5	0.0	0.0
10.0	2.1	359	0.05	0.0	0.0	0.0	0.0	9.5	0.0	0.0
11.0	2.5	484	0.06	0.0	0.0	0.0	0.0	9.6	0.0	0.0
12.0	3.0	636	0.08	0.0	0.0	0.0	0.0	9.6	0.0	0.0
13.0	3.5	815	0.10	0.0	0.0	0.0	0.0	9.7	0.0	0.0
14.0	4.0	1025	0.12	0.0	0.0	0.0	0.0	9.8	0.0	0.0

CDM

TIME	INFLOW	STORAGE	STAGE	OUTFLOW	CULVERT/ LOW LEVEL	RISER WEIR	RISER ORIFICE	BARREL ORIFICE	OVERFLOW WEIR	ES WEIR
(min)	(cfs)	(cf)	(ft)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
15.0	4.6	1267	0.14	0.0	0.0	0.0	0.0	9.9	0.0	0.0
16.0	5.2	1545	0.17	0.0	0.0	0.0	0.0	9.9	0.0	0.0
17.0	5.9	1859	0.19	0.0	0.0	0.0	0.0	10.0	0.0	0.0
18.0	6.6	2212	0.22	0.0	0.0	0.0	0.0	10.1	0.0	0.0
19.0	7.3	2607	0.26	0.0	0.0	0.0	0.0	10.2	0.0	0.0
20.0	8.0	3044	0.29	0.0	0.0	0.0	0.0	10.4	0.0	0.0
21.0	8.8	3526	0.33	0.0	0.0	0.0	0.0	10.5	0.0	0.0
22.0	9.6	4054	0.37	0.0	0.0	0.0	0.0	10.6	0.0	0.0
23.0	10.4	4631	0.41	0.0	0.0	0.0	0.0	10.8	0.0	0.0
24.0	11.3	5258	0.45	0.0	0.0	0.0	0.0	10.9	0.0	0.0
25.0	12.2	5936	0.50	0.0	0.0	0.0	0.0	11.1	0.0	0.0
26.0	13.1	6668	0.55	0.0	0.0	0.0	0.0	11.2	0.0	0.0
27.0	14.0	7454	0.60	0.0	0.0	0.0	0.0	11.4	0.0	0.0
28.0	15.0	8295	0.66	0.0	0.0	0.0	0.0	11.5	0.0	0.0
29.0	15.9	9194	0.72	0.0	0.0	0.0	0.0	11.7	0.0	0.0
30.0	16.9	10150	0.78	0.0	0.0	0.0	0.0	11.9	0.0	0.0
31.0	17.9	11166	0.84	0.0	0.0	0.0	0.0	12.1	0.0	0.0
32.0	19.0	12242	0.91	0.0	0.0	0.0	0.0	12.3	0.0	0.0
33.0	20.0	13380	0.98	0.0	0.0	0.0	0.0	12.5	0.0	0.0
34.0	21.0	14579	1.05	0.0	0.0	0.0	0.0	12.7	0.0	0.0
35.0	22.1	15840	1.12	0.0	0.0	0.0	0.0	12.9	0.0	0.0
36.0	23.1	17165	1.20	0.0	0.0	0.0	0.0	13.1	0.0	0.0
37.0	24.2	18553	1.28	0.0	0.0	0.0	0.0	13.3	0.0	0.0
38.0	25.3	20005	1.36	0.0	0.0	0.0	0.0	13.5	0.0	0.0
39.0	26.4	21522	1.44	0.0	0.0	0.0	0.0	13.7	0.0	0.0
40.0	27.4	23103	1.53	0.0	0.0	0.0	0.0	13.9	0.0	0.0
41.0	28.5	24748	1.62	0.0	0.0	0.0	0.0	14.2	0.0	0.0
42.0	29.6	26459	1.71	0.0	0.0	0.0	0.0	14.4	0.0	0.0
43.0	30.7	28234	1.80	0.0	0.0	0.0	0.0	14.6	0.0	0.0
44.0	31.7	30073	1.90	0.0	0.0	0.0	0.0	14.8	0.0	0.0
45.0	32.8	31976	2.00	0.0	0.0	0.0	0.0	15.1	0.0	0.0
46.0	33.8	33943	2.10	0.0	0.0	0.0	0.0	15.3	0.0	0.0
47.0	34.9	35972	2.20	0.0	0.0	0.0	0.0	15.5	0.0	0.0
48.0	35.9	38065	2.31	0.0	0.0	0.0	0.0	15.8	0.0	0.0
49.0	36.9	40219	2.41	0.0	0.0	0.0	0.0	16.0	0.0	0.0
50.0	37.9	42434	2.52	0.0	0.0	0.0	0.0	16.2	0.0	0.0
51.0	38.9	44710	2.63	0.0	0.0	0.0	0.0	16.5	0.0	0.0
52.0	39.9	47044	2.74	0.0	0.0	0.0	0.0	16.7	0.0	0.0
53.0	40.8	49437	2.86	0.0	0.0	0.0	0.0	16.9	0.0	0.0
54.0	41.8	51887	2.97	0.0	0.0	0.0	0.0	17.2	0.0	0.0
55.0	42.7	54393	3.09	0.0	0.0	0.0	0.0	17.4	0.0	0.0
56.0	43.5	56952	3.21	0.0	0.0	0.0	0.0	17.6	0.0	0.0
57.0	44.4	59565	3.33	0.0	0.0	0.0	0.0	17.9	0.0	0.0
58.0	45.2	62230	3.45	0.0	0.0	0.0	0.0	18.1	0.0	0.0
59.0	46.0	64944	3.58	0.0	0.0	0.0	0.0	18.4	0.0	0.0
60.0	46.8	67707	3.70	0.0	0.0	0.0	0.0	18.6	0.0	0.0
61.0	47.6	70517	3.83	0.0	0.0	0.0	0.0	18.8	0.0	0.0
62.0	48.3	73371	3.95	0.0	0.0	0.0	0.0	19.1	0.0	0.0
63.0	49.0	76268	4.08	0.0	0.0	0.0	0.0	19.3	0.0	0.0
64.0	49.6	79206	4.21	0.0	0.0	0.0	0.0	19.5	0.0	0.0
65.0	50.2	82183	4.34	0.0	0.0	0.0	0.0	19.7	0.0	0.0
66.0	50.8	85197	4.47	0.0	0.0	0.0	0.0	20.0	0.0	0.0
67.0	51.4	88246	4.60	0.0	0.0	0.0	0.0	20.2	0.0	0.0
68.0	51.9	91327	4.73	0.0	0.0	0.0	0.0	20.4	0.0	0.0
69.0	52.3	94439	4.86	0.0	0.0	0.0	0.0	20.7	0.0	0.0
70.0	52.8	97579	4.99	0.0	0.0	0.0	0.0	20.9	0.0	0.0
71.0	53.2	100745	5.13	0.0	0.0	0.0	0.0	21.1	0.0	0.0
72.0	53.5	103935	5.26	0.0	0.0	0.0	0.0	21.3	0.0	0.0
73.0	53.8	107146	5.39	0.0	0.0	0.0	0.0	21.5	0.0	0.0
74.0	54.1	110376	5.53	0.0	0.0	0.0	0.0	21.7	0.0	0.0
75.0	54.3	113621	5.66	0.0	0.0	0.0	0.0	22.0	0.0	0.0
76.0	54.5	116881	5.79	0.2	0.0	0.2	6.9	22.2	0.0	0.0
77.0	54.7	120138	5.92	2.0	0.0	2.0	14.2	22.4	0.0	0.0
78.0	54.8	123296	6.05	4.7	0.0	4.7	18.7	22.6	0.0	0.0
79.0	54.8	126302	6.17	7.7	0.0	7.7	22.1	22.8	0.0	0.0

CDM

TIME	INFLOW	STORAGE	STAGE	OUTFLOW	CULVERT/ LOW LEVEL	RISER WEIR	RISER ORIFICE	BARREL ORIFICE	OVERFLOW WEIR	ES WEIR
(min)	(cfs)	(cf)	(ft)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
80.0	54.9	129128	6.28	11.1	0.0	11.1	24.9	22.9	0.0	0.0
81.0	54.8	131755	6.39	14.5	0.0	14.5	27.2	23.1	0.0	0.0
82.0	54.8	134178	6.49	17.8	0.0	17.8	29.2	23.2	0.0	0.0
83.0	54.7	136394	6.57	21.1	0.0	21.1	30.9	23.4	0.0	0.0
84.0	54.5	138406	6.65	23.5	0.0	24.3	32.3	23.5	0.0	0.0
85.0	54.3	140268	6.73	23.6	0.0	27.3	33.6	23.6	0.0	0.0
86.0	54.1	142112	6.80	26.3	0.0	30.4	34.9	23.7	0.0	2.6
87.0	53.8	143780	6.86	33.1	0.0	33.3	35.9	23.8	0.0	9.3
88.0	53.5	145025	6.91	39.7	0.0	35.5	36.7	23.9	0.0	15.8
89.0	53.2	145855	6.95	44.7	0.0	37.0	37.2	23.9	0.0	20.8
90.0	52.8	146364	6.97	47.9	0.0	37.9	37.5	23.9	0.0	24.0
91.0	52.3	146653	6.98	49.9	0.0	38.4	37.7	24.0	0.0	25.9
92.0	51.9	146801	6.98	50.9	0.0	38.7	37.8	24.0	0.0	26.9
93.0	51.4	146860	6.98	51.3	0.0	38.8	37.8	24.0	0.0	27.3
94.0	50.8	146865	6.99	51.3	0.0	38.8	37.8	24.0	0.0	27.3
95.0	50.2	146835	6.98	51.1	0.0	38.7	37.8	24.0	0.0	27.1
96.0	49.6	146782	6.98	50.7	0.0	38.7	37.8	24.0	0.0	26.8
97.0	49.0	146714	6.98	50.3	0.0	38.5	37.7	24.0	0.0	26.3
98.0	48.3	146635	6.98	49.8	0.0	38.4	37.7	24.0	0.0	25.8
99.0	47.6	146547	6.97	49.2	0.0	38.2	37.6	24.0	0.0	25.2
100.0	46.8	146451	6.97	48.5	0.0	38.0	37.6	23.9	0.0	24.6
101.0	46.1	146349	6.96	47.8	0.0	37.9	37.5	23.9	0.0	23.9
102.0	45.4	146246	6.96	47.2	0.0	37.7	37.5	23.9	0.0	23.2
103.0	44.6	146138	6.96	46.5	0.0	37.5	37.4	23.9	0.0	22.5
104.0	43.9	146029	6.95	45.8	0.0	37.3	37.3	23.9	0.0	21.8
105.0	43.2	145918	6.95	45.1	0.0	37.1	37.3	23.9	0.0	21.2
106.0	42.5	145807	6.94	44.4	0.0	36.9	37.2	23.9	0.0	20.5
107.0	41.8	145696	6.94	43.7	0.0	36.7	37.1	23.9	0.0	19.8
108.0	41.2	145586	6.94	43.0	0.0	36.5	37.0	23.9	0.0	19.1
109.0	40.5	145475	6.93	42.3	0.0	36.3	37.0	23.9	0.0	18.4
110.0	39.8	145365	6.93	41.7	0.0	36.1	36.9	23.9	0.0	17.8
111.0	39.2	145256	6.92	41.0	0.0	35.9	36.8	23.9	0.0	17.1
112.0	38.6	145147	6.92	40.4	0.0	35.7	36.8	23.9	0.0	16.5
113.0	38.0	145038	6.91	39.8	0.0	35.5	36.7	23.9	0.0	15.9
114.0	37.3	144930	6.91	39.1	0.0	35.3	36.6	23.9	0.0	15.3
115.0	36.7	144822	6.91	38.5	0.0	35.1	36.6	23.9	0.0	14.7
116.0	36.1	144715	6.90	37.9	0.0	34.9	36.5	23.8	0.0	14.1
117.0	35.6	144608	6.90	37.3	0.0	34.7	36.4	23.8	0.0	13.5
118.0	35.0	144501	6.89	36.8	0.0	34.5	36.4	23.8	0.0	12.9
119.0	34.4	144395	6.89	36.2	0.0	34.3	36.3	23.8	0.0	12.4
120.0	33.9	144289	6.88	35.6	0.0	34.2	36.2	23.8	0.0	11.8
121.0	33.3	144183	6.88	35.1	0.0	34.0	36.2	23.8	0.0	11.3
122.0	32.8	144077	6.88	34.5	0.0	33.8	36.1	23.8	0.0	10.7
123.0	32.3	143971	6.87	34.0	0.0	33.6	36.0	23.8	0.0	10.2
124.0	31.7	143866	6.87	33.5	0.0	33.4	36.0	23.8	0.0	9.7
125.0	31.2	143761	6.86	33.0	0.0	33.2	35.9	23.8	0.0	9.2
126.0	30.7	143655	6.86	32.5	0.0	33.0	35.8	23.8	0.0	8.7
127.0	30.2	143550	6.86	32.0	0.0	32.9	35.8	23.8	0.0	8.2
128.0	29.7	143444	6.85	31.5	0.0	32.7	35.7	23.8	0.0	7.7
129.0	29.3	143338	6.85	31.0	0.0	32.5	35.6	23.8	0.0	7.3
130.0	28.8	143233	6.84	30.6	0.0	32.3	35.6	23.8	0.0	6.8
131.0	28.3	143126	6.84	30.1	0.0	32.1	35.5	23.8	0.0	6.3
132.0	27.9	143020	6.83	29.7	0.0	31.9	35.4	23.8	0.0	5.9
133.0	27.4	142913	6.83	29.2	0.0	31.7	35.4	23.7	0.0	5.5
134.0	27.0	142805	6.83	28.8	0.0	31.6	35.3	23.7	0.0	5.0
135.0	26.5	142697	6.82	28.4	0.0	31.4	35.2	23.7	0.0	4.6
136.0	26.1	142588	6.82	27.9	0.0	31.2	35.2	23.7	0.0	4.2
137.0	25.7	142478	6.81	27.5	0.0	31.0	35.1	23.7	0.0	3.8
138.0	25.3	142367	6.81	27.2	0.0	30.8	35.0	23.7	0.0	3.4
139.0	24.9	142255	6.80	26.8	0.0	30.6	35.0	23.7	0.0	3.1
140.0	24.5	142141	6.80	26.4	0.0	30.4	34.9	23.7	0.0	2.7
141.0	24.1	142026	6.80	26.0	0.0	30.2	34.8	23.7	0.0	2.3
142.0	23.7	141909	6.79	25.7	0.0	30.0	34.7	23.7	0.0	2.0
143.0	23.3	141790	6.79	25.3	0.0	29.8	34.6	23.7	0.0	1.7
144.0	22.9	141668	6.78	25.0	0.0	29.6	34.6	23.7	0.0	1.3

CDM

TIME	INFLOW	STORAGE	STAGE	OUTFLOW	CULVERT/ LOW LEVEL	RISER WEIR	RISER ORIFICE	BARREL ORIFICE	OVERFLOW WEIR	ES WEIR
(min)	(cfs)	(cf)	(ft)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
145.0	22.6	141543	6.78	24.7	0.0	29.4	34.5	23.7	0.0	1.0
146.0	22.2	141414	6.77	24.4	0.0	29.2	34.4	23.7	0.0	0.8
147.0	21.8	141281	6.77	24.2	0.0	29.0	34.3	23.7	0.0	0.5
148.0	21.5	141143	6.76	23.9	0.0	28.7	34.2	23.6	0.0	0.3
149.0	21.1	140997	6.76	23.7	0.0	28.5	34.1	23.6	0.0	0.1
150.0	20.8	140842	6.75	23.6	0.0	28.2	34.0	23.6	0.0	0.0
151.0	20.5	140673	6.74	23.6	0.0	28.0	33.9	23.6	0.0	0.0
152.0	20.1	140484	6.73	23.6	0.0	27.6	33.8	23.6	0.0	0.0
153.0	19.8	140276	6.73	23.6	0.0	27.3	33.6	23.6	0.0	0.0
154.0	19.5	140049	6.72	23.6	0.0	26.9	33.5	23.6	0.0	0.0
155.0	19.2	139804	6.71	23.6	0.0	26.5	33.3	23.6	0.0	0.0
156.0	18.9	139541	6.70	23.6	0.0	26.1	33.1	23.6	0.0	0.0
157.0	18.6	139260	6.69	23.5	0.0	25.6	32.9	23.5	0.0	0.0
158.0	18.3	138962	6.67	23.5	0.0	25.2	32.7	23.5	0.0	0.0
159.0	18.0	138647	6.66	23.5	0.0	24.6	32.5	23.5	0.0	0.0
160.0	17.7	138315	6.65	23.5	0.0	24.1	32.3	23.5	0.0	0.0
161.0	17.4	137967	6.64	23.5	0.0	23.6	32.0	23.5	0.0	0.0
162.0	17.1	137604	6.62	23.0	0.0	23.0	31.8	23.4	0.0	0.0
163.0	16.8	137251	6.61	22.4	0.0	22.4	31.5	23.4	0.0	0.0
164.0	16.6	136914	6.59	21.9	0.0	21.9	31.3	23.4	0.0	0.0
165.0	16.3	136593	6.58	21.4	0.0	21.4	31.0	23.4	0.0	0.0
166.0	16.0	136285	6.57	21.0	0.0	21.0	30.8	23.4	0.0	0.0
167.0	15.8	135989	6.56	20.5	0.0	20.5	30.6	23.3	0.0	0.0
168.0	15.5	135705	6.55	20.1	0.0	20.1	30.4	23.3	0.0	0.0
169.0	15.3	135431	6.54	19.7	0.0	19.7	30.2	23.3	0.0	0.0
170.0	15.0	135167	6.53	19.3	0.0	19.3	30.0	23.3	0.0	0.0
171.0	14.8	134911	6.51	18.9	0.0	18.9	29.8	23.3	0.0	0.0
172.0	14.5	134664	6.51	18.6	0.0	18.6	29.6	23.3	0.0	0.0
173.0	14.3	134424	6.50	18.2	0.0	18.2	29.4	23.2	0.0	0.0
174.0	14.1	134190	6.49	17.9	0.0	17.9	29.2	23.2	0.0	0.0
175.0	13.9	133964	6.48	17.5	0.0	17.5	29.0	23.2	0.0	0.0
176.0	13.6	133743	6.47	17.2	0.0	17.2	28.8	23.2	0.0	0.0
177.0	13.4	133528	6.46	16.9	0.0	16.9	28.7	23.2	0.0	0.0
178.0	13.2	133318	6.45	16.6	0.0	16.6	28.5	23.2	0.0	0.0
179.0	13.0	133113	6.44	16.3	0.0	16.3	28.3	23.2	0.0	0.0
180.0	12.8	132912	6.44	16.0	0.0	16.0	28.2	23.2	0.0	0.0
181.0	12.6	132716	6.43	15.8	0.0	15.8	28.0	23.1	0.0	0.0
182.0	12.4	132523	6.42	15.5	0.0	15.5	27.9	23.1	0.0	0.0
183.0	12.2	132335	6.41	15.2	0.0	15.2	27.7	23.1	0.0	0.0
184.0	12.0	132150	6.41	15.0	0.0	15.0	27.5	23.1	0.0	0.0
185.0	11.8	131969	6.40	14.7	0.0	14.7	27.4	23.1	0.0	0.0
186.0	11.6	131790	6.39	14.5	0.0	14.5	27.2	23.1	0.0	0.0
187.0	11.4	131615	6.38	14.3	0.0	14.3	27.1	23.1	0.0	0.0
188.0	11.2	131443	6.38	14.0	0.0	14.0	27.0	23.1	0.0	0.0
189.0	11.0	131274	6.37	13.8	0.0	13.8	26.8	23.1	0.0	0.0
190.0	10.9	131107	6.36	13.6	0.0	13.6	26.7	23.1	0.0	0.0
191.0	10.7	130943	6.36	13.4	0.0	13.4	26.5	23.0	0.0	0.0
192.0	10.5	130782	6.35	13.2	0.0	13.2	26.4	23.0	0.0	0.0
193.0	10.3	130622	6.34	13.0	0.0	13.0	26.2	23.0	0.0	0.0
194.0	10.2	130466	6.34	12.8	0.0	12.8	26.1	23.0	0.0	0.0
195.0	10.0	130311	6.33	12.6	0.0	12.6	26.0	23.0	0.0	0.0
196.0	9.9	130159	6.33	12.4	0.0	12.4	25.8	23.0	0.0	0.0
197.0	9.7	130008	6.32	12.2	0.0	12.2	25.7	23.0	0.0	0.0
198.0	9.5	129860	6.31	12.0	0.0	12.0	25.6	23.0	0.0	0.0
199.0	9.4	129714	6.31	11.8	0.0	11.8	25.4	23.0	0.0	0.0
200.0	9.2	129569	6.30	11.6	0.0	11.6	25.3	23.0	0.0	0.0

Client:	Buncombe County
Project:	Landfill Operation
Task:	Stage-Storage

Computed By:	M. Sloop
Date:	4/30/2009
Checked By:	

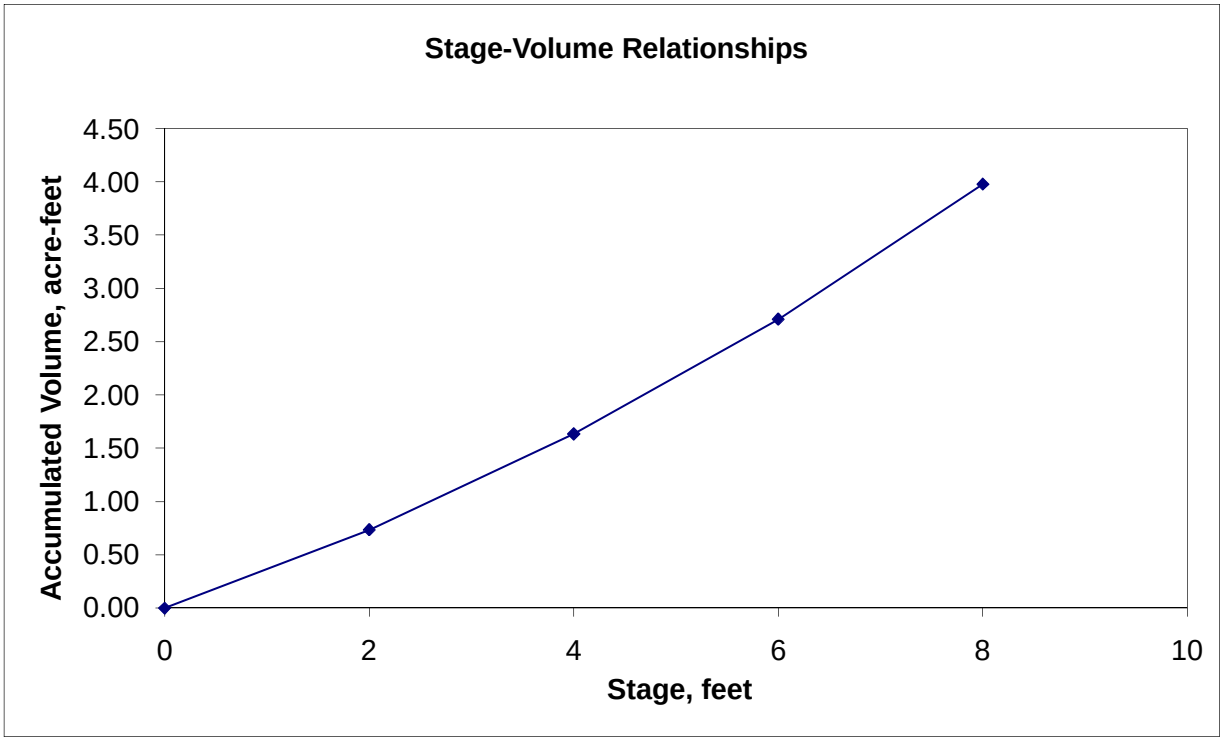
OBJECTIVE
Determine the stage-storage and associated Ks and b values

BACKGROUND
Stage-Storage Function obtained from H.R. Malcom CE785 course pack.

DEVELOPMENT

Elevation (ft)	Stage (ft)	Area (sf)	Incr. Vol (cf)	Acc. Vol (cf)	LN S	LN Z	Z est (ft)	Acc. Vol (ac-ft)
1882	0	14,281	0	0	---	---	---	0.00
1884	2	17,720	32,001	32,001	10.4	0.7	2.0	0.73
1886	4	21,454	39,174	71,175	11.2	1.4	3.9	1.63
1888	6	25,457	46,911	118,086	11.7	1.8	5.8	2.71
1890	8	29,721	55,178	173,264	12.1	2.1	8.0	3.98

b=	**1.22**
Ks=	**13753**



Client:	Buncombe County
Project:	Landfill Operation
Task:	Inflow Hydrograph

Computed By:	M. Sloop
Date:	4/30/2009
Checked By:	

SMALL WATERSHED HYDROGRAPH FORMULATION

Return Period	25	years	NOAA g:	
Duration	24	hours	NOAA h:	
Precipitation	5.79	in		
SCS CN	85			

Watershed Flow Characteristics

Watershed Area	24.58	acres
Hydraulic Length:		feet
Maximum Elevation:		
Minimum Elevation:		
Total Relief:	0	feet
Kirpich K:	1	
Time of Concentration	0.0	minutes
Use T_C =	10+	minutes

Composite C Determination

Land Use	Ci		Ai	Ci*Ai
Wooded	0.2		3.9	0.78
Undisturbed	0.35		18.68	6.538
Disturbed	0.60		2.00	1.2
Pond				0
		Σ	24.58	8.518
			Cc	**0.35**

CALCULATED:

				Calculated	Estimated	Use	
Soil Storage	1.76	inches	Intensity	#VALUE!	6.44	6.4	inches/hour
Runoff Depth	4.10	inches	Discharge	55		55	cfs
Volume of Runoff	100.9	acre-inches					
Time to Peak	80	minutes	Method of Discharge Estimate:			Rational Method	
Use T_P =	80	minutes					

HYDROGRAPH FORMULATION : By step function developed by H.R. Malcom, Ph.D., P.E., North Carolina State University
(Patterned after SCS dimensionless unit hydrograph)

Time (min)	Q (cfs)	Time (min)	Q (cfs)	Time (min)	Q (cfs)	Time (min)	Q (cfs)	Time (min)	Q (cfs)	Time (min)	Q (cfs)
0	0.0	36	23.1	72	53.5	108	41.2	144	22.9	180	12.8
1	0.0	37	24.2	73	53.8	109	40.5	145	22.6	181	12.6
2	0.1	38	25.3	74	54.1	110	39.8	146	22.2	182	12.4
3	0.2	39	26.4	75	54.3	111	39.2	147	21.8	183	12.2
4	0.3	40	27.4	76	54.5	112	38.6	148	21.5	184	12.0
5	0.5	41	28.5	77	54.7	113	38.0	149	21.1	185	11.8
6	0.8	42	29.6	78	54.8	114	37.3	150	20.8	186	11.6
7	1.0	43	30.7	79	54.8	115	36.7	151	20.5	187	11.4
8	1.3	44	31.7	80	54.9	116	36.1	152	20.1	188	11.2
9	1.7	45	32.8	81	54.8	117	35.6	153	19.8	189	11.0
10	2.1	46	33.8	82	54.8	118	35.0	154	19.5	190	10.9
11	2.5	47	34.9	83	54.7	119	34.4	155	19.2	191	10.7
12	3.0	48	35.9	84	54.5	120	33.9	156	18.9	192	10.5
13	3.5	49	36.9	85	54.3	121	33.3	157	18.6	193	10.3
14	4.0	50	37.9	86	54.1	122	32.8	158	18.3	194	10.2
15	4.6	51	38.9	87	53.8	123	32.3	159	18.0	195	10.0
16	5.2	52	39.9	88	53.5	124	31.7	160	17.7	196	9.9
17	5.9	53	40.8	89	53.2	125	31.2	161	17.4	197	9.7
18	6.6	54	41.8	90	52.8	126	30.7	162	17.1	198	9.5
19	7.3	55	42.7	91	52.3	127	30.2	163	16.8	199	9.4
20	8.0	56	43.5	92	51.9	128	29.7	164	16.6	200	9.2
21	8.8	57	44.4	93	51.4	129	29.3	165	16.3		
22	9.6	58	45.2	94	50.8	130	28.8	166	16.0		
23	10.4	59	46.0	95	50.2	131	28.3	167	15.8		
24	11.3	60	46.8	96	49.6	132	27.9	168	15.5		
25	12.2	61	47.6	97	49.0	133	27.4	169	15.3		
26	13.1	62	48.3	98	48.3	134	27.0	170	15.0		
27	14.0	63	49.0	99	47.6	135	26.5	171	14.8		
28	15.0	64	49.6	100	46.8	136	26.1	172	14.5		
29	15.9	65	50.2	101	46.1	137	25.7	173	14.3		
30	16.9	66	50.8	102	45.4	138	25.3	174	14.1		
31	17.9	67	51.4	103	44.6	139	24.9	175	13.9		
32	19.0	68	51.9	104	43.9	140	24.5	176	13.6		
33	20.0	69	52.3	105	43.2	141	24.1	177	13.4		
34	21.0	70	52.8	106	42.5	142	23.7	178	13.2		
35	22.1	71	53.2	107	41.8	143	23.3	179	13.0		

Client:	Buncombe County
Project:	Landfill Operation
Task:	Stage-Storage

Computed By:	M. Sloop
Date:	4/30/2009
Checked By:	

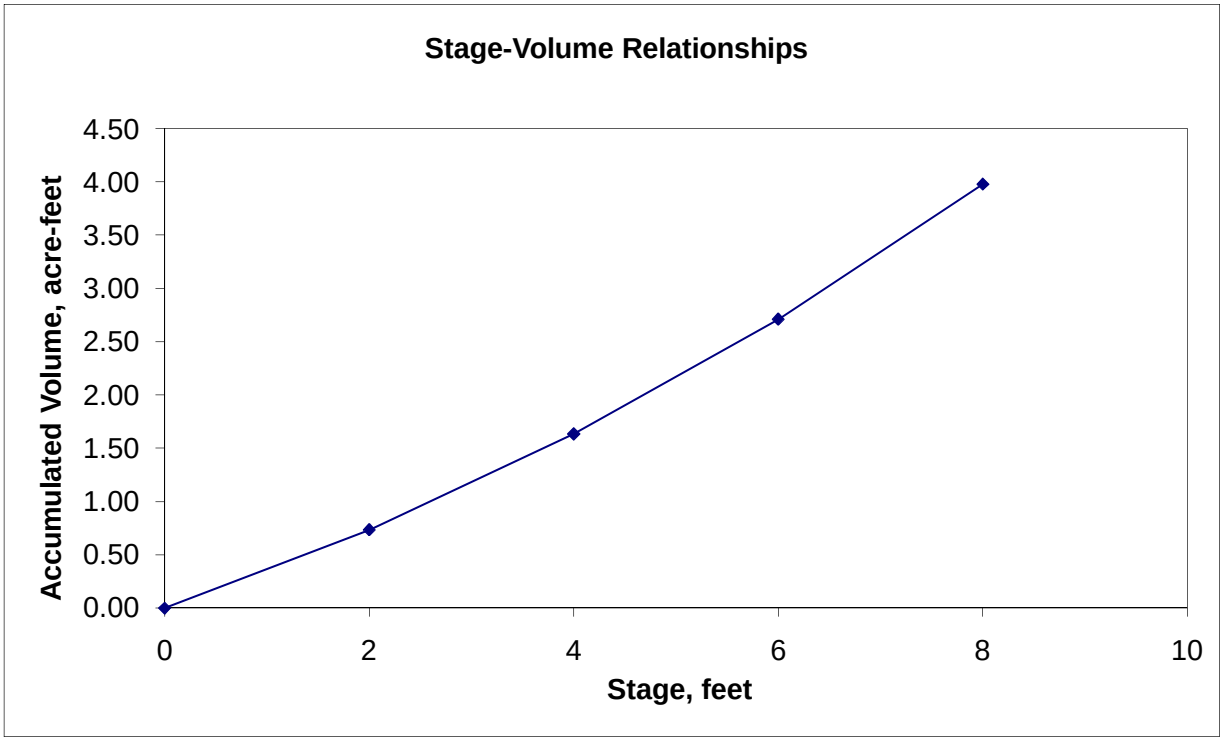
OBJECTIVE
Determine the stage-storage and associated Ks and b values

BACKGROUND
Stage-Storage Function obtained from H.R. Malcom CE785 course pack.

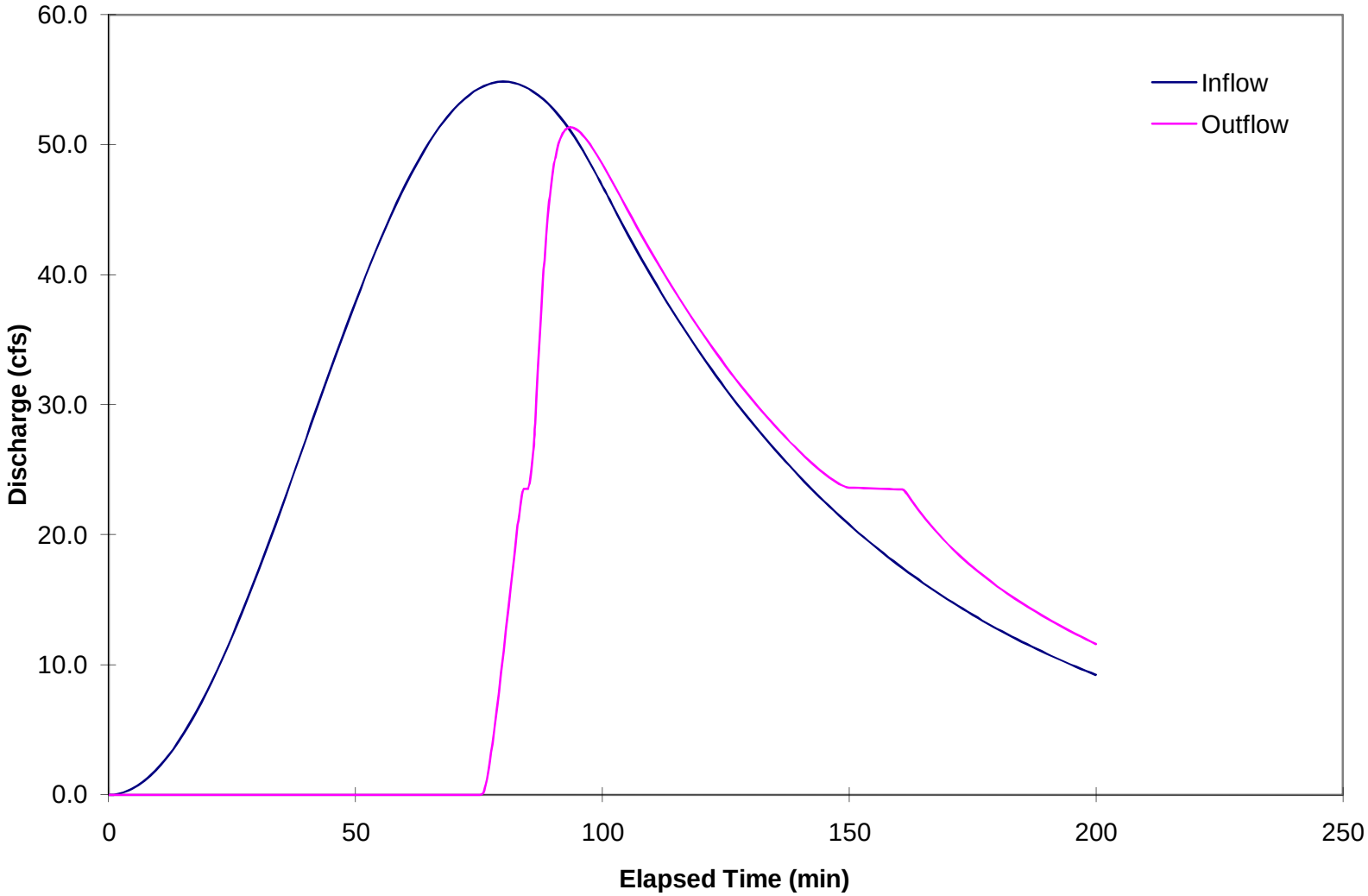
DEVELOPMENT

Elevation (ft)	Stage (ft)	Area (sf)	Incr. Vol (cf)	Acc. Vol (cf)	LN S	LN Z	Z est (ft)	Acc. Vol (ac-ft)
1882	0	14,281	0	0	---	---	---	0.00
1884	2	17,720	32,001	32,001	10.4	0.7	2.0	0.73
1886	4	21,454	39,174	71,175	11.2	1.4	3.9	1.63
1888	6	25,457	46,911	118,086	11.7	1.8	5.8	2.71
1890	8	29,721	55,178	173,264	12.1	2.1	8.0	3.98

b=	**1.22**
Ks=	**13753**



INFLOW-OUTFLOW HYDROGRAPHS



CDM

Attachment #5
Inflow/Outfall Hydrograph - Pond 13
Page1

CDM Calculation Form (Excel)

Client: Buncombe
Project: C&D Landfill Expansion
Detail: Cover Cap Diversion Berm

Job # 5493-60937
Checked By: _____
Date: ___/___/___
Reviewed By: _____
Date: ___/___/___

Calc By: WMB
Date: 5/1/09
Calc.No. _____
Revision# _____
Date: ___/___/___

Calculation Brief Title: Cover Cap Diversion Berm Sizing

1.0 Purpose/Objective

- Size the cover cap diversion berm for the 25-year, 24-hour storm event.

2.0 Procedure

- Using CAD, determine the largest drainag area to one berm.
- Using TR-55 determine the peak flow for the 25-year, 24-hour storm event for the drainage area computed in the above step.
- Using Manning's Equation for open channel flow, determine the required normal depth in the channel for the 25-year, 24-hour storm event.
-Calculate the maximum shear stress based on the calculated normal depth and select a stable lining type.

3.0 References/Data Sources

- Win TR-55
- Manning's Equation

$$Q = \frac{1.49}{n} \bullet AR^{2/3} S^{1/2}$$

Where:
- Q= Maximum Flow Rate (cfs)
- n= Manning's Roughness Coefficient for Channel Lining
- A= Cross-sectional Area (sf)
- R = Hydraulic Radius (ft) = A/P_w
- P_w= Wetted Perimeter (ft)
- S= Slope (ft/ft)

-Channel Shear Stress Equation

$$\tau_d = \gamma d S$$

Where:
- τ_d= Maximum Shear Stress
- γ= Unit Wt. of Water (lbs/cf)
- d= Normal Depth
- S= Slope (ft/ft)

CDM Calculation Form (Excel)	Job # 5493-60937	Calc By: WMB	
Client: Buncombe	Checked By:	Date: 5/1/09	
Project: C&D Landfill Expansion	Date: ___/___/___	Calc.No.	
Detail: Cover Cap Diversion Berm	Reviewed By:	Revision#	
	Date: ___/___/___	Date: ___/___/___	

4.0 Assumptions and Limitations

- Select the 25-year, 24-hour storm event for Buncombe County
- Cap cover vegetation is good condition

5.0 Calculations

Drainage Area Determination:

Task:

Using CAD, determine the largest drainage area for any one diversion berm based on the overall closure plan.

Area = 3 acres

TR-55 Formulation:

Given:	Curve Number =	78
	Sheet Flow Length=	100 ft @ 5% slope
	Shallow Conc Flow Length =	100 ft @ 33% Slope
	Maximum Drainage Area =	3.0 acres
	Channel Velocity =	4 ft/s

Task:

Use TR-55 method to determine the peak runoff for the 25-year, 24-hour storm event.

Q_{25}= 20 cfs use 20 cfs

Normal Depth Calculation:

Given: Channel Cross-Section taken from Detail B/OP-11 of the CSWMC Permit Drawings

Task:

Determine the appropriate channel size and lining type for the typical cover cap diversion berm using the normal depth procedure.

B	Channel width, feet	Q	Design Discharge 25 yr storm, cfs
M	Channel sideslope	n	Manning's roughness coeff.
Y	depth of flow, feet	s	Channel Longitudinal slope
A	Channel Area, square feet		
P	Wetted Perimeter, feet		Indicates input by user.
R	Hydraulic Radius, feet		

CDM Calculation Form (Excel)

Client: Buncombe
Project: C&D Landfill Expansion
Detail: Cover Cap Diversion Berm

Job # 5493-60937
Checked By: _____
Date: ___/___/___
Reviewed By: _____
Date: ___/___/___

Calc By: WMB
Date: 5/1/09
Calc.No. _____
Revision# _____
Date: ___/___/___

INPUT PARAMETERS					
B =	0	Q =	20	M_1 =	2
n =	0.03	s =	0.02	M_2 =	2

Y	A	P	R	Z_{REQ}	Z_{AV}
2	8.00	8.94	0.89	2.85	7.43
1.75	6.13	7.83	0.78	2.85	5.20
1.6	5.12	7.16	0.72	2.85	4.10
1.5	4.50	6.71	0.67	2.85	3.45
1.4	3.92	6.26	0.63	2.85	2.87
1.2	2.88	5.37	0.54	2.85	1.90
1	2.00	4.47	0.45	2.85	1.17

Normal Depth feet= 1.4
Velocity at Normal Depth, feet/sec= 5.1

Maximum Shear Stress:

Given: γ= 62.4 lbs/cf

Task:

Using the Channel Shear Stress Equation, determine the maximum shear stress based upon the calculated normal depth.

d= 1.4 ft (From Normal Depth Procedure above)
S= 0.02 ft/ft

τ_d= 1.7 lbs/sf

6.0 Conclusions/Results

- Based on the calculations above, an 18-inch deep channel will provide 6 inches of freeboard. The channel lining should be vegetated with photodegradable straw net.

CDM	Calculation Form (Excel)	Job #	5493-60937	Calc By:	WMB
Client:	Buncombe County	Checked By:		Date:	5/1/09
Project:	C&D Landfill Expansion	Date:	___/___/___	Calc.No.	
Detail:	Cover Cap Downdrain	Reviewed By:		Revision#	
		Date:	___/___/___	Date:	___/___/___

Calculation Brief Title: Downdrain Pipe Sizing

1.0 Purpose/Objective

- Size the cover cap downdrains for the 25-year, 24-hour storm event.

2.0 Procedure

- Design downdrain inlet using the 25-year, 24-hour runoff from the diversion berm calculation.
- Using TR-55 determine the peak flow for the 25-year, 24-hour storm event for the maximum contributing drainage to any one downdrain.
- Design the downdrain for the 25-year, 24-hour runoff from the maximum contributing drainage area.

3.0 References/Data Sources

- Win TR-55
- FHWA Hydraulic Design of Highway Culverts - Publication No. FHWA - NHI - 01-020 (Sept 01)
- Manning's Equation for Open Channel Flow

4.0 Assumptions and Limitations

- Select the 25-year, 24-hour storm event for Buncombe County
- Cap cover vegetation is good condition
- Inlet Control at the downdrain inlet from the diversion berm

5.0 Calculations

Diversion Berm Flow Rate

Task:

Determine the maximum runoff from the 25-year, 24-hour storm event for any diversion berm (Q_{DB25}).

Q_{DB25}= 20 cfs (See Diversion Berm Calculation)

CDM Calculation Form (Excel)	Job # 5493-60937	Calc By: WMB	
Client: Buncombe County	Checked By:	Date: 5/1/09	
Project: C&D Landfill Expansion	Date: ___/___/___	Calc.No.	
Detail: Cover Cap Downdrain	Reviewed By:	Revision#	
	Date: ___/___/___	Date: ___/___/___	

Downdrain Inlet Sizing

Using FHWA Design Chart for Circular Concrete Pipe the headwater (HW) for the pipe is:

HW= 3.2 ft (See Attachment No. 1)

Downdrain Pipe Size Verification

Determine the largest contributing drainage area to any one downdrain

Area = 3 acres

TR-55 Formulation:

Given:

Curve Number =	78
Sheet Flow Length=	100 ft @ 5% slope
Shallow Conc Flow Length =	100 ft @ 33% Slope
Maximum Drainage Area =	3.0 acres
Channel Velocity =	4 ft/s

Task:

Use TR-55 method to determine the peak runoff for the 25-year, 24-hour storm event.

- See Attachment 3 for TR-55 results

Q_{DD25}= 20 cfs use 20 cfs

Using Manning's equation and the assumed design slope and diameter determine pipe capacity.

$$Q = \frac{1.49}{n} R_h^{2/3} S^{1/2} A$$

D= Diameter (ft)	=	2 ft
Q = flow rate (ft^3 / s)	=	20 cfs
N = number of pipes	=	2
n = friction factor (dimensionless)	=	0.01
R_h = A/Pw = hydraulic radius (ft)	=	0.5 ft
A = cross-sectional area of pipe (sf)	=	3.1 sf
Pw = Wetted Perimeter (ft)	=	6.3 ft
S = slope (ft / ft)	=	0.33 ft/ft
Q_{PIPE}=	=	340 cfs
Factor of Safety = Q_{PIPE}/Q_{DD25}	=	17.0

6.0 Conclusions/Results

- Based on the calculations above, two 24" diameter downdrain pipes will provide adequate flow capacity to capture flow from each diversion berm and the entire contributing drainage area.

CDM Calculation Form (Excel)

Client: Buncombe
Project: C&D Landfill Expansion
Detail: Soil Loss

Job # 5493-60937
Checked By: _____
Date: ___/___/___
Reviewed By: _____
Date: ___/___/___

Calc By: WMB
Date: 5/1/09
Calc.No. _____
Revision# _____
Date: ___/___/___

Calculation Brief Title: Soil Loss

1.0 Purpose/Objective

- Determine the appropriate slope stabilization method for the Phase 5 expansion.

2.0 Procedure

- Using CAD, determine the the slope length
- Using ECMDS Version 4.3 deterine the appropriate slope stabilization method for temporary and permanent slopes.

3.0 References/Data Sources

- North American Green - ECMDS Version 4.3

4.0 Assumptions and Limitations

- Temporary condition will occur for 6 months
- Permanent Cap cover vegetation is good condition

5.0 Calculations

See Attached Calculation Summary Sheets

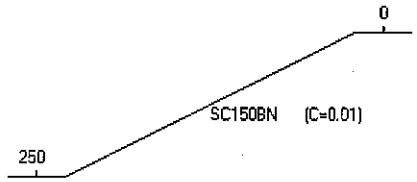
6.0 Conclusions/Results

- Based on the calculations temporary stabilization for slope stability requires a temporary matting - SC150BN by North American Green or equal and permanent stabilization can be accomplished by vegetation alone provided the maximum slope length does not extend beyond 300 feet.

North American Green - ECMDS Version 4.3	5/1/2009	09:31 AM	COMPUTED BY: W. Michael Brinchek
PROJECT NAME: Buncombe County C and D	PROJECT NO.: 65973	SLOPE DESCRIPTION: Finished Landfill Sideslops	

Country	United States
State/Region	North Carolina
City	Asheville
Annual R Factor	175
Total Slope Length (ft)	250
Protection Type	Temporary
Protection Period (months)	6
Beginning Month	January
Adjusted R Value	63.
Slope Gradient (H:1)	3
Soil Type	Silt Loam
K Factor	0.33
Soil Loss Tolerance (in)	0.25

Slope Gradient = 3:1



Not to Scale

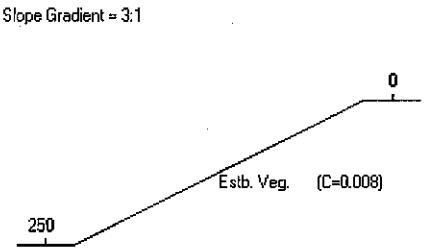
Reach	Cum. Dist. Begin (ft)	Cum. Dist. End (ft)	Material	Vegetation Type Growth Habit	Density	ASL bare (in)	ASL mat (in)	MSL bare (in)	MSL mat (in)	SLT (in)	SF	Remarks	Staple
1	0	250	SC150BN			1.537	0.015	2.657	0.027	0.25	9.410	STABLE	B
2													
3													
	0	250		**Composite**		1.537	0.015						

Vegetation Density=Percentage of soil coverage provided by vegetation
ASLbare=Average Soil Loss potential of unprotected soil (uniform inches)
MSLbare=Maximum Soil Loss potential on unprotected soil (uniform inches)
SLT=Soil Loss Tolerance for slope segment (uniform inches)
Composite=Average soil loss from total slope length (uniform inches)

C=Cover material performance factor (Fraction of soil loss of unprotected)
ASLmat=Average Soil Loss potential w/material (uniform inches)
MSLmat=Maximum Soil Loss potential w/material (uniform inches)
SF=Safety Factor

North American Green - ECMDS Version 4.3	5/1/2009	09:34 AM	COMPUTED BY: W. Michael Brinchek
PROJECT NAME: Buncombe County C and D	PROJECT NO.: 65973		SLOPE DESCRIPTION: Finished Landfill Sideslops

Country	United States
State/Region	North Carolina
City	Asheville
Annual R Factor	175
Total Slope Length (ft)	250
Protection Type	Permanent
Protection Period (months)	
Beginning Month	
Adjusted R Value	175.
Slope Gradient (H:1)	3
Soil Type	Silt Loam
K Factor	0.33
Soil Loss Tolerance (in)	0.03



Reach	Cum. Dist. Begin (ft)	Cum. Dist. End (ft)	Material	Vegetation Type Growth Habit	Density	ASL bare (in)	ASL mat (in)			SLT (in)	SF	Remarks
1	0	250	Estb. Veg.	Sod Former	75-95%	2.995	0.024			0.03	1.252	STABLE
2												
3												
	0	250		**Composite**		2.995	0.024					

Vegetation Density=Percentage of soil coverage provided by vegetation
ASLbare=Average Soil Loss potential of unprotected soil (uniform inches)
MSLbare=Maximum Soil Loss potential on unprotected soil (uniform inches)
SLT=Soil Loss Tolerance for slope segment (uniform inches)
Composite=Average soil loss from total slope length (uniform inches)

C=Cover material performance factor (Fraction of soil loss of unprotected)
ASLmat=Average Soil Loss potential w/material (uniform inches)
MSLmat=Maximum Soil Loss potential w/material (uniform inches)
SF=Safety Factor

Part 5
Engineering Report

Appendix B
Design Geotechnical Evaluation

CDM

Memorandum

To: *Kenton Yang*

From: *Steve Whiteside*
Sacit Akbas

Date: *April 27, 2009*

Subject: *Buncombe County Phase 5 C&D Landfill*

NORTH CAROLINA PROFESSIONAL SEAL 16049 ENGINEER STEPHEN L. WHITESIDE

4/27/09

Purpose

The purpose of this memorandum is to provide the results of CDM's stability and settlement analyses for the proposed construction and demolition (C&D) debris landfill Phase 5 Expansion in Buncombe County, North Carolina.

Project Information and Site Conditions

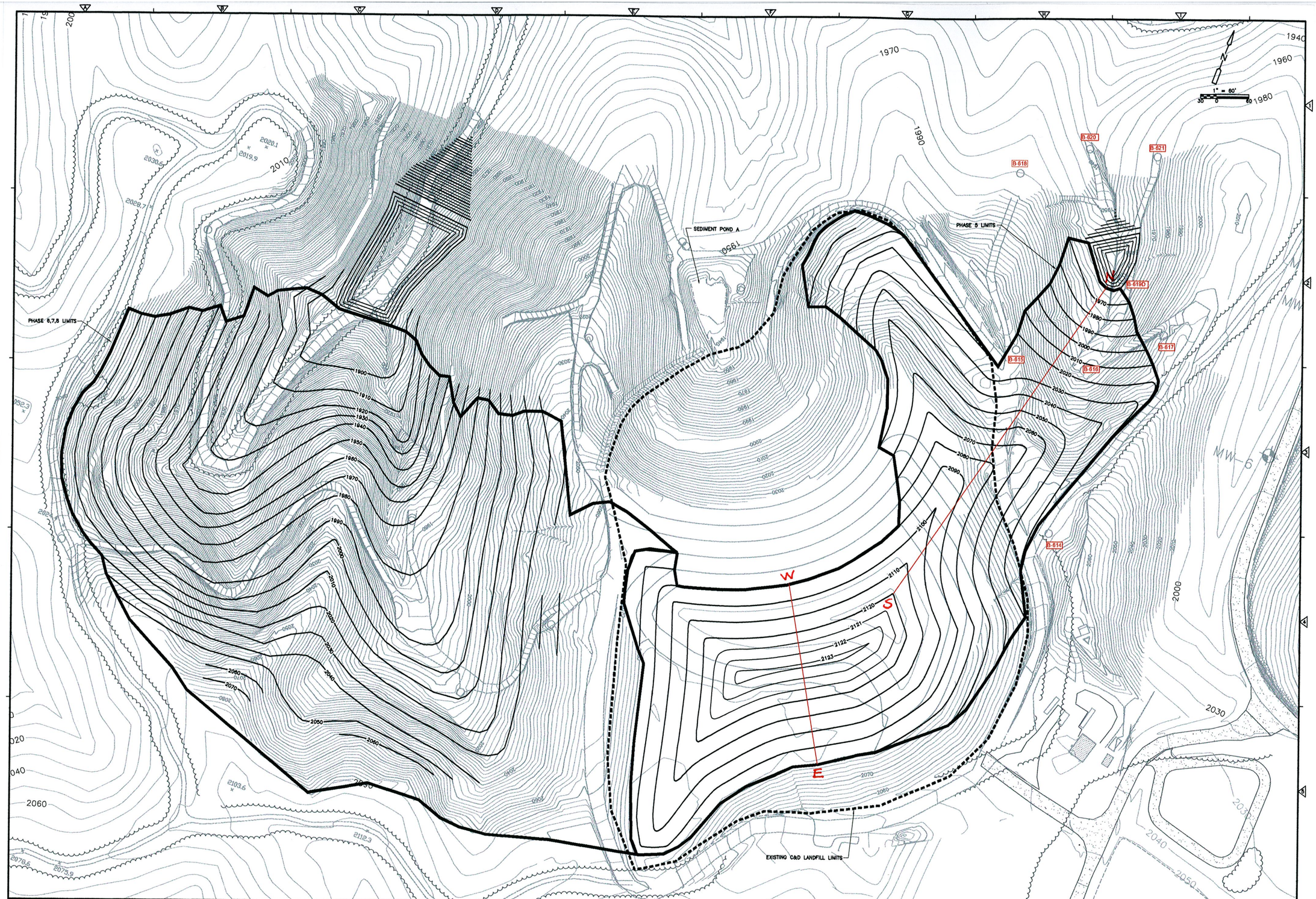
The Buncombe County Solid Waste Management Facility currently has an area for C&D debris disposal in the existing landfill facility. The existing C&D landfill and the proposed expansion are located in the western portion of the approximately 557-acre parcel of land owned by Buncombe County. The proposed Phase 5 C&D landfill expansion footprint covers 18 acres, of which approximately 15.6 acres will piggy-back the existing C&D landfill. **Figure 1** shows the footprints of the existing landfill and the proposed expansion. The proposed Phase 5 C&D landfill expansion has a maximum vertical slope height of 163 feet with side slopes graded at 3 horizontal to 1 vertical (3H:1V).

Two cross sections, north-south and east-west, were analyzed for the Phase 5 Expansion area. The locations of the cross sections are shown on Figure 1. The cross sections are presented on **Figures 2A** and **2B,** respectively.

The existing disposal facility is located off Panther Branch Road in Alexander, North Carolina.

Subsurface Conditions

The subsurface data utilized in the geotechnical analyses are based upon CDM's most recent site investigation conducted in June 2008. Nine (9) test borings were drilled at eight locations within the proposed Phase 5 Expansion area. The CDM Design Hydrogeologic report for



REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: K. YANG
DRAWN BY: J. KILLINGSWORTH
SHEET CHK'D BY: K. YANG
CROSS CHK'D BY: O. GABEL
APPROVED BY: K. YANG
DATE: OCTOBER 2006

CDM
Camp Dresser & McKee
5420 Glenwood Avenue, Suite 300
Raleigh, North Carolina 27612
Tel: (919) 781-5733
consulting • engineering • construction • operations

BUNCOMBE COUNTY
NORTH CAROLINA

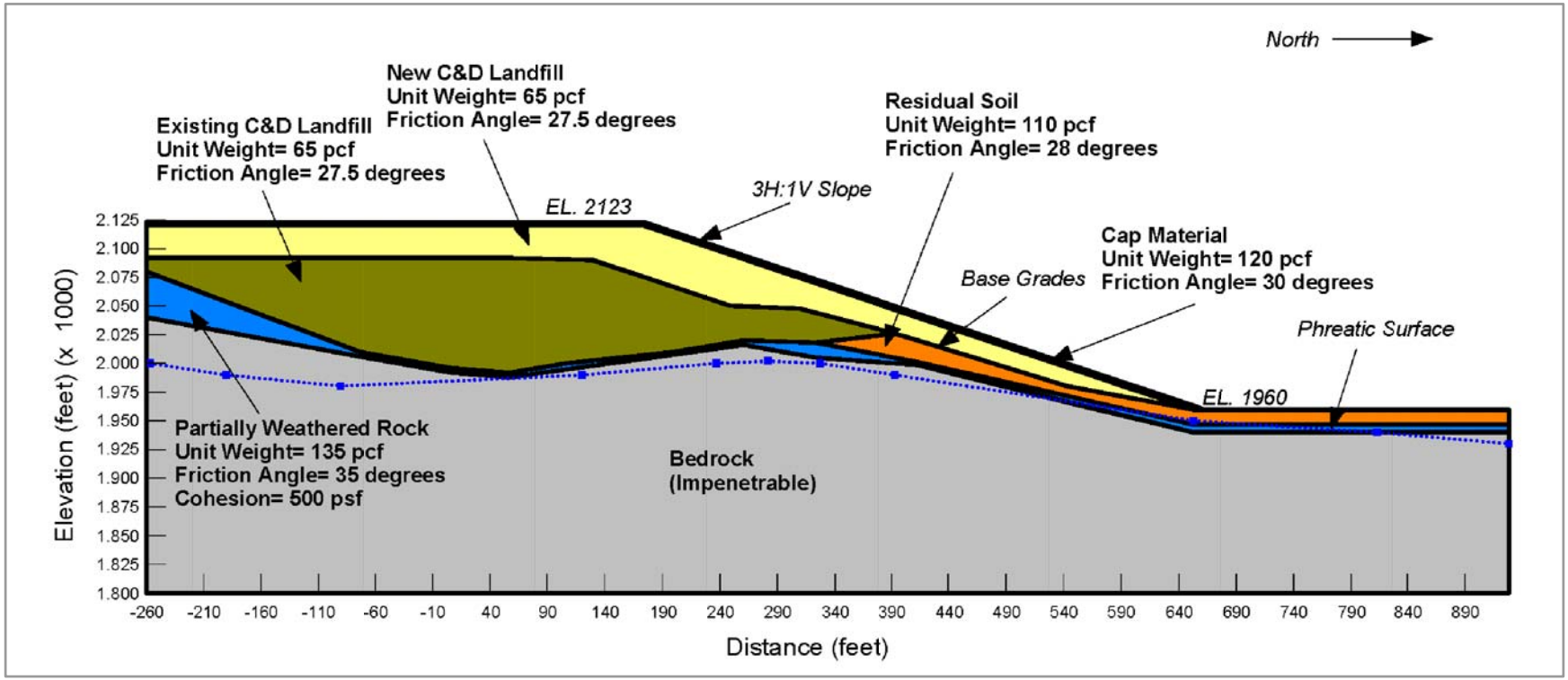
BUNCOMBE COUNTY C&D LANDFILL
FACILITY PLAN

LANDFILL OPERATION
TRANSITION CONTOURS - PHASE 5 CLOSURE / PHASE 6 BASEGRADES

PROJECT NO. 6447-65973
FILE NAME: LO-2.DWG

Figure No: 1

NOT FOR CONSTRUCTION



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BUNCOMBE COUNTY

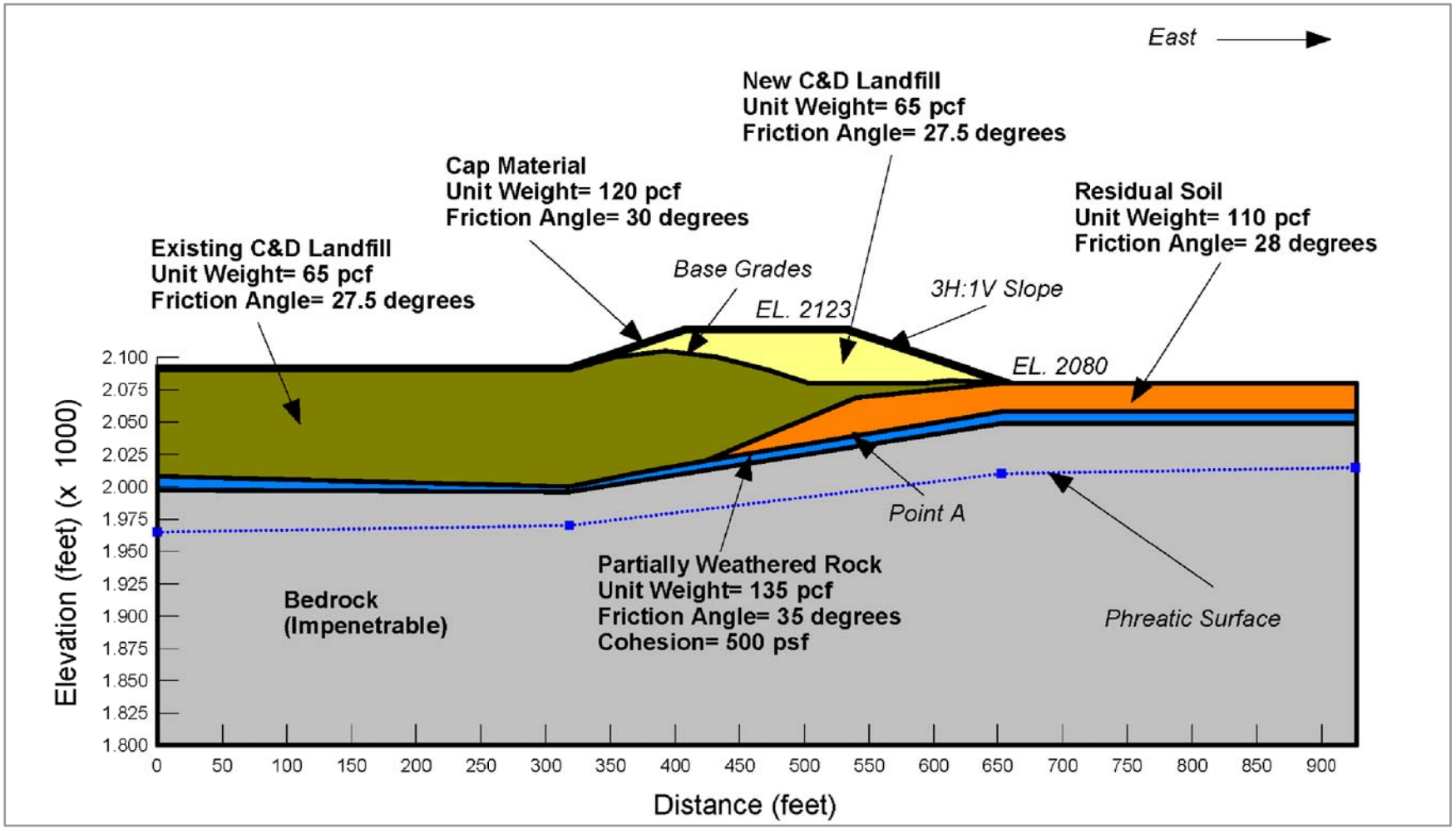
PHASE 5 C & D
LANDFILL EXPANSION

TYPICAL NORTH-SOUTH
CROSS SECTION

PROJECT NO.	6447-65973
DATE	02/20/2009

Figure No.

2-A



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BUNCOMBE COUNTY

PHASE 5 C & D
LANDFILL EXPANSION

TYPICAL EAST-WEST
CROSS SECTION

PROJECT NO. 6447-65973
DATE 02/20/2009

Figure No.
2-B

Buncombe County C&D Phase 5 Expansion dated February 2009 contains subsurface data and a discussion of regional geology and subsurface conditions. Information contained in that report is not reiterated herein. **Attachments A** and **B** contain applicable boring logs and laboratory test results from that report.

Design Parameters

The landfill will consist of the following components in order of their occurrence below final closure grade:

- An 18-inch erosion layer consisting of earthen material that is capable of sustaining native plant growth;
- An 18-inch low-permeability barrier of earthen material with a permeability no greater than 1.0×10^{-5} cm per second; and
- C&D waste.

A summary of design properties for each of these components is presented in **Table 1**.

Table 1: Summary of Landfill Component Design Properties

Layer No.	Materials	Unit Weight (pcf)	Friction Angle (degrees)	Cohesion (psf)	Basis for Parameter Selection
1	Cap Materials	120	30	0	Literature Search
2.	C&D Waste	65	27.5	0	Literature Search

The subsurface strata and design properties assumed for the geotechnical analyses are summarized, in order of their occurrence below existing grade, in **Table 2**.

Depth from the ground surface to the top of the bedrock unit within the proposed Phase 5 C&D landfill expansion area ranged from 3.5 feet in boring B-620 to 29 feet in B-618.

Groundwater levels within the landfill footprint are based upon the seasonal Potentiometric Contour Map presented on Sheet 3 of the CDM Design Hydrogeologic report and included in **Attachment C**. The potentiometric contour map was developed based on groundwater levels measured on September 10, 2008 in piezometers installed for the current investigation.

Table 2: Summary of Subsurface Design Properties

Layer No.	Materials	Layer Thickness (ft)	Unit Weight (pcf)	Friction Angle (degrees)	Cohesion (psf)	Basis for Parameter Selection
1	Layer 1 – Residual Soil - Sand and Silt	3.5-19	110	28	0	SPT N-Values and Lab Tests from CDM Design Hydrogeologic Report (February 2009)
2	Layer 2 – Partially Weathered Rock	0-10	135	35	500	
3	Layer 3 – Bedrock	-	Impenetrable			

Slope Stability Analyses

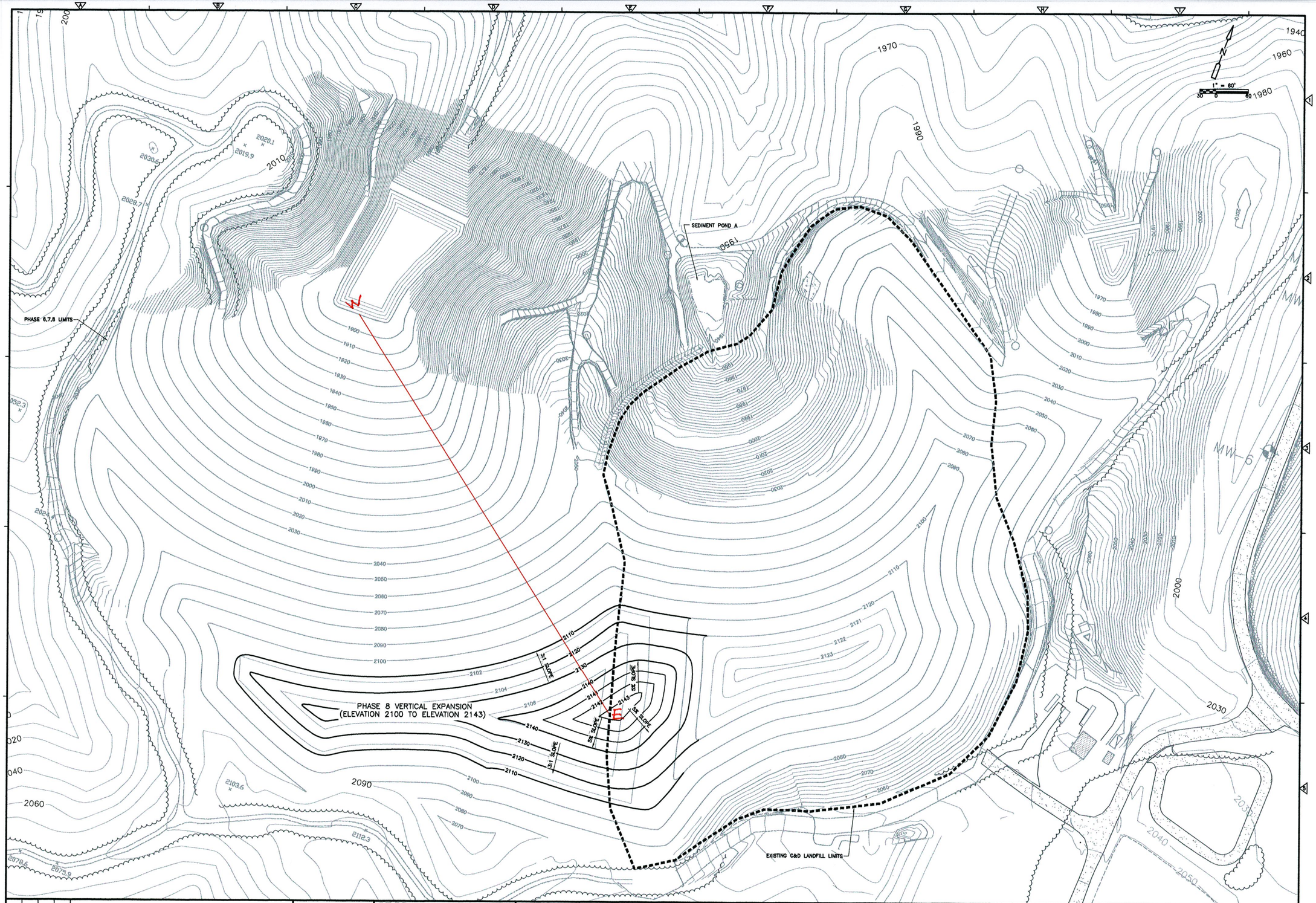
Analyses for overall (global) stability were performed using the SLOPE/W version 2007 modeling software package distributed by GEO-SLOPE International, Ltd. While several stability methods are available for SLOPE/W software, the Spencer method was selected for the analyses presented in this report.

This computer program calculates factors of safety against circular and block failures of the global landfill mass based upon the input values for slope geometry, soil and waste properties, and groundwater conditions. For the slope stability analyses, the bedrock was assumed to be impenetrable, such that the failure surfaces do not penetrate into the bedrock. The minimum acceptable factor of safety for overall global stability is 1.5 under static loading conditions.

Slope stability analyses for Phase 5 expansion were performed for the two cross sections shown on Figures 2A and 2B. Based on the analyses, the computed minimum factor of safety against a circular failure is 1.6 for both cross sections. The minimum factors of safety against a block failure for the north-south and east-west cross sections are 1.8 and 2.2, respectively.

A preliminary slope stability analysis was also performed for one cross section of the Phase 6 through 8 C&D landfill expansion with a proposed vertical height of 250 feet. The location of the cross section is shown on **Figure 3**. Based on the analyses, the computed minimum factors of safety against circular and block failures are 1.6 and 1.8, respectively.

Results of the SLOPE/W analyses are presented in **Attachment D.**



REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: K. YANG
DRAWN BY: J. KILLINGSWORTH
SHEET CHK'D BY: K. YANG
CROSS CHK'D BY: O. GABEL
APPROVED BY: K. YANG
DATE: OCTOBER 2008

CDM
Camp Dresser & McKee
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consulting • engineering • construction • operations

BUNCOMBE COUNTY
NORTH CAROLINA

BUNCOMBE COUNTY C&D LANDFILL
FACILITY PLAN

LANDFILL OPERATION
TRANSITION CONTOURS - PHASE 8 CLOSURE

PROJECT NO. 6447-85973
FILE NAME: LO-5.DWG

Figure No: 3

NOT FOR CONSTRUCTION

Veneer Stability

A two-part wedge analysis was used to calculate the factor of safety against veneer sliding for the cap materials on the side slopes of the landfill. A two-part wedge analysis is essentially the ratio of the resisting forces to the driving forces. The minimum acceptable factor of safety against veneer sliding is generally considered to be 1.5 for static conditions. The analysis was performed for drained conditions (h_w = 0 feet) in the cap material above the C&D waste assuming that the permeability of the erosion layer will be low enough that surface runoff will be promoted and infiltration will be limited. If water readily infiltrates the erosion layer, the water level could build up and result in a failure because there is no drainage net or drainage layer on top of the low-permeability layer.

Based upon a maximum slope length (side slope of the landfill) of 489 feet (slope height of 163 feet at 3H:1V), the factor of safety for veneer stability is 1.58 for drained conditions.

The calculations for the closure cap materials veneer stability are included in **Attachment E**.

Settlement Analyses

CDM performed settlement analyses for the proposed landfill geometry to estimate the magnitude of settlement of foundation soils due to the loads from C&D waste and cap materials.

Foundation settlement under the weight of the proposed C&D landfill was analyzed for the most critical point, where the thicknesses of the new waste and residual soil are 40 and 29 feet, respectively. This point is shown on Figure 2B as Point A. The Schmertmann method was used for the settlement analyses with vertical stress influence factors based upon Boussinesq stress distribution (for homogeneous isotropic elastic material). Two extreme cases were considered for the settlement analyses: all of the residual soil is either sand or silt. Based on the analyses, the estimated settlement will range from 6 to 11 inches. The actual settlement is anticipated to be closer to the lower value. The results of the analyses are included in **Attachment F**.

Limitations

This memorandum has been prepared for specific application to the subject project in accordance with generally accepted geotechnical engineering practices. No other warranty, express or implied, is made. In the event that any changes in the nature, design, or location of the proposed landfill cell are planned, the conclusions and preliminary recommendations presented in this report should not be considered valid, unless changes are reviewed and conclusions of this memorandum are modified or verified in writing.

The preliminary recommendations submitted in this report are based in part upon the data obtained from the referenced borings. The nature and extent of variations between the explorations may not become evident until construction. If variations then appear evident, it may be necessary to re-evaluate the recommendations of the report.

Attachments

Figure 1 – Phase 5 Closure Grades
Figure 2A&2B – Typical North-South and East-West Cross Sections of Phase 5
Figure 3 – Phase 8 Closure Grades
Attachment A – Boring Logs
Attachment B – Laboratory Test Results
Attachment C – Potentiometric Contour Map
Attachment D – SLOPE/W Analyses Results
Attachment E – Veneer Stability Analyses Results
Attachment F – Settlement Analyses Results

Reviewed by: Rebecca Grant Ascoli

Attachment A

Boring Logs

CAMP DRESSER & McKEE

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BOREHOLE LOG
B-614

Client: Buncombe County
Project Location: Asheville, NC

Project Name: C&D Landfill Substantial Amendment
Project Number: 6447-65973

Drilling Contractor: A&E Drilling
Drilling Method/Rig: HSA 8.5" OD/CME 750x/Schramm T450
Drillers: Lee Brown/Billy Nash
Drilling Date: Start: 6-2-08 **End:** 6-10-08
Borehole Coordinates:
N 738,489.50 E 919,891.00

Surface Elevation (ft.): 2043.8
Total Depth (ft.): 42
Depth to Initial Water Level (ft. BGS): 42
Abandonment Method: Converted to Monitoring Well
Field Screening Instrument: None
Logged By: D. Caldwell

Sample Type	Sample Number	Sample Advance/ Recovery (inches)	Elev. Depth (feet)	Pocket Penetrometer (tsf)	Blows per 6-in	Graphic Log	USCS Classification	Material Description
			2043.8					
SS	S-1	24/16	0		WOH WOH 2 3		ML	Dry, very soft to soft, brown, SILT, little sand.
SS	S-2	24/24	2038.8 5		5 5 7 10		SM/ML	Dry, medium dense, brown, fine to medium SAND and SILT, trace clay.
							SM	Dry, medium dense, light gray and orange mottled, fine to medium SAND, some silt, little clay. **-RESIDUAL SOIL-**
SS	S-3	6/6			50/6"		PWR	Dry, very dense, light gray, fine to medium SAND, little silt. **-PARTIALLY WEATHERED ROCK-**
			2033.8 10					
								Auger refusal at 11.5 feet below ground surface. Continued into bedrock with Air Rotary to first water bearing fracture. Boring terminated at 42 feet below ground surface.
			2028.8					

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Hammer Weight = 140 pounds, Drop Height = 30 inches
Split Spoon = 2 inches OD, 24 inches long

WOH = Weight of Hammer

Reviewed by: I.S. Akbas 02/23/09 **Date:**

CAMP DRESSER & McKEE

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BOREHOLE LOG
B-615

Client: Buncombe County
Project Location: Asheville, NC

Project Name: C&D Landfill Substantial Amendment
Project Number: 6447-65973

Drilling Contractor: A&E Drilling
Drilling Method/Rig: HSA 8.5" OD/CME 750x/Schramm T450
Drillers: Lee Brown/Billy Nash
Drilling Date: Start: 6-4-08 **End:** 6-12-08
Borehole Coordinates:
N 738,785.80 E 919,711.10

Surface Elevation (ft.): 2021.6
Total Depth (ft.): 51.3
Depth to Initial Water Level (ft. BGS): 33.5
Abandonment Method: Converted to Monitoring Well
Field Screening Instrument:
Logged By: D. Caldwell

Sample Type	Sample Number	Sample Advance/ Recovery (inches)	Elev. Depth (feet)	Pocket Penetrometer (tsf)	Blows per 6-in	Graphic Log	USCS Classification	Material Description
			2021.6					
SS	S-1	24/10	0		5 8 8 9		SM/ML	Dry, medium dense, brown, fine to medium SAND and SILT, trace gravel. Relict rock fabric visible. **-RESIDUAL SOIL-**
SS	S-2	24/24	2016.6 5		5 7 9 9			Dry, medium dense, light gray, brown, and black mottled, fine to medium SAND and SILT and CLAY.
SS	S-3	24/18	2011.6 10		14 20 21 31			Dry, dense, light to dark gray and reddish brown mottled, fine to medium SAND and SILT.
			2006.6		5 3			Dry, loose, yellowish brown, fine to medium SAND and Clayey SILT.

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Hammer Weight = 140 pounds, Drop Height = 30 inches
Split Spoon = 2 inches OD, 24 inches long

Shelby tube collected from 13.5 to 15.5 feet below ground surface (24" Advance / 14" Recovery).

Reviewed by: I. S. Akbas 02/23/09 **Date:**

CAMP DRESSER & McKEE

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BOREHOLE LOG
B-615

Client: Buncombe County

Project Name: C&D Landfill Substantial Amendment

Project Location: Asheville, NC

Project Number: 6447-65973

Sample Type	Sample Number	Sample Advance/ Recovery (inches)	Elev. Depth (feet)	Pocket Penetrometer (tsf)	Blows per 6-in	Graphic Log	USCS Classification	Material Description
			2006.6					
SS	S-4	24/24	15		5 8		SM/ML	Dry, loose, light to dark gray and reddish brown mottled, fine to medium SAND and SILT.
SS	S-5	4/4	2001.6 20		50/4"		PWR	Dry, very dense, gray, fine to medium GRAVEL, some sand, little silt. **-PARTIALLY WEATHERED ROCK-**
			1996.6 25					Auger refusal at 21.5 feet below ground surface. Continued into bedrock with Air Rotary to first water bearing fracture. Boring terminated at 51.3 feet below ground surface.
			1991.6 30					
			1986.6 35					

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BOREHOLE LOG
B-616

Client: Buncombe County
Project Location: Asheville, NC

Project Name: C&D Landfill Substantial Amendment
Project Number: 6447-65973

Drilling Contractor: A&E Drilling
Drilling Method/Rig: HSA 8.5" OD/CME 750x/Schramm T450
Drillers: Lee Brown/Billy Nash
Drilling Date: Start: 6-2-08 **End:** 6-11-08
Borehole Coordinates:
N 738,797.70 E 919,841.80

Surface Elevation (ft.): 1981.5
Total Depth (ft.): 31
Depth to Initial Water Level (ft. BGS): 12
Abandonment Method: Converted to Monitoring Well
Field Screening Instrument:
Logged By: D. Caldwell

Sample Type	Sample Number	Sample Advance/ Recovery (inches)	Elev. Depth (feet)	Pocket Penetrometer (tsf)	Blows per 6-in	Graphic Log	USCS Classification	Material Description
			1981.5					
SS	S-1	24/18	0		1 1 1 2		SC/CL	Moist, very loose, brown, fine to medium SAND and CLAY and SILT, trace roots.
SS	S-2	24/24	1976.5 5		1 9 18 32		SC	Moist, medium dense, brown, fine to medium SAND and CLAY and SILT. Dry, medium dense, gray and orange, fine SAND, some clay.
SS	S-3	16/15	1971.5 10		16 20 50/4"		PWR	Dry, very dense, light to dark gray mottled, fine to coarse SAND, little silt. -PARTIALLY WEATHERED ROCK-
			1966.5					Auger refusal at 12.0 feet below ground surface. Continued into bedrock with Air Rotary to first water bearing fracture. Boring terminated at 31 feet below ground surface.

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Hammer Weight = 140 pounds, Drop Height = 30 inches
Split Spoon = 2 inches OD, 24 inches long

Shelby tube collected from 2.5 to 4.5 feet below ground surface (24" Advance / 24" Recovery)

Reviewed by: I.S. Alkbas 2/23/09 **Date:**

BOREHOLE C&D EXPANSION, REVISED WITH LAB DATA.GPJ CDM_CORP.GDT 2/23/09

CAMP DRESSER & McKEE

CDM

BOREHOLE LOG
B-617

Client: Buncombe County
Project Location: Asheville, NC

Project Name: C&D Landfill Substantial Amendment
Project Number: 6447-65973

Drilling Contractor: A&E Drilling
Drilling Method/Rig: HSA 8.5" OD/CME 750x/Schramm T450
Drillers: Lee Brown/Billy Nash
Drilling Date: Start: 6-2-08 **End:** 6-12-08
Borehole Coordinates:
N 738,909.20 E 919,958.60

Surface Elevation (ft.): 2005.4
Total Depth (ft.): 61
Depth to Initial Water Level (ft. BGS): 45
Abandonment Method: Converted to Monitoring Well
Field Screening Instrument:
Logged By: D. Caldwell

Sample Type	Sample Number	Sample Advance/ Recovery (inches)	Elev. Depth (feet)	Pocket Penetrometer (tsf)	Blows per 6-in	Graphic Log	USCS Classification	Material Description
			2005.4					
SS	S-1	24/17	0		1 5 15 25		SM	Dry, medium dense, gray, black, and yellow mottled, fine to coarse SAND, some gravel, silt.
SS	S-2	18/18			17 35 50/6"			Dry, very dense, gray, black, and yellow mottled, fine to coarse SAND, some gravel, silt.
			2000.4 5				PWR	-PARTIALLY WEATHERED ROCK-
SS	S-3	15/15			17 49 50/3"			Dry, very dense, gray and orange mottled, fine to coarse SAND, some gravel, silt.
			1995.4 10					
SS	S-4	3/3			50/3"			Dry, very dense, dark gray and black, fine GRAVEL, some sand.
			1990.4					Auger refusal at 13.5 feet below ground surface. Continued into bedrock with Air Rotary to first water bearing

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Hammer Weight = 140 pounds, Drop Height = 30 inches
Split Spoon = 2 inches OD, 24 inches long

Reviewed by: I.S. Akbar 2/23/09 **Date:**

CAMP DRESSER & McKEE

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BOREHOLE LOG
B-617

Client: Buncombe County
Project Location: Asheville, NC
Project Name: C&D Landfill Substantial Amendment
Project Number: 6447-65973

Sample Type	Sample Number	Sample Advance/ Recovery (inches)	Elev. Depth (feet)	Pocket Penetrometer (tsf)	Blows per 6-in	Graphic Log	USCS Classification	Material Description
			1990.4 / 15					fracture. Boring terminated at 61 feet below ground surface.
			1985.4 / 20					
			1980.4 / 25					
			1975.4 / 30					
			1970.4 / 35					

CAMP DRESSER & McKEE

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BOREHOLE LOG
B-618

Client: Buncombe County
Project Location: Asheville, NC

Project Name: C&D Landfill Substantial Amendment
Project Number: 6447-65973

Drilling Contractor: A&E Drilling
Drilling Method/Rig: HSA 8.5" OD/CME 750x/Schram mT450
Drillers: Lee Brown/Billy Nash
Drilling Date: Start: 6-4-08 **End:** 6-12-08
Borehole Coordinates:
N 739,095.00 E 919,599.70

Surface Elevation (ft.): 1985.5
Total Depth (ft.): 50
Depth to Initial Water Level (ft. BGS): 45
Abandonment Method: Converted to Monitoring Well
Field Screening Instrument:
Logged By: D. Caldwell

Sample Type	Sample Number	Sample Advance/ Recovery (inches)	Elev. Depth (feet)	Pocket Penetrometer (tsf)	Blows per 6-in	Graphic Log	USCS Classification	Material Description
			1985.5					
SS	S-1	24/14	0		3 4 5 6		ML	Moist, stiff, orangish brown, SILT, some sand, few roots. Relict fabric visible. **-RESIDUAL SOIL-**
							SM/ML	Dry, loose, light brown, fine to medium SAND and SILT.
SS	S-2	24/16	1980.5 / 5		5 6 8 9			Dry, medium dense, white, light gray, and orange mottled, fine to medium SAND and SILT.
SS	S-3	24/16	1975.5 / 10		4 5 6 10			Dry, medium dense, white, light gray, and orange mottled, fine to medium SAND and Clayey SILT.
			1970.5		6 13			Dry, dense, gray, fine to medium SAND and SILT.

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Hammer Weight = 140 pounds, Drop Height = 30 inches
Split Spoon = 2 inches OD, 24 inches long

Shelby tube collected from 7 to 9 feet below ground surface (24" Advance / 24" Recovery)

Reviewed by: I.S. Abbas 2/23/09 **Date:**

BOREHOLE C&D EXPANSION, REVISED WITH LAB DATA.GPJ CDM_CORP.GDT 2/23/09

CAMP DRESSER & McKEE

CDM

BOREHOLE LOG
B-618

Client: Buncombe County
Project Name: C&D Landfill Substantial Amendment
Project Location: Asheville, NC
Project Number: 6447-65973

Sample Type	Sample Number	Sample Advance/ Recovery (inches)	Elev. Depth (feet)	Pocket Penetrometer (tsf)	Blows per 6-in	Graphic Log	USCS Classification	Material Description
			1970.5					
SS	S-4	24/15	15		21 26		SM/ML	
SS	S-5	3/3			50/3"		PWR	Dry, very dense, gray and brown, fine to medium, SAND and Clayey SILT. **-PARTIALLY WEATHERED ROCK-**
			1965.5 20					
SS	S-6	17/17	1960.5 25		12 13 50/5"			Dry, very dense, gray and brown, fine to medium SAND and Clayey SILT.
			1955.5 30					Auger refusal at 29 feet below ground surface. Continued into bedrock with Air Rotary to first water bearing fracture. Boring terminated at 50 feet below ground surface.
			1950.5 35					

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BOREHOLE LOG
B-619D

Client: Buncombe County
Project Location: Asheville, NC

Project Name: C&D Landfill Substantial Amendment
Project Number: 6447-65973

Drilling Contractor: A&E Drilling
Drilling Method/Rig: HSA 8.5" OD/CME 750x/Schramm T450
Drillers: Lee Brown/Billy Nash
Drilling Date: Start: 6-3-08 **End:** 6-10-08
Borehole Coordinates:
N 738,982.90 E 919,848.50

Surface Elevation (ft.): 1963.4
Total Depth (ft.): 30
Depth to Initial Water Level (ft. BGS): 12
Abandonment Method: Converted to Monitoring Well
Field Screening Instrument:
Logged By: D. Caldwell

Sample Type	Sample Number	Sample Advance/ Recovery (inches)	Elev. Depth (feet)	Pocket Penetrometer (tsf)	Blows per 6-in	Graphic Log	USCS Classification	Material Description
			1963.4					
			0				AUGER	No sample at surface. Material was moved into place by bulldozer while clearing area.
SS	S-1	24/24	1958.4 / 5		3 6 8 9		CL/SC	Moist, stiff, brown, CLAY and SILT and SAND. **-RESIDUAL SOIL-**
							SM/ML	Dry, medium dense, brown, gray, and orange mottled, fine to medium SAND and SILT. Relict rock fabric visible.
SS	S-2	24/24	1953.4 / 10		14 9 10 14			Dry, medium dense, brown, gray, and orange mottled, fine to medium SAND and Clayey SILT.
SS	S-3	1/0			50/1"		PWR	No sample recovery. **-PARTIALLY WEATHERED ROCK-**
			1948.4					

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Hammer Weight = 140 pounds, Drop Height = 30 inches
Split Spoon = 2 inches OD, 24 inches long

Deep well of nested pair.

Reviewed by: I.S. Akbas 2/23/09 **Date:**

CAMP DRESSER & McKEE

CDM

BOREHOLE LOG
B-619D

Client: Buncombe County
Project Location: Asheville, NC
Project Name: C&D Landfill Substantial Amendment
Project Number: 6447-65973

Sample Type	Sample Number	Sample Advance/ Recovery (inches)	Elev. Depth (feet)	Pocket Penetrometer (tsf)	Blows per 6-in	Graphic Log	USCS Classification	Material Description
			1948.4 / 15				PWR	Auger refusal at 15.5 feet below ground surface.
NQ	C-1	60/53	1943.4 / 20		1:10 1:00 1:00 1:10 2:00		GNEISS	**RUN 1: 15.5 to 20.5 feet below ground surface** REC = 88%, RQD = 56% Hard, fresh to completely weathered, gray, pink, and black, aphanitic to coarse-grained, UNDIFFERENTIATED GNEISS; heavily foliated, horizontal to moderately dipping, extremely close; joint set horizontal, very close to moderate, rough, stepped, open.
NQ	C-2	60/57	1938.4 / 25		1:00 1:00 1:10 1:05 1:30			**RUN 2: 20.5 to 25.5 feet below ground surface** REC = 95%, RQD = 85% Hard, fresh to completely weathered, gray and black, aphanitic to coarse-grained, UNDIFFERENTIATED GNEISS; heavily foliated, horizontal to moderately dipping, extremely close; joint set horizontal, very close to moderate, rough, stepped, open.
			1933.4 / 30 1928.4 / 35					Continued into bedrock with Air Rotary to first water bearing fracture. Boring terminated at 30 feet below ground surface.

CAMP DRESSER & McKEE

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BOREHOLE LOG
B-620

Client: Buncombe County
Project Location: Asheville, NC

Project Name: C&D Landfill Substantial Amendment
Project Number: 6447-65973

Drilling Contractor: A&E Drilling
Drilling Method/Rig: HSA 8.5" OD/CME 750x/Schramm T450
Drillers: Lee Brown/Billy Nash
Drilling Date: Start: 6-3-08 **End:** 6-11-08
Borehole Coordinates:
N 739,183.30 E 919,704.70

Surface Elevation (ft.): 1937.9
Total Depth (ft.): 51.5
Depth to Initial Water Level (ft. BGS): 48
Abandonment Method: Converted to Monitoring Well
Field Screening Instrument:
Logged By: D. Caldwell

Sample Type	Sample Number	Sample Advance/ Recovery (inches)	Elev. Depth (feet)	Pocket Penetrometer (tsf)	Blows per 6-in	Graphic Log	USCS Classification	Material Description
			1937.9					
SS	S-1	24/12	0		1 2 2 3		ML/SM	Moist, soft to medium stiff, brown, Clayey SILT and SAND, trace gravel.
			1932.9 / 5					Auger refusal at 3.5 feet below ground surface. Continued into bedrock with Air Rotary to first water bearing fracture. Boring terminated at 51.5 feet below ground surface.
			1927.9 / 10					
			1922.9					

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Hammer Weight = 140 pounds, Drop Height = 30 inches
Split Spoon = 2 inches OD, 24 inches long

Reviewed by: I.S. Akbas 2/23/09 **Date:**

CAMP DRESSER & McKEE

CDM

BOREHOLE LOG
B-621

Client: Buncombe County
Project Location: Asheville, NC

Project Name: C&D Landfill Substantial Amendment
Project Number: 6447-65973

Drilling Contractor: A&E Drilling
Drilling Method/Rig: HSA 8.5" OD/CME 750x/Schramm T450
Drillers: Lee Brown/Billy Nash
Drilling Date: Start: 6-3-08 **End:** 6-11-08
Borehole Coordinates:
N 739,215.20 E 919,828.10

Surface Elevation (ft.): 1972.5
Total Depth (ft.): 45
Depth to Initial Water Level (ft. BGS): 35
Abandonment Method: Converted to Monitoring Well
Field Screening Instrument:
Logged By: D. Caldwell

Sample Type	Sample Number	Sample Advance/ Recovery (inches)	Elev. Depth (feet)	Pocket Penetrometer (tsf)	Blows per 6-in	Graphic Log	USCS Classification	Material Description
			1972.5					
SS	S-1	24/16	0		4 5 6 6		SM/ML	Dry, medium dense, brown, orange, and black mottled, fine to medium SAND and SILT and CLAY, trace gravel. Relict rock fabric visible **-RESIDUAL SOIL-**
SS	S-2	16/16	1967.5 5		9 16 50/4"		PWR	Dry, very dense, brown, orange, and black mottled, fine to medium SAND and SILT and CLAY. **-PARTIALLY WEATHERED ROCK-**
SS	S-3	6/6	1962.5 10		50/6"			Dry, very dense, gray, red, and black mottled, fine to medium SAND and Clayey SILT.
			1957.5					Auger refusal at 11.5 feet below ground surface. Continued into bedrock with Air Rotary to first water bearing fracture. Boring terminated at 45 feet below ground surface.

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Hammer Weight = 140 pounds, Drop Height = 30 inches
Split Spoon = 2 inches OD, 24 inches long

Reviewed by: I.S. Akbas 2/23/09 **Date:**

Attachment B

Laboratory Test Results

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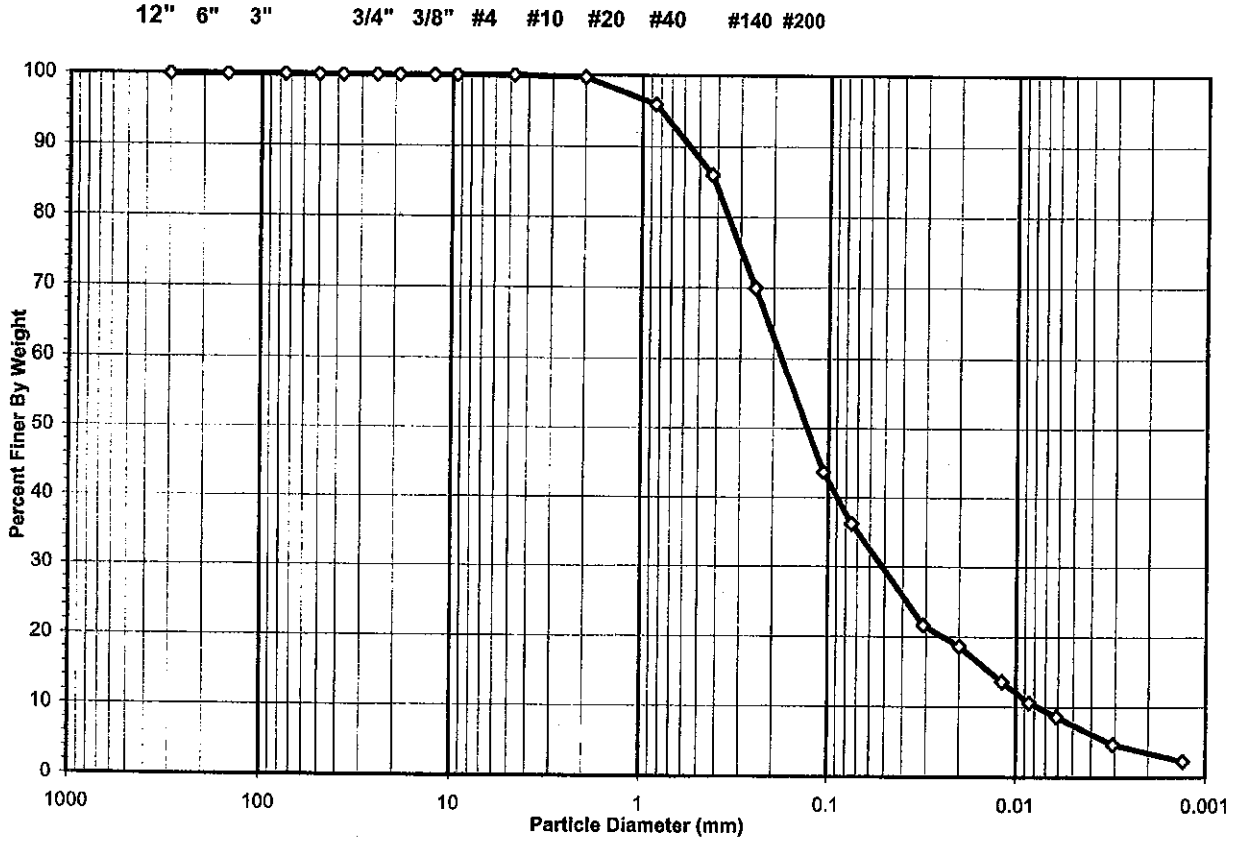
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-614
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	3.5-5.5
Project No.	2008-598-01	Sample No.	S-2
Lab ID	2008-598-01-01	Soil Color	**LIGHT TAN**

	SIEVE ANALYSIS					HYDROMETER
USCS	cobbles	gravel	sand			silt and clay fraction
USDA	cobbles	gravel	sand			silt	clay



Sieve Sizes (mm)	USCS Summary	Percentage
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	63.78
Finer Than #200	*Silt & Clay*	36.22

USCS Symbol ***SM, TESTED***

USCS Classification ***SILTY SAND***

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-01 #10 Split Hydro rev 8.xls]Sheet1*

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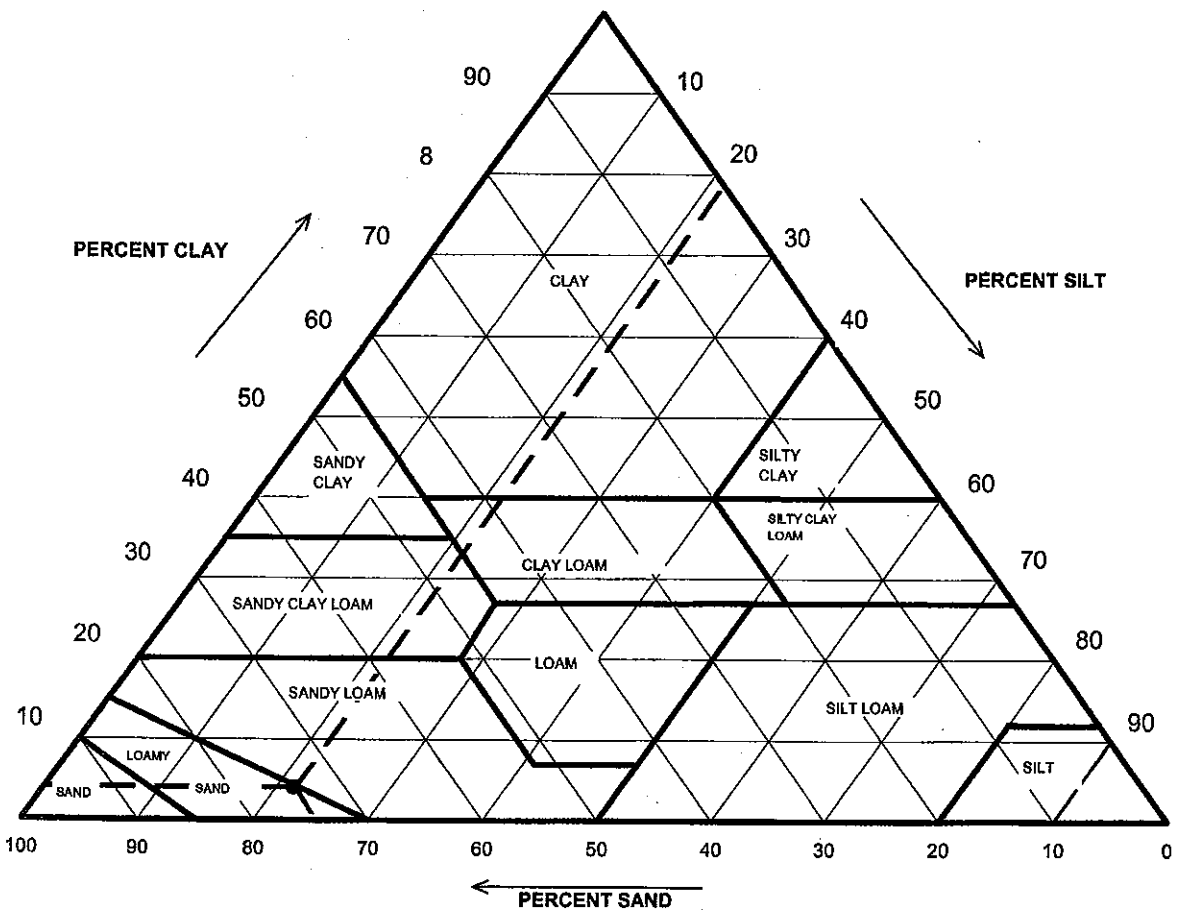
INTEGRITY IN TESTING

USDA CLASSIFICATION CHART

Client	CDM	Boring No.	B-614
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	3.5-5.5
Project No.	2008-598-01	Sample No.	S-2
Lab ID	2008-598-01-01	Soil Color	LIGHT TAN



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	0.25	**0.00**
2	99.75	*Sand*	74.27	**74.46**
0.05	25.47	*Silt*	21.46	**21.52**
0.002	4.01	*Clay*	4.01	**4.02**

USDA Classification: ***LOAMY SAND***

DCN: CT-S3P DATE:02/15/05 REVISION:8 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-01 #10 Split Hydro rev 8.xls]Sheet1

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WASH SIEVE ANALYSIS #10 SPLIT

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-614
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	3.5-5.5
Project No.	2008-598-01	Sample No.	S-2
Lab ID	2008-598-01-01	Soil Color	**LIGHT TAN**

Moisture Content/sieve +10 Material		Moisture Content for Hydrometer Portion	
Tare No.	250	Tare No.	L-1
Wgt.Tare + Wet Soil (gm)	222.43	Wgt.Tare + Wet Soil (gm)	50.80
Wgt.Tare + Dry Soil (gm)	216.62	Wgt.Tare + Dry Soil (gm)	50.29
Weight of Tare (gm)	169.42	Weight of Tare (gm)	15.80
Weight of Water (gm)	5.81	Weight of Water (gm)	0.51
Weight of Dry Soil (gm)	47.20	Weight of Dry Soil (gm)	34.49
Moisture Content (%)	**12.3**	**Moisture Content (%)**	**1.5**

Soil Specimen Data			
Wet Weight +#10 Material (gm)	53.01	Weight of the Dry Sample (gm)	145.74
Dry Weight +#10 Material(gm)	47.2	Weight of minus #200 material (gm)	35.78
Wet Weight Hydro. Material.(gm)	100.00	Weight of plus #200 material (gm)	109.96
Dry Weight Hydro. Material (gm)	98.54		
Total Dry Weight Sample (gm)	145.74	**J-FACTOR (%FINER THAN #10)**	**0.9975**

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.00	0.00	0.00	100.00	**100.00**
#10	2.00	0.12	0.25	0.25	99.75	**99.75**
#20	0.85	3.72	3.78	3.78	96.22	**95.98**
#40	0.425	9.93	10.08	13.85	86.15	**85.93**
#60	0.250	15.79	16.02	29.88	70.12	**69.95**
#140	0.106	25.96	26.34	56.22	43.78	**43.67**
#200	0.075	7.36	7.47	63.69	36.31	**36.22**
Pan	-	35.78	36.31	100.00	-	-

Notes :

Tested By SD Date 7/14/2008 Checked By GEM Date 7-16-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-01 #10 Split Hydro rev 8.xls]Sheet1*

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HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-614
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	3.5-5.5
Project No.	2008-598-01	Sample No.	S-2
Lab ID	2008-598-01-01	Soil Color	**LIGHT TAN**

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	25.0	25.0	25.5	3.35	21.6	21.7	0.01253	0.0309	**21.6**
5		22.0	25.5	3.35	18.6	18.7	0.01253	0.0200	**18.6**
15		17.0	25.5	3.35	13.6	13.7	0.01253	0.0119	**13.6**
30		14.0	25.5	3.35	10.6	10.7	0.01253	0.0086	**10.6**
60		12.0	25.5	3.35	8.6	8.7	0.01253	0.0061	**8.6**
250		8.0	25.5	3.35	4.6	4.6	0.01253	0.0031	**4.6**
1440		6.0	24.2	3.73	2.3	2.3	0.01272	0.0013	**2.3**

Soil Specimen Data		**Other Corrections**	
Tare + Dry Material (gm)	98.54	a - Factor	0.986
Weight of Tare (gm)	0		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 10	99.75
Weight of Dry Material (gm)	98.54		
		Specific Gravity	2.72 Assumed

Note:

Tested By JBD Date 7/11/2008 Checked By GEM Date 7-16-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-01 #10 Split Hydro rev 8.xls]Sheet1*

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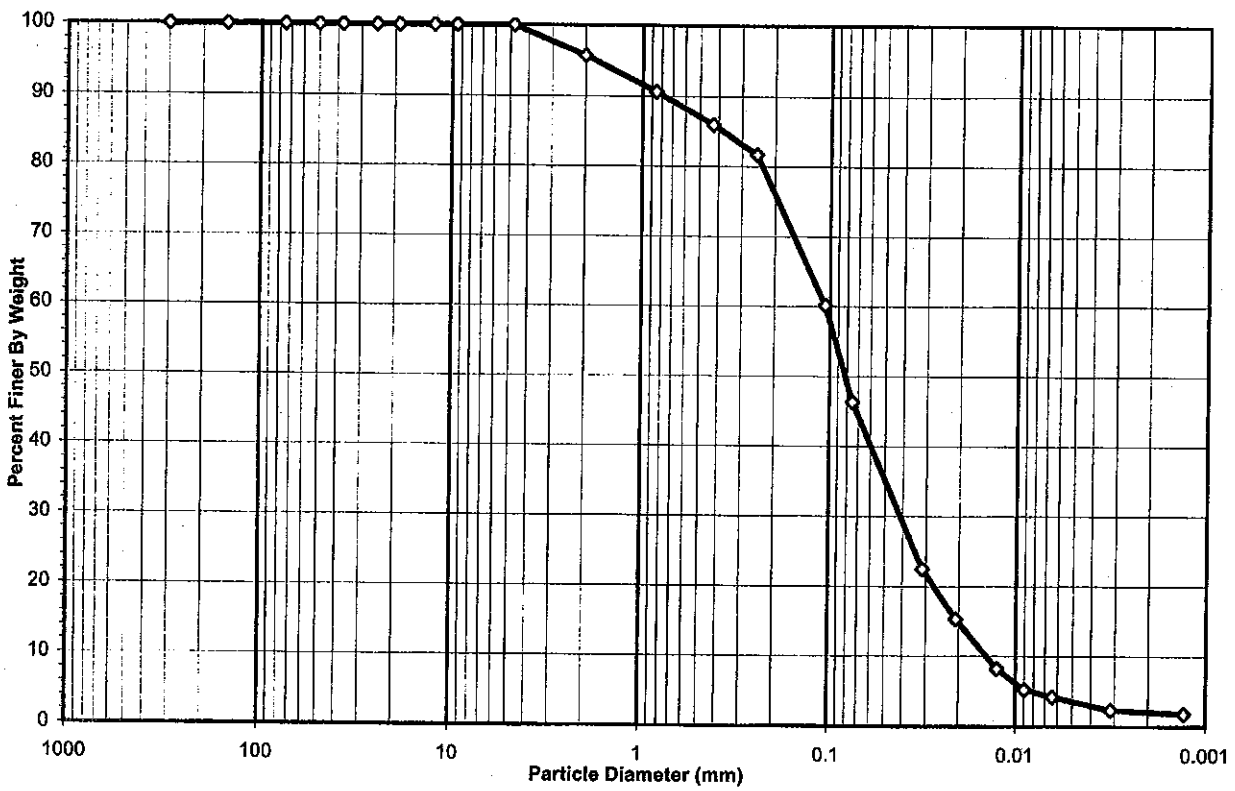
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-615
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	4-6
Project No.	2008-598-01	Sample No.	S-2
Lab ID	2008-598-01-02	Soil Color	**LIGHT BROWN**

	SIEVE ANALYSIS					HYDROMETER
USCS	cobbles	gravel	sand			silt and clay fraction
USDA	cobbles	gravel	sand			silt / clay

12" 6" 3" 3/4" 3/8" #4 #10 #20 #40 #140 #200



Sieve Sizes (mm)	USCS Summary	Percentage
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	53.66
Finer Than #200	*Silt & Clay*	46.34

USCS Symbol ***SM, TESTED***

USCS Classification ***SILTY SAND***

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-02 #10 Split Hydro rev 8.xls]Sheet1*

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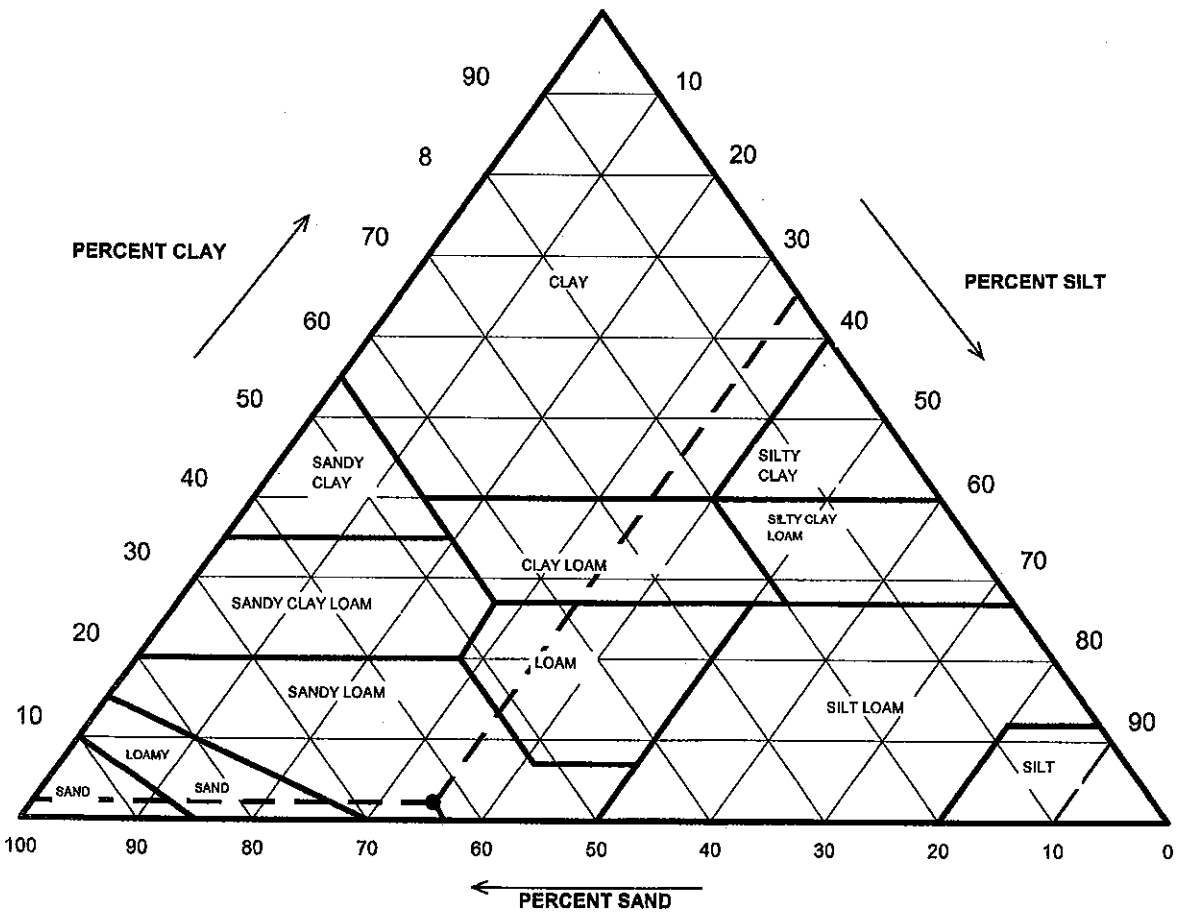
Client	CDM	Boring No.	B-615
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	4-6
Project No.	2008-598-01	Sample No.	S-2
Lab ID	2008-598-01-02	Soil Color	LIGHT BROWN



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	4.25	**0.00**
2	95.75	*Sand*	60.54	**63.23**
0.05	35.21	*Silt*	33.16	**34.63**
0.002	2.05	*Clay*	2.05	**2.14**

USDA Classification: ***SANDY LOAM***

DCN: CT-S3P DATE:02/15/05 REVISION:8 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-02 #10 Split Hydro rev 8.xls]Sheet1

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WASH SIEVE ANALYSIS #10 SPLIT

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-615
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	4-6
Project No.	2008-598-01	Sample No.	S-2
Lab ID	2008-598-01-02	Soil Color	**LIGHT BROWN**

Moisture Content/sieve +10 Material		Moisture Content for Hydrometer Portion	
Tare No.	213	Tare No.	R-1
Wgt.Tare + Wet Soil (gm)	224.44	Wgt.Tare + Wet Soil (gm)	55.23
Wgt.Tare + Dry Soil (gm)	219.60	Wgt.Tare + Dry Soil (gm)	52.51
Weight of Tare (gm)	173.44	Weight of Tare (gm)	15.65
Weight of Water (gm)	4.84	Weight of Water (gm)	2.72
Weight of Dry Soil (gm)	46.16	Weight of Dry Soil (gm)	36.86
Moisture Content (%)	**10.5**	**Moisture Content (%)**	**7.4**

Soil Specimen Data			
Wet Weight +#10 Material (gm)	51.00	Weight of the Dry Sample (gm)	139.29
Dry Weight +#10 Material(gm)	46.2	Weight of minus #200 material (gm)	45.07
Wet Weight Hydro. Material.(gm)	100.00	Weight of plus #200 material (gm)	94.22
Dry Weight Hydro. Material (gm)	93.13		
Total Dry Weight Sample (gm)	139.29	**J-FACTOR (%FINER THAN #10)**	**0.9575**

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.00	0.00	0.00	100.00	**100.00**
#10	2.00	1.96	4.25	4.25	95.75	**95.75**
#20	0.85	4.99	5.36	5.36	94.64	**90.62**
#40	0.425	4.56	4.90	10.25	89.75	**85.93**
#60	0.250	4.14	4.45	14.70	85.30	**81.68**
#140	0.106	20.97	22.52	37.22	62.78	**60.12**
#200	0.075	13.40	14.39	51.61	48.39	**46.34**
Pan	-	45.07	48.39	100.00	-	-

Notes :

Tested By SD Date 7/16/2008 Checked By GM Date 7-16-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-02 #10 Split Hydro rev 8.xls]Sheet1*

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HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-615
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	4-6
Project No.	2008-598-01	Sample No.	S-2
Lab ID	2008-598-01-02	Soil Color	**LIGHT BROWN**

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	26.0	26.0	23.7	3.88	22.1	23.4	0.01279	0.0314	**22.4**
5		19.0	23.7	3.88	15.1	16.0	0.01279	0.0208	**15.3**
15		12.0	23.7	3.88	8.1	8.6	0.01279	0.0125	**8.2**
30		9.0	23.8	3.85	5.2	5.5	0.01278	0.0090	**5.2**
60		8.0	23.8	3.85	4.2	4.4	0.01278	0.0064	**4.2**
250		6.0	24.3	3.70	2.3	2.4	0.01270	0.0031	**2.3**
1440		5.0	25.9	3.24	1.8	1.9	0.01247	0.0013	**1.8**

Soil Specimen Data		**Other Corrections**	
Tare + Dry Material (gm)	93.13	a - Factor	0.986
Weight of Tare (gm)	0		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 10	95.75
Weight of Dry Material (gm)	93.13		
		Specific Gravity	2.72 Assumed

Note:

Tested By JBD Date 7/15/2008 Checked By GEM Date 7-16-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-02 #10 Split Hydro rev 8.xls]Sheet1

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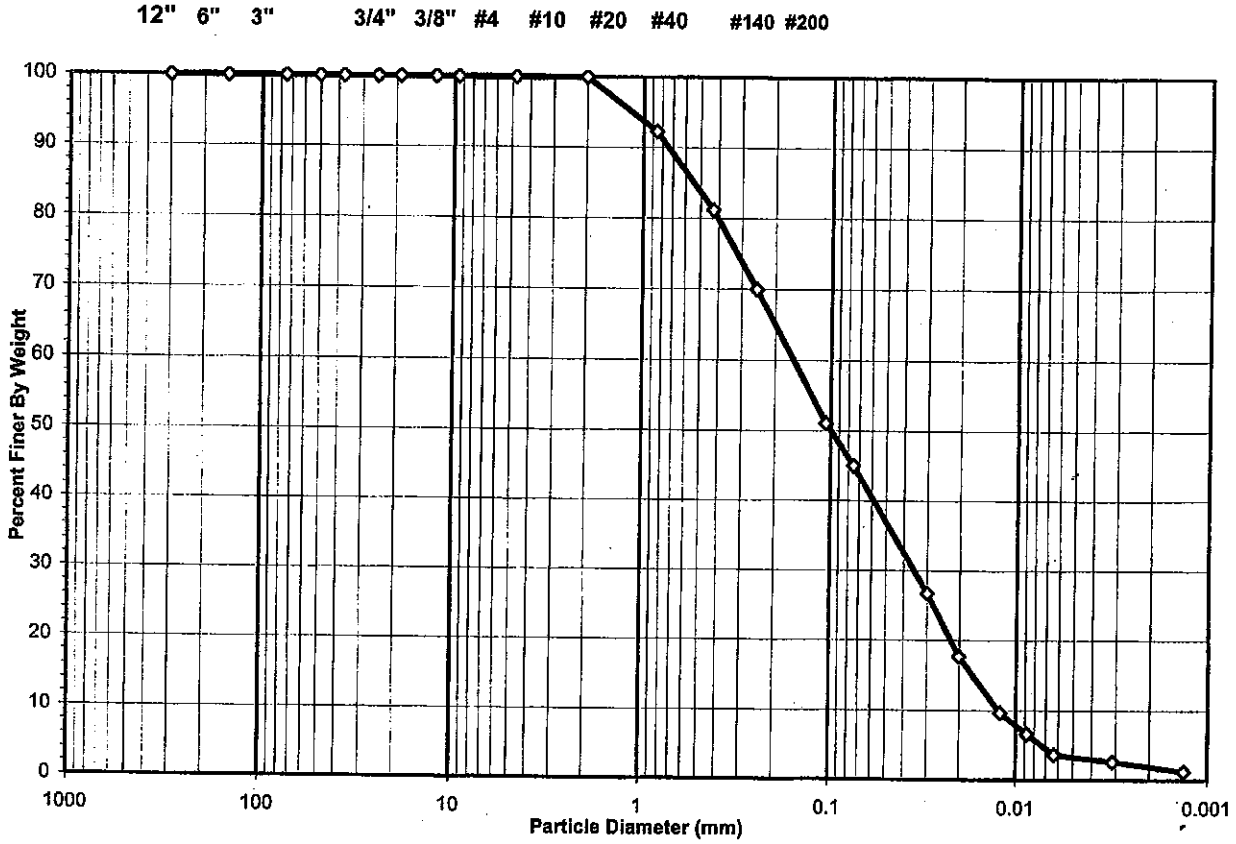
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-615
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	14-15
Project No.	2008-598-01	Sample No.	S-4T
Lab ID	2008-598-01-03	Soil Color	**LIGHT BROWN**

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



USCS Summary		
Sieve Sizes (mm)		**Percentage**
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	55.00
Finer Than #200	*Silt & Clay*	45.00

USCS Symbol ***SC-SM, TESTED***

USCS Classification ***SILTY, CLAYEY SAND***

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-03 #10 Split Hydro rev 8.xls]Sheet1*

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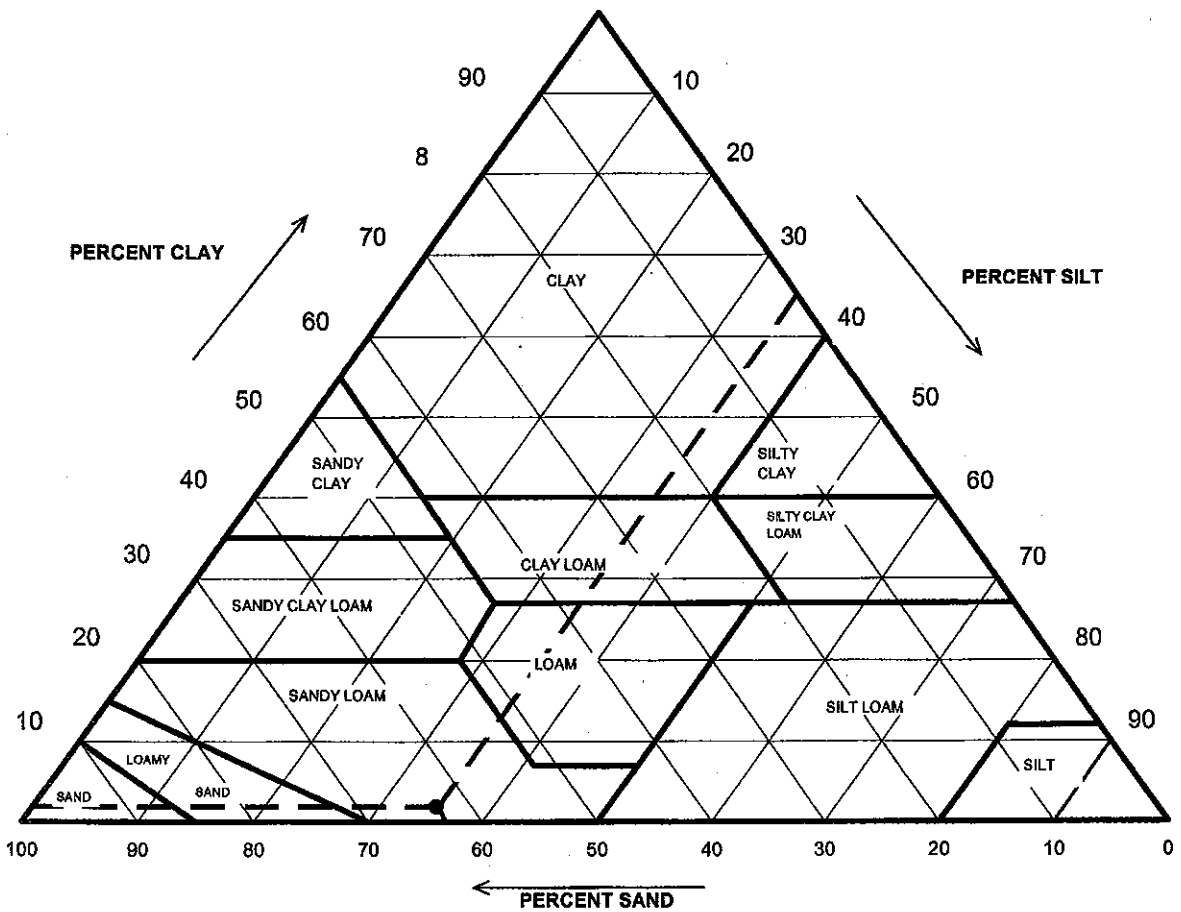
Client	CDM	Boring No.	B-615
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	14-15
Project No.	2008-598-01	Sample No.	S-4T
Lab ID	2008-598-01-03	Soil Color	LIGHT BROWN



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	0.00	**0.00**
2	100.00	*Sand*	63.09	**63.09**
0.05	36.91	*Silt*	35.00	**35.00**
0.002	1.91	*Clay*	1.91	**1.91**

USDA Classification: ***SANDY LOAM***

DCN: CT-S3P DATE:02/15/05 REVISION:8 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-03 #10 Split Hydro rev 8.xls]Sheet1

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WASH SIEVE ANALYSIS #10 SPLIT

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-615
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	14-15
Project No.	2008-598-01	Sample No.	S-4T
Lab ID	2008-598-01-03	Soil Color	**LIGHT BROWN**

Moisture Content/sieve +10 Material		Moisture Content for Hydrometer Portion	
Tare No.	203	Tare No.	B-1
Wgt.Tare + Wet Soil (gm)	237.70	Wgt.Tare + Wet Soil (gm)	61.91
Wgt.Tare + Dry Soil (gm)	228.33	Wgt.Tare + Dry Soil (gm)	61.35
Weight of Tare (gm)	171.12	Weight of Tare (gm)	22.06
Weight of Water (gm)	9.37	Weight of Water (gm)	0.56
Weight of Dry Soil (gm)	57.21	Weight of Dry Soil (gm)	39.29
Moisture Content (%)	**16.4**	**Moisture Content (%)**	**1.4**

Soil Specimen Data			
Wet Weight +#10 Material (gm)	66.58	Weight of the Dry Sample (gm)	155.80
Dry Weight +#10 Material(gm)	57.2	Weight of minus #200 material (gm)	44.36
Wet Weight Hydro. Material.(gm)	100.00	Weight of plus #200 material (gm)	111.44
Dry Weight Hydro. Material (gm)	98.59		
Total Dry Weight Sample (gm)	155.80	**J-FACTOR (%FINER THAN #10)**	**1.0000**

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.00	0.00	0.00	100.00	**100.00**
#10	2.00	0.00	0.00	0.00	100.00	**100.00**
#20	0.85	7.61	7.72	7.72	92.28	**92.28**
#40	0.425	10.92	11.08	18.79	81.21	**81.21**
#60	0.250	11.08	11.24	30.03	69.97	**69.97**
#140	0.106	18.64	18.91	48.94	51.06	**51.06**
#200	0.075	5.98	6.07	55.00	45.00	**45.00**
Pan	-	44.36	45.00	100.00	-	-

Notes :

Tested By SD Date 7/14/2008 Checked By GEM Date 7-15-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-03 #10 Split Hydro rev 8.xls]Sheet1*

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INTEGRITY IN TESTING

HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-615
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	14-15
Project No.	2008-598-01	Sample No.	S-4T
Lab ID	2008-598-01-03	Soil Color	**LIGHT BROWN**

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	30.0	30.0	25.5	3.35	26.6	26.6	0.01253	0.0299	**26.6**
5		21.0	25.5	3.35	17.6	17.6	0.01253	0.0201	**17.6**
15		13.0	25.5	3.35	9.6	9.6	0.01253	0.0122	**9.6**
30		10.0	25.5	3.35	6.6	6.6	0.01253	0.0088	**6.6**
60		7.0	25.5	3.35	3.6	3.6	0.01253	0.0063	**3.6**
250		6.0	25.5	3.35	2.6	2.6	0.01253	0.0031	**2.6**
1440		5.0	24.0	3.79	1.2	1.2	0.01275	0.0013	**1.2**

Soil Specimen Data		**Other Corrections**	
Tare + Dry Material (gm)	98.59	a - Factor	0.986
Weight of Tare (gm)	0		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 10	100.00
Weight of Dry Material (gm)	98.59		
		Specific Gravity	2.72 Assumed

Note:

Tested By JBD Date 7/11/2008 Checked By GBM Date 7-15-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-03 #10 Split Hydro rev 8.xls]Sheet1*

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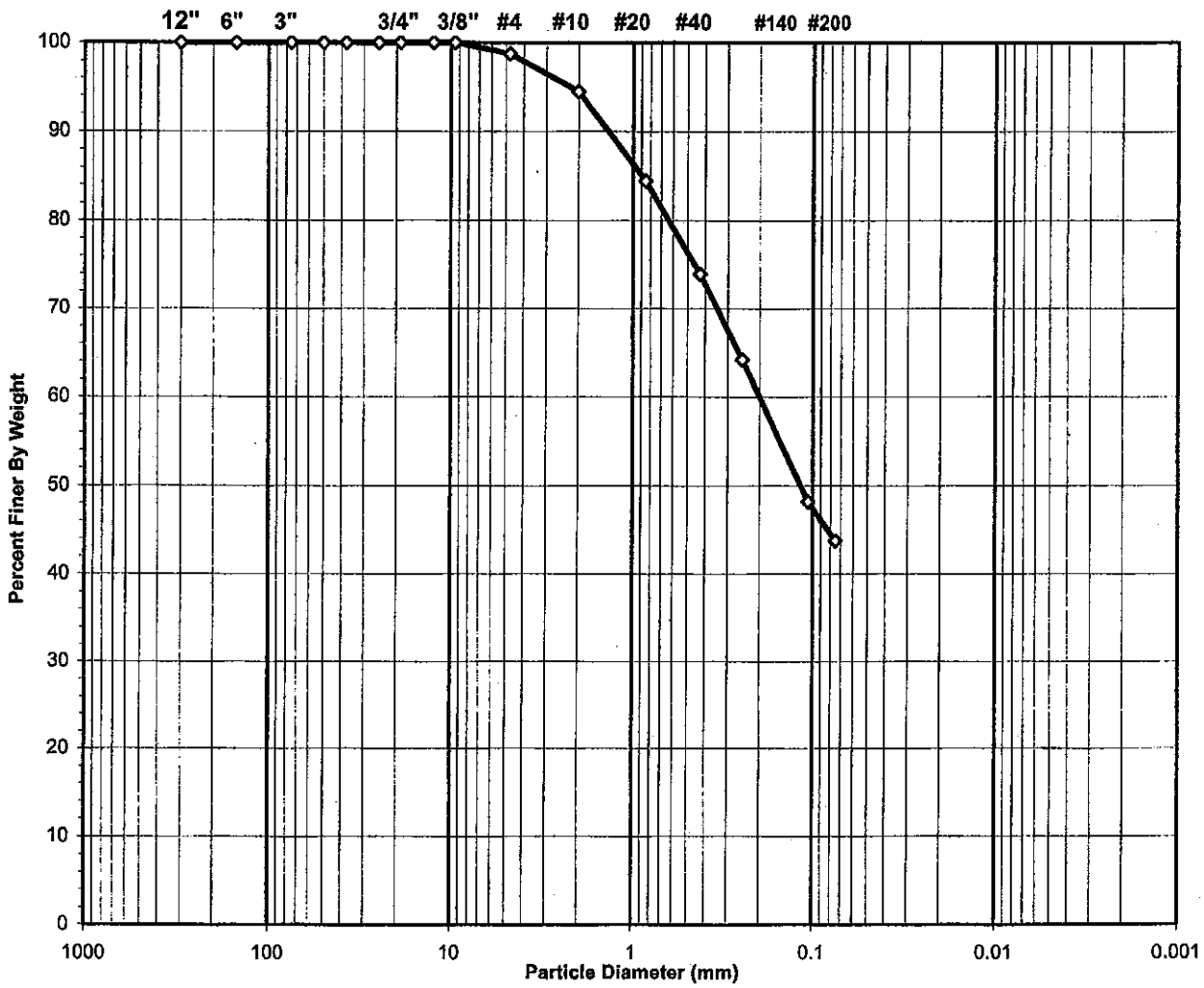
SIEVE ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	616
Client Reference	BUNCOMBE CO. C&D LF SUBSTANTIAL PE	Depth (ft)	2.5-4.5
Project No.	2008-603-01	Sample No.	T-1
Lab ID	2008-603-01-01	Soil Color	**DARK BROWN**

	SIEVE ANALYSIS		***HYDROMETER***
USCS	**gravel**	**sand**	**silt and clay**



USCS Symbol ***SC, TESTED***

USCS Classification ***CLAYEY SAND***

Tested By SD Date 7/17/2008 Checked By GEM Date 7-21-08

 DCN: CT-S3C DATE 6-25-98 REVISION: 2 *\\Server\c\2008 PROJECTS\2008-603 CDM\[2008-603-01-01 SIEVON REV 4.XLS]Sheet1*

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WASH SIEVE ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	616
Client Reference	BUNCOMBE CO. C&D LF SUBSTANTIAL PERMIT	Depth (ft)	2.5-4.5
Project No.	2008-603-01	Sample No.	T-1
Lab ID	2008-603-01-01	Soil Color	**DARK BROWN**

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	200	Tare No.	NA
Wgt.Tare + Wet Specimen (gm)	404.97	Wgt.Tare + Wet Specimen (gm)	NA
Wgt.Tare + Dry Specimen (gm)	371.34	Wgt.Tare + Dry Specimen (gm)	NA
Weight of Tare (gm)	171.78	Weight of Tare (gm)	NA
Weight of Water (gm)	33.63	Weight of Water (gm)	NA
Weight of Dry Soil (gm)	199.56	Weight of Dry Soil (gm)	NA
Moisture Content (%)	**16.9**	**Moisture Content (%)**	**NA**

Wet Weight -3/4" Sample (gm)	NA	Weight of the Dry Specimen (gm)	199.56
Dry Weight - 3/4" Sample (gm)	112.3	Weight of minus #200 material (gm)	87.25
Wet Weight +3/4" Sample (gm)	NA	Weight of plus #200 material (gm)	112.31
Dry Weight + 3/4" Sample (gm)	0.00		
Total Dry Weight Sample (gm)	NA		

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.50	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	0.00	0.0	0.0	100.0	**100.0**
#4	4.75	2.48	1.2	1.2	98.8	**98.8**
#10	2.00	8.57	4.3	5.5	94.5	**94.5**
#20	0.850	19.99	10.0	15.6	84.4	**84.4**
#40	0.425	20.94	10.5	26.0	74.0	**74.0**
#60	0.250	19.50	9.8	35.8	64.2	**64.2**
#140	0.106	31.89	16.0	51.8	48.2	**48.2**
#200	0.075	8.94	4.5	56.3	43.7	**43.7**
Pan	-	87.25	43.7	100.0	-	-

Tested By SD Date 7/17/2008 Checked By GEM Date 7-21-08

DCN: CT-S3C DATE 6-25-98 REVISION: 2

\\Server\c\2008 PROJECTS\2008-603 CDM\[2008-603-01-01 SIEVON REV 4.XLS]Sheet1

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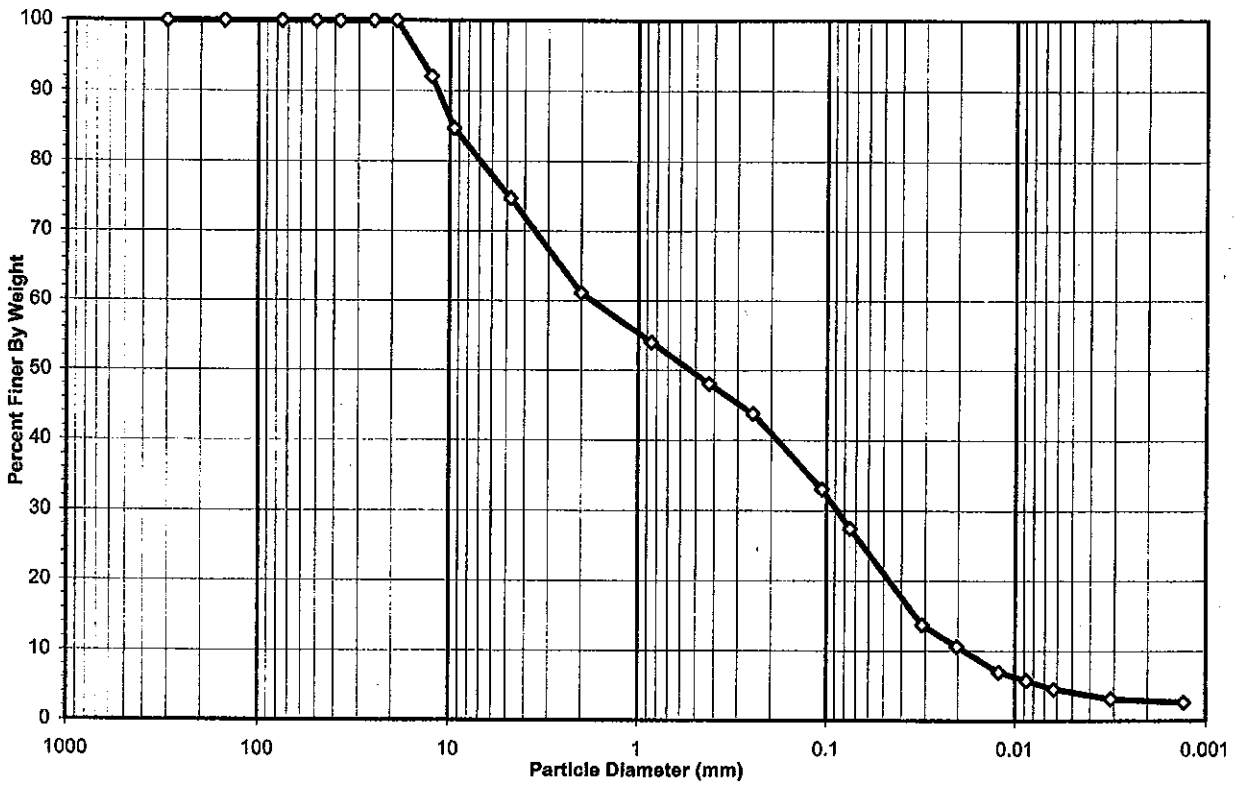
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-617
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	8.5-10
Project No.	2008-598-01	Sample No.	S-3
Lab ID	2008-598-01-04	Soil Color	**BROWN TAN**

	SIEVE ANALYSIS					HYDROMETER	
USCS	cobbles	gravel		sand		silt and clay fraction	
USDA	cobbles	gravel		sand		silt	clay

12" 6" 3" 3/4" 3/8" #4 #10 #20 #40 #140 #200



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	25.28
#4 To #200	*Sand*	47.29
Finer Than #200	*Silt & Clay*	27.43

USCS Symbol ***SM, TESTED***

USCS Classification ***SILTY SAND WITH GRAVEL***

DCN: CT-S3P DATE:02/15/05 REVISION:8 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-04 #10 Split Hydro rev 8.xls]Sheet1

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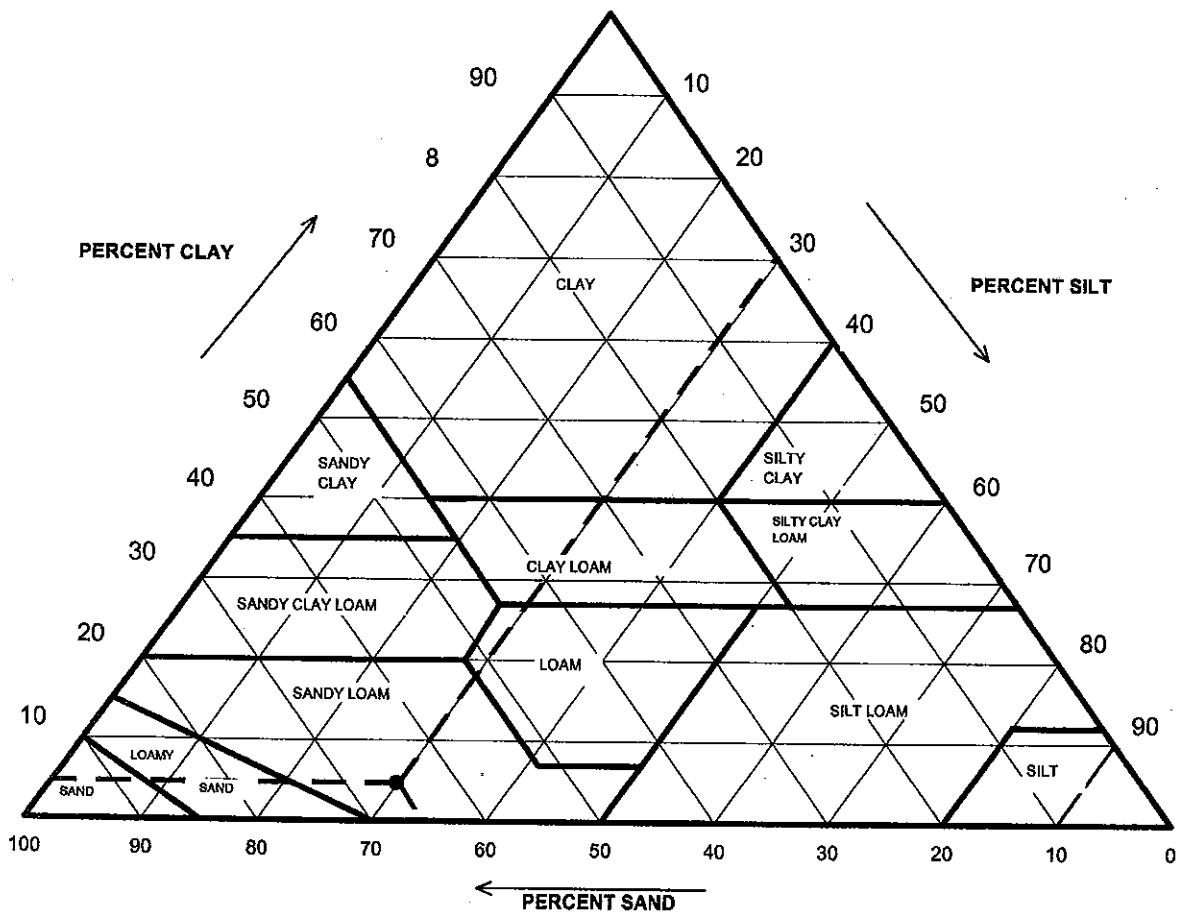
USDA CLASSIFICATION CHART

Client	CDM	Boring No.	B-617
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	8.5-10
Project No.	2008-598-01	Sample No.	S-3
Lab ID	2008-598-01-04	Soil Color	BROWN TAN



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	38.90	**0.00**
2	61.10	*Sand*	40.01	**65.48**
0.05	21.10	*Silt*	18.23	**29.83**
0.002	2.87	*Clay*	2.87	**4.69**

USDA Classification: ***SANDY LOAM***

DCN: CT-S3P DATE:02/15/05 REVISION:8 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-04 #10 Split Hydro rev 8.xls]Sheet1

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WASH SIEVE ANALYSIS #10 SPLIT

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-617
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	8.5-10
Project No.	2008-598-01	Sample No.	S-3
Lab ID	2008-598-01-04	Soil Color	**BROWN TAN**

Moisture Content/sieve +10 Material		Moisture Content for Hydrometer Portion	
Tare No.	P-12	Tare No.	S-1
Wgt.Tare + Wet Soil (gm)	257.19	Wgt.Tare + Wet Soil (gm)	55.34
Wgt.Tare + Dry Soil (gm)	254.55	Wgt.Tare + Dry Soil (gm)	54.64
Weight of Tare (gm)	196.45	Weight of Tare (gm)	15.55
Weight of Water (gm)	2.64	Weight of Water (gm)	0.70
Weight of Dry Soil (gm)	58.10	Weight of Dry Soil (gm)	39.09
Moisture Content (%)	**4.5**	**Moisture Content (%)**	**1.8**

Soil Specimen Data			
Wet Weight +#10 Material (gm)	60.74	Weight of the Dry Sample (gm)	156.34
Dry Weight +#10 Material(gm)	58.1	Weight of minus #200 material (gm)	44.10
Wet Weight Hydro. Material.(gm)	100.00	Weight of plus #200 material (gm)	112.24
Dry Weight Hydro. Material (gm)	98.24		
Total Dry Weight Sample (gm)	156.34	**J-FACTOR (%FINER THAN #10)**	**0.6110**

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.5	4.62	7.95	7.95	92.05	**92.05**
3/8"	9.50	4.25	7.31	15.27	84.73	**84.73**
#4	4.75	5.82	10.02	25.28	74.72	**74.72**
#10	2.00	7.91	13.61	38.90	61.10	**61.10**
#20	0.85	11.48	11.69	11.69	88.31	**53.96**
#40	0.425	9.49	9.66	21.35	78.65	**48.06**
#60	0.250	6.85	6.97	28.32	71.68	**43.80**
#140	0.106	17.31	17.62	45.94	54.06	**33.03**
#200	0.075	9.01	9.17	55.11	44.89	**27.43**
Pan	-	44.10	44.89	100.00	-	-

Notes :

Tested By SD Date 7/15/2008 Checked By GEM Date 7-17-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-04 #10 Split Hydro rev 8.xls]Sheet1*

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HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-617
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	8.5-10
Project No.	2008-598-01	Sample No.	S-3
Lab ID	2008-598-01-04	Soil Color	**BROWN TAN**

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	26.0	26.0	24.4	3.67	22.3	22.4	0.01269	0.0311	**13.7**
5		21.0	24.4	3.67	17.3	17.4	0.01269	0.0203	**10.6**
15		15.0	24.4	3.67	11.3	11.4	0.01269	0.0122	**6.9**
30		13.0	24.4	3.67	9.3	9.4	0.01269	0.0087	**5.7**
60		11.0	24.4	3.67	7.3	7.4	0.01269	0.0062	**4.5**
250		9.0	23.6	3.91	5.1	5.1	0.01281	0.0031	**3.1**
1440		8.0	24.2	3.73	4.3	4.3	0.01272	0.0013	**2.6**

Soil Specimen Data		**Other Corrections**	
Tare + Dry Material (gm)	98.24	a - Factor	0.986
Weight of Tare (gm)	0		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 10	61.10
Weight of Dry Material (gm)	98.24		
		Specific Gravity	2.72 Assumed

Note:

Tested By JBD Date 7/14/2008 Checked By GEM Date 7-17-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-04 #10 Split Hydro rev 8.xls]Sheet1

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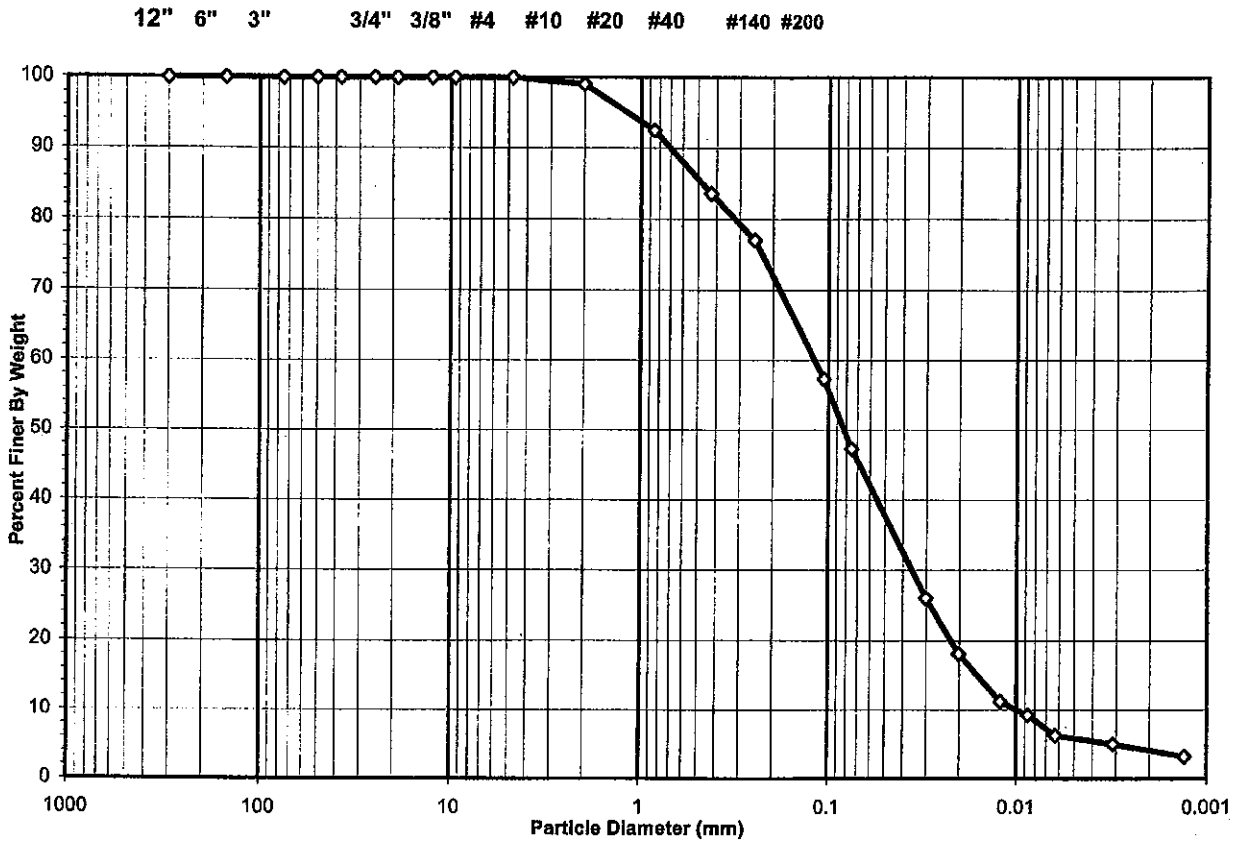
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-618
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	9-11
Project No.	2008-598-01	Sample No.	S-3
Lab ID	2008-598-01-05	Soil Color	**LIGHT BROWN**

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	52.74
Finer Than #200	*Silt & Clay*	47.26

USCS Symbol ***SM, TESTED***

USCS Classification ***SILTY SAND***

DCN: CT-S3P DATE:02/15/05 REVISION:8 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-05 #10 Split Hydro rev 8.xls]Sheet1

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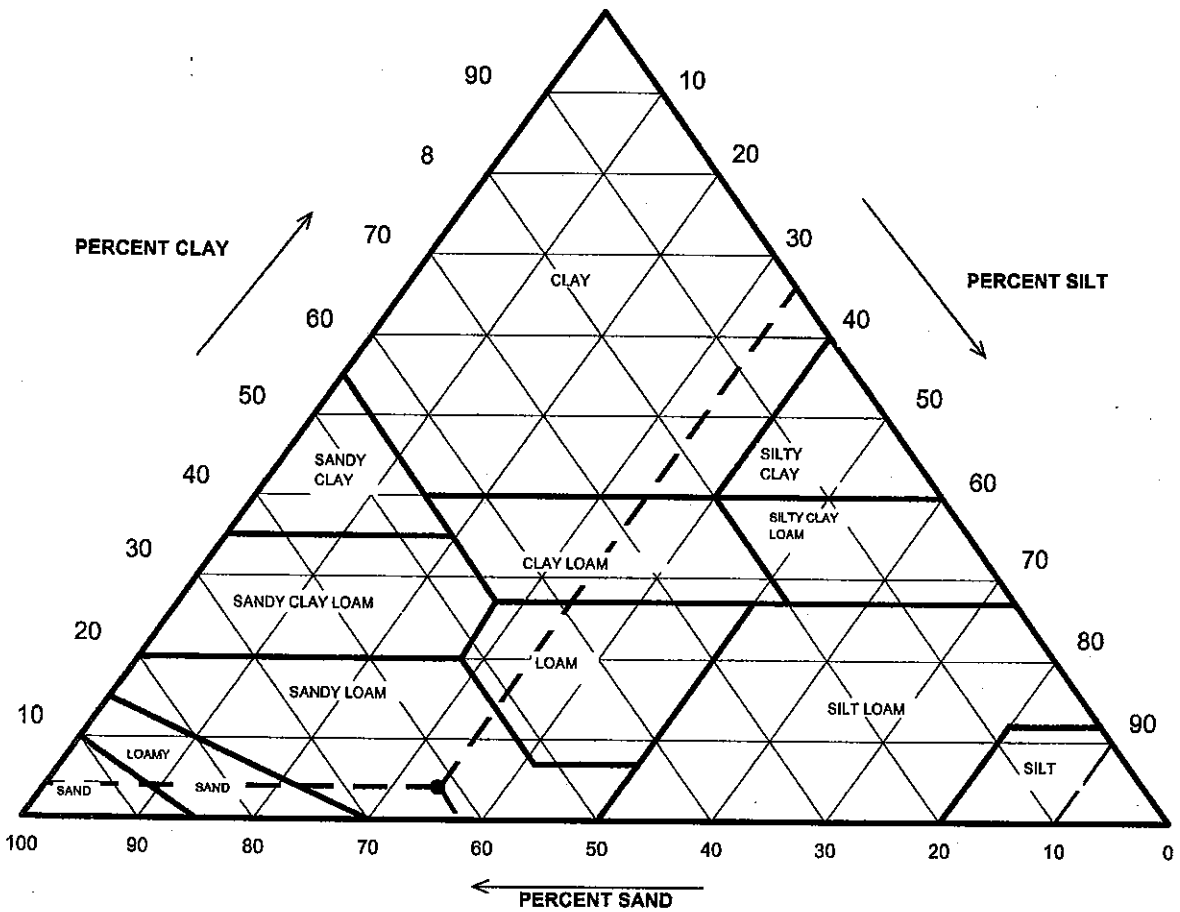
USDA CLASSIFICATION CHART

Client	CDM	Boring No.	B-618
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	9-11
Project No.	2008-598-01	Sample No.	S-3
Lab ID	2008-598-01-05	Soil Color	LIGHT BROWN



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	0.93	**0.00**
2	99.07	*Sand*	61.29	**61.87**
0.05	37.78	*Silt*	33.70	**34.02**
0.002	4.07	*Clay*	4.07	**4.11**

USDA Classification: ***SANDY LOAM***

DCN: CT-S3P DATE:02/15/05 REVISION:8 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-05 #10 Split Hydro rev 8.xls]Sheet1

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WASH SIEVE ANALYSIS #10 SPLIT

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-618
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	9-11
Project No.	2008-598-01	Sample No.	S-3
Lab ID	2008-598-01-05	Soil Color	**LIGHT BROWN**

Moisture Content/sieve +10 Material		Moisture Content for Hydrometer Portion	
Tare No.	200	Tare No.	E-2
Wgt.Tare + Wet Soil (gm)	229.34	Wgt.Tare + Wet Soil (gm)	61.85
Wgt.Tare + Dry Soil (gm)	223.33	Wgt.Tare + Dry Soil (gm)	61.45
Weight of Tare (gm)	171.85	Weight of Tare (gm)	21.90
Weight of Water (gm)	6.01	Weight of Water (gm)	0.40
Weight of Dry Soil (gm)	51.48	Weight of Dry Soil (gm)	39.55
Moisture Content (%)	**11.7**	**Moisture Content (%)**	**1.0**

Soil Specimen Data			
Wet Weight +#10 Material (gm)	57.49	Weight of the Dry Sample (gm)	150.48
Dry Weight +#10 Material(gm)	51.5	Weight of minus #200 material (gm)	47.23
Wet Weight Hydro. Material.(gm)	100.00	Weight of plus #200 material (gm)	103.25
Dry Weight Hydro. Material (gm)	99.00		
Total Dry Weight Sample (gm)	150.48	**J-FACTOR (%FINER THAN #10)**	**0.9907**

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.00	0.00	0.00	100.00	**100.00**
#10	2.00	0.48	0.93	0.93	99.07	**99.07**
#20	0.85	6.62	6.69	6.69	93.31	**92.44**
#40	0.425	8.88	8.97	15.66	84.34	**83.56**
#60	0.250	6.51	6.58	22.23	77.77	**77.04**
#140	0.106	19.73	19.93	42.16	57.84	**57.30**
#200	0.075	10.03	10.13	52.29	47.71	**47.26**
Pan	-	47.23	47.71	100.00	-	-

Notes :

Tested By SD Date 7/15/2008 Checked By CEM Date 7-15-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-05 #10 Split Hydro rev 8.xls]Sheet1

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HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-618
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	9-11
Project No.	2008-598-01	Sample No.	S-3
Lab ID	2008-598-01-05	Soil Color	**LIGHT BROWN**

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	30.0	30.0	24.5	3.65	26.4	26.2	0.01267	0.0302	**26.0**
5		22.0	24.5	3.65	18.4	18.3	0.01267	0.0202	**18.1**
15		15.0	24.5	3.65	11.4	11.3	0.01267	0.0122	**11.2**
30		13.0	24.5	3.65	9.4	9.3	0.01267	0.0087	**9.2**
60		10.0	24.5	3.65	6.4	6.3	0.01267	0.0063	**6.3**
250		9.0	23.5	3.94	5.1	5.0	0.01282	0.0031	**5.0**
1440		7.0	24.1	3.76	3.2	3.2	0.01273	0.0013	**3.2**

Soil Specimen Data		**Other Corrections**	
Tare + Dry Material (gm)	99.00	a - Factor	0.986
Weight of Tare (gm)	0		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 10	99.07
Weight of Dry Material (gm)	99.00		
		Specific Gravity	2.72 Assumed

Note:

Tested By JBD Date 7/14/2008 Checked By GEM Date 7-15-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-05 #10 Split Hydro rev 8.xls]Sheet1

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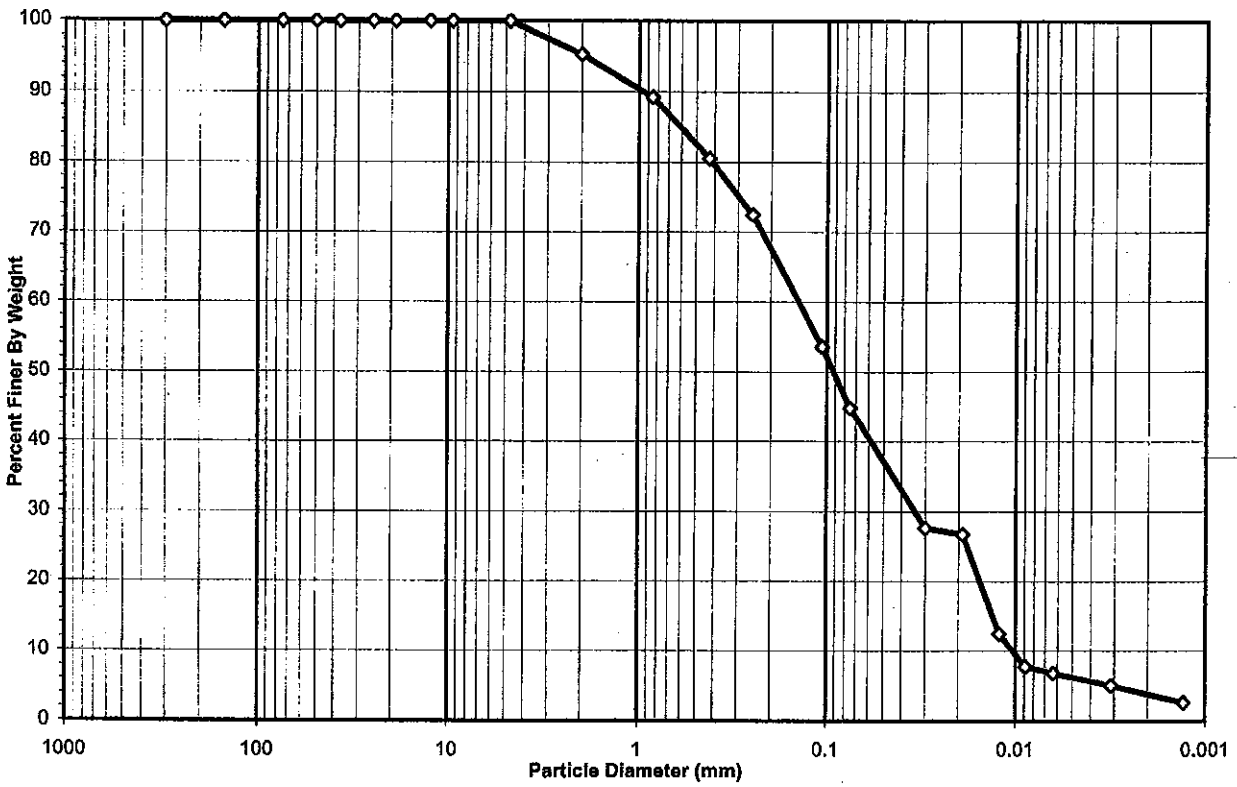
INTEGRITY IN TESTING

SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-618
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	24-26
Project No.	2008-598-01	Sample No.	S-6
Lab ID	2008-598-01-06	Soil Color	**GRAY WHITE BROWN**

	SIEVE ANALYSIS					HYDROMETER
USCS	cobbles	gravel	sand			silt and clay fraction
USDA	cobbles	gravel	sand		silt	clay

12" 6" 3" 3/4" 3/8" #4 #10 #20 #40 #140 #200



Sieve Sizes (mm)	USCS Summary	Percentage
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	55.23
Finer Than #200	*Silt & Clay*	44.77

USCS Symbol ***SM, TESTED***

USCS Classification ***SILTY SAND***

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\2008-598-01-06 #10 Split Hydro rev 8.xls]Sheet1*

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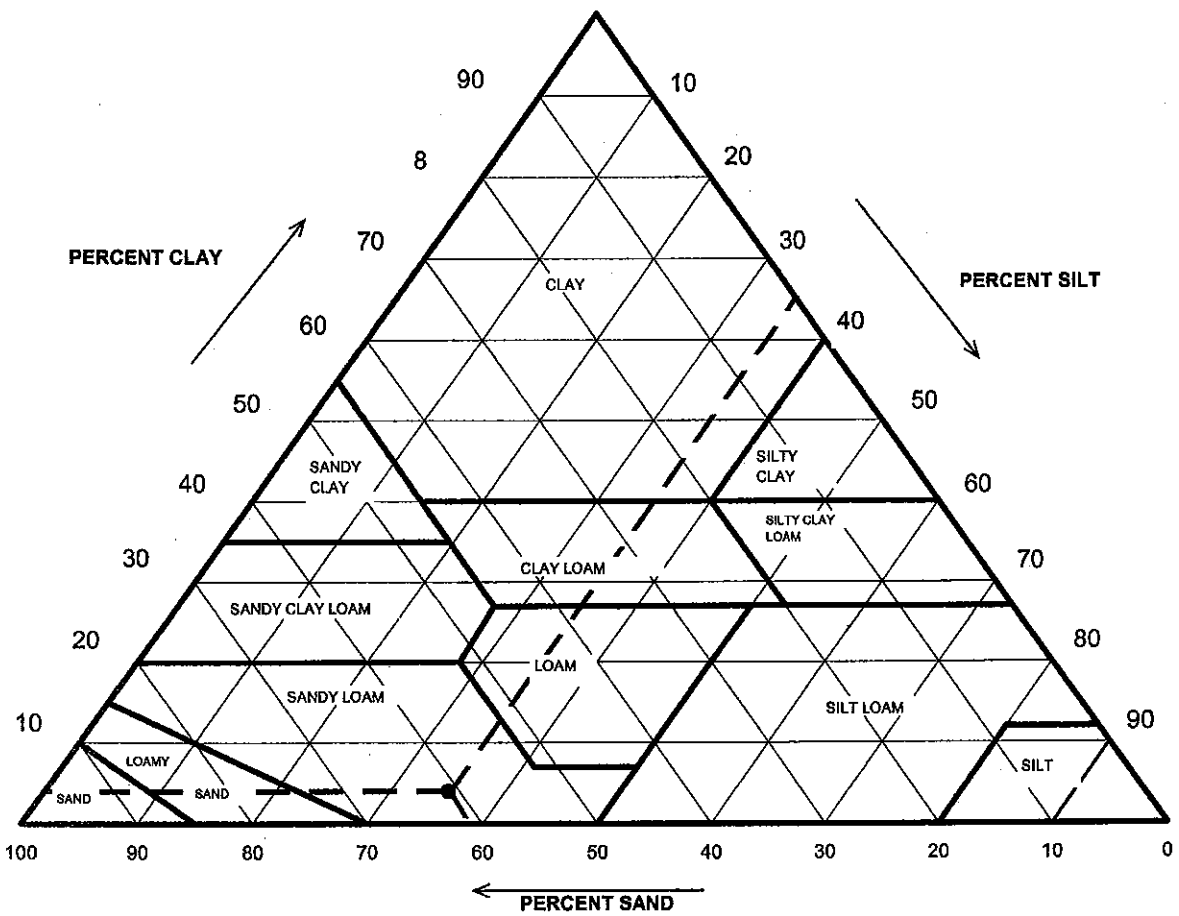
USDA CLASSIFICATION CHART

Client	CDM	Boring No.	B-618
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	24-26
Project No.	2008-598-01	Sample No.	S-6
Lab ID	2008-598-01-06	Soil Color	GRAY WHITE BROWN



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	4.70	**0.00**
2	95.30	*Sand*	58.12	**60.98**
0.05	37.18	*Silt*	33.38	**35.03**
0.002	3.80	*Clay*	3.80	**3.99**

USDA Classification: ***SANDY LOAM***

DCN: CT-S3P DATE:02/15/05 REVISION:8 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-06 #10 Split Hydro rev 8.xls]Sheet1

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WASH SIEVE ANALYSIS #10 SPLIT

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-618
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	24-26
Project No.	2008-598-01	Sample No.	S-6
Lab ID	2008-598-01-06	Soil Color	**GRAY WHITE BROWN**

Moisture Content/sieve +10 Material		Moisture Content for Hydrometer Portion	
Tare No.	212	Tare No.	C-2
Wgt.Tare + Wet Soil (gm)	204.52	Wgt.Tare + Wet Soil (gm)	45.46
Wgt.Tare + Dry Soil (gm)	201.83	Wgt.Tare + Dry Soil (gm)	45.28
Weight of Tare (gm)	171.60	Weight of Tare (gm)	15.63
Weight of Water (gm)	2.69	Weight of Water (gm)	0.18
Weight of Dry Soil (gm)	30.23	Weight of Dry Soil (gm)	29.65
Moisture Content (%)	**8.9**	**Moisture Content (%)**	**0.6**

Soil Specimen Data			
Wet Weight +#10 Material (gm)	32.92	Weight of the Dry Sample (gm)	129.67
Dry Weight +#10 Material(gm)	30.2	Weight of minus #200 material (gm)	46.72
Wet Weight Hydro. Material.(gm)	100.04	Weight of plus #200 material (gm)	82.95
Dry Weight Hydro. Material (gm)	99.44		
Total Dry Weight Sample (gm)	129.67	**J-FACTOR (%FINER THAN #10)**	**0.9530**

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.00	0.00	0.00	100.00	**100.00**
#10	2.00	1.42	4.70	4.70	95.30	**95.30**
#20	0.85	6.33	6.37	6.37	93.63	**89.24**
#40	0.425	9.05	9.10	15.47	84.53	**80.56**
#60	0.250	8.47	8.52	23.99	76.01	**72.44**
#140	0.106	19.73	19.84	43.83	56.17	**53.53**
#200	0.075	9.14	9.19	53.02	46.98	**44.77**
Pan	-	46.72	46.98	100.00	-	-

Notes :

Tested By SD Date 7/16/2008 Checked By GAM Date 7-21-08

DCN: CT-B3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-06 #10 Split Hydro rev 8.xls]Sheet1*

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HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-618
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	24-26
Project No.	2008-598-01	Sample No.	S-6
Lab ID	2008-598-01-06	Soil Color	**GRAY WHITE BROWN**

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	33.0	33.0	23.7	3.88	29.1	29.0	0.01287	0.0300	**27.6**
5		32.0	23.7	3.88	28.1	28.0	0.01287	0.0191	**26.7**
15		17.0	23.7	3.88	13.1	13.1	0.01287	0.0122	**12.4**
30		12.0	23.8	3.85	8.2	8.1	0.01285	0.0089	**7.7**
60		11.0	23.8	3.85	7.2	7.1	0.01285	0.0063	**6.8**
250		9.0	24.3	3.70	5.3	5.3	0.01278	0.0031	**5.0**
1440		6.0	25.8	3.27	2.7	2.7	0.01256	0.0013	**2.6**

Soil Specimen Data		**Other Corrections**	
Tare + Dry Material (gm)	99.44	a - Factor	0.99
Weight of Tare (gm)	0		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 10	95.30
Weight of Dry Material (gm)	99.44		
		Specific Gravity	2.7 Assumed

Note:

Tested By JBD Date 7/14/2008 Checked By GZM Date 7-21-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-06 #10 Split Hydro rev 8.xls]Sheet1

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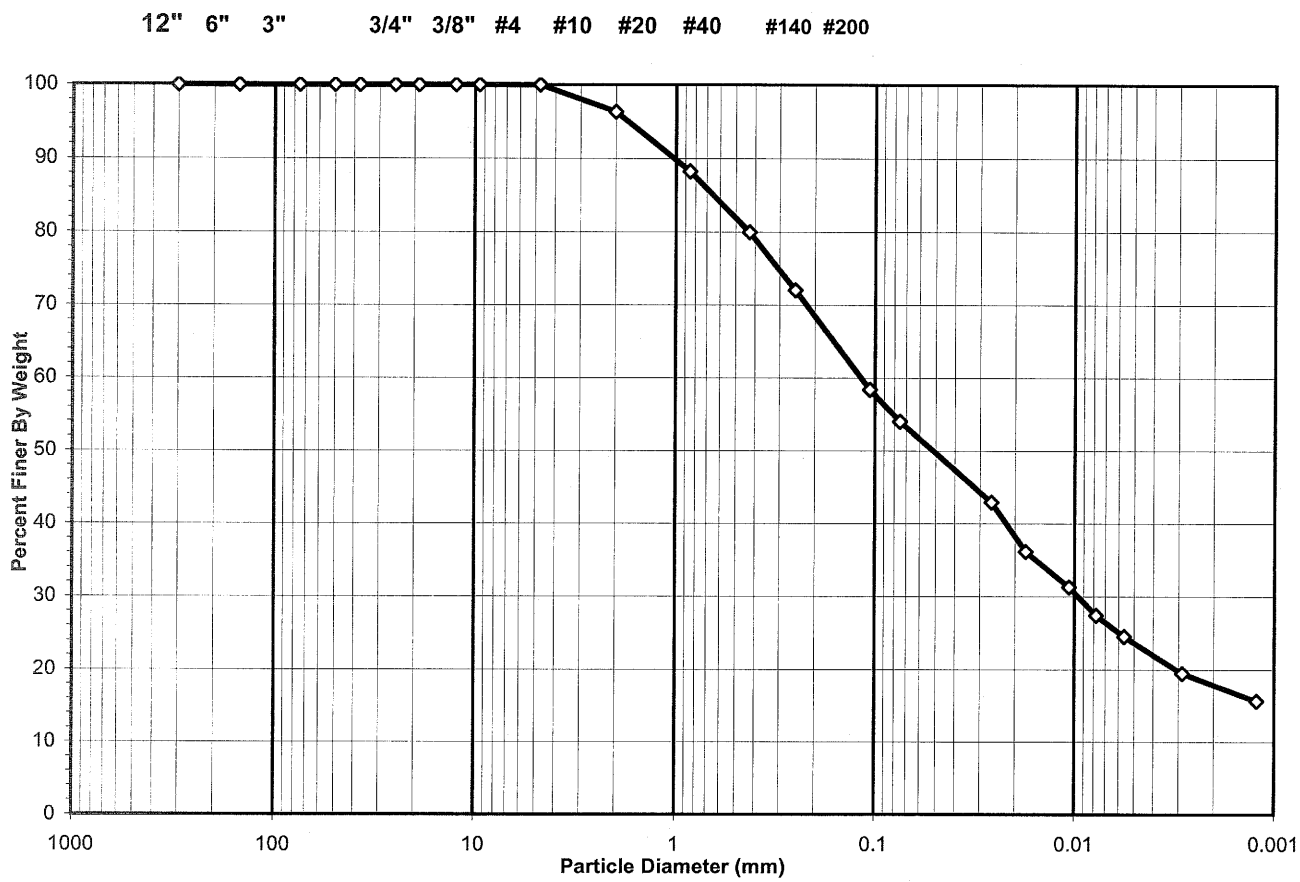
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	4-5
Project No.	2008-598-01	Sample No.	S-1T
Lab ID	2008-598-01-07	Soil Color	**BROWN**

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	46.02
Finer Than #200	*Silt & Clay*	53.98

USCS Symbol ***CL, TESTED***

USCS Classification ***SANDY LEAN CLAY***

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-07 #10 Split Hydro rev 8.xls]Sheet1*

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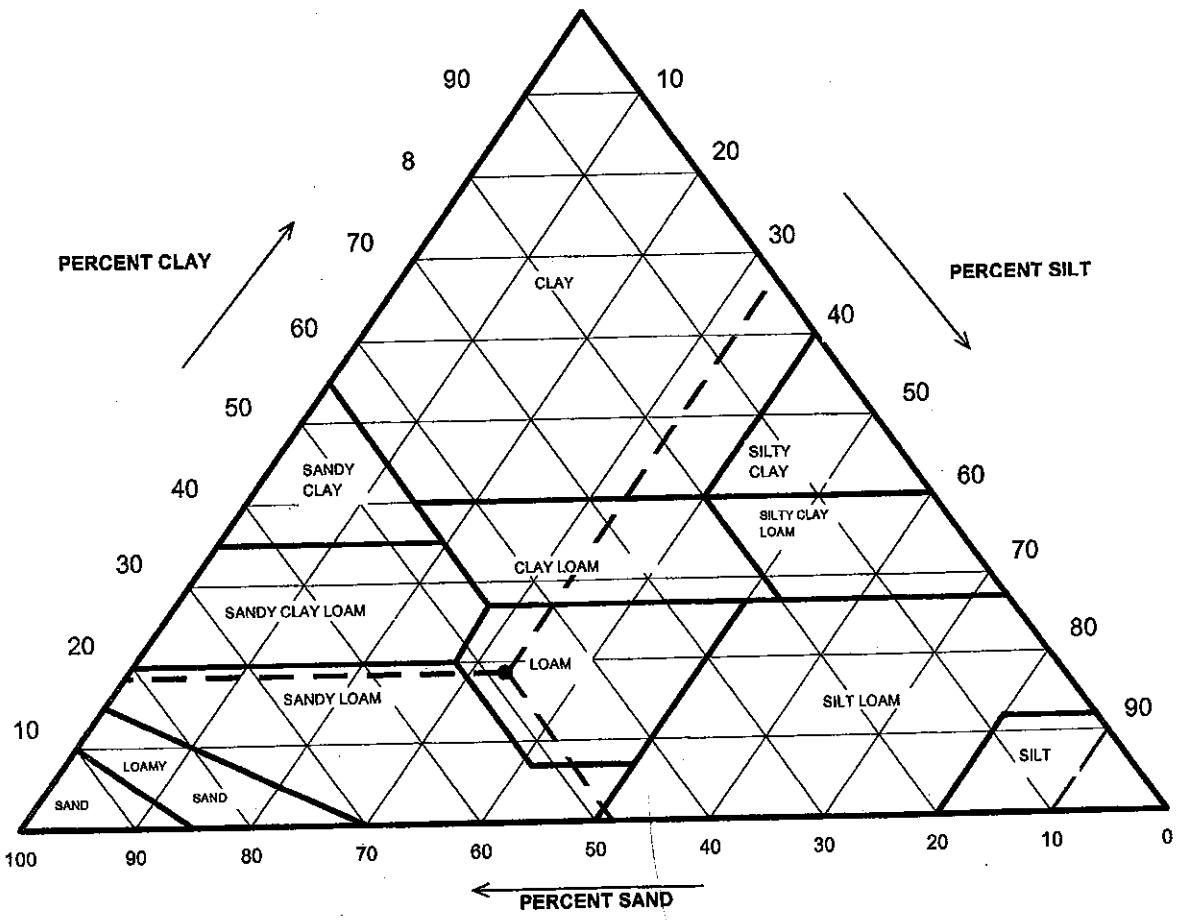
USDA CLASSIFICATION CHART

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	4-5
Project No.	2008-598-01	Sample No.	S-1T
Lab ID	2008-598-01-07	Soil Color	BROWN



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	3.70	**0.00**
2	96.30	*Sand*	46.60	**48.39**
0.05	49.70	*Silt*	31.86	**33.08**
0.002	17.85	*Clay*	17.85	**18.53**

USDA Classification: ***LOAM***

DCN: CT-S3P DATE:02/15/05 REVISION:8 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-07 #10 Split Hydro rev 8.xls]Sheet1

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WASH SIEVE ANALYSIS #10 SPLIT

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	4-5
Project No.	2008-598-01	Sample No.	S-1T
Lab ID	2008-598-01-07	Soil Color	**BROWN**

Moisture Content/sieve +10 Material		Moisture Content for Hydrometer Portion	
Tare No.	215	Tare No.	P-1
Wgt.Tare + Wet Soil (gm)	224.13	Wgt.Tare + Wet Soil (gm)	38.84
Wgt.Tare + Dry Soil (gm)	216.91	Wgt.Tare + Dry Soil (gm)	38.45
Weight of Tare (gm)	172.33	Weight of Tare (gm)	15.71
Weight of Water (gm)	7.22	Weight of Water (gm)	0.39
Weight of Dry Soil (gm)	44.58	Weight of Dry Soil (gm)	22.74
Moisture Content (%)	**16.2**	**Moisture Content (%)**	**1.7**

Soil Specimen Data			
Wet Weight +#10 Material (gm)	51.80	Weight of the Dry Sample (gm)	142.92
Dry Weight +#10 Material(gm)	44.6	Weight of minus #200 material (gm)	55.12
Wet Weight Hydro. Material.(gm)	100.03	Weight of plus #200 material (gm)	87.80
Dry Weight Hydro. Material (gm)	98.34		
Total Dry Weight Sample (gm)	142.92	**J-FACTOR (%FINER THAN #10)**	**0.9630**

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.00	0.00	0.00	100.00	**100.00**
#10	2.00	1.65	3.70	3.70	96.30	**96.30**
#20	0.85	8.23	8.37	8.37	91.63	**88.24**
#40	0.425	8.43	8.57	16.94	83.06	**79.99**
#60	0.250	8.11	8.25	25.19	74.81	**72.04**
#140	0.106	13.95	14.18	39.37	60.63	**58.38**
#200	0.075	4.50	4.58	43.95	56.05	**53.98**
Pan	-	55.12	56.05	100.00	-	-

Notes :

Tested By SD Date 7/15/2008 Checked By Gem Date 7-21-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-07 #10 Split Hydro rev 8.xls]Sheet1*

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HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	4-5
Project No.	2008-598-01	Sample No.	S-1T
Lab ID	2008-598-01-07	Soil Color	**BROWN**

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	48.0	48.0	24.2	3.73	44.3	44.6	0.01279	0.0263	**42.9**
5		41.0	24.2	3.73	37.3	37.5	0.01279	0.0177	**36.1**
15		36.0	24.2	3.73	32.3	32.5	0.01279	0.0106	**31.3**
30		32.0	24.2	3.73	28.3	28.5	0.01279	0.0078	**27.4**
60		29.0	24.2	3.73	25.3	25.4	0.01279	0.0056	**24.5**
250		24.0	23.5	3.94	20.1	20.2	0.01290	0.0029	**19.4**
1440		20.0	23.8	3.85	16.2	16.3	0.01285	0.0012	**15.7**

Soil Specimen Data		Other Corrections	
Tare + Dry Material (gm)	98.34	a - Factor	0.99
Weight of Tare (gm)	0	Percent Finer than # 10	96.30
Weight of Deflocculant (gm)	5.0	Specific Gravity	2.7 Assumed
Weight of Dry Material (gm)	98.34		

Note:

Tested By JBD Date 7/15/2008 Checked By GZM Date 7-21-08

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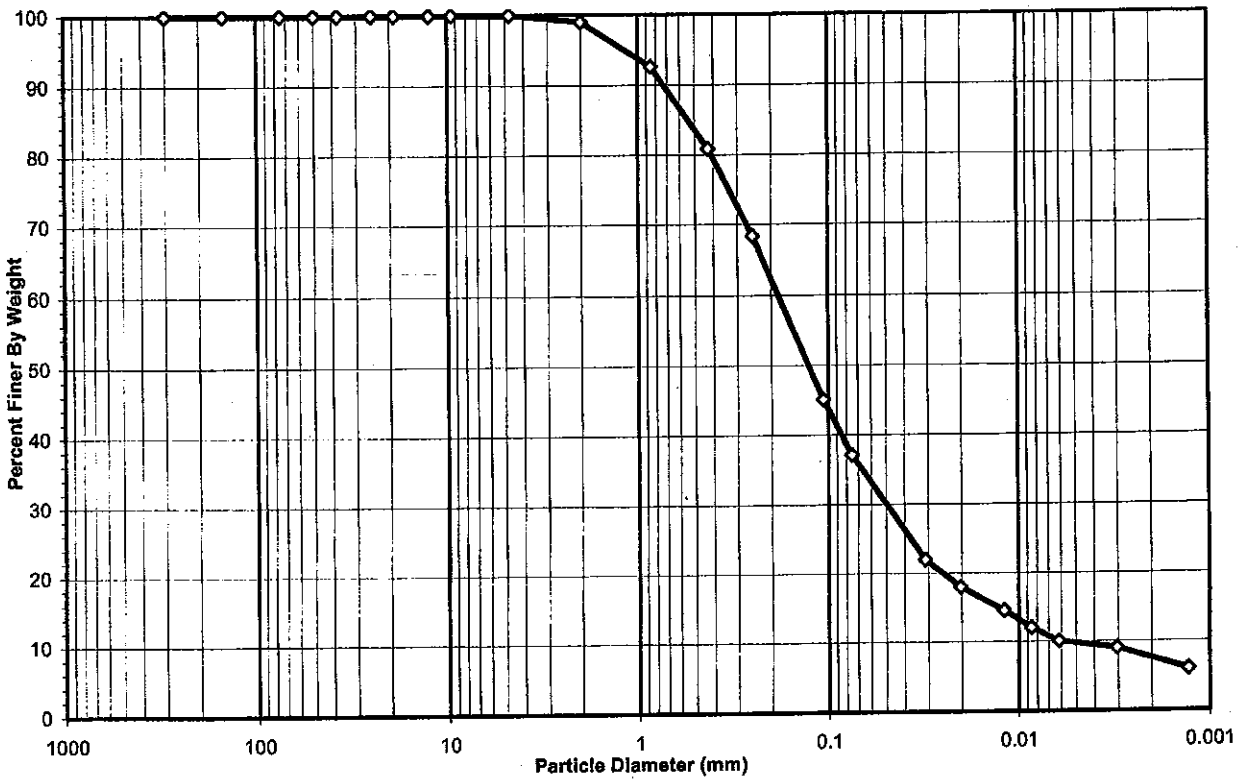
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	5-6
Project No.	2008-598-01	Sample No.	S-1B
Lab ID	2008-598-01-08	Soil Color	**BROWN WHITE**

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay

12" 6" 3" 3/4" 3/8" #4 #10 #20 #40 #140 #200



USCS Summary		
Sieve Sizes (mm)		**Percentage**
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	62.89
Finer Than #200	*Silt & Clay*	37.11

USCS Symbol ***SM, TESTED (NON PLASTIC FINES)***

USCS Classification ***SILTY SAND***

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\ct\2008 PROJECTS\2008-598 CDM\[2008-598-01-08 #10 Split Hydro rev 8.xls]Sheet1*

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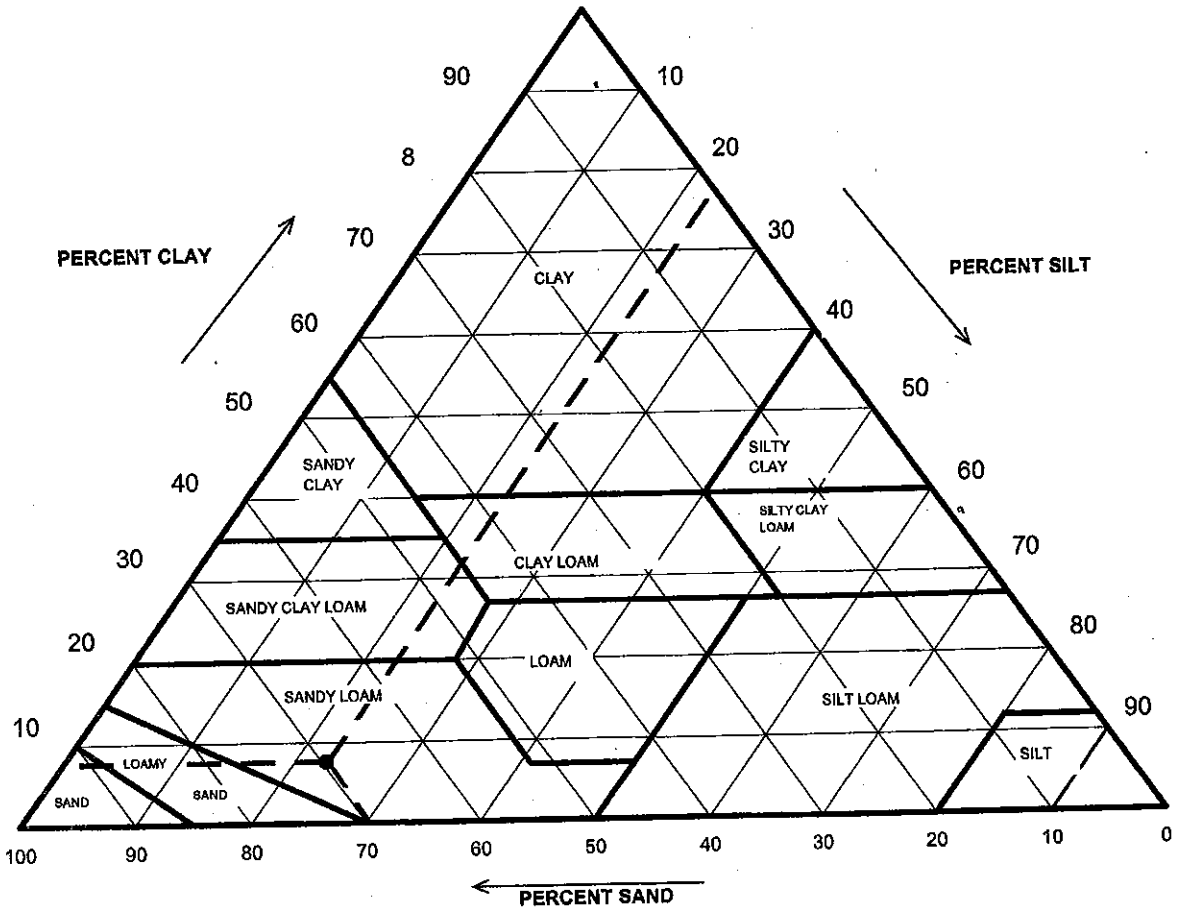
USDA CLASSIFICATION CHART

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	5-6
Project No.	2008-598-01	Sample No.	S-1B
Lab ID	2008-598-01-08	Soil Color	BROWN WHITE



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	0.95	**0.00**
2	99.05	*Sand*	68.94	**69.61**
0.05	30.10	*Silt*	22.53	**22.74**
0.002	7.57	*Clay*	7.57	**7.65**

USDA Classification: ***SANDY LOAM***

DCN: CT-S3P DATE:02/15/05 REVISION:8 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-08 #10 Spfit Hydro rev 8.xls]Sheet1

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INTEGRITY IN TESTING

WASH SIEVE ANALYSIS #10 SPLIT

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	5-6
Project No.	2008-598-01	Sample No.	S-1B
Lab ID	2008-598-01-08	Soil Color	**BROWN WHITE**

Moisture Content/sieve +10 Material		Moisture Content for Hydrometer Portion	
Tare No.	202	Tare No.	B-1
Wgt.Tare + Wet Soil (gm)	283.68	Wgt.Tare + Wet Soil (gm)	56.57
Wgt.Tare + Dry Soil (gm)	275.01	Wgt.Tare + Dry Soil (gm)	56.40
Weight of Tare (gm)	197.38	Weight of Tare (gm)	22.07
Weight of Water (gm)	8.67	Weight of Water (gm)	0.17
Weight of Dry Soil (gm)	77.63	Weight of Dry Soil (gm)	34.33
Moisture Content (%)	**11.2**	**Moisture Content (%)**	**0.5**

Soil Specimen Data			
Wet Weight +#10 Material (gm)	86.30	Weight of the Dry Sample (gm)	177.15
Dry Weight +#10 Material(gm)	77.6	Weight of minus #200 material (gm)	37.29
Wet Weight Hydro. Material.(gm)	100.01	Weight of plus #200 material (gm)	139.86
Dry Weight Hydro. Material (gm)	99.52		
Total Dry Weight Sample (gm)	177.15	**J-FACTOR (%FINER THAN #10)**	**0.9905**

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated **Percent Finer (%)**
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.00	0.00	0.00	100.00	**100.00**
#10	2.00	0.74	0.95	0.95	99.05	**99.05**
#20	0.85	6.49	6.52	6.52	93.48	**92.59**
#40	0.425	11.77	11.83	18.35	81.65	**80.87**
#60	0.250	12.61	12.67	31.02	68.98	**68.32**
#140	0.106	23.35	23.46	54.48	45.52	**45.08**
#200	0.075	8.01	8.05	62.53	37.47	**37.11**
Pan	-	37.29	37.47	100.00	-	-

Notes :

Tested By SD Date 7/15/2008 Checked By GCM Date 7-21-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-08 #10 Split Hydro rev 8.xls]Sheet1*

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HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	5-6
Project No.	2008-598-01	Sample No.	S-1B
Lab ID	2008-598-01-08	Soil Color	**BROWN WHITE**

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	26.0	26.0	24.4	3.67	22.3	22.1	0.01269	0.0311	**21.9**
5		22.0	24.4	3.67	18.3	18.2	0.01269	0.0202	**18.0**
15		18.5	24.5	3.65	14.9	14.7	0.01267	0.0119	**14.6**
30		16.0	24.2	3.73	12.3	12.2	0.01272	0.0086	**12.0**
60		14.0	24.2	3.73	10.3	10.2	0.01272	0.0061	**10.1**
250		13.0	24.0	3.79	9.2	9.1	0.01275	0.0030	**9.0**
1440		10.0	23.8	3.85	6.2	6.1	0.01278	0.0013	**6.0**

Soil Specimen Data		**Other Corrections**	
Tare + Dry Material (gm)	99.52	a - Factor	0.986
Weight of Tare (gm)	0		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 10	99.05
Weight of Dry Material (gm)	99.52		
		Specific Gravity	2.72 Assumed

Note:

Tested By JBD Date 7/14/2008 Checked By GJM Date 7-21-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-08 #10 Split Hydro rev 8.xls]Sheet1*

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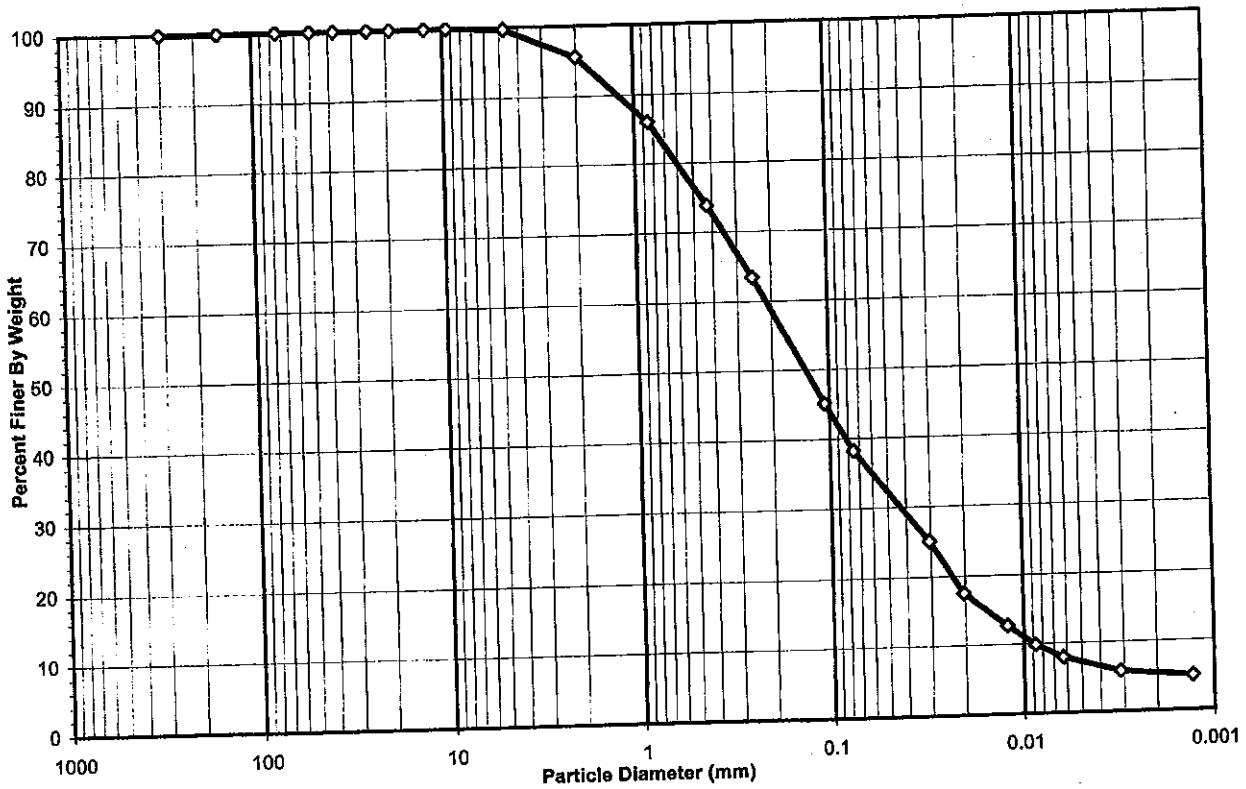
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	9-11
Project No.	2008-598-01	Sample No.	S-2
Lab ID	2008-598-01-09	Soil Color	**BROWN TAN**

	SIEVE ANALYSIS											HYDROMETER	
USCS	cobbles		gravel			sand						silt and clay fraction	
USDA	cobbles		gravel				sand					silt	clay
	12"	6"	3"	3/4"	3/8"	#4	#10	#20	#40	#140	#200		



Sieve Sizes (mm)	USCS Summary	Percentage
Greater Than #4	*Gravel*	0.26
#4 To #200	*Sand*	61.51
Finer Than #200	*Silt & Clay*	38.23

USCS Symbol ***SM, TESTED***

USCS Classification ***SILTY SAND***

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-09 #10 Split Hydro rev 8.xls]Sheet1*

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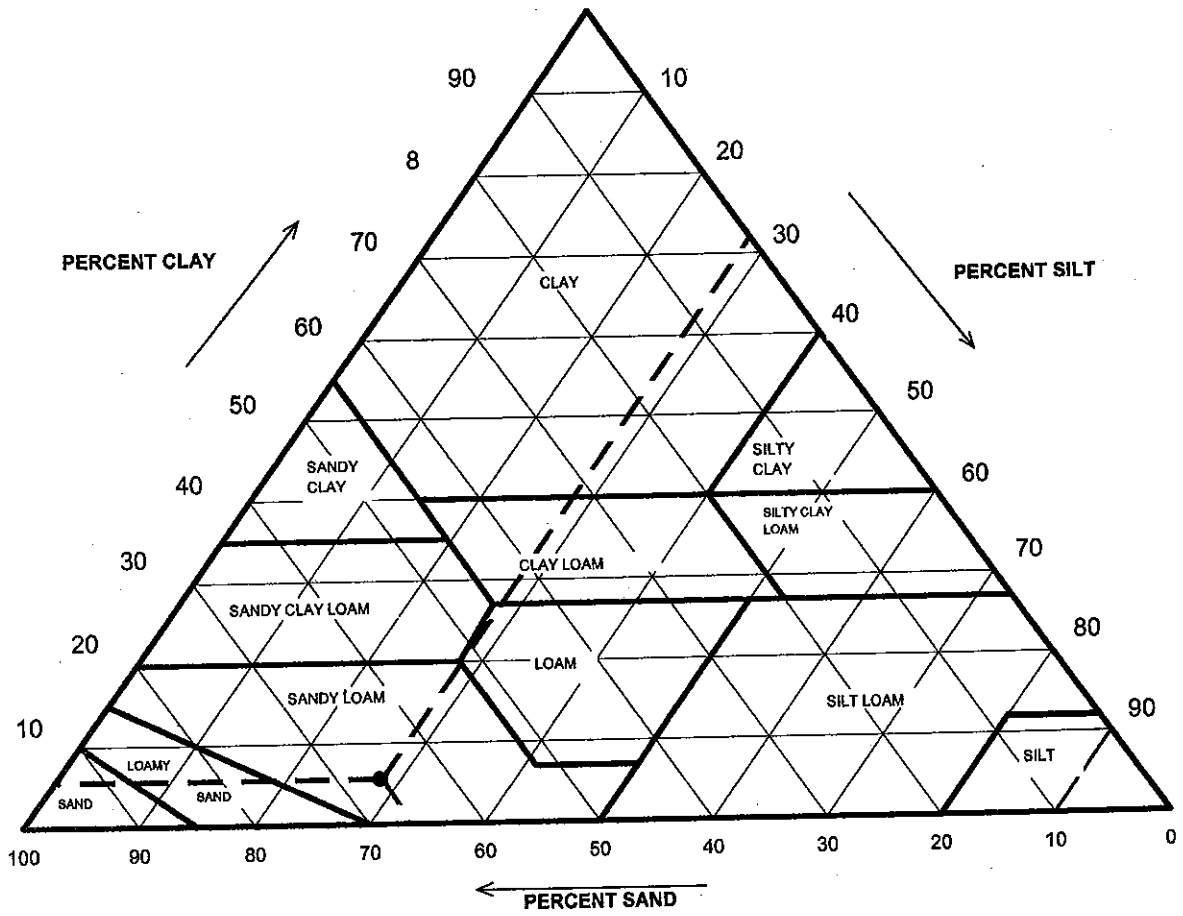
USDA CLASSIFICATION CHART

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	9-11
Project No.	2008-598-01	Sample No.	S-2
Lab ID	2008-598-01-09	Soil Color	BROWN TAN



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	4.39	**0.00**
2	95.61	*Sand*	63.29	**66.20**
0.05	32.32	*Silt*	26.94	**28.17**
0.002	5.38	*Clay*	5.38	**5.63**

USDA Classification: ***SANDY LOAM***

DCN: CT-S3P DATE:02/15/05 REVISION:8 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-09 #10 Split Hydro rev 8.xls]Sheet1

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WASH SIEVE ANALYSIS #10 SPLIT

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	9-11
Project No.	2008-598-01	Sample No.	S-2
Lab ID	2008-598-01-09	Soil Color	**BROWN TAN**

Moisture Content/sieve +10 Material		Moisture Content for Hydrometer Portion	
Tare No.	214	Tare No.	R-1
Wgt.Tare + Wet Soil (gm)	236.93	Wgt.Tare + Wet Soil (gm)	45.59
Wgt.Tare + Dry Soil (gm)	229.01	Wgt.Tare + Dry Soil (gm)	45.42
Weight of Tare (gm)	171.34	Weight of Tare (gm)	15.65
Weight of Water (gm)	7.92	Weight of Water (gm)	0.17
Weight of Dry Soil (gm)	57.67	Weight of Dry Soil (gm)	29.77
Moisture Content (%)	**13.7**	**Moisture Content (%)**	**0.6**

Soil Specimen Data			
Wet Weight +#10 Material (gm)	65.59	Weight of the Dry Sample (gm)	157.15
Dry Weight +#10 Material(gm)	57.7	Weight of minus #200 material (gm)	39.77
Wet Weight Hydro. Material.(gm)	100.05	Weight of plus #200 material (gm)	117.38
Dry Weight Hydro. Material (gm)	99.48		
Total Dry Weight Sample (gm)	157.15	**J-FACTOR (%FINER THAN #10)**	**0.9561**

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.15	0.26	0.26	99.74	**99.74**
#10	2.00	2.38	4.13	4.39	95.61	**95.61**
#20	0.85	9.97	10.02	10.02	89.98	**86.03**
#40	0.425	12.64	12.71	22.73	77.27	**73.88**
#60	0.250	10.89	10.95	33.67	66.33	**63.42**
#140	0.106	19.04	19.14	52.81	47.19	**45.12**
#200	0.075	7.17	7.21	60.02	39.98	**38.23**
Pan	-	39.77	39.98	100.00	-	-

Notes :

Tested By SD Date 7/15/2008 Checked By GEM Date 7-21-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-09 #10 Split Hydro rev 8.xls]Sheet1

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HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	9-11
Project No.	2008-598-01	Sample No.	S-2
Lab ID	2008-598-01-09	Soil Color	**BROWN TAN**

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	30.0	30.0	24.5	3.65	26.4	26.2	0.01275	0.0304	**25.1**
5		22.0	24.5	3.65	18.4	18.3	0.01275	0.0203	**17.5**
15		17.0	24.5	3.65	13.4	13.3	0.01275	0.0121	**12.7**
30		14.0	24.5	3.65	10.4	10.3	0.01275	0.0087	**9.9**
60		12.0	24.5	3.65	8.4	8.3	0.01275	0.0062	**7.9**
250		10.0	23.6	3.91	6.1	6.1	0.01288	0.0031	**5.8**
1440		9.0	24.1	3.76	5.2	5.2	0.01281	0.0013	**5.0**

Soil Specimen Data		**Other Corrections**	
Tare + Dry Material (gm)	99.48	a - Factor	0.99
Weight of Tare (gm)	0		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 10	95.61
Weight of Dry Material (gm)	99.48		
		Specific Gravity	2.7 Assumed

Note:

Tested By JBD Date 7/14/2008 Checked By GEM Date 7-21-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-09 #10 Split Hydro rev 8.xls]Sheet1

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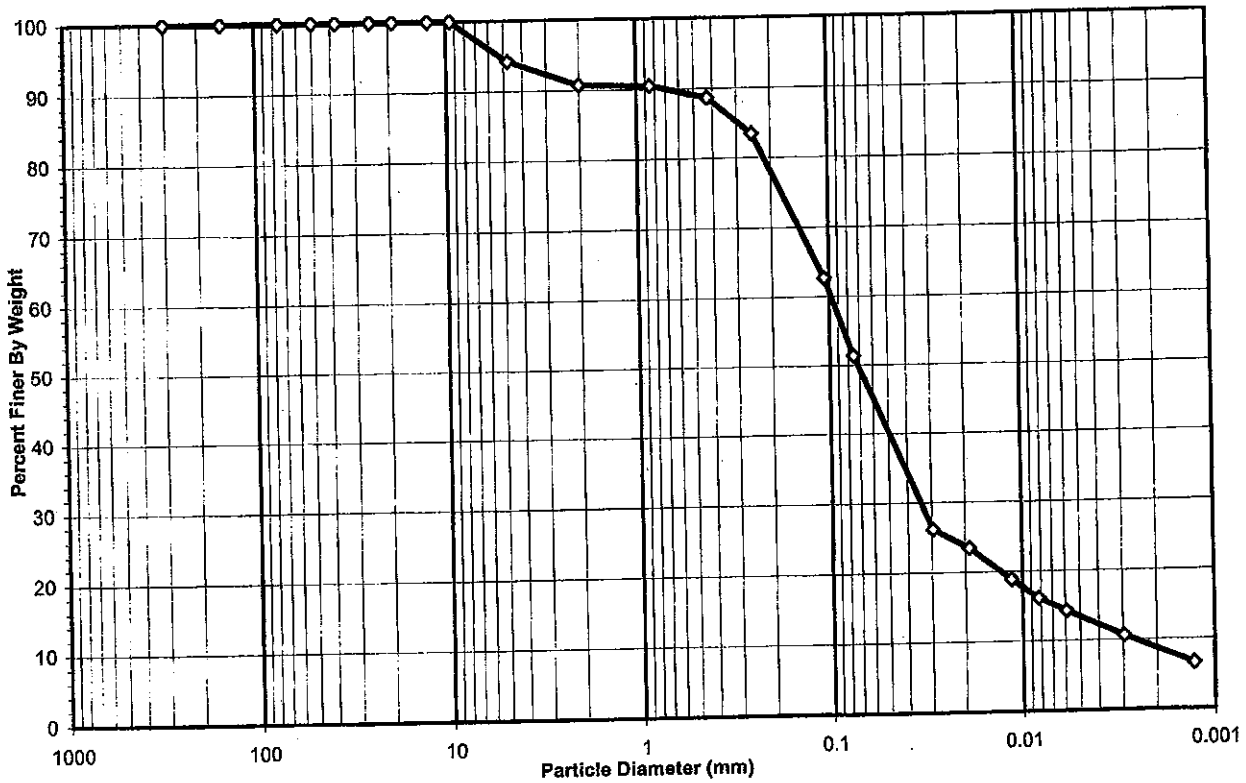
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-620
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	0-2
Project No.	2008-598-01	Sample No.	S-1
Lab ID	2008-598-01-10	Soil Color	**BROWN**

	SIEVE ANALYSIS					HYDROMETER	
USCS	cobbles	gravel	sand			silt and clay fraction	
USDA	cobbles	gravel		sand		silt	clay

12" 6" 3" 3/4" 3/8" #4 #10 #20 #40 #140 #200



USCS Summary		
Sieve Sizes (mm)		**Percentage**
Greater Than #4	*Gravel*	5.74
#4 To #200	*Sand*	42.98
Finer Than #200	*Silt & Clay*	51.28

USCS Symbol ***ML, TESTED***

USCS Classification ***SANDY SILT***

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-10 #10 Split Hydro rev 8.xls]Sheet1*

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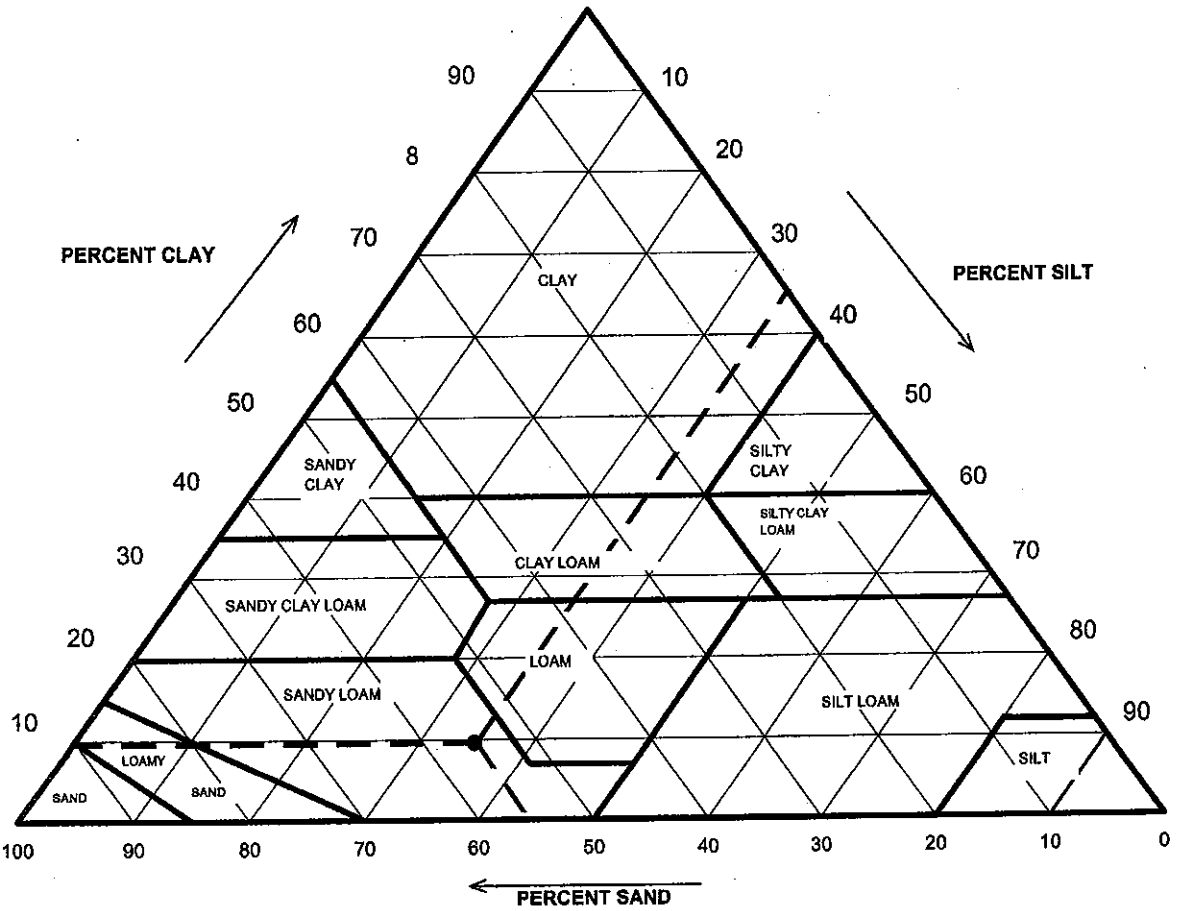
USDA CLASSIFICATION CHART

Client	CDM	Boring No.	B-620
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	0-2
Project No.	2008-598-01	Sample No.	S-1
Lab ID	2008-598-01-10	Soil Color	BROWN



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	9.25	**0.00**
2	90.75	*Sand*	50.38	**55.51**
0.05	40.37	*Silt*	31.63	**34.85**
0.002	8.74	*Clay*	8.74	**9.64**

USDA Classification: ***SANDY LOAM***

DCN: CT-S3P DATE:02/15/05 REVISION:8 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-10 #10 Split Hydro rev 8.xls]Sheet1

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WASH SIEVE ANALYSIS #10 SPLIT

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-620
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	0-2
Project No.	2008-598-01	Sample No.	S-1
Lab ID	2008-598-01-10	Soil Color	**BROWN**

Moisture Content/sieve +10 Material		Moisture Content for Hydrometer Portion	
Tare No.	208	Tare No.	C-2
Wgt.Tare + Wet Soil (gm)	216.14	Wgt.Tare + Wet Soil (gm)	41.65
Wgt.Tare + Dry Soil (gm)	210.06	Wgt.Tare + Dry Soil (gm)	41.15
Weight of Tare (gm)	169.85	Weight of Tare (gm)	15.64
Weight of Water (gm)	6.08	Weight of Water (gm)	0.50
Weight of Dry Soil (gm)	40.21	Weight of Dry Soil (gm)	25.51
Moisture Content (%)	**15.1**	**Moisture Content (%)**	**2.0**

Soil Specimen Data			
Wet Weight +#10 Material (gm)	46.29	Weight of the Dry Sample (gm)	138.29
Dry Weight +#10 Material(gm)	40.2	Weight of minus #200 material (gm)	55.42
Wet Weight Hydro. Material.(gm)	100.00	Weight of plus #200 material (gm)	82.87
Dry Weight Hydro. Material (gm)	98.08		
Total Dry Weight Sample (gm)	138.29	**J-FACTOR (%FINER THAN #10)**	**0.9075**

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	2.31	5.74	5.74	94.26	**94.26**
#10	2.00	1.41	3.51	9.25	90.75	**90.75**
#20	0.85	0.30	0.31	0.31	99.69	**90.47**
#40	0.425	1.96	2.00	2.30	97.70	**88.66**
#60	0.250	5.61	5.72	8.02	91.98	**83.47**
#140	0.106	22.48	22.92	30.94	69.06	**62.67**
#200	0.075	12.31	12.55	43.50	56.50	**51.28**
Pan	-	55.42	56.50	100.00	-	-

Notes :

Tested By SD Date 7/14/2008 Checked By GZM Date 7-16-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-10 #10 Split Hydro rev 8.xls]Sheet1*

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HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-620
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	0-2
Project No.	2008-598-01	Sample No.	S-1
Lab ID	2008-598-01-10	Soil Color	**BROWN**

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	32.0	32.0	25.5	3.35	28.6	28.8	0.01253	0.0295	**26.1**
5		29.0	25.5	3.35	25.6	25.8	0.01253	0.0190	**23.4**
15		24.0	25.5	3.35	20.6	20.8	0.01253	0.0114	**18.8**
30		21.0	25.5	3.35	17.6	17.7	0.01253	0.0082	**16.1**
60		19.0	25.5	3.35	15.6	15.7	0.01253	0.0059	**14.3**
250		15.0	25.5	3.35	11.6	11.7	0.01253	0.0029	**10.6**
1440		11.0	24.0	3.79	7.2	7.2	0.01275	0.0013	**6.6**

Soil Specimen Data		Other Corrections	
Tare + Dry Material (gm)	98.08	a - Factor	0.986
Weight of Tare (gm)	0		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 10	90.75
Weight of Dry Material (gm)	98.08		
		Specific Gravity	2.72 Assumed

Note:

Tested By JBD Date 7/11/2008 Checked By GEM Date 7-16-08

DCN: CT-S3P DATE:02/15/05 REVISION:6 *\\Server\c\2008 PROJECTS\2008-598 CDM\(2008-598-01-10 #10 Split Hydro rev 8.xls)Sheet1*

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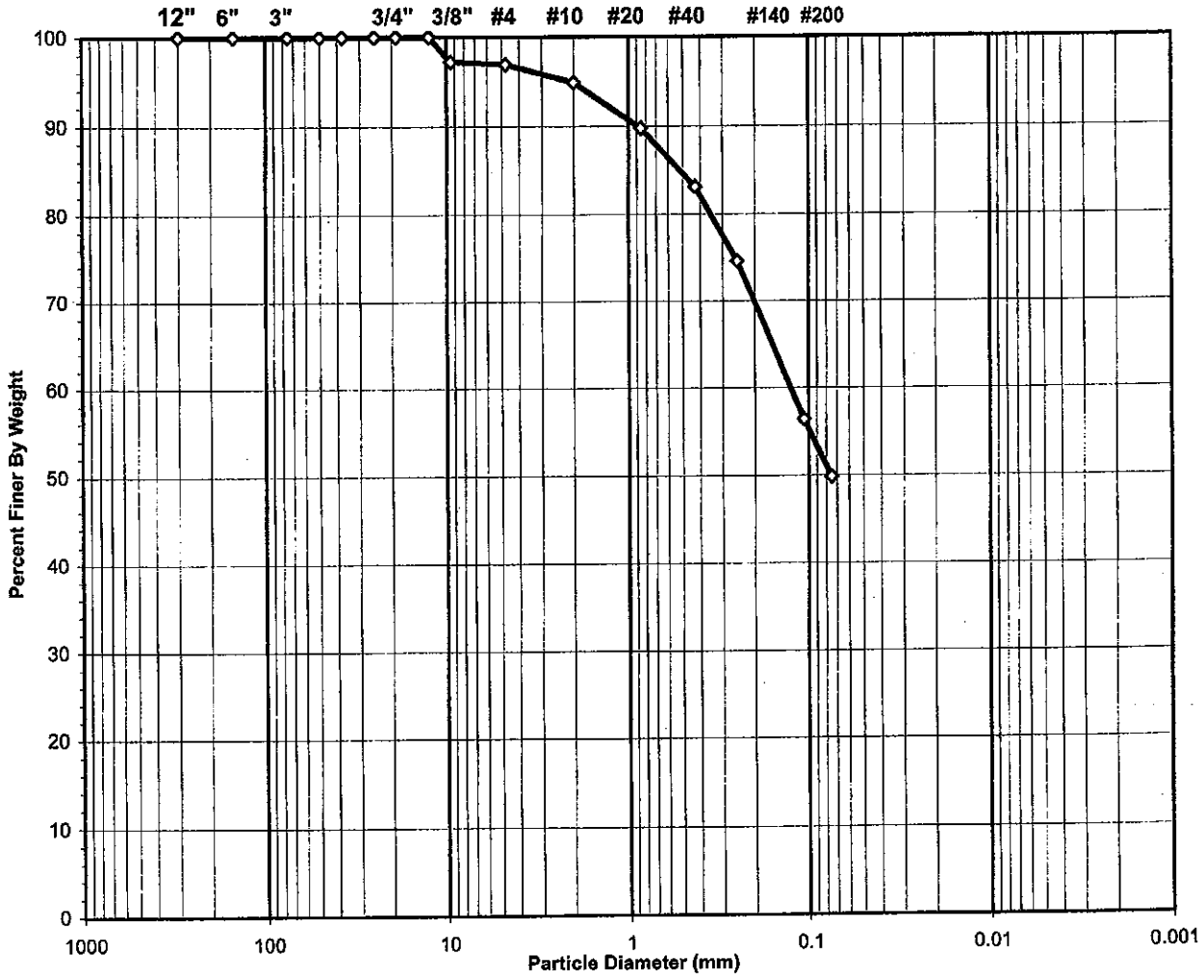
SIEVE ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	621
Client Reference	BUNCOMBE CO. C&D LF SUBSTANTIAL PE	Depth (ft)	0-2
Project No.	2008-603-01	Sample No.	S-1
Lab ID	2008-603-01-04	Soil Color	**BROWN**

USCS	SIEVE ANALYSIS		HYDROMETER
	gravel	sand	silt and clay



USCS Symbol ***SM, TESTED***

USCS Classification ***SILTY SAND***

Tested By SD Date 7/17/2008 Checked By GEM Date 7-21-08

page 1 of 2 DCN: CT-S3C DATE 6-25-98 REVISION: 2 *\\Server\c\2008 PROJECTS\2008-603 CDM\[2008-603-01-04 SIEVON REV 4.XLS]Sheet1*

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WASH SIEVE ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	621
Client Reference	BUNCOMBE CO. C&D LF SUBSTANTIAL PERMIT	Depth (ft)	0-2
Project No.	2008-603-01	Sample No.	S-1
Lab ID	2008-603-01-04	Soil Color	**BROWN**

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	215	Tare No.	NA
Wgt.Tare + Wet Specimen (gm)	278.87	Wgt.Tare + Wet Specimen (gm)	NA
Wgt.Tare + Dry Specimen (gm)	267.85	Wgt.Tare + Dry Specimen (gm)	NA
Weight of Tare (gm)	172.30	Weight of Tare (gm)	NA
Weight of Water (gm)	11.02	Weight of Water (gm)	NA
Weight of Dry Soil (gm)	95.55	Weight of Dry Soil (gm)	NA
Moisture Content (%)	**11.5**	**Moisture Content (%)**	**NA**

Wet Weight -3/4" Sample (gm)	NA	Weight of the Dry Specimen (gm)	95.55
Dry Weight - 3/4" Sample (gm)	47.9	Weight of minus #200 material (gm)	47.61
Wet Weight +3/4" Sample (gm)	NA	Weight of plus #200 material (gm)	47.94
Dry Weight + 3/4" Sample (gm)	0.00		
Total Dry Weight Sample (gm)	NA		

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.50	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	2.66	2.8	2.8	97.2	**97.2**
#4	4.75	0.29	0.3	3.1	96.9	**96.9**
#10	2.00	1.95	2.0	5.1	94.9	**94.9**
#20	0.850	4.90	5.1	10.3	89.7	**89.7**
#40	0.425	6.33	6.6	16.9	83.1	**83.1**
#60	0.250	8.15	8.5	25.4	74.6	**74.6**
#140	0.106	17.41	18.2	43.6	56.4	**56.4**
#200	0.075	6.25	6.5	50.2	49.8	**49.8**
Pan	-	47.61	49.8	100.0	-	-

Tested By SD Date 7/17/2008 Checked By GEM Date 7-21-08

DCN: CT-S3C DATE 6-25-98 REVISION: 2

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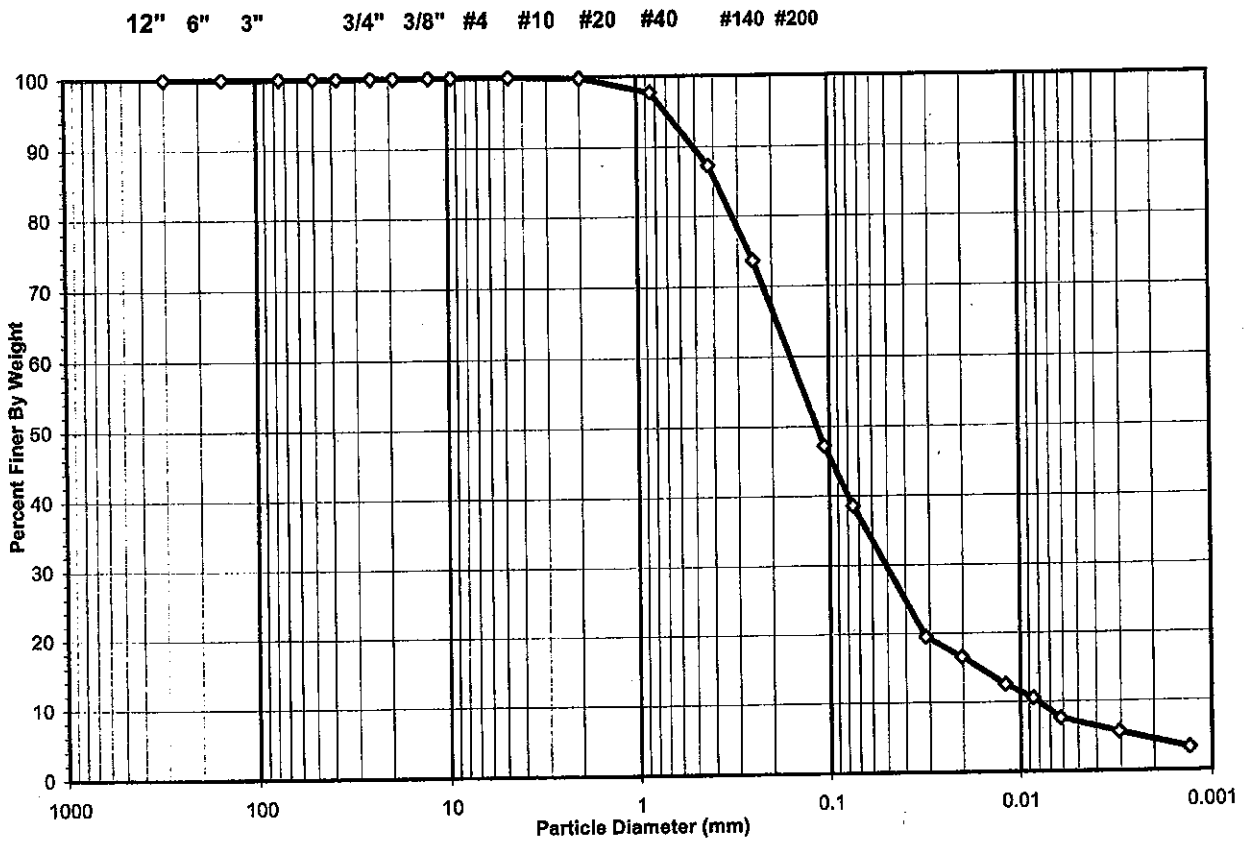
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-621
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	9-11
Project No.	2008-598-01	Sample No.	S-3
Lab ID	2008-598-01-11	Soil Color	**BROWN**

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



Sieve Sizes (mm)	USCS Summary	Percentage
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	61.46
Finer Than #200	*Silt & Clay*	38.54

USCS Symbol ***SM, TESTED***

USCS Classification ***SILTY SAND***

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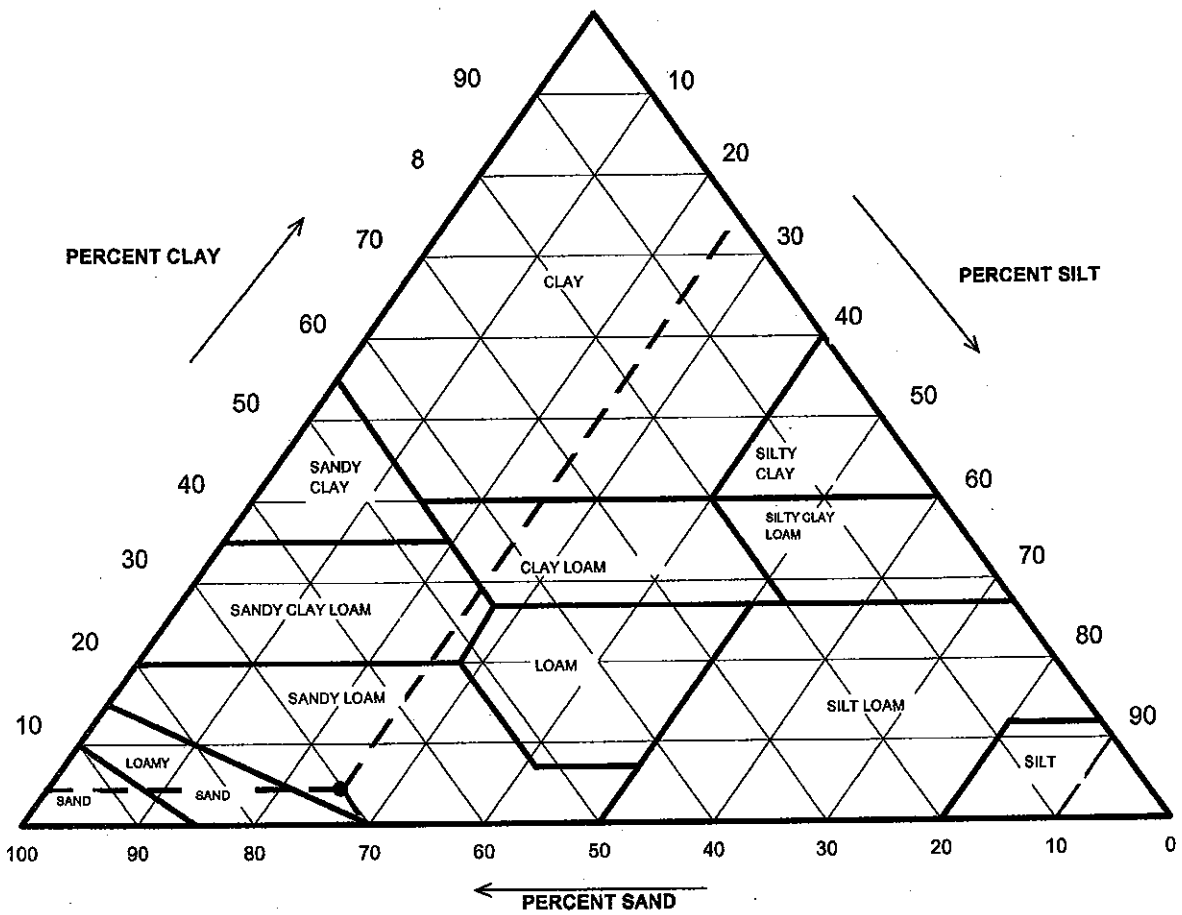
USDA CLASSIFICATION CHART

Client	CDM	Boring No.	B-621
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	9-11
Project No.	2008-598-01	Sample No.	S-3
Lab ID	2008-598-01-11	Soil Color	BROWN



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	0.17	**0.00**
2	99.83	*Sand*	70.16	**70.28**
0.05	29.67	*Silt*	25.25	**25.29**
0.002	4.42	*Clay*	4.42	**4.43**

USDA Classification: ***SANDY LOAM***

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WASH SIEVE ANALYSIS #10 SPLIT

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-621
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	9-11
Project No.	2008-598-01	Sample No.	S-3
Lab ID	2008-598-01-11	Soil Color	**BROWN**

Moisture Content/sieve +10 Material		Moisture Content for Hydrometer Portion	
Tare No.	201	Tare No.	K-1
Wgt.Tare + Wet Soil (gm)	227.39	Wgt.Tare + Wet Soil (gm)	35.44
Wgt.Tare + Dry Soil (gm)	224.44	Wgt.Tare + Dry Soil (gm)	35.31
Weight of Tare (gm)	170.76	Weight of Tare (gm)	15.74
Weight of Water (gm)	2.95	Weight of Water (gm)	0.13
Weight of Dry Soil (gm)	53.68	Weight of Dry Soil (gm)	19.57
Moisture Content (%)	**5.5**	**Moisture Content (%)**	**0.7**

Soil Specimen Data			
Wet Weight +#10 Material (gm)	56.63	Weight of the Dry Sample (gm)	153.02
Dry Weight +#10 Material(gm)	53.7	Weight of minus #200 material (gm)	38.35
Wet Weight Hydro. Material.(gm)	100.00	Weight of plus #200 material (gm)	114.67
Dry Weight Hydro. Material (gm)	99.34		
Total Dry Weight Sample (gm)	153.02	**J-FACTOR (%FINER THAN #10)**	**0.9983**

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.00	0.00	0.00	100.00	**100.00**
#10	2.00	0.09	0.17	0.17	99.83	**99.83**
#20	0.85	2.05	2.06	2.06	97.94	**97.77**
#40	0.425	10.45	10.52	12.58	87.42	**87.27**
#60	0.250	13.57	13.66	26.24	73.76	**73.63**
#140	0.106	26.31	26.48	52.73	47.27	**47.19**
#200	0.075	8.61	8.67	61.40	38.60	**38.54**
Pan	-	38.35	38.60	100.00	-	-

Notes :

Tested By SD Date 7/14/2008 Checked By GEM Date 7-15-08

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HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-621
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	9-11
Project No.	2008-598-01	Sample No.	S-3
Lab ID	2008-598-01-11	Soil Color	**BROWN**

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	23.0	23.0	25.5	3.35	19.6	19.5	0.01253	0.0314	**19.5**
5		20.0	25.5	3.35	16.6	16.5	0.01253	0.0202	**16.5**
15		16.0	25.5	3.35	12.6	12.6	0.01253	0.0120	**12.5**
30		14.0	25.5	3.35	10.6	10.6	0.01253	0.0086	**10.5**
60		11.0	25.5	3.35	7.6	7.6	0.01253	0.0062	**7.6**
250		9.0	25.5	3.35	5.6	5.6	0.01253	0.0031	**5.6**
1440		7.0	24.2	3.73	3.3	3.2	0.01272	0.0013	**3.2**

Soil Specimen Data		**Other Corrections**	
Tare + Dry Material (gm)	99.34	a - Factor	0.986
Weight of Tare (gm)	0		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 10	99.83
Weight of Dry Material (gm)	99.34		
		Specific Gravity	2.72 Assumed

Note:

Tested By JBD Date 7/11/2008 Checked By GAM Date 7-15-08

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ATTERBERG LIMITS

ASTM D 4318-98 / AASHTO T89 (SOP - S4A)

Client	CDM	Boring No.	B-614
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	3.5-5.5
Project No.	2008-598-01	Sample No.	S-2
Lab ID	2008-598-01-01	Soil Description	**LIGHT TAN SILT**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

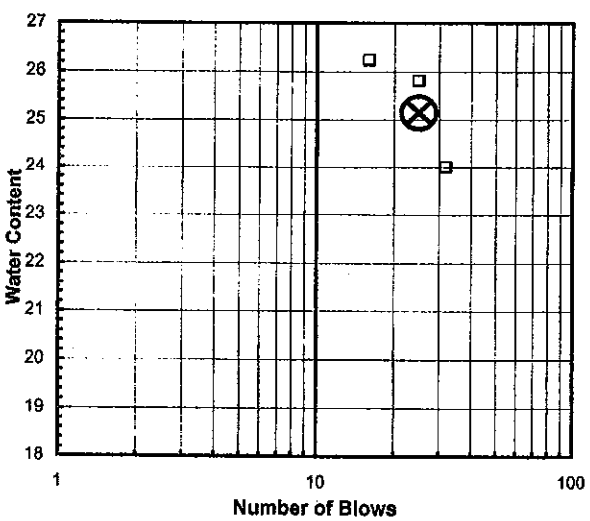
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	L-1	K-1	P-1	MULTIPOINT
Wt. of Tare & WS (gm)	28.32	31.31	25.02	
Wt. of Tare & DS (gm)	25.72	28.12	23.22	
Wt. of Tare (gm)	15.81	15.76	15.72	
Wt. of Water (gm)	2.6	3.2	1.8	
Wt. of DS (gm)	9.9	12.4	7.5	
Moisture Content (%)	**26.2**	**25.8**	**24.0**	
Number of Blows	**16**	**25**	**32**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	B-1	E-2	
Wt. of Tare & WS (gm)	32.92	32.40	
Wt. of Tare & DS (gm)	30.75	30.33	
Wt. of Tare (gm)	22.07	21.91	
Wt. of Water (gm)	2.2	2.1	
Wt. of DS (gm)	8.7	8.4	
Moisture Content (%)	**25.0**	**24.6**	**0.4**

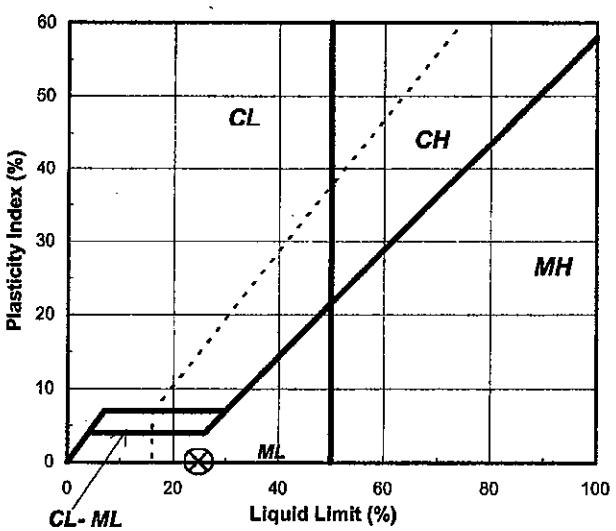
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**25**
Plastic Limit (%)	**25**
Plasticity Index (%)	**0**
USCS Symbol	**ML**

Flow Curve



Plasticity Chart



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ATTERBERG LIMITS

ASTM D 4318-98 / AASHTO T89 (SOP - S4A)

Client	CDM	Boring No.	B-615
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	4-6
Project No.	2008-598-01	Sample No.	S-2
Lab ID	2008-598-01-02	Soil Description	**LIGHT BROWN SILT**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

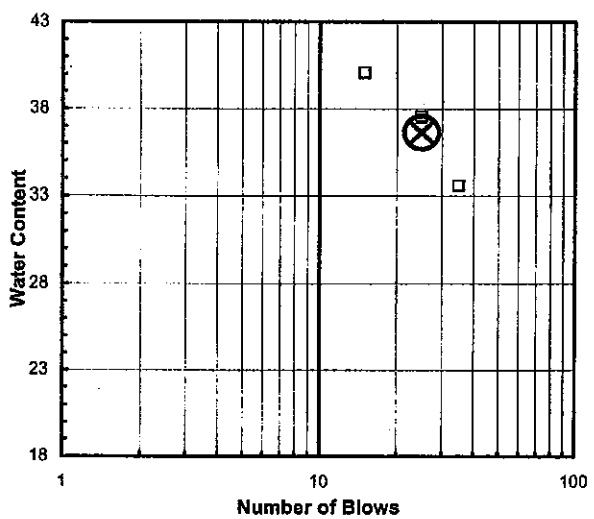
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	Q	K	U	MULTIPOINT
Wt. of Tare & WS (gm)	25.11	25.22	27.86	
Wt. of Tare & DS (gm)	22.27	22.50	24.68	
Wt. of Tare (gm)	15.18	15.25	15.21	
Wt. of Water (gm)	2.8	2.7	3.2	
Wt. of DS (gm)	7.1	7.3	9.5	
Moisture Content (%)	**40.1**	**37.5**	**33.6**	
Number of Blows	**15**	**25**	**35**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	A-P	A-B	
Wt. of Tare & WS (gm)	22.92	22.90	
Wt. of Tare & DS (gm)	21.25	21.19	
Wt. of Tare (gm)	15.60	15.57	
Wt. of Water (gm)	1.7	1.7	
Wt. of DS (gm)	5.7	5.6	
Moisture Content (%)	**29.6**	**30.4**	**-0.9**

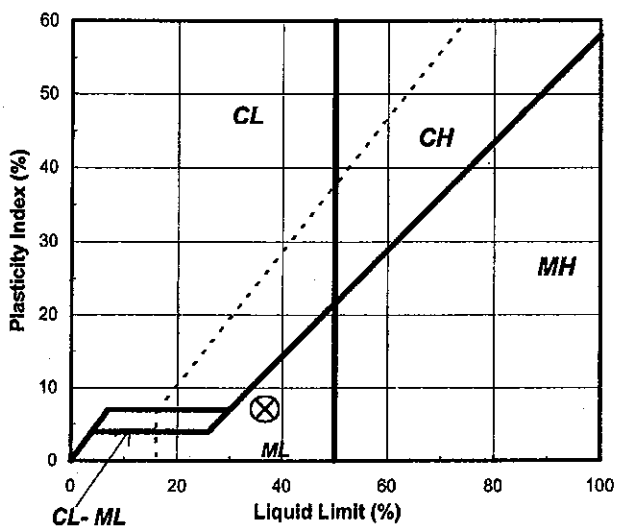
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**37**
Plastic Limit (%)	**30**
Plasticity Index (%)	**7**
USCS Symbol	**ML**

Flow Curve



Plasticity Chart



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ATTERBERG LIMITS

ASTM D 4318-98 / AASHTO T89 (SOP - S4A)

Client	CDM	Boring No.	B-615
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	14-15
Project No.	2008-598-01	Sample No.	S-4T
Lab ID	2008-598-01-03	Soil Description	**LIGHT BROWN SILTY CLAY**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

(Minus No. 40 sieve material, Airdried)

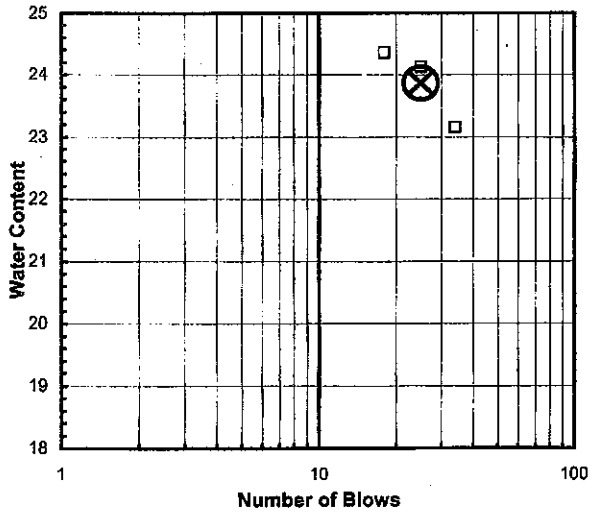
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	P	W	M	MULTIPOINT
Wt. of Tare & WS (gm)	26.27	22.80	24.64	
Wt. of Tare & DS (gm)	24.10	21.36	22.79	
Wt. of Tare (gm)	15.19	15.14	15.12	
Wt. of Water (gm)	2.2	1.4	1.9	
Wt. of DS (gm)	8.9	6.2	7.7	
Moisture Content (%)	**24.4**	**23.2**	**24.1**	
Number of Blows	**18**	**34**	**25**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	O	J	
Wt. of Tare & WS (gm)	22.78	22.04	
Wt. of Tare & DS (gm)	21.52	20.90	
Wt. of Tare (gm)	15.24	15.14	
Wt. of Water (gm)	1.3	1.1	
Wt. of DS (gm)	6.3	5.8	
Moisture Content (%)	**20.1**	**19.8**	**0.3**

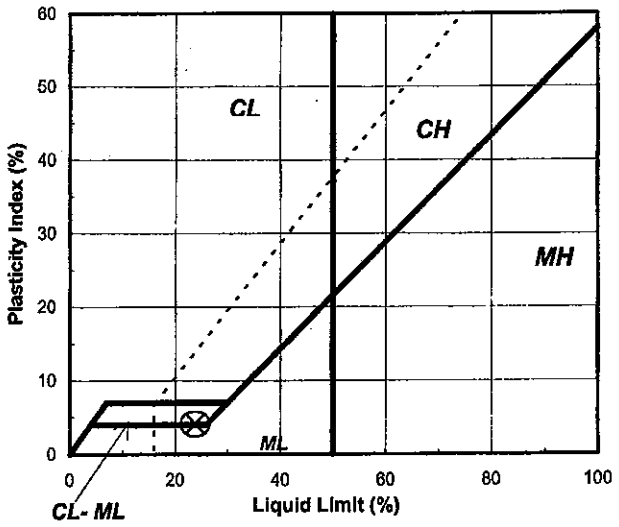
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**24**
Plastic Limit (%)	**20**
Plasticity Index (%)	**4**
USCS Symbol	**CL-ML**

Flow Curve



Plasticity Chart



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ATTERBERG LIMITS

ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	CDM	Boring No.	616
Client Reference	BUNCOMBE CO. C&D LF SUBSTANTIAL PERMIT	Depth (ft)	2.5-4.5
Project No.	2008-603-01	Sample No.	T-1
Lab ID	2008-603-01-01	Soil Description	**DARK BROWN LEAN CLAY**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

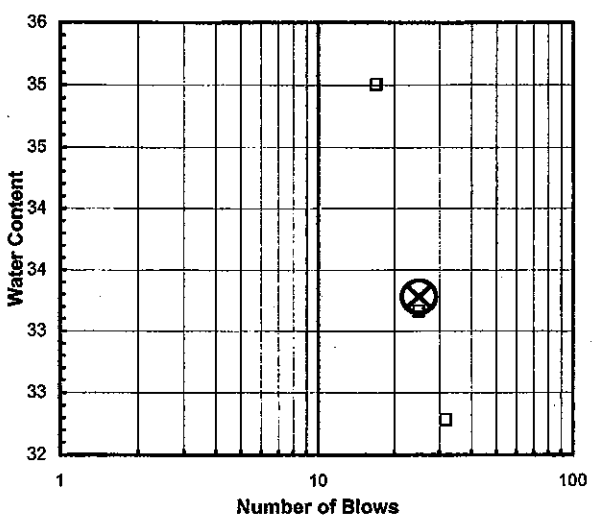
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	A-D	F	E	MULTIPOINT
Wt. of Tare & WS (gm)	27.83	28.13	27.45	
Wt. of Tare & DS (gm)	24.61	24.89	24.49	
Wt. of Tare (gm)	15.41	15.12	15.32	
Wt. of Water (gm)	3.2	3.2	3.0	
Wt. of DS (gm)	9.2	9.8	9.2	
Moisture Content (%)	**35.0**	**33.2**	**32.3**	
Number of Blows	**17**	**25**	**32**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	A-O	H	
Wt. of Tare & WS (gm)	23.13	23.04	
Wt. of Tare & DS (gm)	21.87	21.73	
Wt. of Tare (gm)	15.47	15.15	
Wt. of Water (gm)	1.3	1.3	
Wt. of DS (gm)	6.4	6.6	
Moisture Content (%)	**19.7**	**19.9**	**-0.2**

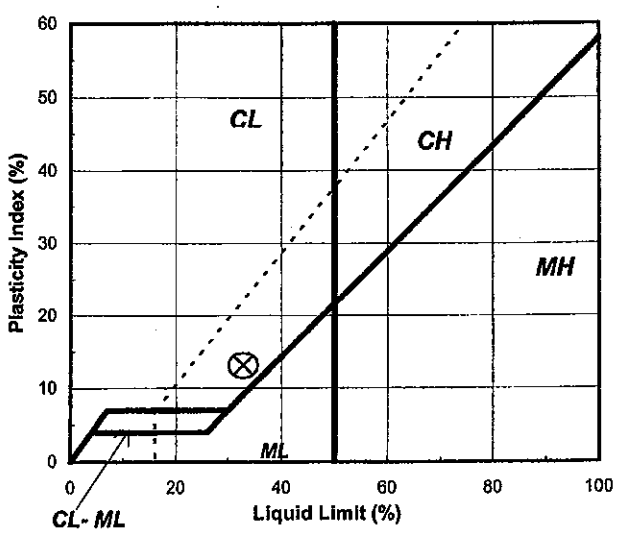
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**33**
Plastic Limit (%)	**20**
Plasticity Index (%)	**13**
USCS Symbol	**CL**

Flow Curve



Plasticity Chart



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ASTM D 4318-98 / AASHTO T89 (SOP - S4A)

Client	CDM	Boring No.	B-617
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	8.5-10
Project No.	2008-598-01	Sample No.	S-3
Lab ID	2008-598-01-04	Soil Description	**BROWN TAN SILT**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

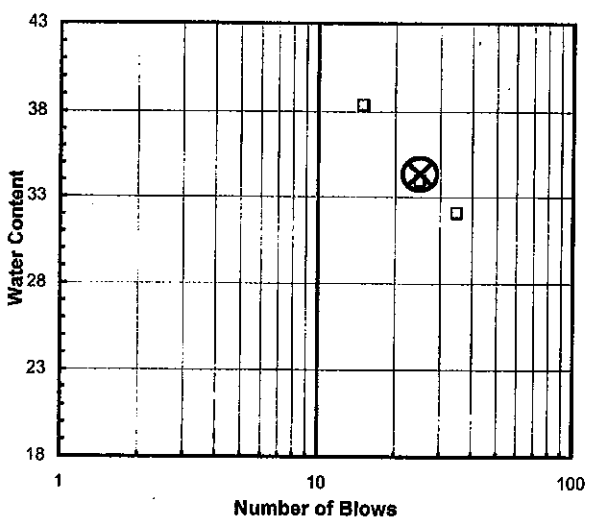
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	Q	K	A-B	MULTIPOINT
Wt. of Tare & WS (gm)	30.36	26.37	27.49	
Wt. of Tare & DS (gm)	26.15	23.55	24.60	
Wt. of Tare (gm)	15.17	15.24	15.59	
Wt. of Water (gm)	4.2	2.8	2.9	
Wt. of DS (gm)	11.0	8.3	9.0	
Moisture Content (%)	**38.3**	**33.9**	**32.1**	
Number of Blows	**15**	**25**	**35**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	U	A-P	
Wt. of Tare & WS (gm)	22.41	23.74	
Wt. of Tare & DS (gm)	20.71	21.90	
Wt. of Tare (gm)	15.18	15.60	
Wt. of Water (gm)	1.7	1.8	
Wt. of DS (gm)	5.5	6.3	
Moisture Content (%)	**30.7**	**29.2**	**1.5**

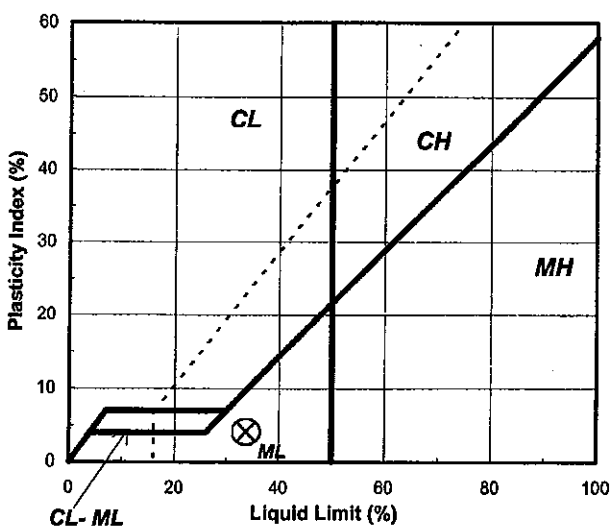
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**34**
Plastic Limit (%)	**30**
Plasticity Index (%)	**4**
USCS Symbol	**ML**

Flow Curve



Plasticity Chart



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ATTERBERG LIMITS

ASTM D 4318-98 / AASHTO T89 (SOP - S4A)

Client	CDM	Boring No.	B-618
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	9-11
Project No.	2008-598-01	Sample No.	S-3
Lab ID	2008-598-01-05	Soil Description	**LIGHT BROWN SILT**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

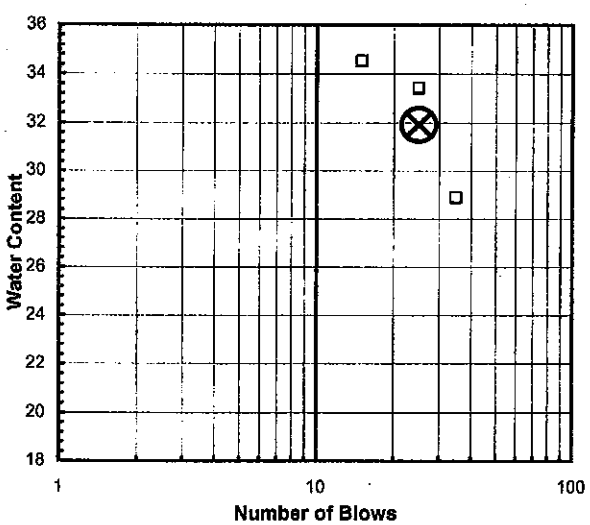
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	F	E	H	MULTIPOINT
Wt. of Tare & WS (gm)	29.53	31.11	28.06	
Wt. of Tare & DS (gm)	25.83	27.15	25.17	
Wt. of Tare (gm)	15.11	15.30	15.17	
Wt. of Water (gm)	3.7	4.0	2.9	
Wt. of DS (gm)	10.7	11.9	10.0	
Moisture Content (%)	**34.5**	**33.4**	**28.9**	
Number of Blows	**15**	**25**	**35**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	A-D	A-O	
Wt. of Tare & WS (gm)	21.79	22.16	
Wt. of Tare & DS (gm)	20.29	20.59	
Wt. of Tare (gm)	15.42	15.48	
Wt. of Water (gm)	1.5	1.6	
Wt. of DS (gm)	4.9	5.1	
Moisture Content (%)	**30.8**	**30.7**	**0.1**

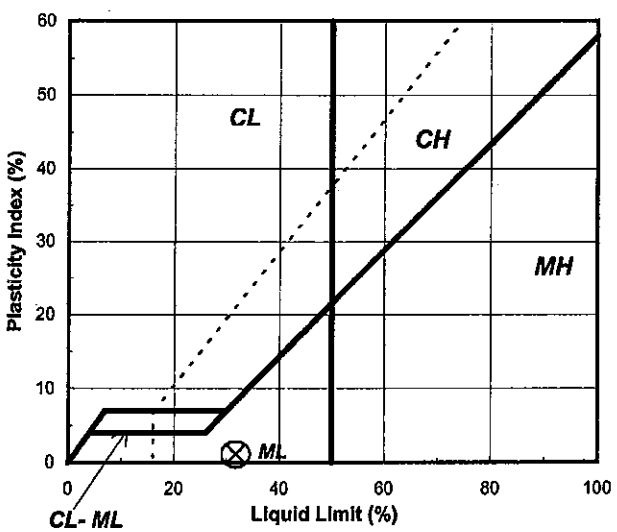
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**32**
Plastic Limit (%)	**31**
Plasticity Index (%)	**1**
USCS Symbol	**ML**

Flow Curve



Plasticity Chart



Tested By JBD *Date* 7/11/2008 *Checked By* GM *Date* 7-14-08

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INTEGRITY IN TESTING

ATTERBERG LIMITS

ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	CDM	Boring No.	B-618
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	24-26
Project No.	2008-598-01	Sample No.	S-6
Lab ID	2008-598-01-06	Soil Description	**GRAY WHITE BROWN SILT**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

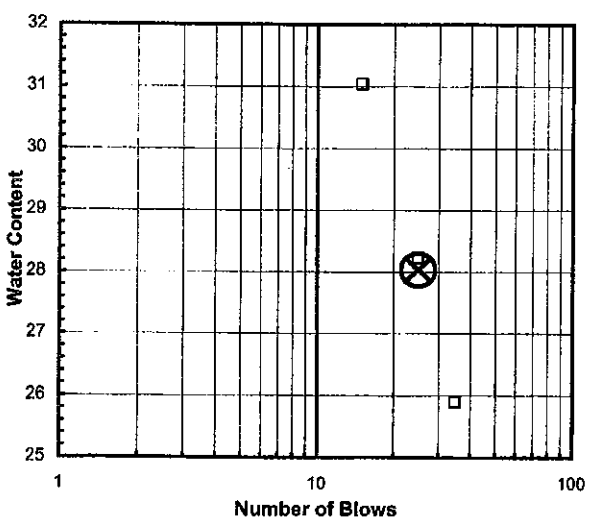
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	A-C	A-L	K-Q	MULTIPOINT
Wt. of Tare & WS (gm)	27.97	26.57	28.91	
Wt. of Tare & DS (gm)	25.04	24.14	26.15	
Wt. of Tare (gm)	15.60	15.53	15.49	
Wt. of Water (gm)	2.9	2.4	2.8	
Wt. of DS (gm)	9.4	8.6	10.7	
Moisture Content (%)	**31.0**	**28.2**	**25.9**	
Number of Blows	**15**	**25**	**35**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	D	I	
Wt. of Tare & WS (gm)	23.22	23.89	
Wt. of Tare & DS (gm)	21.62	22.14	
Wt. of Tare (gm)	15.16	15.23	
Wt. of Water (gm)	1.6	1.8	
Wt. of DS (gm)	6.5	6.9	
Moisture Content (%)	**24.8**	**25.3**	**-0.6**

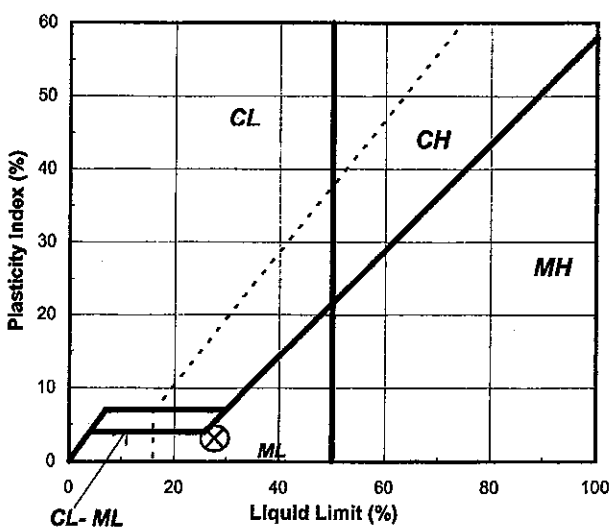
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**28**
Plastic Limit (%)	**25**
Plasticity Index (%)	**3**
USCS Symbol	**ML**

Flow Curve



Plasticity Chart



Tested By JBD *Date* 7/17/2008 *Checked By* GEM *Date* 7-2-08

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ATTERBERG LIMITS

ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	4-5
Project No.	2008-598-01	Sample No.	S-1T
Lab ID	2008-598-01-07	Soil Description	**BROWN LEAN CLAY**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

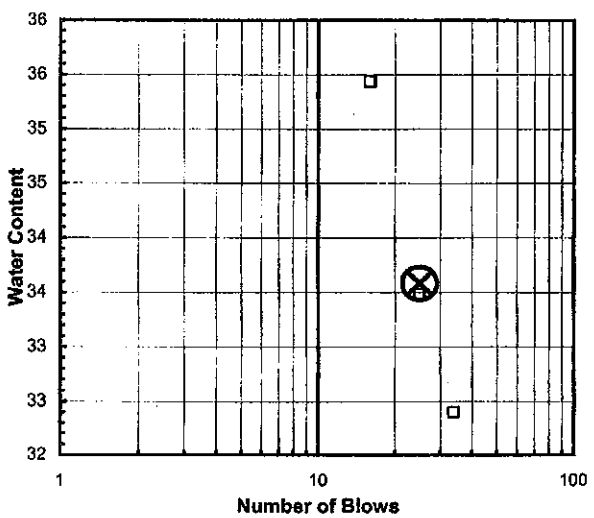
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	A-D	F	E	MULTIPOINT
Wt. of Tare & WS (gm)	27.05	27.23	26.18	
Wt. of Tare & DS (gm)	24.01	24.19	23.52	
Wt. of Tare (gm)	15.43	15.11	15.31	
Wt. of Water (gm)	3.0	3.0	2.7	
Wt. of DS (gm)	8.6	9.1	8.2	
Moisture Content (%)	**35.4**	**33.5**	**32.4**	
Number of Blows	**16**	**25**	**34**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	A-O	H	
Wt. of Tare & WS (gm)	22.88	21.31	
Wt. of Tare & DS (gm)	21.65	20.35	
Wt. of Tare (gm)	15.47	15.15	
Wt. of Water (gm)	1.2	1.0	
Wt. of DS (gm)	6.2	5.2	
Moisture Content (%)	**19.9**	**18.5**	**1.4**

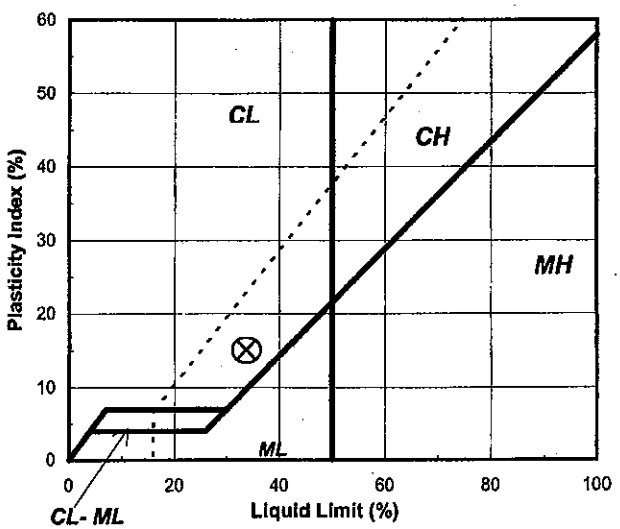
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**34**
Plastic Limit (%)	**19**
Plasticity Index (%)	**15**
USCS Symbol	**CL**

Flow Curve



Plasticity Chart



Tested By SD *Date* 7/17/2008 *Checked By* GZM *Date* 7-21-08

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INTEGRITY IN TESTING

ATTERBERG LIMIT

ASTM D 4318-00 (SOP - S4)

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	5-6
Project No.	2008-598-01	Sample No.	S-1B
Lab ID	2008-598-01-08	Visual Description	**BROWN WHITE**
			(Minus No. 40 sieve material, Wet Method)

NON - PLASTIC MATERIAL

Tested By SD *Date* 7/17/2008 *Checked By* GTM *Date* 7-21-08

DCN: CT-S4C DATE: 7-11-97 REVISION : 2

\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-08 Limit-(NP).xls]Sheet1

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INTEGRITY IN TESTING

ATTERBERG LIMITS

ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	9-11
Project No.	2008-598-01	Sample No.	S-2
Lab ID	2008-598-01-09	Soil Description	**BROWN TAN SILT**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

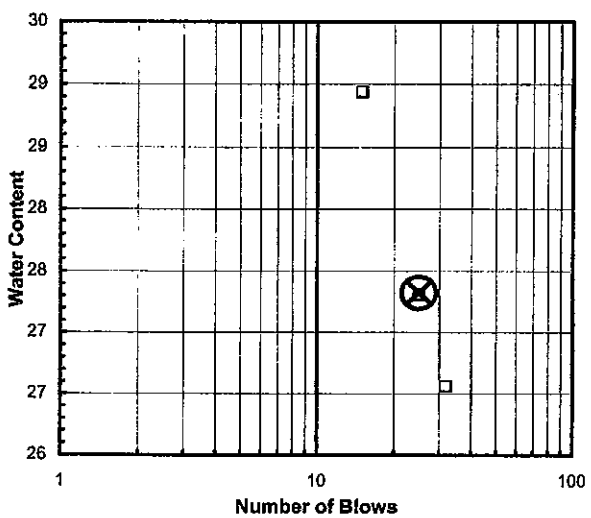
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	A-Q	R-1	B-B	MULTIPOINT
Wt. of Tare & WS (gm)	27.14	29.01	28.91	
Wt. of Tare & DS (gm)	24.53	26.14	26.10	
Wt. of Tare (gm)	15.51	15.63	15.52	
Wt. of Water (gm)	2.6	2.9	2.8	
Wt. of DS (gm)	9.0	10.5	10.6	
Moisture Content (%)	**28.9**	**27.3**	**26.6**	
Number of Blows	**15**	**25**	**32**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	S	A-P	
Wt. of Tare & WS (gm)	21.86	25.22	
Wt. of Tare & DS (gm)	20.63	23.30	
Wt. of Tare (gm)	15.24	15.61	
Wt. of Water (gm)	1.2	1.9	
Wt. of DS (gm)	5.4	7.7	
Moisture Content (%)	**22.8**	**25.0**	**-2.1**

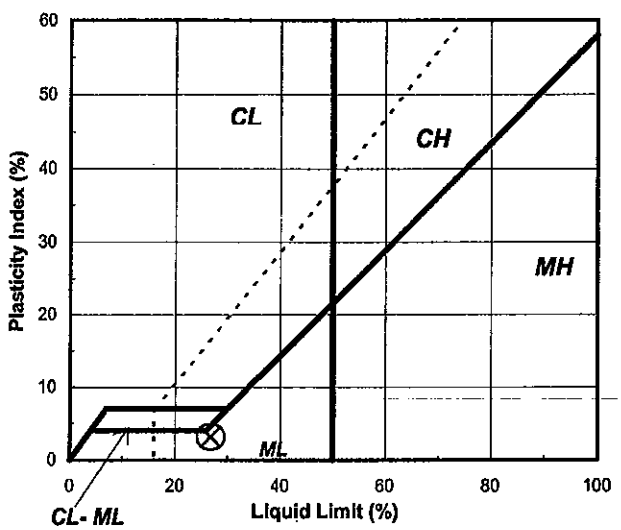
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**27**
Plastic Limit (%)	**24**
Plasticity Index (%)	**3**
USCS Symbol	**ML**

Flow Curve



Plasticity Chart



Tested By SD *Date* 7/17/2008 *Checked By* CAM *Date* 7-24-08

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INTEGRITY IN TESTING

ATTERBERG LIMITS

ASTM D 4318-98 / AASHTO T89 (SOP - S4A)

Client	CDM	Boring No.	B-620
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	0-2
Project No.	2008-598-01	Sample No.	S-1
Lab ID	2008-598-01-10	Soil Description	**BROWN SILT**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

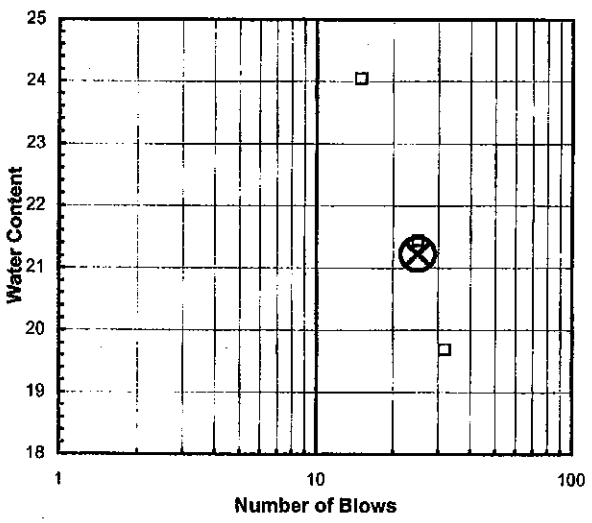
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	A-1	Y	A-N	MULTIPOINT
Wt. of Tare & WS (gm)	28.34	26.26	24.57	
Wt. of Tare & DS (gm)	25.85	24.38	23.07	
Wt. of Tare (gm)	15.49	15.61	15.45	
Wt. of Water (gm)	2.5	1.9	1.5	
Wt. of DS (gm)	10.4	8.8	7.6	
Moisture Content (%)	**24.0**	**21.4**	**19.7**	
Number of Blows	**15**	**25**	**32**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	A-K	A-M	
Wt. of Tare & WS (gm)	25.62	24.68	
Wt. of Tare & DS (gm)	23.99	23.15	
Wt. of Tare (gm)	15.56	15.38	
Wt. of Water (gm)	1.6	1.5	
Wt. of DS (gm)	8.4	7.8	
Moisture Content (%)	**19.3**	**19.7**	**-0.4**

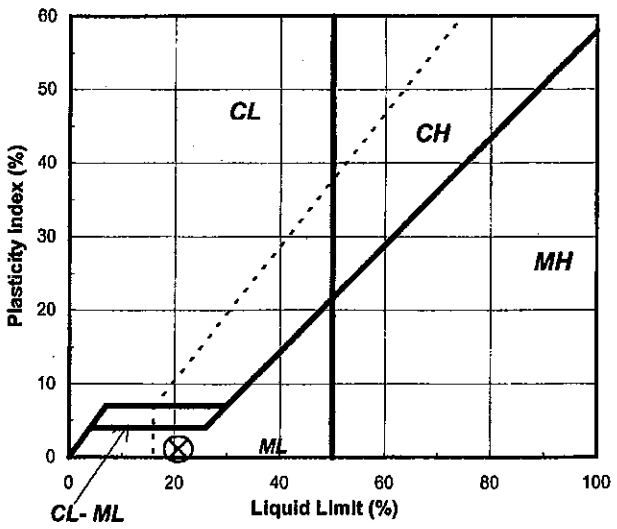
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**21**
Plastic Limit (%)	**20**
Plasticity Index (%)	**1**
USCS Symbol	**ML**

Flow Curve



Plasticity Chart



Tested By SD *Date* 7/15/2008 *Checked By* GEM *Date* 7-16-08

page 1 of 1 **DCN:** CT-S4B **DATE:** 10/8/2001 **REVISION:** 2

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INTEGRITY IN TESTING

ATTERBERG LIMITS

ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	CDM	Boring No.	621
Client Reference	BUNCOMBE CO. C&D LF SUBSTANTIAL PERMIT	Depth (ft)	0-2
Project No.	2008-603-01	Sample No.	S-1
Lab ID	2008-603-01-04	Soil Description	**BROWN SILT**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

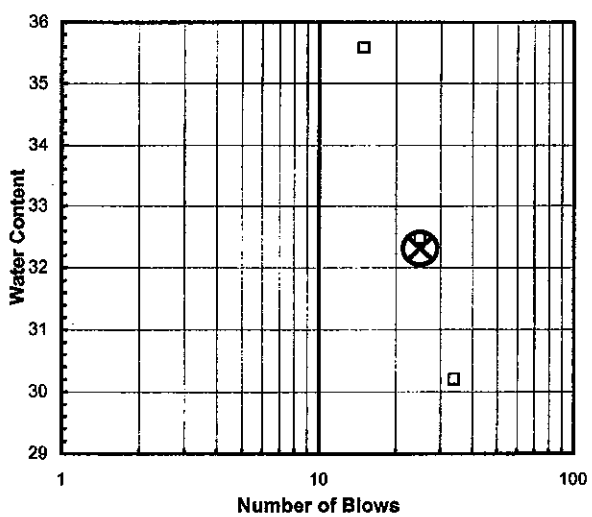
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	L-1	M-1	F-1	MULTIPOINT
Wt. of Tare & WS (gm)	29.66	31.24	28.16	
Wt. of Tare & DS (gm)	26.02	27.48	25.27	
Wt. of Tare (gm)	15.79	15.90	15.70	
Wt. of Water (gm)	3.6	3.8	2.9	
Wt. of DS (gm)	10.2	11.6	9.6	
Moisture Content (%)	**35.6**	**32.5**	**30.2**	
Number of Blows	**15**	**25**	**34**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	A-H	A-T	
Wt. of Tare & WS (gm)	23.52	24.06	
Wt. of Tare & DS (gm)	21.95	22.42	
Wt. of Tare (gm)	15.57	15.58	
Wt. of Water (gm)	1.6	1.6	
Wt. of DS (gm)	6.4	6.8	
Moisture Content (%)	**24.6**	**24.0**	**0.6**

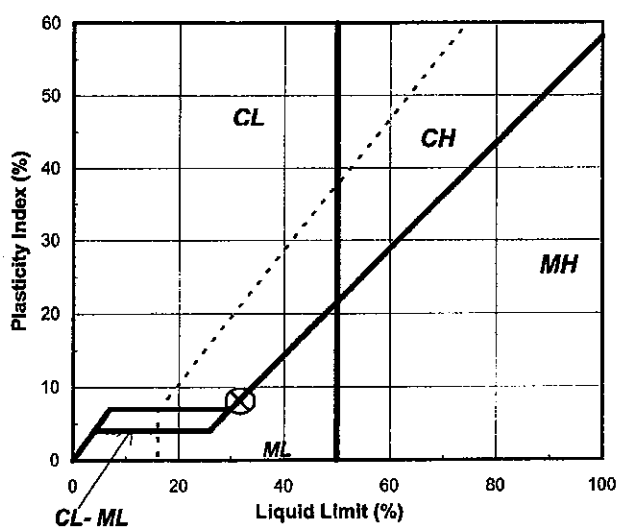
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**32**
Plastic Limit (%)	**24**
Plasticity Index (%)	**8**
USCS Symbol	**ML**

Flow Curve



Plasticity Chart



Tested By SD *Date* 7/18/2008 *Checked By* GEM *Date* 7-21-08

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INTEGRITY IN TESTING

ONE POINT ATTERBERG LIMIT

ASTM D 4318-96 (SOP - S4)

Client	CDM	Boring No.	B-621
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	9-11
Project No.	2008-598-01	Sample No.	S-3
Lab ID	2008-598-01-11	Soil Description	**BROWN SILT**
			(MInus No. 40 sieve material, Airdried)

Liquid Limit Test	**1**	**2**
Tare Number	E	E
Wt. of Tare & WS (gm)	35.5	35.5
Wt. of Tare & DS (gm)	31.54	31.54
Wt. of Tare (gm)	15.29	15.29
Wt. of Water (gm)	3.96	3.96
Wt. of DS (gm)	16.25	16.25
Moisture Content (%)	**24.4**	**24.4**
Number of Blows	**25**	**25**

Blows	**K-factor**
20	0.974
21	0.979
22	0.985
23	0.990
24	0.995
25	1.000
26	1.005
27	1.009
28	1.014
29	1.018
30	1.022

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	F	A-D	
Wt. of Tare & WS (gm)	25.41	24.84	
Wt. of Tare & DS (gm)	23.54	23.1	
Wt. of Tare (gm)	15.28	15.4	
Wt. of Water (gm)	1.87	1.74	
Wt. of DS (gm)	8.26	7.7	
Moisture Content (%)	**22.6**	**22.6**	**0.0**

Note: The acceptable range of the two Moisture contents is ± 2.6

Liquid Limit Test Results

Test 1

LL = 24.4
LL^{CORR} = 24

Test 2

LL = 24.4
LL^{CORR} = 24

Summary

Liquid Limit (%)	**24**	**Plasticity Index (%)**	**1**
Plastic Limit (%)	**23**	**USCS Symbol**	**ML**

Tested By SD *Date* 7/14/2008 *Checked By* GAM *Date* 7-15-08

DCN: CT-S4A DAT 10/08/01 REVISION: 4

\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-11 1pt.limit.xls]Sheet1

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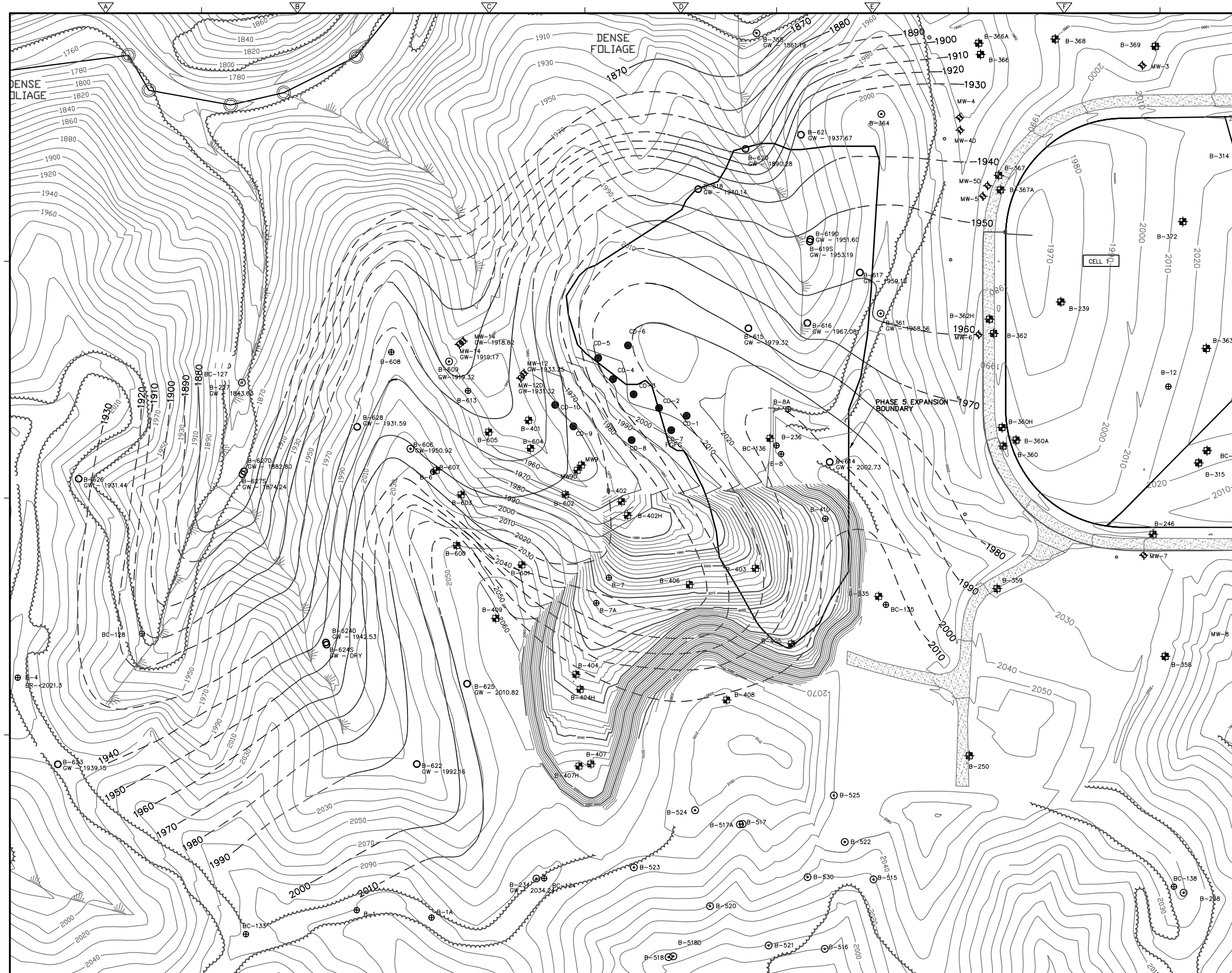
Attachment C

Potentiometric Contour Map



LEGEND:

MW-2	MONITORING WELL
B-8	BOREHOLE
B-601	EXISTING PIEZOMETER
B-254	ABANDONED PIEZOMETER
GW-1953.74	GROUNDWATER ELEVATION (DATA COLLECTED 7/17/2008)
CD-1	BOREHOLE INSTALLED MARCH 2002
B-622	PIEZOMETER INSTALLED JUNE 2008

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: D. FORBES
DRAWN BY: J. KILLINGSWORTH
SHEET CHK'D BY:
CROSS CHK'D BY:
APPROVED BY:
DATE: OCTOBER 2008

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BUNCOMBE COUNTY
NORTH CAROLINA

C&D LANDFILL SUBSTANTIAL AMENDMENT
DESIGN HYDROGEOLOGIC INVESTIGATION

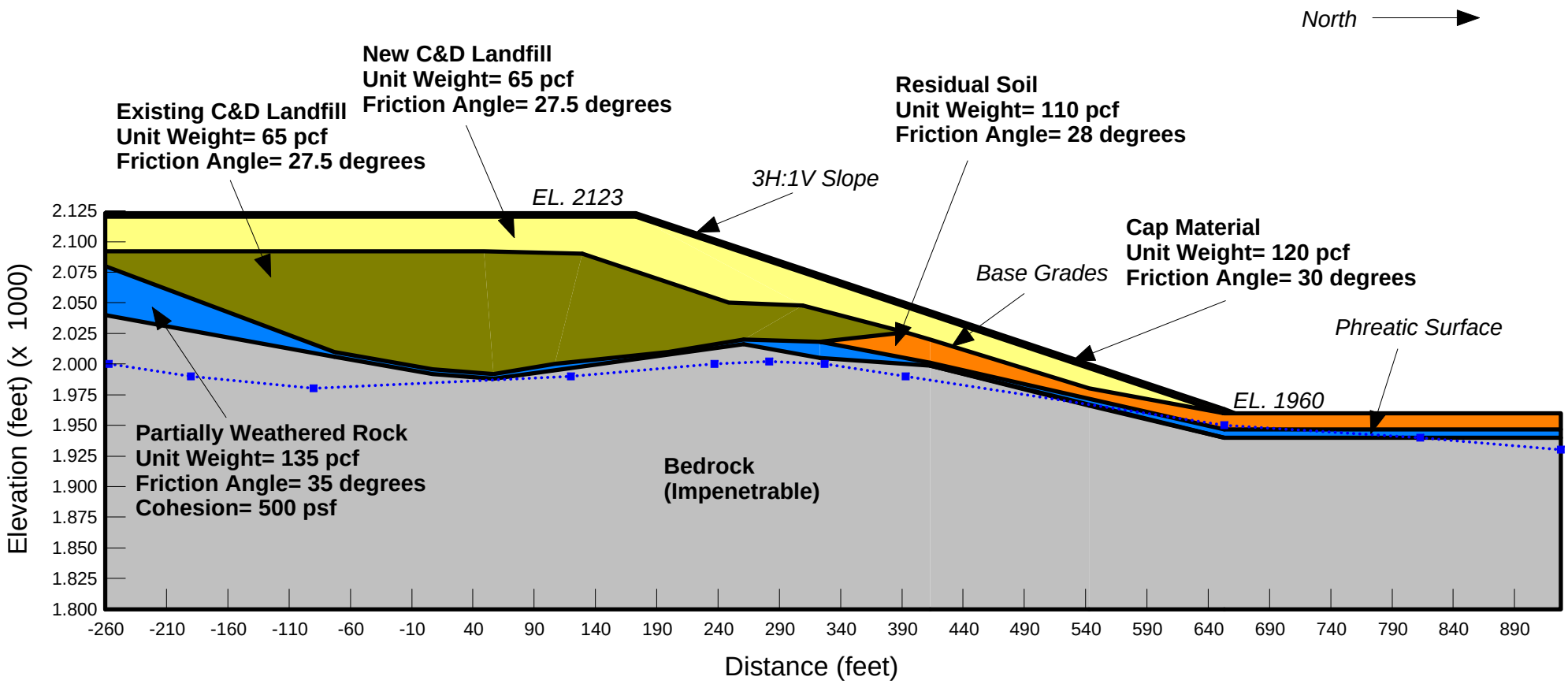
POTENTIOMETRIC CONTOUR MAP

PROJECT NO. 6447-65973
FILE NAME: Sheet 3.dwg
SHEET NO.
3

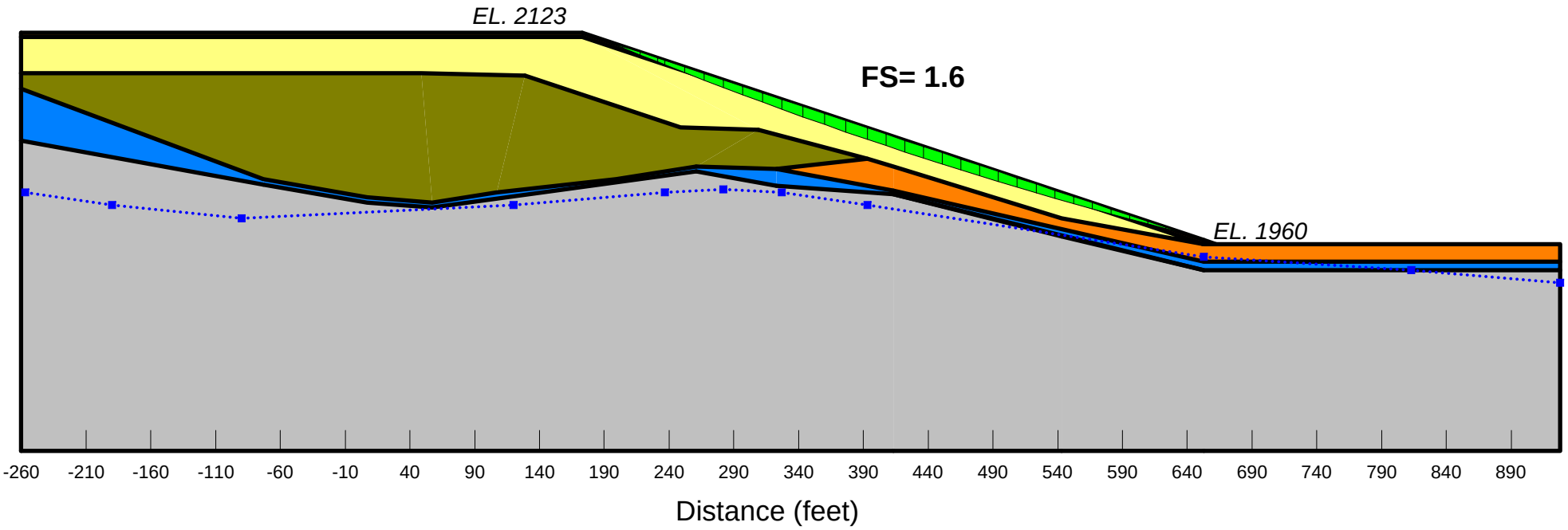
Attachment D

SLOPE/W Analyses Results

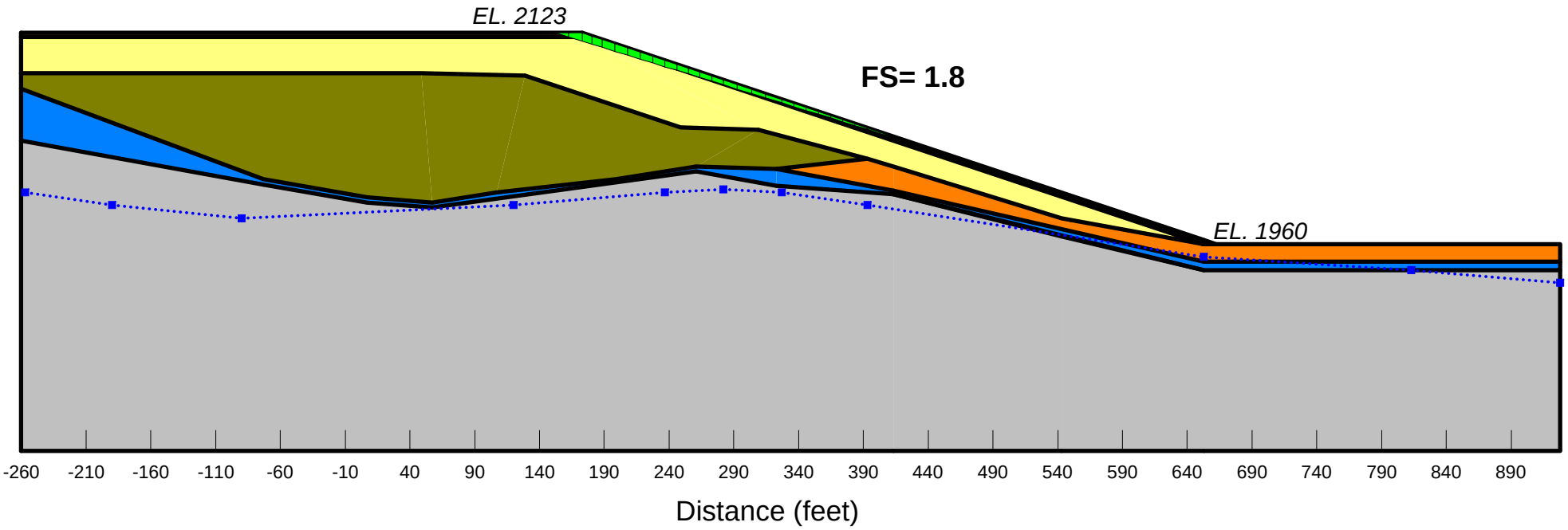
Buncombe County
Phase 5 C&D Landfill Expansion
North-South Cross Section
Model Set-up



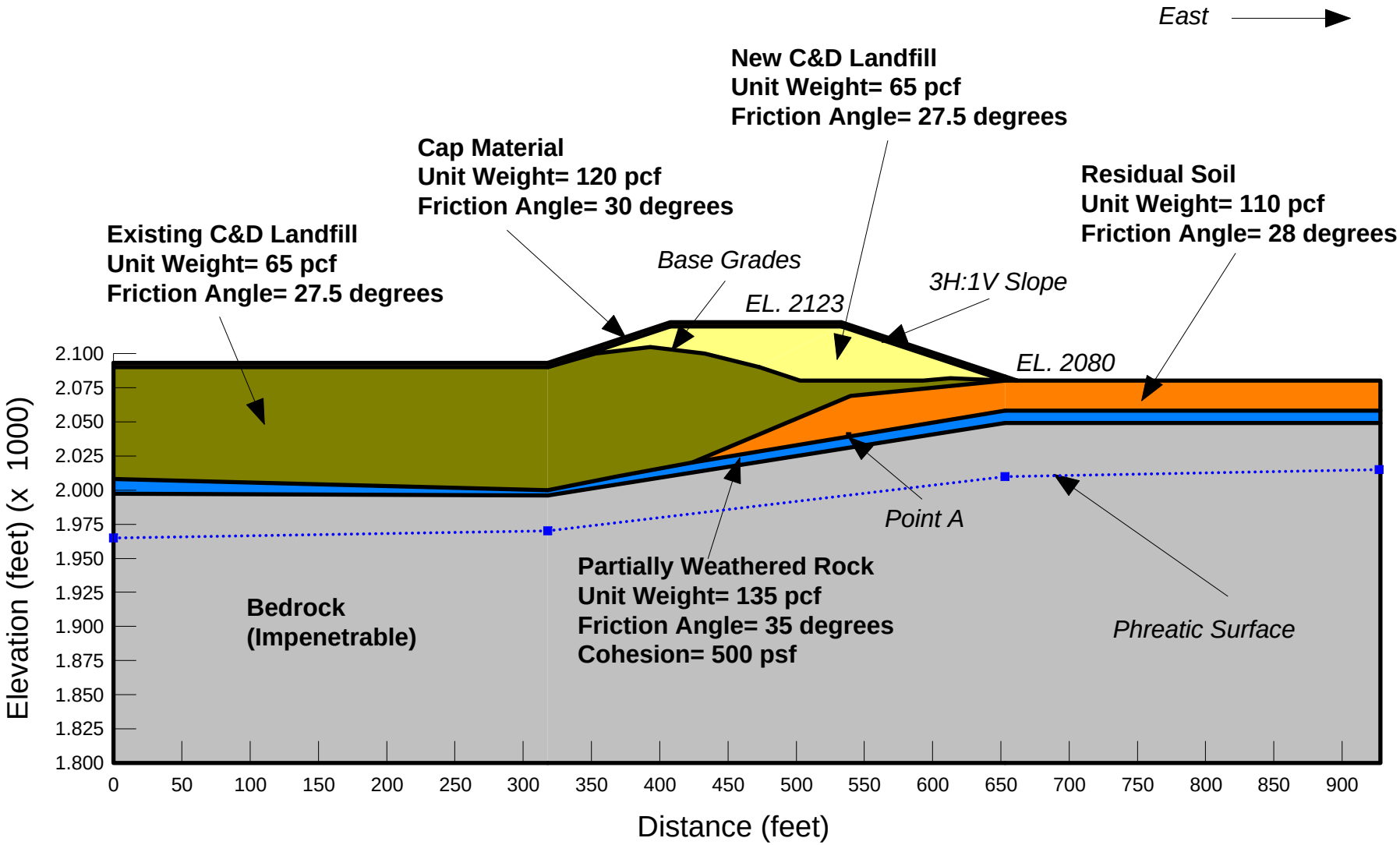
Buncombe County
Phase 5 C&D Landfill Expansion
North-South Cross Section
Circular Failure Surface



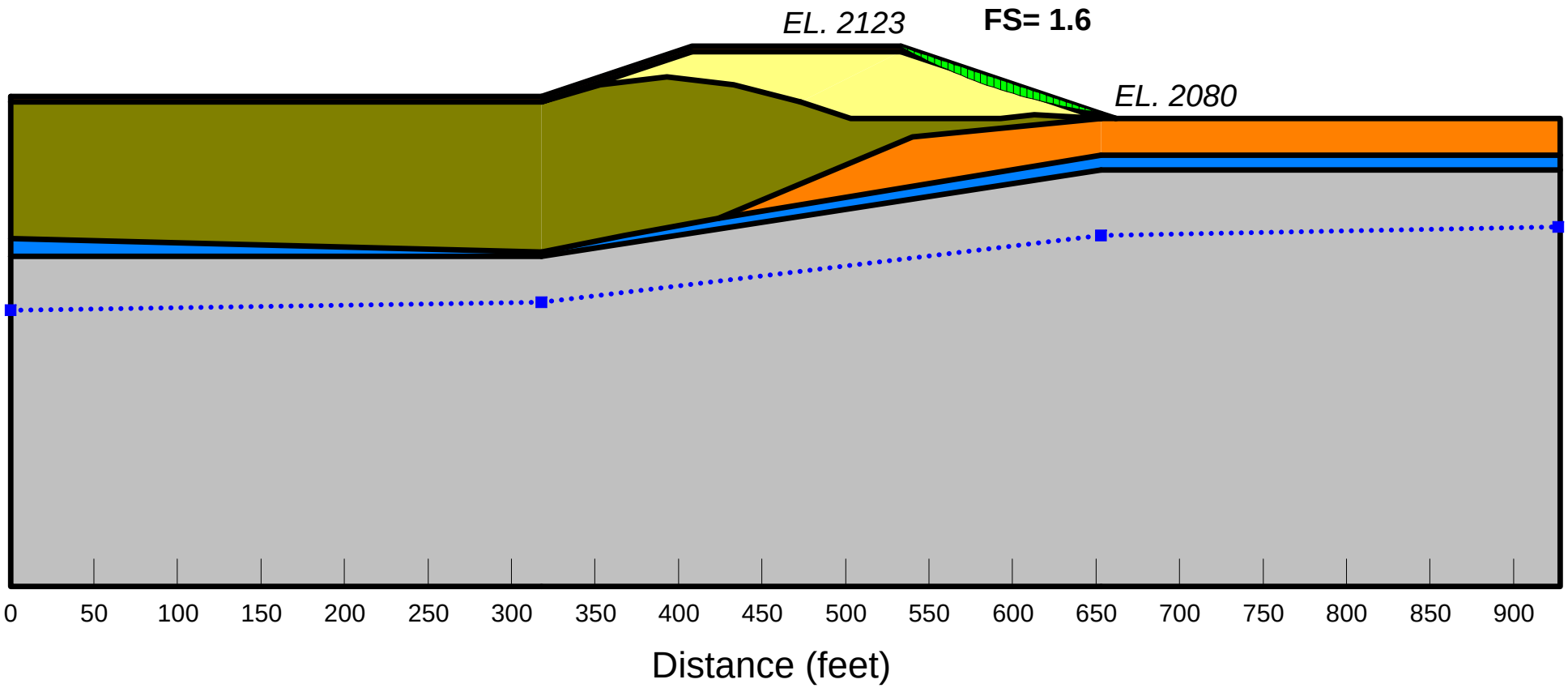
Buncombe County
Phase 5 C&D Landfill Expansion
North-South Cross Section
Block Failure Surface



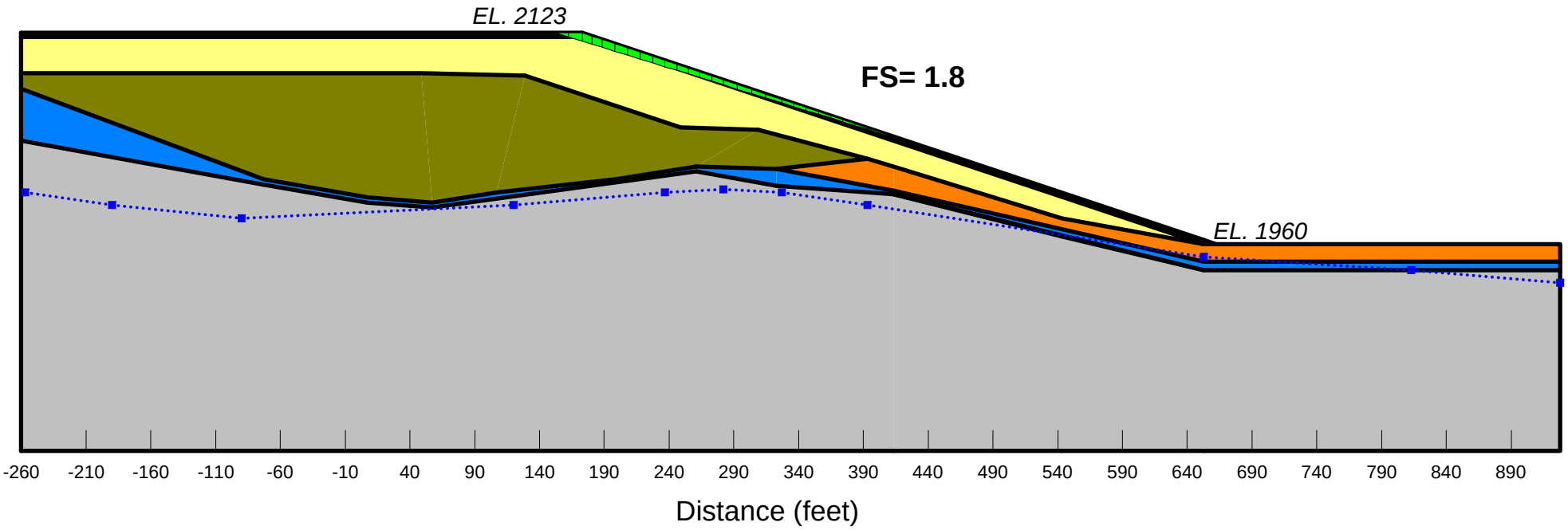
Buncombe County
Phase 5 C&D Landfill Expansion
East-West Cross Section
Model Set-up



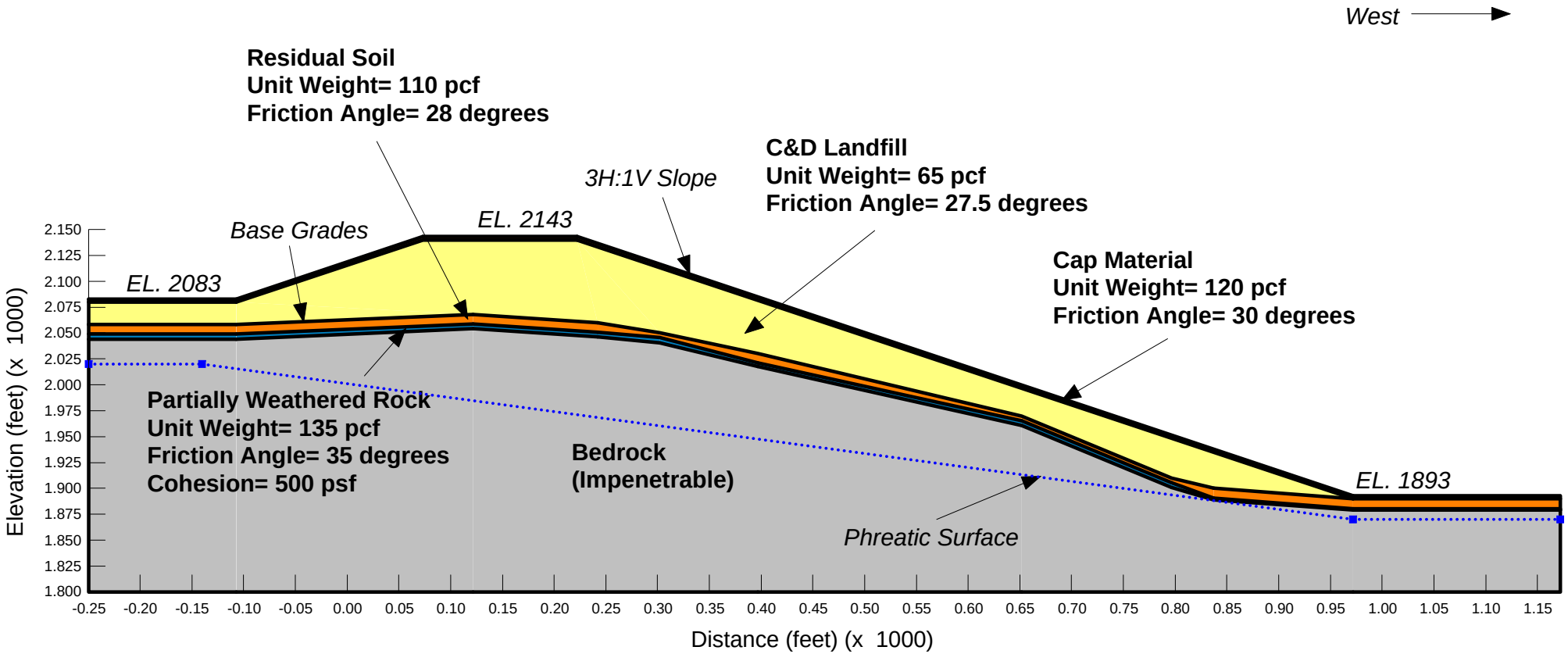
Buncombe County
Phase 5 C&D Landfill Expansion
East-West Cross Section
Circular Failure Surface



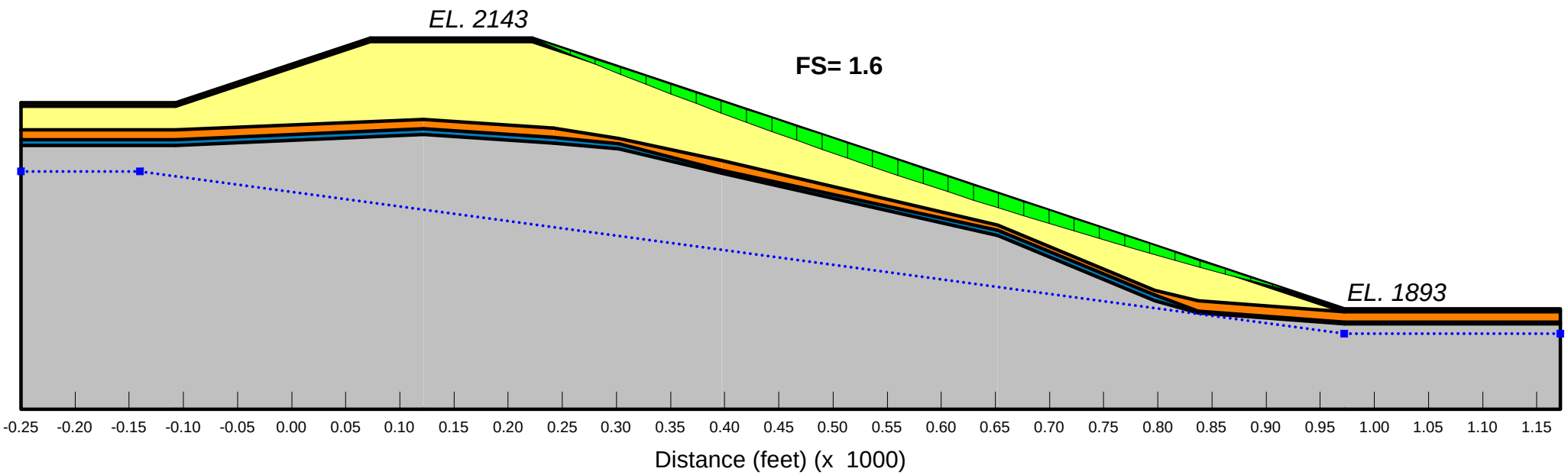
Buncombe County
Phase 5 C&D Landfill Expansion
North-South Cross Section
Block Failure Surface



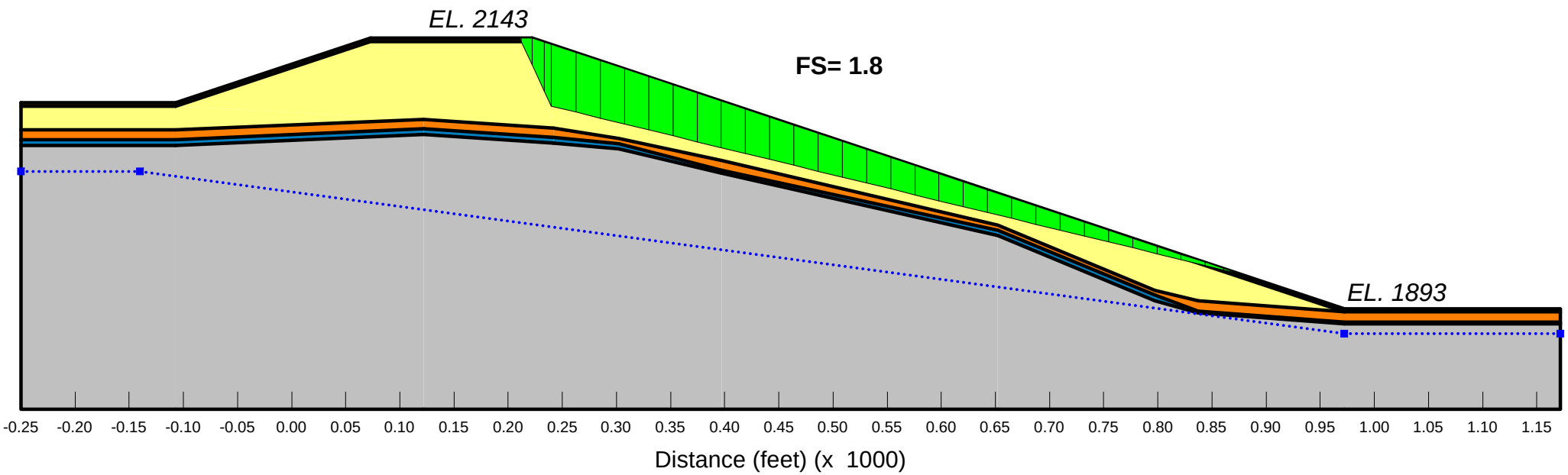
Buncombe County
Phases 6 through 8 C&D Landfill Expansion
Typical East- West Cross Section
Model Set-up



Buncombe County
Phases 6 through 8 C&D Landfill Expansion
East- West Cross Section
Circular Failure Surface



Buncombe County
Phases 6 through 8 C&D Landfill Expansion
East- West Cross Section
Block Failure Surface



Attachment E

Veneer Stability Analyses Results

Veneer Slope Stability Analysis

Parallel Seepage Over a Finite Slope (3:1)

Input Parameter	Value	Unit	Definition
h	3	ft	Thickness of Cover Layer
H	163	ft	Height of Slope
h_w	0	ft	Depth of Water
γ_{total}	120	lb/ft^3	Total Unit Weight
γ_{dry}	110	lb/ft^3	Dry Unit Weight
ϕ_{soil}	30	Degrees	Friction Angle of Soil (Drained) or (Undrained)
ϕ_{soil}	0.52	Radians	
δ	27.5	Degrees	Interfacial Friction Angle
δ	0.48	Radians	
Slope (H:V)	3	1	Slope Ratio
β	18.44	Degrees	Slope Angle
β	0.32	Radians	

Ouput Terms	Value	Unit	Definition
W_A	168,449	lbs/ft	Total Weight of Active Wedge
U_N	0.00	lbs/ft	Resultant of Pore Pressures Acting Perpendicular to Slope
U_H	0.00	lbs/ft	Resultant of Pore Pressures Acting Between Wedges
N_A	159,805	lbs/ft	Effective Force Normal to Failure Plane of Active Wedge
W_P	1,650.00	lbs/ft	Total Weight of Passive Wedge
U_V	0.00	lbs/ft	Resultant of Pore Pressures Acting on Passive Wedge Base

Quadratic Terms	
a	50,535
b	-89,598
c	15,188
FS	**1.58**

Reference: Koerner, Robert M. and Daniel, David E. (1997) Final Covers for Solid Waste Landfills and Abandoned Dumps, American Society of Civil Engineers, pp.190-193.

Attachment F

Settlement Analyses Results

CLIENT:	Buncombe County	**JOB NO:**	6447-65973	**COMP BY:**	I. S. A.
PROJECT:	Substantial Amendment	**DATE CHK:**	2/27/09	**DATE:**	2/20/2009
DETAIL:	Settlement	**CHECK BY:**	RGA	**PAGE NO:**	1 of 6
FILE NAME:	Assume 40-foot-thick C&D Waste and 3-foot-thick Cap Material				
	Assume compressible soil layer is 29 feet in thickness and the profile consists of silt only.				

Purpose: To estimate the amount of settlement at the site under C&D Waste and Cap Material.

Problem: Model foundation settlement due to increase in load on foundation soils

Reference: 1. Schmertmann, John "Static Cone To Compare Static Settlement Over Sands", Journal of the Soil Mechanics and Foundations Division, ASCE, May 1970.

2. Boussinesq Stress Influence Diagrams.

3. USACE, "Engineering Design - Settlement Analysis", EM 1110-1-1904, September 30, 1990.

Soil Information: CDM Borings in vicinity

Assumptions: - Vertical stress increases are based on Boussinesq stress distribution below corner of a rectangular surface (homogeneous, isotropic, elastic halfspace).
- All split spoon sampling was carried out according to ASTM D1556.
- Loading occurs instantaneously.
- Soils below the foundation are cohesionless.

CLIENT: Buncombe County **JOB NO:** 6447-65973 **COMP BY:** I. S. A.
PROJECT: Substantial Amendment **DATE CHK:** 2/27/09 **DATE:** 2/20/09
DETAIL: Schmertmann Settlement **CHECK BY:** RGA **PAGE NO:** 2 of 6
FILE NAME: Assume 40-foot-thick C&D Waste and 3-foot-thick Cap Material
Assume compressible soil layer is 29 feet in thickness and the profile consists of silt only.

Depth	Layer Description	614	615	616	617	618	619D	620	621
		SPT N-Value	SPT N-Value	SPT N-Value	SPT N-Value	SPT N-Value	SPT N-Value	SPT N-Value	SPT N-Value
0	Silt	2	16	2	20	9		4	11
4		12	16	27	>50	14	14		>50
9		>50	41	>50	>50	11	19		>50
13.5			8		>50	34	>50		
19			>50			>50			
24						>50			
29									

Design SPT N-value Based on two 19-foot-deep Borings		
N SPT Value	Depth (ft)	
9	0	
14	4	
11	9	
8	13	
8	18	Assumed
8	23	
8	28	

CLIENT:	Buncombe County	**JOB NO:**	6447-65973	**COMP BY:**	I. S. A.
PROJECT:	Substantial Amendment	**DATE CHK:**	2/27/09	**DATE:**	2/20/2009
DETAIL:	Schmertmann Settlement	**CHECK BY:**	RGA	**PAGE NO:**	3 of 6
FILE NAME:	Assume 40-foot-thick C&D Waste and 3-foot-thick Cap Material				
	Assume compressible soil layer is 29 feet in thickness and the profile consists of silt only.				

Soil Type:	Silt	(See Reference Page)
Depth of Water Table (d) ft.	0	
Depth of Foundation (D) ft.	0	
Length of Foundation (L) ft.	340	
Width of Foundation (B) ft.	340	
L/B	1.00	
Z/B	2.00	
Compressible Layer Thickness (H) ft.	29	(From Model Profile)
Existing overburden pressure (tsf)	0.00	(At Foundation Level)
Additional Loading (tsf)	1.48	(Based on Additional Load @ Foundation Level)
Foundation Load	2,960	psf

CLIENT:	Buncombe County	**JOB NO:**	6447-65973	**COMP BY:**	I. S. A.
PROJECT:	Substantial Amendment	**DATE CHK:**	2/27/09	**DATE:**	2/20/2009
DETAIL:	Schmertmann Settlement	**CHECK BY:**	KGA	**PAGE NO:**	4 of 6
FILE NAME:	Assume 40-foot-thick C&D Waste and 3-foot-thick Cap Material				
	Assume compressible soil layer is 29 feet in thickness and the profile consists of silt only.				

Increments	Depth (ft.)	Strain Influence
1	2.00	0.99
2	6.50	0.99
3	11.50	0.99
4	16.50	0.99
5	21.50	0.99
6	26.50	0.99

CLIENT:	Buncombe County	**JOB NO:**	6447-65973	**COMP BY:**	I. S. A.
PROJECT:	Substantial Amendment	**DATE CHK:**	2/27/09	**DATE:**	2/20/2009
DETAIL:	Schmertmann Settlement	**CHECK BY:**	RGA	**PAGE NO:**	5 of 6
FILE NAME:	Assume 40-foot-thick C&D Waste and 3-foot-thick Cap Material				

Assume compressible soil layer is 29 feet in thickness and the profile consists of silt only.

Soil Type:		
Soil	***q_c/N***	***Descrpition***
Silt	2	Combination of silts, sandy silts, slightly cohesive sand-silts.
Silty Sand	2.75	Silty sands
Sand	4	Clean to slightly silty sands.

Where: q_c = Average Dutch Cone Resistance
N = SPT N value

Strain Condition:		
Strain	***Es/qc***	***Descrpition***
Axisymmetric	2.5	L/B = 1
Plane	3.5	L/B > 10

CLIENT:	Buncombe County	**JOB NO:**	6447-65973	**COMP BY:**	I. S. A.
PROJECT:	Substantial Amendment	**DATE CHK:**	2/27/09	**DATE:**	2/20/2009
DETAIL:	Schmertmann Settlement	**CHECK BY:**	RGA	**PAGE NO:**	6 of 6
FILE NAME:	Assume 40-foot-thick C&D Waste and 3-foot-thick Cap Material				

Assume compressible soil layer is 29 feet in thickness and the profile consists of silt only.

Layer	Delta Z	Avg. SPT (1)	Corrected qc (tsf) (2)	Es (tsf) (3)	Depth to Mid Layer	Iz (4)	(Iz/Es)*Delta Z) (5)
1	4	9	18.00	45.0	2.00	0.99	0.0880
2	5	14	28.00	70.0	6.50	0.99	0.0707
3	5	11	22.00	55.0	11.50	0.99	0.0900
4	5	8	16.00	40.0	16.50	0.99	0.1238
5	5	8	16.00	40.0	21.50	0.99	0.1238
6	5	8	16.00	40.0	26.50	0.99	0.1238
	29						

Total Settlement/tsf 0.6200 ft/tsf

Notes:

1 Refer to SPT vs. Depth for average N values (not corrected).
2 Refer to reference page for values.
3 Schmertmann SPT-correlations modified by Ladd, E_s = average equivalent modulus over depth z for foundation type.
4 Strain influence is based on Boussinesq distribution.
5 Represents the settlement attributed to each layer assuming C_1 equal to 1.

Settlements

t = 0 year e = **11.01** Inches

t = 1 years e = **13.21** Inches

CLIENT:	Buncombe County	**JOB NO:**	6447-65973	**COMP BY:**	I. S. A.
PROJECT:	Substantial Amendment	**DATE CHK:**	2/27/09	**DATE:**	2/20/2009
DETAIL:	Settlement	**CHECK BY:**	RGA	**PAGE NO:**	1 of 6
FILE NAME:	Assume 40-foot-thick C&D Waste and 3-foot-thick Cap Material				
	Assume compressible soil layer is 29 feet in thickness and the profile consists of sand only.				

Purpose: To estimate the amount of settlement at the site under C&D Waste and Cap Material.

Problem: Model foundation settlement due to increase in load on foundation soils

Reference: 1. Schmertmann, John "Static Cone To Compare Static Settlement Over Sands", Journal of the Soil Mechanics and Foundations Division, ASCE, May 1970.

2. Boussinesq Stress Influence Diagrams.

3. USACE, "Engineering Design - Settlement Analysis", EM 1110-1-1904, September 30, 1990.

Soil Information: CDM Borings in vicinity

Assumptions:
- Vertical stress increases are based on Boussinesq stress distribution below corner of a rectangular surface (homogeneous, isotropic, elastic halfspace).
- All split spoon sampling was carried out according to ASTM D1556.
- Loading occurs instantaneously.
- Soils below the foundation are cohesionless.

CLIENT: Buncombe County **JOB NO:** 6447-65973 **COMP BY:** I. S. A.
PROJECT: Substantial Amendment **DATE CHK:** 2/27/09 **DATE:** 2/20/09
DETAIL: Schmertmann Settlement **CHECK BY:** KGA **PAGE NO:** 2 of 6
FILE NAME: Assume 40-foot-thick C&D Waste and 3-foot-thick Cap Material
Assume compressible soil layer is 29 feet in thickness and the profile consists of sand only.

Depth	Layer Description	614	615	616	617	618	619D	620	621
		SPT N-Value	SPT N-Value	SPT N-Value	SPT N-Value	SPT N-Value	SPT N-Value	SPT N-Value	SPT N-Value
0	Silt	2	16	2	20	9		4	11
4		12	16	27	>50	14	14		>50
9		>50	41	>50	>50	11	19		>50
13.5			8		>50	34	>50		
19			>50			>50			
24						>50			
29									

Design SPT N-value Based on two 19-foot-deep Borings		
N SPT Value	Depth (ft)	
9	0	
14	4	
11	9	
8	13	
8	18	Assumed
8	23	
8	28	

CLIENT:	Buncombe County	**JOB NO:**	6447-65973	**COMP BY:**	I. S. A.
PROJECT:	Substantial Amendment	**DATE CHK:**	2/27/09	**DATE:**	2/20/2009
DETAIL:	Schmertmann Settlement	**CHECK BY:**	RGA	**PAGE NO:**	3 of 6
FILE NAME:	Assume 40-foot-thick C&D Waste and 3-foot-thick Cap Material				
	Assume compressible soil layer is 29 feet in thickness and the profile consists of sand only.				

Soil Type:	Sand	(See Reference Page)
Depth of Water Table (d) ft.	0	
Depth of Foundation (D) ft.	0	
Length of Foundation (L) ft.	340	
Width of Foundation (B) ft.	340	
L/B	1.00	
Z/B	2.00	
Compressible Layer Thickness (H) ft.	29	(From Model Profile)
Existing overburden pressure (tsf)	0.00	(At Foundation Level)
Additional Loading (tsf)	1.48	(Based on Additional Load @ Foundation Level)
Foundation Load	2,960	psf

CLIENT:	Buncombe County	**JOB NO:**	6447-65973	**COMP BY:**	I. S. A.
PROJECT:	Substantial Amendment	**DATE CHK:**	2/27/09	**DATE:**	2/20/2009
DETAIL:	Schmertmann Settlement	**CHECK BY:**	RGA	**PAGE NO:**	4 of 6
FILE NAME:	Assume 40-foot-thick C&D Waste and 3-foot-thick Cap Material				
	Assume compressible soil layer is 29 feet in thickness and the profile consists of sand only.				

Increments	Depth (ft.)	Strain Influence
1	2.00	0.99
2	6.50	0.99
3	11.50	0.99
4	16.50	0.99
5	21.50	0.99
6	26.50	0.99

CLIENT:	Buncombe County	**JOB NO:**	6447-65973	**COMP BY:**	I. S. A.
PROJECT:	Substantial Amendment	**DATE CHK:**	2/27/09	**DATE:**	2/20/2009
DETAIL:	Schmertmann Settlement	**CHECK BY:**	RGA	**PAGE NO:**	5 of 6

FILE NAME: Assume 40-foot-thick C&D Waste and 3-foot-thick Cap Material
Assume compressible soil layer is 29 feet in thickness and the profile consists of sand only.

Soil Type:		
Soil	***q_c/N***	***Descrpition***
Silt	2	Combination of silts, sandy silts, slightly cohesive sand-silts.
Silty Sand	2.75	Silty sands
Sand	4	Clean to slightly silty sands.

Where: q_c = Average Dutch Cone Resistance
N = SPT N value

Strain Condition:		
Strain	***Es/qc***	***Descrpition***
Axisymmetric	2.5	L/B = 1
Plane	3.5	L/B > 10

CLIENT:	Buncombe County	**JOB NO:**	6447-65973	**COMP BY:**	I. S. A.
PROJECT:	Substantial Amendment	**DATE CHK:**	2/27/09	**DATE:**	2/20/2009
DETAIL:	Schmertmann Settlement	**CHECK BY:**	RGA	**PAGE NO:**	6 of 6

FILE NAME: Assume 40-foot-thick C&D Waste and 3-foot-thick Cap Material
Assume compressible soil layer is 29 feet in thickness and the profile consists of sand only.

Layer	Delta Z	Avg. SPT (1)	Corrected qc (tsf) (2)	Es (tsf) (3)	Depth to Mid Layer	Iz (4)	(Iz/Es)*Delta Z) (5)
1	4	9	36.00	90.0	2.00	0.99	0.0440
2	5	14	56.00	140.0	6.50	0.99	0.0354
3	5	11	44.00	110.0	11.50	0.99	0.0450
4	5	8	32.00	80.0	16.50	0.99	0.0619
5	5	8	32.00	80.0	21.50	0.99	0.0619
6	5	8	32.00	80.0	26.50	0.99	0.0619
	29						

Total Settlement/tsf 0.3100 ft/tsf

Notes:

1. Refer to SPT vs. Depth for average N values (not corrected).
2. Refer to reference page for values.
3. Schmertmann SPT-correlations modified by Ladd, E_s = average equivalent modulus over depth z for foundation type.
4. Strain influence is based on Boussinesq distribution.
5. Represents the settlement attributed to each layer assuming C_1 equal to 1.

Settlements

t = 0 year	e =	**5.51**	Inches
t = 1 years	e =	**6.61**	Inches

Part 5
Engineering Report

Appendix C
Design Hydrogeological Report

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Appendix C
Design Hydrogeologic Investigation

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Appendix C
Design Hydrogeologic Investigation

Rule .0539(d)(3) of the North Carolina Solid Waste Management Rules requires that a Design Hydrogeologic Report be prepared in accordance with the requirements set forth in Rule .0538(b). This document is intended to fulfill all of the specified criteria delineated in this rule.

1 Purpose and Scope

The Design Hydrogeologic Report presented herein is designed to address the applicable Solid Waste Management Rules for the Permit to Construct for Phase 5 of the Buncombe County Solid Waste Management C&D Landfill Facility. The report compiles information from all field activities that have been conducted to date, summarizing data from previously-submitted documents, as well as subsequent investigation activities, to provide a comprehensive characterization of the geology and hydrogeology at the landfill site. The goal of this investigation is to provide sufficient technical information to design a Water Quality Monitoring Plan for Phase 5 as specified in Rule .0538(b)(2).

1.1 Report Contents

Section 1 of the Design Hydrogeologic Report discusses the purpose and scope of the report, summarizes previous and current investigation activities, and provides a cross-reference between each applicable regulatory requirement set forth in Rule .1623(b) and corresponding sections of this report. Section 2 presents a summary of the methodologies used in this field investigation, as well as data collection and evaluation activities. Section 3 presents the results of this field investigation and data analysis activities. Conclusions derived from this and previous investigations are presented in Section 4, along with a discussion of hydrogeologic factors affecting the landfill design and development of the Water Quality Monitoring Plan.

1.2 Previous Investigations

Law Environmental, Inc. initially investigated the site in 1990 (Law 1991). The investigation consisted of seventeen exploratory soil test borings using hollow-stem augers at twelve locations. Split spoon soil samples were collected at regular intervals using standard penetration test methods (ASTM D-1586). Groundwater was not encountered in any of the borings during drilling. Two borings that were left open overnight also did not accumulate groundwater. No permanent piezometers or monitoring wells were constructed. The report cited an absence of perennial surface water features and a small drainage area entering the site as advantages for landfill development, but identified limited excavation depth, lack of low permeability soils, and soil workability problems as potential constraints.

Phase I Investigation

In November 1992, a Site Plan Application (CDM 1992) was submitted on behalf of Buncombe County to the North Carolina Division of Solid Waste Management - Solid

Waste Section (SWS). A Geological and Hydrogeological Evaluation as per SWS Rule .1623(a) was included as Section 4 of that report. The evaluation presented results of a Phase I investigation encompassing the 557-acre proposed Buncombe County Landfill site (the Site). During this Phase I investigation, three 20-foot coring holes and 38 hollow-stem auger borings were drilled, and 19 piezometers were installed. Split spoon soil samples were collected at 5-foot intervals while the auger borings were drilled. Blow counts required to accomplish sample collection were also recorded. Collected soil samples were analyzed for geotechnical properties, including soil classification (25 samples), grain size distribution (25 samples), Atterberg Limits (10 samples), standard proctor compaction (seven samples), natural moisture content (seven samples), porosity (14 samples), and hydraulic conductivity (seven samples undisturbed, seven samples remolded). The rock cores were examined and descriptions recorded for fracture frequency and orientation, general mineralogy, rock quality designation, and other properties.

Water level measurements were taken in the piezometers at the time of completion, at 24 hours and at least seven days after installation. Piezometer measuring points were surveyed to state plane coordinates and mean sea level elevation. Falling head permeability tests (slug tests) were performed in five piezometers to obtain hydraulic conductivity data. Most of the piezometers installed were dry due to auger refusal encountered before reaching groundwater. A comprehensive literature search was also conducted during the Phase I evaluation. This search identified reference materials and mapping done by others to characterize the geology and hydrogeology of the site, as well as the surrounding region. The report concluded that the site appeared to be suitable for landfill development.

Phase II Investigation

In 1993, additional field activities were conducted to address SWS comments provided by letter dated April 29, 1993, concerning the Site Hydrogeologic Report. The results of these additional field activities were presented in the Response to Completeness Review (RCR) Site Plan Application (CDM 1993). As part of that document, GEI Consultants, Inc. (GEI) conducted a lineament/fracture trace analysis, a geophysical investigation, and a Phase II Geological/Hydrogeological Site Evaluation. The lineament/fracture trace analysis and geophysical investigation included lineament analyses on maps and aerial photographs, a fracture trace analysis of rock outcroppings within the Site, and a very low frequency (VLF) geophysical survey of the Site.

The Phase II Geological/Hydrogeological Site Evaluation was subsequently conducted and included the drilling of boreholes at 27 locations. Some of the boring locations were selected based on the results of the VLF survey. Multiple drilling techniques were often used at each location. Thirteen locations were investigated using hollow-stem augers with split spoon sampling as well as air rotary/hammer drilling, four locations by hollow-stem auger with split spoon sampling and rock coring, nine locations by air rotary/hammer drilling only, and one location by all

three methods. One permanent piezometer was installed at each of the 27 locations. Water levels were measured in each piezometer at the time of installation, at 24 hours and at least seven days after installation. Eight of the piezometers were installed adjacent to borings drilled during the Phase I investigation that yielded no water. Piezometer measuring points were surveyed to state plane coordinates and mean sea level elevation. Water levels were also measured in the piezometers installed during the Phase I investigation. Six slug tests and/or recovery tests were performed in five piezometers to obtain additional hydraulic conductivity data.

The Site Hydrogeologic Report as required under Rule .1623(a), consisting of Section 4 of the Site Plan Application (CDM 1992) and the Response to Completeness Review, Site Plan Application (CDM 1993), has been previously submitted to the SWS. Data and information in these documents have been reproduced in this report only to the extent necessary to support the Geological and Hydrogeological Study required for the C&D Landfill expansion.

Phase III Investigation
In March 1995, a Permit To Construct Application (CDM, 1995a) was submitted to the SWS. The Design Hydrogeologic Report was included as Appendix G of the report. The Phase III investigation focused on the area within and around the Subtitle D landfill Cells 1-3. The Cell 1-3 Area extended beyond the cell boundaries and past adjacent topographic divides in order to sufficiently characterize the hydrogeologic regime beneath Cells 1-3.

Over 71 boreholes were drilled at 39 locations during the Phase III investigation. Air rotary hammer drilling was used for 44 borings, three boreholes were cored, and 24 boreholes were drilled using hollow-stem auger drilling techniques. Geotechnical samples were collected during hollow-stem auger drilling at nine locations within the Cell 1-3 Area, and blow counts were taken at all 24 auger locations.

Piezometers were installed in 39 boreholes at 29 locations, making a total of nine nested well pairs. Observation wells were installed in eight boreholes, and two pumping wells were constructed. Water level measurements were taken at each of the piezometers at time of boring, and at 24 hours at least seven days after boring. Piezometer measuring points were surveyed to state plane coordinates and mean sea level elevation. Slug testing was performed in 10 piezometers to obtain additional hydraulic conductivity data. Two pumping tests were performed in two hollows within the Cell 1-3 Area to further characterize the groundwater system.

Additional information on the site hydrogeology and the water quality monitoring plan was presented in two Response to Comments letters dated June, 1995 and August, 1995 (CDM, 1995b and 1995c).

Monitoring Well Installation - Cells 1-3
After construction of Cells 1-3, thirteen groundwater monitoring wells and two methane gas monitoring wells were installed around the perimeter of Cells 1-3, in

accordance with the approved Water Quality Monitoring Plan for the Subtitle D landfill. A discussion of the field activities and the results of the initial baseline sampling event were presented in the Water Quality Monitoring System Installation and Initial Sampling Report (CDM 1996).

All the groundwater monitoring wells were installed using air rotary drilling methods since groundwater was located at or below the top of bedrock. The methane gas monitoring wells were installed using hollow-stem auger methods. Slug tests were conducted on all wells following development to obtain hydraulic conductivity data. One round of groundwater samples were collected from the thirteen monitoring wells and the three surface water locations and submitted for laboratory analysis of the Appendix I constituents list.

Phase IV Investigation
The Phase IV investigation focused on the area within and surrounding the existing Phase I and II C&D landfill. Since the current C&D landfill is located within the confines of a single drainage basin, the investigation focused on the area within the drainage feature. Sheet 1 delineates this area of focused investigation as well as the location of Cells 1-3 and previously installed piezometers.

Nineteen boreholes were drilled at ten locations during the Phase IV investigation. Air rotary hammer drilling was used for nine borings and ten boreholes were drilled using hollow-stem auger drilling techniques. Geotechnical samples were collected during hollow-stem auger drilling at seven locations and blow counts were taken at all 10 auger locations.

Piezometers were installed in twelve boreholes at nine locations, making a total of three nested well pairs. Water level measurements were taken at each of the piezometers at time of boring, and at 24 hours, and at least seven days after boring. Piezometer measuring points were surveyed to state plane coordinates and mean sea level elevation.

Monitoring Well Installation – Phase I C&D
Installation of two monitoring wells for the C&D landfill (MW-9 and MW-9d) was completed in October of 1997. The wells are located within the drainage feature, down-gradient of the existing C&D landfill. The wells were slug tested for estimation of hydraulic conductivity after development, surveyed to state plane coordinates and mean sea level elevation, and sampled. Borelogs, slug test and initial sampling results were forwarded to the SWS in a letter report dated July 2, 1998.

Additional Geologic Investigation
During permitting of the existing C&D landfill, the SWS expressed concerns regarding the complexity of the geology in the western portion of the landfill. To address these concerns, CDM contracted Gram, Inc. to perform a geologic mapping study of the area. A letter report by Gram, Inc. (January 11, 1999) was forwarded to

the SWS and included in the Phase 3 Construction and Demolition Debris Landfill Permit Application (CDM, October 2000).

Phase V Investigation
The Phase V investigation focused on the Phase III expansion area of the C&D landfill adjacent to the south and east of the existing C&D landfill. Since the C&D landfill expansion was located within the confines of a single drainage basin, the C&D investigation focused on the area within the drainage divides. The Phase 3 Construction and Demolition Debris Landfill Permit Application was submitted to the SWS in October 2000.

Seven boreholes were drilled at five locations during the Phase V investigation. Air rotary hammer drilling was used for installation of all piezometers. Hollow-stem auger drilling was used for geologic description at each location prior to piezometer installation. Rock coring was performed at one location (B-519). Standard penetration tests (blow counts) were taken at all 5 auger locations.

Piezometers were installed in seven boreholes at five locations, making a total of two nested well pairs. Water level measurements were taken at each of the piezometers at time of boring, and at 24 hours, and at least seven days after boring. Piezometer measuring points were surveyed to state plane coordinates and mean sea level elevation.

Additional Phase V Investigation
The Additional Phase V investigation also focused on the Phase III expansion area of the C&D landfill. Based on comments by the SWS, additional information regarding bedrock and groundwater flow in the fractured bedrock was needed.

Twelve piezometers and one pumping well were installed at thirteen locations during the additional investigation. Air rotary hammer drilling was used for installation of all piezometers and the pumping well. Hollow-stem auger drilling was used for geologic description and locating the top of bedrock at each location, with the exception of the pumping well. Rock coring was performed at two locations. Standard penetration tests (blow counts) were taken at all 12 auger locations.

Water level measurements were taken at each of the piezometers at time of boring, and at 24 hours, and at least seven days after boring. Piezometer measuring points were surveyed to state plane coordinates and mean sea level elevation.

Following the completion of the air rotary and hollow stem auger work, the piezometers were allowed to equilibrate for a period of two weeks. The pumping well was fitted with a 4-inch submersible pump and a pump test was performed. During the pump test, groundwater measurements were collected from all of the piezometers within the Phase III C&D landfill area. The pump test was allowed to run for a period of 56 hours. After stopping the test, groundwater elevation measurements were collected from the piezometers to estimate recharge rates.

Following submission of the additional investigation data in January 2002, the SWS determined that the Phase III C&D Landfill expansion site was not suitable for landfill development. As an alternative, it was decided by the SWS that further C&D landfill expansion was practical west and north of the existing Phase I and II C&D landfill.

A field investigation was performed in March 2002 to determine the depth to bedrock and/or groundwater in order to obtain the data necessary to design the expansion. Ten hollow stem auger borings were advanced in the proposed landfill expansion site. Borings were advanced using 2¼ inch inside diameter hollow stem augers and standard split spoon sampling techniques down to auger refusal. The depth to auger refusal was assumed to the top of bedrock. Blow counts, sample descriptions, and auger refusal depths were noted for each boring. Following completion, each boring was left open for an extended period (in some cases, overnight) to provide for monitoring of groundwater levels. In all cases, groundwater was not encountered. The boreholes were backfilled with a bentonite/cement grout. The boring locations were surveyed by a North Carolina registered surveyor for northing and easting coordinates and ground elevation.

Phase VI Investigation
The Phase VI investigation focused on the Subtitle D Cell 6 area and the Phase IV expansion area of the C&D landfill adjacent to the existing Phase I and II C&D landfill. Results of the Cell 6 investigation were submitted to the SWS in the Design Hydrogeologic Report in December 2004.

Since the proposed C&D landfill expansion is located within the confines of a single drainage basin, the C&D investigation focused on the area within the drainage divides. Thirteen boreholes were drilled at 13 locations during the Phase VI investigation. Seven borings were converted to temporary piezometers for groundwater elevation measurements while the remaining borings were used to collect lithologic and geotechnical data only. Air rotary hammer drilling was used for installation of all piezometers. Hollow-stem auger drilling was used for lithologic and geotechnical data collection at all borings. Rock coring was performed at one location (B-601). Standard penetration tests (blow counts) were taken at all locations.

Water level measurements were taken at each of the piezometers at time of boring, and at 24 hours, and at least seven days after boring. Piezometer measuring points were surveyed to state plane coordinates and mean sea level elevation.

Following SWS approval and permit issuance, two monitoring wells (MW-14/14d) were installed downgradient of the Phase IV landfill.

1.3 Current Investigation

The Phase VII investigation focused on the proposed expansion facility plan area adjacent to the existing Phases of the active C&D landfill. The proposed facility plan boundary included two individual drainage basins to the west and north side of the

existing active C&D landfill. The investigation focused on the area within the two drainages.

Eighteen boreholes were drilled at 15 locations during the Phase VII investigation. All borings were converted to temporary piezometers for groundwater elevation measurements and lithologic and geotechnical data was collected at each location. Air rotary hammer drilling was used for installation of all piezometers. Hollow-stem auger drilling was used for lithologic and geotechnical data collection at all borings. Rock coring was performed at three locations (B-619d, B-623, and B-627d). Standard penetration tests (blow counts) were taken at all locations.

The site to the west will be used for future expansions. This report is intended to address the permit requirements for the area to the north (Phase 5 Expansion) of the existing landfill. Within the Phase 5 area, 9 boreholes were drilled at 8 locations during the Phase VII investigation. All borings were converted to temporary piezometers for groundwater elevation measurements and lithologic and geotechnical data was collected at each location. Air rotary hammer drilling was used for installation of all piezometers. Hollow-stem auger drilling was used for lithologic and geotechnical data collection at all borings. Rock coring was performed at location B-619d. Standard penetration tests (blow counts) were taken at all locations.

Water level measurements were taken at each of the piezometers at time of boring, and at 24 hours, and at least seven days after boring. Piezometer measuring points were surveyed to state plane coordinates and mean sea level elevation.

2 Methodology

This section presents the methodology and data reduction used during the Phase 5 C&D Landfill hydrogeologic field investigation. As described in Section 1.3, the current investigation included borehole drilling, piezometer installation, water level measurements, and well surveying.

2.1 Drilling Methods

The following section details the drilling methods used to install borings and piezometers and collect geologic and hydrogeologic data for the Phase 5 C&D landfill expansion.

2.1.1 Borehole Drilling

Borehole drilling methods included air rotary, hollow-stem auger, and rock coring. During the field investigation, two drill rigs (one air rotary and one hollow-stem) operated simultaneously. Boring locations are provided on Sheet 1. Boring logs from the Phase 5 area investigation are provided in Appendix A. Boreholes and piezometers installed during this investigation are identified by 600-series numbers, whereas the 100 through 500 series boreholes and piezometers correspond to previous

investigations. Only logs for borings from previous investigations relevant to the Phase 5 Area are included in Appendix A.

Air Rotary Drilling

Air rotary drilling, utilizing a Schram truck-mounted rig, was conducted at 9 locations within the proposed Phase 5 area. The air rotary boreholes were drilled solely for the purpose of piezometer installation in bedrock. Lithologic samples were collected continuously using a shovel to observe the cuttings blown from the bottom of the hole. Grain size of the cuttings was observed to be a function of the properties of the rock being drilled. Potable water was occasionally added to suppress drilling dust. Logs of the borings are presented in Appendix A.

Fractures or soft spots were noted during drilling by observing the drill rods and by listening to the drill chatter. Fractures were often indicated by the sudden drop of the drill rod and a pause in the chatter from the percussion bit. Coarser drill cuttings and/or clay were often noted in samples associated with fracture zone observations.

The bedrock boreholes typically targeted the first water-bearing zones appropriate for piezometer installation. Air lift yield aquifer tests were periodically performed as described below to determine whether groundwater had been encountered, and to estimate the groundwater yield. Upon reaching the desired depth of the blow test, the drill string was retracted 20 feet from the bottom of the hole. After waiting five to ten minutes, the string was lowered to the bottom of the hole and the on-board air compressor was used to blow air through the drill string at the bottom of the hole, blowing water up and out of the top of the borehole. After allowing a sufficient period to remove accumulated water from the hole and dry out any added water, the amount of water being discharged at the surface was noted. Water production varied from none, to a fine mist, to a stream of water flowing from the boring. The observed rate of water production is generally related to the amount of water yielded from the formation to the hole. The observed rate of water production can be also affected by the depth of immersion of the drill string into the water column, the amount of time the boring has been allowed to sit prior to blowing, and the length of time the blowing occurs. In some cases pressure from the air discharge can inhibit movement of water from the formation into the borehole, depending upon the location of the discharge interval relative to the drill bit.

The air rotary drilled boreholes were developed by blowing water out of the hole using the drill string placed at the bottom of the hole until the boring was substantially free of cuttings.

Often when a substantial fracture was encountered during drilling, water would be observed at the surface during the drilling operation. This was interpreted to indicate the presence a water-bearing feature such as fracture(s) or weathered zone, and the borehole would be terminated soon after.

Hollow-Stem Auger (HSA) Drilling
Hollow-stem auger drilling was conducted at all locations, including those at which air rotary drilling was performed, to obtain lithologic information. All hollow-stem auger borings were advanced to the top of the bedrock (auger refusal).

Hollow-stem auger drilling was done from an ATV-mounted CME 750 drill rig using 6-inch outer diameter augers. Lithologic information was obtained through split spoon sampling at 5-foot intervals as outlined in ASTM D-1586. Blow counts were noted during the driving of the split spoon sampler, and the sample was examined by the field geologist or geotechnical engineer and described for color, grain size, USCS code, texture, and moisture content. The field descriptions were entered into the field logbook or dedicated field log sheets. Hollow-stem auger borehole logs are provided in Appendix A. The depth of the first encountered blow count of 50 within a 6-inch interval was used to define the top of partially weathered rock (PWR), and the depth of auger refusal was used to define the top of bedrock.

Geotechnical samples collected during HSA drilling included jar samples and undisturbed (Shelby tubes) samples. Jar samples were collected by placing split spoon samples in glass jars. Jar samples were analyzed as described in Section 2.6. The laboratory results are discussed in Section 3.2 and the raw data is provided in Appendix B.

Undisturbed Shelby tubes were collected as specified in ASTM D-1587 by attaching an empty 2-foot long, 3-inch diameter galvanized steel tube to the drilling rods, lowering it to the bottom of the auger hole and hydraulically pushing the tube into the undisturbed formation below the borehole bottom. After the tube was retrieved, the ends were sealed with melted paraffin wax and capped. The sample tubes were maintained in an upright position and protected from shock and temperature extremes until delivered to the laboratory. Undisturbed Shelby tubes were analyzed as described in Section 2.6. The laboratory results are discussed in Section 3.2.4 and the data is provided in Appendix B.

Rock Coring
The CME 750 rig used for HSA drilling was also used for rock coring. One location, B-619d within the Phase 5 Area was cored. Conventional rock coring techniques were utilized as described below. An HQ size double tube core barrel was attached to the bottom of the drill rods and lowered to the bottom of the borehole. The desired coring interval was drilled using a carbide-toothed bit and clear, potable water. When the desired interval had been penetrated, the core barrel and drill rods were retrieved from the borehole. The core sample was then extruded and placed into a box labeled with the core ID and depth intervals.

The rock core was described in the field and the percent recovery, rock quality designation (RQD), orientation and frequency of fractures, observed fracture infilling or coatings, gross mineralogy, and other notable characteristics were recorded. The

RQD was determined by dividing the total length of rock fragment longer than four inches over the total length cored. Logs of the core borings are contained in Appendix A and described in Section 3.1.4.

2.2 Piezometer Installations

As discussed in Section 1.3, 9 piezometers were installed at 8 locations during the current investigation in the Phase 5 Area. The piezometer locations are shown on Sheet 1 along with those installed in and around the Phase 5 area during previous investigations. Table 1 provides a summary of piezometer completion data for the recently installed piezometers and piezometers installed during previous investigations that were relevant to the Phase 5 investigation.

All piezometers installed during this investigation were screened in bedrock, with the exception of B-619, which was installed across the bedrock/PWR boundary. Completion diagrams are provided along with the borehole logs in Appendix A. Piezometers installed in bedrock targeted the first significant water-bearing zone for completion, as indicated by the air-lift testing during air rotary drilling.

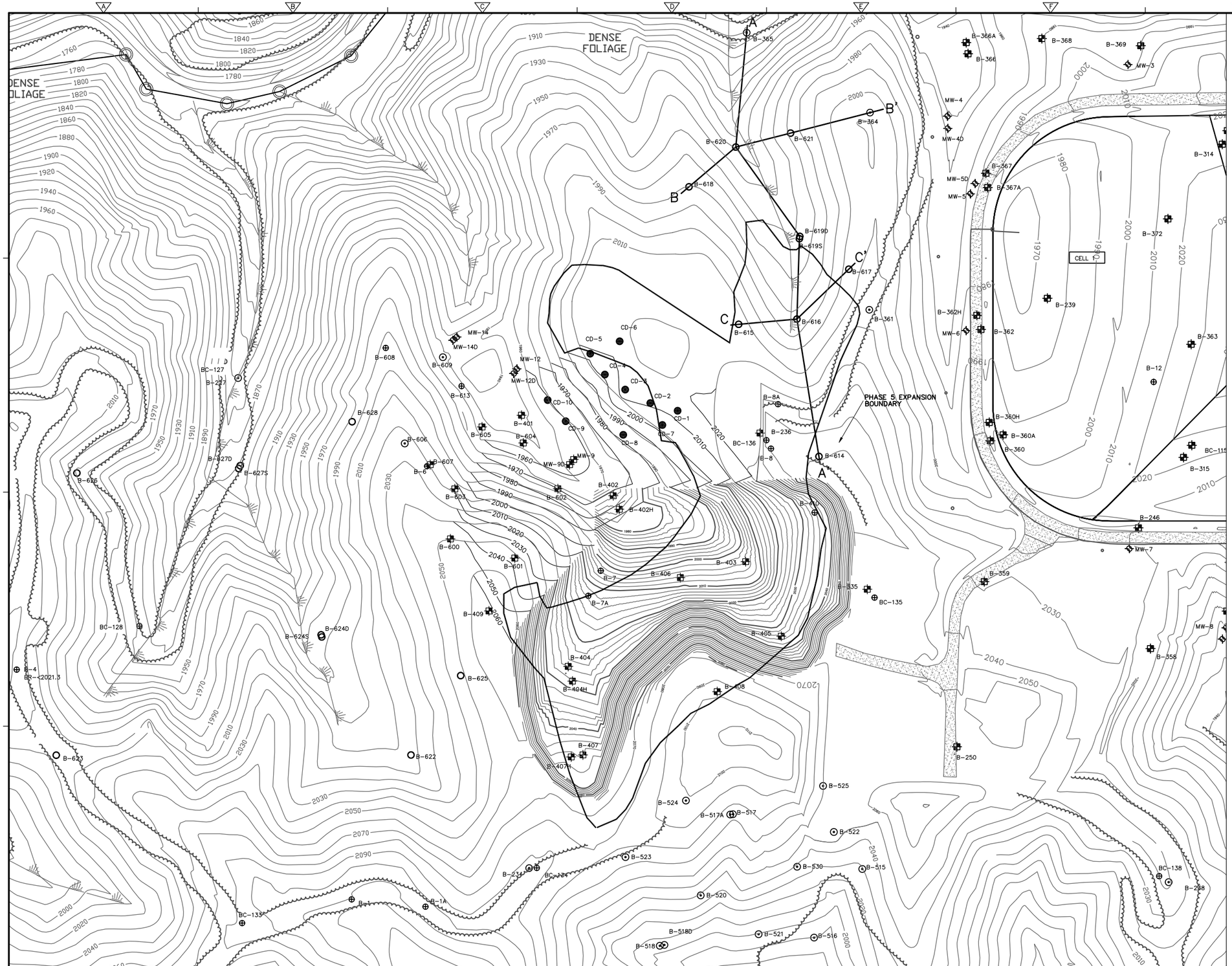
The piezometers were constructed of 2-inch diameter PVC casing, with a 10-foot, 0.010-inch slot PVC screen and bottom cap. A filter pack consisting of #2 silica sand was placed around the well screen to a minimum of 2 feet above the top of screen. The piezometer annulus above the filter pack was then sealed with a minimum of 2 feet of 3/8-inch hydrated bentonite pellets. The bentonite was allowed to set-up for at least several hours prior to grouting. The remainder of the annulus was then filled with a Portland cement/bentonite grout poured from the surface. Locking steel protective covers with a 3-foot by 3-foot concrete pad were installed over all piezometers.

2.3 Water Level Measurements

Water level measurements were taken using an electronic water level meter with an accuracy of 0.01 feet. Water level measurements were taken relative to the north side of the top of each PVC well casing (TOC = top of casing). Water levels were monitored both during and after the piezometer completion. Water levels were collected after piezometer completion, when possible, 24 hours after completion, and at least seven days after completion. Measurement of water levels at precise time periods after completion was not always possible due to conflicts with other drilling operations and the expedited nature of the field investigation. However, adequate measurements were taken for the purposes of the installation. Water level measurements are provided in presented in Section 3.3.1.

2.4 Piezometer Surveying

Ed Holmes and Associates, Inc. conducted the surveying. All of the newly installed piezometers were surveyed to the TOC measuring point and to ground surface. Northing and easting coordinates were reported in the State Plane coordinate system, and elevations were surveyed to mean sea level (msl).



LEGEND:

MW-2	MONITORING WELL
B-8	BOREHOLE
B-601	EXISTING PIEZOMETER
B-254	ABANDONED PIEZOMETER
CD-1	BOREHOLE INSTALLED MARCH 2002
B-622	PIEZOMETER INSTALLED JUNE 2008

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: D. FORBES
DRAWN BY: J. KILLINGSWORTH
SHEET CHK'D BY:
CROSS CHK'D BY:
APPROVED BY:
DATE: FEBRUARY 2009

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BUNCOMBE COUNTY
NORTH CAROLINA

C&D LANDFILL SUBSTANTIAL AMENDMENT
DESIGN HYDROGEOLOGIC INVESTIGATION

SITE MAP

PROJECT NO. 6447-65973
FILE NAME: Sheet 1.dwg
SHEET NO.
1

Table 1
Summary of Piezometer and Monitoring Well Completion Data
Buncombe County Construction and Demolition Landfill - Phase 5 Expansion
Design Hydrogeologic Investigation

Well	Completion Date	Drilling Method	Monitoring Interval Lithology	Top of PVC Elevation (feet msl)	Ground Surface Elevation (feet msl)	Borehole Depth (feet bgs)	Screen Interval (feet bgs)	Top of Sand (feet bgs)	Top of Seal (feet bgs)	Borehole Diam (inches)	Casing Diam (inches)
B-129	8/19/1992	Core	Bedrock	2015.06	2013.30	42.0	37.0-42.0	-	17.0	3.0	2.0
B-227	11/23/1993	Air	Bedrock	1853.80	1851.80	23.0	13.0-23.0	8.0	6.0	6.0	2.0
B-234	11/16/1993	Air	Bedrock	2094.66	2092.70	80.0	70.0-80.0	68.0	66.0	6.0	2.0
B-236	11/18/93	Air	Bedrock	2051.88	2049.98	61.0	46.0-61.0	44.0	42.0	6.0	2.0
B-238	11/16/1993	Air	Bedrock	2041.82	2041.40	144.0	129.0-144.0	127.0	125.0	6.0	2.0
B-250	11/16/93	Air	Bedrock	2076.23	2074.90	182.0	167-182	165.0	163.0	6.0	2.0
B-335	10/18/94	Air	Bedrock	2074.68	2071.60	101.0	91.0-101.0	85.0	83.0	6.0	2.0
B-361	10/18/94	Air	Bedrock	2018.19	2015.30	96.0	85.5-95.5	83.0	81.0	6.0	2.0
B-364	10/18/94	Air	Bedrock	2011.14	2008.40	100.0	90.0-100.0	86.5	84.0	6.0	2.0
B-365	10/26/94	Air	Bedrock	1872.89	1870.30	140.0	90.0-100.0	78.0	74.0	6.0	2.0
MW-4	10/10/1996	Air	Bedrock	1944.35	1942.48	25.0	9.0-24.0	7.0	5.0	8.0	2.0
MW-4d	10/11/1996	Air	Bedrock	1944.64	1942.79	55.0	45.0-55.0	43.0	40.0	6.0	2.0
MW-5	10/9/1996	Air	Bedrock	1977.12	1975.39	50.0	35.0-50.0	33.0	31.0	6.0	2.0
MW-5d	10/10/1996	Air	Bedrock	1976.92	1975.31	81.0	71.0-81.0	68.5	66.5	6.0	2.0
MW-6	10/8/1996	Air	Bedrock	1987.34	1985.39	50.0	35.0-50.0	27.0	24.5	6.0	2.0
MW-7	10/4/1996	Air	Bedrock	2022.83	2020.72	61.0	41.0-57.0	40.0	38.0	6.0	2.0
MW-9	10/9/1997	Air	Bedrock	1966.54	1963.70	25.8	10.8-25.8	8.0	6.0	6.0	2.0
MW-9d	10/9/1997	Air	Bedrock	1966.34	1963.60	39.5	34.5-39.5	31.5	29.0	6.0	2.0
MW-12	6/25/2002	Air	Saprolite/Bedrock	1947.39	1944.71	17.0	7.0-17.0	5.0	3.0	6.0	2.0
MW-12d	6/25/2002	Air	Bedrock	1947.10	1944.28	37.0	27.0-37.0	25.0	23.0	6.0	2.0
MW-14	4/5/2006	Air	PWR/Bedrock	1952.78	1949.8	49.0	39.0-49.0	35.5	33.0	6.0	2.0
MW-14d	4/5/2006	Air	Bedrock	1953.77	1950.5	88.0	78.0-88.0	74.5	71.5	6.0	2.0
B-401	3/13/1997	Air	Bedrock	1949.58	1947.90	16.0	11.0-16.0	9.5	7.5	6.0	2.0
B-402	3/13/1997	Air	Bedrock	1972.29	1970.04	17.5	12.5-17.5	10.5	8.5	6.0	2.0
B-402H	3/17/1997	HSA	Saprolite	1972.78	1970.42	10.5	5.0-10.0	3.0	1.5	8.0	2.0
B-403	3/13/1997	Air	Bedrock	2019.14	2016.48	30.0	25.0-30.0	23.0	21.0	6.0	2.0
B-404	3/12/1997	Air	Bedrock	2031.06	2028.50	20.0	15.0-20.0	13.0	11.0	6.0	2.0
B-404H	3/18/1997	HSA	Saprolite	2030.54	2028.50	13.5	5.0-11.0	3.0	1.5	8.0	2.0
B-405	3/12/1997	Air	Bedrock	2048.57	2045.49	37.0	27.0-37.0	24.0	22.0	6.0	2.0
B-406	3/13/1997	Air	Bedrock	2040.69	2037.00	76.0	66.0-76.0	64.0	62.0	6.0	2.0
B-407	3/13/1997	Air	Bedrock	2051.25	2048.53	39.0	29.0-39.0	26.0	24.0	6.0	2.0
B-407H	3/20/1997	HSA	Saprolite	2051.22	2048.03	15.0	10.0-15.0	8.0	6.0	8.0	2.0
B-408	3/11/1997	Air	Bedrock	2099.07	2096.43	94.0	84.0-94.0	77.0	75.0	6.0	2.0
B-409	3/11/1997	Air	Bedrock	2067.67	2065.36	60.0	50.0-60.0	47.5	45.5	6.0	2.0
B-515	4/29/1999	Air	Saprolite/Bedrock	2031.78	2028.40	31.5	21.5-31.5	19.5	17.5	6.0	2.0
B-516	5/3/1999	Air	Bedrock	1993.68	1990.74	25.6	15.6-25.6	13.6	11.6	6.0	2.0
B-517	5/4/1999	Air	Bedrock	2079.04	2076.16	70.0	60.0-70.0	58.0	56.0	6.0	2.0
B-517d	5/4/1999	Air	Bedrock	2078.80	2075.55	85.0	75.0-85.0	73.0	71.0	6.0	2.0
B-518	5/4/1999	Air	Saprolite/Bedrock	2005.54	2002.53	10.0	5.0-10.0	4.5	2.5	6.0	2.0
B-518d	10/10/2001	Air	Bedrock	2005.21	2002.49	25.0	15.0-25.0	14.0	12.0	6.0	2.0
B-519	5/3/1999	Air	Saprolite/Bedrock	1958.36	1955.54	10.5	5.5-10.5	4.5	2.5	6.0	2.0
B-519d	5/3/1999	Air	Bedrock	1959.11	1956.24	101.0	91.0-101.0	89.0	87.0	6.0	2.0
B-520	10/10/2001	Air	Bedrock	2044.17	2041.53	85.0	75.0-85.0	70.0	68.0	6.0	2.0
B-521	10/11/2001	Air	Bedrock	2005.18	2002.64	52.0	42.0-52.0	39.0	37.0	6.0	2.0
B-522	10/10/2001	Air	Bedrock	2058.81	2055.14	80.0	60.0-70.0	45.0	43.0	6.0	2.0
B-523	10/10/2001	Air	Bedrock	2080.42	2077.76	137.0	117.0-137.0	116.0	114.0	6.0	2.0
B-524	10/8/2001	Air	Bedrock	2101.58	2098.63	88.0	78.0-88.0	76.0	74.0	6.0	2.0
B-525	10/8/2001	Air	Bedrock	2061.44	2058.74	53.0	43.0-53.0	40.0	38.0	6.0	2.0
B-526	10/11/2001	Air	Bedrock	1972.51	1969.51	38.0	28.0-38.0	25.0	23.0	6.0	2.0
B-527	10/11/2001	Air	Bedrock	1976.56	1973.66	32.0	22.0-32.0	20.0	18.0	6.0	2.0
B-528	10/11/2001	Air	Bedrock	1950.28	1947.66	62.0	52.0-62.0	49.0	47.0	6.0	2.0
B-529	10/11/2001	Air	Bedrock	1962.31	1959.58	26.0	16.0-26.0	14.0	13.0	6.0	2.0
B-530	10/10/2001	Air	Bedrock	2045.01	2042.24	100.0	80.0-100.0	78.0	76.0	6.0	2.0

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Pumping Well	10/12/2001	Air	Bedrock	1955.22	1953.52	110.0	Open	--	--	6.0	6.0
B-600	9/27/2004	Air	Bedrock	2055.38	2052.74	65.0	55.0-65.0	47.0	44.0	6.0	2.0
B-601	9/27/2004	Air	Bedrock	2056.24	2053.61	117.0	107.0-117.0	102.0	97.0	6.0	2.0
B-602	10/5/2004	Air	Bedrock	1978.36	1975.52	46.0	36.0-46.0	33.0	30.0	6.0	2.0
B-603	10/5/2004	Air	Bedrock	2013.61	2010.97	80.0	70.0-80.0	67.0	64.0	6.0	2.0
B-605	10/6/2004	Air	Saprolite/Bedrock	1956.65	1953.98	26.0	16.0-26.0	13.0	10.0	6.0	2.0
B-606	10/6/2004	Air	Bedrock	2027.09	2024.28	75.0	65.0-75.0	62.0	59.0	6.0	2.0
B-609	10/6/2004	Air	Bedrock	1955.19	1952.18	80.0	70.0-80.0	68.0	65.0	6.0	2.0
B-614	6/10/2008	Air	Bedrock	2047.20	2043.80	42.0	32.0-42.0	30.0	28.0	6.0	2.0
B-615	6/12/2008	Air	Bedrock	2023.40	2021.60	51.0	41.0-51.0	40.0	38.0	6.0	2.0
B-616	6/11/2008	Air	Bedrock	1984.90	1981.50	31.0	21.0-31.0	20.5	18.5	6.0	2.0
B-617	6/12/2008	Air	Bedrock	2008.70	2005.40	61.0	51.0-61.0	49.0	47.0	6.0	2.0
B-618	6/12/2008	Air	Bedrock	1987.20	1985.50	50.0	40.0-50.0	38.5	36.5	6.0	2.0
B-619	6/10/2008	Air	Saprolite/PWR	1965.70	1963.50	14.0	4.0-14.0	3.5	2.0	6.0	2.0
B-619d	6/10/2008	Air	Bedrock	1966.70	1963.40	30.0	20.0-30.0	17.0	15.0	6.0	2.0
B-620	6/11/2008	Air	Bedrock	1940.90	1937.90	51.5	41.5-51.5	41.0	39.0	6.0	2.0
B-621	6/11/2008	Air	Bedrock	1975.80	1972.50	45.0	35.0-45.0	34.0	32.0	6.0	2.0
B-622	6/18/2008	Air	Bedrock	2006.40	2003.10	46.0	36.0-46.0	34.0	32.0	6.0	2.0
B-623	6/13/2008	Air	Bedrock	2027.40	2025.20	99.0	89.0-99.0	88.0	86.0	6.0	2.0
B-624	6/18/2008	Air	Saprolite/Bedrock	1980.50	1977.20	20.0	10.0-20.0	8.0	6.0	6.0	2.0
B-624d	6/18/2008	Air	Bedrock	1980.40	1977.10	40.0	30.0-40.0	28.0	26.0	6.0	2.0
B-625	6/13/2008	Air	Bedrock	2054.40	2051.90	62.0	52.0-62.0	51.5	49.5	6.0	2.0
B-626	6/17/2008	Air	Bedrock	1981.30	1979.70	57.0	47.0-57.0	45.0	43.0	6.0	2.0
B-627	6/17/2008	Air	PWR/Bedrock	1883.00	1880.10	18.0	8.0-18.0	11.0	9.0	6.0	2.0
B-627d	6/17/2008	Air	Bedrock	1882.80	1880.30	124.0	114.0-124.0	112.0	110.0	6.0	2.0
B-628	6/12/2008	Air	Bedrock	1990.30	1987.90	63.5	53.5-63.5	52.0	50.0	6.0	2.0

Notes:

Piezometers in bold located in proposed Phase 5 expansion area during current or previous investigations.

Piezometers in italics have been abandoned during previous construction/investigation activities.

--Pumping Well is located in former Phase III area and is completed with 6-inch PVC casing from 0 - 20 ft. bls, and open hole in bedrock from 20 - 110 ft. bls.

2.5 Slug Tests

Slug testing was performed on three newly installed piezometers within the Phase 5 area (B-615, B-617, B-619d). Both slug-in (displacement) and slug-out (recovery) tests were conducted at each piezometer using a stainless steel solid slug and a transducer/data logger. The transducer/data logger was lowered to approximately 10 to 15 feet below the water level in the piezometer, taped into place, and a reference water level was collected. Immediately after starting the data logger, the slug was lowered to approximately 1.5 feet below the water surface and taped into place. The data logger was then monitored until water levels stabilized. The data logger was then re-started for the slug-out test and the slug was immediately withdrawn from the piezometer. The data logger was monitored until the water level stabilized.

The data was then analyzed using the Bouwer and Rice method (Bouwer, 1989) to estimate horizontal hydraulic conductivity. Slug test results are discussed in Section 3.3.

2.6 Geotechnical Testing

Undisturbed Shelby tube, jar samples and bulk samples collected during this investigation were analyzed for various geotechnical properties by Geotechnics geotechnical laboratory in Raleigh, North Carolina. The testing program consisted of analyses for grain size distribution, soil classification, Atterberg limits, porosity and in-situ and remolded hydraulic conductivity. Laboratory geotechnical data from the samples collected during this investigation in the Phase 5 area are presented in Appendix B. Geotechnical data for samples collected during this investigation is discussed in Section 3.2.

3 Current Investigation Results

This section presents the results of the Phase 5 area investigation which included borehole drilling, rock coring, geotechnical testing, piezometer installations, water level measurements, and aquifer characterization (slug testing). The regional geology and hydrogeology have been previously discussed (CDM 1995, 2004), and, therefore, will not be re-iterated in this report. The site geology and geotechnical results are discussed in Section 3.1. Laboratory testing results are discussed in Section 3.2. The site hydrogeology is evaluated in detail in Section 3.3 and includes water level results, potentiometric surface mapping, and slug test analysis. Section 3.4 presents a hydrogeologic conceptual model for the site with hydrogeologic cross sections and discussions on groundwater recharge and discharge.

3.1 Site Geology

The Buncombe County landfill site area has been preliminarily mapped by the North Carolina Geological Survey (Wiener 1970). This mapping shows that the site is underlain to a large degree by granite gneiss and biotite gneiss. The North Carolina Geological Survey did not differentiate a part of the central portion of the proposed

landfill site during this mapping effort. Exploratory drilling in this area has shown it to also be underlain by gneiss. Marble and calc-silicate units have been mapped in a small area near the French Broad River along the southern boundary of the site. Each of these materials was observed in outcrop during reconnaissance at the site (CDM 1993). A narrow band of calc-silicate rock was also mapped within the vicinity of the C&D Landfill although current and past field investigations did not confirmed this. If present, this unit likely consists of small compositional distinctions relative to adjacent materials. Exploratory activities in this portion of the site have not identified any significant differences in engineering and hydrologic properties that could be associated with this unit relative to the surrounding gneiss. A small east-west trending diorite dike was mapped along the bottom of Blevin Branch just north of the east half of the Cell 1-3 Area. This structure is truncated by a younger granite gneiss unit that comprises much of the bedrock underlying the proposed landfill site. This infers that this unit was not emplaced along a zone of recent structural weakness. The reported dike location lies beyond the limits of any proposed landfill development, and diorite intrusions were not observed in any of the exploratory borings at the site.

In late November 1998, CDM contracted Gram, Inc. to further characterize the geologically complex west/northwest portion of the landfill. The results of the Gram geologic mapping were provided in the Permit Amendment Application Cells 4 and 5 – Design Hydrogeologic Report (CDM February 2000). The study concentrated on the two large road-cut outcrops exposed along the east-west trending entrance road to the landfill at the northern margin and in the exposed bedrock within the Phase I and II C&D area.

The Gram mapping made four major conclusions. First, the bedrock exposed at the road-cut and within the C&D landfill is dominated by migmatitic biotite hornblende gneiss that is interlayered with amphibolite. This common Blue Ridge sequence is present over an area tens of miles in length and width (Merschat and Wiener 1990). Second, a metamorphic isograd was not present at the landfill and the different lithologies observed (interlayered gneiss and amphibolite) result from chemical differences between the parent rocks. A metamorphic isograd requires the identification of specific index minerals, and the formation of these index minerals requires more silica and aluminum (and water during metamorphism) than is present in the rocks at the landfill. Third, the fractured bedrock at the landfill occurred following metamorphism (approximately 1 billion years ago) as a result of tectonics. The dominant direction of fracturing is N30E to N60E, 70 to 90 degrees SE and the uniformity of fracture directions through the bedrock suggest a consistent set of pathways for groundwater movement (i.e., fractures are secondary permeability for groundwater movement). And fourth, although several possible faults were observed in one outcrop along the landfill entrance, they are likely of limited displacement and extent and were not observed within the landfill. According to Gram, Inc., “these possible faults provide no evidence of enhanced porosity from dissolution or brecciated material and are expected to be equivalent to fractures in the bedrock.”

During this investigation, it was determined that the dominant lithology in the area is migmatic biotite hornblende gneiss. Layers of amphibolite were found with the gneiss as dikes or small pods within the gneiss. Although present in the area, no calc-silicate rocks, granitic rocks, meta-sedimentary rocks, or marble were observed in the road cut or exposures at the C&D site (GRAM, 1999).

Structural Geology

Foliation attitude measurements were collected during the 1970 mapping effort and supplemented during the 1993 field reconnaissance and 1998 field mapping. They indicate that foliation generally strikes between N 0° and N 40° east and dips 60° to 90° southeasterly. This generally coincides with the dominant structural fabric inferred by the regional mapping. Variations from the normal foliation orientation were observed in small areas of outcrop throughout the site, and appear to be related to localized deformation associated with the metamorphism of the rock mass or disturbance of the observation area by mass wasting.

Photolineament trends at the site and adjacent areas compiled from aerial photographs (CDM 1993) identified three prominent lineament directions. One direction trends N 10° to 30° east and is believed to be associated with the dominant structural fabric of the region as well as foliation of the rock mass. Most of the photolineaments within the site also appeared to be associated with the first pattern. The other lineament trends are east west and North 52° west.

Measurements of fracture orientations were also recorded from observed outcroppings during reconnaissance of the site (CDM 1993) and during the additional geologic investigation (GRAM, 1999). Analysis of these measurements indicated two major trends to be present at the site. These are North 50° east and North 15° west. Secondary sets of fracturing range from North 35° west to North 85° west. A strong association between the orientation of fractures and foliation was not apparent in the outcrops.

Possible faulting was observed along the road cut at the entrance road. This faulting is representative of post-tectonic movement. The possible faults are likely of limited displacement extent, and were not observed within the C&D area (GRAM, 1999).

A very low frequency (VLF) electromagnetic geophysical survey was also conducted at the Site (CDM 1993) for the purpose of identifying anomalous conductive features, which could represent zones of preferential groundwater occurrence and/or movement. Specifically, many of the photolineaments described above were evaluated by the survey. The survey identified nine features of potential interest at depths of 30 to 50 meters (98 to 164 feet). Many of these features as well as the photolineaments were targeted by exploratory borings drilled during the subsequent investigations.

Drilling Observations
Three major lithologic distinctions have been made at the C&D Landfill expansion area based on observations from the subsurface investigations. These are saprolite, partially weathered rock (PWR), and bedrock. In addition, small localized areas of alluvium or colluvium were encountered near the drainage features. Descriptions of each material encountered at specific boring locations are provided in the boring logs contained in Appendix A. Each of these units is discussed in the following sections of the report. Table 2 lists all of the borings drilled at the C&D Landfill and the depths at which the above geologic units were encountered.

3.1.1 Alluvium

Alluvium was present in small localized areas within or adjacent to the drainage features. Where present, the alluvium was found to be of limited thickness and overlaid PWR or bedrock. The alluvium ranged in grain size from clayey silt to poorly sorted sands.

3.1.2 Saprolite

Saprolite (saprolitic soils) is the uppermost unit present at the site and is present at most locations except small areas where bedrock outcrops at the ground surface or depth to bedrock is shallow and within most surface drainage features where the PWR or alluvium is the uppermost unit. These soils are derived from the in-place chemical weathering of bedrock materials, and are characterized by the presence of relict mineral fabric from the original rock mass. These soils are typically finer near the surface where weathering is more advanced, and become more dense and coarser in texture as weathering decreases with depth.

Near the surface, they are generally comprised of fine sandy silt, or sandy silt with clay, with silty clay or silty sand present at some locations. They grade to silty sand or very sandy silt with depth. Hard rock fragments are commonly present in this lower portion of the saprolite, which become larger and more frequent with depth. The contact with the underlying partially weathered rock (PWR) or bedrock is typically gradational. These soils are typically red/brown or light to dark brown in color and usually micaceous with some areas being very micaceous. Locally grey, dark grey or green/grey colors are present, and appear to correlate with an abundance of mafic minerals in the rock mass from which they were derived. Thin zones of light brown or orange/tan lean clay are also present locally. For the purposes of this investigation, the base of the saprolite unit has been defined as the depth at which soil penetration using a split spoon sampler is greater than 50 blows per 6 inches. This definition is used to permit consistent identification of the saprolite/PWR contact.

Table 2
Summary of Lithological Data
Buncombe County Construction and Demolition Landfill - Phase 5 Expansion
Design Hydrogeologic Investigation

Borehole	Surveyed Ground Surface Elevation (feet msl)	Depth to PWR (feet bgs)	PWR Elevation (feet msl)	Depth to Bedrock (feet bgs)	Bedrock Elevation (feet msl)
CD-1	2021.49	4.0	2017.5	13.0	2008.5
CD-2	2021.95	3.5	2018.5	16.0	2006.0
CD-3	2017.54	3.5	2014.0	8.5	2009.0
CD-4	2015.95	9.0	2007.0	20.0	1996.0
CD-5	2015.55	4.0	2011.6	18.5	1997.1
CD-6	2015.40	3.5	2011.9	12.0	2003.4
CD-7	2011.85	8.5	2003.4	13.0	1998.9
CD-8	1996.27	4.5	1991.8	19.0	1977.3
CD-9	1969.61	8.5	1961.1	17.0	1952.6
CD-10	1968.48	8.5	1960.0	12.0	1956.5
B-1	2090.0	19.0	2071.0	19.0	2071.0
B-1A	2070.0	16.0	2054.0	25.0	2045.0
B-4	2040.0	12.0	2028.0	18.7	2021.3
B-5	1895.0	3.0	1892.0	8.0	1887.0
B-5A	1900.0	6.0	1894.0	10.0	1890.0
B-6	2020.0	28.0	1992.0	33.6	1986.4
B-7	2000.0	3.0	1997.0	6.0	1994.0
B-7A	2010.0	3.0	2007.0	6.0	2004.0
B-8	ND	12.0	2037.0	25.0	2024.0
B-8A	ND	8.0	2033.0	21.0	2020.0
BC-127	1851.8	10.0	1841.8	12.0	1839.8
B-227	-	-	-	-	-
BC-128	1942.2	10.0	1932.2	16.5	1925.7
BC-129	2013.3	15.0	1998.3	22.0	1991.3
BC-133	2092.5	9.0	2083.5	22.5	2070.0
BC-134	2092.7	35.0	2057.7	38.0	2054.7
B-234	-	-	-	-	-
BC-135	ND	15.0	2057.0	17.5	2054.5
B-335	0.0	-	-	-	-
BC-136	ND	10.0	2040.0	20.5	2029.5
B-236	2050.0	-	-	-	-
BC-137	1922.0	3.0	1919.0	9.0	1913.0
B-138	2041.4	25.0	2016.4	69.0	1972.4
B-238		-	-	-	-
B-250	2074.9	51.5	2023.4	51.5	2023.4
B-358	1956.6	5.0	1951.6	10.0	1946.6
B-359	2045.5	36.0	2009.5	45.0	2000.5
B-360H	1974.4	11.0	1963.4	14.0	1960.4
B-360	1977.5	-	-	-	-
B-360A	1977.1	-	-	-	-
B-361	2015.3	13.0	2002.3	27.0	1988.3
B-362H	1956.7	11.0	1945.7	21.0	1935.7
B-362	1959.0	-	-	-	-
B-364	2008.4	3.0	2005.4	15.5	1992.9
B-365	1870.3	4.0	1866.3	5.0	1865.3
B-366	1929.9	-	-	-	-
B-366A	1930.8	3.0	1927.8	5.5	1925.3
B-367	1943.9	9.0	1934.9	11.5	1932.4
B-367A	1944.6				

Table 2
Summary of Lithological Data
Buncombe County Construction and Demolition Landfill - Phase 5 Expansion
Design Hydrogeologic Investigation

Borehole	Surveyed Ground Surface Elevation (feet msl)	Depth to PWR (feet bgs)	PWR Elevation (feet msl)	Depth to Bedrock (feet bgs)	Bedrock Elevation (feet msl)
B-401	1947.5	4.5	1943.0	5.5	1942.0
B-402	1970.4	3.5	1966.9	10.5	1959.9
B-403	2016.4	12.0	2004.4	22.5	1993.9
B-404	2028.3	8.0	2020.3	13.5	2014.8
B-405	2045.5	16.0	2029.5	22.5	2023.0
B-406	2037.0	18.5	2018.5	39.5	1997.5
B-407	2048.0	18.0	2030.0	30.0	2018.0
B-408	2096.4	38.0	2058.4	47.0	2049.4
B-409	2065.4	9.0	2056.4	15.5	2049.9
B-410	2048.9	19.0	2029.9	26.0	2022.9
MW-9/9d	1963.3	3.5	1959.8	9.5	1953.8
MW-12/12d	1947.4	5.0	1942.4	15.0	1932.4
MW-14/14d	1950.7	25.0	1925.7	33.0	1917.7
B-515	2028.4	14.0	2014.4	22.5	2005.9
B-516	1990.7	3.5	1987.2	8.0	1982.7
B-517	2076.2	33.5	2042.7	38.0	2038.2
B-517d	2075.6	33.5	2042.1	38.0	2037.6
B-518	2002.5	8.5	1994.0	10.0	1992.5
B-518d	2002.5	8.5	1994.0	10.0	1992.5
B-519	1955.5	8.5	1947.0	9.0	1946.5
B-519d	1956.2	8.5	1947.7	9.0	1947.2
B-520	2041.5	8.5	2033.0	15.0	2026.5
B-521	2002.6	3.5	1999.1	8.5	1994.1
B-522	2055.1	10.0	2045.1	17.0	2038.1
B-523	2077.8	13.5	2064.3	18.5	2059.3
B-524	2098.6	14.5	2084.1	61.0	2037.6
B-525	2058.7	9.5	2049.2	23.5	2035.2
B-526	1969.5	3.5	1966.0	4.0	1965.5
B-527	1973.7	19.0	1954.7	23.0	1950.7
B-528	1947.7	7.5	1940.2	8.0	1939.7
B-529	1959.6	3.5	1956.1	5.0	1954.6
B-530	2042.2	4.0	2038.2	6.5	2035.7
B-600	2052.7	13.5	2039.2	21.0	2031.7
B-601	2053.6	4.0	2049.6	20.0	2033.6
B-602	1975.5	9.0	1966.5	10.5	1965.0
B-603	2011.0	9.0	2002.0	19.0	1992.0
B-604	1955.2	4.5	1950.7	5.5	1949.7
B-605	1954.0	12.0	1942.0	13.0	1941.0
B-606	2024.3	0.0	2024.3	23.0	2001.3
B-607	2019.4	0.0	2019.4	6.0	2013.4
B-608	1991.7	4.0	1987.7	17.0	1974.7
B-609	1952.2	9.0	1943.2	11.5	1940.7
B-613	1951.7	3.5	1948.2	12.5	1939.2
B-614	2043.8	8.5	2035.3	11.5	2032.3
B-615	2021.6	19.0	2002.6	21.5	2000.1
B-616	1981.5	10.0	1971.5	12.0	1969.5
B-617	2005.4	5.5	1999.9	13.5	1991.9
B-618	1985.5	19.0	1966.5	29.0	1956.5
B-619	1963.5	13.0	1950.5	14.5	1949.0
B-619d	1963.4	13.0	1950.4	14.5	1948.9
B-620	1937.9	0.0	1937.9	3.5	1934.4

Table 2
Summary of Lithological Data
Buncombe County Construction and Demolition Landfill - Phase 5 Expansion
Design Hydrogeologic Investigation

Borehole	Surveyed Ground Surface Elevation (feet msl)	Depth to PWR (feet bgs)	PWR Elevation (feet msl)	Depth to Bedrock (feet bgs)	Bedrock Elevation (feet msl)
B-621	1972.5	5.0	1967.5	11.5	1961.0
B-622	2003.1	9.0	1994.1	12.0	1991.1
B-623	2025.2	19.5	2005.7	29.5	1995.7
B-624	1977.2	4.5	1972.7	9.5	1967.7
B-624d	1977.1	4.5	1972.6	9.5	1967.6
B-625	2051.9	4.5	2047.4	7.5	2044.4
B-626	1979.7	0.0	1979.7	7.5	1972.2
B-627	1880.1	9.5	1870.6	11.0	1869.1
B-627d	1880.3	9.5	1870.8	11.0	1869.3
B-628	1987.9	4.5	1983.4	11.5	1976.4

ND = Not Determined
Depth to bedrock defined by auger refusal.
PWR = Partially weathered rock, determined by a blow count of 50 for 6 inches.
Boreholes in bold installed in proposed Phase 5 expansion area.

Across the entire C&D Landfill area, saprolite was observed to range in thickness from not present at borings B-606, -607, -620, -and -626 to greater than 51.5 feet at B-250, and averaged about 11 feet. The unit was generally thicker beneath hills and ridges than side slopes or drainages. Within the proposed Phase 5 C&D area, the saprolite ranges from not present (B-620) to 19 feet in thickness (B-615 and -618) and averages about 9 feet in thickness. The saprolitic soils were typically moist but none were observed to be saturated.

3.1.3 Partially Weathered Rock

At most locations, the saprolite transitionally grades in to the parent bedrock from which it is derived. This transition zone has been designated the PWR unit. It is characterized by deeply weathered bedrock material that can be penetrated by hollow-stem augers but requires more than 50 blows to advance a split spoon sampler 6 inches. The PWR consists of reddish brown, brown, white, or yellow/orange silty sand with some intervals of sandy silt. Hard, but weathered, rock fragments were also present at many locations. Local areas of tan to cream coloration are also present as well as grey/green materials derived from mafic rich rocks.

Within the proposed Phase 5 C&D Landfill expansion, the PWR unit ranged from 1.5 feet (B-619) to 10 feet (B-618) and averaged about 5 feet in thickness. Overall, PWR thickness across the entire Buncombe County site ranges from absent where alluvium, colluviums or saprolite directly overlies bedrock to more than 44 feet, but within the existing and proposed expansion areas of the C&D landfill, the average PWR thickness is around 6 feet.

The PWR was observed to be dry or only slightly moist at most locations. Saturated conditions were observed in the PWR at only one location (B-619) within the proposed expansion area.

3.1.4 Bedrock

Bedrock beneath the entire site consists of foliated and banded hornblende biotite (undifferentiated) gneiss and granitic gneiss and, to a lesser extent, amphibolite and biotite or quartz biotite schist. The undifferentiated gneiss is light grey in color where unweathered, and generally comprises 60 to 95 percent of the rock mass. The more mafic foliation planes and bands consist of hornblende or other amphibole minerals and/or biotite, are dark grey/green to black in color, and are generally more strongly foliated, especially where biotite is prevalent. Locally, these minerals compose most of the rock mass, and are only interbanded with granitic minerals. Accessory minerals consist of pyroxenes, pyrite, and quartz. Quartz veins are also indicated by the presence of white quartz float on the ground surface at some locations and were occasionally observed in some of the exploratory borings. The quartz was sometimes observed to contain vugs (cavities) and exhibit the familiar crystalline structure.

Weathering in the bedrock is highly variable and generally decreases with depth. However, at many locations, some zones are completely decomposed to soil-like

materials similar to those described for the PWR unit, but occur within or beneath intervals of more competent material. Similarly, engineering and hydrologic properties (i.e., porosity) are likely similar in these intervals as those within the PWR unit.

Observations from the rock cores collected during the current investigation from borings B-619d, B-623, and B-627d generally showed a moderate to highly fractured top 5 to 10 feet of bedrock that becomes increasingly competent with depth. Recovery values ranged from 40 to 100 percent and Rock Quality Designation (RQD) values ranged from 10 to 85 percent in the expansion area.

Observations from core samples collected during this and previous investigations in both the C&D and Subtitle D landfill areas indicate that the bedrock is variably fractured. RQD values of the recovered cores ranged from 0 percent up to 100 percent, and averaged 47 percent and recovery values ranged from 0 percent to 100 percent and averaged 68 percent. In general, recovery and RQD values increased with depth. A summary of the rock core observations from the entire site is presented in Table 3.

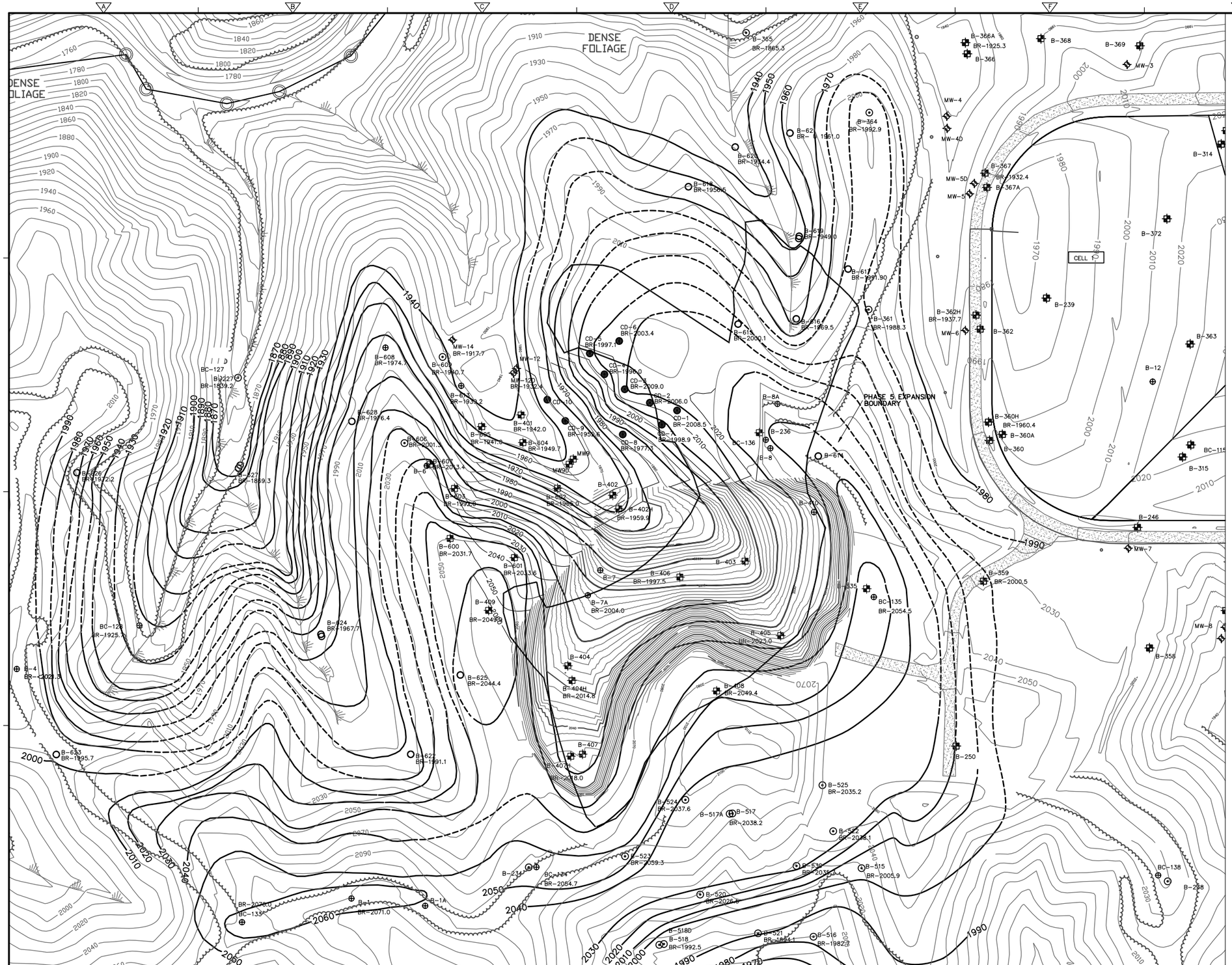
Based on observation of the cores, a conservative effective porosity of about 1 to 5 percent has been estimated for the competent bedrock material. This estimated effective porosity is higher than the 0.1 percent value estimated by Heath (1980) for bedrock aquifers in granite gneiss in the Blue Ridge Province. Fracture density in bedrock generally decreases with depth. Site estimates were made from shallow bedrock cores, and Heath's estimate was for bedrock aquifer systems as a whole, therefore the Site estimate for effective porosity is correspondingly higher than Heath's 0.1 percent value.

Although oxidation was frequently observed to parallel foliation planes, fractures were not generally observed to be closely oriented with the foliation, except in the upper portion of the core. This is consistent with fracture orientation measurements made in surface outcroppings as previously discussed (CDM 1993, GRAM 1999). The fractures were mostly open and oxidized. Some were filled with orange clay.

Depth from the ground surface to the top of the bedrock unit within the proposed Phase 5 C&D Landfill expansion area ranged from 3.5 feet in B-620 up to 29 feet in B-618. The average bedrock depth was approximately 15 feet over the proposed Landfill expansion area. The depth to bedrock is generally shallow in drainage features, and deeper beneath upland areas. Sheet 2 is a contour map of the bedrock surface developed from depth to bedrock measurements observed in the exploratory borings drilled throughout the proposed C&D landfill expansion site from this and previous investigations. It shows that the bedrock surface over most of the C&D Landfill area is a subdued reflection of surficial topography.

Table 3
Summary of Rock Core Observations
Buncombe County Construction and Demolition Landfill - Phase 5 Expansion
Design Hydrogeologic Investigation

Boring	Core Run Depth (feet)	Recovery (%)	RQD (%)	Material Description
Cell 3 (Subtitle D Landfill)				
B-314C	33.5-37.5	85	42	Granite (Undifferentiated) Gneiss, soft, weathered
	37.5-47.0	99	94	Granite (Undifferentiated) Gneiss
Cell 4 (Subtitle D Landfill)				
BC-107A	56.4-61.4	15	0	Biotite Quartz Schist
	61.4-66.4	20	0	Biotite Quartz Schist
	66.4-71.4	25	0	66.4-67.5 - Biotite Quartz Schist, 67.5-71.4 - Amphibolite
	71.4-46.4	15	0	Biotite Quartz Schist
B-503B	48.5-53.5	58	40	Undifferentiated Gneiss, w/bioite, feldspar, and some quartz, migmatic, very fractured to 58.5'
	53.5-58.5	98	23.7	Undifferentiated Gneiss
	58.5-63.5	100	90	Undifferentiated Gneiss
	63.5-68.5	100	70	Undifferentiated Gneiss
Cell 5 (Subtitle D Landfill)				
B-514B	18-20	85	37	Undifferentiated Gneiss, w/bioite, horneblend, feldspar, and some quartz
	20-25	87	81	Undifferentiated Gneiss
	25-30	98	86	Undifferentiated Gneiss
	30-35	93	59	Undifferentiated Gneiss
	35-38	67	46	Undifferentiated Gneiss
Cell 6 (Subtitle D Landfill)				
B-702	30-40	94		Granitic Gneiss with biotite, feldspar, and quartz. Small quartz veins (~6") at 31.5' and 35.5'.
B-704	39-49	46		Granitic Gneiss with biotite, feldspar, and quartz. Soft, very fractured.
B-707	19-29	83		Granititc Gneiss with biotite, feldspar, and quartz. Increasing RQD with depth
C&D Landfill Phase 1 and 2				
MW-9/9d	9.5-19.5	57	39	Undifferentiated Gneiss, w/ biotite, quartz, and feldspar (granitic texture)
	19.5-24.5	35	7	Undifferentiated Gneiss, w/ biotite, and hornblende
	24.5-29.5	90	74	Undifferentiated Gneiss w/ biotite, horneblende, some plagioclase
C&D Landfill Expansion Phase 3				
B-519d	9.0-14.0	37	25	Undifferentiated Gneiss, w/ plagioclase (60%), quartz (20%), and biotite (20%), trace hornblende
	14-19	100	100	Undifferentiated Gneiss, w/ biotite (10-20%), and hornblende (<10%), pyrite @ 17.8'
	19-24	100	100	Undifferentiated Gneiss
	24-29	100	77	Undifferentiated Gneiss, migmatic, distinct foliation
B-521	8.5-18.5	67	55	Fractured, Undifferentiated Gneiss
B-530	6.5-16.5	28	27	Very Fractured, Undifferentiated Gneiss
	16.5-21.5	27	31	Very Fractured, Undifferentiated Gneiss
C&D Landfill Expansion Phase 4				
B-601	20-30	30	4	Very Fractured, Undifferentiated Gneiss w/ biotite, quartz, and feldspar (granitic texture)
C&D Landfill Expansion Phase 5				
B-619d	15.5-20.5	88	56	Moderately fractured, foliated, horizontal to moderate dipping, Undifferentiated Gneiss (granitic texture)
	20.5-25.5	95	85	Slightly fractured, foliated, horizontal to moderate dipping, Undifferentiated Gneiss (granitic texture)
B-623	31.5-36.5	40	10	Very fractured, foliated, horizontal to moderate dipping, Undifferentiated Gneiss (quartz/biotite)
	36.5-41.5	68	37	Very fractured, foliated, horizontal to moderate dipping, Undifferentiated Gneiss (quartz/biotite)
B-627d	11.5-16.5	100	60	Moderately fractured, Undifferentiated Gneiss (quartz/feldspar/hornblende/mica). Granitic texture.
	16.5-21.5	80	72	Slightly fractured, foliated, Undifferentiated Gneiss (quartz/feldspar/hornblende/mica). Granitic texture



LEGEND:

MW-2	MONITORING WELL
B-8	BOREHOLE
B-601	EXISTING PIEZOMETER
B-254	ABANDONED PIEZOMETER
BR-1953.74	BEDROCK ELEVATION (DEFINED AS DEPTH TO AUGER REFUSAL)
CD-1	BOREHOLE INSTALLED MARCH 2002
B-622	PIEZOMETER INSTALLED JUNE 2008

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: D. FORBES
DRAWN BY: J. KILLINGSWORTH
SHEET CHK'D BY:
CROSS CHK'D BY:
APPROVED BY:
DATE: FEBRUARY 2009

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BUNCOMBE COUNTY
NORTH CAROLINA

C&D LANDFILL SUBSTANTIAL AMENDMENT
DESIGN HYDROGEOLOGIC INVESTIGATION

BEDROCK CONTOUR MAP

PROJECT NO. 6447-65973
FILE NAME: Sheet 2.dwg

SHEET NO.
2

3.2 Testing Program

Table 4 summarizes the results of the geotechnical testing performed on samples in and around the proposed Phase 5 C&D area during this and previous investigations. The following sections discuss Standard Penetration (SPT), particle size, soil classification (USCS), formation descriptions, and saturated hydraulic conductivity, porosity, effective porosity, and dispersive characteristics for each unit of the uppermost aquifer at the expansion site.

3.2.1 Standard Penetration Testing

Standard Penetration Testing (SPT), in accordance with ASTM Standard D1586, was conducted at all boring locations during this investigation. SPT's were conducted over 2-foot intervals, typically every 5-feet from ground surface to the termination of the boring. Blow counts were recorded for every 6-inches and recorded. In addition to SPT's, pocket penetrometer or Torvane readings were collected on select intervals in boring B-616. The split spoon sample was placed in a sealed glass jar and labeled by boring number, sample number, depth interval, and blow count. Blow counts and pocket penetrometer or Torvane readings (where applicable) are presented on the boring logs in Appendix A.

3.2.2 Particle Size Analysis and Unified Soil Classification

Within the proposed Phase 5 area, 11 split-spoon, 4 Shelby Tube and 2 bulk samples were submitted for laboratory analysis for grain size, USCS classification, natural moisture content, and Atterberg limits. USCS classifications ranged from CL in B-619 (4-5) to SM in all but 4 samples. Natural moisture content values ranged from 4.5% in B-617 (8.5-10) to 16.2% in B-619 (4-5).

A summary of the geotechnical laboratory results is provided on Table 4. Copies of the laboratory data for the samples collected from the Phase 5 area during the current investigation are provided in Appendix B.

3.2.3 Formation Descriptions

Formation descriptions were made in the field during drilling by an on-site geologist or geotechnical engineer. Formation descriptions were made according to moisture content, consistency, color, and grain size. Alterations to the field descriptions, where necessary, were made according to the geotechnical laboratory results. Boring logs are provided in Appendix A. Copies of the field notes for the current investigation are provided in Appendix C.

Table 4
Summary of Geotechnical Testing Results
Buncombe County Construction and Demolition Landfill - Phase 5 Expansion
Design Hydrogeologic Investigation

Boring No.	Depth (feet)	Lithology	Sample Type	USCS Classification	Natural Moisture Content	Volume Percent Water	Porosity (%)	Effective Porosity (%)	Undisturbed Hydraulic Conductivity (cm/sec)	Remolded Hydraulic Conductivity (cm/sec)	Moisture Density Relationship (pcf)	Atterberg Limits		
												Liquid Limit	Plastic Limit	Plasticity Index
BC-133	10.0-15.0	PWR	Bag	SM										
BC-133	21.5-22.5	PWR	Bag	SM										
BC-135	0-5.0	Saprolite	Bag	SM										
BC-138	14.0-19.0	Saprolite	Bag	SM										
BC-138	19.0-19.7	Saprolite	UD	SM	30.4		43.0		5.30E-07					
B-360	9.0-11.0	Regolith	UD	ML	26.4		41.2		2.90E-07					
B-362	1.0-3.0	Saprolite	UD	SM	26.6		45.3		7.40E-05					
B-362	9.4-11.4	Regolith	UD	SM			44.0							
P-403	4.0-6.0	Saprolite	UD	CL-ML		98	34.0		1.50E-06			28	21	7
P-403	0.0-11.0	Saprolite	Bag	SC								37	24	13
P-404	0.0-13.0	Saprolite	Bag	SC-SM								25	21	4
P-405	0.0-12.0	Saprolite	Bag	CL						2.10E-07		38	24	14
P-406	22.0-22.7	Saprolite	UD	SM		52	46.0					32	NP	-
P-406	0.0-20.0	Saprolite	Bag	SM						4.80E-06		32	29	3
P-407	10.0-11.0	Saprolite	UD	SC		88	44.0		9.50E-08			37	24	13
P-407	0.0-10.0	Saprolite	Bag	SC								34	18	16
P-408	0.0-11.0	Saprolite	Bag	SM								43	32	11
B-502A	18.5-20.0	Saprolite	UD	SM	19.5		51.8		2.00E-04			45	NP	-
B-509A	7.0-9.0	Saprolite	UD	ML	15.2		48.9		9.90E-06			47	45	2
B-513A	12.0-14.0	Saprolite	UD	CL	21.5		22.2		1.50E-07			35	23	12
B-514A	10.0-12.0	Saprolite	UD	ML	20.0		65.7		1.20E-07			35	30	5
B-519B	3.5-5.0	Saprolite	UD	SM-SC	13.4		64.6		1.50E-05			28	22	6
B-600	5.0-7.0	Saprolite	UD	SM	15.3		39.7		2.00E-07			NP	NP	-
B-605	8.5-10	Saprolite	Bag	SM	5.2							NP	NP	-
B-608	13.5-15.0	PWR	Bag	SM	6.5							NP	NP	-
B-614	3.5-5.5	Saprolite	Jar	SM	12.3			27				25	25	0
B-615	4.0-6.0	Saprolite	Jar	SM	10.5			27				37	30	7
B-615	13.5-15.5	Saprolite	UD	SM	8.5		37.0		1.60E-06			33	25	8
B-615	14.0-15.0	Saprolite	Jar	SC-SM	16.4			26				24	20	4
B-616	2.5-4.5	Saprolite	UD	SC	16.9							33	20	13
B-617	8.5-10.0	PWR	Jar	SM	4.5			24				34	30	4
B-618	7.0-9.0	Saprolite	UD	SM	11.1		40.0		5.50E-06			36	32	4
B-618	9.0-11.0	Saprolite	Jar	SM	11.7			23				32	31	1
B-618	24.0-26.0	PWR	Jar	SM	8.9			21				28	25	3
B-618			Bulk	ML			48.0			2.50E-07	91.0			
B-619	4.0-5.0	Saprolite	Jar	CL	16.2			8				34	19	15
B-619	5.0-6.0	Saprolite	Jar	SM	11.2			22				NP	NP	-
B-619	9.0-11.0	Saprolite	Jar	SM	13.7			21				27	24	3
B-619			Bulk	SM			34.2			3.20E-06	115.0			

Table 4
Summary of Geotechnical Testing Results
Buncombe County Construction and Demolition Landfill - Phase 5 Expansion
Design Hydrogeologic Investigation

Boring No.	Depth (feet)	Lithology	Sample Type	USCS Classification	Natural Moisture Content	Volume Percent Water	Porosity (%)	Effective Porosity (%)	Undisturbed Hydraulic Conductivity (cm/sec)	Remolded Hydraulic Conductivity (cm/sec)	Moisture Density Relationship (pcf)	Atterberg Limits		
												Liquid Limit	Plastic Limit	Plasticity Index
B-620	0.0-2.0	Alluvium	Jar	ML	15.1			16				21	20	1
B-621	0.0-2.0	Saprolite	UD	SM	11.5							32	24	8
B-621	9.0-11.0	PWR	Jar	SM	5.5			26				24	23	1
B-622	9.0-11.0	PWR	Jar	SM	10.9			22				NP	NP	-
B-622			Bulk	SM			33.2			1.20E-06	117.1			
B-623	1.0-3.0	Saprolite	UD	CH	38.7		50.7		6.10E-08			73	34	39
B-623	4.0-6.0	Saprolite	Jar	SM	29.8			24				48	33	15
B-623	14.0-16.0	Saprolite	Jar	SM	17.7			22				43	30	13
B-623	24.0-26.0	PWR	Jar	SM	6.0			20				NP	NP	-
B-624	0.0-2.0	Saprolite	Jar	SM	23.8			12				42	34	8
B-624	4.0-6.0	PWR	Jar	SM	6.4			21				NP	NP	-
B-625	4.0-5.0	PWR	Jar	SM	6.5			18						
B-626	0.0-1.0	Saprolite	Jar	ML	16.8			15				30	23	7
B-626	3.0-5.0	Saprolite	Jar	SM	8.2			20				27	24	3
B-627	1.0-3.5	Alluvium	UD	--	13.3		28.3		3.30E-06			-	-	-
Average					**14.9**		**43.1**	**20.8**	**2.08E-05**	**1.93E-06**				
Geometric Mean					**13.0**		**41.8**	**20.0**	**1.46E-06**	**9.93E-07**				

Table includes borings from C&D and applicable adjacent Subtitle D sites.
Boreholes in bold located within proposed Phase 5 expansion area.
USCS - Unified Soil Classification System
UD - Undisturbed Sample (Shelby Tube)
PWR - Partially weathered rock
** - Remolded
- Not Calculated

3.2.4 Geotechnical Laboratory Testing

The following section provides laboratory analysis data for hydraulic conductivity, porosity, and effective porosity.

Porosity and hydraulic conductivity values were obtained from 2 Shelby Tube and 2 remolded samples collected from the Phase 5 area during this investigation. Porosity values in the Shelby Tube samples ranged from 37% in B-615 (13.5-15.5) to 40% in B-618 (7-9) and undisturbed hydraulic conductivity values ranged from 1.60×10^{-6} cm/sec in B-615 (13.5-15.5) to 5.50×10^{-6} cm/sec in B-618 (7-9). Permeability values in the remolded samples ranged from 2.50×10^{-7} cm/sec in B-618 to 3.20×10^{-6} cm/sec in B-619.

Porosity values were calculated from the initial void ratio by using the equation:

$$n = e/(1+e)$$

where:
n = porosity
e = void ratio

Values for effective porosity (n_e) for these samples were estimated based on the grain size analyses applied to the soil classification triangle which illustrates the relationship between grain size and specific yield values (Johnson, 1967). Estimated effective porosity values ranged from 8% in the shallow clay (B-619 4-5) to 27% in the weathered saprolite (B-614 3.5-5.5 and B-615 4-6). Table 4 presents a summary of the results of the geotechnical laboratory testing for this and previous investigations.

3.2.5 Dispersive Characteristics

Estimates were made for longitudinal and transverse dispersivity for the uppermost aquifer at the site, which in this case is the saturated PWR and shallow fractured bedrock. Using an equation provided by the Solid Waste Section, longitudinal dispersivity (D_l) was estimated by the following calculation:

$$D_l = C \times L \times \frac{Kdh}{n_e dl}$$

where:
C = Constant (0.1)
L = Length to compliance boundary
K = hydraulic conductivity
dh/dl = hydraulic gradient
n_e = effective porosity

For this estimation, an average hydraulic conductivity value of 3.05×10^{-4} cm/sec (0.87 ft/day) was used. This value represents the average K of the piezometers installed in

the Phase 5 area during the current investigation, based on slug test analyses. An average hydraulic gradient of 0.15 ft/ft was used. This value represents measurements collected on September 10, 2008 from piezometers installed in the Phase 5 area during the current investigation. An average effective porosity of 15% was used. This value represents the average estimated effective porosity from samples collected from the PWR and a conservative assumed effective porosity of 10% (Heath's estimates are 0.1%). A length of 250 feet was used. This value represents the distance from the edge of waste to the compliance boundary.

Using the estimations and calculation described above, an average longitudinal dispersivity of 21.75 ft was determined. Assuming that transverse dispersivity is 10% of longitudinal dispersivity, transverse dispersivity was estimated at 2 ft.

Longitudinal dispersivity was also estimated using an EPA calculator. Assuming a plume length of 250 feet, longitudinal dispersivity ranged from 0.41 ft to 1500 ft. And by using the formula from Xu and Eckstein (1995) on the EPA site, assuming a plume length of 250 feet, a longitudinal dispersivity of 12.5 ft was determined. Therefore, transverse dispersivity ranges from 0.041 ft to 150 ft.

These calculations are intended for unconsolidated materials. As discussed throughout this report, groundwater flow in bedrock is in the fractures and is limited by degree of fracturing, size of fractures, and interconnectedness of fractures.

3.3 Site Hydrogeology

Results of investigation activities designed to characterize the hydrogeology beneath the Site are presented in this section. These activities included water level measurements and aquifer slug testing.

3.3.1 Water Level Measurements

Water level measurements collected from the piezometers installed during the current investigation are provided in Table 5. These include measurements at the time of boring, 24 hours after installation, June 18, 2008, July 17, 2008, August 12, 2008, and September 10, 2008. The water level measurements taken during the September 10, 2008 event were used to construct the potentiometric contour map presented on Sheet 3. In addition to the current investigation piezometers, historic data from previous investigations are also included.

Table 5 also includes the highest recorded elevations for the piezometers and the monitoring wells installed during previous investigations. For the 200-series piezometers, this includes water level measurements dating back to November 1993. For the 300-series piezometers, water level measurements date back to February 1995 (CDM 1995a). For the 400-series piezometers, this includes water level measurements dating from March 1997 (CDM 1997). The 500-series piezometers date back to 1999 (CDM, October 2000). In most cases, piezometers from previous investigations have been abandoned.

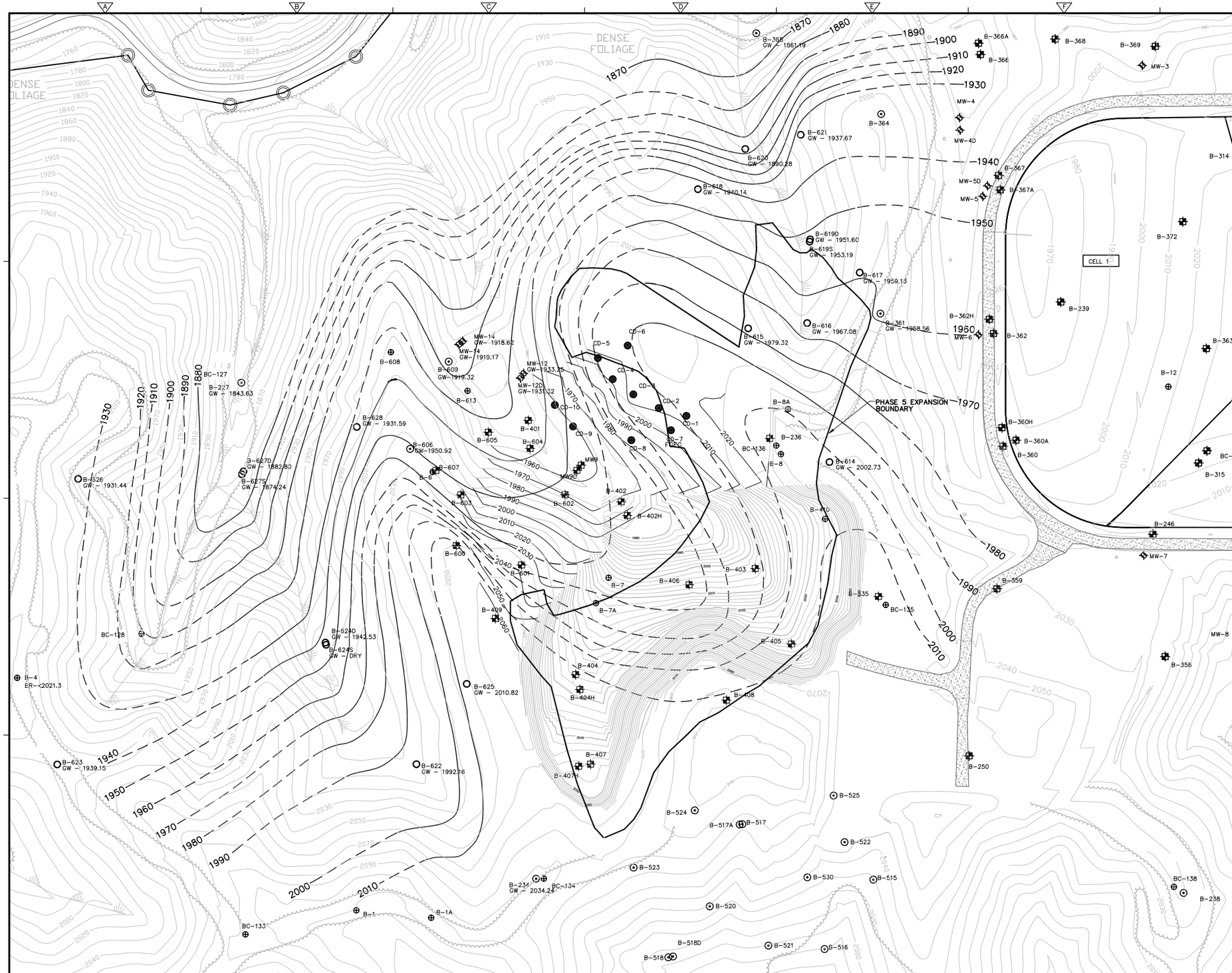
Table 5
Groundwater Elevations
Buncombe County Construction and Demolition Landfill - Phase 5 Expansion
Design Hydrogeologic Investigation

Well	Top of PVC Elevation (feet msl)	Ground Surface Elevation (feet msl)	Groundwater Elevation @TOB (feet msl)	Groundwater Elevation @ 24 hours (feet msl)	Groundwater Elevation 4/30/1997 (feet msl)	Groundwater Elevation 5/5/1999 (feet msl)	Groundwater Elevation 9/13/1999 (feet msl)	Groundwater Elevation 10/29/2001 (feet msl)	Groundwater Elevation 3/7/2002 (feet msl)	Groundwater Elevation 6/26/2002 (feet msl)	Groundwater Elevation 10/14/2004 (feet msl)	Groundwater Elevation 3/3/2005 (feet msl)	Groundwater Elevation 6/18/2008 (feet msl)	Groundwater Elevation 7/17/2008 (feet msl)	Groundwater Elevation 8/12/2008 (feet msl)	Groundwater Elevation 9/10/2008 (feet msl)	Estimated Seasonal High Elevation	Estimated Long-Term Seasonal High
B-227	1853.80	1851.8			1845.48	1845.01	1843.55		1843.75				1843.64	1843.64	1843.60	1843.63	1849.48	1851.8
B-234	2094.66	2092.7			2044.55	2044.51	2042.41		2034.18				2034.71	2034.55	2034.43	2034.24	2048.55	2051.55
B-335	2074.68	2071.6			2016.77	NM	NM		NM								2017.8**	2020.8
B-236	2051.88	2050.0			2008.84	NM	NM		NM								2009.4	2012.4
B-361	2018.19	2015.3			1961.70	1961.61	1961.33		NM				1959.74	1960.01	1958.88	1958.56	1965.70	1968.7
B-364	2011.14	2008.4																
B-365	1872.89	1870.3												1861.31		1861.19		
MW-4	1944.35	1942.5			1932.50	1930.92	1929.88		1928.86	1929.94		1935.49			1929.71		1935.49	1938.5
MW-4d	1944.64	1942.8			1931.69	1929.90	1927.67		1926.96	1928.68		1934.60			1928.93		1934.60	1937.6
MW-5	1977.12	1975.4			1939.89	1939.61	NM		1937.97	1938.44		1942.05			1939.75		1942.05	1945.1
MW-5d	1976.92	1975.3			1939.56	1938.37	NM		1936.41	1936.93		1940.48			1937.67		1940.48	1943.5
MW-6	1987.34	1985.4			1957.68	1957.43	1957.07		1954.18	1954.80		1960.13			1956.16		1960.13	1963.1
MW-7	2022.83	2020.7			1974.33	1974.47	1974.11		1970.20	1970.59		1974.45					1975.1	1978.1
MW-9	1966.54	1963.5				1950.97	1950.25		1951.65	1951.14		1953.28					1953.28	1956.3
MW-9d	1966.34	1963.3				1950.80	1950.08		1951.52	1951.03		1953.15					1953.15	1956.2
MW-12	1947.39	1944.7	1931.7							1933.54		1940.41	1934.34	1933.79	1933.20	1933.25	1944.41	1944.7
MW-12d	1947.10	1944.3	1918.3							1930.98		1939.67	1932.66	1932.59	1931.31	1931.32	1943.67	1944.3
MW-14	1952.78	1949.8	1909.8										1918.86	1919.36	1918.59	1918.62	1923.36	1926.4
MW-14d	1953.77	1950.5	1869.5										1919.54	1919.86	1919.24	1919.17	1923.86	1926.9
B-401	1949.58	1947.9	1936.0	1941.14	1940.22	NM	NM										1940.22**	1943.2**
B-402	1972.29	1970.0	ND	1964.96	1964.48	NM	NM										1964.48**	1967.5**
B-402H	1972.78	1970.4	ND	1967.66	1967.56	NM	NM										1967.56**	1970.4**
B-403	2019.14	2016.5	1988.5	1988.62	1988.75	NM	NM										1988.76**	1991.8**
B-404	2031.06	2028.5	2010.5	2022.33	2024.02	NM	NM										2024.02**	2027.0**
B-404H	2030.54	2028.5	ND	2025.19	2022.97	NM	NM										2022.97**	2026.0**
B-405	2048.57	2045.5	2011.5	2023.81	2024.21	NM	NM										2024.21	2027.2
B-406	2040.69	2037.0	ND	1971.36	1968.44	NM	NM										1968.44**	1971.4**
B-407	2051.25	2048.5	2020.5	2045.38	2045.45	NM	NM										2045.45	2048.5
B-407H	2051.22	2048.0	ND	2044.64	2045.79	NM	NM										2045.79	2048.8
B-408	2099.07	2096.4	2019.4	2027.70	2027.04	2020.80	NM										2027.04	2030
B-409	2067.67	2065.4	2010.4	2014.62	2015.53	2014.97	2014.36					2012.39					2015.53	2018.5
B-515	2031.78	2028.4	1997.4	2007.11		2007.12	2007.16	2005.61	2003.53			2007.28					2007.28	2010.2
B-516	1993.68	1990.7	1966.1	1965.73		1988.57	1986.46	1980.76	1979.08			1983.49					1988.57	1990.7
B-517	2079.04	2076.2	2009.2	2010.47		2010.47	2022.41	2019.96	2018.45			NM					2022.41	2025.4
B-517d	2078.80	2075.6	1991.6	2007.68		2007.68	2022.16	2019.33	2017.90			NM					2022.16	2025.2
B-518	2005.54	2002.5	1994.5	1999.49		1999.49	1999.11	1999.26	1998.10			1999.05					1999.49	2002.5
B-518d	2005.21	2002.5	1987.5	1988.53				1987.62	1985.71			1990.24					1990.24	1993.2
B-519	1958.36	1955.5	1946.4	1946.25		1951.17	1947.62	1947.65	1947.46			1951.90					1951.17	1954.2
B-519d	1959.11	1956.2	[1]	[1]		[1]	[1]	1956.97	1956.53			1956.61					[1*]	[1*]
B-520	2044.17	2041.5	1959.5	1980.91				1983.27	1982.02			1986.77					1986.77	1989.3
B-521	2005.18	2002.6	1952.6	1964.71				1965.18	1964.88			1973.21					1973.21	1976.2
B-522	2058.81	2055.1	DRY	1995.11				2012.98	2010.61			2014.88					2014.88	2017.9
B-523	2080.42	2077.8	DRY	1967.42				2022.28	2021.03			2022.26					2022.28	2025.3
B-524	2101.58	2098.6	2012.6	2024.30				2023.88	2022.69			NM					2024.3	2027.3
B-525	2061.44	2058.7	2005.7	2019.39				2020.15	2017.01			NM					2020.15	2023.2
B-526	1972.51	1969.5	1931.5	1959.06				1959.43	1958.51			1964.93					1964.93	1967.9
B-527	1976.56	1973.7	1943.7	1951.40				1951.29	1950.34			1958.17					1958.17	1961.2
B-528	1950.28	1947.7	1886.7	1906.93				1909.57	1908.90			1911.26					1911.26	1914.3
B-529	1962.31	1959.6	1933.6	1938.61				1938.79	1937.36			1938.01					1938.79	1941.8
B-530	2045.01	2042.2	DRY	1964.41				1980.46	1977.87			1983.19					1983.19	1986.2
Pumping Well	1955.22	1953.5	1855.5	[1]				[1]	[1]			[1]					[1]	[1]

Table 5
Groundwater Elevations
Buncombe County Construction and Demolition Landfill - Phase 5 Expansion
Design Hydrogeologic Investigation

Well	Top of PVC Elevation (feet msl)	Ground Surface Elevation (feet msl)	Groundwater Elevation @TOB (feet msl)	Groundwater Elevation @ 24 hours (feet msl)	Groundwater Elevation 4/30/1997 (feet msl)	Groundwater Elevation 5/5/1999 (feet msl)	Groundwater Elevation 9/13/1999 (feet msl)	Groundwater Elevation 10/29/2001 (feet msl)	Groundwater Elevation 3/7/2002 (feet msl)	Groundwater Elevation 6/26/2002 (feet msl)	Groundwater Elevation 10/14/2004 (feet msl)	Groundwater Elevation 3/3/2005 (feet msl)	Groundwater Elevation 6/18/2008 (feet msl)	Groundwater Elevation 7/17/2008 (feet msl)	Groundwater Elevation 8/12/2008 (feet msl)	Groundwater Elevation 9/10/2008 (feet msl)	Estimated Seasonal High Elevation	Estimated Long-Term Seasonal High
B-600	2055.38	2052.7	1992.7								2011.61	2010.90					2011.61	2014.6
B-601	2056.24	2053.6	1953.6								1962.15	1963.26					1963.26	1966.3
B-602	1978.36	1975.5	1933.5								1951.83	1955.74					1955.74	1958.7
B-603	2013.61	2011.0	1936.0								1953.21	1953.48					1953.48	1956.5
B-605	1956.60	1954.0	1931.0								1939.20	1942.76					1942.76	1945.8
B-606	2027.09	2024.3	1952.3								1953.48	1952.62	1951.51	1951.30	1951.14	1950.92	1957.48	1960.5
B-609	1955.19	1952.2	1884.2								1921.83	1923.44	1919.76	1920.12	1919.45	1919.32	1927.44	1930.4
B-614	2047.20	2043.8	2001.8	2004.73									2004.73	2003.69	2003.05	2002.73	2008.73	2011.7
B-615	2023.40	2021.6	1988.1	1987.69									1987.69	1984.45	1981.60	1979.32	1991.69	1994.7
B-616	1984.90	1981.5	1969.5	1969.49									1969.49	1968.93	1967.99	1967.08	1973.49	1976.5
B-617	2008.70	2005.4	1960.4	1960.42									1960.42	1960.08	1959.54	1959.13	1964.42	1967.4
B-618	1987.20	1985.5	1940.5	1940.73									1940.73	1940.45	1940.33	1940.14	1944.73	1947.7
B-619	1965.70	1963.5	1953.5	1953.86									1953.86	1953.67	1952.88	1953.19	1957.86	1960.9
B-619d	1966.70	1963.4	1951.4	1951.75									1951.75	1951.73	1951.32	1951.60	1955.75	1958.8
B-620	1940.90	1937.9	1889.9	1891.20									1891.20	1890.69	1890.63	1890.28	1895.20	1898.2
B-621	1975.80	1972.5	1937.5	1937.93									1937.93	1937.80	1937.66	1937.67	1941.93	1944.9
B-622	2006.40	2003.1	1988.6	1990.90									1991.90	1992.59	1991.11	1992.16	1996.59	1999.6
B-623	2027.40	2025.2	1940.6	1940.22									1940.22	1939.73	1939.45	1939.15	1944.22	1947.2
B-624	1980.50	1977.2	DRY	DRY									DRY	DRY	DRY	DRY	1968.00	1970.0
B-624d	1980.40	1977.1	1943.9	1947.19									1947.19	1948.60	1945.32	1942.53	1952.60	1955.6
B-625	2054.40	2051.9	2004.4	2004.75									2004.75	2010.27	2010.37	2010.82	2014.82	2017.8
B-626	1981.30	1979.7	1933.0	1932.53									1932.53	1931.63	1931.65	1931.44	1936.53	1939.5
B-627	1883.00	1880.1	1875.2	1875.17									1875.17	1875.10	1873.45	1874.24	1879.17	1880.1
B-627d	1882.80	1880.3	1873.8	1873.72									1873.72	1882.68	1882.78	1882.80	1880.30	1880.3
B-628	1990.30	1987.9	1933.9	1933.66									1933.66	1934.48	1932.70	1931.59	1938.48	1941.5

Piezometers in bold are located within proposed Phase 5 expansion area.
Piezometers and Monitoring Wells in italic have been abandoned during previous investigations.
ND - Not Determined
NM - Not Measured (well abandoned)
TOB - Time of boring
* - Groundwater elevation measured during previous investigations.
** - Groundwater elevation represents highest elevation after well stabilization.
[1] - Piezometer demonstrates artesian characteristics.
[1*] - Piezometer demonstrated artesian characteristics until the installation of the 6" pumping well, approximately 50 feet downgradient.



LEGEND:

MW-2	MONITORING WELL
B-8	BOREHOLE
B-601	EXISTING PIEZOMETER
B-254	ABANDONED PIEZOMETER
GW-1953.74	GROUNDWATER ELEVATION (DATA COLLECTED 7/17/2008)
CD-1	BOREHOLE INSTALLED MARCH 2002
B-622	PIEZOMETER INSTALLED JUNE 2008

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: D. FORBES
DRAWN BY: J. KILLINGSWORTH
SHEET CHK'D BY:
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BUNCOMBE COUNTY
NORTH CAROLINA

C&D LANDFILL SUBSTANTIAL AMENDMENT
DESIGN HYDROGEOLOGIC INVESTIGATION

POTENTIOMETRIC CONTOUR MAP

PROJECT NO. 6447-65973
FILE NAME: Sheet 3.dwg
SHEET NO.
3

Water levels in most piezometers are below the top of bedrock. In the Phase 5 area, saturated conditions above the bedrock surface were encountered in only in piezometer B-619s. B-619s is located in the drainage feature within the proposed C&D Landfill expansion area.

Since installation, water table elevations remained fairly constant; however, elevations in B-615 have varied significantly. The water table elevation in B-615 decreased approximately 8 feet between the readings collected following installation on June 18, 2008 and September 10, 2008.

3.3.1.1 Horizontal and Vertical Gradients

Horizontal Gradients

Sheet 3 presents a potentiometric surface contour map for the proposed Phase 5 C&D area. The map was constructed from water level data collected on September 10, 2008. The potentiometric surface is interpolated from data from piezometers screened at various monitoring interval depths. Because the groundwater beneath the site is a complex three dimensional fractured bedrock aquifer, the potentiometric surface maps represent an idealized shallow bedrock system.

The contour map shows that the potentiometric surface generally is a subdued reflection of surface topography. Topographic divides are typically groundwater divides and groundwater flow converges into the main surficial drainage feature. Groundwater flows radially away from the topographically high area (B-614), north toward Blevin Branch (B-365).

In the Phase 5 area, groundwater flow follows the drainage morphology which trends south (topographic high) to north (topographic low) toward Blevin Branch. The drainage feature running through the Phase 5 area acts as the dominant drainage control feature for the area. The average hydraulic gradient with the Phase 5 hollow is about 0.15 ft/ft. Because topography influences groundwater flow, it follows that steeper hydraulic gradients would occur in areas where relief is greatest and lower gradients would occur where relief is less exaggerated.

Vertical Gradients

Vertical gradient data is evaluated by comparing water levels from nested piezometer sets. Nested piezometer pairs are present at one location in the Phase 5 area: B-619/B-619d. Vertical gradients are calculated as the difference in water level elevation between two nested piezometers, divided by the vertical distance from the saturated screen midpoint of the shallow piezometer to the screen midpoint of the deeper piezometer. The distance between monitoring intervals of the nested piezometers was 11.6 feet.

Based on the groundwater data from September 10, 2008, the nested piezometer pair at B-619 exhibited a vertical gradient of -0.14 ft/ft. A negative value indicates a downward gradient. The downward vertical hydraulic gradient likely decreases

further down the drainage feature and eventually becomes an upward gradient and discharges to Blevin Branch.

Site-wide, water level data from nested monitoring well pairs indicate that upward gradients exist near and within drainage features. Monitoring wells MW-5/5D, MW-8/8D, and MW-14/14d, and piezometers B-627/627D, all of which are located in drainage features, have typically shown an upward vertical gradient. Although nested pair MW-2/2D displays a very weak downward vertical gradient, it is expected that just north of this location, and approaching Blevin Branch, an upward vertical gradient exists. The occurrence of upward vertical gradients in the drainage features provide evidence that Blevin Branch and the unamed creeks feeding it and the French Broad River serve as discharge points for the saprolite, PWR, and shallow bedrock aquifer.

3.3.1.2 Temporal Trends

Table 5 summarizes water level measurements collected on a nominal basis from all of the piezometers completed during this and previous investigations. Because most of the piezometers have been abandoned, the water levels are presented for the discussion of temporal trends only.

In general, bedrock, and not the elevation of the water table, is the limiting factor in determining the landfill base grades. The water table occurs in PWR only in the base of topographic low areas (drainage features). Fill will be placed in these low areas to ensure proper separation and maintain manageable slopes. Therefore, separation from the seasonal high water table is not an issue for most of the site.

An evaluation of seasonal fluctuations in the water table elevations in the piezometers installed during previous investigations indicated that the seasonal high water levels typically occurred in late March to early May (CDM, October 2000). Based on the groundwater elevations collected from the monitoring wells and existing piezometers, it appears that the data collected on June 18, 2008 represents seasonal high water table for the monitoring wells, unless otherwise noted. However, due to the current drought status in the region, it is likely that the elevations are still lower than normal.

There are several existing piezometers in and adjacent to the current investigation area installed during previous investigations. Three wells in particular (B-227, B-234, and B-361) have data going back more than ten years. In order to estimate long-term seasonal high levels, CDM reviewed historic groundwater levels from the existing site piezometers and several inactive and active wells in the USGS and NCDENR Division of Water Resources groundwater level monitoring networks in the vicinity of the landfill or similar terrain and depth. Well names, locations, depths and monitoring zones are provided in the table below (CDM, December 2004).

NCDENR – Division of Water Resources Inactive Groundwater Level Monitoring Network

Quad	Name	County	Total Depth	Monitoring Zone
M 84P1	Swannanoa	Buncombe	99	Bedrock
Q 85N1	Hendersonville	Henderson	48	Bedrock
P 84G2	Hendersonville	Henderson	44	Saprolite
M 90T1	Canton Watershed RS 1	Haywood	35	Saprolite

USGS Groundwater Climate Response Network

Designation	Name	County	Total Depth	Monitoring Zone
NC-40	Champion Well	Haywood	18.5	Saprolite/Bedrock
NC-144	Blantyre Well	Transylvania	58	Saprolite

Hydrographs and well statistics were compared for all of the NCDENR and USGS wells; particularly maximum water levels compared to minimum water levels. The average difference between the maximum recorded highs and the maximum recorded lows for all of these wells were about 8 feet. In this case, the maximum value would be 4 feet above the mean.

In the case of the newly installed Buncombe County C&D piezometers, there is insufficient data to determine an average groundwater level; however, based on the groundwater elevations recorded since installation, the groundwater data collected at the site in June 2008 are most likely representative of average levels.

In order to construct an estimated seasonal high potentiometric contour map, a conservative value of 4 feet was added to the highest recorded elevation (in most cases the June 18, 2008 data). A review of monthly statistics from the Champion Well and the Blantyre Well indicate that an average value of 3 feet above the mean value is typical for the seasonal high.

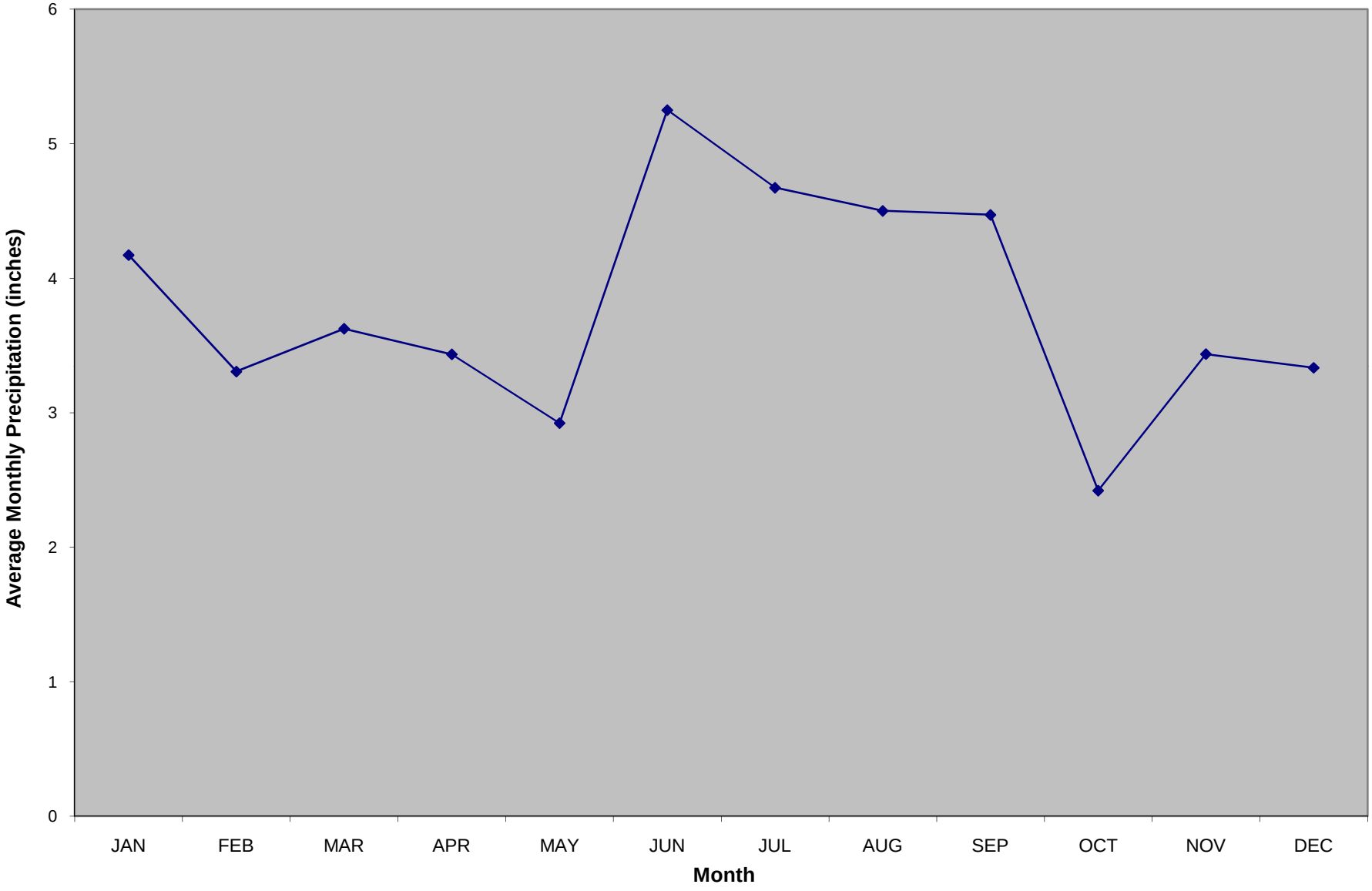
The Estimated Seasonal High values for the existing monitoring wells and piezometers are included on Table 5. Copies of the hydrographs and well statistical data for the USGS and NCDENR wells are included in Appendix D. Table 6 and Figure 1 present monthly precipitation totals from January 1995 to July 2008 at the Asheville Airport. Figure 2 provides a graphic view of yearly precipitation totals from 1995 to 2007. A seasonal high groundwater contour map is provided on Sheet 4.

Table 6
Annual Precipitation Data - Asheville Airport
Buncombe County Construction and Demolition Landfill - Phase 5 Expansion
Design Hydrogeologic Investigation

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual Total
1995	7.09	2.93	2.46	1.01	6.05	8.91	3.66	9.27	2	7.26	3.69	1.55	55.88
1996	7.29	2.78	3.43	2.01	2.59	3.57	4.88	6.73	5.26	0.7	4.48	3.98	47.70
1997	4.49	5.29	5.49	5.32	2.94	8.37	3	1.38	4.92	3.94	1.65	3.02	49.81
1998	10	6.4	3.77	8.73	2.28	3.68	2.02	2.3	1.66	1.8	2.8	3.12	48.56
1999	6.43	3.37	2.85	2.45	2.54	4.44	3.89	3.4	2.22	3.34	3.34	2.02	40.29
2000	3.19	2.37	3.87	5.17	1.31	2.81	2.88	4.46	3.33	0	4.29	2.44	36.12
2001	2.68	2.75	5.02	1.35	2.54	2.97	5.54	3.24	4.37	0.63	1.43	2.35	34.87
2002	3.66	1.33	4.38	1.77	3.43	6.19	2.05	2.12	6.09	3.17	4.28	6.41	44.88
2003	1.25	4.5	4.41	5.26	8.37	6.16	10.88	6.86	3.03	2.36	3.93	2.8	59.81
2004	0.83	4.2	2.02	2.95	3.23	7.39	4.68	3.79	13.71	1.11	5.02	3.44	52.37
2005	2	2.57	3.33	2.86	1.65	10.09	10.26	5.71	0.34	1.2	3.74	3.51	47.26
2006	3.58	2.55	0.91	4.58	1.69	5.16	2.81	7.12	7.8	2.93	4.52	4.64	48.29
2007	3.35	1.45	4.29	1.77	0.96	2.91	4.85	2.84	3.4	3.02	1.49	4.06	34.39
2008	2.56	3.79	4.51	2.84	1.33	0.85	4.02	3.79	--	--	--	--	--
Average	4.17	3.31	3.62	3.43	2.92	5.25	4.67	4.50	4.47	2.42	3.44	3.33	46.17

Source - Climatological Data - Annual Summary North Carolina

Figure 1
Average Monthly Precipitation
Asheville Airport
Asheville, North Carolina

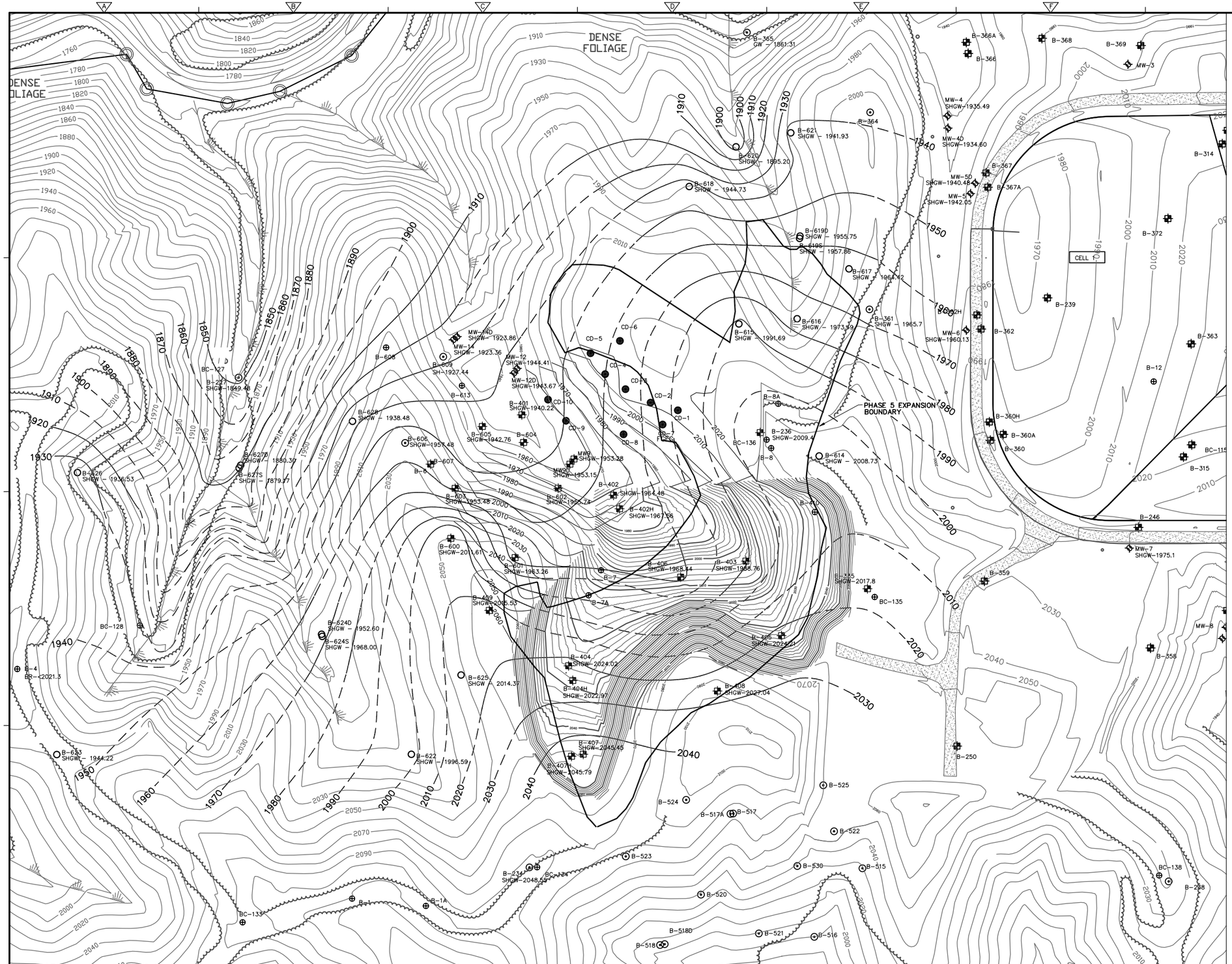


CDM

Monthly average data from January 1995 to Present

Figure 2
Average Annual Precipitation
1995 to 2007
Asheville Airport
Asheville, North Carolina

CDM



LEGEND:

MW-2	MONITORING WELL
B-8	BOREHOLE
B-601	EXISTING PIEZOMETER
B-254	ABANDONED PIEZOMETER
SHGW-1953.74	SEASONAL HIGH GROUNDWATER ELEVATION
CD-1	BOREHOLE INSTALLED MARCH 2002
B-622	PIEZOMETER INSTALLED JUNE 2008

REV. NO.	DATE	DRWN	CHKD	REMARKS

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DRAWN BY: J. KILLINGSWORTH
SHEET CHK'D BY:
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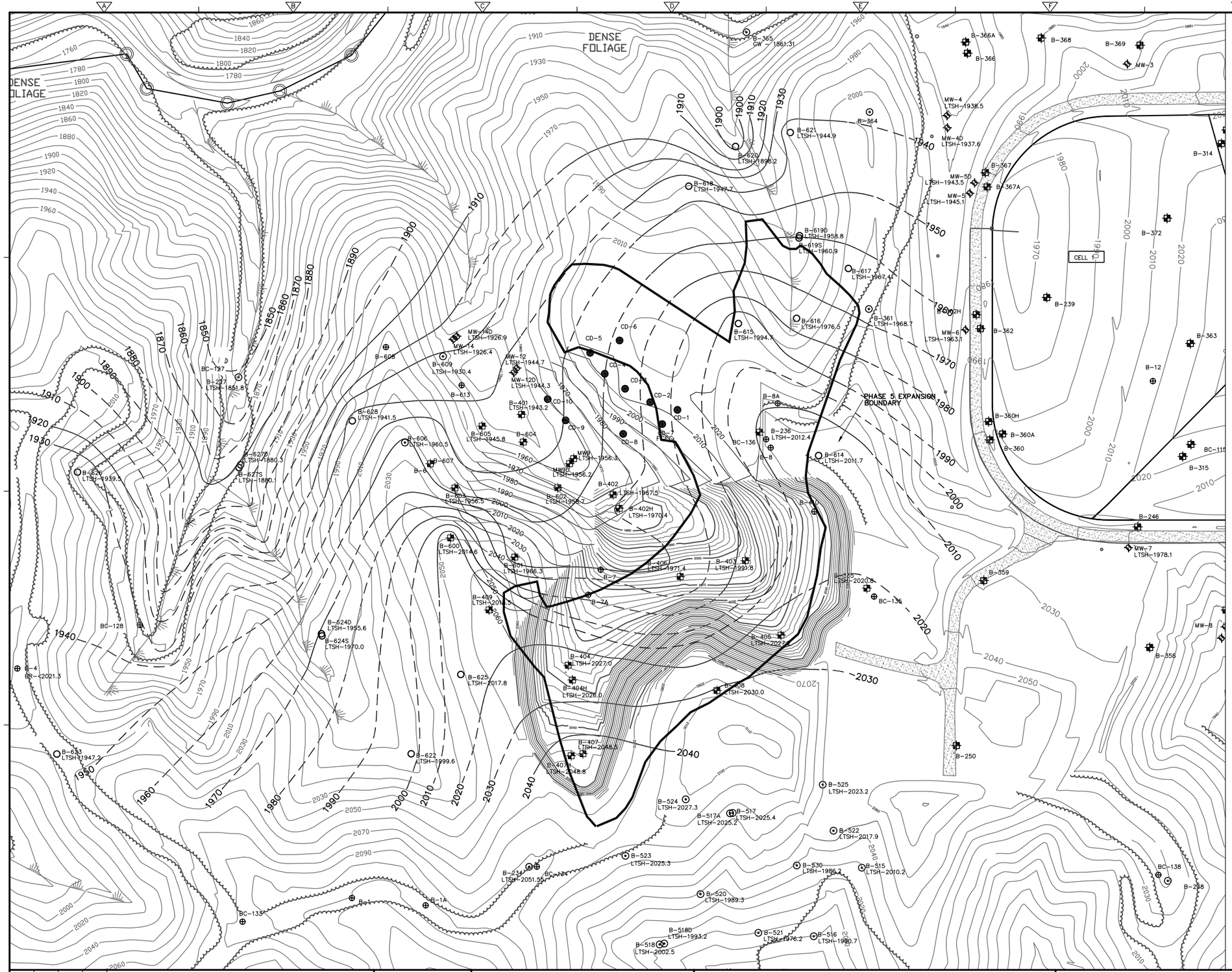
BUNCOMBE COUNTY
NORTH CAROLINA

C&D LANDFILL SUBSTANTIAL AMENDMENT
DESIGN HYDROGEOLOGIC INVESTIGATION

SEASONAL HIGH GROUNDWATER CONTOUR MAP

PROJECT NO. 6447-65973
FILE NAME: Sheet 4.dwg

SHEET NO.
4



LEGEND:

MW-2	MONITORING WELL
B-8	BOREHOLE
B-601	EXISTING PIEZOMETER
B-254	ABANDONED PIEZOMETER
LTSH-1953.74	LONG TERM SEASONAL HIGH GROUNDWATER ELEVATION
CD-1	BOREHOLE INSTALLED MARCH 2002
B-622	PIEZOMETER INSTALLED JUNE 2008

REV. NO.	DATE	DRWN	CHKD	REMARKS

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NORTH CAROLINA

C&D LANDFILL SUBSTANTIAL AMENDMENT
DESIGN HYDROGEOLOGIC INVESTIGATION

LONG TERM SEASONAL HIGH
GROUNDWATER CONTOUR MAP

PROJECT NO. 6447-65973
FILE NAME: Sheet 5.dwg
SHEET NO.
5

3.3.2 Slug Test Results

Calculated hydraulic conductivities (using recovery values) within the bedrock unit in the Phase 5 area ranged from 0.23 ft/day (B-619d) to 1.30 ft/day (B-615). The average bedrock hydraulic conductivity within the Phase 5 area was 0.87 ft/day. The average hydraulic conductivity for all piezometers, screened in both saprolite/PWR and bedrock, in and around the Phase 5 area was 1.53 ft/day. A summary of calculated K values is provided on Table 7. Calculations and graphs for the K values are provided in Appendix E.

It should be noted that hydraulic conductivities from slug testing in bedrock represent vertically averaged values, as the actual hydraulic conductivity will vary throughout the well monitoring interval with variable fracturing of the bedrock.

3.4 Hydrogeologic Conceptual Model

Cross-sections identifying hydrogeologic and stratigraphic units and stabilized water table elevations are provided in Figures 3 through 5. These Sections provide hydrogeologic cross-sections sections A-A′, B-B′, and C-C′. Cross-section references are shown on the Figures and also provided on Sheet 1.

3.4.1 Precipitation and Groundwater Recharge

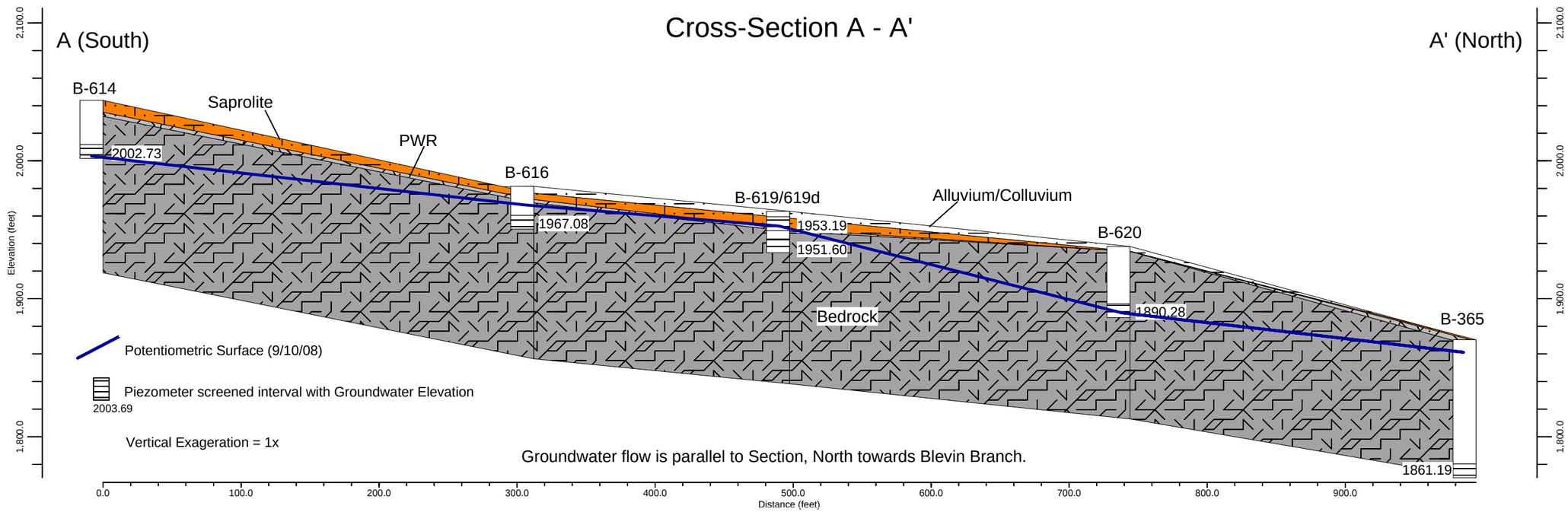
Primarily downward vertical gradients have been observed in nested wells throughout the Phase 5 area and adjacent C&D Landfill areas. Factors affecting infiltration of precipitation include the rate of precipitation, slope, soil texture, and vegetative cover. Much of the site is comprised of steep slopes and fine grained soils that inhibit infiltration. Areas of lower relief such as flat hilltops and drainage bottoms are expected to be the locations of greatest recharge (less so in the drainage bottoms due to the higher observed fine content of soils). Areas covered by forest litter would also be expected to enhance infiltration. Most of the site has been cleared for borrow, is covered forest, or is active landfill. The borrow and landfilled areas would most likely enhance infiltration, especially on the flat hilltops, but would also increase run-off on the sloped areas.

As previously discussed in Section 3.1, the average monthly precipitation at the site does not vary greatly over the year. However, precipitation during the summer months typically occurs as sporadic high intensity events of short duration, which leads to runoff. In addition, plant evapotranspiration in the summer leads to higher removal of soil moisture and decreases the potential for deep infiltration. Winter precipitation occurs as events of longer duration and lesser intensity; consequently infiltration and groundwater recharge should be greater in the winter months than in the summer. Approximately 5 to 10 inches per year of precipitation (13 to 26 percent of average annual precipitation) are expected to result in groundwater recharge, based on typical regional recharge values.

Table 7
Calculated Hydraulic Conductivity Values
Buncombe County Construction and Demolition Landfill - Phase 5 Expansion
Design Hydrogeologic Investigation

Well ID	Boring Depth (ft)	Aquifer Monitored Interval	K (in/sec)	K (ft/min)	K (ft/day)	K (cm/sec)
B-615 Slug In	51	Bedrock	3.36E-04	1.68E-03	2.42	8.54E-04
B-615 Slug Out	51	Bedrock	1.80E-04	9.01E-04	1.30	4.58E-04
B-617 Slug In	61	Bedrock	3.81E-05	1.90E-04	0.27	9.67E-05
B-617 Slug Out	61	Bedrock	9.70E-05	4.85E-04	0.70	2.46E-04
B-619d Slug In	30	Bedrock	3.84E-05	1.92E-04	0.28	9.74E-05
B-619d Slug Out	30	Bedrock	3.13E-05	1.56E-04	0.23	7.94E-05
B-625 Slug In	62	Bedrock	4.15E-04	2.07E-03	2.99	1.05E-03
B-625 Slug Out	62	Bedrock	2.77E-04	1.38E-03	1.99	7.02E-04
B-625re Slug In	62	Bedrock	1.94E-04	9.69E-04	1.39	4.92E-04
B-625re Slug Out	62	Bedrock	2.67E-04	1.33E-03	1.92	6.77E-04
B-627s Slug In	18	Saprolite/Bedrock	4.28E-04	2.14E-03	3.08	1.09E-03
B-627s Slug Out	18	Saprolite/Bedrock	4.55E-04	2.28E-03	3.28	1.16E-03
MW-9 Slug In*	26	Bedrock	2.00E-05	1.00E-04	0.14	5.08E-05
MW-9 Slug Out*	26	Bedrock	2.00E-05	1.00E-04	0.14	5.08E-05
MW-9d Slug In*	40	Bedrock	8.00E-05	4.00E-04	0.55	2.03E-04
MW-9d Slug Out*	40	Bedrock	7.00E-05	3.50E-04	0.50	1.78E-04
MW-14 Slug Out*	49	PWR/Bedrock	4.28E-04	2.14E-03	3.08	1.09E-03
MW-14d Slug Out*	88	Bedrock	4.55E-04	2.28E-03	3.28	1.16E-03
		Average Phase 5 Expansion Area	1.20E-04	6.01E-04	0.87	3.05E-04
		Average Existing C&D Area Monitoring Wells	1.79E-04	8.94E-04	1.28	4.54E-04
		Average C&D Facility Area	2.13E-04	1.06E-03	1.53	5.40E-04

** Monitoring wells at existing C&D landfill (MW-9/9d have been abandoned).*



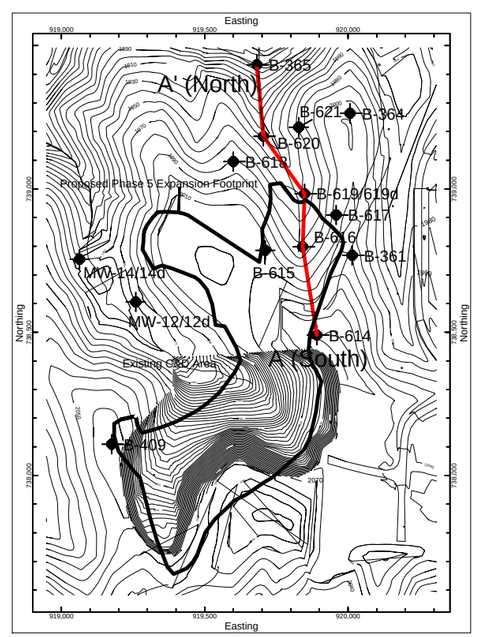
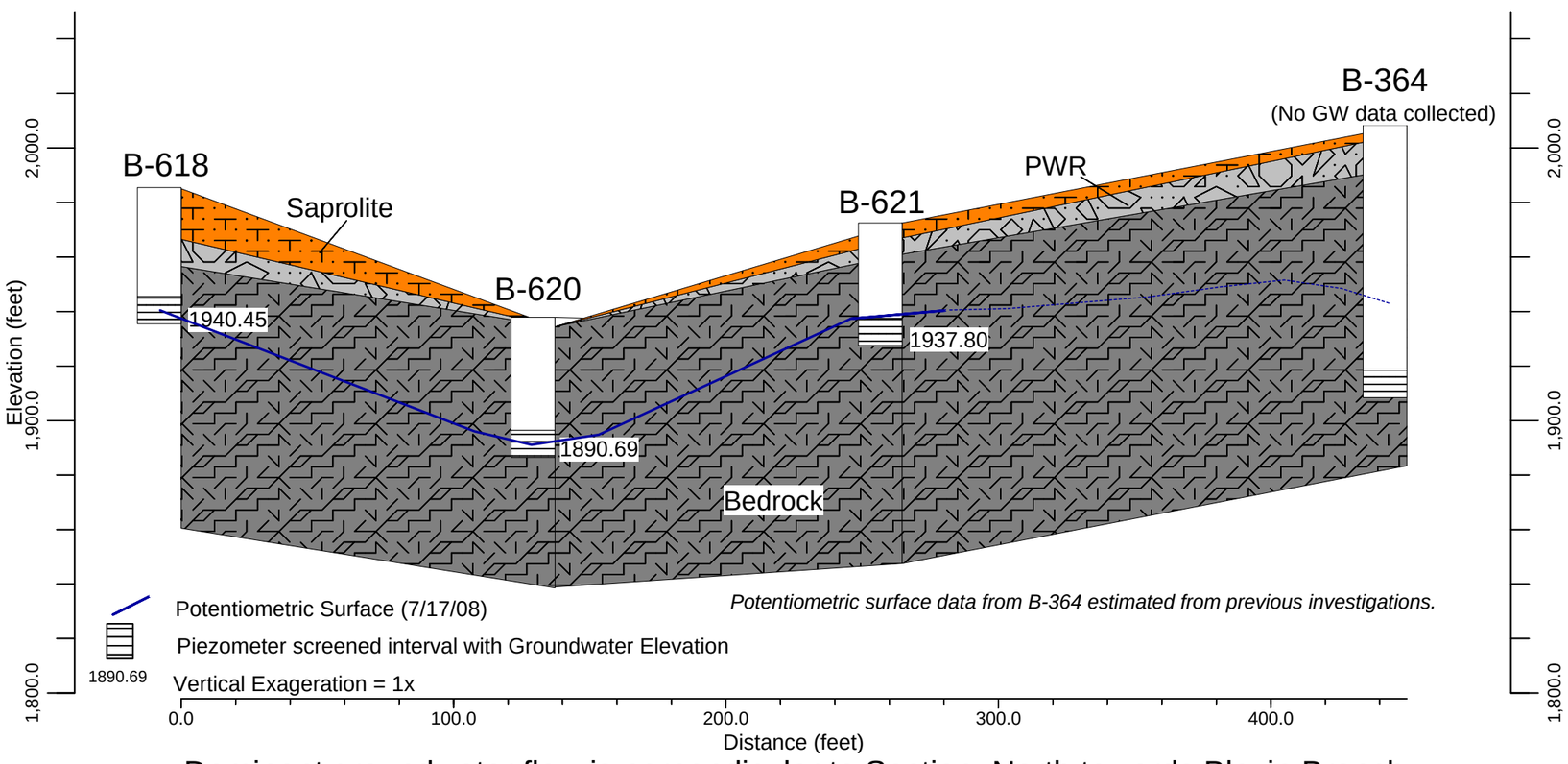
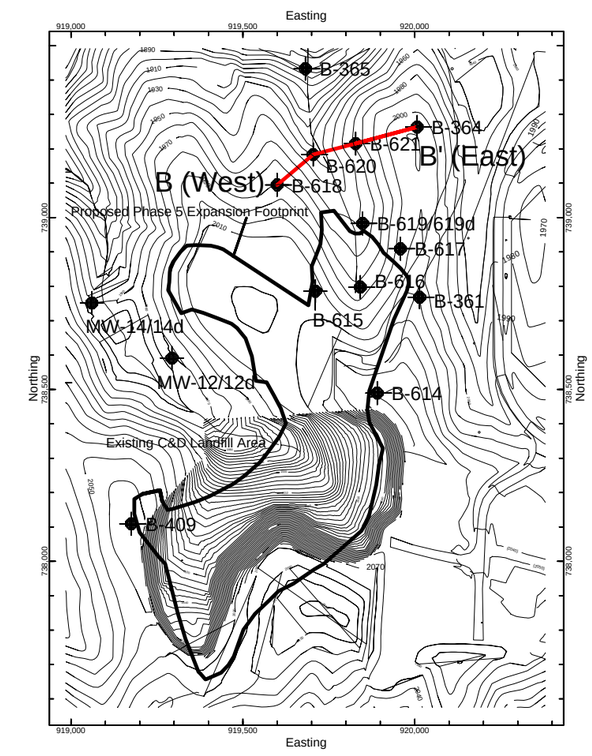


Figure 3
Cross-Section A - A'
Buncombe County C&D Landfill Phase 5 Expansion
Design Hydrogeologic Investigation

CDM

Cross-Section B - B'

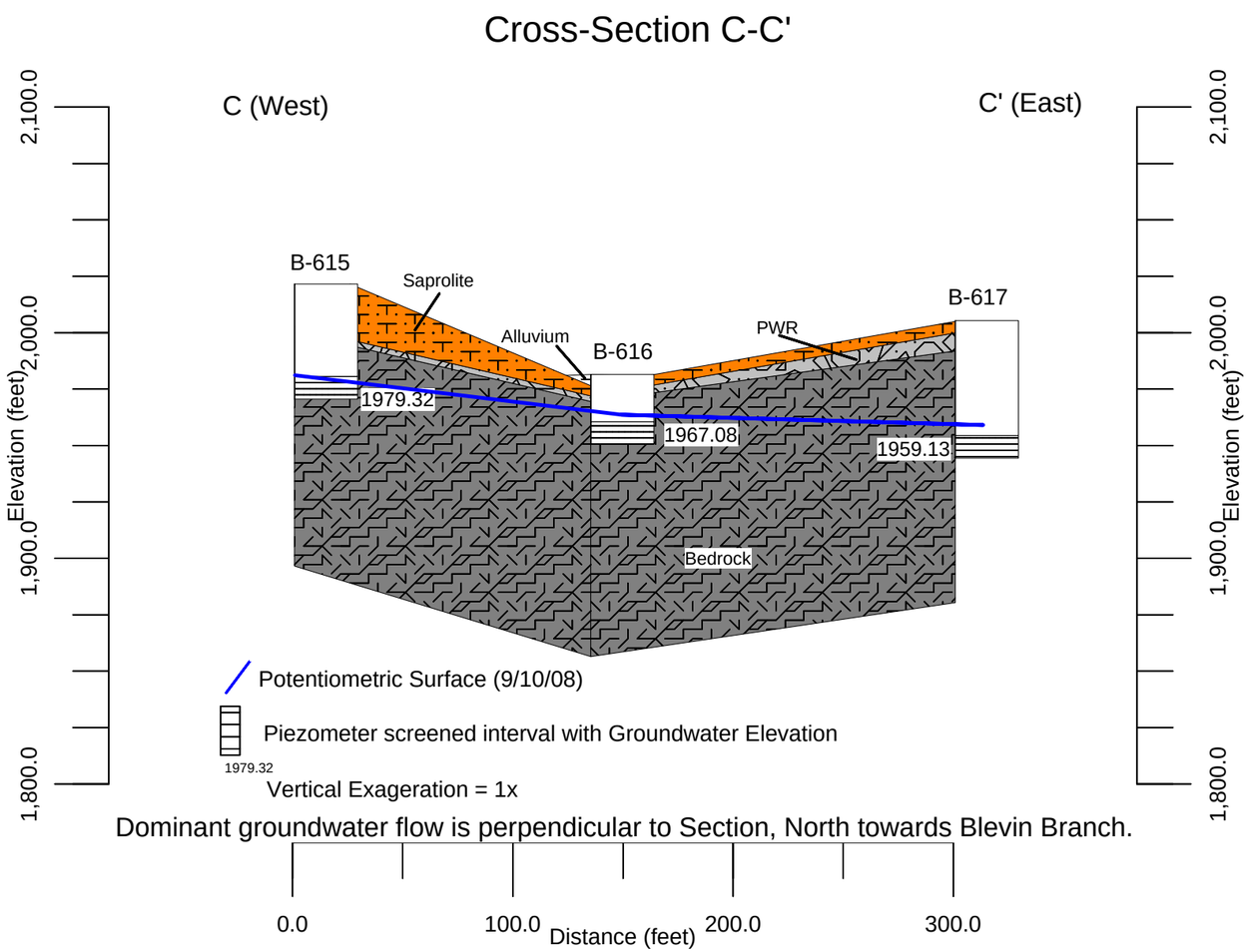




Dominant groundwater flow is perpendicular to Section, North towards Blevin Branch.

Figure 4
Cross-Section B - B'
Buncombe County C&D Landfill Phase 5 Expansion
Design Hydrogeologic Investigation

CDM



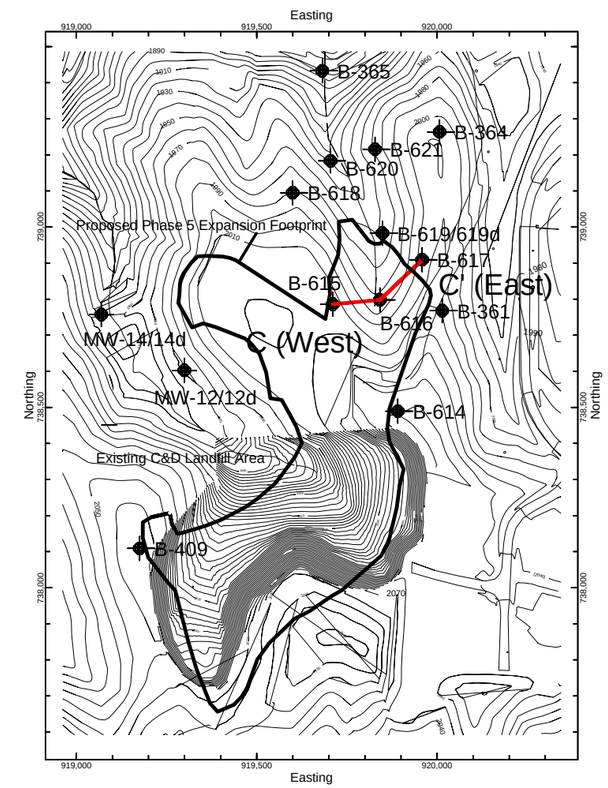


Figure 5
Cross-Section C - C'
Buncombe County C&D Landfill Phase 5 Expansion
Design Hydrogeologic Investigation

CDM

Precipitation that infiltrates into the ground will seep downward as wetting fronts following precipitation. These wetting fronts will follow the path of least resistance through zones of relatively higher conductivity in the saprolite and PWR. Upon reaching a less permeable surface such as the top of hard, unfractured bedrock, the water will spread laterally until it finds another relatively higher conductivity pathway downward such as a weathered zone or a fracture, or until it is discharged to the surface water system. These discharges are generally intermittent, and occur in the secondary drainage features following precipitation events. As saturation is not generally observed within the overburden, the fractured bedrock material is apparently capable of transmitting water at a rate exceeding infiltration except in local areas. The slug test and previous pumping tests results indicated that the fractured bedrock materials were often more permeable than the saprolite and PWR units.

3.4.2 Groundwater Flow

Over most locations in the Phase 5 area, the saturated zone lies within the bedrock beneath the saprolite and PWR hydrogeologic units. At some locations, the saturated zone is within the saprolite and/or PWR. The saturation found in these areas likely represents water that has infiltrated in surrounding areas, and then has moved laterally, possibly on the bedrock surface, until it accumulated in the lower elevation area. Within the overburden materials, the zone of highest conductance usually lies immediately above the bedrock surface, due to the lesser amounts of clay minerals in this interval than at the ground surface.

A downward gradient was identified in well nest B-619. Water within the saturated zone of the PWR must therefore generally either move laterally or downward. If laterally moving water intersects the ground surface before it finds a path permitting further downward migration, it will be discharged as surface water. No springs or seeps were noted in the proposed Phase 5 footprint. Cross-sections from this and previous investigations indicate that groundwater in the lower portion of the drainage features moves laterally along the PWR/bedrock interface (CDM, October 2000, June 2005).

Since the PWR is only locally saturated, the bedrock groundwater system is the primary water-bearing unit of concern for the site. The bulk of groundwater flow within the Blue Ridge Province is in the upper several hundred feet, due to the decrease in fracturing and thus bedrock permeability with depth (Freeze and Cherry 1979). Bedrock fracture flow is complex, with flow dependent upon fracture size, orientation, the degree of infilling, and interconnectedness. Localized weathered zones will also affect bedrock fracture flow. Since bedrock fracture flow systems cannot be characterized by direct observation, indirect methods must be utilized.

Aquifer hydraulic conductivity and transmissivity values derived from slug and pumping tests during this and previous investigations have indicated that the saturated PWR and fractured bedrock aquifer system is homogeneous. Slug tests were performed on select piezometers within the current investigation area. In addition,

data from slug tests conducted during previous investigations in and around the current C&D and existing Subtitle D area were also reviewed. Given the lithologically similar conditions found at the Phase 5 area and the active C&D Landfill and the Subtitle D area, this data would likely be representative of the hydraulic conductivity expected at the proposed C&D Landfill expansion. Hydraulic conductivity results were discussed in Section 3.3.2.

Within the current C&D area, hydraulic conductivity (K) values were 0.14 ft/day in MW-9 and 0.55 ft/day in MW-9d and 3.08 and 3.88 ft/day in MW-14 and MW-14d, respectively. Wells MW-9, -9d, and -14d are screened within bedrock and MW-14 is screened across the PWR/bedrock interface. Across the entire Buncombe County site, saprolite/PWR hydraulic conductivity (K) values ranged from 0.02 ft/day in B-119 to 1.28 ft/day in B-513. Hydraulic conductivities within the bedrock unit ranged from 0.02 ft/day in B-252 up to 47 ft/day in B-372.

Two long-term pumping tests were conducted in the two drainage features in Cells 1-3. Further discussion of the pump tests is contained in the Design Hydrogeologic Report (CDM, 1995a). Assuming a saturated thickness of 100 feet, the pumping test hydraulic conductivities ranged from 0.015 to 52 ft/day in the two drainage features in Cells 1-3. These ranges agree with the slug test hydraulic conductivities. This wide range in hydraulic conductivity values is due primarily to the varied nature of the bedrock fractures. At locations where a major fracture was encountered, hydraulic conductivities were very high, and likewise, in areas in which only minor or no fractures were encountered, hydraulic conductivities were comparatively low. The fractures appeared to be sufficiently interconnected beneath Cells 1-3, and similar conditions are expected in the C&D Landfill area. Pumping test results yielded some similarities in drawdown response in groups of observation wells, indicating fracture interconnection.

A third long-term pumping test was performed in the proposed Phase III C&D expansion area, southeast of the existing C&D landfill. Similar results were seen in the analysis of the C&D landfill pump test and the two pump tests conducted in the Subtitle D Landfill Cells 1-3, in that similarities in drawdown were seen between some of the observation wells and the pumping well. Based on the results of the pumping test, hydraulic conductivity values within the bedrock aquifer ranged from 0.07 ft/day to 31.68 ft/day and averaged 6 ft/day. These ranges agreed with the hydraulic conductivity values obtained from slug tests across the entire site (0.02 ft/day to 47 ft/day) and the values obtained from the pump tests conducted in the Cells 1-3 area (0.015 ft/day to 52 ft/day). The results of the pump test completed during the investigation at the Phase III C&D Landfill expansion were discussed further in the Additional Hydrogeologic Investigation Report (CDM, January 2002).

3.4.2.1 Groundwater Velocity

In the proposed C&D Landfill Phase 5 expansion area, groundwater flows away from the topographic high point in the vicinity of piezometer B-614 toward the secondary

and primary drainage features. The ridges bracketing the drainage feature form hydraulic divides, such that groundwater flow within the area is confined to the central drainage feature. The gradient from the top of the ridge (B-614) in the Phase 5 expansion down the drainage feature (B-365) as measured on September 10, 2008 was 0.15 ft/ft. Gradient values across the Phase 5 area averaged approximately 0.15 ft/ft.

Using the calculated hydraulic conductivity values from slug testing and horizontal hydraulic gradient information, groundwater velocity values can be calculated. The average linear velocity of groundwater flow was calculated using the following formula:

$$\mathbf{V_x = \frac{Kdh}{n_e dl}}$$

Where,
V_x = average linear velocity
K = hydraulic conductivity
dh/dl = hydraulic gradient
n_e = effective porosity

The average linear flow velocity is provided in Table 8. Average groundwater flow velocity at the site was 0.61 ft/day and ranged from 0.16 ft/day in B-617 to 1.36 ft/day in B-615.

The hydraulic conductivity was obtained from the slug test data presented in Table 7. The hydraulic gradient values were estimated using the potentiometric contour map from September 10, 2008 data. The effective porosity values were estimated based on average values for PWR and the discussion of fractured bedrock in Section 3.1.4.

Using the velocity calculation as described above, the estimated time to travel 250 feet from the edge of waste to the compliance boundary would be 409 days. This value suggests that a release of a conservative (nonretarded) contaminant from the landfill would likely take several months to 1 year to reach a monitoring system, after the release had reached groundwater. It should be noted that the estimated velocity rates are for average aquifer conditions and that actual velocity rates within bedrock fractures may vary significantly.

3.4.3 Surface Water Interactions and Groundwater Discharge

No groundwater discharge features (seeps or springs) were identified in the Phase 5 footprint area. The drainage feature flows north and discharges surface water runoff directly to Blevin Branch. The discharge of groundwater from the bedrock system in the Phase 5 area and across most of the C&D area has not been directly observed; however, there are bedrock springs in other areas of the County's property. While not directly observed, shallow bedrock groundwater in the Phase 5 area appears to discharge north to Blevin Branch.

Table 8
Summary of Calculated Groundwater Flow Velocities
Buncombe County Construction and Demolition Landfill - Phase 5 Expansion
Design Hydrogeologic Investigation

Piezometer Designation	Horizontal Gradient [1] (ft/ft)	Estimated Effective Porosity [2]	Hydraulic Conductivity [3] (ft/day)			**Average Linear Velocity (ft/day)**		
			Maximum	*Minimum*	*Average*	*Maximum*	*Minimum*	*Average*
B-615	0.11	0.15	2.42	1.3	1.86	1.77	0.95	1.36
B-617	0.05	0.15	0.7	0.27	0.49	0.23	0.09	0.16
B-619d	0.18	0.15	0.28	0.23	0.26	0.34	0.28	0.31

[1] Horizontal Gradient calculated from September 2008 potentiometric contours and distances on Sheet 3.

[2]- A conservative average value of 15% was used based on bedrock estimates by Heath and average PWR values from Johnson Soil Triangle (Table 4).

[3]-Values from calculated Hydraulic Conductivity calculations provided on Table 7.

4 Conclusions

This section presents conclusions based upon site investigation activities to date. These conclusions include considerations regarding the landfill design and considerations for the water quality monitoring plan.

4.1 Landfill Construction Considerations

Based on the findings of presented in this report and previous reports, the Phase 5 C&D Landfill area is considered to be suitable for expansion of the Buncombe County Solid Waste Management Facility. Similar to previous investigations for adjacent C&D Phases 1-4, the following issues should be considered in the landfill design.

- The separation between the base of the landfill and the seasonal high water table surface is not a site concern since the base of the landfill will be limited by the depth to bedrock. The depth to water below the expansion site, with the exception of a few areas of low elevation is within bedrock. With the exception of the base of the drainage feature, the depth to the top of bedrock is above the water table. Saturated overburden conditions were only found in one piezometer located in a low-lying topographic area of the secondary drainage feature within the Phase 5 area. Fill will be placed in this area.

- After construction of the landfill, groundwater recharge will decrease due to the placement of lower permeability separation material and improved run-off control, thus, reduced precipitation available for infiltration, and the later placement of the landfill cap. This reduction in groundwater recharge will cause a lowering in the water table surface; however, no change of direction of groundwater flow is anticipated. With the decrease in the water table surface, a decrease in the hydraulic gradient beneath the landfill will occur. This will decrease the groundwater flow velocity.

4.2 Water Quality Monitoring Plan Considerations

- The Site groundwater system is largely composed of a complex fractured bedrock aquifer system. Based on slug tests and pumping tests, this system is on a large-scale equivalent to a homogenous, anisotropic porous media, but on a small-scale may be somewhat random.

- In the Phase 5 area groundwater flows from area of higher topography to the area of lower topography, with convergent flows into the central drainage feature (hollow). This convergent flow can be monitored with wells completed near or within the features at the base of the hollow.

- Due to the downward gradients found throughout the site, deep bedrock groundwater should be monitored along with the shallower system. The deeper bedrock can be monitored by the installation of wells in deeper bedrock zones in which water bearing fractures are found.

4.3 Piezometer Abandonment

All borings intersecting groundwater at the site during this investigation have been constructed and maintained as permanent monitoring wells in accordance with NCAC 02C .0108.

Rule .0538(b)(2)(J) requires that all borings at the site not converted to permanent monitoring wells shall be properly abandoned in accordance with the NCAC 02C .0113. All piezometers within the landfill footprint will be overdrilled to the full depth of the boring and abandoned with cement or bentonite grout to a level that does not exceed in height the elevation of the proposed basegrade. Well abandonment records will be submitted following abandonment.

5 References

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Appendix A

Bore Logs and Well Construction Diagrams

CAMP DRESSER & McKEE INC.

Client Buncombe County Site Proposed Landfill Job No. 6447-010 Soil Bore/ Well No. **B-361H**

Drill Contractor Metro Drill Inc. Drilling Method Hollow Stem Auger Date Drilled 10/19/94

Piez/Casing Size & Type NA Screened Length/Interval NA Total Depth 27.0'

Field Geologist/Technician FW/DH Stickup NA Casing Elevation NA Static Water Level Dry

DEPTH (feet)	Lithology	DESCRIPTION Grain size - Lithology: Color, cements, bedding, odor, miscellaneous, (plasticity, hardness, textural maturity,etc.)	USCS	Blow Count 6",6",6"	Samples	Water Level	WELL CONSTRUCTION
		Silty sand to sandy silt, yellow to med orange-brown, fine-med, w/ relict gneiss texture, moist.	SM	7,8,10			
10		SAA, mixes to light orange-red-brown.	SM	8,17,25			
		PWR at 13'.					
		Silty sand, light red-brown to tan, fine-very fine, w/ 5% rock fragments to 3mm.	SM	50/5.5"			
20		SAA.	SM	50/2"			
		SAA.	SM	50/3"			
30		*Borehole refusal at 27.0' bgs.*					
40							
50							
60							
70							

Drill Rig Type Acker AD-2 Borehole Diameter 6"

CAMP DRESSER & McKEE INC.

Client Buncombe County Site Proposed Landfill Job No. 6447-010 Soil Bore/ Well No. **B-361**
Drill Contractor Caldwell Drilling Drilling Method Air Rotary Date Drilled 10/12/94
Piez/Casing Size & Type 2" PVC Screened Length/Interval 85.5-95.5' Total Depth 100'
Field Geologist/Technician FW Stickup 2.9' Casing Elevation 2018.19 Static Water Level 58'

DEPTH (feet)	Lithology	DESCRIPTION Lithological Description from Cuttings	USCS	Drilling Comments	Samples	Water Level	WELL CONSTRUCTION
		Silty sand-sandy silt, medium red-brown, fine, w/ rock fragments to 3mm, moist.	SM				
20		SAA, silty sand.	SM				
		Silty sand, light red-brown, fine-very fine, slightly moist.		*27.0' HSA refusal.*			
40		Silty sand, medium red-brown, w/ 5% rock fragments to 5mm.					
		SAA, slightly moist.					
60		SAA.		55-68' soft rock		▼	
		SAA.		68-96' hard rock			
80		SAA, w/ 1% rock fragments.					
		Silty sand, medium grey-brown, fine-medium w/ 1% rock fragments to 5mm.					
100		Silty sand, medium red-brown, fine w/ 5% rock fragments to 5mm.		95' 5 min blow test, >5 gpm			
		Drilled to 100'.					
120							
140							

Drill Rig Type Tamrock T25K2W Borehole Diameter 6"

CAMP DRESSER & McKEE INC.

Client Buncombe County Site Proposed Landfill Job No. 6447-010 Soil Bore/ Well No. **B-364H**

Drill Contractor Metro Drill Inc. Drilling Method Hollow Stem Auger Date Drilled 10/22/94

Piez/Casing Size & Type NA Screened Length/Interval NA Total Depth 15.5'

Field Geologist/Technician TG/FW Stickup NA Casing Elevation NA Static Water Level Dry

DEPTH (feet)	Lithology	DESCRIPTION Grain size - Lithology: Color, cements, bedding, odor, miscellaneous, (plasticity, hardness, textural maturity,etc.)	USCS	Blow Count 6",6",6"	Samples	Water Level	WELL CONSTRUCTION
		0-3' Sandy silt w/ some clay, tan.	ML	50/5"			
		3' Silty fine sand trace clay, white to tan, w/1-2 % rock fragments that crumble to fine-med sand w/ moderate pressure, relicit foliation. *PWR at 3'.*	SM	50/5"			
		8' SAA, slightly larger rock fragments.					
10		13' SAA, w/ 5% rock fragments, 10-20 mm, rock crumbles under moderate pressure, consists of quartz w/ some biotite (granitic gneiss).	SM	50/1"			
		Borehole refusal at 15.5' bgs.					
20							
30							
40							
50							
60							
70							

Drill Rig Type Acker AD-2 Borehole Diameter 6"

CAMP DRESSER & McKEE INC.

Client Buncombe County Site Proposed Landfill Job No. 6447-010 Soil Bore/ Well No. **B-364**

Drill Contractor Caldwell Drilling Drilling Method Air Rotary Date Drilled 10/18/94

Piez/Casing Size & Type 2" PVC Screened Length/Interval 90'-100' Total Depth 100'

Field Geologist/Technician FW/DH Stickup 2.7' Casing Elevation 2011.14 Static Water Level 88'

DEPTH (feet)	Lithology	DESCRIPTION Lithological Description from Cuttings	USCS	Drilling Comments	Samples	Water Level	WELL CONSTRUCTION
		Silty sand, light tan-cream, fine-very fine, w/ 1% rock fragments to 3mm, slightly moist.	SM				
20		SAA, light pale-brown.		*15.5' HSA refusal.*			
		Silty sand, medium red-brown, fine-very fine, w/ 3% rock fragments to 5mm, slightly moist.		30' hard			
40		Silty sand, dark grey, fine-very fine.		40' dry			
		SAA, light grey.		55' some water hard			
60		Silty sand, medium grey, fine, w/ 30 % rock fragments to 10mm.					
		Silty sand, medium-dark grey, w/ 1% rock fragments to 3mm.					
80		SAA, fine, w/ silty seams.					
		Silty sand w/ some clay, fine, w/ 20% rock fragments to 10mm.				▼	
		Silty sand, light grey, fine-very fine, w/ 1% rock fragments to 3mm.		100' 8 min blow test, good water			
100		*Drilled to 100'.*					
120							
140							

Drill Rig Type Tamrock T25K2W Borehole Diameter 6"

CAMP DRESSER & McKEE INC.

Client Buncombe County Site Proposed Landfill Job No. 6447-010 Soil Bore/ Well No. **B-365H**

Drill Contractor Metro Drill Inc. Drilling Method Hollow Stem Auger Date Drilled 10/19/94

Piez/Casing Size & Type NA Screened Length/Interval NA Total Depth 5.0'

Field Geologist/Technician TG/FW Stickup NA Casing Elevation NA Static Water Level Dry

DEPTH (feet)	Lithology	DESCRIPTION Grain size - Lithology: Color, cements, bedding, odor, miscellaneous, (plasticity, hardness, textural maturity,etc.)	USCS	Blow Count 6",6",6"	Samples	Water Level	WELL CONSTRUCTION
		0-2' Sandy silt w/ some clay, tan.	ML				
		2-5' Fine sandy silt w/ 10-40mm rock fragments interbedded w/ PWR lenses.	ML	16,13, 50/5.5"			
		PWR at 4'.					
10		*Borehole refusal at 5.0' bgs.*					
20							
30							
40							
50							
60							
70							

Drill Rig Type Acker AD-2 Borehole Diameter 6"

CAMP DRESSER & McKEE INC.

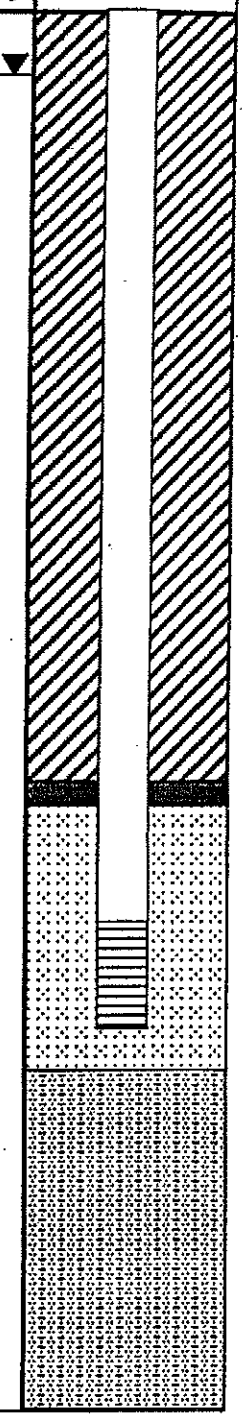
Client Buncombe County Site Proposed Landfill Job No. 6447-010 Soil Bore/ Well No. **B-365**

Drill Contractor Caldwell Drilling Drilling Method Air Rotary Date Drilled 10/18/94

Piez/Casing Size & Type 2" PVC Screened Length/Interval 90-100' Total Depth 140'

Field Geologist/Technician FW/DH Stickup 2.6' Casing Elevation 1872.89 Static Water Level 7'

DEPTH (feet)	Lithology	DESCRIPTION Lithological Description from Cuttings	USCS	Drilling Comments	Samples	Water Level	WELL CONSTRUCTION
		Silty sand, medium grey, fine, w/ 3% rock fragments to 3mm.		*5' HSA refusal.* Hard at surface			
20		SAA, w/ 5% rock fragments to 5mm.					
		SAA, w/ 20% rock fragments to 5mm.		Dry			
40		SAA, w/ 1% rock fragments to 10mm.		Dry			
		SAA, w/ 5% rock fragments.					
60		SAA.					
		SAA, light grey.		70' Blow test, dry			
80		SAA, medium grey, w/ 10% rock fragments to 5mm.					
		SAA, w/ 3% rock fragments.					
100		SAA.					
		Sandy silt, light grey, w/ 1% rock fragments to 3mm.					
120		Silty sand, light grey, w/ 1% rock fragments to 3mm.					
		SAA.		130' hard, dry			
140		SAA. *Drilled to 140'.*		140' 30 min blow test, dry			



Drill Rig Type Tamrock T25K2W Borehole Diameter 6"

CAMP DRESSER & McKEE

CDM

BORING LOG & MONITORING WELL DETAIL

614

Client: Buncombe County
Project Name: C&D Landfill Substantial Amendment
Project Location: Asheville, NC
Project Number: 6447-65973

Drilling Contractor: A&E Drilling
Surface Elevation (ft.): 2043.8
Drilling Method/Rig: HSA 8.5" OD/CME 750x/Schram T450
Total Depth (ft.): 42
Drillers: Lee Brown/Billy Nash
Depth to Initial Water Level (ft. BGS): 42
Drilling Date: Start: 6-2-08 **End:** 6-10-08
Development Method: None
Borehole Coordinates:
Field Screening Instrument: None
N 738,489.50 E 919,891.00
Logged By: D. Caldwell
Development Date: Start End
Top of Riser Elevation (ft.):

Sample Type	Sample Number	Pocket Pen. Reading (tsf)	Blows per 6 Inches	Sample Recovery (in.)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
								2043.8	Protective Casing; *Ground Surface*
SS	S-1		WOH WOH 2 3	24/16	ML	Dry, very soft to soft, brown, SILT, little sand.		0	Type II Portland Cement
SS	S-2		5 5 7 10	24/24	SM	Dry, medium dense, brown, fine to medium SAND, some silt, trace clay. Dry, medium dense, light gray and orange mottled, fine to medium SAND, some silt, little clay. **-RESIDUAL SOIL-**		2038.8 5	
SS	S-3		50/6"	6/6	PWR	Dry, very dense, light gray, fine to medium SAND, little silt. **-PARTIALLY WEATHERED ROCK-**		2033.8 10	
						Auger refusal at 11.5 feet below ground surface. Continued into bedrock with Air Rotary to first water bearing fracture. Boring terminated at 42 feet below ground surface.		2028.8 15	
								2023.8	

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Reviewed by: **Date:**

CAMP DRESSER & McKEE

CDM

BORING LOG & MONITORING WELL DETAIL

614

Client: Buncombe County

Project Name: C&D Landfill Substantial Amendment

Project Location: Asheville, NC

Project Number: 6447-65973

Sample Type	Sample Number	Pocket Pen. Reading (tsf)	Blows per 6 Inches	Sample Recovery (in.)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
								2023.8	
								20	
								2018.8	
								25	
									Bentonite Chips 2015.8 28.0
								2013.8	#2 Filter Sand 2013.8 30.0
								30	
									2" PVC, Schedule 40, 10-slot
								2008.8	
								35	
								2003.8	
								40	
									2002.3 2001.8 42.0
								1998.8	
								45	
								1993.8	
								50	
								1988.8	
								55	
								1983.8	

CAMP DRESSER & McKEE

CDM

BORING LOG & MONITORING WELL DETAIL

615

Client: Buncombe County
Project Name: C&D Landfill Substantial Amendment
Project Location: Asheville, NC
Project Number: 6447-65973

Drilling Contractor: A&E Drilling
Surface Elevation (ft.): 2021.6
Drilling Method/Rig: HSA 8.5" OD/CME 750x/Schram T450
Total Depth (ft.): 51.3
Drillers: Lee Brown/Billy Nash
Depth to Initial Water Level (ft. BGS): 33.5
Drilling Date: Start: 6-4-08 **End:** 6-12-08
Development Method:
Borehole Coordinates:
Field Screening Instrument:
N 738,785.80 E 919,711.10
Logged By: D. Caldwell
Development Date: Start End
Top of Riser Elevation (ft.):

Sample Type	Sample Number	Pocket Pen. Reading (tsf)	Blows per 6 Inches	Sample Recovery (in.)	Stratum Designation	Material Description	Graphic Log	Elev. / Depth (ft.)	Well Construction Detail
									Protective Casing
								2021.6	*Ground Surface*
SS	S-1		5 8 8 9	24/10	SM/ML	Dry, medium dense, brown, SAND and SILT, trace gravel. Relict rock fabric visible. **-RESIDUAL SOIL-**		0	Type II Portland Cement
SS	S-2		5 7 9 9	24/24		Dry, medium dense, light gray, brown, and black mottled, SAND and SILT, trace clay.		2016.6 / 5	
SS	S-3		14 20 21 31	24/18		Dry, dense, light to dark gray and reddish brown mottled, SAND and SILT.		2011.6 / 10	
ST / SS	T-1 / S-4		5 3 5 8	24/12 / 24/24		Shelby tube collected from 13.5 to 15.5 feet below ground surface. (Advance/Recovery=24"/12") Dry, loose, yellowish brown, SAND and SILT, trace clay. Dry, loose, light to dark gray and reddish brown mottled, SAND and SILT.		2006.6 / 15	
SS	S-5		50/4"	4/4	PWR	Dry, very dense, gray, GRAVEL, some		2001.6	

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Shelby tube collected from 13.5 to 15.5 feet below ground surface.

Reviewed by: **Date:**

CAMP DRESSER & McKEE

CDM

BORING LOG& MONITORING WELL DETAIL

615

Client: Buncombe County

Project Name: C&D Landfill Substantial Amendment

Project Location: Asheville, NC

Project Number: 6447-65973

Sample Type	Sample Number	Pocket Pen. Reading (tsf)	Blows per 6 Inches	Sample Recovery (in.)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
								2001.6	
					PWR	sand, little silt. **-PARTIALLY WEATHERED ROCK-**		20	
						Auger refusal at 21.5 feet below ground surface. Continued into bedrock with Air Rotary to first water bearing fracture. Boring terminated at 51.3 feet below ground surface.		1996.6 25	
								1991.6 30	
								1986.6 35	
								1981.6 40	Bentonite Chips: 1983.6 – 38.0 #2 Filter Sand: 1981.6 – 40.0 2" PVC, Schedule 40, 10-slot
								1976.6 45	
								1971.6 50	1970.9 1970.4 51.3
								1966.6 55	
								1961.6	

CAMP DRESSER & McKEE

CDM

BORING LOG & MONITORING WELL DETAIL

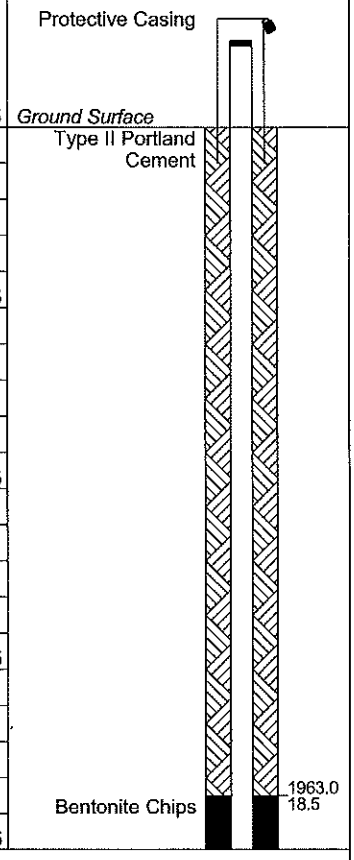
616

Client: Buncombe County
Project Name: C&D Landfill Substantial Amendment
Project Location: Asheville, NC
Project Number: 6447-65973

Drilling Contractor: A&E Drilling
Surface Elevation (ft.): 1981.5
Drilling Method/Rig: HSA 8.5" OD/CME 750x/Schram T450
Total Depth (ft.): 31
Drillers: Lee Brown/Billy Nash
Depth to Initial Water Level (ft. BGS): 12
Drilling Date: Start: 6-2-08 **End:** 6-11-08
Development Method:
Borehole Coordinates:
Field Screening Instrument:
N 738,797.70 E 919,841.80
Logged By: D. Caldwell
Development Date: Start End
Top of Riser Elevation (ft.):

Sample Type	Sample Number	Pocket Pen. Reading (tsf)	Blows per 6 Inches	Sample Recovery (in.)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)
SS	S-1		1 1 1 2	24/18	SC/CL	Moist, very loose, brown, SAND and SILT, trace clay. A few roots.		1981.5 Ground Surface; 0
ST	T-1			24/24		Shelby tube collected from 2.5 to 4.5 feet below ground surface. (Advance/Recovery=24"/24")		
SS	S-2		1 9 18 32	24/24		Moist, medium dense, brown, SAND and SILT, trace clay.		1976.5 5
					SC	Dry, medium dense, gray and orange, fine SAND, some clay.		
SS	S-3		16 20 50/4"	16/15				1971.5 10
					PWR	Dry, very dense, light to dark gray mottled, fine to coarse SAND, little silt. **-PARTIALLY WEATHERED ROCK-**		
						Auger refusal at 12.0 feet below ground surface. Continued into bedrock with Air Rotary to first water bearing fracture. Boring terminated at 31 feet below ground surface.		1966.5 15; 1961.5

Well Construction Detail



EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Shelby tube collected from 2.5 to 4.5 feet below ground surface.

Reviewed by: **Date:**

MONITORING WELL C&D EXPANSION.GPJ CDM_CORP.GDT 9/11/08

CAMP DRESSER & McKEE

CDM

BORING LOG & MONITORING WELL DETAIL

616

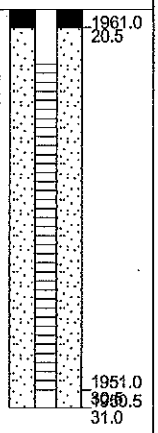
Client: Buncombe County

Project Name: C&D Landfill Substantial Amendment

Project Location: Asheville, NC

Project Number: 6447-65973

Sample Type	Sample Number	Pocket Pen. Reading (tsf)	Blows per 6 Inches	Sample Recovery (in.)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
								1961.5	
								20	#2 Filter Sand; 2" PVC, Schedule 40, 10-slot; 1961.0 / 20.5
								1956.5 / 25	
								1951.5 / 30	1951.0 / 30.5
								1946.5 / 35	31.0
								1941.5 / 40	
								1936.5 / 45	
								1931.5 / 50	
								1926.5 / 55	
								1921.5	



CAMP DRESSER & McKEE

CDM

BORING LOG & MONITORING WELL DETAIL

617

Client: Buncombe County
Project Name: C&D Landfill Substantial Amendment
Project Location: Asheville, NC
Project Number: 6447-65973

Drilling Contractor: A&E Drilling
Surface Elevation (ft.): 2005.4
Drilling Method/Rig: HSA 8.5" OD/CME 750x/Schram T450
Total Depth (ft.): 61
Drillers: Lee Brown/Billy Nash
Depth to Initial Water Level (ft. BGS): 45
Drilling Date: Start: 6-2-08 **End:** 6-12-08
Development Method:
Borehole Coordinates:
Field Screening Instrument:
N 738,909.20 E 919,958.60
Logged By: D. Caldwell
Development Date: Start End
Top of Riser Elevation (ft.):

Sample Type	Sample Number	Pocket Pen. Reading (tsf)	Blows per 6 Inches	Sample Recovery (in.)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
									Protective Casing
								2005.4	*Ground Surface*
SS	S-1		1 5 15 25	24/17	SM	Dry, medium dense, gray, black, and yellow mottled, fine to coarse SAND, some gravel and silt.		0	Type II Portland Cement
SS	S-2		17 35 50/6"	18/18		Dry, very dense, gray, black, and yellow mottled, fine to coarse SAND, some gravel and silt.		2000.4 5	
SS	S-3		17 49 50/3"	15/15	PWR	Dry, very dense, gray and orange mottled, fine to coarse SAND, some gravel and silt. **-PARTIALLY WEATHERED ROCK-**		1995.4 10	
SS	S-4		50/3"	3/3		Dry, very dense, dark gray and black, GRAVEL, some sand.		1990.4 15	
						Auger refusal at 13.5 feet below ground surface. Continued into bedrock with Air Rotary to first water bearing fracture. Boring terminated at 61 feet below ground surface.		1985.4	

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Reviewed by: **Date:**

CAMP DRESSER & McKEE

CDM

BORING LOG& MONITORING WELL DETAIL

617

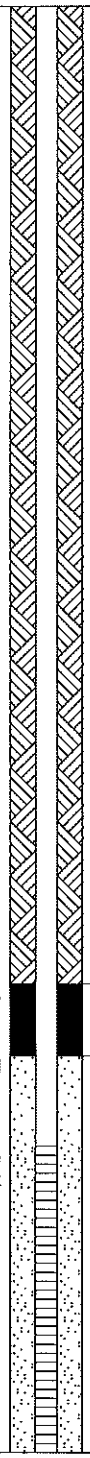
Client: Buncombe County

Project Name: C&D Landfill Substantial Amendment

Project Location: Asheville, NC

Project Number: 6447-65973

Sample Type	Sample Number	Pocket Pen. Reading (tsf)	Blows per 6 Inches	Sample Recovery (in.)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
								1985.4	
								20	
								1980.4	
								25	
								1975.4	
								30	
								1970.4	
								35	
								1965.4	
								40	
								1960.4	
								45	
									Bentonite Chips (1958.4 – 47.0)
									#2 Filter Sand (1956.4 – 49.0)
								1955.4	
								50	
									2" PVC, Schedule 40, 10-slot
								1950.4	
								55	
								1945.4	



CAMP DRESSER & McKEE

CDM

BORING LOG & MONITORING WELL DETAIL

617

Client: Buncombe County

Project Name: C&D Landfill Substantial Amendment

Project Location: Asheville, NC

Project Number: 6447-65973

Sample Type	Sample Number	Pocket Pen. Reading (tsf)	Blows per 6 Inches	Sample Recovery (in.)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
								1945.4	
								60	1944.9 / 60.5 / 1944.4 / 61.0
								1940.4 / 65	
								1935.4 / 70	
								1930.4 / 75	
								1925.4 / 80	
								1920.4 / 85	
								1915.4 / 90	
								1910.4 / 95	
								1905.4	

CAMP DRESSER & McKEE

CDM

BORING LOG & MONITORING WELL DETAIL

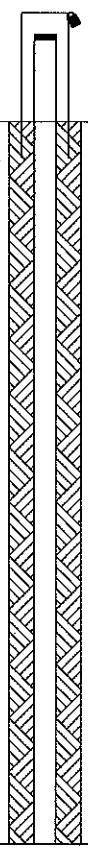
618

Client: Buncombe County
Project Name: C&D Landfill Substantial Amendment
Project Location: Asheville, NC
Project Number: 6447-65973

Drilling Contractor: A&E Drilling
Surface Elevation (ft.): 1985.5
Drilling Method/Rig: HSA 8.5" OD/CME 750x/Schram T450
Total Depth (ft.): 50
Drillers: Lee Brown/Billy Nash
Depth to Initial Water Level (ft. BGS): 45
Drilling Date: Start: 6-4-08 **End:** 6-12-08
Development Method:
Borehole Coordinates:
Field Screening Instrument:
N 739,095.00 E 919,599.70
Logged By: D. Caldwell
Development Date: Start End
Top of Riser Elevation (ft.):

Sample Type	Sample Number	Pocket Pen. Reading (tsf)	Blows per 6 Inches	Sample Recovery (in.)	Stratum Designation	Material Description	Elev. Depth (ft.)
							1985.5 Ground Surface
SS	S-1		3 4 5 6	24/14	ML	Moist, stiff, orangish brown, SILT, some sand, few roots.	0
					SM/ML	Relict fabric visible. -RESIDUAL SOIL- Dry, loose, light brown, SAND and SILT.	
SS	S-2		5 6 8 9	24/16		Dry, medium dense, white, light gray, and orange mottled, SAND and SILT.	1980.5 5
ST	T-1			24/24		Shelby tube collected from 7 to 9 feet below ground surface. (Advance/Recovery=24"/24")	
SS	S-3		4 5 6 10	24/16		Dry, medium dense, white, light gray, and orange mottled, SAND and SILT.	1975.5 10
SS	S-4		6 13 21 26	24/15		Dry, dense, gray, SAND and SILT.	1970.5 15
SS	S-5		50/3"	3/3	PWR	Dry, very dense, gray and brown, fine to	1965.5

Well Construction Detail



EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Shelby tube collected from 7 to 9 feet below ground surface.

Reviewed by: **Date:**

CAMP DRESSER & McKEE

CDM

BORING LOG & MONITORING WELL DETAIL

618

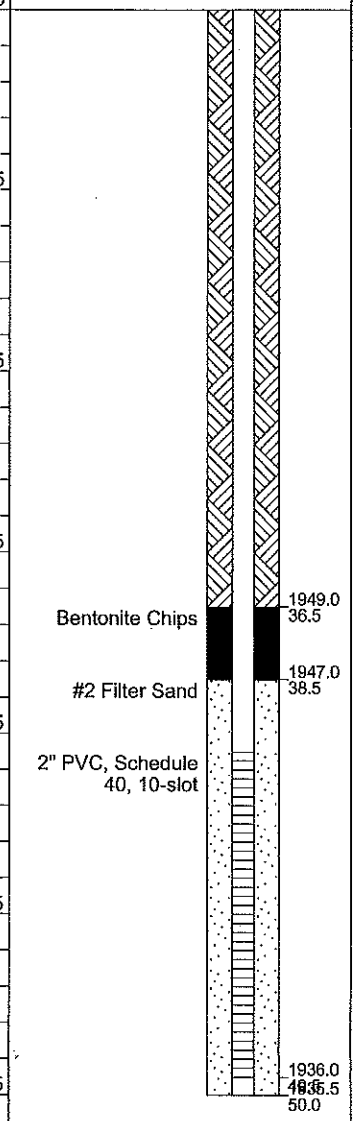
Client: Buncombe County

Project Name: C&D Landfill Substantial Amendment

Project Location: Asheville, NC

Project Number: 6447-65973

Sample Type	Sample Number	Pocket Pen. Reading (tsf)	Blows per 6 Inches	Sample Recovery (in.)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
								1965.5	
					PWR	coarse SAND, some silt, trace gravel and clay. **-PARTIALLY WEATHERED ROCK-**		20	
SS	S-6		12 13 50/5"	17/17		Dry, very dense, gray and brown, fine to coarse SAND, some silt, trace gravel and clay.		1960.5 25	
						Auger refusal at 29 feet below ground surface. Continued into bedrock with Air Rotary to first water bearing fracture. Boring terminated at 50 feet below ground surface.		1955.5 30	
								1950.5 35	
								1945.5 40	
								1940.5 45	
								1935.5 50	
								1930.5 55	
								1925.5	



CAMP DRESSER & McKEE

CDM

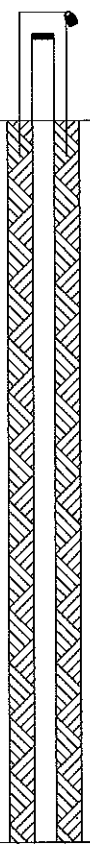
BORING LOG & MONITORING WELL DETAIL

620

Client: Buncombe County
Project Name: C&D Landfill Substantial Amendment
Project Location: Asheville, NC
Project Number: 6447-65973

Drilling Contractor: A&E Drilling
Surface Elevation (ft.): 1937.9
Drilling Method/Rig: HSA 8.5" OD/CME 750x/Schram T450
Total Depth (ft.): 51.5
Drillers: Lee Brown/Billy Nash
Depth to Initial Water Level (ft. BGS): 48
Drilling Date: Start: 6-3-08 **End:** 6-11-08
Development Method:
Borehole Coordinates:
Field Screening Instrument:
N 739,183.30 E 919,704.70
Logged By: D. Caldwell
Development Date: Start End
Top of Riser Elevation (ft.):

Sample Type	Sample Number	Pocket Pen. Reading (tsf)	Blows per 6 Inches	Sample Recovery (in.)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
								1937.9	Protective Casing; *Ground Surface*
SS	S-1		1 2 2 3	24/12	SM	Moist, very loose to loose, brown, fine to coarse SAND, some silt.		0	Type II Portland Cement
						Auger refusal at 3.5 feet below ground surface. Continued into bedrock with Air Rotary to first water bearing fracture. Boring terminated at 51.5 feet below ground surface.		1932.9 / 5	
								1927.9 / 10	
								1922.9 / 15	
								1917.9	



EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Reviewed by: **Date:**

CAMP DRESSER & McKEE

CDM

BORING LOG & MONITORING WELL DETAIL

620

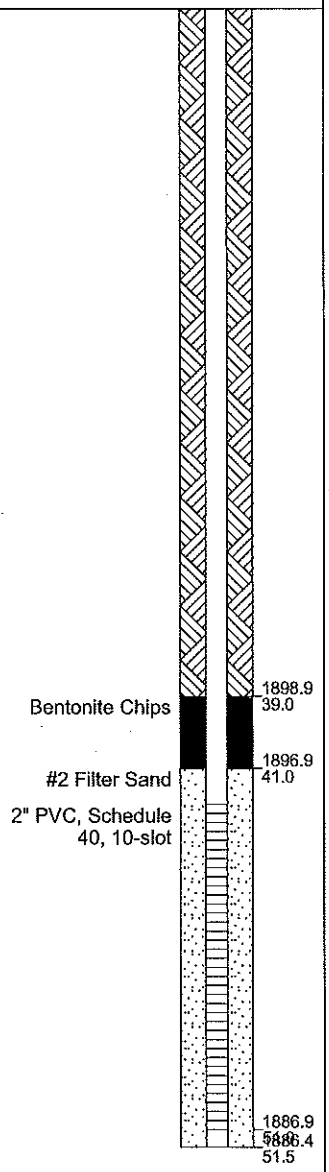
Client: Buncombe County

Project Name: C&D Landfill Substantial Amendment

Project Location: Asheville, NC

Project Number: 6447-65973

Sample Type	Sample Number	Pocket Pen. Reading (tsf)	Blows per 6 Inches	Sample Recovery (in.)	Stratum Designation	Material Description	Graphic Log	Elev. / Depth (ft.)	Well Construction Detail
								1917.9	
								20	
								1912.9 / 25	
								1907.9 / 30	
								1902.9 / 35	
								1897.9 / 40	Bentonite Chips; #2 Filter Sand; 2" PVC, Schedule 40, 10-slot
								1892.9 / 45	
								1887.9 / 50	
								1882.9 / 55	
								1877.9	



CAMP DRESSER & McKEE

CDM

BORING LOG & MONITORING WELL DETAIL

621

Client: Buncombe County
Project Name: C&D Landfill Substantial Amendment
Project Location: Asheville, NC
Project Number: 6447-65973

Drilling Contractor: A&E Drilling
Surface Elevation (ft.): 1972.5
Drilling Method/Rig: HSA 8.5" OD/CME 750x/Schram T450
Total Depth (ft.): 45
Drillers: Lee Brown/Billy Nash
Depth to Initial Water Level (ft. BGS): 35
Drilling Date: Start: 6-3-08 **End:** 6-11-08
Development Method:
Borehole Coordinates:
Field Screening Instrument:
N 739,215.20 E 919,828.10
Logged By: D. Caldwell
Development Date: Start End
Top of Riser Elevation (ft.):

Sample Type	Sample Number	Pocket Pen. Reading (tsf)	Blows per 6 Inches	Sample Recovery (in.)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
								1972.5	Protective Casing; *Ground Surface*
SS	S-1		4 5 6 6	24/16	SM	Dry, medium dense, brown, orange, and black mottled, fine to coarse SAND, some silt. Relict rock fabric visible **-RESIDUAL SOIL-**		0	Type II Portland Cement
SS	S-2		9 16 50/4"	16/16	PWR	Dry, very dense, brown, orange, and black mottled, fine to medium SAND, some silt. **-PARTIALLY WEATHERED ROCK-**		1967.5 / 5	
SS	S-3		50/6"	6/6		Dry, very dense, gray, red, and black mottled, fine to medium SAND, little silt.		1962.5 / 10	
						Auger refusal at 11.5 feet below ground surface. Continued into bedrock with Air Rotary to first water bearing fracture. Boring terminated at 45 feet below ground surface.		1957.5 / 15	
								1952.5	

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
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SAMPLING TYPES:
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BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Reviewed by: **Date:**

CAMP DRESSER & McKEE

CDM

BORING LOG& MONITORING WELL DETAIL

621

Client: Buncombe County

Project Name: C&D Landfill Substantial Amendment

Project Location: Asheville, NC

Project Number: 6447-65973

Sample Type	Sample Number	Pocket Pen. Reading (tsf)	Blows per 6 Inches	Sample Recovery (in.)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
								1952.5	
								20	
								1947.5	
								25	
								1942.5	
								30	
									Bentonite Chips 1940.5 32.0
									#2 Filter Sand 1938.5 34.0
								1937.5	
								35	2" PVC, Schedule 40, 10-slot
								1932.5	
								40	
								1927.5	1928.0
								45	45.0
								1922.5	
								50	
								1917.5	
								55	
								1912.5	

Appendix B

Geotechnical Laboratory Data

geotechnics
INTEGRITY IN TESTING

MOISTURE CONTENT

ASTM D 2216 (SOP-S1)

Client CDM
Client Reference BUNCOMBE CO. C&D LF EXP.
Project No. 2008-598-01

PG.1

Lab ID	.001	.002	.003	.004	.005
Boring No.	B-614	B-615	B-615	B-617	B-618
Depth (ft)	3.5-5.5	4-6	14-15	8.5-10	9-11
Sample No.	S-2	S-2	S-4T	S-3	S-3
Tare Number	250	213	203	P-12	200
Wt. of Tare & WS (gm)	222.43	224.44	237.7	257.19	229.34
Wt. of Tare & DS (gm)	216.62	219.6	228.33	254.55	223.33
Wt. of Tare (gm)	169.42	173.44	171.12	196.45	171.85
Wt. of Water (gm)	5.81	4.84	9.37	2.64	6.01
Wt. of DS (gm)	47.2	46.16	57.21	58.1	51.48
Water Content (%)	**12.3**	**10.5**	**16.4**	**4.5**	**11.7**

Lab ID	.006	.007	.008	.009	.010
Boring No.	B-618	B-619	B-619	B-619	B-620
Depth (ft)	24-26	4-5	5-6	9-11	0-2
Sample No.	S-6	S-1T	S-1B	S-2	S-1
Tare Number	212	215	202	214	208
Wt. of Tare & WS (gm)	204.52	224.13	283.68	236.93	216.14
Wt. of Tare & DS (gm)	201.83	216.91	275.01	229.01	210.06
Wt. of Tare (gm)	171.6	172.33	197.38	171.34	169.85
Wt. of Water (gm)	2.69	7.22	8.67	7.92	6.08
Wt. of DS (gm)	30.23	44.58	77.63	57.67	40.21
Water Content (%)	**8.9**	**16.2**	**11.2**	**13.7**	**15.1**

Notes : *NA*

Tested By *SD* *Date* *7/17/2008* *Checked By* GEM *Date* 7-21-08

DCN: CT-S1 DATE 6-30-98 REVISION: 2
\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01 PG1 WATCONT.XLS]Sheet1

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geotechnics
INTEGRITY IN TESTING

MOISTURE CONTENT

ASTM D 2216 (SOP-S1)

Client CDM
Client Reference BUNCOMBE CO. C&D LF EXP.
Project No. 2008-598-01

PG.2

Lab ID	.011	.012	.013	.014	.015
Boring No.	B-621	B-622	B-623	B-623	B-623
Depth (ft)	9-11	9-11	4-6	14-16	24-26
Sample No.	S-3	S-3	S-2	S-4	S-6
Tare Number	201	216	318	319	P-12
Wt. of Tare & WS (gm)	227.39	198.05	273.68	249.17	259.84
Wt. of Tare & DS (gm)	224.44	195.38	258.53	243.13	256.24
Wt. of Tare (gm)	170.76	170.79	207.63	208.98	196.42
Wt. of Water (gm)	2.95	2.67	15.15	6.04	3.6
Wt. of DS (gm)	53.68	24.59	50.9	34.15	59.82
Water Content (%)	**5.5**	**10.9**	**29.8**	**17.7**	**6.0**

Lab ID	.016	.017	.018	.019	.020
Boring No.	B-624	B-624	B-625	B-626	B-626
Depth (ft)	0-2	4-6	4-5	0-1	3-5
Sample No.	S-1	S-2	S-1T	S-1T	S-2
Tare Number	820	316	209	211	318
Wt. of Tare & WS (gm)	285.28	297.96	234.77	275.39	296.44
Wt. of Tare & DS (gm)	270.46	292.58	230.92	260.39	289.68
Wt. of Tare (gm)	208.06	208.13	171.71	171.18	207.59
Wt. of Water (gm)	14.82	5.38	3.85	15	6.76
Wt. of DS (gm)	62.4	84.45	59.21	89.21	82.09
Water Content (%)	**23.8**	**6.4**	**6.5**	**16.8**	**8.2**

Notes : *NA*

Tested By *SD* *Date* *7/17/2008* *Checked By* GEM *Date* 7-21-08

 DCN: CT-S1 DATE 6-30-98 REVISION: 2 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01 PG2 WATCONT.XLS]Sheet1*

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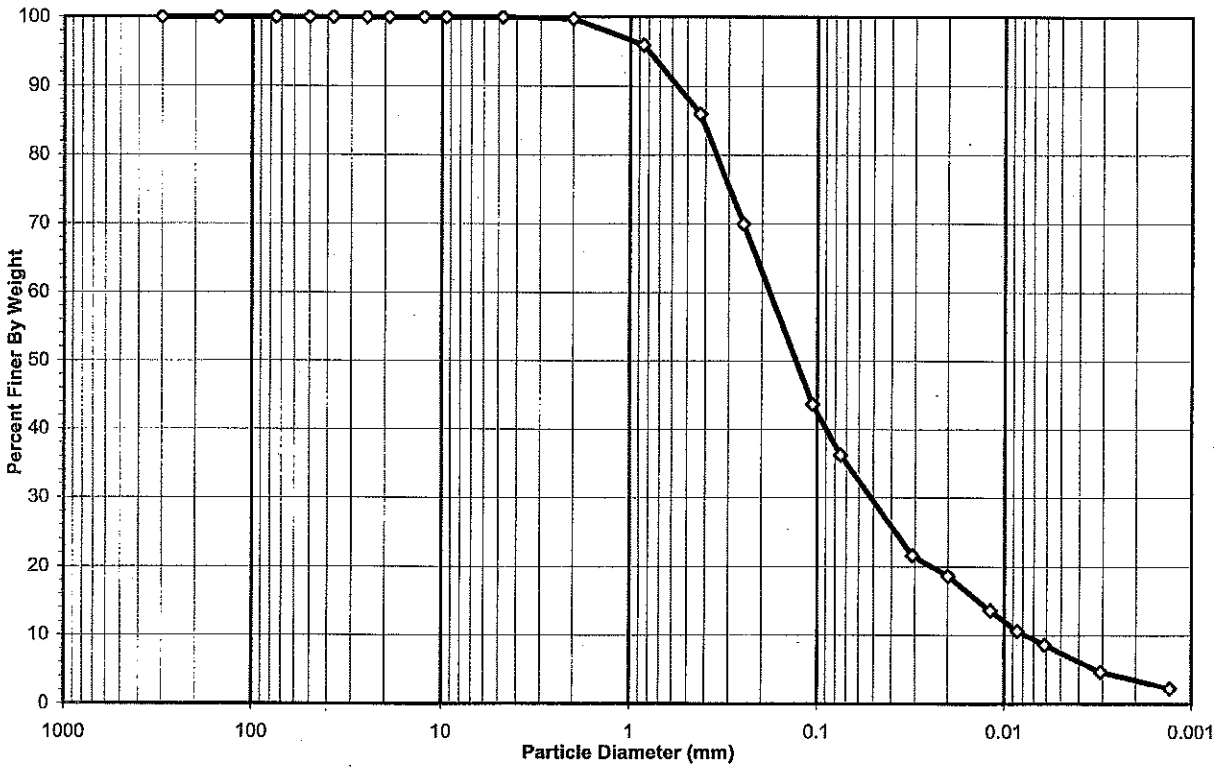
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-614
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	3.5-5.5
Project No.	2008-598-01	Sample No.	S-2
Lab ID	2008-598-01-01	Soil Color	**LIGHT TAN**

	SIEVE ANALYSIS					HYDROMETER
USCS	cobbles	gravel		sand		silt and clay fraction
USDA	cobbles	gravel		sand	silt	clay

12" 6" 3" 3/4" 3/8" #4 #10 #20 #40 #140 #200



USCS Summary		
Sieve Sizes (mm)		**Percentage**
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	63.78
Finer Than #200	*Silt & Clay*	36.22

USCS Symbol ***SM, TESTED***

USCS Classification ***SILTY SAND***

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-01 #10 Split Hydro rev 8.xls]Sheet1*

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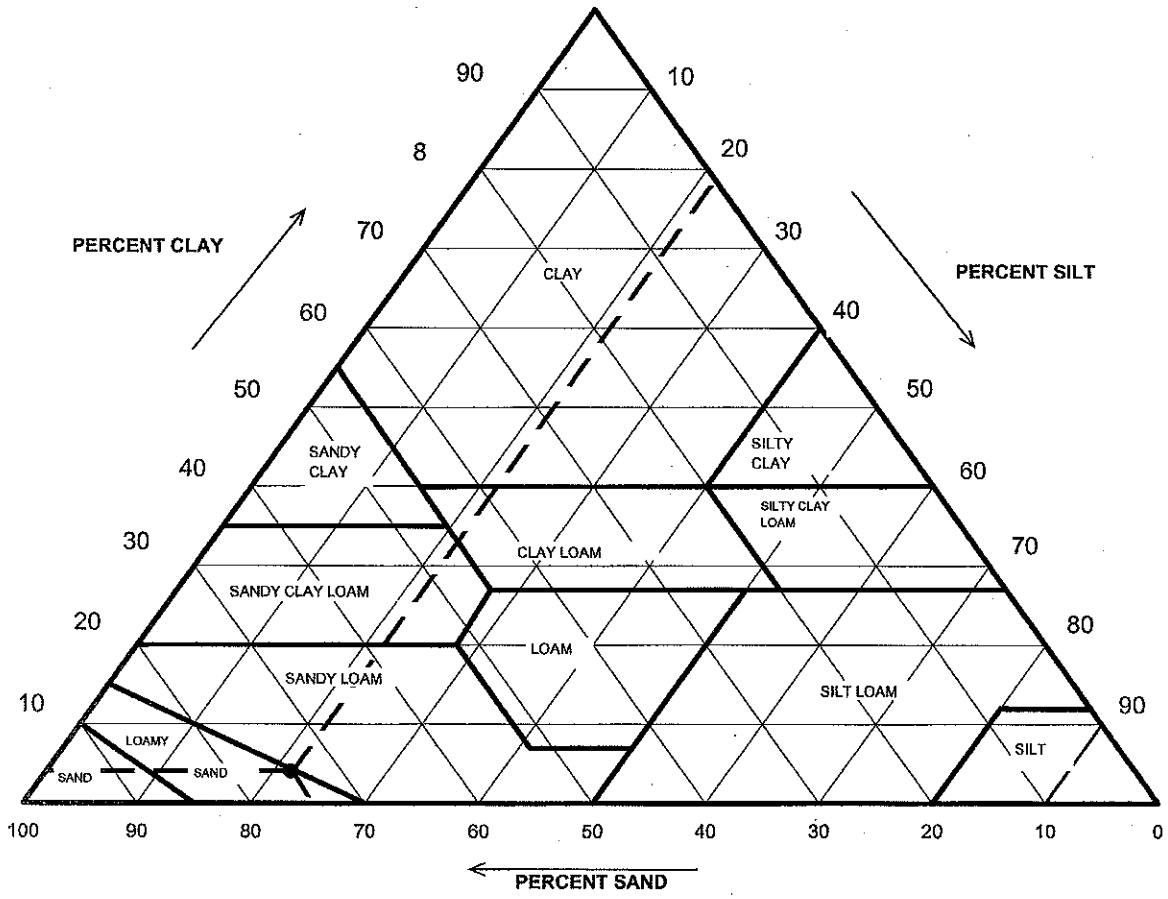
USDA CLASSIFICATION CHART

Client	CDM	Boring No.	B-614
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	3.5-5.5
Project No.	2008-598-01	Sample No.	S-2
Lab ID	2008-598-01-01	Soil Color	LIGHT TAN



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	0.25	**0.00**
2	99.75	*Sand*	74.27	**74.46**
0.05	25.47	*Silt*	21.46	**21.52**
0.002	4.01	*Clay*	4.01	**4.02**

USDA Classification: ***LOAMY SAND***

DCN: CT-S3P DATE:02/15/05 REVISION:8 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-01 #10 Split Hydro rev 8.xls]Sheet1

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WASH SIEVE ANALYSIS #10 SPLIT

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-614
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	3.5-5.5
Project No.	2008-598-01	Sample No.	S-2
Lab ID	2008-598-01-01	Soil Color	**LIGHT TAN**

Moisture Content/sieve +10 Material		Moisture Content for Hydrometer Portion	
Tare No.	250	Tare No.	L-1
Wgt.Tare + Wet Soil (gm)	222.43	Wgt.Tare + Wet Soil (gm)	50.80
Wgt.Tare + Dry Soil (gm)	216.62	Wgt.Tare + Dry Soil (gm)	50.29
Weight of Tare (gm)	169.42	Weight of Tare (gm)	15.80
Weight of Water (gm)	5.81	Weight of Water (gm)	0.51
Weight of Dry Soil (gm)	47.20	Weight of Dry Soil (gm)	34.49
Moisture Content (%)	**12.3**	**Moisture Content (%)**	**1.5**

Soil Specimen Data			
Wet Weight +#10 Material (gm)	53.01	Weight of the Dry Sample (gm)	145.74
Dry Weight +#10 Material(gm)	47.2	Weight of minus #200 material (gm)	35.78
Wet Weight Hydro. Material.(gm)	100.00	Weight of plus #200 material (gm)	109.96
Dry Weight Hydro. Material (gm)	98.54		
Total Dry Weight Sample (gm)	145.74	**J-FACTOR (%FINER THAN #10)**	**0.9975**

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.00	0.00	0.00	100.00	**100.00**
#10	2.00	0.12	0.25	0.25	99.75	**99.75**
#20	0.85	3.72	3.78	3.78	96.22	**95.98**
#40	0.425	9.93	10.08	13.85	86.15	**85.93**
#60	0.250	15.79	16.02	29.88	70.12	**69.95**
#140	0.106	25.96	26.34	56.22	43.78	**43.67**
#200	0.075	7.36	7.47	63.69	36.31	**36.22**
Pan	-	35.78	36.31	100.00	-	-

Notes :

Tested By SD Date 7/14/2008 Checked By GEM Date 7-16-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-01 #10 Split Hydro rev 8.xls]Sheet1*

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HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-614
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	3.5-5.5
Project No.	2008-598-01	Sample No.	S-2
Lab ID	2008-598-01-01	Soil Color	**LIGHT TAN**

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	25.0	25.0	25.5	3.35	21.6	21.7	0.01253	0.0309	**21.6**
5		22.0	25.5	3.35	18.6	18.7	0.01253	0.0200	**18.6**
15		17.0	25.5	3.35	13.6	13.7	0.01253	0.0119	**13.6**
30		14.0	25.5	3.35	10.6	10.7	0.01253	0.0086	**10.6**
60		12.0	25.5	3.35	8.6	8.7	0.01253	0.0061	**8.6**
250		8.0	25.5	3.35	4.6	4.6	0.01253	0.0031	**4.6**
1440		6.0	24.2	3.73	2.3	2.3	0.01272	0.0013	**2.3**

Soil Specimen Data		**Other Corrections**	
Tare + Dry Material (gm)	98.54	a - Factor	0.986
Weight of Tare (gm)	0		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 10	99.75
Weight of Dry Material (gm)	98.54		
		Specific Gravity	2.72 Assumed

Note:

Tested By JBD Date 7/11/2008 Checked By GEM Date 7-16-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-01 #10 Split Hydro rev 8.xls]Sheet1*

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ATTERBERG LIMITS

ASTM D 4318-98 / AASHTO T89 (SOP - S4A)

Client	CDM	Boring No.	B-614
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	3.5-5.5
Project No.	2008-598-01	Sample No.	S-2
Lab ID	2008-598-01-01	Soil Description	**LIGHT TAN SILT**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

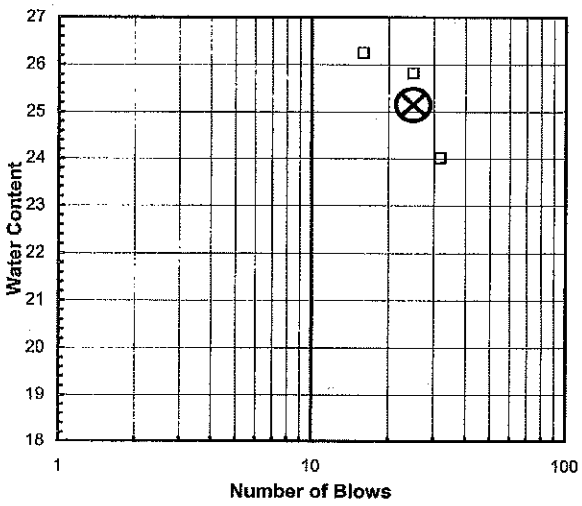
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	L-1	K-1	P-1	**MULTIPOINT**
Wt. of Tare & WS (gm)	28.32	31.31	25.02	
Wt. of Tare & DS (gm)	25.72	28.12	23.22	
Wt. of Tare (gm)	15.81	15.76	15.72	
Wt. of Water (gm)	2.6	3.2	1.8	
Wt. of DS (gm)	9.9	12.4	7.5	
Moisture Content (%)	**26.2**	**25.8**	**24.0**	
Number of Blows	**16**	**25**	**32**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	B-1	E-2	
Wt. of Tare & WS (gm)	32.92	32.40	
Wt. of Tare & DS (gm)	30.75	30.33	
Wt. of Tare (gm)	22.07	21.91	
Wt. of Water (gm)	2.2	2.1	
Wt. of DS (gm)	8.7	8.4	
Moisture Content (%)	**25.0**	**24.6**	**0.4**

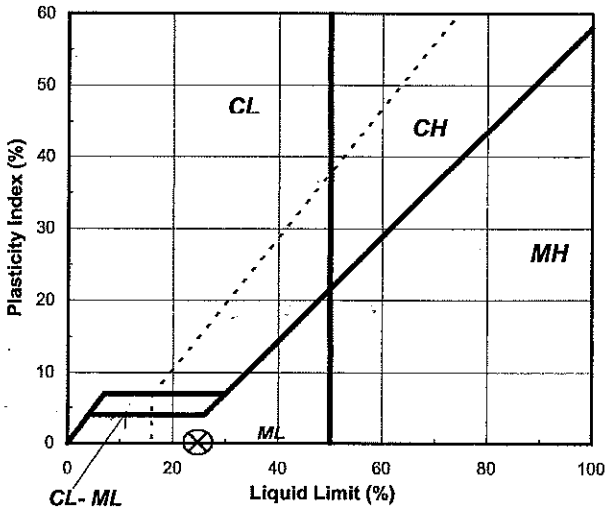
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**25**
Plastic Limit (%)	**25**
Plasticity Index (%)	**0**
USCS Symbol	**ML**

Flow Curve



Plasticity Chart



Tested By SD *Date* 7/15/2008 *Checked By* GEM *Date* 7-16-08

page 1 of 1 **DCN:** CT-S4B **DATE:** 10/8/2001 **REVISION:** 2

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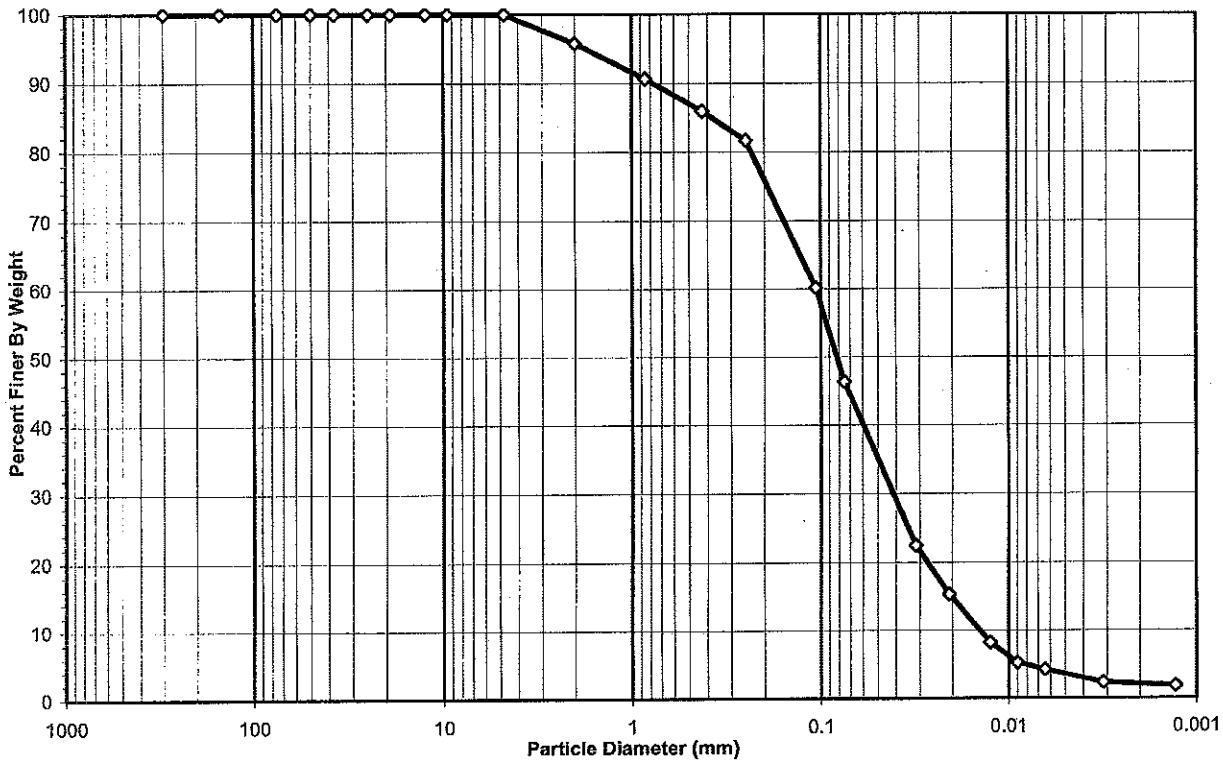
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-615
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	4-6
Project No.	2008-598-01	Sample No.	S-2
Lab ID	2008-598-01-02	Soil Color	**LIGHT BROWN**

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay

12" 6" 3" 3/4" 3/8" #4 #10 #20 #40 #140 #200



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	53.66
Finer Than #200	*Silt & Clay*	46.34

USCS Symbol ***SM, TESTED***

USCS Classification ***SILTY SAND***

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-02 #10 Split Hydro rev 8.xls]Sheet1*

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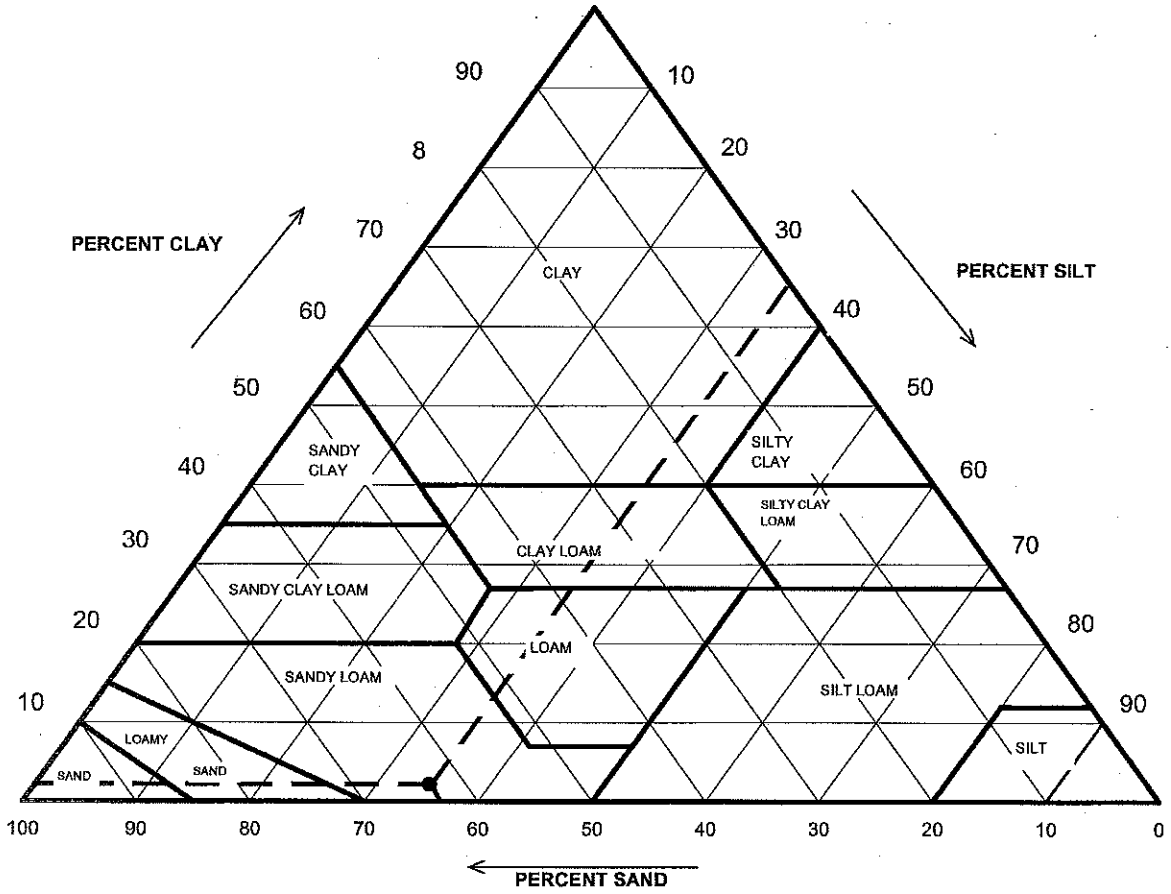
USDA CLASSIFICATION CHART

Client	CDM	Boring No.	B-615
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	4-6
Project No.	2008-598-01	Sample No.	S-2
Lab ID	2008-598-01-02	Soil Color	LIGHT BROWN



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	4.25	**0.00**
2	95.75	*Sand*	60.54	**63.23**
0.05	35.21	*Silt*	33.16	**34.63**
0.002	2.05	*Clay*	2.05	**2.14**

USDA Classification: ***SANDY LOAM***

DCN: CT-S3P DATE:02/15/05 REVISION:6 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-02 #10 Split Hydro rev 8.xls]Sheet1

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WASH SIEVE ANALYSIS #10 SPLIT

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-615
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	4-6
Project No.	2008-598-01	Sample No.	S-2
Lab ID	2008-598-01-02	Soil Color	**LIGHT BROWN**

Moisture Content/sieve +10 Material		Moisture Content for Hydrometer Portion	
Tare No.	213	Tare No.	R-1
Wgt.Tare + Wet Soil (gm)	224.44	Wgt.Tare + Wet Soil (gm)	55.23
Wgt.Tare + Dry Soil (gm)	219.60	Wgt.Tare + Dry Soil (gm)	52.51
Weight of Tare (gm)	173.44	Weight of Tare (gm)	15.65
Weight of Water (gm)	4.84	Weight of Water (gm)	2.72
Weight of Dry Soil (gm)	46.16	Weight of Dry Soil (gm)	36.86
Moisture Content (%)	**10.5**	**Moisture Content (%)**	**7.4**

Soil Specimen Data			
Wet Weight +#10 Material (gm)	51.00	Weight of the Dry Sample (gm)	139.29
Dry Weight +#10 Material(gm)	46.2	Weight of minus #200 material (gm)	45.07
Wet Weight Hydro. Material.(gm)	100.00	Weight of plus #200 material (gm)	94.22
Dry Weight Hydro. Material (gm)	93.13		
Total Dry Weight Sample (gm)	139.29	**J-FACTOR (%FINER THAN #10)**	**0.9575**

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.00	0.00	0.00	100.00	**100.00**
#10	2.00	1.96	4.25	4.25	95.75	**95.75**
#20	0.85	4.99	5.36	5.36	94.64	**90.62**
#40	0.425	4.56	4.90	10.25	89.75	**85.93**
#60	0.250	4.14	4.45	14.70	85.30	**81.68**
#140	0.106	20.97	22.52	37.22	62.78	**60.12**
#200	0.075	13.40	14.39	51.61	48.39	**46.34**
Pan	-	45.07	48.39	100.00	-	-

Notes :

Tested By SD Date 7/16/2008 Checked By GBM Date 7-16-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-02 #10 Split Hydro rev 8.xls]Sheet1*

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HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-615
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	4-6
Project No.	2008-598-01	Sample No.	S-2
Lab ID	2008-598-01-02	Soil Color	**LIGHT BROWN**

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	26.0	26.0	23.7	3.88	22.1	23.4	0.01279	0.0314	**22.4**
5		19.0	23.7	3.88	15.1	16.0	0.01279	0.0208	**15.3**
15		12.0	23.7	3.88	8.1	8.6	0.01279	0.0125	**8.2**
30		9.0	23.8	3.85	5.2	5.5	0.01278	0.0090	**5.2**
60		8.0	23.8	3.85	4.2	4.4	0.01278	0.0064	**4.2**
250		6.0	24.3	3.70	2.3	2.4	0.01270	0.0031	**2.3**
1440		5.0	25.9	3.24	1.8	1.9	0.01247	0.0013	**1.8**

Soil Specimen Data		**Other Corrections**	
Tare + Dry Material (gm)	93.13	a - Factor	0.986
Weight of Tare (gm)	0		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 10	95.75
Weight of Dry Material (gm)	93.13		
		Specific Gravity	2.72 Assumed

Note:

Tested By JBD Date 7/15/2008 Checked By GBM Date 7-16-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-02 #10 Split Hydro rev 8.xls]Sheet1*

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ATTERBERG LIMITS

ASTM D 4318-98 / AASHTO T89 (SOP - S4A)

Client	CDM	Boring No.	B-615
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	4-6
Project No.	2008-598-01	Sample No.	S-2
Lab ID	2008-598-01-02	Soil Description	**LIGHT BROWN SILT**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

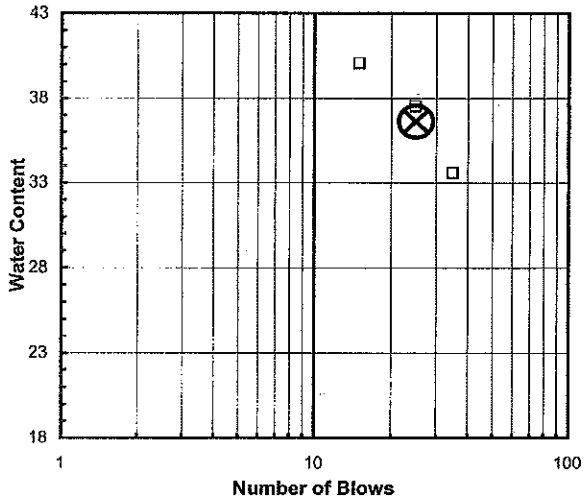
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	Q	K	U	MULTIPOINT
Wt. of Tare & WS (gm)	25.11	25.22	27.86	
Wt. of Tare & DS (gm)	22.27	22.50	24.68	
Wt. of Tare (gm)	15.18	15.25	15.21	
Wt. of Water (gm)	2.8	2.7	3.2	
Wt. of DS (gm)	7.1	7.3	9.5	
Moisture Content (%)	**40.1**	**37.5**	**33.6**	
Number of Blows	**15**	**25**	**35**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	A-P	A-B	
Wt. of Tare & WS (gm)	22.92	22.90	
Wt. of Tare & DS (gm)	21.25	21.19	
Wt. of Tare (gm)	15.60	15.57	
Wt. of Water (gm)	1.7	1.7	
Wt. of DS (gm)	5.7	5.6	
Moisture Content (%)	**29.6**	**30.4**	**-0.9**

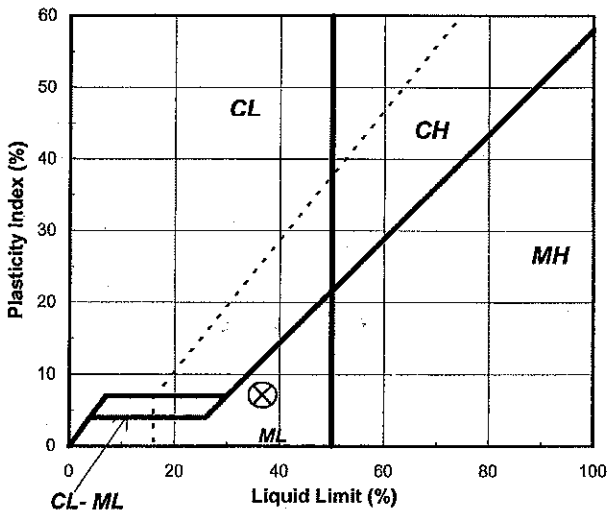
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**37**
Plastic Limit (%)	**30**
Plasticity Index (%)	**7**
USCS Symbol	**ML**

Flow Curve



Plasticity Chart



Tested By SD *Date* 7/11/2008 *Checked By* GEM *Date* 7-14-08

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INTEGRITY IN TESTING

ATTERBERG LIMITS

ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	CDM	Boring No.	615
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	13.5-15.5
Project No.	2008-598-02	Sample No.	T-1
Lab ID	2008-598-02-04	Soil Description	**LIGHT BROWN SILT**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

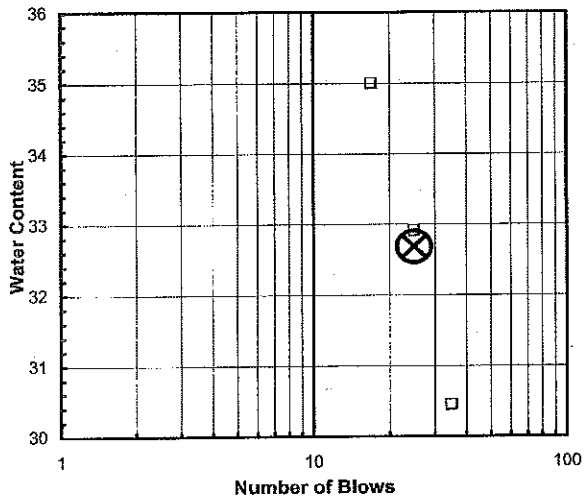
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	J	O	M	MULTIPOINT
Wt. of Tare & WS (gm)	28.37	28.68	29.74	
Wt. of Tare & DS (gm)	24.94	25.35	26.33	
Wt. of Tare (gm)	15.14	15.23	15.13	
Wt. of Water (gm)	3.4	3.3	3.4	
Wt. of DS (gm)	9.8	10.1	11.2	
Moisture Content (%)	**35.0**	**32.9**	**30.4**	
Number of Blows	**17**	**25**	**35**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	W	P	
Wt. of Tare & WS (gm)	23.63	21.69	
Wt. of Tare & DS (gm)	21.96	20.38	
Wt. of Tare (gm)	15.14	15.19	
Wt. of Water (gm)	1.7	1.3	
Wt. of DS (gm)	6.8	5.2	
Moisture Content (%)	**24.5**	**25.2**	**-0.8**

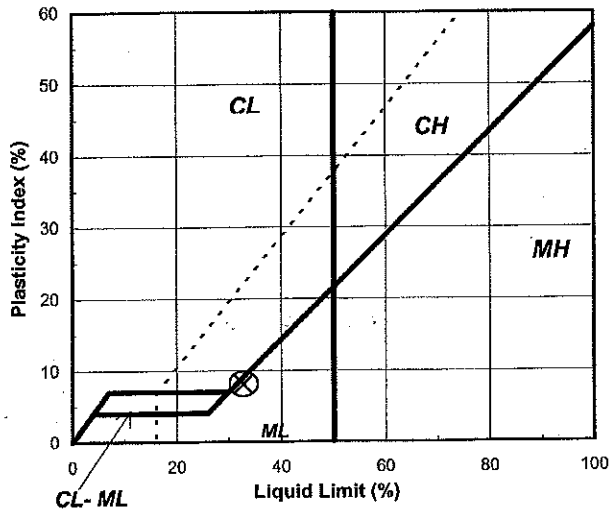
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**33**
Plastic Limit (%)	**25**
Plasticity Index (%)	**8**
USCS Symbol	**ML**

Flow Curve



Plasticity Chart



Tested By SD *Date* 7/23/2008 *Checked By* GM *Date* 7-24-08

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SIEVE ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	615
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	13.5-15.5
Project No.	2008-598-02	Sample No.	T-1
Lab ID	2008-598-02-04	Soil Color	**LIGHT BROWN**

	SIEVE ANALYSIS		HYDROMETER
USCS	gravel	sand	silt and clay

USCS Symbol ***SM, TESTED***

USCS Classification ***SILTY SAND***

Tested By SD Date 7/23/2008 Checked By GAM Date 7-24-08

 DCN: CT-S3C DATE 6-25-98 REVISION: 2 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-02-04 SIEVON REV 4.XLS]Sheet1*

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WASH SIEVE ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	615
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	13.5-15.5
Project No.	2008-598-02	Sample No.	T-1
Lab ID	2008-598-02-04	Soil Color	**LIGHT BROWN**

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	213	Tare No.	NA
Wgt.Tare + Wet Specimen (gm)	633.82	Wgt.Tare + Wet Specimen (gm)	NA
Wgt.Tare + Dry Specimen (gm)	597.59	Wgt.Tare + Dry Specimen (gm)	NA
Weight of Tare (gm)	173.30	Weight of Tare (gm)	NA
Weight of Water (gm)	36.23	Weight of Water (gm)	NA
Weight of Dry Soil (gm)	424.29	Weight of Dry Soil (gm)	NA
Moisture Content (%)	**8.5**	**Moisture Content (%)**	**NA**

Wet Weight -3/4" Sample (gm)	NA	Weight of the Dry Specimen (gm)	424.29
Dry Weight - 3/4" Sample (gm)	253.3	Weight of minus #200 material (gm)	157.27
Wet Weight +3/4" Sample (gm)	NA	Weight of plus #200 material (gm)	267.02
Dry Weight + 3/4" Sample (gm)	13.74		
Total Dry Weight Sample (gm)	NA		

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	13.74	3.2	3.2	96.8	**96.8**
1/2"	12.50	10.86	2.6	5.8	94.2	**94.2**
3/8"	9.50	2.90	0.7	6.5	93.5	**93.5**
#4	4.75	27.88	6.6	13.1	86.9	**86.9**
#10	2.00	36.38	8.6	21.6	78.4	**78.4**
#20	0.850	38.54	9.1	30.7	69.3	**69.3**
#40	0.425	30.26	7.1	37.8	62.2	**62.2**
#60	0.250	27.25	6.4	44.3	55.7	**55.7**
#140	0.106	56.79	13.4	57.6	42.4	**42.4**
#200	0.075	22.42	5.3	62.9	37.1	**37.1**
Pan	-	157.27	37.1	100.0	-	**-**

Tested By SD Date 7/23/2008 Checked By GEM Date 7-24-08

DCN: CT-S3C DATE 6-25-98 REVISION: 2

\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-02-04 SIEVON REV 4.XLS]Sheet1

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PERMEABILITY TEST

ASTM D 5084-90(Reapproved 1997)
(SOP-S22A & S22B)

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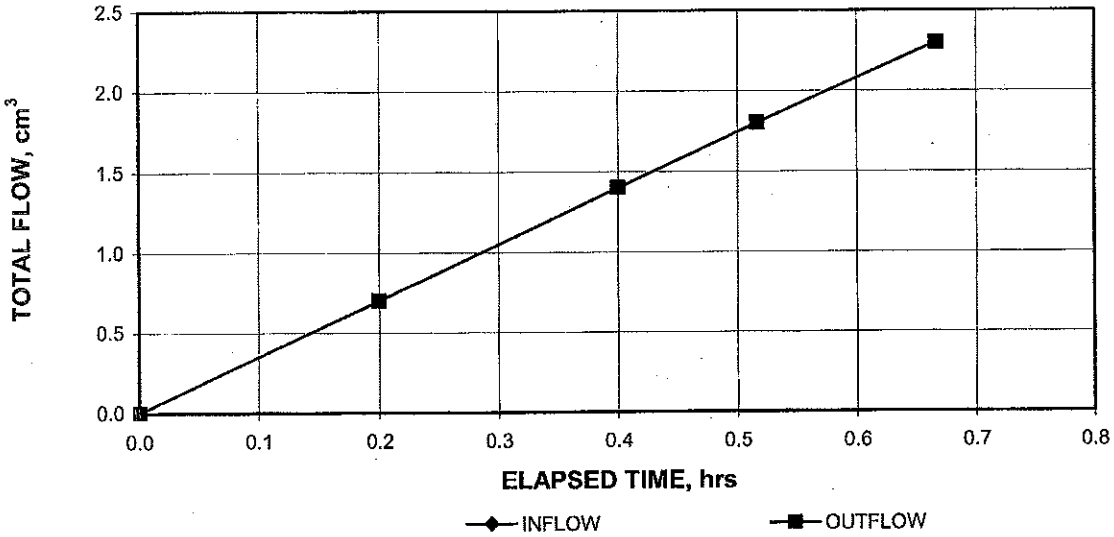
INTEGRITY IN TESTING

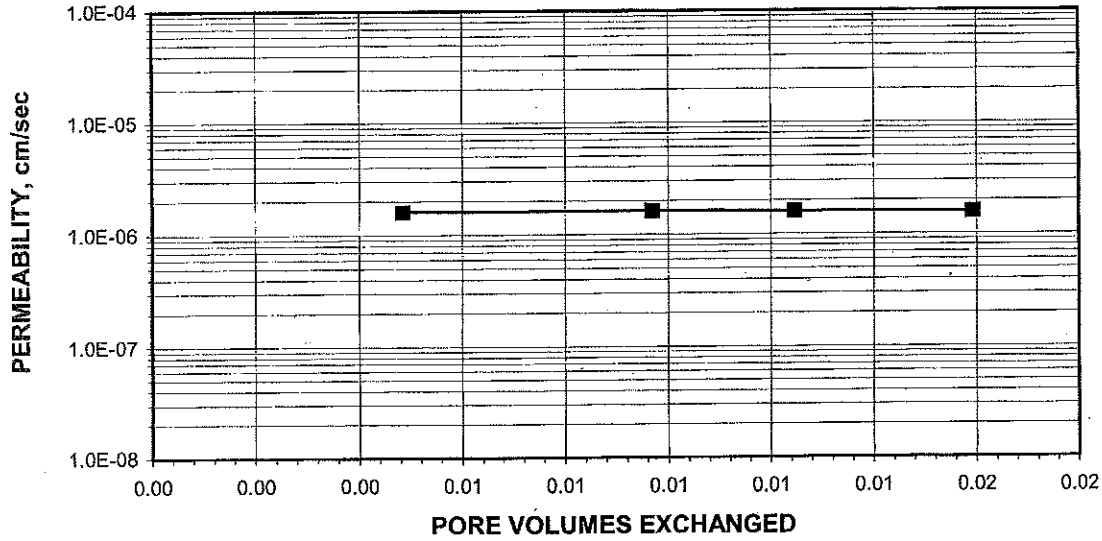
Client	CDM	Boring No.	615
Client Project	BUNCOMBE COUNTY C&D LF EXP.	Depth (ft.)	13.5-15.5
Project No.	2008-598-02	Sample No.	T-1
Lab ID No.	2008-598-02-04		

AVERAGE PERMEABILITY = 1.6E-06 cm/sec @ 20°C
AVERAGE PERMEABILITY = 1.6E-08 m/sec @ 20°C

TOTAL FLOW vs. ELAPSED TIME



PORE VOLUMES EXCHANGED vs. PERMEABILITY



Tested By: TMS Date: 7/17/2008 Checked By: GEM Date: 7-21-08

DCN: CT-22 DATE: 01-08-99 REVISION:2Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-02-04 PERM.xls]Sheet1

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PERMEABILITY TEST

ASTM D 5084-90(Reapproved 1997)
(SOP-S22A & S22B)

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INTEGRITY IN TESTING

Client	CDM	Boring No.	615
Client Project	BUNCOMBE COUNTY C&D LF EXP.	Depth (ft.)	13.5-15.5
Project No.	2008-598-02	Sample No.	T-1
Lab ID No.	2008-598-02-04		
		Specific Gravity	2.70 Assumed
		Sample Condition	Undisturbed

Visual Description: TAN SANDY CLAY

MOISTURE CONTENT:	BEFORE TEST	AFTER TEST
Tare Number	A-1	305
Wt. of Tare & WS (gm.)	284.98	406.82
Wt. of Tare & DS (gm.)	262.63	351.32
Wt. of Tare (gm.)	97.90	84.55
Wt. of Water (gm.)	22.35	55.50
Wt. of DS (gm.)	164.73	266.77
Moisture Content (%)	**13.6**	**20.8**

SPECIMEN:	BEFORE TEST	AFTER TEST
Wt. of Tube & WS (gm.)	747.63	NA
Wt. of Tube (gm.)	0.00	NA
Wt. of WS (gm.)	747.63	795.27
Length 1 (in.)	3.645	3.653
Length 2 (in.)	3.655	3.607
Length 3 (in.)	3.618	3.660
Top Diameter (in.)	2.908	2.904
Middle Diameter (in.)	2.869	2.852
Bottom Diameter (in.)	2.875	2.880
Average Length (in.)	3.64	3.64
Average Area (in.^{2})	6.53	6.51
Sample Volume (cm^3)	389.59	388.22
Unit Wet Wt. (gm./ cm^3)	1.92	2.05
Unit Wet Wt. (pcf)	119.8	127.9
Unit Dry Wt. (pcf)	105.5	105.9
Unit Dry Wt. (gm./ cm^3)	1.69	1.70
Void Ratio, e	0.60	0.59
Porosity, n	0.37	0.37
Pore Volume (cm^3)	145.8	144.4

Tested By: TMS Date: 7/17/2008 Checked By: GEM Date: 7-24-08

DCN: CT-22 DATE: 01-08-99 REVISION:2 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-02-04 PERM.xls]Sheet1

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PERMEABILITY TEST

ASTM D 5084-90(Reapproved 1997)
(SOP-S22A & S22B)

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INTEGRITY IN TESTING

Client	CDM	Boring No.	615
Client Project	BUNCOMBE COUNTY C&D LF EXP.	Depth (ft.)	13.5-15.5
Project No.	2008-598-02	Sample No.	T-1
Lab ID No.	2008-598-02-04		

Pressure Heads (Constant)		Final Sample Dimensions	
Top Cap (psi)	38.6	Sample Length (cm), L	9.25
Bottom Cap (psi)	40.0	Sample Diameter (cm)	7.31
Cell (psi)	45.0	Sample Area (cm^2), A	41.99
Total Pressure Head (cm)	98.4	Inflow Burette Area (cm^2), a-in	0.891
Hydraulic Gradient	10.65	Outflow Burette Area (cm^2), a-out	0.883
		B Parameter (%)	96

AVERAGE PERMEABILITY = 1.6E-06 cm/sec @ 20°C
AVERAGE PERMEABILITY = 1.6E-08 m/sec @ 20°C

DATE (mm/dd/yy)	TIME (hr)	TIME (min)	ELAPSED TIME t (hr)	TOTAL INFLOW (cm^3)	TOTAL OUTFLOW (cm^3)	TOTAL HEAD h (cm)	FLOW (0 flow) (1 stop)	TEMP. (°C)	INCREMENTAL PERMEABILITY @ 20°C (cm/sec)
7/17/2008	10	29	0.0	0.0	0.0	124.9	0	23.0	NA
7/17/2008	10	41	0.2	0.7	0.7	123.3	0	23.0	1.6E-06
7/17/2008	10	53	0.4	1.4	1.4	121.7	0	23.0	1.6E-06
7/17/2008	11	0	0.5	1.8	1.8	120.8	0	23.0	1.6E-06
7/17/2008	11	9	0.7	2.3	2.3	119.7	1	23.0	1.6E-06

Tested By: TMS Date: 7/17/2008 Checked By: GEM Date: 7-21-08

DCN: CT-22 DATE: 01-08-99 REVISION:2 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-02-04 PERM.xls]Sheet1

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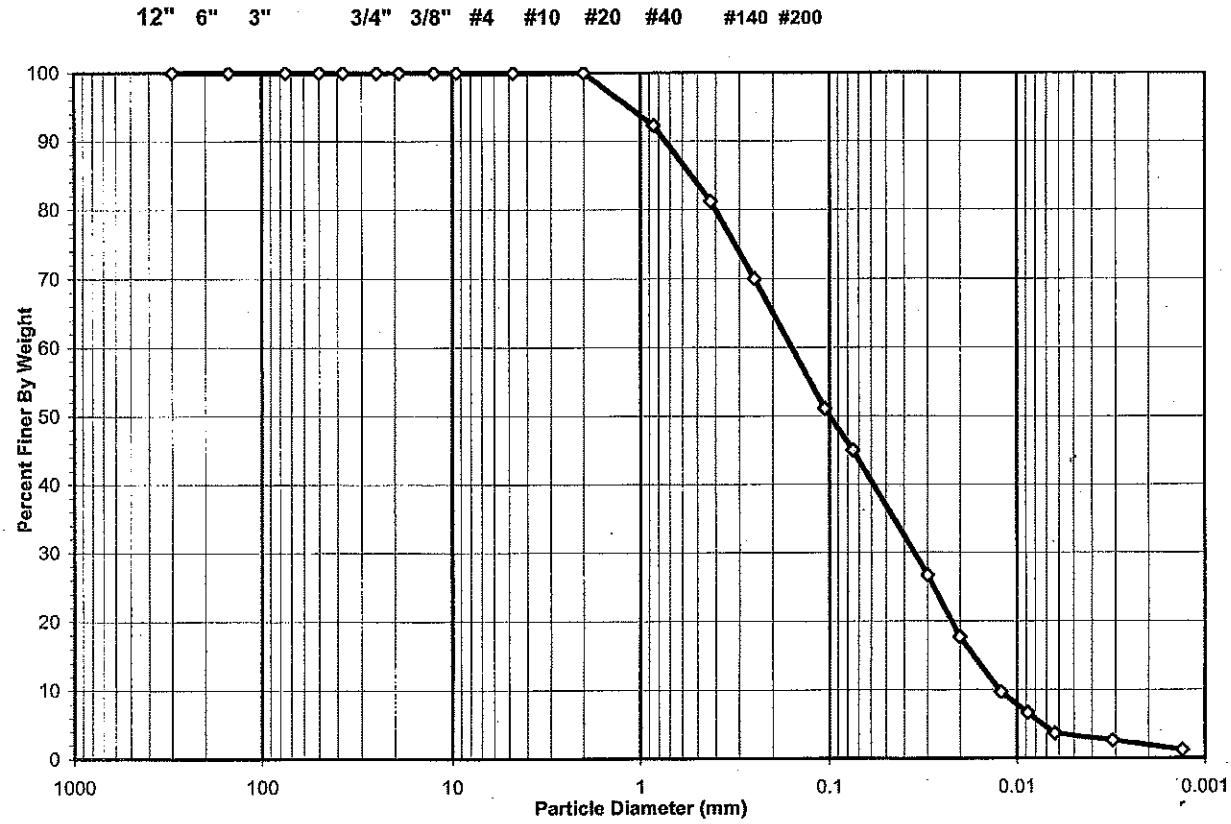
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-615
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	14-15
Project No.	2008-598-01	Sample No.	S-4T
Lab ID	2008-598-01-03	Soil Color	**LIGHT BROWN**

	SIEVE ANALYSIS					HYDROMETER
USCS	cobbles	gravel	sand			silt and clay fraction
USDA	cobbles	gravel	sand		silt	clay



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	55.00
Finer Than #200	*Silt & Clay*	45.00

USCS Symbol ***SC-SM, TESTED***

USCS Classification ***SILTY, CLAYEY SAND***

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-03 #10 Split Hydro rev 8.xls]Sheet1*

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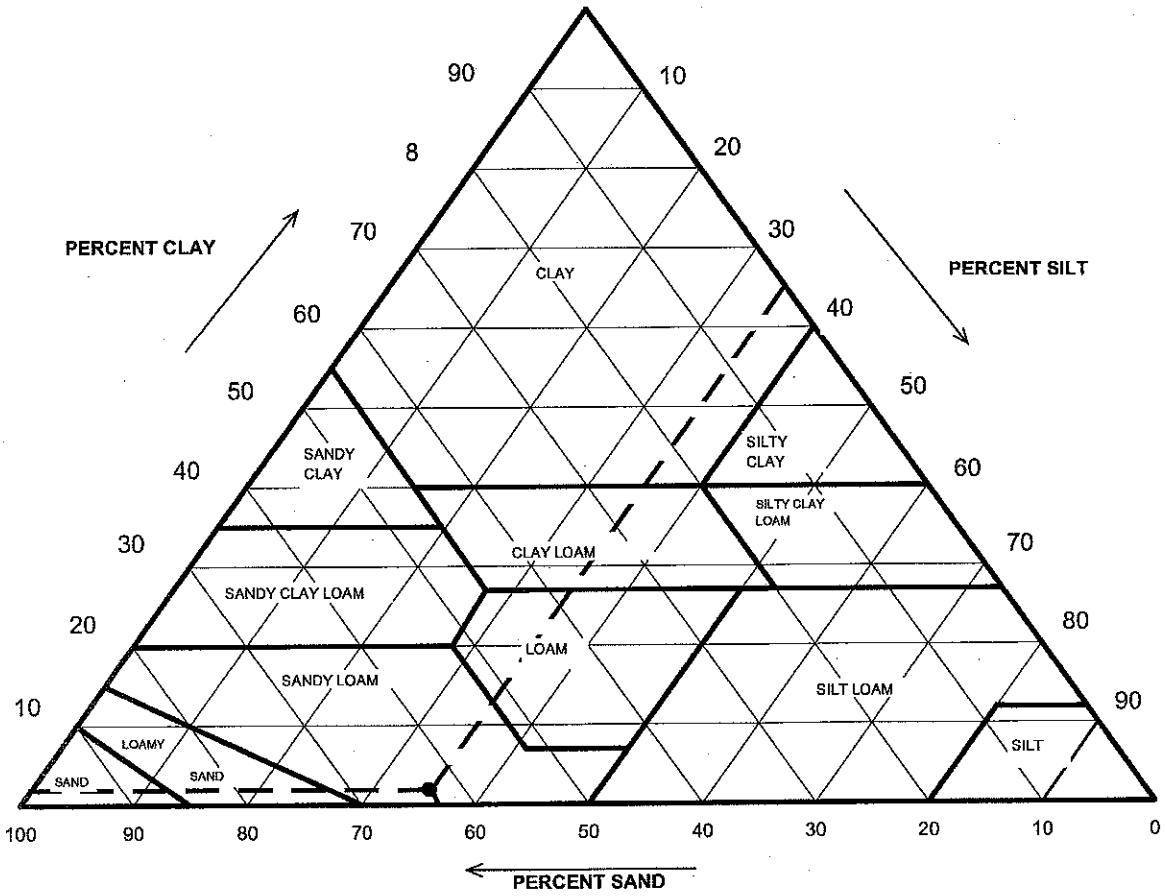
USDA CLASSIFICATION CHART

Client	CDM	Boring No.	B-615
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	14-15
Project No.	2008-598-01	Sample No.	S-4T
Lab ID	2008-598-01-03	Soil Color	LIGHT BROWN



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	0.00	**0.00**
2	100.00	*Sand*	63.09	**63.09**
0.05	36.91	*Silt*	35.00	**35.00**
0.002	1.91	*Clay*	1.91	**1.91**

USDA Classification: ***SANDY LOAM***

DCN: CT-S3P DATE:02/15/05 REVISION:8 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-03 #10 Split Hydro rev 8.xls]Sheet1

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WASH SIEVE ANALYSIS #10 SPLIT

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-615
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	14-15
Project No.	2008-598-01	Sample No.	S-4T
Lab ID	2008-598-01-03	Soil Color	**LIGHT BROWN**

Moisture Content/sieve +10 Material		Moisture Content for Hydrometer Portion	
Tare No.	203	Tare No.	B-1
Wgt.Tare + Wet Soil (gm)	237.70	Wgt.Tare + Wet Soil (gm)	61.91
Wgt.Tare + Dry Soil (gm)	228.33	Wgt.Tare + Dry Soil (gm)	61.35
Weight of Tare (gm)	171.12	Weight of Tare (gm)	22.06
Weight of Water (gm)	9.37	Weight of Water (gm)	0.56
Weight of Dry Soil (gm)	57.21	Weight of Dry Soil (gm)	39.29
Moisture Content (%)	**16.4**	**Moisture Content (%)**	**1.4**

Soil Specimen Data			
Wet Weight +#10 Material (gm)	66.58	Weight of the Dry Sample (gm)	155.80
Dry Weight +#10 Material(gm)	57.2	Weight of minus #200 material (gm)	44.36
Wet Weight Hydro. Material.(gm)	100.00	Weight of plus #200 material (gm)	111.44
Dry Weight Hydro. Material (gm)	98.59		
Total Dry Weight Sample (gm)	155.80	**J-FACTOR (%FINER THAN #10)**	**1.0000**

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.00	0.00	0.00	100.00	**100.00**
#10	2.00	0.00	0.00	0.00	100.00	**100.00**
#20	0.85	7.61	7.72	7.72	92.28	**92.28**
#40	0.425	10.92	11.08	18.79	81.21	**81.21**
#60	0.250	11.08	11.24	30.03	69.97	**69.97**
#140	0.106	18.64	18.91	48.94	51.06	**51.06**
#200	0.075	5.98	6.07	55.00	45.00	**45.00**
Pan	-	44.36	45.00	100.00	-	-

Notes :

Tested By SD Date 7/14/2008 Checked By GEM Date 7-15-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-03 #10 Split Hydro rev 8.xls]Sheet1*

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HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-615
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	14-15
Project No.	2008-598-01	Sample No.	S-4T
Lab ID	2008-598-01-03	Soil Color	**LIGHT BROWN**

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	30.0	30.0	25.5	3.35	26.6	26.6	0.01253	0.0299	**26.6**
5		21.0	25.5	3.35	17.6	17.6	0.01253	0.0201	**17.6**
15		13.0	25.5	3.35	9.6	9.6	0.01253	0.0122	**9.6**
30		10.0	25.5	3.35	6.6	6.6	0.01253	0.0088	**6.6**
60		7.0	25.5	3.35	3.6	3.6	0.01253	0.0063	**3.6**
250		6.0	25.5	3.35	2.6	2.6	0.01253	0.0031	**2.6**
1440		5.0	24.0	3.79	1.2	1.2	0.01275	0.0013	**1.2**

Soil Specimen Data		**Other Corrections**	
Tare + Dry Material (gm)	98.59	a - Factor	0.986
Weight of Tare (gm)	0		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 10	100.00
Weight of Dry Material (gm)	98.59		
		Specific Gravity	2.72 Assumed

Note:

Tested By JBD Date 7/11/2008 Checked By GEM Date 7-15-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\(2008-598-01-03 #10 Split Hydro rev 8.xls]Sheet1*

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INTEGRITY IN TESTING

ATTERBERG LIMITS

ASTM D 4318-98 / AASHTO T89 (SOP - S4A)

Client	CDM	Boring No.	B-615
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	14-15
Project No.	2008-598-01	Sample No.	S-4T
Lab ID	2008-598-01-03	Soil Description	**LIGHT BROWN SILTY CLAY**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

(Minus No. 40 sieve material, Airdried)

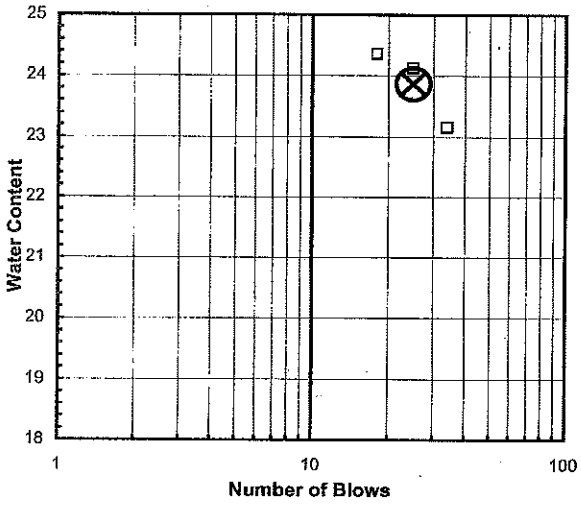
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	P	W	M	MULTIPOINT
Wt. of Tare & WS (gm)	26.27	22.80	24.64	
Wt. of Tare & DS (gm)	24.10	21.36	22.79	
Wt. of Tare (gm)	15.19	15.14	15.12	
Wt. of Water (gm)	2.2	1.4	1.9	
Wt. of DS (gm)	8.9	6.2	7.7	
Moisture Content (%)	**24.4**	**23.2**	**24.1**	
Number of Blows	**18**	**34**	**25**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	O	J	
Wt. of Tare & WS (gm)	22.78	22.04	
Wt. of Tare & DS (gm)	21.52	20.90	
Wt. of Tare (gm)	15.24	15.14	
Wt. of Water (gm)	1.3	1.1	
Wt. of DS (gm)	6.3	5.8	
Moisture Content (%)	**20.1**	**19.8**	**0.3**

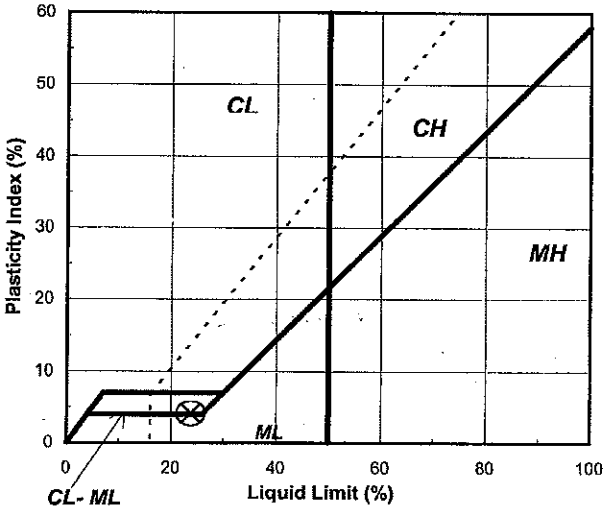
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**24**
Plastic Limit (%)	**20**
Plasticity Index (%)	**4**
USCS Symbol	**CL-ML**

Flow Curve



Plasticity Chart



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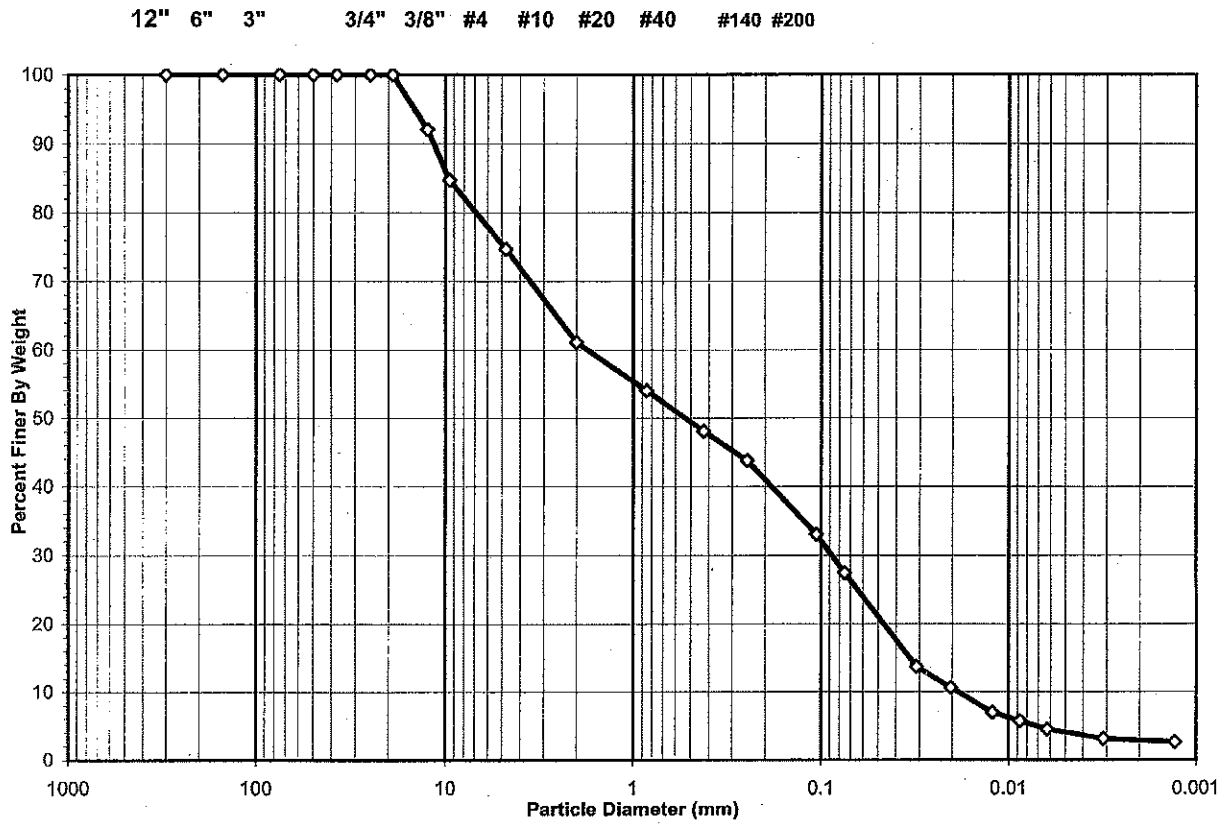
INTEGRITY IN TESTING

SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-617
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	8.5-10
Project No.	2008-598-01	Sample No.	S-3
Lab ID	2008-598-01-04	Soil Color	**BROWN TAN**

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



Sieve Sizes (mm)	USCS Summary	Percentage
Greater Than #4	*Gravel*	25.28
#4 To #200	*Sand*	47.29
Finer Than #200	*Silt & Clay*	27.43

USCS Symbol ***SM, TESTED***

USCS Classification ***SILTY SAND WITH GRAVEL***

DCN: CT-S3P DATE:02/16/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-04 #10 Split Hydro rev 8.xls]Sheet1*

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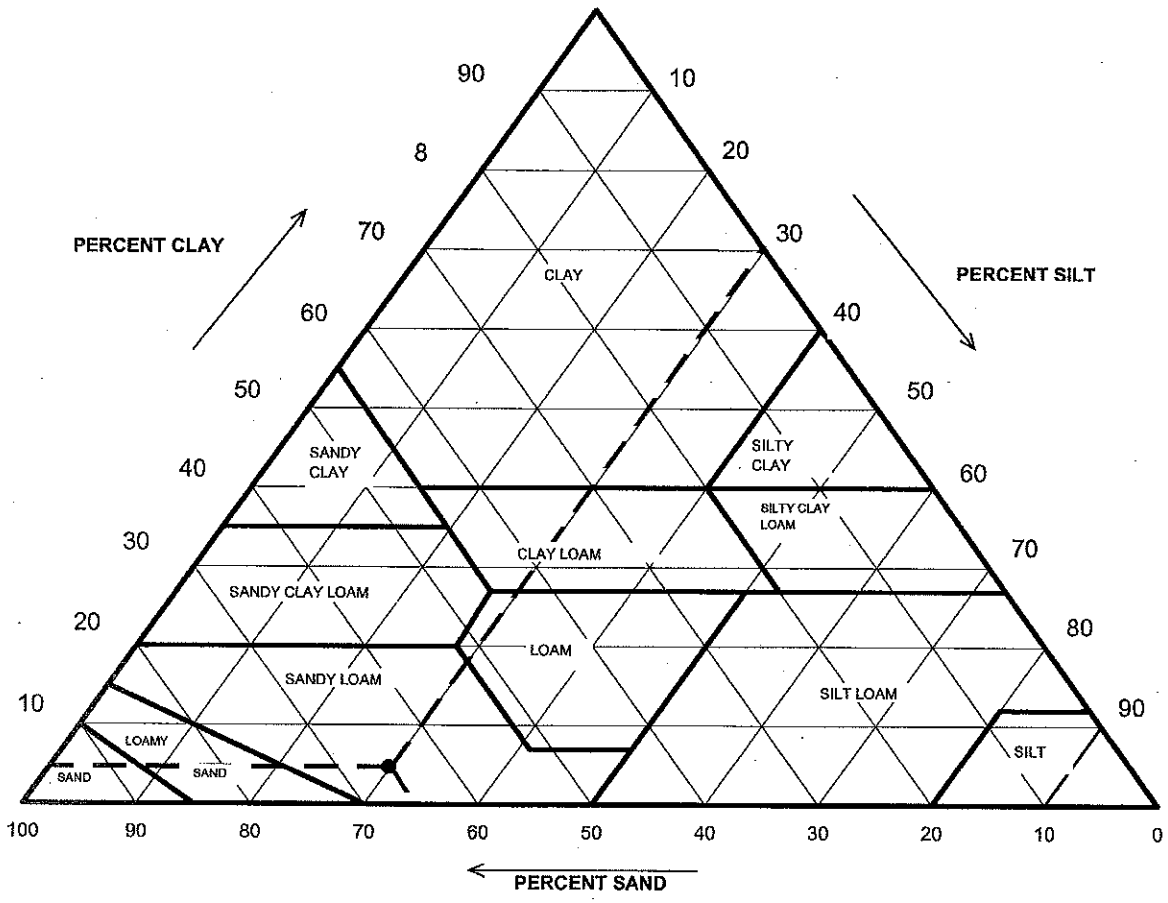
USDA CLASSIFICATION CHART

Client	CDM	Boring No.	B-617
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	8.5-10
Project No.	2008-598-01	Sample No.	S-3
Lab ID	2008-598-01-04	Soil Color	BROWN TAN



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	38.90	**0.00**
2	61.10	*Sand*	40.01	**65.48**
0.05	21.10	*Silt*	18.23	**29.83**
0.002	2.87	*Clay*	2.87	**4.69**

USDA Classification: ***SANDY LOAM***

DCN: CT-S3P DATE:02/15/05 REVISION:8 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-04 #10 Split Hydro rev 8.xls]Sheet1

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WASH SIEVE ANALYSIS #10 SPLIT

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-617
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	8.5-10
Project No.	2008-598-01	Sample No.	S-3
Lab ID	2008-598-01-04	Soil Color	**BROWN TAN**

Moisture Content/sieve +10 Material		Moisture Content for Hydrometer Portion	
Tare No.	P-12	Tare No.	S-1
Wgt.Tare + Wet Soil (gm)	257.19	Wgt.Tare + Wet Soil (gm)	55.34
Wgt.Tare + Dry Soil (gm)	254.55	Wgt.Tare + Dry Soil (gm)	54.64
Weight of Tare (gm)	196.45	Weight of Tare (gm)	15.55
Weight of Water (gm)	2.64	Weight of Water (gm)	0.70
Weight of Dry Soil (gm)	58.10	Weight of Dry Soil (gm)	39.09
Moisture Content (%)	**4.5**	**Moisture Content (%)**	**1.8**

Soil Specimen Data			
Wet Weight +#10 Material (gm)	60.74	Weight of the Dry Sample (gm)	156.34
Dry Weight +#10 Material(gm)	58.1	Weight of minus #200 material (gm)	44.10
Wet Weight Hydro. Material.(gm)	100.00	Weight of plus #200 material (gm)	112.24
Dry Weight Hydro. Material (gm)	98.24		
Total Dry Weight Sample (gm)	156.34	**J-FACTOR (%FINER THAN #10)**	**0.6110**

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.5	4.62	7.95	7.95	92.05	**92.05**
3/8"	9.50	4.25	7.31	15.27	84.73	**84.73**
#4	4.75	5.82	10.02	25.28	74.72	**74.72**
#10	2.00	7.91	13.61	38.90	61.10	**61.10**
#20	0.85	11.48	11.69	11.69	88.31	**53.96**
#40	0.425	9.49	9.66	21.35	78.65	**48.06**
#60	0.250	6.85	6.97	28.32	71.68	**43.80**
#140	0.106	17.31	17.62	45.94	54.06	**33.03**
#200	0.075	9.01	9.17	55.11	44.89	**27.43**
Pan	-	44.10	44.89	100.00	-	-

Notes :

Tested By SD Date 7/15/2008 Checked By GEM Date 7-17-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-04 #10 Split Hydro rev 8.xls]Sheet1

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HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-617
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	8.5-10
Project No.	2008-598-01	Sample No.	S-3
Lab ID	2008-598-01-04	Soil Color	**BROWN TAN**

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	26.0	26.0	24.4	3.67	22.3	22.4	0.01269	0.0311	**13.7**
5		21.0	24.4	3.67	17.3	17.4	0.01269	0.0203	**10.6**
15		15.0	24.4	3.67	11.3	11.4	0.01269	0.0122	**6.9**
30		13.0	24.4	3.67	9.3	9.4	0.01269	0.0087	**5.7**
60		11.0	24.4	3.67	7.3	7.4	0.01269	0.0062	**4.5**
250		9.0	23.6	3.91	5.1	5.1	0.01281	0.0031	**3.1**
1440		8.0	24.2	3.73	4.3	4.3	0.01272	0.0013	**2.6**

Soil Specimen Data		**Other Corrections**	
Tare + Dry Material (gm)	98.24	a - Factor	0.986
Weight of Tare (gm)	0		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 10	61.10
Weight of Dry Material (gm)	98.24		
		Specific Gravity	2.72 Assumed

Note:

Tested By JBD Date 7/14/2008 Checked By GBM Date 7-17-08

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ATTERBERG LIMITS

ASTM D 4318-98 / AASHTO T89 (SOP - S4A)

Client	CDM	Boring No.	B-617
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	8.5-10
Project No.	2008-598-01	Sample No.	S-3
Lab ID	2008-598-01-04	Soil Description	**BROWN TAN SILT**

Note: The* USCS *symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

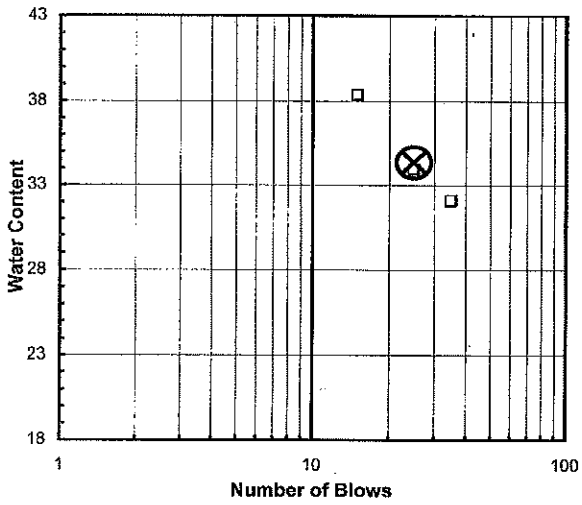
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	Q	K	A-B	MULTIPOINT
Wt. of Tare & WS (gm)	30.36	26.37	27.49	
Wt. of Tare & DS (gm)	26.15	23.55	24.60	
Wt. of Tare (gm)	15.17	15.24	15.59	
Wt. of Water (gm)	4.2	2.8	2.9	
Wt. of DS (gm)	11.0	8.3	9.0	
Moisture Content (%)	**38.3**	**33.9**	**32.1**	
Number of Blows	**15**	**25**	**35**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	U	A-P	
Wt. of Tare & WS (gm)	22.41	23.74	
Wt. of Tare & DS (gm)	20.71	21.90	
Wt. of Tare (gm)	15.18	15.60	
Wt. of Water (gm)	1.7	1.8	
Wt. of DS (gm)	5.5	6.3	
Moisture Content (%)	**30.7**	**29.2**	**1.5**

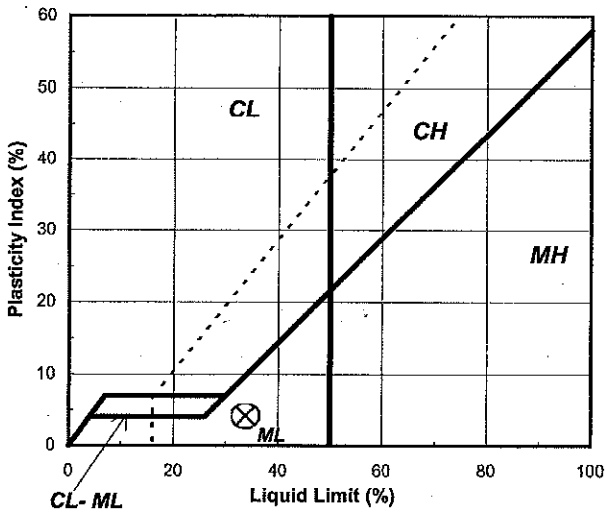
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**34**
Plastic Limit (%)	**30**
Plasticity Index (%)	**4**
USCS Symbol	**ML**

Flow Curve



Plasticity Chart



Tested By SD *Date* 7/16/2008 *Checked By* GEM *Date* 7-17-08

page 1 of 1 **DCN:** CT-S4B **DATE:** 10/8/2001 **REVISION:** 2

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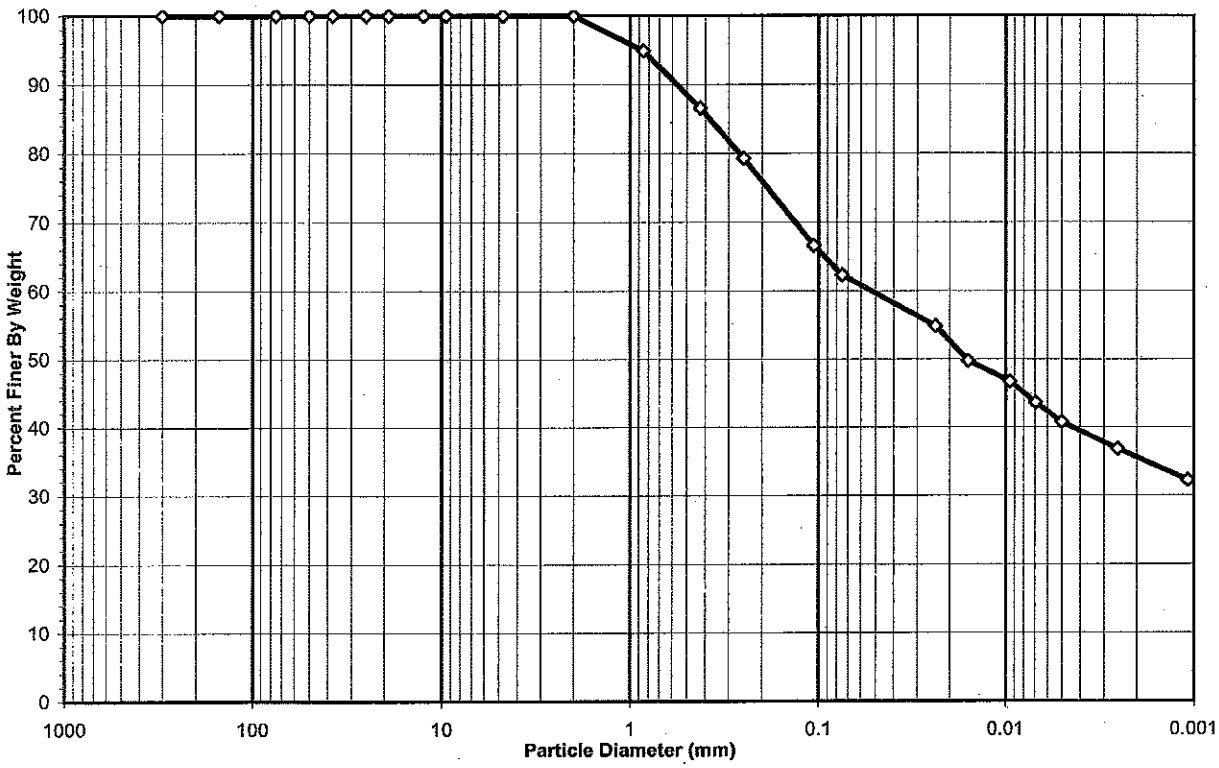
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-618
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	0-6
Project No.	2008-598-01	Sample No.	NA
Lab ID	2008-598-01-22	Soil Color	**RED BROWN**

	SIEVE ANALYSIS				HYDROMETER	
USCS	cobbles	gravel	sand		silt and clay fraction	
USDA	cobbles	gravel	sand		silt	clay

12" 6" 3" 3/4" 3/8" #4 #10 #20 #40 #140 #200



USCS Summary		
Sieve Sizes (mm)		**Percentage**
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	37.71
Finer Than #200	*Silt & Clay*	62.29

USCS Symbol ***ml, ASSUMED***

USCS Classification ***SANDY SILT***

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-22 #10 Split Hydro rev 8.xls]Sheet1*

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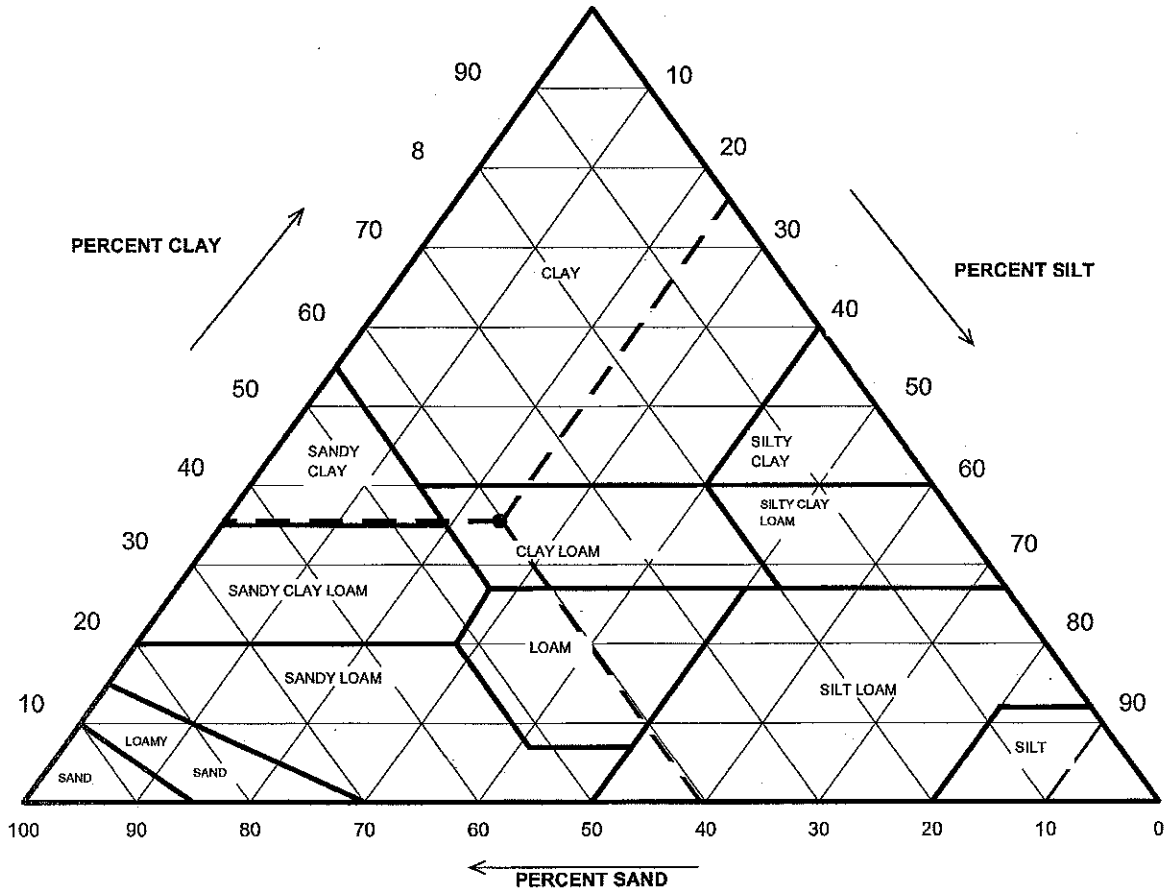
USDA CLASSIFICATION CHART

Client	CDM	Boring No.	B-618
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	0-6
Project No.	2008-598-01	Sample No.	NA
Lab ID	2008-598-01-22	Soil Color	RED BROWN



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	0.00	**0.00**
2	100.00	*Sand*	40.35	**40.35**
0.05	59.65	*Silt*	24.11	**24.11**
0.002	35.55	*Clay*	35.55	**35.55**

USDA Classification: ***CLAY LOAM***

DCN: CT-S3P DATE:02/15/05 REVISION:8 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-22 #10 Split Hydro rev 8.xls]Sheet1

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WASH SIEVE ANALYSIS #10 SPLIT

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-618
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	0-6
Project No.	2008-598-01	Sample No.	NA
Lab ID	2008-598-01-22	Soil Color	**RED BROWN**

Moisture Content/sieve +10 Material		Moisture Content for Hydrometer Portion	
Tare No.	307	Tare No.	M-1
Wgt.Tare + Wet Soil (gm)	677.90	Wgt.Tare + Wet Soil (gm)	36.74
Wgt.Tare + Dry Soil (gm)	557.82	Wgt.Tare + Dry Soil (gm)	36.24
Weight of Tare (gm)	111.10	Weight of Tare (gm)	15.96
Weight of Water (gm)	120.08	Weight of Water (gm)	0.50
Weight of Dry Soil (gm)	446.72	Weight of Dry Soil (gm)	20.28
Moisture Content (%)	**26.9**	**Moisture Content (%)**	**2.5**

Soil Specimen Data			
Wet Weight +#10 Material (gm)	566.80	Weight of the Dry Sample (gm)	544.35
Dry Weight +#10 Material(gm)	446.7	Weight of minus #200 material (gm)	60.81
Wet Weight Hydro. Material.(gm)	100.04	Weight of plus #200 material (gm)	483.54
Dry Weight Hydro. Material (gm)	97.63		
Total Dry Weight Sample (gm)	544.35	**J-FACTOR (%FINER THAN #10)**	**1.0000**

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.00	0.00	0.00	100.00	**100.00**
#10	2.00	0.00	0.00	0.00	100.00	**100.00**
#20	0.85	5.00	5.12	5.12	94.88	**94.88**
#40	0.425	8.12	8.32	13.44	86.56	**86.56**
#60	0.250	7.10	7.27	20.71	79.29	**79.29**
#140	0.106	12.40	12.70	33.41	66.59	**66.59**
#200	0.075	4.20	4.30	37.71	62.29	**62.29**
Pan	-	60.81	62.29	100.00	-	-

Notes :

Tested By SD Date 7/16/2008 Checked By GJM Date 7-28-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-22 #10 Split Hydro rev 8.xls]Sheet1*

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HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-618
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	0-6
Project No.	2008-598-01	Sample No.	NA
Lab ID	2008-598-01-22	Soil Color	**RED BROWN**

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	58.0	58.0	23.5	3.94	54.1	54.8	0.01290	0.0238	**54.8**
5		53.0	23.5	3.94	49.1	49.7	0.01290	0.0159	**49.7**
15		50.0	23.5	3.94	46.1	46.7	0.01290	0.0095	**46.7**
30		47.0	23.5	3.94	43.1	43.7	0.01290	0.0069	**43.7**
60		44.0	23.8	3.85	40.2	40.7	0.01285	0.0050	**40.7**
250		40.0	24.3	3.70	36.3	36.8	0.01278	0.0025	**36.8**
1440		35.0	25.8	3.27	31.7	32.2	0.01256	0.0011	**32.2**

Soil Specimen Data		**Other Corrections**	
Tare + Dry Material (gm)	97.63	a - Factor	0.99
Weight of Tare (gm)	0		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 10	100.00
Weight of Dry Material (gm)	97.63		
		Specific Gravity	2.7 Assumed

Note:

Tested By JBD Date 7/15/2008 Checked By GBM Date 7-28-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-22 #10 Split Hydro rev 8.xls]Sheet1*

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INTEGRITY IN TESTING

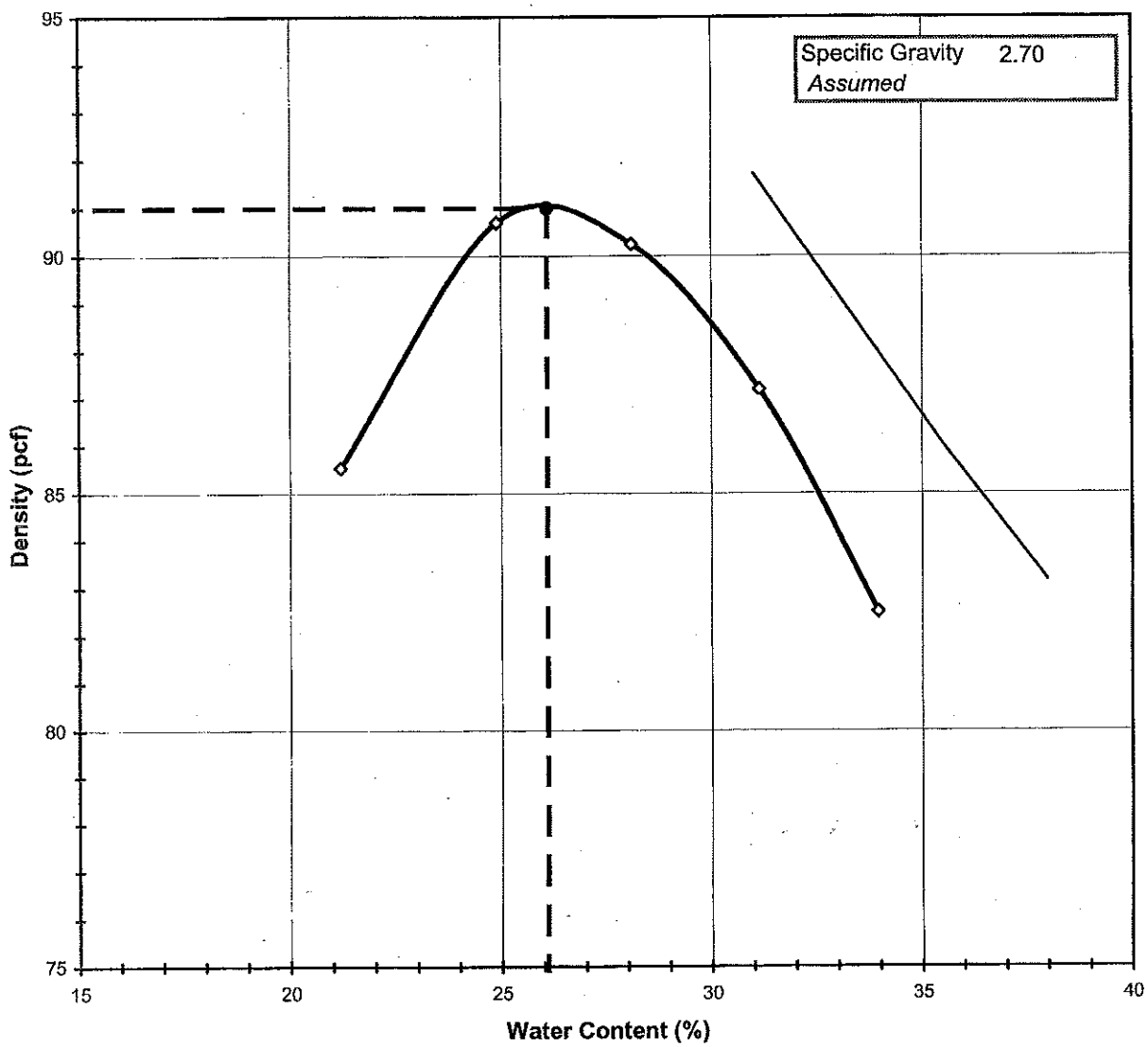
MOISTURE DENSITY RELATIONSHIP

ASTM D698-91 SOP-S12

Client	CDM	Boring No.	B-618
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	0-6
Project No.	2008-598-01	Sample No.	NA
Lab ID	2008-598-01-22	Test Method	**STANDARD**

Visual Description RED BROWN SANDY SILT

Optimum Water Content **26.1**
Maximum Dry Density **91.0**



Tested By *DW* *Date* *7/11/2008* *Checked By* GEM *Date* 7-28-08

 DCN:CT-S12 DATE:12/11/00 REVISION 5 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-22 Proctor.XLS]Sheet1*

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MOISTURE - DENSITY RELATIONSHIP

ASTM D698-91 SOP-S12

Client	CDM	Boring No.	B-618
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	0-6
Project No.	2008-598-01	Sample No.	NA
Lab ID	2008-598-01-22		

Visual Description RED BROWN SANDY SILT

Total Weight of the Sample (gm)	21164
As Received Water Content(%)	27
Assumed Specific Gravity	2.70
Percent Retained on 3/4"	1
Percent Retained on 3/8"	NA
Percent Retained on #4	2
Oversize Material	Not included
Procedure Used	A

TestType		**STANDARD**
Rammer Weight (lbs)		5.5
Rammer Drop (in)		12
Rammer Type		MECHANICAL
Machine ID	R	174
Mold ID	R	172
Mold diameter		4"
Weight of the Mold		4326
Volume of the Mold(cc)		937

Mold / Specimen

Point No.	**1**	**2**	**3**	**4**	**5**
Wt. of Mold & WS (gm)	5883	6027	6062	6043	5986
Wt.of Mold (gm)	4326	4326	4326	4326	4326
Wt. of WS	1557	1702	1737	1718	1660
Mold Volume (cc)	937	937	937	937	937

Moisture Content / Density

Tare Number	250	200	216	399	K-7
Wt. of Tare & WS (gm)	697.80	689.70	519.20	451.70	437.20
Wt. of Tare & DS (gm)	605.35	586.40	442.67	364.96	354.37
Wt. of Tare (gm)	169.20	171.50	170.30	86.40	110.40
Wt. of Water (gm)	92.45	103.30	76.53	86.74	82.83
Wt. of DS (gm)	436.15	414.90	272.37	278.56	243.97

Wet Density (gm/cc)	1.66	1.82	1.85	1.83	1.77
Wet Density (pcf)	103.7	113.3	115.6	114.3	110.5
Moisture Content (%)	**21.2**	**24.9**	**28.1**	**31.1**	**34.0**
Dry Density (pcf)	**85.5**	**90.7**	**90.2**	**87.2**	**82.5**

Zero Air Voids

Moisture Content (%)	31.0	35.5	38.0
Dry Unit Weight (pcf)	91.7	86.0	83.2

Tested By DW *Date* 7/11/2008 *Checked By* GEM *Date* 7-28-08

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INTEGRITY IN TESTING

FLEXIBLE WALL PERMEABILITY TEST

PERMOMETER METHOD

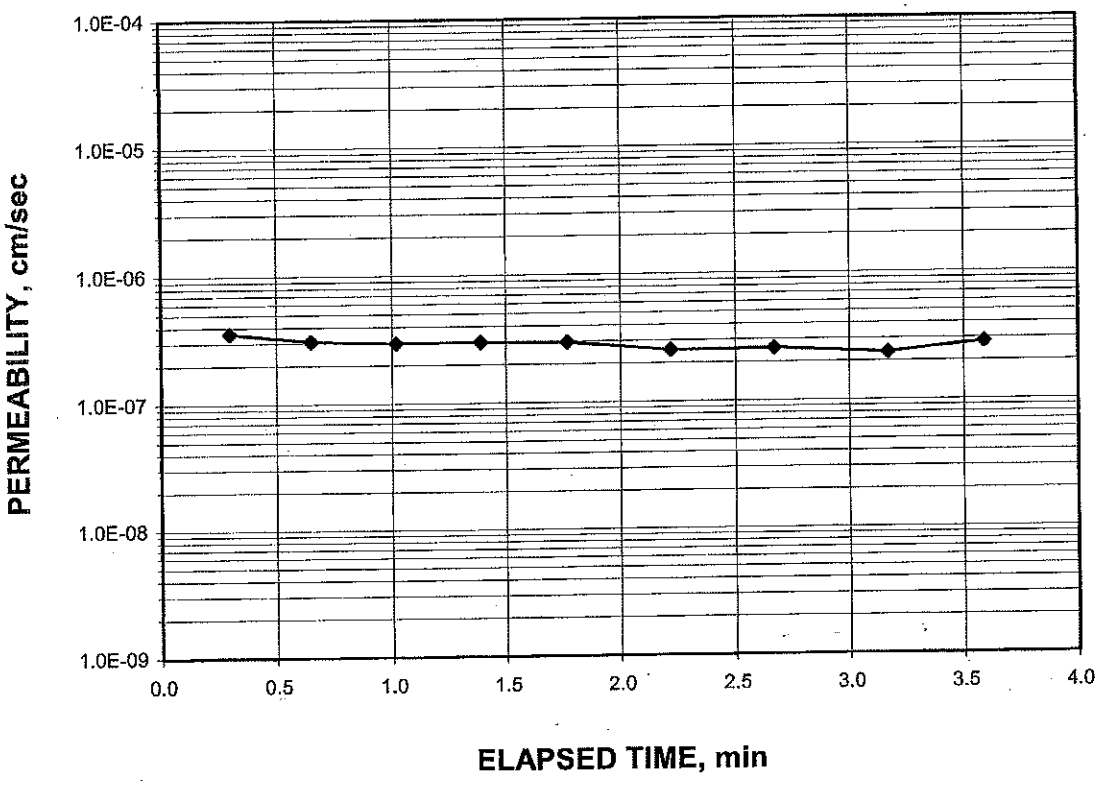
ASTM D 5084-97
(SOP-S22C)

Client	CDM	Boring No.	B-618
Client Project	BUNCOMBE CO. C&D LF EXP.	Depth (ft.)	0-6
Project No.	2008-598-01	Sample No.	NA
Lab ID No.	2008-598-01-22		

Visual Description: RED/BROWN SANDY SILT

AVERAGE PERMEABILITY = 2.5E-07 cm/sec @ 20°C
AVERAGE PERMEABILITY = 2.5E-09 m/sec @ 20°C

PERMEABILITY vs. TIME



Tested By: TMS Date: 7/16/2008 Checked By: GEM Date: 7-28-08

DCN: CT-22A DATE:12-21-98 REVISION: 4 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-22 PERMOM.xls]Sheet1

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FLEXIBLE WALL PERMEABILITY TEST

PERMOMETER METHOD

ASTM D 5084-03
(SOP-S22A & B)

Client	CDM	Boring No.	B-618
Client Project	BUNCOMBE CO. C&D LF EXP.	Depth (ft.)	0-6
Project No.	2008-598-01	Sample No.	NA
Lab ID No.	2008-598-01-22		

Specific Gravity	2.70	Assumed
Sample Condition		Remolded

Visual Description: RED/BROWN SANDY SILT

MOISTURE CONTENT:	BEFORE TEST	AFTER TEST
Tare Number	317	305
Wt. of Tare & WS (gm.)	377.20	429.84
Wt. of Tare & DS (gm.)	312.16	343.07
Wt. of Tare (gm.)	84.14	84.47
Wt. of Water (gm.)	65.04	86.77
Wt. of DS (gm.)	228.02	258.60
Moisture Content (%)	**28.5**	**33.6**

SPECIMEN:	BEFORE TEST	AFTER TEST
Wt. of Tube & WS (gm.)	768.96	NA
Wt. of Tube (gm.)	0.00	NA
Wt. of WS (gm.)	768.96	799.05
Length 1 (in.)	4.012	4.059
Length 2 (in.)	4.012	4.065
Length 3 (in.)	4.012	4.057
Top Diameter (in.)	2.872	2.861
Middle Diameter (in.)	2.872	2.861
Bottom Diameter (in.)	2.872	2.859
Average Length (in.)	4.01	4.06
Average Area (in.^{2})	6.48	6.43
Sample Volume (cm^3)	425.91	427.55
Unit Wet Wt. (gm./ cm^3)	1.805	1.869
Unit Wet Wt. (pcf)	112.7	116.7
Unit Dry Wt. (pcf)	87.7	87.4
Unit Dry Wt. (gm./ cm^3)	1.405	1.399
Void Ratio, e	0.922	0.929
Porosity, n	0.480	0.482
Pore Volume (cm^3)	204.3	206.0

Tested By: TMS Date: 7/16/2008 Checked By: GEM Date: 7-28-08

DCN: CT-22A DATE:12-21-98 REVISION: 4\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-22 PERMOM.xls]Sheet1

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FLEXIBLE WALL PERMEABILITY TEST

PERMOMETER METHOD

ASTM D 5084-03
(SOP-S22A & B)

Client	CDM	Boring No.	B-618
Client Project	BUNCOMBE CO. C&D LF EXP.	Depth (ft.)	0-6
Project No.	2008-598-01	Sample No.	NA
Lab ID No.	2008-598-01-22		

Test Pressures		Final Sample Dimensions	
Cell Pressure(psi)	55.0	Sample Length (cm), L	10.31
Back Pressure(psi)	50.0	Sample Area (cm^2), A	41.46
Eff. Cons. Pressure(psi)	5.0	Pipette Area (cm^2), a_p	0.03142
Response (%)	95	Annulus Area (cm^2), a_a	0.76712
		Equilibrium Level (cm), R_{eq}	1.75

AVERAGE PERMEABILITY = 2.5E-07 cm/sec @ 20°C
AVERAGE PERMEABILITY = 2.5E-09 m/sec @ 20°C

DATE	TIME		ELAPSED TIME t	PIPETTE READING R_p	INCREMENT GRADIENT i	FLOW CONDITION (0 flow)	TEMP.	INCREMENTAL PERMEABILITY @ 20°C
(mm/dd/yy)	(hr)	(min)	(min)	(cm)	(cm/cm)	(1 stop)	(°C)	(cm/sec)
7/16/08	8	54.3	0	10.5	11.1	0	23.1	NA
7/16/08	8	54.6	0	10.4	11.0	0	23.1	3.6E-07
7/16/08	8	54.9	1	10.3	10.8	0	23.1	3.1E-07
7/16/08	8	55.3	1	10.2	10.7	0	23.1	2.9E-07
7/16/08	8	55.7	1	10.1	10.6	0	23.1	3.0E-07
7/16/08	8	56.1	2	10.0	10.4	0	23.1	2.9E-07
7/16/08	8	56.5	2	9.9	10.3	0	23.1	2.5E-07
7/16/08	8	57	3	9.8	10.2	0	23.1	2.5E-07
7/16/08	8	57.5	3	9.7	10.1	0	23.1	2.3E-07
7/16/08	8	57.9	4	9.6	9.9	1	23.1	2.8E-07

Tested By: TMS Date: 7/16/2008 Checked By: GEM Date: 7-28-08

DCN: CT-22A DATE:12-21-98 REVISION: 4 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-22 PERMOM.xls]Sheet1

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INTEGRITY IN TESTING

ATTERBERG LIMITS

ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	CDM	Boring No.	618
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	7-9
Project No.	2008-598-02	Sample No.	T-1
Lab ID	2008-598-02-05	Soil Description	**BROWN SILT**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

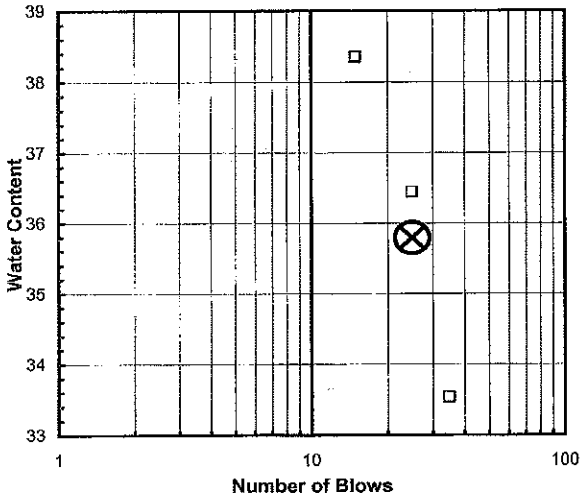
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	K-A	A-L	A-C	MULTIPOINT
Wt. of Tare & WS (gm)	28.74	28.10	29.07	
Wt. of Tare & DS (gm)	25.07	24.74	25.68	
Wt. of Tare (gm)	15.50	15.52	15.57	
Wt. of Water (gm)	3.7	3.4	3.4	
Wt. of DS (gm)	9.6	9.2	10.1	
Moisture Content (%)	**38.3**	**36.4**	**33.5**	
Number of Blows	**15**	**25**	**35**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	I	D	
Wt. of Tare & WS (gm)	21.68	23.41	
Wt. of Tare & DS (gm)	20.09	21.42	
Wt. of Tare (gm)	15.22	15.14	
Wt. of Water (gm)	1.6	2.0	
Wt. of DS (gm)	4.9	6.3	
Moisture Content (%)	**32.6**	**31.7**	**1.0**

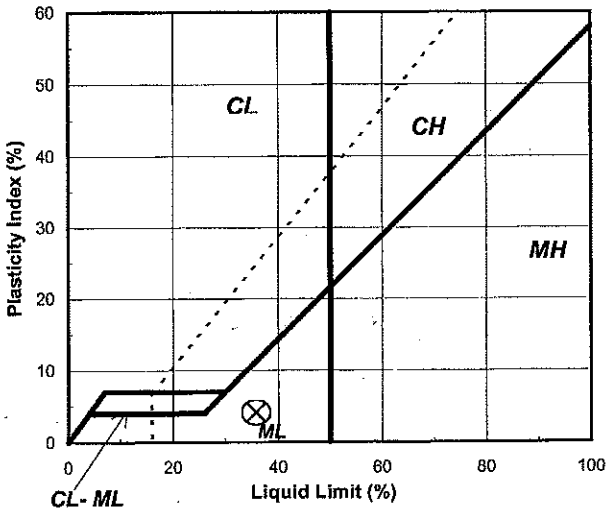
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**36**
Plastic Limit (%)	**32**
Plasticity Index (%)	**4**
USCS Symbol	**ML**

Flow Curve



Plasticity Chart



Tested By JBD *Date* 7/23/2008 *Checked By* GEM *Date* 7-24-08

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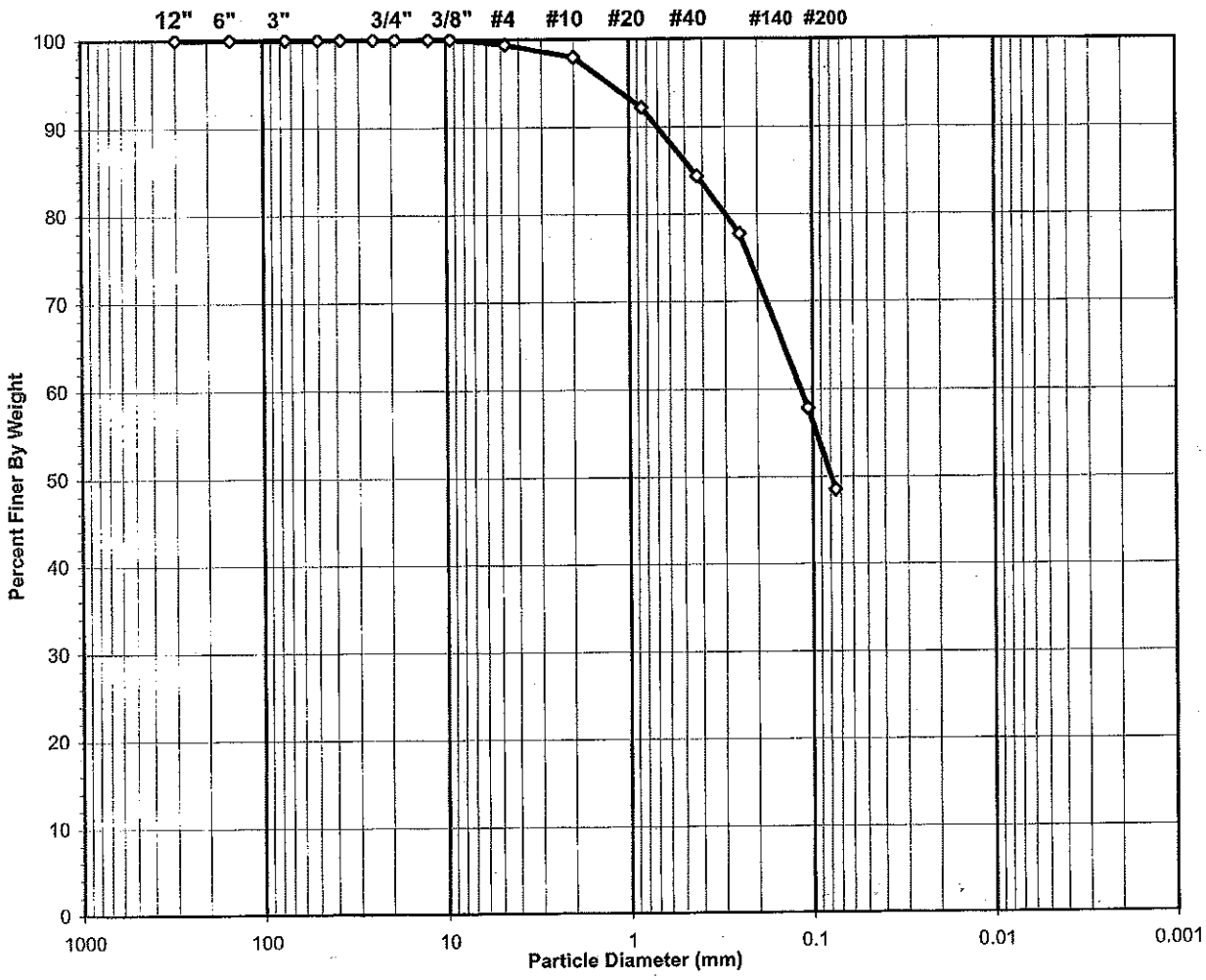
INTEGRITY IN TESTING

SIEVE ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	618
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	7-9
Project No.	2008-598-02	Sample No.	T-1
Lab ID	2008-598-02-05	Soil Color	**BROWN**

USCS	SIEVE ANALYSIS		HYDROMETER
	gravel	sand	silt and clay



USCS Symbol ***SM, TESTED***

USCS Classification ***SILTY SAND***

Tested By SD Date 7/23/2008 Checked By GEM Date 7-24-08

 DCN: CT-S3C DATE 6-25-98 REVISION: 2 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-02-05 SIEVON REV 4.XLS]Sheet1*

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INTEGRITY IN TESTING

WASH SIEVE ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	618
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	7-9
Project No.	2008-598-02	Sample No.	T-1
Lab ID	2008-598-02-05	Soil Color	**BROWN**

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	209	Tare No.	NA
Wgt.Tare + Wet Specimen (gm)	349.88	Wgt.Tare + Wet Specimen (gm)	NA
Wgt.Tare + Dry Specimen (gm)	332.11	Wgt.Tare + Dry Specimen (gm)	NA
Weight of Tare (gm)	171.76	Weight of Tare (gm)	NA
Weight of Water (gm)	17.77	Weight of Water (gm)	NA
Weight of Dry Soil (gm)	160.35	Weight of Dry Soil (gm)	NA
Moisture Content (%)	**11.1**	**Moisture Content (%)**	**NA**

Wet Weight -3/4" Sample (gm)	NA	Weight of the Dry Specimen (gm)	160.35
Dry Weight - 3/4" Sample (gm)	82.6	Weight of minus #200 material (gm)	77.78
Wet Weight +3/4" Sample (gm)	NA	Weight of plus #200 material (gm)	82.57
Dry Weight + 3/4" Sample (gm)	0.00		
Total Dry Weight Sample (gm)	NA		

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.50	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	0.00	0.0	0.0	100.0	**100.0**
#4	4.75	0.96	0.6	0.6	99.4	**99.4**
#10	2.00	2.34	1.5	2.1	97.9	**97.9**
#20	0.850	9.21	5.7	7.8	92.2	**92.2**
#40	0.425	12.62	7.9	15.7	84.3	**84.3**
#60	0.250	10.54	6.6	22.2	77.8	**77.8**
#140	0.106	31.90	19.9	42.1	57.9	**57.9**
#200	0.075	15.00	9.4	51.5	48.5	**48.5**
Pan	-	77.78	48.5	100.0	-	-

Tested By SD Date 7/23/2008 Checked By GLM Date 7-24-08

DCN: CT-S3C DATE 6-25-98 REVISION: 2

\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-02-05 SIEVON REV 4.XLS]Sheet1

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PERMEABILITY TEST

ASTM D 5084-90(Reapproved 1997)
(SOP-S22A & S22B)

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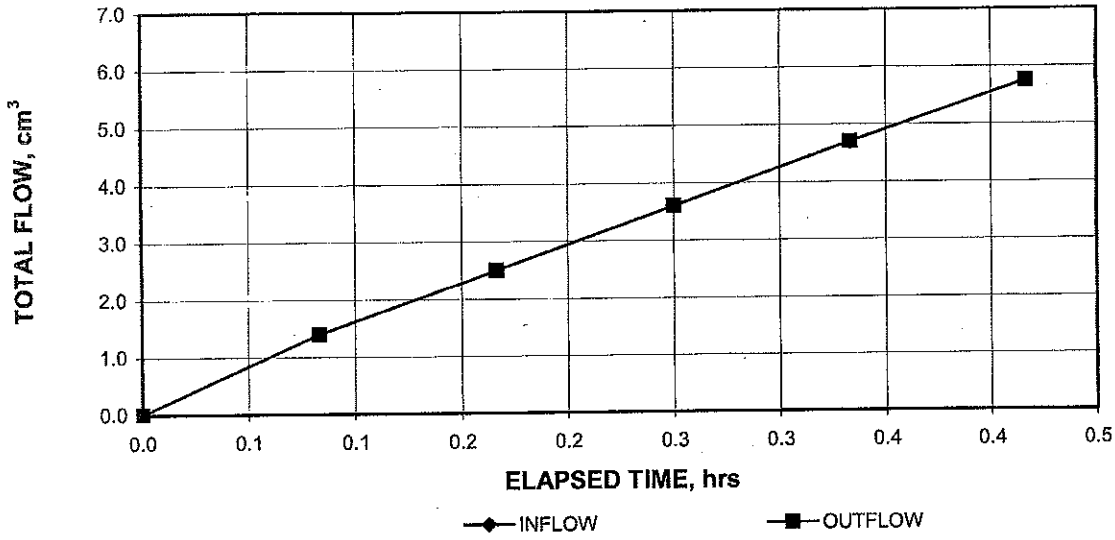
INTEGRITY IN TESTING

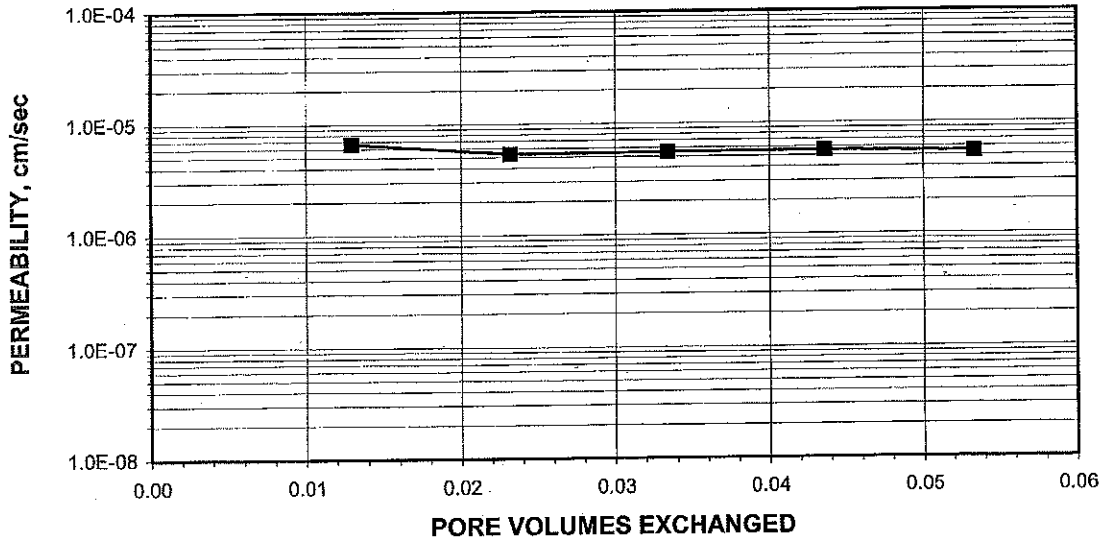
Client	CDM	Boring No.	618
Client Project	BUNCOMBE COUNTY C&D LF EXP.	Depth (ft.)	7.0-9.0
Project No.	2008-598-02	Sample No.	T-1
Lab ID No.	2008-598-02-05		

AVERAGE PERMEABILITY = 5.5E-06 cm/sec @ 20°C
AVERAGE PERMEABILITY = 5.5E-08 m/sec @ 20°C

TOTAL FLOW vs. ELAPSED TIME



PORE VOLUMES EXCHANGED vs. PERMEABILITY



Tested By: TMS Date: 7/17/2008 Checked By: GEM Date: 7-21-08

DCN: CT-22 DATE: 01-08-99 REVISION:\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-02-05 PERM.xls]Sheet1

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PERMEABILITY TEST

ASTM D 5084-90(Reapproved 1997)
(SOP-S22A & S22B)

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INTEGRITY IN TESTING

Client	CDM	Boring No.	618
Client Project	BUNCOMBE COUNTY C&D LF EXP.	Depth (ft.)	7.0-9.0
Project No.	2008-598-02	Sample No.	T-1
Lab ID No.	2008-598-02-05		
		Specific Gravity	2.70 Assumed
		Sample Condition	Undisturbed

Visual Description: TAN SANDY SILT

MOISTURE CONTENT:	BEFORE TEST	AFTER TEST
Tare Number	A-5	312
Wt. of Tare & WS (gm.)	400.54	623.06
Wt. of Tare & DS (gm.)	379.49	506.86
Wt. of Tare (gm.)	98.98	84.22
Wt. of Water (gm.)	21.05	116.20
Wt. of DS (gm.)	280.51	422.64
Moisture Content (%)	**7.5**	**27.5**

SPECIMEN:	BEFORE TEST	AFTER TEST
Wt. of Tube & WS (gm.)	530.54	NA
Wt. of Tube (gm.)	0.00	NA
Wt. of WS (gm.)	530.54	629.19
Length 1 (in.)	2.912	2.799
Length 2 (in.)	2.910	2.874
Length 3 (in.)	2.905	2.833
Top Diameter (in.)	2.852	2.821
Middle Diameter (in.)	2.845	2.812
Bottom Diameter (in.)	2.850	2.832
Average Length (in.)	2.91	2.84
Average Area (in.^{2})	6.37	6.25
Sample Volume (cm^3)	303.89	290.54
Unit Wet Wt. (gm./ cm^3)	1.75	2.17
Unit Wet Wt. (pcf)	109.0	135.2
Unit Dry Wt. (pcf)	101.4	106.0
Unit Dry Wt. (gm./ cm^3)	1.62	1.70
Void Ratio, e	0.66	0.59
Porosity, n	0.40	0.37
Pore Volume (cm^3)	121.1	107.8

Tested By: TMS Date: 7/17/2008 Checked By: GBM Date: 7-21-08

DCN: CT-22 DATE: 01-08-99 REVISION:2 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-02-05 PERM.xls]Sheet1

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PERMEABILITY TEST

ASTM D 5084-90(Reapproved 1997)
(SOP-S22A & S22B)

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Client	CDM	Boring No.	618
Client Project	BUNCOMBE COUNTY C&D LF EXP.	Depth (ft.)	7.0-9.0
Project No.	2008-598-02	Sample No.	T-1
Lab ID No.	2008-598-02-05		

Pressure Heads (Constant)		Final Sample Dimensions	
Top Cap (psi)	48.7	Sample Length (cm), L	7.20
Bottom Cap (psi)	50.0	Sample Diameter (cm)	7.17
Cell (psi)	55.0	Sample Area (cm^2), A	40.34
Total Pressure Head (cm)	91.4	Inflow Burette Area (cm^2), a-in	0.877
Hydraulic Gradient	12.69	Outflow Burette Area (cm^2), a-out	0.886
		B Parameter (%)	95

AVERAGE PERMEABILITY = 5.5E-06 cm/sec @ 20°C
AVERAGE PERMEABILITY = 5.5E-08 m/sec @ 20°C

DATE (mm/dd/yy)	TIME (hr)	TIME (min)	ELAPSED TIME t (hr)	TOTAL INFLOW (cm^3)	TOTAL OUTFLOW (cm^3)	TOTAL HEAD h (cm)	FLOW (0 flow) (1 stop)	TEMP. (°C)	INCREMENTAL PERMEABILITY @ 20°C (cm/sec)
7/17/2008	11	23	0.0	0.0	0.0	116.9	0	23.0	NA
7/17/2008	11	28	0.1	1.4	1.4	113.8	0	23.0	6.6E-06
7/17/2008	11	33	0.2	2.5	2.5	111.3	0	23.0	5.3E-06
7/17/2008	11	38	0.3	3.6	3.6	108.9	0	23.0	5.5E-06
7/17/2008	11	43	0.3	4.7	4.7	106.4	0	23.0	5.6E-06
7/17/2008	11	48	0.4	5.8	5.8	104.1	1	23.0	5.5E-06

Tested By: TMS Date: 7/17/2008 Checked By: GBM Date: 7-21-08

DCN: CT-22 DATE: 01-08-99 REVISION:2 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-02-05 PERM.xls]Sheet1

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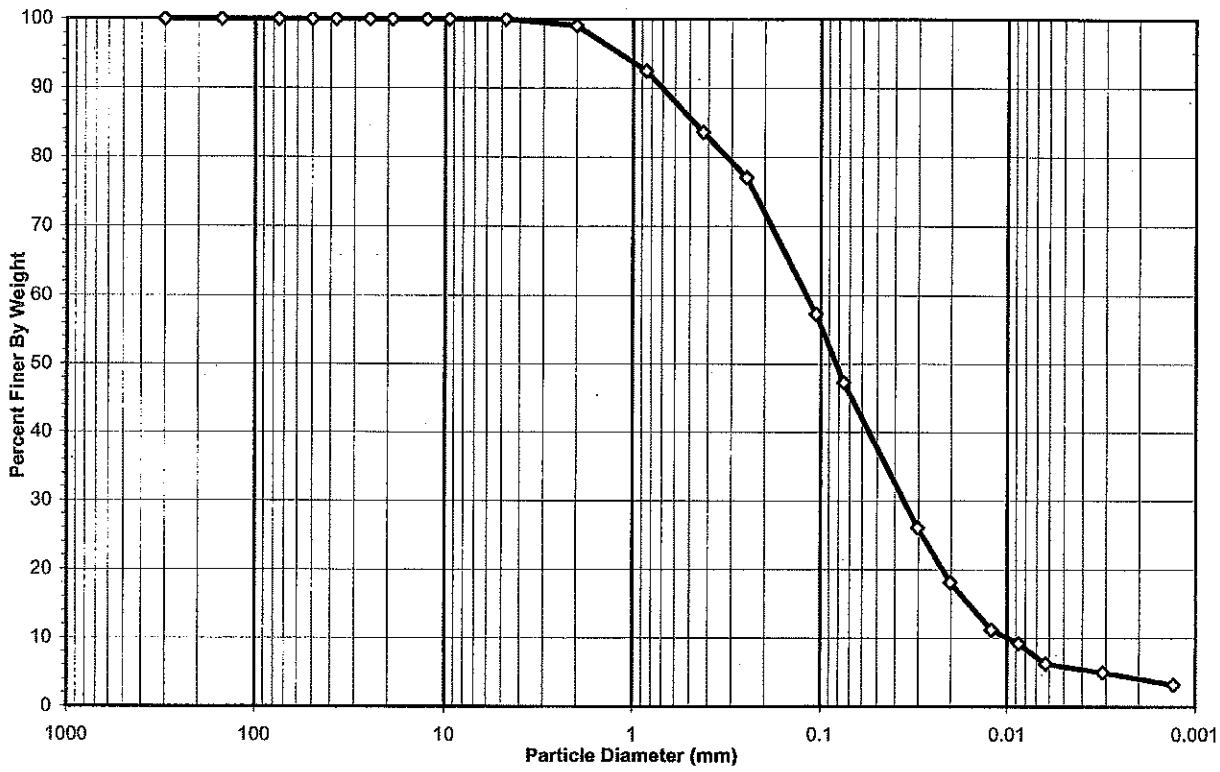
INTEGRITY IN TESTING

SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-618
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	9-11
Project No.	2008-598-01	Sample No.	S-3
Lab ID	2008-598-01-05	Soil Color	**LIGHT BROWN**

	SIEVE ANALYSIS					HYDROMETER
USCS	cobbles	gravel	sand			silt and clay fraction
USDA	cobbles	gravel	sand		silt	clay

12" 6" 3" 3/4" 3/8" #4 #10 #20 #40 #140 #200



USCS Summary		
Sieve Sizes (mm)		**Percentage**
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	52.74
Finer Than #200	*Silt & Clay*	47.26

USCS Symbol ***SM, TESTED***

USCS Classification ***SILTY SAND***

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-05 #10 Split Hydro rev 8.xls]Sheet1*

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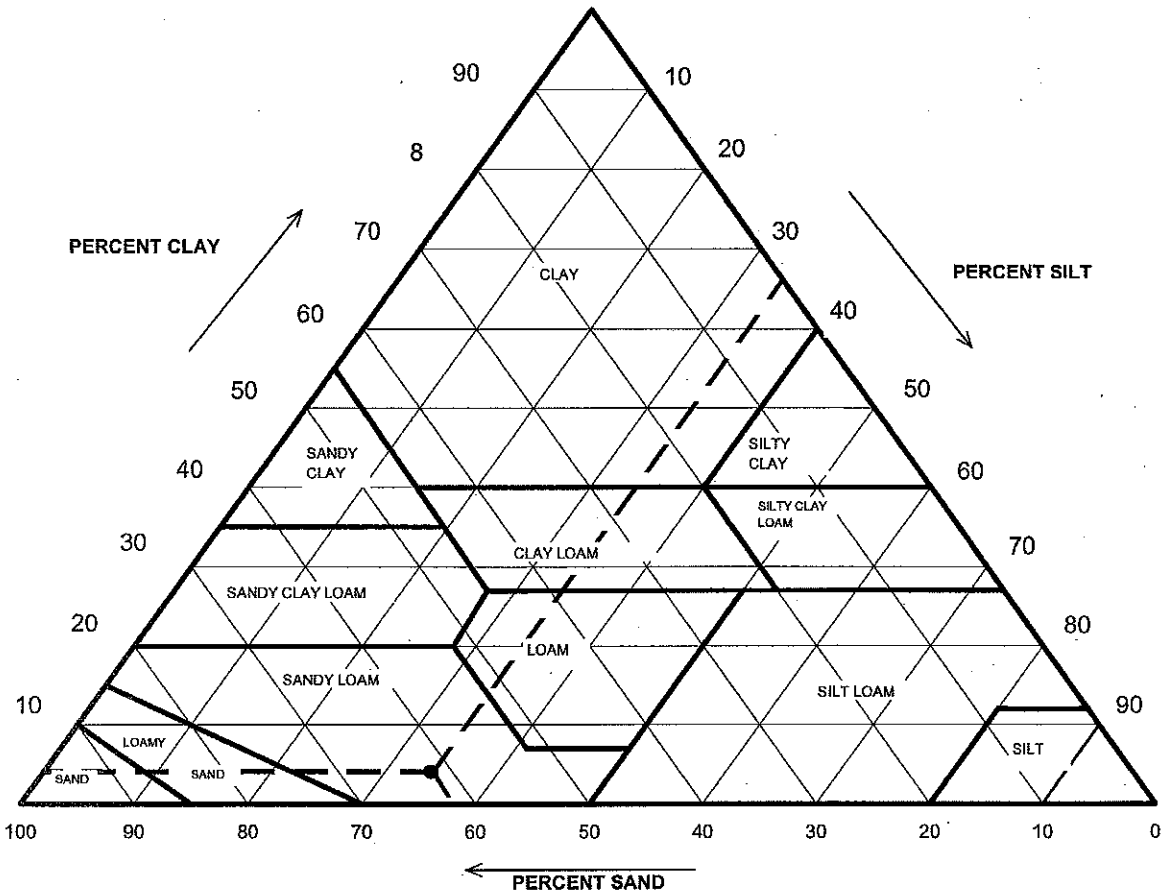
INTEGRITY IN TESTING

USDA CLASSIFICATION CHART

Client	CDM	Boring No.	B-618
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	9-11
Project No.	2008-598-01	Sample No.	S-3
Lab ID	2008-598-01-05	Soil Color	LIGHT BROWN



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	0.93	**0.00**
2	99.07	*Sand*	61.29	**61.87**
0.05	37.78	*Silt*	33.70	**34.02**
0.002	4.07	*Clay*	4.07	**4.11**

USDA Classification: ***SANDY LOAM***

DCN: CT-S3P DATE:02/15/05 REVISION:8 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-05 #10 Split Hydro rev 8.xls]Sheet1

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INTEGRITY IN TESTING

WASH SIEVE ANALYSIS #10 SPLIT

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-618
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	9-11
Project No.	2008-598-01	Sample No.	S-3
Lab ID	2008-598-01-05	Soil Color	**LIGHT BROWN**

Moisture Content/sieve +10 Material		Moisture Content for Hydrometer Portion	
Tare No.	200	Tare No.	E-2
Wgt.Tare + Wet Soil (gm)	229.34	Wgt.Tare + Wet Soil (gm)	61.85
Wgt.Tare + Dry Soil (gm)	223.33	Wgt.Tare + Dry Soil (gm)	61.45
Weight of Tare (gm)	171.85	Weight of Tare (gm)	21.90
Weight of Water (gm)	6.01	Weight of Water (gm)	0.40
Weight of Dry Soil (gm)	51.48	Weight of Dry Soil (gm)	39.55
Moisture Content (%)	**11.7**	**Moisture Content (%)**	**1.0**

Soil Specimen Data			
Wet Weight +#10 Material (gm)	57.49	Weight of the Dry Sample (gm)	150.48
Dry Weight +#10 Material(gm)	51.5	Weight of minus #200 material (gm)	47.23
Wet Weight Hydro. Material.(gm)	100.00	Weight of plus #200 material (gm)	103.25
Dry Weight Hydro. Material (gm)	99.00		
Total Dry Weight Sample (gm)	150.48	**J-FACTOR (%FINER THAN #10)**	**0.9907**

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.00	0.00	0.00	100.00	**100.00**
#10	2.00	0.48	0.93	0.93	99.07	**99.07**
#20	0.85	6.62	6.69	6.69	93.31	**92.44**
#40	0.425	8.88	8.97	15.66	84.34	**83.56**
#60	0.250	6.51	6.58	22.23	77.77	**77.04**
#140	0.106	19.73	19.93	42.16	57.84	**57.30**
#200	0.075	10.03	10.13	52.29	47.71	**47.26**
Pan	-	47.23	47.71	100.00	-	-

Notes :

Tested By SD Date 7/15/2008 Checked By GBM Date 7-15-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-05 #10 Split Hydro rev 8.xls]Sheet1*

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HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-618
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	9-11
Project No.	2008-598-01	Sample No.	S-3
Lab ID	2008-598-01-05	Soil Color	**LIGHT BROWN**

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	30.0	30.0	24.5	3.65	26.4	26.2	0.01267	0.0302	**26.0**
5		22.0	24.5	3.65	18.4	18.3	0.01267	0.0202	**18.1**
15		15.0	24.5	3.65	11.4	11.3	0.01267	0.0122	**11.2**
30		13.0	24.5	3.65	9.4	9.3	0.01267	0.0087	**9.2**
60		10.0	24.5	3.65	6.4	6.3	0.01267	0.0063	**6.3**
250		9.0	23.5	3.94	5.1	5.0	0.01282	0.0031	**5.0**
1440		7.0	24.1	3.76	3.2	3.2	0.01273	0.0013	**3.2**

Soil Specimen Data		**Other Corrections**	
Tare + Dry Material (gm)	99.00	a - Factor	0.986
Weight of Tare (gm)	0		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 10	99.07
Weight of Dry Material (gm)	99.00		
		Specific Gravity	2.72 Assumed

Note:

Tested By JBD Date 7/14/2008 Checked By GJM Date 7-15-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\2008-598-01-05 #10 Split Hydro rev 8.xls]Sheet1*

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ATTERBERG LIMITS

ASTM D 4318-98 / AASHTO T89 (SOP - S4A)

Client	CDM	Boring No.	B-618
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	9-11
Project No.	2008-598-01	Sample No.	S-3
Lab ID	2008-598-01-05	Soil Description	**LIGHT BROWN SILT**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

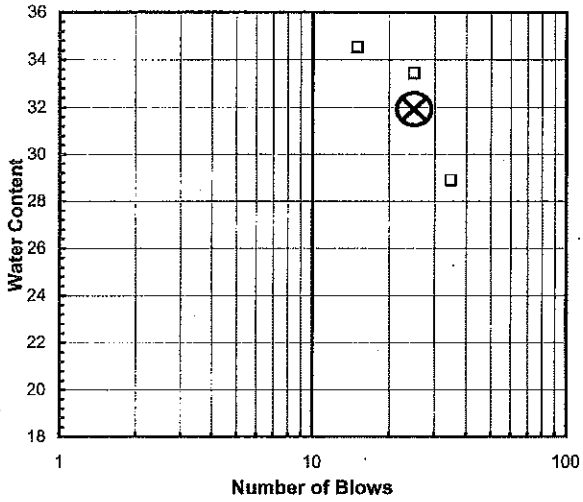
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	F	E	H	MULTIPOINT
Wt. of Tare & WS (gm)	29.53	31.11	28.06	
Wt. of Tare & DS (gm)	25.83	27.15	25.17	
Wt. of Tare (gm)	15.11	15.30	15.17	
Wt. of Water (gm)	3.7	4.0	2.9	
Wt. of DS (gm)	10.7	11.9	10.0	
Moisture Content (%)	**34.5**	**33.4**	**28.9**	
Number of Blows	**15**	**25**	**35**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	A-D	A-O	
Wt. of Tare & WS (gm)	21.79	22.16	
Wt. of Tare & DS (gm)	20.29	20.59	
Wt. of Tare (gm)	15.42	15.48	
Wt. of Water (gm)	1.5	1.6	
Wt. of DS (gm)	4.9	5.1	
Moisture Content (%)	**30.8**	**30.7**	**0.1**

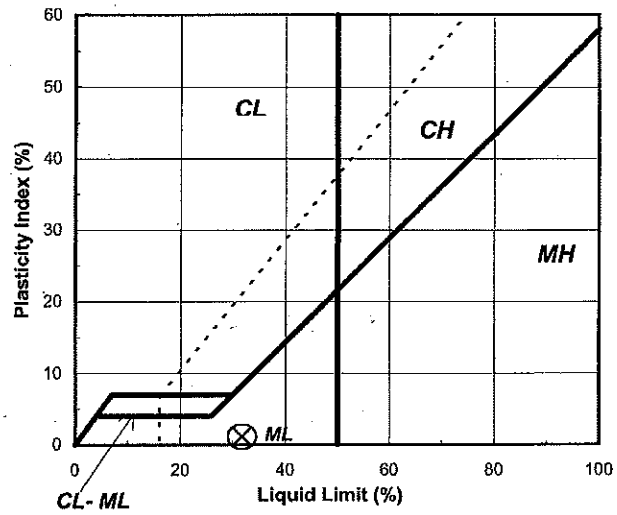
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**32**
Plastic Limit (%)	**31**
Plasticity Index (%)	**1**
USCS Symbol	**ML**

Flow Curve



Plasticity Chart



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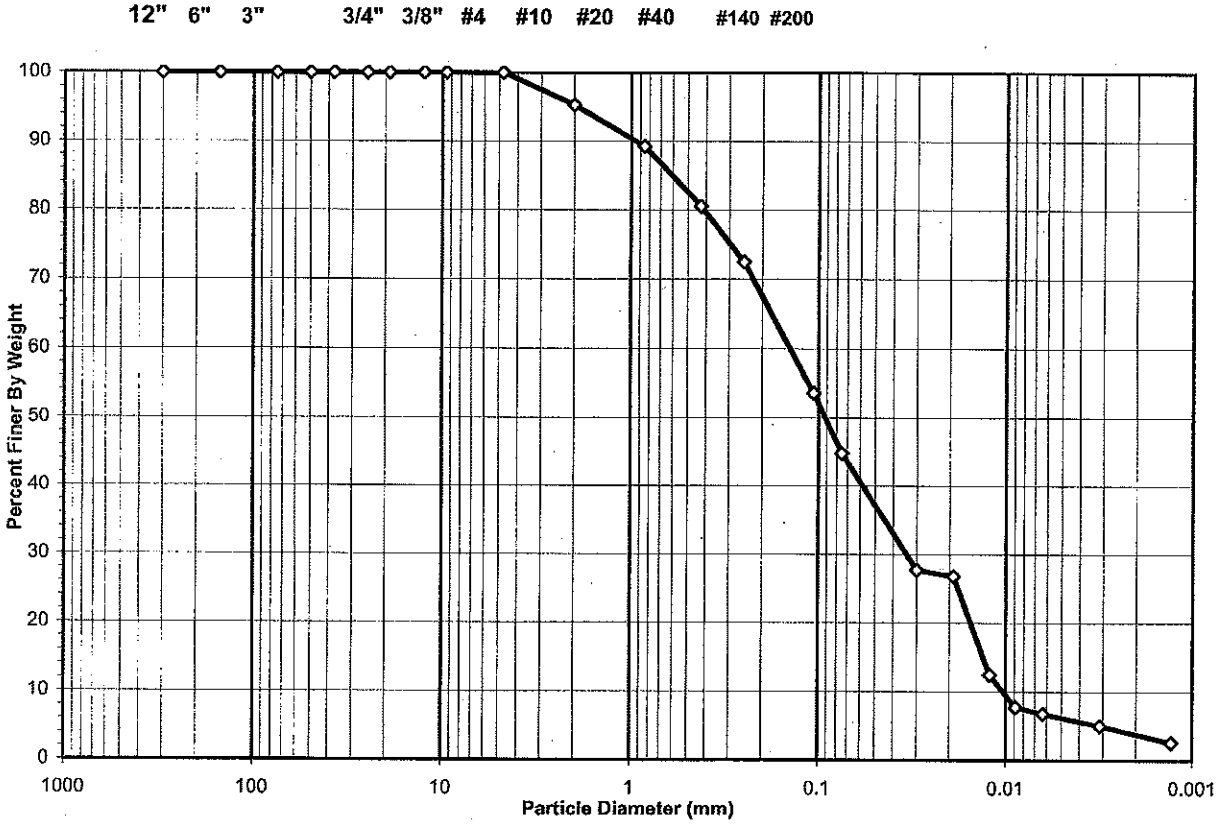
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-618
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	24-26
Project No.	2008-598-01	Sample No.	S-6
Lab ID	2008-598-01-06	Soil Color	**GRAY WHITE BROWN**

	SIEVE ANALYSIS				HYDROMETER	
USCS	cobbles	gravel	sand		silt and clay fraction	
USDA	cobbles	gravel	sand		silt	clay



USCS Summary		
Sieve Sizes (mm)		**Percentage**
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	55.23
Finer Than #200	*Silt & Clay*	44.77

USCS Symbol ***SM, TESTED***

USCS Classification ***SILTY SAND***

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-06 #10 Split Hydro rev 8.xls]Sheet1*

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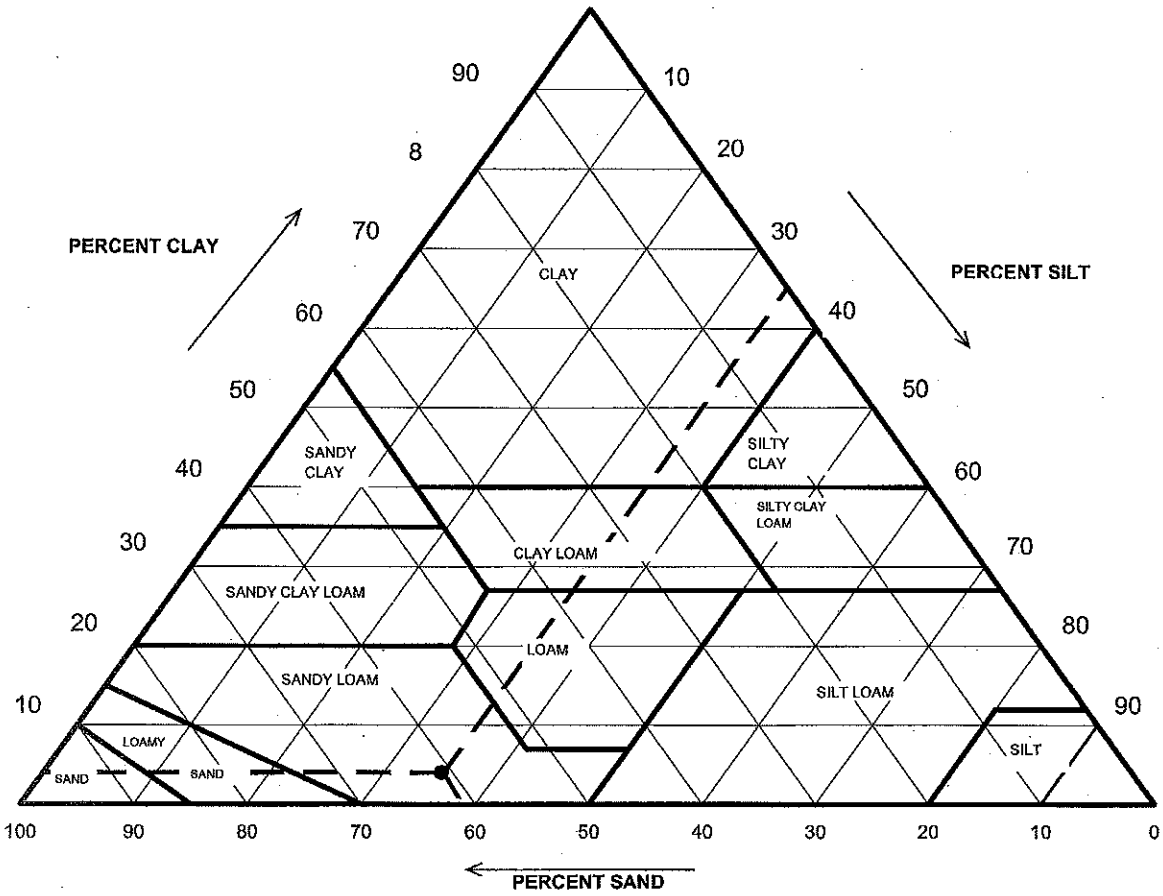
USDA CLASSIFICATION CHART

Client	CDM	Boring No.	B-618
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	24-26
Project No.	2008-598-01	Sample No.	S-6
Lab ID	2008-598-01-06	Soil Color	GRAY WHITE BROWN



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	4.70	**0.00**
2	95.30	*Sand*	58.12	**60.98**
0.05	37.18	*Silt*	33.38	**35.03**
0.002	3.80	*Clay*	3.80	**3.99**

USDA Classification: ***SANDY LOAM***

DCN: CT-S3P DATE:02/15/05 REVISION:8 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-06 #10 Split Hydro rev 8.xls]Sheet1

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WASH SIEVE ANALYSIS #10 SPLIT

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-618
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	24-26
Project No.	2008-598-01	Sample No.	S-6
Lab ID	2008-598-01-06	Soil Color	**GRAY WHITE BROWN**

Moisture Content/sieve +10 Material		Moisture Content for Hydrometer Portion	
Tare No.	212	Tare No.	C-2
Wgt.Tare + Wet Soil (gm)	204.52	Wgt.Tare + Wet Soil (gm)	45.46
Wgt.Tare + Dry Soil (gm)	201.83	Wgt.Tare + Dry Soil (gm)	45.28
Weight of Tare (gm)	171.60	Weight of Tare (gm)	15.63
Weight of Water (gm)	2.69	Weight of Water (gm)	0.18
Weight of Dry Soil (gm)	30.23	Weight of Dry Soil (gm)	29.65
Moisture Content (%)	**8.9**	**Moisture Content (%)**	**0.6**

Soil Specimen Data			
Wet Weight +#10 Material (gm)	32.92	Weight of the Dry Sample (gm)	129.67
Dry Weight +#10 Material(gm)	30.2	Weight of minus #200 material (gm)	46.72
Wet Weight Hydro. Material.(gm)	100.04	Weight of plus #200 material (gm)	82.95
Dry Weight Hydro. Material (gm)	99.44		
Total Dry Weight Sample (gm)	129.67	**J-FACTOR (%FINER THAN #10)**	**0.9530**

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.00	0.00	0.00	100.00	**100.00**
#10	2.00	1.42	4.70	4.70	95.30	**95.30**
#20	0.85	6.33	6.37	6.37	93.63	**89.24**
#40	0.425	9.05	9.10	15.47	84.53	**80.56**
#60	0.250	8.47	8.52	23.99	76.01	**72.44**
#140	0.106	19.73	19.84	43.83	56.17	**53.53**
#200	0.075	9.14	9.19	53.02	46.98	**44.77**
Pan	-	46.72	46.98	100.00	-	-

Notes :

Tested By SD Date 7/16/2008 Checked By GEM Date 7-21-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-06 #10 Split Hydro rev 8.xls]Sheet1*

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HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-618
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	24-26
Project No.	2008-598-01	Sample No.	S-6
Lab ID	2008-598-01-06	Soil Color	**GRAY WHITE BROWN**

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	33.0	33.0	23.7	3.88	29.1	29.0	0.01287	0.0300	**27.6**
5		32.0	23.7	3.88	28.1	28.0	0.01287	0.0191	**26.7**
15		17.0	23.7	3.88	13.1	13.1	0.01287	0.0122	**12.4**
30		12.0	23.8	3.85	8.2	8.1	0.01285	0.0089	**7.7**
60		11.0	23.8	3.85	7.2	7.1	0.01285	0.0063	**6.8**
250		9.0	24.3	3.70	5.3	5.3	0.01278	0.0031	**5.0**
1440		6.0	25.8	3.27	2.7	2.7	0.01256	0.0013	**2.6**

Soil Specimen Data		**Other Corrections**	
Tare + Dry Material (gm)	99.44	a - Factor	0.99
Weight of Tare (gm)	0		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 10	95.30
Weight of Dry Material (gm)	99.44		
		Specific Gravity	2.7 Assumed

Note:

Tested By JBD Date 7/14/2008 Checked By GEM Date 7-21-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-06 #10 Split Hydro rev 8.xls]Sheet1*

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ATTERBERG LIMITS

ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	CDM	Boring No.	B-618
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	24-26
Project No.	2008-598-01	Sample No.	S-6
Lab ID	2008-598-01-06	Soil Description	**GRAY WHITE BROWN SILT**

***Note: The* USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.** (Minus No. 40 sieve material, Airdried)

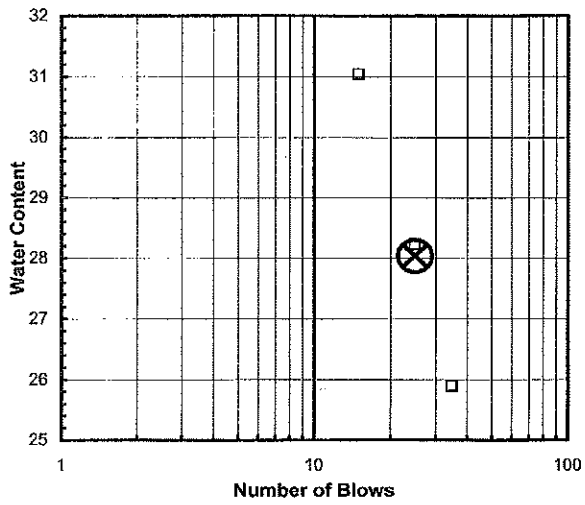
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	A-C	A-L	K-Q	**MULTIPOINT**
Wt. of Tare & WS (gm)	27.97	26.57	28.91	
Wt. of Tare & DS (gm)	25.04	24.14	26.15	
Wt. of Tare (gm)	15.60	15.53	15.49	
Wt. of Water (gm)	2.9	2.4	2.8	
Wt. of DS (gm)	9.4	8.6	10.7	
Moisture Content (%)	**31.0**	**28.2**	**25.9**	
Number of Blows	**15**	**25**	**35**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	D	I	
Wt. of Tare & WS (gm)	23.22	23.89	
Wt. of Tare & DS (gm)	21.62	22.14	
Wt. of Tare (gm)	15.16	15.23	
Wt. of Water (gm)	1.6	1.8	
Wt. of DS (gm)	6.5	6.9	
Moisture Content (%)	**24.8**	**25.3**	**-0.6**

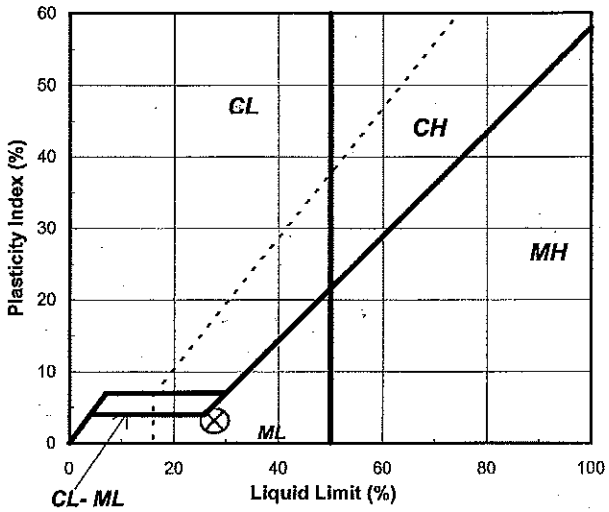
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**28**
Plastic Limit (%)	**25**
Plasticity Index (%)	**3**
USCS Symbol	**ML**

Flow Curve



Plasticity Chart



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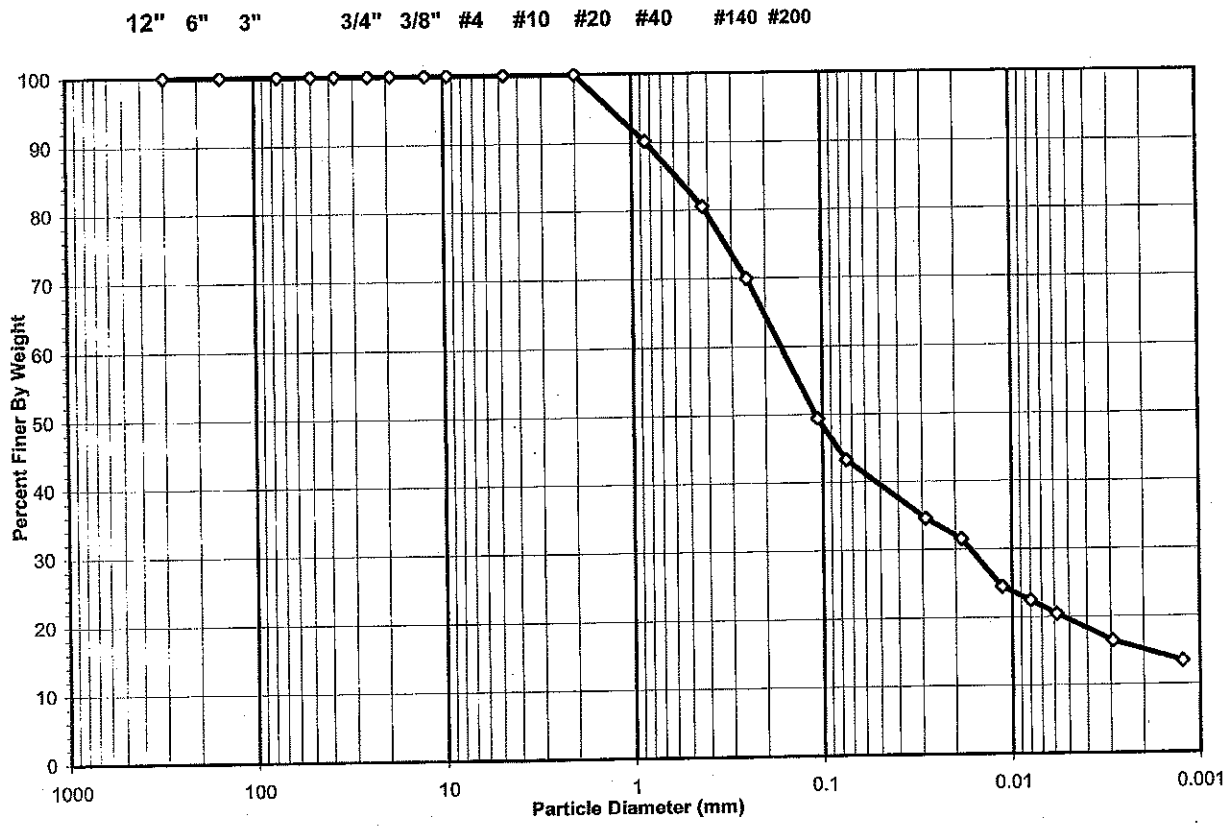
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	0-6
Project No.	2008-598-01	Sample No.	NA
Lab ID	2008-598-01-23	Soil Color	**DARK BROWN**

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	56.74
Finer Than #200	*Silt & Clay*	43.26

USCS Symbol ***sm, ASSUMED***

USCS Classification ***SILTY SAND***

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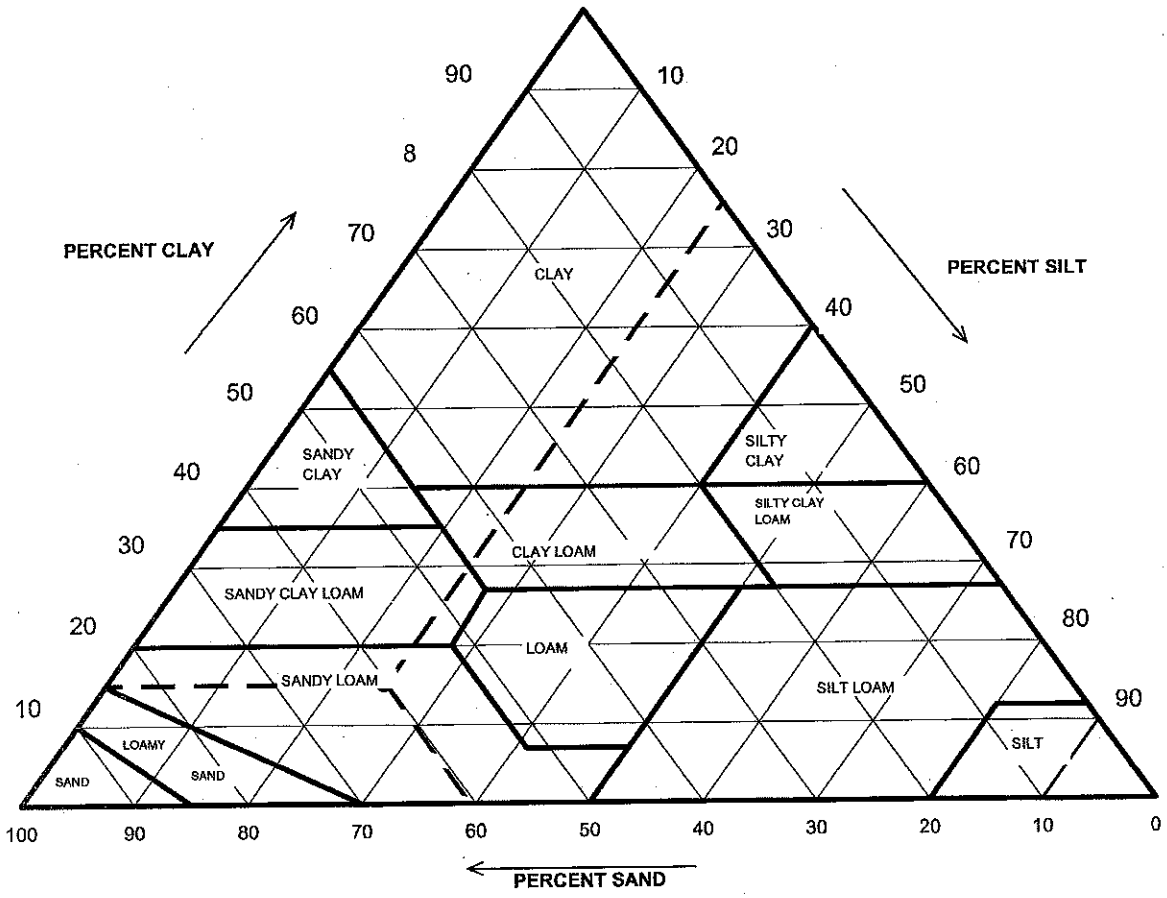
USDA CLASSIFICATION CHART

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	0-6
Project No.	2008-598-01	Sample No.	NA
Lab ID	2008-598-01-23	Soil Color	DARK BROWN



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	0.00	**0.00**
2	100.00	*Sand*	60.41	**60.41**
0.05	39.59	*Silt*	24.48	**24.48**
0.002	15.10	*Clay*	15.10	**15.10**

USDA Classification: ***SANDY LOAM***

DCN: CT-S3P DATE:02/15/05 REVISION:8 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-23 #10 Split Hydro rev 8.xls]Sheet1

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WASH SIEVE ANALYSIS #10 SPLIT

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	0-6
Project No.	2008-598-01	Sample No.	NA
Lab ID	2008-598-01-23	Soil Color	**DARK BROWN**

Moisture Content/sieve +10 Material		Moisture Content for Hydrometer Portion	
Tare No.	318	Tare No.	C-2
Wgt.Tare + Wet Soil (gm)	600.50	Wgt.Tare + Wet Soil (gm)	50.35
Wgt.Tare + Dry Soil (gm)	530.79	Wgt.Tare + Dry Soil (gm)	49.75
Weight of Tare (gm)	86.60	Weight of Tare (gm)	15.63
Weight of Water (gm)	69.71	Weight of Water (gm)	0.60
Weight of Dry Soil (gm)	444.19	Weight of Dry Soil (gm)	34.12
Moisture Content (%)	**15.7**	**Moisture Content (%)**	**1.8**

Soil Specimen Data			
Wet Weight +#10 Material (gm)	513.90	Weight of the Dry Sample (gm)	542.48
Dry Weight +#10 Material(gm)	444.2	Weight of minus #200 material (gm)	42.52
Wet Weight Hydro. Material.(gm)	100.02	Weight of plus #200 material (gm)	499.96
Dry Weight Hydro. Material (gm)	98.29		
Total Dry Weight Sample (gm)	542.48	**J-FACTOR (%FINER THAN #10)**	**1.0000**

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.00	0.00	0.00	100.00	**100.00**
#10	2.00	0.00	0.00	0.00	100.00	**100.00**
#20	0.85	9.64	9.81	9.81	90.19	**90.19**
#40	0.425	9.47	9.63	19.44	80.56	**80.56**
#60	0.250	10.45	10.63	30.07	69.93	**69.93**
#140	0.106	20.20	20.55	50.62	49.38	**49.38**
#200	0.075	6.01	6.11	56.74	43.26	**43.26**
Pan	-	42.52	43.26	100.00	-	-

Notes :

Tested By SD Date 7/18/2008 Checked By GEM Date 7-28-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-23 #10 Split Hydro rev 8.xls]Sheet1*

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INTEGRITY IN TESTING

HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	0-6
Project No.	2008-598-01	Sample No.	NA
Lab ID	2008-598-01-23	Soil Color	**DARK BROWN**

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	38.0	38.0	24.3	3.70	34.3	34.5	0.01278	0.0287	**34.5**
5		35.0	24.3	3.70	31.3	31.5	0.01278	0.0186	**31.5**
15		28.0	24.3	3.70	24.3	24.5	0.01278	0.0113	**24.5**
31		26.0	24.3	3.70	22.3	22.5	0.01278	0.0080	**22.5**
60		24.0	24.3	3.70	20.3	20.4	0.01278	0.0058	**20.4**
250		20.0	24.4	3.67	16.3	16.4	0.01276	0.0029	**16.4**
1440		17.0	24.3	3.70	13.3	13.4	0.01278	0.0012	**13.4**

Soil Specimen Data		**Other Corrections**	
Tare + Dry Material (gm)	98.29	a - Factor	0.99
Weight of Tare (gm)	0		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 10	100.00
Weight of Dry Material (gm)	98.29		
		Specific Gravity	2.7 Assumed

Note:

Tested By JBD Date 7/14/2008 Checked By GEM Date 7-28-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-23 #10 Split Hydro rev 8.xls]Sheet1*

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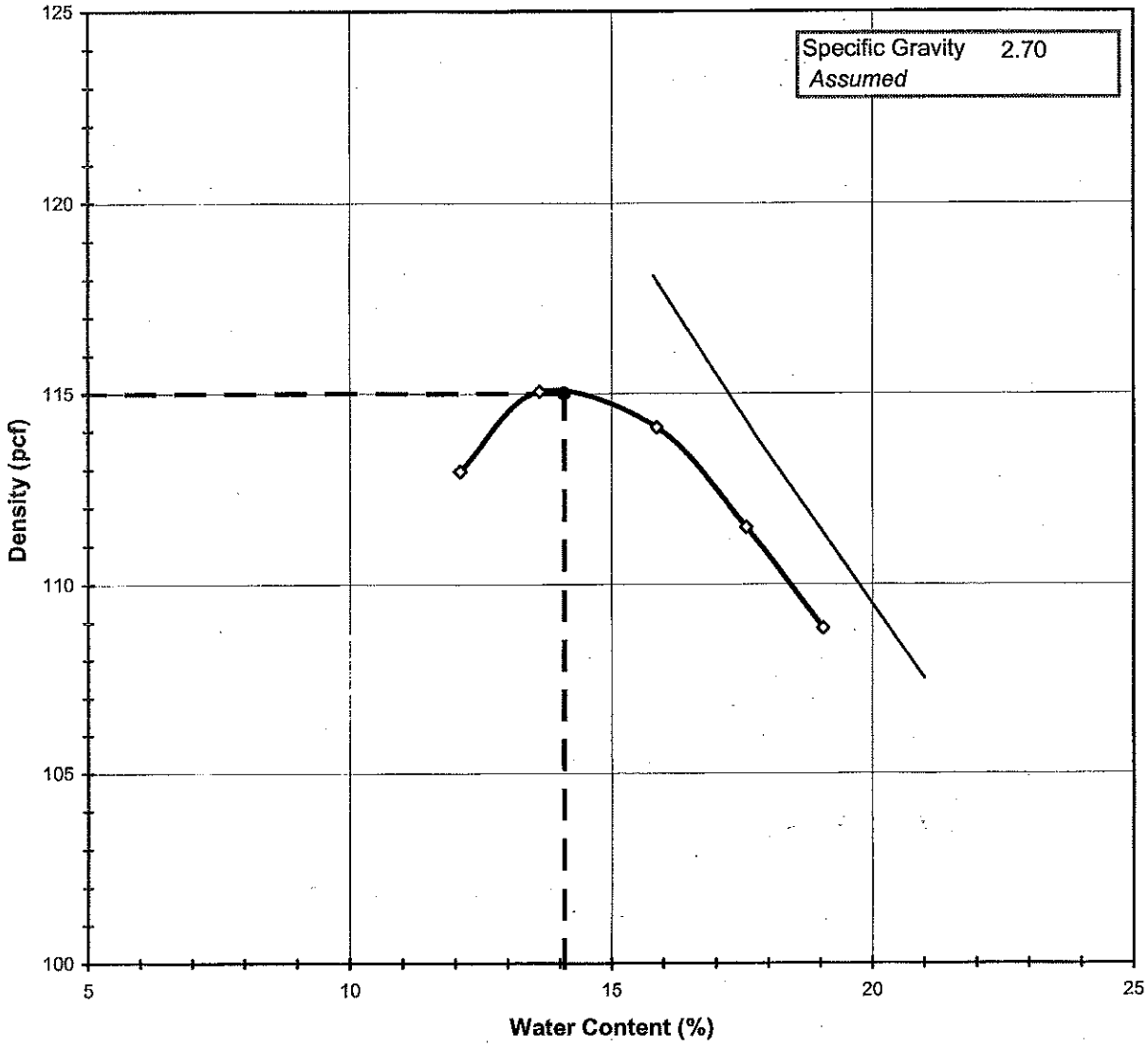
MOISTURE DENSITY RELATIONSHIP

ASTM D698-91 SOP-S12

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	0-6
Project No.	2008-598-01	Sample No.	NA
Lab ID	2008-598-01-23	Test Method	**STANDARD**

Visual Description DARK BROWN SILTY SAND

Optimum Water Content	**14.1**
Maximum Dry Density	**115.0**



Tested By DW *Date* 7/11/2008 *Checked By* GCM *Date* 7-28-08

 DCN:CT-S12 DATE:12/11/00 REVISION 5 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-23 Proctor.XLS]Sheet1*

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MOISTURE - DENSITY RELATIONSHIP

ASTM D698-91 SOP-S12

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	0-6
Project No.	2008-598-01	Sample No.	NA
Lab ID	2008-598-01-23		

Visual Description DARK BROWN SILTY SAND

Total Weight of the Sample (gm)	22625
As Received Water Content(%)	16
Assumed Specific Gravity	2.70
Percent Retained on 3/4"	1
Percent Retained on 3/8"	NA
Percent Retained on #4	6
Oversize Material	Not included
Procedure Used	B

TestType		STANDARD
Rammer Weight (lbs)		5.5
Rammer Drop (in)		12
Rammer Type		MECHANICAL
Machine ID	R	174
Mold ID	R	172
Mold diameter		4"
Weight of the Mold		4326
Volume of the Mold(cc)		937

Mold / Specimen

Point No.	**1**	**2**	**3**	**4**	**5**
Wt. of Mold & WS (gm)	6227	6289	6311	6295	6272
Wt.of Mold (gm)	4326	4326	4326	4326	4326
Wt. of WS	1902	1963	1986	1969	1946
Mold Volume (cc)	937	937	937	937	937

Moisture Content / Density

Tare Number	314	315	309	305	310
Wt. of Tare & WS (gm)	520.10	561.00	516.00	659.50	681.90
Wt. of Tare & DS (gm)	473.14	507.01	460.36	573.53	590.42
Wt. of Tare (gm)	84.70	110.40	109.70	84.40	110.30
Wt. of Water (gm)	46.96	53.99	55.64	85.97	91.48
Wt. of DS (gm)	388.44	396.61	350.66	489.13	480.12
Wet Density (gm/cc)	2.03	2.09	2.12	2.10	2.08
Wet Density (pcf)	126.6	130.7	132.2	131.1	129.6
Moisture Content (%)	**12.1**	**13.6**	**15.9**	**17.6**	**19.1**
Dry Density (pcf)	**112.9**	**115.1**	**114.1**	**111.5**	**108.8**

Zero Air Voids

Moisture Content (%)	15.8	17.8	21.0
Dry Unit Weight (pcf)	118.1	113.8	107.5

Tested By DW *Date* 7/11/2008 *Checked By* GBM *Date* 7-28-08

DCN:CT-S12 DATE:12/11/00 REVISION 5

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FLEXIBLE WALL PERMEABILITY TEST

PERMOMETER METHOD

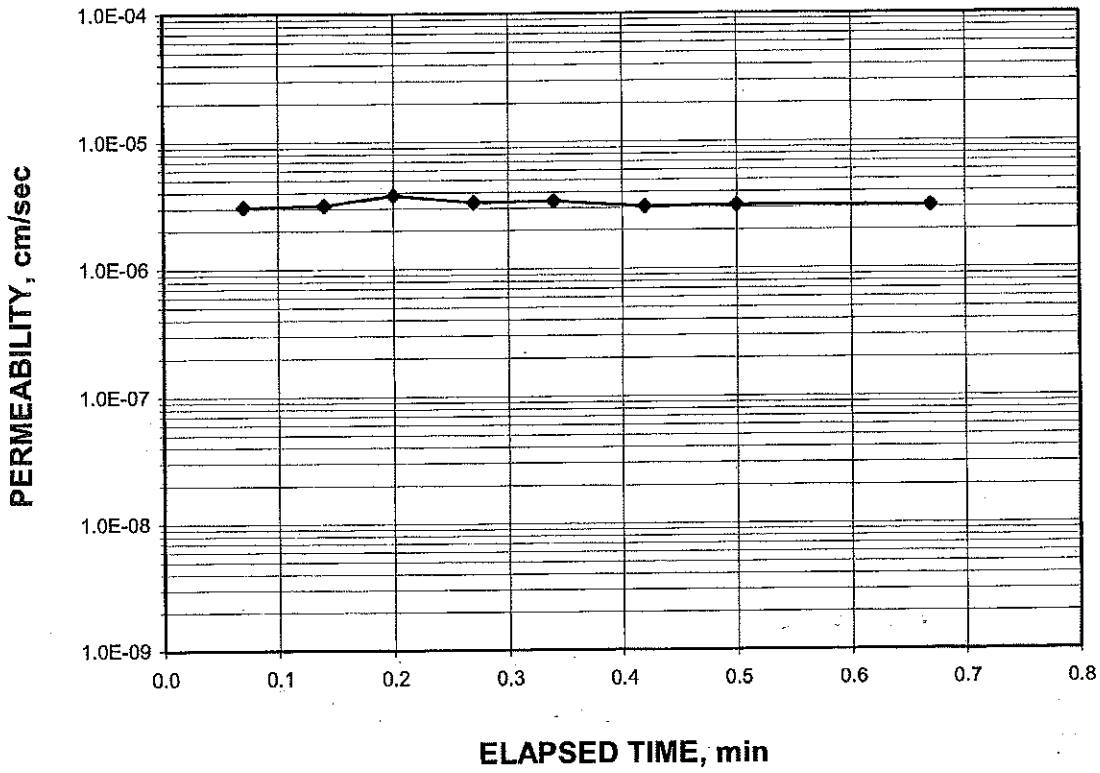
ASTM D 5084-97
(SOP-S22C)

Client	CDM	Boring No.	B-619
Client Project	BUNCOMBE CO. C&D LF EXP.	Depth (ft.)	0-6
Project No.	2008-598-01	Sample No.	NA
Lab ID No.	2008-598-01-23		

Visual Description: DARK BROWN SILTY SAND

AVERAGE PERMEABILITY = 3.2E-06 cm/sec @ 20°C
AVERAGE PERMEABILITY = 3.2E-08 m/sec @ 20°C

PERMEABILITY vs. TIME



Tested By: TMS Date: 7/16/2008 Checked By: GEM Date: 7-28-08

DCN: CT-22A DATE:12-21-98 REVISION: 4 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-23 PERMOM.xls]Sheet1

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FLEXIBLE WALL PERMEABILITY TEST

PERMOMETER METHOD

ASTM D 5084-03
(SOP-S22A & B)

Client	CDM	Boring No.	B-619
Client Project	BUNCOMBE CO. C&D LF EXP.	Depth (ft.)	0-6
Project No.	2008-598-01	Sample No.	NA
Lab ID No.	2008-598-01-23		

Specific Gravity	2.70	Assumed
Sample Condition		Remolded

Visual Description: DARK BROWN SILTY SAND

MOISTURE CONTENT:	BEFORE TEST	AFTER TEST
Tare Number	K-7	310
Wt. of Tare & WS (gm.)	302.02	600.65
Wt. of Tare & DS (gm.)	276.01	526.61
Wt. of Tare (gm.)	110.36	109.98
Wt. of Water (gm.)	26.01	74.04
Wt. of DS (gm.)	165.65	416.63
Moisture Content (%)	**15.7**	**17.8**

SPECIMEN:	BEFORE TEST	AFTER TEST
Wt. of Tube & WS (gm.)	875.25	NA
Wt. of Tube (gm.)	0.00	NA
Wt. of WS (gm.)	875.25	890.90
Length 1 (in.)	4.012	3.991
Length 2 (in.)	4.012	4.040
Length 3 (in.)	4.012	4.042
Top Diameter (in.)	2.872	2.837
Middle Diameter (in.)	2.872	2.834
Bottom Diameter (in.)	2.872	2.842
Average Length (in.)	4.01	4.02
Average Area (in.^{2})	6.48	6.32
Sample Volume (cm^3)	425.91	417.07
Unit Wet Wt. (gm./ cm^3)	2.055	2.136
Unit Wet Wt. (pcf)	128.3	133.3
Unit Dry Wt. (pcf)	110.9	113.2
Unit Dry Wt. (gm./ cm^3)	1.776	1.814
Void Ratio, e	0.520	0.489
Porosity, n	0.342	0.328
Pore Volume (cm^3)	145.7	136.9

Tested By: TMS Date: 7/16/2008 Checked By: GEM Date: 7-28-08

DCN: CT-22A DATE:12-21-98 REVISION: 4 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-23 PERMOM.xls]Sheet1
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FLEXIBLE WALL PERMEABILITY TEST

PERMOMETER METHOD

ASTM D 5084-03
(SOP-S22A & B)

Client	CDM	Boring No.	B-619
Client Project	BUNCOMBE CO. C&D LF EXP.	Depth (ft.)	0-6
Project No.	2008-598-01	Sample No.	NA
Lab ID No.	2008-598-01-23		

Test Pressures		Final Sample Dimensions	
Cell Pressure(psi)	55.0	Sample Length (cm), L	10.22
Back Pressure(psi)	50.0	Sample Area (cm^2), A	40.80
Eff. Cons. Pressure(psi)	5.0	Pipette Area (cm^2), a_p	0.03142
Response (%)	95	Annulus Area (cm^2), a_a	0.76712
		Equilibrium Level (cm), R_{eq}	1.75

AVERAGE PERMEABILITY = 3.2E-06 cm/sec @ 20°C
AVERAGE PERMEABILITY = 3.2E-08 m/sec @ 20°C

DATE (mm/dd/yy)	TIME (hr)	TIME (min)	ELAPSED TIME t (min)	PIPETTE READING R_p (cm)	INCREMENT GRADIENT i (cm/cm)	FLOW CONDITION (0 flow) (1 stop)	TEMP. (°C)	INCREMENTAL PERMEABILITY @ 20°C (cm/sec)
7/16/08	8	4.58	0	10.5	11.2	0	23.1	NA
7/16/08	8	4.65	0	10.3	10.9	0	23.1	3.1E-06
7/16/08	8	4.72	0	10.1	10.7	0	23.1	3.2E-06
7/16/08	8	4.78	0	9.9	10.4	0	23.1	3.8E-06
7/16/08	8	4.85	0	9.7	10.2	0	23.1	3.3E-06
7/16/08	8	4.92	0	9.5	9.9	0	23.1	3.4E-06
7/16/08	8	5	0	9.3	9.6	0	23.1	3.0E-06
7/16/08	8	5.08	1	9.1	9.4	0	23.1	3.1E-06
7/16/08	8	5.25	1	8.7	8.9	1	23.1	3.1E-06

Tested By: TMS Date: 7/16/2008 Checked By: GEM Date: 7-28-08

DCN: CT-22A DATE:12-21-98 REVISION: 4\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-23 PERMOM.xls]Sheet1
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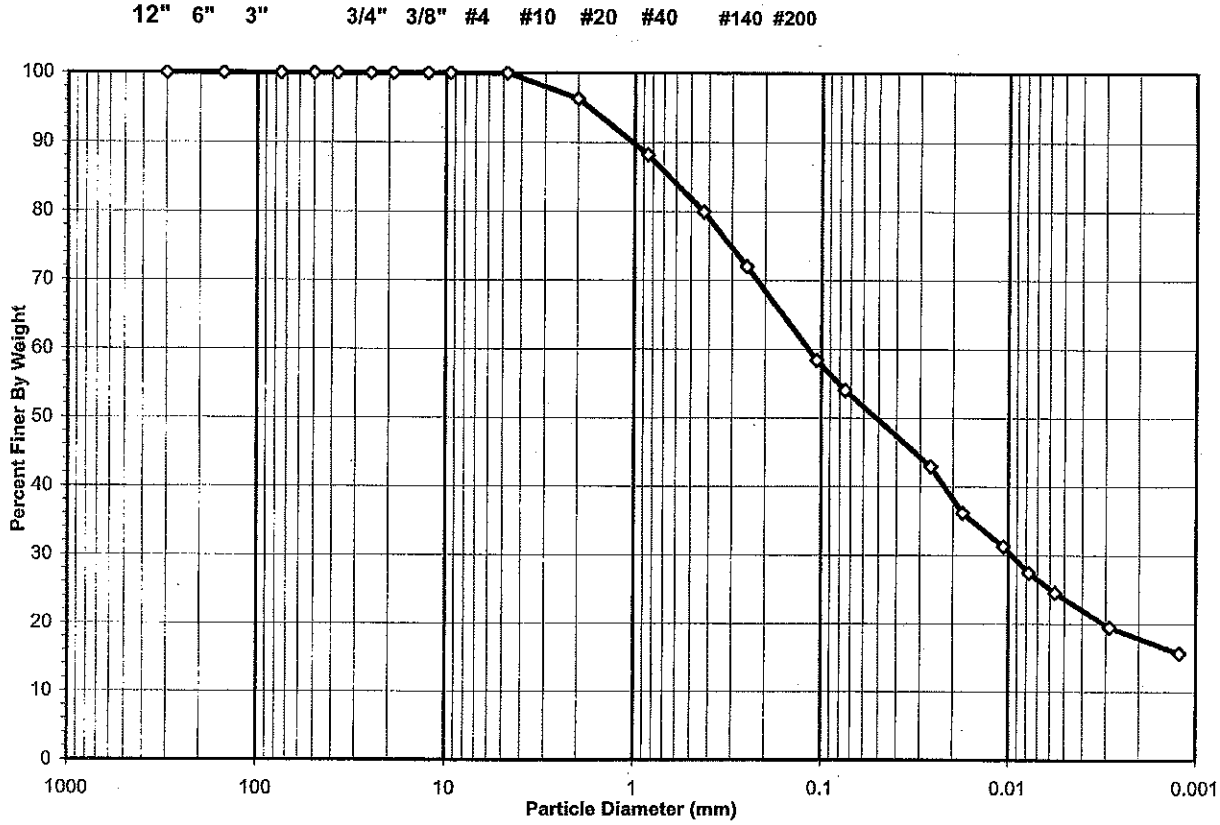
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	4-5
Project No.	2008-598-01	Sample No.	S-1T
Lab ID	2008-598-01-07	Soil Color	**BROWN**

	SIEVE ANALYSIS					HYDROMETER
USCS	cobbles	gravel	sand			silt and clay fraction
USDA	cobbles	gravel	sand		silt	clay



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	46.02
Finer Than #200	*Silt & Clay*	53.98

USCS Symbol ***CL, TESTED***

USCS Classification ***SANDY LEAN CLAY***

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-07 #10 Split Hydro rev 8.xls]Sheet1*

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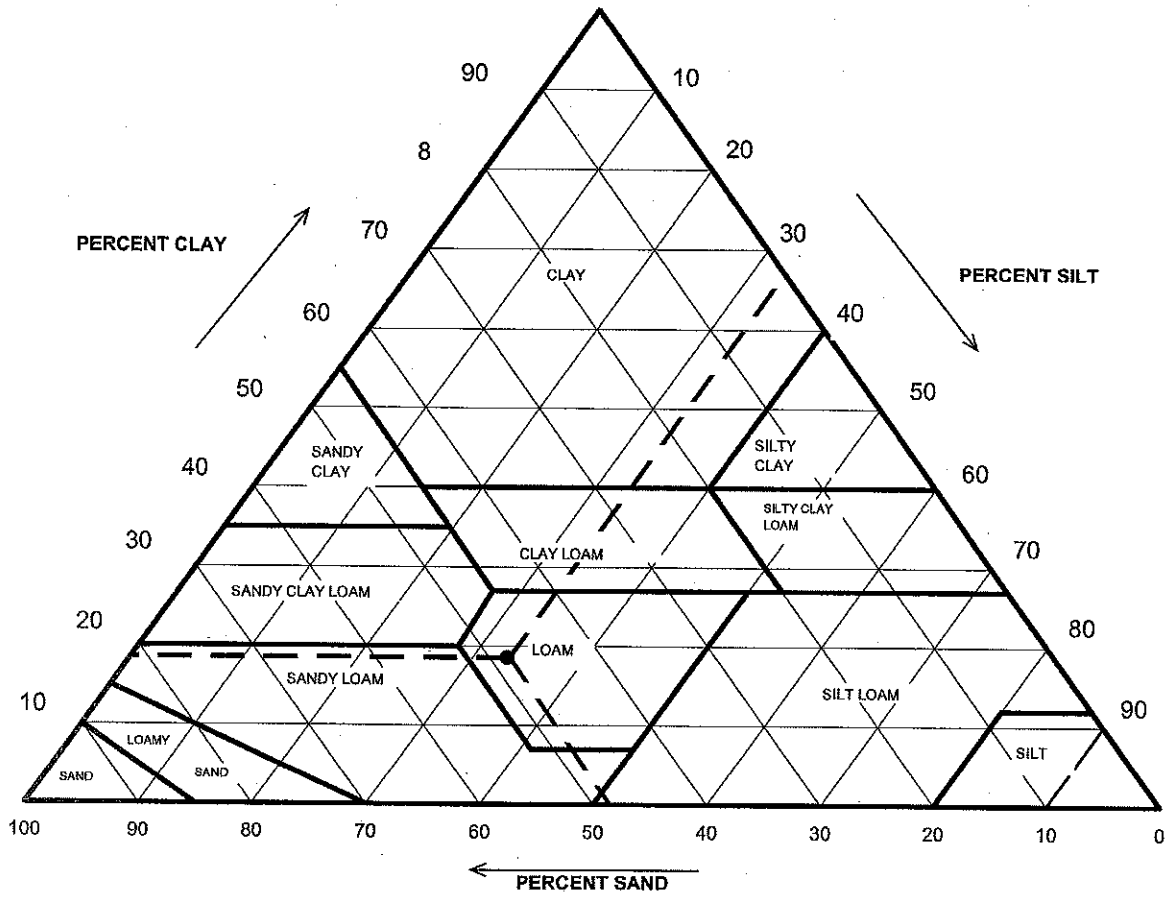
USDA CLASSIFICATION CHART

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	4-5
Project No.	2008-598-01	Sample No.	S-1T
Lab ID	2008-598-01-07	Soil Color	BROWN



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	3.70	**0.00**
2	96.30	*Sand*	46.60	**48.39**
0.05	49.70	*Silt*	31.86	**33.08**
0.002	17.85	*Clay*	17.85	**18.53**

USDA Classification: ***LOAM***

DCN: CT-S3P DATE:02/15/05 REVISION:8 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-07 #10 Split Hydro rev 8.xls]Sheet1

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WASH SIEVE ANALYSIS #10 SPLIT

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	4-5
Project No.	2008-598-01	Sample No.	S-1T
Lab ID	2008-598-01-07	Soil Color	**BROWN**

Moisture Content/sieve +10 Material		Moisture Content for Hydrometer Portion	
Tare No.	215	Tare No.	P-1
Wgt.Tare + Wet Soil (gm)	224.13	Wgt.Tare + Wet Soil (gm)	38.84
Wgt.Tare + Dry Soil (gm)	216.91	Wgt.Tare + Dry Soil (gm)	38.45
Weight of Tare (gm)	172.33	Weight of Tare (gm)	15.71
Weight of Water (gm)	7.22	Weight of Water (gm)	0.39
Weight of Dry Soil (gm)	44.58	Weight of Dry Soil (gm)	22.74
Moisture Content (%)	**16.2**	**Moisture Content (%)**	**1.7**

Soil Specimen Data			
Wet Weight +#10 Material (gm)	51.80	Weight of the Dry Sample (gm)	142.92
Dry Weight +#10 Material(gm)	44.6	Weight of minus #200 material (gm)	55.12
Wet Weight Hydro. Material.(gm)	100.03	Weight of plus #200 material (gm)	87.80
Dry Weight Hydro. Material (gm)	98.34		
Total Dry Weight Sample (gm)	142.92	**J-FACTOR (%FINER THAN #10)**	**0.9630**

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.00	0.00	0.00	100.00	**100.00**
#10	2.00	1.65	3.70	3.70	96.30	**96.30**
#20	0.85	8.23	8.37	8.37	91.63	**88.24**
#40	0.425	8.43	8.57	16.94	83.06	**79.99**
#60	0.250	8.11	8.25	25.19	74.81	**72.04**
#140	0.106	13.95	14.18	39.37	60.63	**58.38**
#200	0.075	4.50	4.58	43.95	56.05	**53.98**
Pan	-	55.12	56.05	100.00	-	-

Notes :

Tested By SD Date 7/15/2008 Checked By Gem Date 7-21-08

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HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	4-5
Project No.	2008-598-01	Sample No.	S-1T
Lab ID	2008-598-01-07	Soil Color	**BROWN**

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	48.0	48.0	24.2	3.73	44.3	44.6	0.01279	0.0263	**42.9**
5		41.0	24.2	3.73	37.3	37.5	0.01279	0.0177	**36.1**
15		36.0	24.2	3.73	32.3	32.5	0.01279	0.0106	**31.3**
30		32.0	24.2	3.73	28.3	28.5	0.01279	0.0078	**27.4**
60		29.0	24.2	3.73	25.3	25.4	0.01279	0.0056	**24.5**
250		24.0	23.5	3.94	20.1	20.2	0.01290	0.0029	**19.4**
1440		20.0	23.8	3.85	16.2	16.3	0.01285	0.0012	**15.7**

Soil Specimen Data		Other Corrections	
Tare + Dry Material (gm)	98.34	a - Factor	0.99
Weight of Tare (gm)	0		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 10	96.30
Weight of Dry Material (gm)	98.34		
		Specific Gravity	2.7 Assumed

Note:

Tested By JBD Date 7/15/2008 Checked By GEM Date 7-21-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-07 #10 Split Hydro rev 8.xls]Sheet1*

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ATTERBERG LIMITS

ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	4-5
Project No.	2008-598-01	Sample No.	S-1T
Lab ID	2008-598-01-07	Soil Description	**BROWN LEAN CLAY**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

(Minus No. 40 sieve material, Airdried)

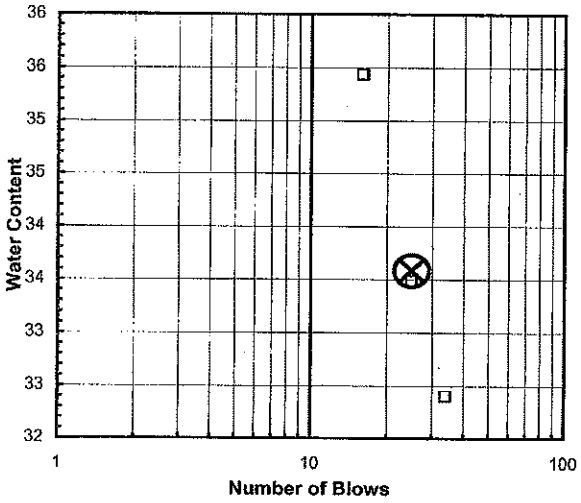
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	A-D	F	E	MULTIPOINT
Wt. of Tare & WS (gm)	27.05	27.23	26.18	
Wt. of Tare & DS (gm)	24.01	24.19	23.52	
Wt. of Tare (gm)	15.43	15.11	15.31	
Wt. of Water (gm)	3.0	3.0	2.7	
Wt. of DS (gm)	8.6	9.1	8.2	
Moisture Content (%)	**35.4**	**33.5**	**32.4**	
Number of Blows	**16**	**25**	**34**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	A-O	H	
Wt. of Tare & WS (gm)	22.88	21.31	
Wt. of Tare & DS (gm)	21.65	20.35	
Wt. of Tare (gm)	15.47	15.15	
Wt. of Water (gm)	1.2	1.0	
Wt. of DS (gm)	6.2	5.2	
Moisture Content (%)	**19.9**	**18.5**	**1.4**

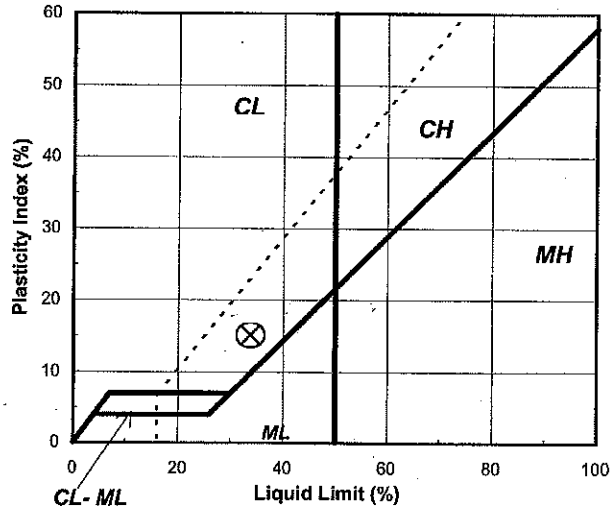
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**34**
Plastic Limit (%)	**19**
Plasticity Index (%)	**15**
USCS Symbol	**CL**

Flow Curve



Plasticity Chart



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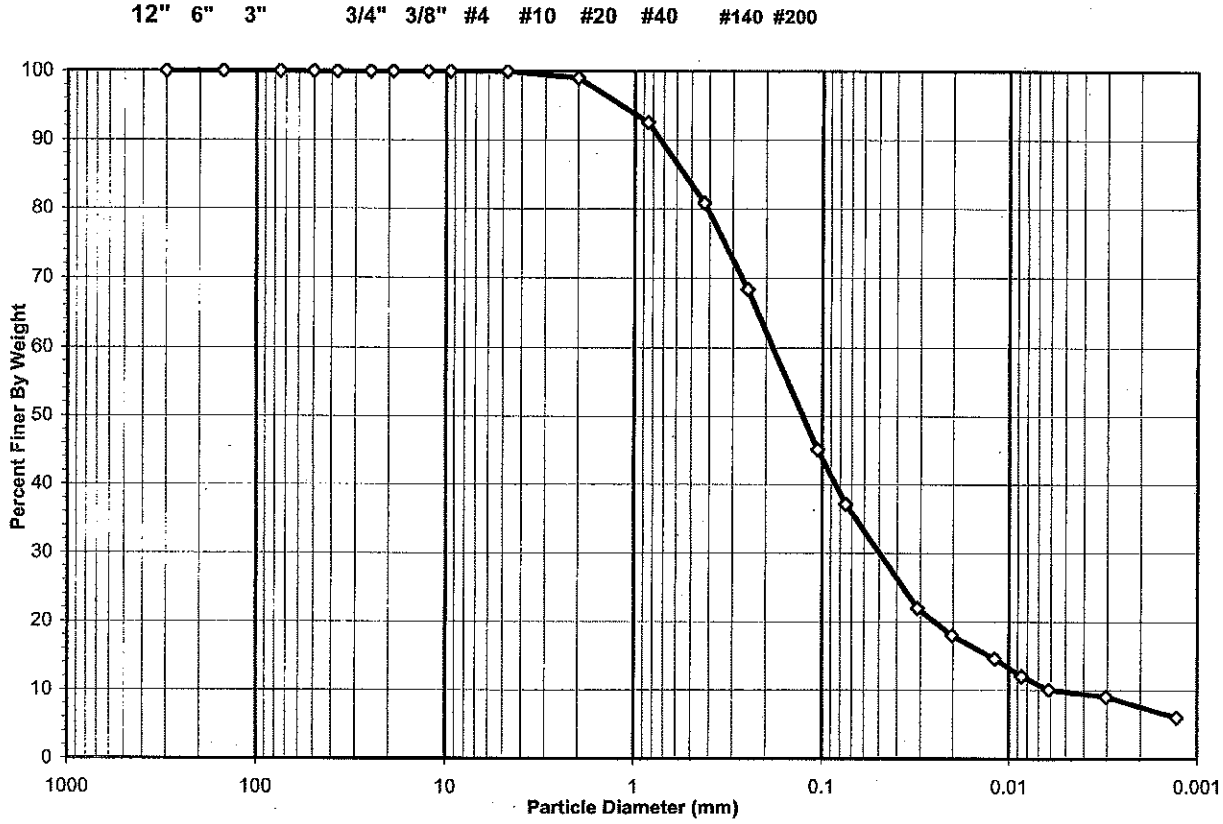
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	5-6
Project No.	2008-598-01	Sample No.	S-1B
Lab ID	2008-598-01-08	Soil Color	**BROWN WHITE**

	SIEVE ANALYSIS					HYDROMETER
USCS	cobbles	gravel	sand			silt and clay fraction
USDA	cobbles	gravel	sand		silt	clay



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	62.89
Finer Than #200	*Silt & Clay*	37.11

USCS Symbol ***SM, TESTED (NON PLASTIC FINES)***

USCS Classification ***SILTY SAND***

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-08 #10 Split Hydro rev 8.xls]Sheet1*

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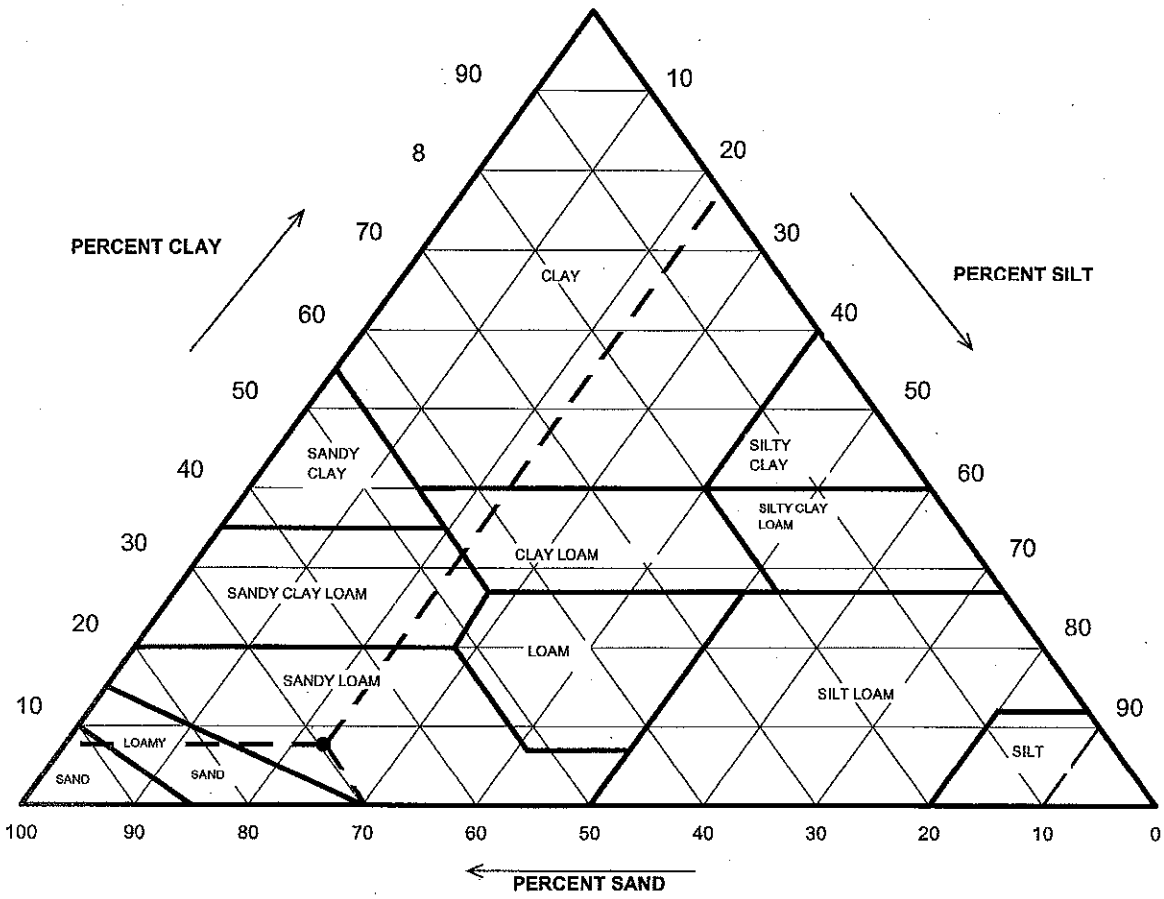
USDA CLASSIFICATION CHART

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	5-6
Project No.	2008-598-01	Sample No.	S-1B
Lab ID	2008-598-01-08	Soil Color	BROWN WHITE



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	0.95	**0.00**
2	99.05	*Sand*	68.94	**69.61**
0.05	30.10	*Silt*	22.53	**22.74**
0.002	7.57	*Clay*	7.57	**7.65**

USDA Classification: ***SANDY LOAM***

DCN: CT-S3P DATE:02/15/05 REVISION:8 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-08 #10 Split Hydro rev 8.xls]Sheet1

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WASH SIEVE ANALYSIS #10 SPLIT

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	5-6
Project No.	2008-598-01	Sample No.	S-1B
Lab ID	2008-598-01-08	Soil Color	**BROWN WHITE**

Moisture Content/sieve +10 Material		Moisture Content for Hydrometer Portion	
Tare No.	202	Tare No.	B-1
Wgt.Tare + Wet Soil (gm)	283.68	Wgt.Tare + Wet Soil (gm)	56.57
Wgt.Tare + Dry Soil (gm)	275.01	Wgt.Tare + Dry Soil (gm)	56.40
Weight of Tare (gm)	197.38	Weight of Tare (gm)	22.07
Weight of Water (gm)	8.67	Weight of Water (gm)	0.17
Weight of Dry Soil (gm)	77.63	Weight of Dry Soil (gm)	34.33
Moisture Content (%)	**11.2**	**Moisture Content (%)**	**0.5**

Soil Specimen Data			
Wet Weight +#10 Material (gm)	86.30	Weight of the Dry Sample (gm)	177.15
Dry Weight +#10 Material(gm)	77.6	Weight of minus #200 material (gm)	37.29
Wet Weight Hydro. Material.(gm)	100.01	Weight of plus #200 material (gm)	139.86
Dry Weight Hydro. Material (gm)	99.52		
Total Dry Weight Sample (gm)	177.15	**J-FACTOR (%FINER THAN #10)**	**0.9905**

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.00	0.00	0.00	100.00	**100.00**
#10	2.00	0.74	0.95	0.95	99.05	**99.05**
#20	0.85	6.49	6.52	6.52	93.48	**92.59**
#40	0.425	11.77	11.83	18.35	81.65	**80.87**
#60	0.250	12.61	12.67	31.02	68.98	**68.32**
#140	0.106	23.35	23.46	54.48	45.52	**45.08**
#200	0.075	8.01	8.05	62.53	37.47	**37.11**
Pan	-	37.29	37.47	100.00	-	-

Notes :

Tested By SD Date 7/15/2008 Checked By GEM Date 7-21-08

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HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	5-6
Project No.	2008-598-01	Sample No.	S-1B
Lab ID	2008-598-01-08	Soil Color	**BROWN WHITE**

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	26.0	26.0	24.4	3.67	22.3	22.1	0.01269	0.0311	**21.9**
5		22.0	24.4	3.67	18.3	18.2	0.01269	0.0202	**18.0**
15		18.5	24.5	3.65	14.9	14.7	0.01267	0.0119	**14.6**
30		16.0	24.2	3.73	12.3	12.2	0.01272	0.0086	**12.0**
60		14.0	24.2	3.73	10.3	10.2	0.01272	0.0061	**10.1**
250		13.0	24.0	3.79	9.2	9.1	0.01275	0.0030	**9.0**
1440		10.0	23.8	3.85	6.2	6.1	0.01278	0.0013	**6.0**

Soil Specimen Data		**Other Corrections**	
Tare + Dry Material (gm)	99.52	a - Factor	0.986
Weight of Tare (gm)	0		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 10	99.05
Weight of Dry Material (gm)	99.52		
		Specific Gravity	2.72 Assumed

Note:

Tested By JBD Date 7/14/2008 Checked By GEM Date 7-21-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-08 #10 Split Hydro rev 8.xls]Sheet1*

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ATTERBERG LIMIT

ASTM D 4318-00 (SOP - S4)

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	5-6
Project No.	2008-598-01	Sample No.	S-1B
Lab ID	2008-598-01-08	Visual Description	**BROWN WHITE**
			(Minus No. 40 sieve material, Wet Method)

NON - PLASTIC MATERIAL

Tested By SD *Date* 7/17/2008 *Checked By* GEM *Date* 7-21-08

DCN: CT-S4C DATE: 7-11-97 REVISION : 2

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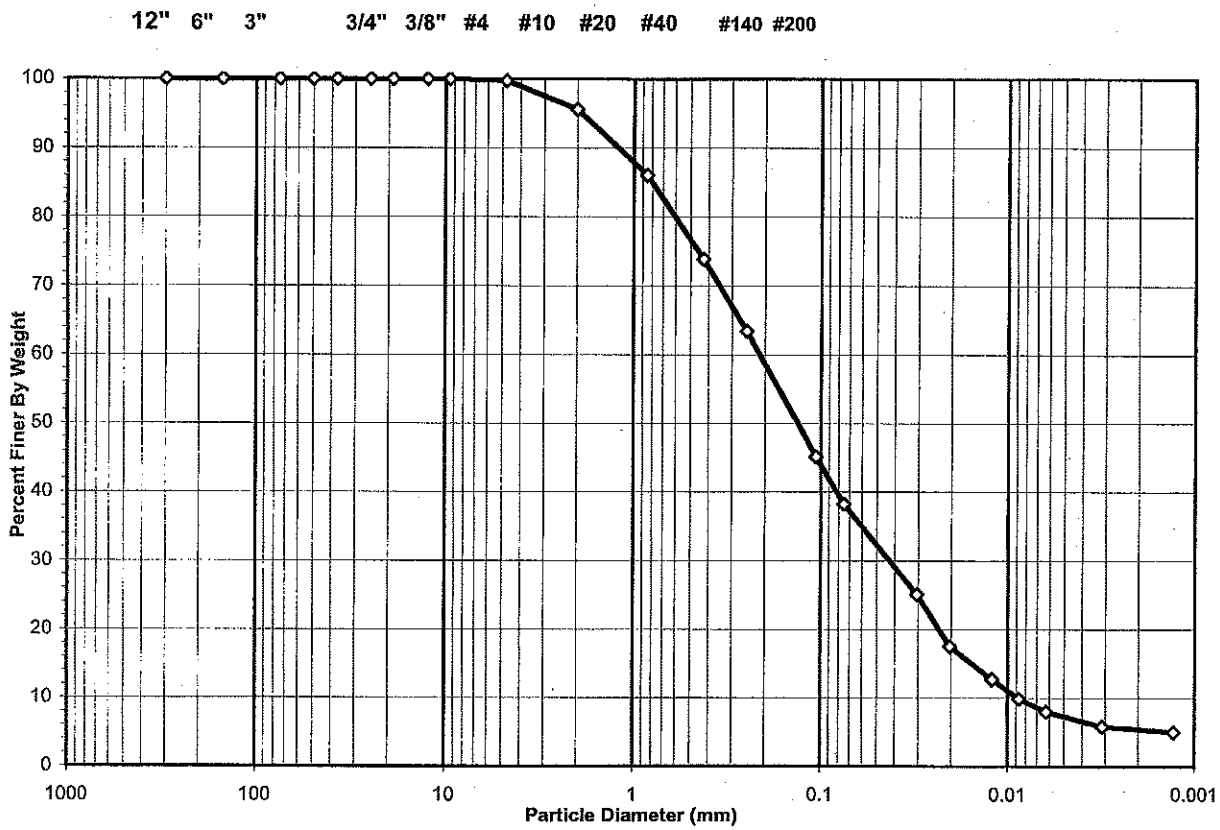
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	9-11
Project No.	2008-598-01	Sample No.	S-2
Lab ID	2008-598-01-09	Soil Color	**BROWN TAN**

	SIEVE ANALYSIS					HYDROMETER
USCS	cobbles	gravel	sand			silt and clay fraction
USDA	cobbles	gravel	sand		silt	clay



USCS Summary		
Sieve Sizes (mm)		**Percentage**
Greater Than #4	*Gravel*	0.26
#4 To #200	*Sand*	61.51
Finer Than #200	*Silt & Clay*	38.23

USCS Symbol ***SM, TESTED***

USCS Classification ***SILTY SAND***

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-09 #10 Split Hydro rev 8.xls]Sheet1*

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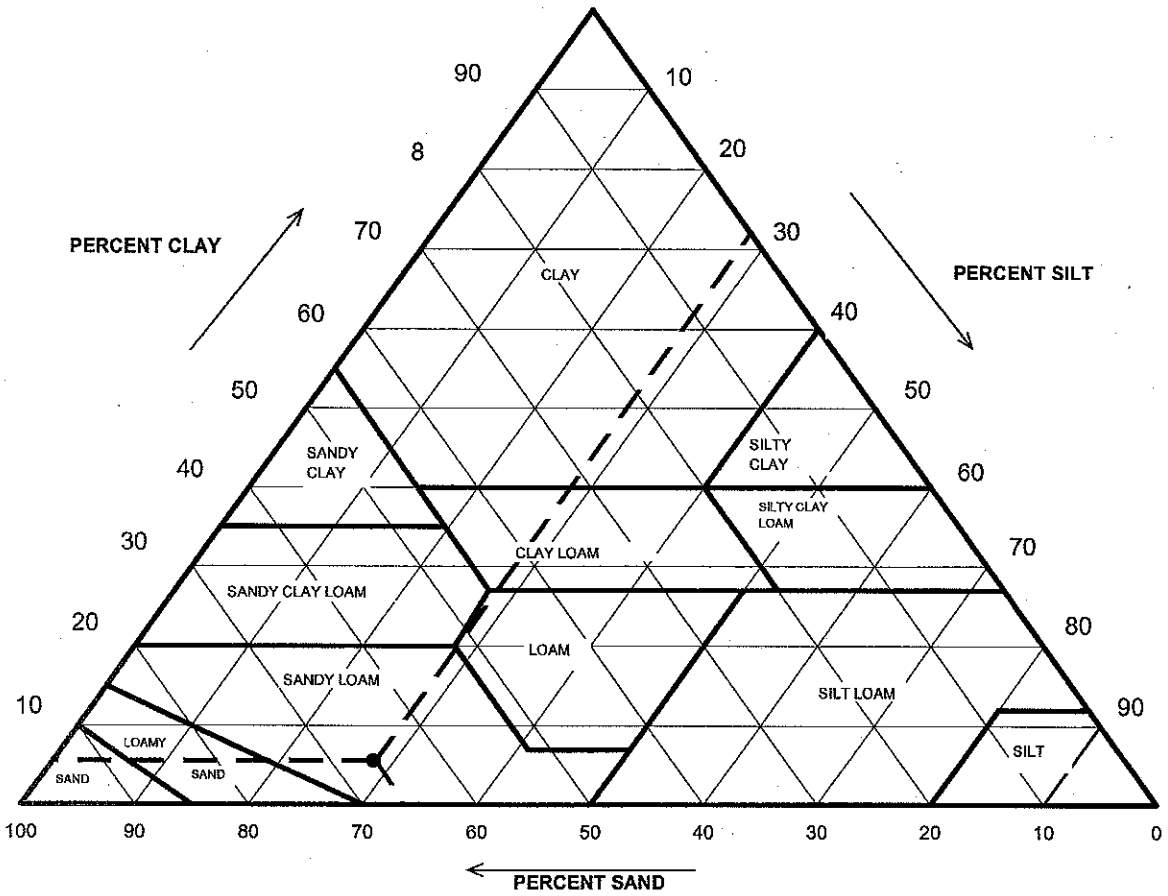
USDA CLASSIFICATION CHART

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	9-11
Project No.	2008-598-01	Sample No.	S-2
Lab ID	2008-598-01-09	Soil Color	BROWN TAN



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	4.39	**0.00**
2	95.61	*Sand*	63.29	**66.20**
0.05	32.32	*Silt*	26.94	**28.17**
0.002	5.38	*Clay*	5.38	**5.63**

USDA Classification: ***SANDY LOAM***

DCN: CT-S3P DATE:02/15/05 REVISION:8 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-09 #10 Split Hydro rev 8.xls]Sheet1

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WASH SIEVE ANALYSIS #10 SPLIT

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	9-11
Project No.	2008-598-01	Sample No.	S-2
Lab ID	2008-598-01-09	Soil Color	**BROWN TAN**

Moisture Content/sieve +10 Material		Moisture Content for Hydrometer Portion	
Tare No.	214	Tare No.	R-1
Wgt.Tare + Wet Soil (gm)	236.93	Wgt.Tare + Wet Soil (gm)	45.59
Wgt.Tare + Dry Soil (gm)	229.01	Wgt.Tare + Dry Soil (gm)	45.42
Weight of Tare (gm)	171.34	Weight of Tare (gm)	15.65
Weight of Water (gm)	7.92	Weight of Water (gm)	0.17
Weight of Dry Soil (gm)	57.67	Weight of Dry Soil (gm)	29.77
Moisture Content (%)	**13.7**	**Moisture Content (%)**	**0.6**

Soil Specimen Data			
Wet Weight +#10 Material (gm)	65.59	Weight of the Dry Sample (gm)	157.15
Dry Weight +#10 Material(gm)	57.7	Weight of minus #200 material (gm)	39.77
Wet Weight Hydro. Material.(gm)	100.05	Weight of plus #200 material (gm)	117.38
Dry Weight Hydro. Material (gm)	99.48		
Total Dry Weight Sample (gm)	157.15	**J-FACTOR (%FINER THAN #10)**	**0.9561**

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.15	0.26	0.26	99.74	**99.74**
#10	2.00	2.38	4.13	4.39	95.61	**95.61**
#20	0.85	9.97	10.02	10.02	89.98	**86.03**
#40	0.425	12.64	12.71	22.73	77.27	**73.88**
#60	0.250	10.89	10.95	33.67	66.33	**63.42**
#140	0.106	19.04	19.14	52.81	47.19	**45.12**
#200	0.075	7.17	7.21	60.02	39.98	**38.23**
Pan	-	39.77	39.98	100.00	-	-

Notes :

Tested By SD Date 7/15/2008 Checked By GBM Date 7-21-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-09 #10 Split Hydro rev 8.xls]Sheet1*

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HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	9-11
Project No.	2008-598-01	Sample No.	S-2
Lab ID	2008-598-01-09	Soil Color	**BROWN TAN**

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	30.0	30.0	24.5	3.65	26.4	26.2	0.01275	0.0304	**25.1**
5		22.0	24.5	3.65	18.4	18.3	0.01275	0.0203	**17.5**
15		17.0	24.5	3.65	13.4	13.3	0.01275	0.0121	**12.7**
30		14.0	24.5	3.65	10.4	10.3	0.01275	0.0087	**9.9**
60		12.0	24.5	3.65	8.4	8.3	0.01275	0.0062	**7.9**
250		10.0	23.6	3.91	6.1	6.1	0.01288	0.0031	**5.8**
1440		9.0	24.1	3.76	5.2	5.2	0.01281	0.0013	**5.0**

Soil Specimen Data		**Other Corrections**	
Tare + Dry Material (gm)	99.48	a - Factor	0.99
Weight of Tare (gm)	0		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 10	95.61
Weight of Dry Material (gm)	99.48		
		Specific Gravity	2.7 Assumed

Note:

Tested By JBD Date 7/14/2008 Checked By GEM Date 7-21-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 \\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-09 #10 Split Hydro rev 8.xls]Sheet1

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ATTERBERG LIMITS

ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	CDM	Boring No.	B-619
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	9-11
Project No.	2008-598-01	Sample No.	S-2
Lab ID	2008-598-01-09	Soil Description	**BROWN TAN SILT**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

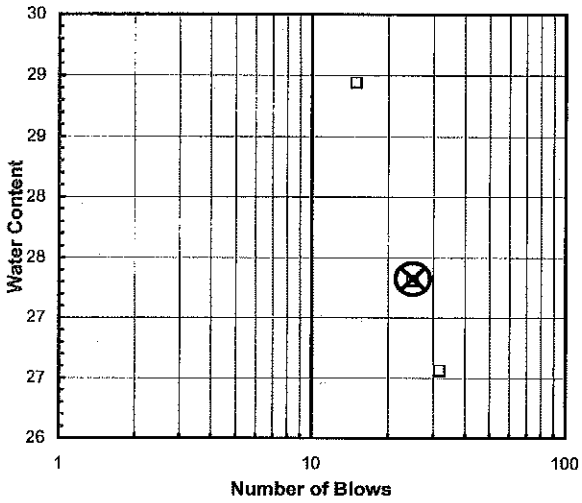
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	A-Q	R-1	B-B	MULTIPOINT
Wt. of Tare & WS (gm)	27.14	29.01	28.91	
Wt. of Tare & DS (gm)	24.53	26.14	26.10	
Wt. of Tare (gm)	15.51	15.63	15.52	
Wt. of Water (gm)	2.6	2.9	2.8	
Wt. of DS (gm)	9.0	10.5	10.6	
Moisture Content (%)	**28.9**	**27.3**	**26.6**	
Number of Blows	**15**	**25**	**32**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	S	A-P	
Wt. of Tare & WS (gm)	21.86	25.22	
Wt. of Tare & DS (gm)	20.63	23.30	
Wt. of Tare (gm)	15.24	15.61	
Wt. of Water (gm)	1.2	1.9	
Wt. of DS (gm)	5.4	7.7	
Moisture Content (%)	**22.8**	**25.0**	**-2.1**

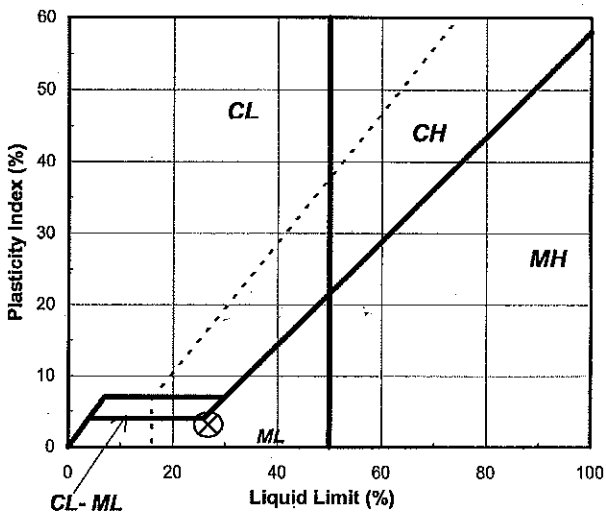
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**27**
Plastic Limit (%)	**24**
Plasticity Index (%)	**3**
USCS Symbol	**ML**

Flow Curve



Plasticity Chart



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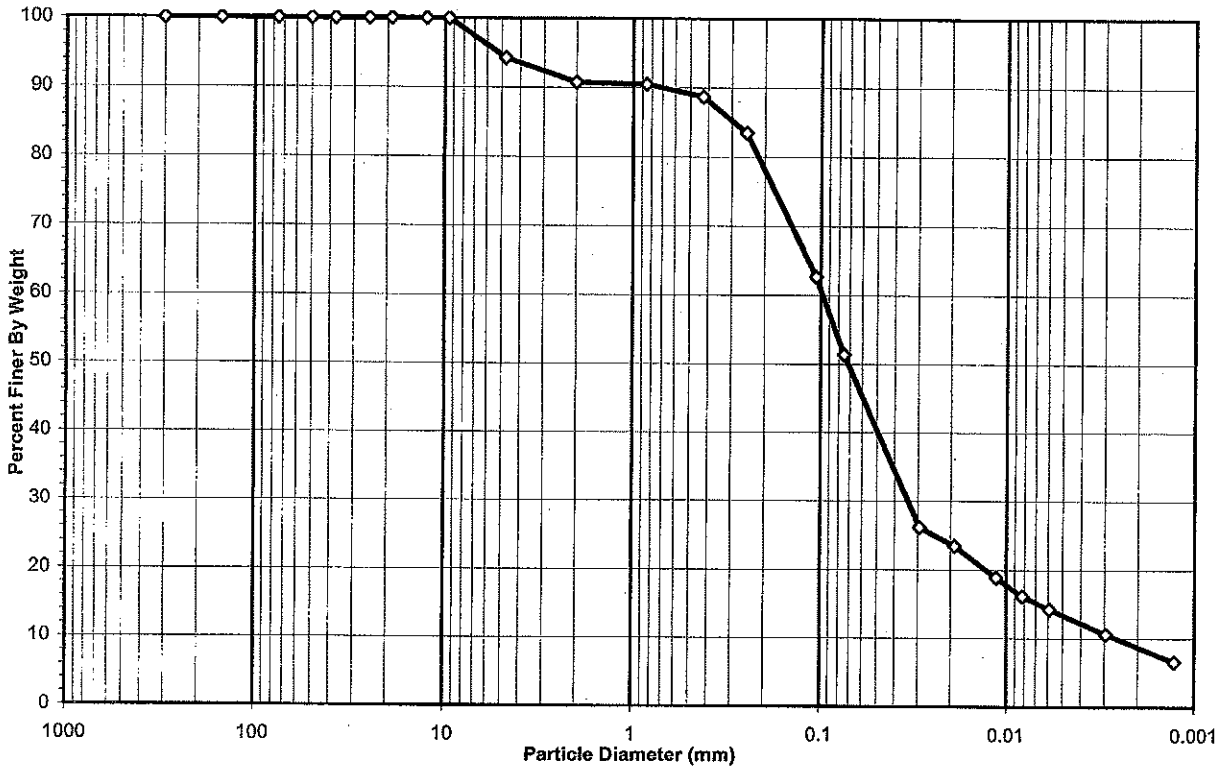
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-620
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	0-2
Project No.	2008-598-01	Sample No.	S-1
Lab ID	2008-598-01-10	Soil Color	**BROWN**

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay

12" 6" 3" 3/4" 3/8" #4 #10 #20 #40 #140 #200



Sieve Sizes (mm)	USCS Summary	Percentage
Greater Than #4	*Gravel*	5.74
#4 To #200	*Sand*	42.98
Finer Than #200	*Silt & Clay*	51.28

USCS Symbol ***ML, TESTED***

USCS Classification ***SANDY SILT***

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-10 #10 Split Hydro rev 8.xls]Sheet1*

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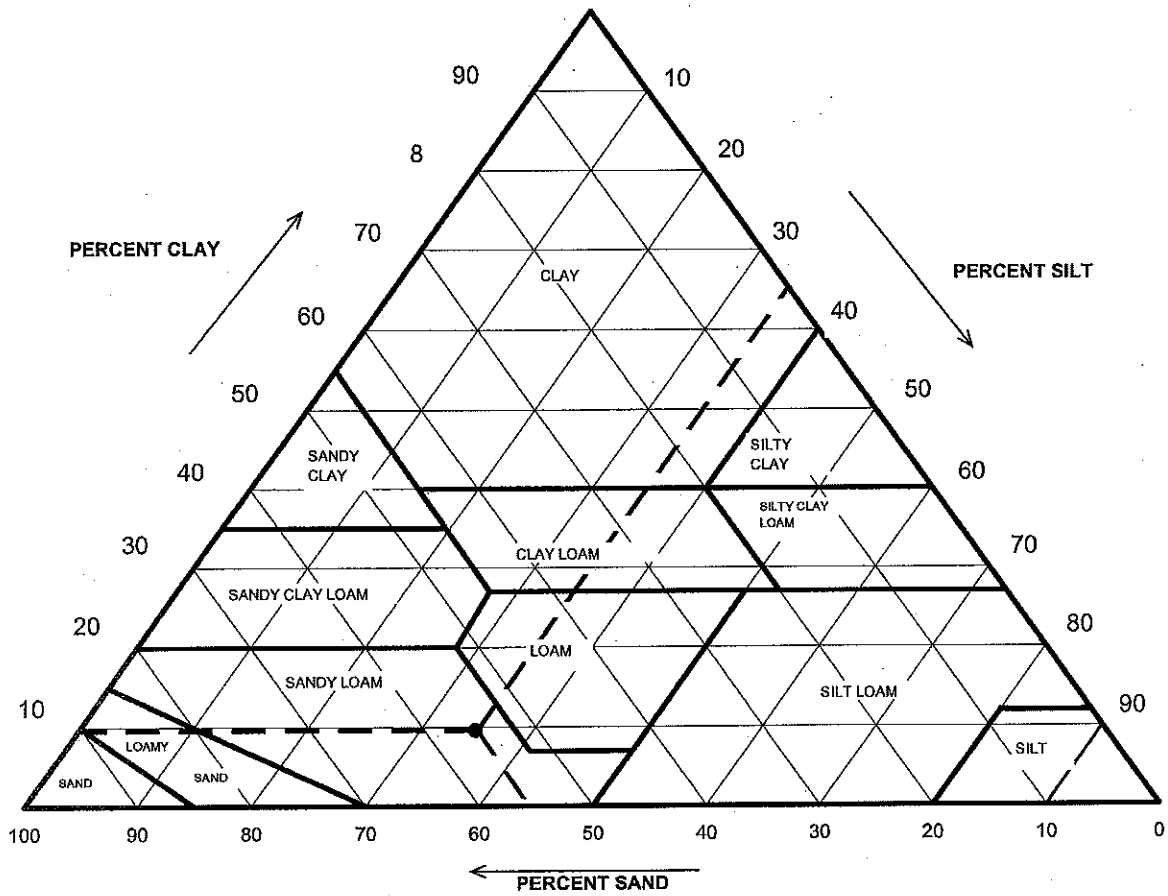
INTEGRITY IN TESTING

USDA CLASSIFICATION CHART

Client	CDM	Boring No.	B-620
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	0-2
Project No.	2008-598-01	Sample No.	S-1
Lab ID	2008-598-01-10	Soil Color	BROWN



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	9.25	**0.00**
2	90.75	*Sand*	50.38	**55.51**
0.05	40.37	*Silt*	31.63	**34.85**
0.002	8.74	*Clay*	8.74	**9.64**

USDA Classification: ***SANDY LOAM***

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WASH SIEVE ANALYSIS #10 SPLIT

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-620
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	0-2
Project No.	2008-598-01	Sample No.	S-1
Lab ID	2008-598-01-10	Soil Color	**BROWN**

Moisture Content/sieve +10 Material		Moisture Content for Hydrometer Portion	
Tare No.	208	Tare No.	C-2
Wgt.Tare + Wet Soil (gm)	216.14	Wgt.Tare + Wet Soil (gm)	41.65
Wgt.Tare + Dry Soil (gm)	210.06	Wgt.Tare + Dry Soil (gm)	41.15
Weight of Tare (gm)	169.85	Weight of Tare (gm)	15.64
Weight of Water (gm)	6.08	Weight of Water (gm)	0.50
Weight of Dry Soil (gm)	40.21	Weight of Dry Soil (gm)	25.51
Moisture Content (%)	**15.1**	**Moisture Content (%)**	**2.0**

Soil Specimen Data			
Wet Weight +#10 Material (gm)	46.29	Weight of the Dry Sample (gm)	138.29
Dry Weight +#10 Material(gm)	40.2	Weight of minus #200 material (gm)	55.42
Wet Weight Hydro. Material.(gm)	100.00	Weight of plus #200 material (gm)	82.87
Dry Weight Hydro. Material (gm)	98.08		
Total Dry Weight Sample (gm)	138.29	**J-FACTOR (%FINER THAN #10)**	**0.9075**

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	2.31	5.74	5.74	94.26	**94.26**
#10	2.00	1.41	3.51	9.25	90.75	**90.75**
#20	0.85	0.30	0.31	0.31	99.69	**90.47**
#40	0.425	1.96	2.00	2.30	97.70	**88.66**
#60	0.250	5.61	5.72	8.02	91.98	**83.47**
#140	0.106	22.48	22.92	30.94	69.06	**62.67**
#200	0.075	12.31	12.55	43.50	56.50	**51.28**
Pan	-	55.42	56.50	100.00	-	-

Notes :

Tested By SD Date 7/14/2008 Checked By GZM Date 7-16-08

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HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-620
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	0-2
Project No.	2008-598-01	Sample No.	S-1
Lab ID	2008-598-01-10	Soil Color	**BROWN**

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	32.0	32.0	25.5	3.35	28.6	28.8	0.01253	0.0295	**26.1**
5		29.0	25.5	3.35	25.6	25.8	0.01253	0.0190	**23.4**
15		24.0	25.5	3.35	20.6	20.8	0.01253	0.0114	**18.8**
30		21.0	25.5	3.35	17.6	17.7	0.01253	0.0082	**16.1**
60		19.0	25.5	3.35	15.6	15.7	0.01253	0.0059	**14.3**
250		15.0	25.5	3.35	11.6	11.7	0.01253	0.0029	**10.6**
1440		11.0	24.0	3.79	7.2	7.2	0.01275	0.0013	**6.6**

Soil Specimen Data		**Other Corrections**	
Tare + Dry Material (gm)	98.08	a - Factor	0.986
Weight of Tare (gm)	0		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 10	90.75
Weight of Dry Material (gm)	98.08		
		Specific Gravity	2.72 Assumed

Note:

Tested By JBD Date 7/11/2008 Checked By GEM Date 7-16-08

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ATTERBERG LIMITS

ASTM D 4318-98 / AASHTO T89 (SOP - S4A)

Client	CDM	Boring No.	B-620
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	0-2
Project No.	2008-598-01	Sample No.	S-1
Lab ID	2008-598-01-10	Soil Description	**BROWN SILT**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

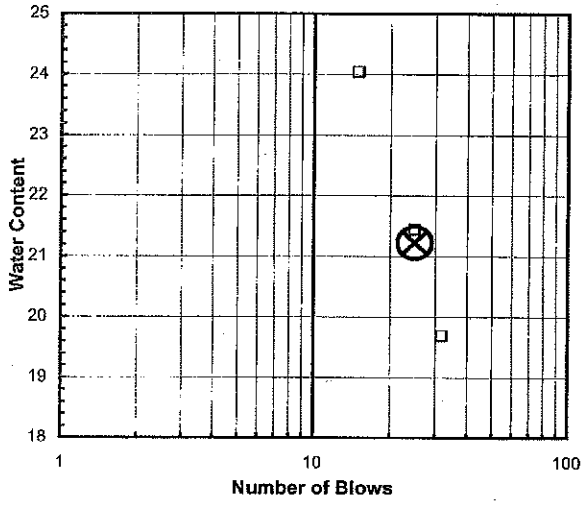
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	A-1	Y	A-N	MULTIPOINT
Wt. of Tare & WS (gm)	28.34	26.26	24.57	
Wt. of Tare & DS (gm)	25.85	24.38	23.07	
Wt. of Tare (gm)	15.49	15.61	15.45	
Wt. of Water (gm)	2.5	1.9	1.5	
Wt. of DS (gm)	10.4	8.8	7.6	
Moisture Content (%)	**24.0**	**21.4**	**19.7**	
Number of Blows	**15**	**25**	**32**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	A-K	A-M	
Wt. of Tare & WS (gm)	25.62	24.68	
Wt. of Tare & DS (gm)	23.99	23.15	
Wt. of Tare (gm)	15.56	15.38	
Wt. of Water (gm)	1.6	1.5	
Wt. of DS (gm)	8.4	7.8	
Moisture Content (%)	**19.3**	**19.7**	**-0.4**

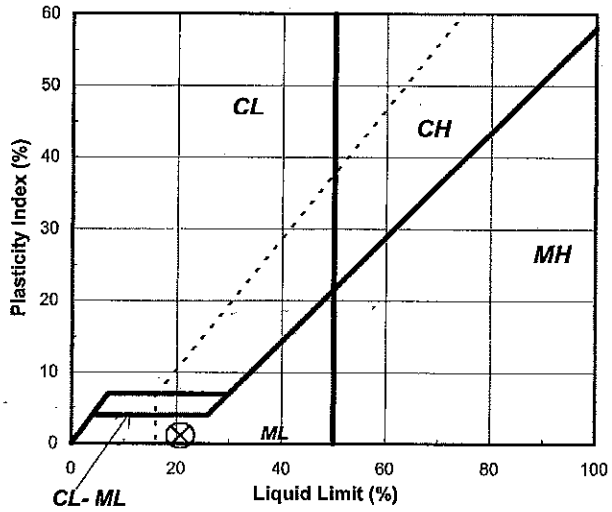
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**21**
Plastic Limit (%)	**20**
Plasticity Index (%)	**1**
USCS Symbol	**ML**

Flow Curve



Plasticity Chart



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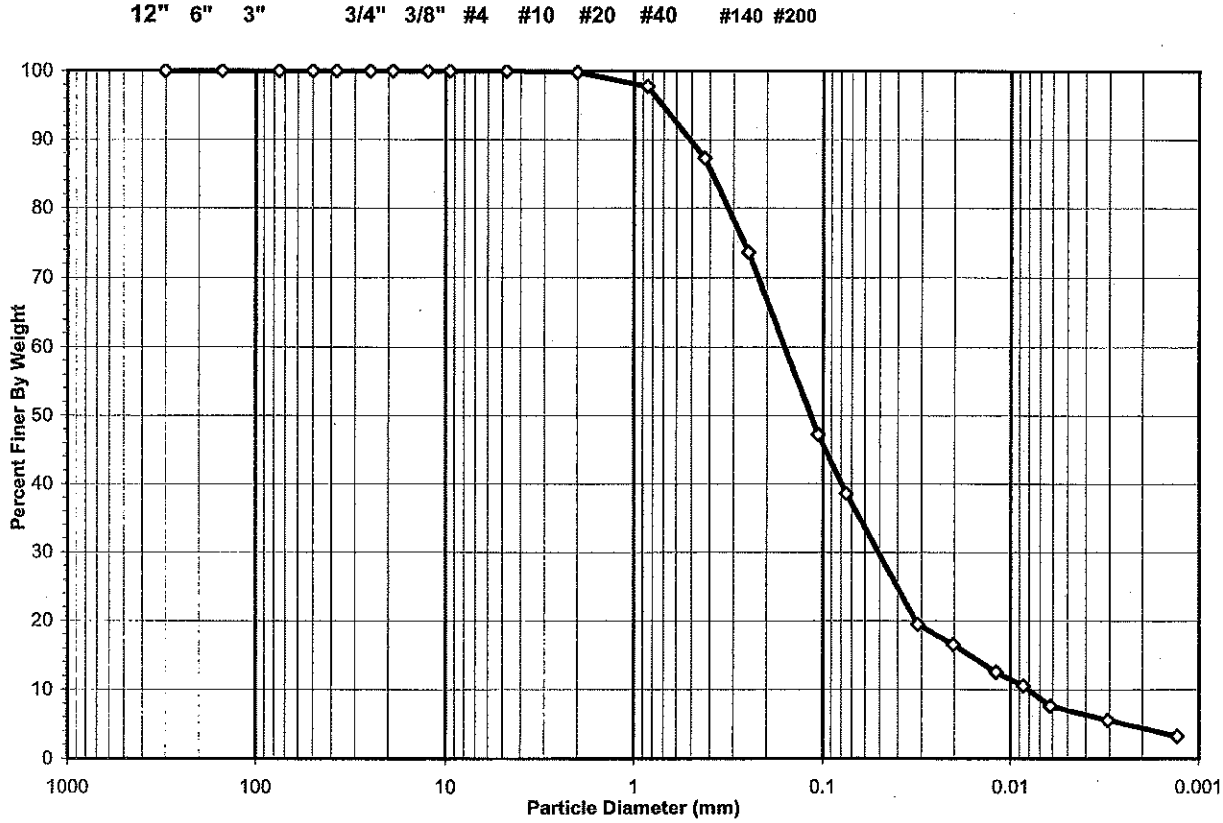
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-621
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	9-11
Project No.	2008-598-01	Sample No.	S-3
Lab ID	2008-598-01-11	Soil Color	**BROWN**

	SIEVE ANALYSIS					HYDROMETER
USCS	cobbles	gravel	sand			silt and clay fraction
USDA	cobbles	gravel	sand		silt	clay



Sieve Sizes (mm)	USCS Summary	Percentage
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	61.46
Finer Than #200	*Silt & Clay*	38.54

USCS Symbol ***SM, TESTED***

USCS Classification ***SILTY SAND***

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-11 #10 Split Hydro rev 8.xls]Sheet1*

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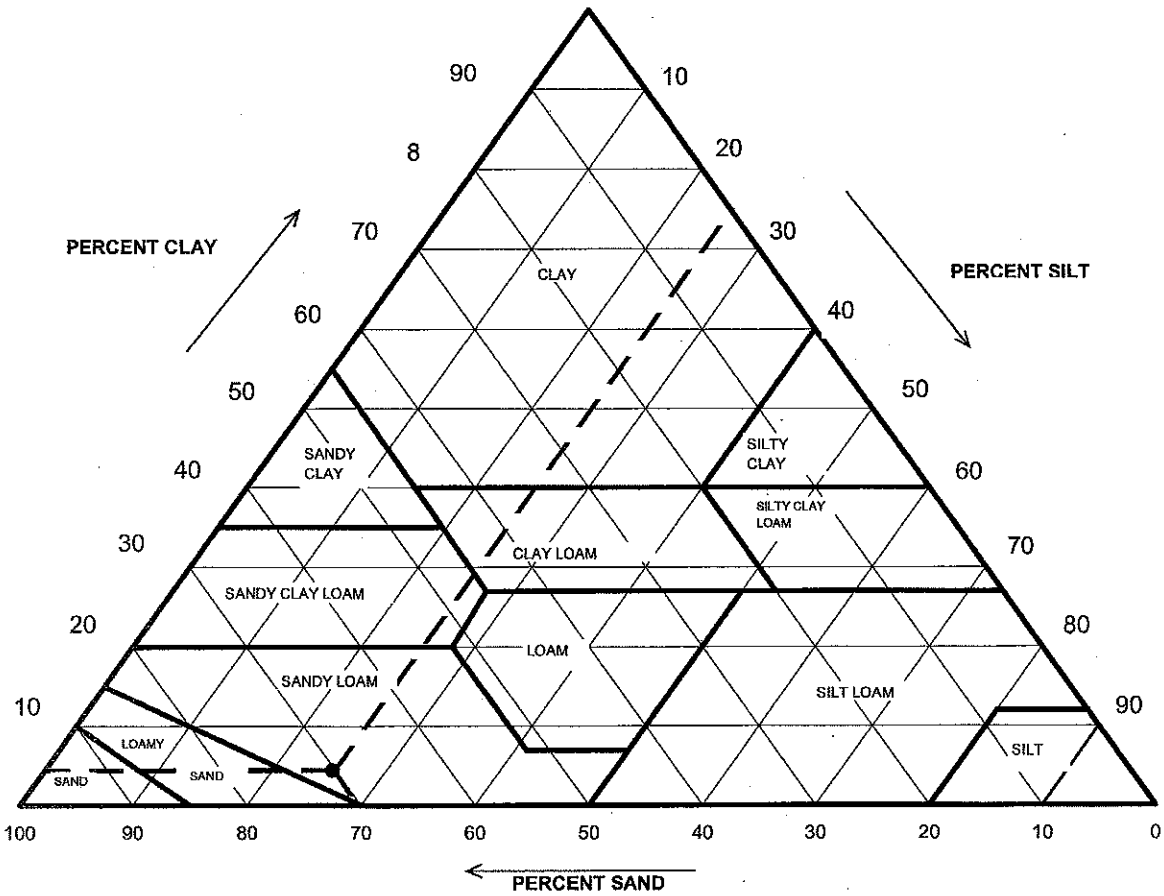
USDA CLASSIFICATION CHART

Client	CDM	Boring No.	B-621
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	9-11
Project No.	2008-598-01	Sample No.	S-3
Lab ID	2008-598-01-11	Soil Color	BROWN



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	0.17	**0.00**
2	99.83	*Sand*	70.16	**70.28**
0.05	29.67	*Silt*	25.25	**25.29**
0.002	4.42	*Clay*	4.42	**4.43**

USDA Classification: ***SANDY LOAM***

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WASH SIEVE ANALYSIS #10 SPLIT

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-621
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	9-11
Project No.	2008-598-01	Sample No.	S-3
Lab ID	2008-598-01-11	Soil Color	**BROWN**

Moisture Content/sieve +10 Material		Moisture Content for Hydrometer Portion	
Tare No.	201	Tare No.	K-1
Wgt.Tare + Wet Soil (gm)	227.39	Wgt.Tare + Wet Soil (gm)	35.44
Wgt.Tare + Dry Soil (gm)	224.44	Wgt.Tare + Dry Soil (gm)	35.31
Weight of Tare (gm)	170.76	Weight of Tare (gm)	15.74
Weight of Water (gm)	2.95	Weight of Water (gm)	0.13
Weight of Dry Soil (gm)	53.68	Weight of Dry Soil (gm)	19.57
Moisture Content (%)	**5.5**	**Moisture Content (%)**	**0.7**

Soil Specimen Data			
Wet Weight +#10 Material (gm)	56.63	Weight of the Dry Sample (gm)	153.02
Dry Weight +#10 Material(gm)	53.7	Weight of minus #200 material (gm)	38.35
Wet Weight Hydro. Material.(gm)	100.00	Weight of plus #200 material (gm)	114.67
Dry Weight Hydro. Material (gm)	99.34		
Total Dry Weight Sample (gm)	153.02	**J-FACTOR (%FINER THAN #10)**	**0.9983**

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.00	0.00	0.00	100.00	**100.00**
#10	2.00	0.09	0.17	0.17	99.83	**99.83**
#20	0.85	2.05	2.06	2.06	97.94	**97.77**
#40	0.425	10.45	10.52	12.58	87.42	**87.27**
#60	0.250	13.57	13.66	26.24	73.76	**73.63**
#140	0.106	26.31	26.48	52.73	47.27	**47.19**
#200	0.075	8.61	8.67	61.40	38.60	**38.54**
Pan	-	38.35	38.60	100.00	-	-

Notes :

Tested By SD Date 7/14/2008 Checked By GEM Date 7-15-08

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HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	CDM	Boring No.	B-621
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	9-11
Project No.	2008-598-01	Sample No.	S-3
Lab ID	2008-598-01-11	Soil Color	**BROWN**

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	23.0	23.0	25.5	3.35	19.6	19.5	0.01253	0.0314	**19.5**
5		20.0	25.5	3.35	16.6	16.5	0.01253	0.0202	**16.5**
15		16.0	25.5	3.35	12.6	12.6	0.01253	0.0120	**12.5**
30		14.0	25.5	3.35	10.6	10.6	0.01253	0.0086	**10.5**
60		11.0	25.5	3.35	7.6	7.6	0.01253	0.0062	**7.6**
250		9.0	25.5	3.35	5.6	5.6	0.01253	0.0031	**5.6**
1440		7.0	24.2	3.73	3.3	3.2	0.01272	0.0013	**3.2**

Soil Specimen Data		**Other Corrections**	
Tare + Dry Material (gm)	99.34	a - Factor	0.986
Weight of Tare (gm)	0		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 10	99.83
Weight of Dry Material (gm)	99.34		
		Specific Gravity	2.72 Assumed

Note:

Tested By JBD Date 7/11/2008 Checked By CAM Date 7-15-08

DCN: CT-S3P DATE:02/15/05 REVISION:8 *\\Server\c\2008 PROJECTS\2008-598 CDM\[2008-598-01-11 #10 Split Hydro rev 8.xls]Sheet1*

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INTEGRITY IN TESTING

ONE POINT ATTERBERG LIMIT

ASTM D 4318-96 (SOP - S4)

Client	CDM	Boring No.	B-621
Client Reference	BUNCOMBE CO. C&D LF EXP.	Depth (ft)	9-11
Project No.	2008-598-01	Sample No.	S-3
Lab ID	2008-598-01-11	Soil Description	**BROWN SILT**
			(MInus No. 40 sieve material, Airdried)

Liquid Limit Test	**1**	**2**	**Blows**	**K-factor**
Tare Number	E	E	20	0.974
Wt. of Tare & WS (gm)	35.5	35.5	21	0.979
Wt. of Tare & DS (gm)	31.54	31.54	22	0.985
Wt. of Tare (gm)	15.29	15.29	23	0.990
Wt. of Water (gm)	3.96	3.96	24	0.995
Wt. of DS (gm)	16.25	16.25	25	1.000
			26	1.005
Moisture Content (%)	**24.4**	**24.4**	27	1.009
Number of Blows	**25**	**25**	28	1.014
			29	1.018
			30	1.022

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	F	A-D	
Wt. of Tare & WS (gm)	25.41	24.84	
Wt. of Tare & DS (gm)	23.54	23.1	
Wt. of Tare (gm)	15.28	15.4	
Wt. of Water (gm)	1.87	1.74	
Wt. of DS (gm)	8.26	7.7	
Moisture Content (%)	**22.6**	**22.6**	**0.0**

Note: The acceptable range of the two Moisture contents is ± 2.6

Liquid Limit Test Results

Test 1

LL = 24.4

LL^{CORR} = 24

Test 2

LL = 24.4

LL^{CORR} = 24

Summary

Liquid Limit (%)	**24**	**Plasticity Index (%)**	**1**
Plastic Limit (%)	**23**	**USCS Symbol**	**ML**

Tested By SD *Date* 7/14/2008 *Checked By* GBM *Date* 7-15-08

DCN: CT-S4A DAT 10/08/01 REVISION: 4

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Appendix C

Field Notes

Projects

5/29/2008

9:40 DC + MC on site for marking borings, meet w/ dozer driver (William)

13:00 Boring sites marked
Returning to Raleigh

David Caldwell

6/2/08 Buncombe Co Landfill

10:00 PC on site, waiting for drillers

10:30 Drillers arrive, filling up water tanks, etc.

10:55 Drillers unloading rig, etc
Setting up on 614

13:00 Drillers back from lunch
Starting on 614

17:00 Completed 614, 617 to refusal
Started on 616
Landfill closing for the day
Meeting drillers at 7:30 am.

David Caldwell

6/3/08 Buncombe LF

8:00 PC & Drillers on site
Continuing on 616

9:30 Setting up on 619
Drillers out to receive
delivery of materials

10:00 Drillers return, resume
work on 619

19:00 Completed 619, 620, 621
to refusal
Cored 10' on 619
End of day

David Caldwell

6/4/08 Buncombe Co LF

7:30 DC & Drillers on-site
Moving vehicles off of 619

9:30 Setting up on 618

12:00 Break for lunch

13:30 Finished 618
Moving to 615

18:00 Completed 615, 622
End of Day

David Caldwell

6/5/08 Buncombe Co LF

7:45 DC & Drillers on site
Setting up on 624

10:55 Well 361 WL @ 58.2'
below top of PVC

11:30 Setting up on 623
Break for lunch

16:30 Well 234 WL @ 60.0'
below top of casing

18:30 Completed 623
End of Day

David Caldwell

6/6/08 Buncombe Co. LF

7:30 DC + Drillers on-site
Moving to 627

9:00 Had to clear more road
for site of 627 -
Setting up drill rig

16:40 Water level on 623
@ 22.5'
Finished coring 627
Reaming out to set well

17:00 Will return & finish Mon-Tues
June 9-10

David Caldwell

6/9/08

12:15 DC on-site
Drillers arrived 11:45,
breaking down from 627

Spoke to Dan Forbes about getting
a well in at 627. OK to pull
tri-cone reamer and complete
with air hammer rig.

13:10 Pulling ST @ 627 from
1' BGS
Moving to 626

17:00 626, 625 completed
Need more road cleared to
reach 628, will complete
on 6/10

David Caldwell

6/10/08

7:45 DG & Drillers on-site
William is finishing dozer work to access 628

WL in 606 @ 75.5' below top of PVC

WL in 234 @ 60.0' below top of PVC

☆ WL in 619 @ 8.5' BGS

WL in 361 @ 58.3' below top of PVC

☆ WL in 623 @ 24.5' BGS

WL in 227 @ 10.5' below top of PVC

☆ WL in 627 @ 3.0' BGS

☆ - Rock core borings

6/10/08 Continued

11:00 Completed 628
Drillers starting to load equipment for return to Greenville

11:45 Air rig arrives, loading material for well installation

13:00 Setting up on 614

14:30 Completed 614
Setting up on 619 (Nested Pair)

15:30 Completed nested pair at 619 (Deep & Shallow)

Starting on 621 in the morning

David Caldwell

6/11/08

8:30 DC on site, waiting for drillers

9:00 Drillers arrive, using dozer to scrape road after rain last night

9:45 Setting up on 621

11:45 Completed 621 after considerable delay in charging drilling battery

12:40 Return from lunch
Set up on 620

16:00 Completed 620
Set up on 616
Finished 616
Set upon 617, to finish tomorrow

6/12/08

8:30 DC on-site, waiting for drillers at 617

9:10 Drillers arrive at 617

10:00 Completed 617
Moving to 618
Dozer will need to do more clearing

11:00 Set up on 618

12:15 Completed 618
Break for lunch

13:00 Set up on 615, charging battery

14:30 Completed 615
Rig in for battery charging
Driller out to inspect roads on West side
DC to check water levels

Time	Boring	Depth from surface to water
14:40	618	45'
15:00	620	48'
15:15	621	35'
15:20	619s	10'
15:20	619d	12'
15:35	616	12'
15:45	617	45'
15:55	614	42'
15:50	361	56.5'
16:00	615	33.5'

16:10 Returning to hotel

David Caldwell

6/13/08

9:00 PC & Driller on-site
Waiting for support crew and well supplies

11:30 Completed 625
Moving to 628

13:00 Completed 628
Moving to 623
Break for lunch

14:00 Setting up on 623

15:30 Completed 623
Returning to Raleigh

David Caldwell

6-17-08 68° Sunny

1015- Forbes onsite to complete CAD Expansion drilling

- Drill Crew is set up on 627. 627 was augered to refusal in the middle of the access road. Buncombe Co. asked to keep the wells off the access road if possible. Upon arrival, the drill crew and equipment operator have built a pad just off the road near the original auger location. Pad is 4-6ft higher in elevation compared to access road

1040- Begin drilling 627 d

627 d

- Bedrock/(±) 14 ft - Competent @ (±) 17 ft
  PWR
  H_2O at contact zone (14 Ft)
- 18 - 41 ft - competent rock / producing a gray rock flour
- 41 - 61 Ft - competent rock
- 61 - 81 Ft - Competent rock / rock flour is dry
- 81 - 100 ft - Competent rock
- Allow to sit for 15 minutes. Blew H_2O out but is most likely from contact zone.

1140 - Called Matt Colone of CDM to discuss. Will drill to 120 to find H_2O.

- 118 (±) small Fracture
- 124 Terminate boring
- Drill rod is wet at (±) 117 ft

Well 227 TD = 22.23
WL = 10.16

6-17-08 72° Sunny

627 d

Screen → 124 - 114
Sand → 112 - 124
Bentonite → 110 - 112
Grout → 0 - 110

1230 - Break for lunch

1255 - Begin drilling 627

- PWR/ Bedrock @ 14 ft.
- Soft @ 16 ft/
- Competent @ 17 ft
- Terminate boring @ 18 ft

627

18 - 13 → Screen
11 - 18 → Sand
9 - 11 → Bentonite
0 - 9 → Grout

1535 - Mob to 626

1400 - Setting up to drill 626

626

- (±) 12 ft Bedrock / Soft
- 16 - 17.5 Soft zone
- Drill to 24 ft to see if H_2O is present. let sit for 5 minutes. No H_2O.
- Cuttings are weathered (weathered granitic gneiss)

6-17-08 78° Sunny

626 Continued

- (I) 28 More competent - Gray rock flour
- (I) 38 - 38.5 ft - soft [redacted] zone
- 41 Ft let sit to see if H_2O is in soft zone at 38 Ft. No H_2O
- 46 - 51 Ft Fracture / H_2O / soft zone filled with sediment / Cuttings and sediment are brown in color
- 51 - 57 Ft - gray rock flour

Terminate boring @ 57 Ft

* Not enough PVC to install well. Will leave borehole open and install PVC in the morning

1550 - Check in with Jerry Mears. Obtain well keys to collect H_2O levels from existing wells.

1605 - Offsite

6-17-08

Drilling Summary Page

- Reuben Caldwell Drilling Inc.
- Drill Rig - Schramm T450 WS Rotadrill
- Driller - Billy Nash
- Heper - Donald Nash
- Equipment Operator - William Crow
- 6" Air Hammer / 2-inch PVC / #2 SAND FILTER

Well Total Depths

Loc	TD
614	42
615	51.25
616	31
617	61
618	50
619s	14
619d	30
620	51.5
621	45
623	99
625	62
626	57
627d	124
627	18
628	63.5
624 shallow	20
622	46
624 deep	40

Total Drilling Footage = 905.25

6-18-08 66° Sunny

0825- Forbes onsite. Begin collecting water levels while waiting for the drill crew to arrive

Loc	DTW (TOC)	DTW (Ground)	
615	35.71	33.56	
618	46.47	44.24	
MW-12D	14.44		
MW-12	13.05		
??? B-609	35.43	- No well tag or ID on PVC Located across from MW-14 cluster	
MW-14	33.92		
MW-14d	34.23		
627 shallow	7.83	4.86	
627 deep	9.08	6.51	
623	87.18	84.66	
234-B	59.95		
B-227	10.16		Collected on
614	42.47		6/19/08
617	48.78		6/19/08
616	15.41		6/19/08
619s	11.84	9.17	6/19/08
619d	14.95		6/19/08
620	49.70	46.40	6/19/08
621	37.87		6/19/08
B-361	58.45		
B-606	75.58		
628	56.64	54.04	
625	49.65	47.48	

6-18-08 70° Sunny

Loc	DTW (TOC)	DTW (ground)
626	48.77	46.70 Collected on 6/19/08
624s	Dry	
624d	33.21	6/19/08
622	14.50	6/19/08

- All water levels collected prior to development

Wells that have been completed with Pro-cover, pad, and ID tag as of 6/19/08

614	624 deep	621
617	628	
622	616	
624 shallow	619 deep	

Wells that have not been fully completed as of 6/19/08

627 shallow	615
627 deep	618
626	619 shallow
623	620
625	

620 has not been completed prior to gauging H_2O level. Measured 27 Ft. from ground surface to H_2O in open hole

6-18-08 70° Sunny

0915- Drill crew onsite. Install PVC in 626. Set up to install 624d

1030- Begin drilling 624d

624d

- Rock @ ± 6Ft
  - Soft zone from 8-9Ft (±)
  - let sit to see if H_2O is on top
  - Soft zone from 11-12 Ft
    Drilled to 13 and let sit
    No H_2O - Continue drilling
- Drilled to 20Ft. Let sit. Pulled air-hammer up at 13Ft and appeared to have some moisture on it
  - Cuttings are a white/gray rock flour
- Drilled to 21 Ft and terminated boring
  - About 5 Ft of water in boring
- 1100- Called Mat Colone of CDM to see about installing a nested pair
  Will continue drilling till 1st H_2O producing fracture is encountered

23-25 - soft zone / fracture
27-28 - soft zone / fracture
33-37 - Large Fracture / Cuttings change from white/gray rock flour to brown / producing good H_2O

- Terminate boring @ 40 Ft

6-18-08 72° Sunny

624d

40-30 → Screen
28-40 → Sand
26-28 → Bentonite
0-26 → Grout

1145- Break for lunch
- Collect H_2O levels while drill crew is at lunch

1220- Return to drill crew. Driller is at 18Ft and says there is no H_2O. 624 is 5Ft in front of 624d. Drill to 20 Ft and let sit for 10 minutes. Pull hammer up and appears to be moist. Will set well to see if any H_2O comes in

624

20-10 → Screen
8-20 → Sand
6-8 → Grout/Bentonite
0-6 → Grout

1500- Mob to 622
- Collected a bucket of soil for testing. Not much cuttings left from Augering 1/4 bucket is from Augered location and the rest is surficial from where the dozer was clearing

6-18-08 76° Sunny

622

- Bedrock (±) 12 Ft (soft/weathered)
- 12 - 26 Intermediate soft zones from 17-18 and 23-25. Allow to sit to see if H_2O is present. No H_2O. Continue drilling
- More competent @ ± 27 Ft - dark gray rock floor
- Fracture @ 31 Ft
- Fracture @ 34 Ft
  > (±) 6 inches each fracture
- Drill to 36 Ft and let sit
- Fracture at 39-41 Ft (brown cuttings) (little H_2O)
- Drill to 46 Ft. / Pull rod and hammer H_2O is (±) 7 Ft up on drill rod from bottom of hammer
- Terminate boring at 46 Ft

622
46 - 36 → Screen
34 - 46 → Sand
32 - 34 → Bentonite
0 - 32 → Grout

1430 - Drill crew offsite.
Proceed to 625 to begin slug testing
- Setting up to Slug Test

1610 - Setting up to slug test 627 shallow

6-18-08 80° Sunny

SLUG Test

625 Slug In - 1450
- 1524 STOP TEST
SLUG OUT - 1526
- 1555 STOP TEST

627 shallow SLUG IN - 1621
- 1709 STOP TEST
SLUG OUT - 1706
- 1717 STOP TEST
Checked H_2O level prior to stopping slug out Test. Had Recovered 100%

1730 - Offsite

6-19-08 64° Sunny

0800 - Forbes onsite

0820 - Setting up to Slug Test

615 Slug In - 0830
- 0902 STOP TEST
Slug out - 0903
- 0928 STOP TEST

- Checked H_2O level prior to stopping test
Fully recovered

619 Deep Slug In - 0948
- 1019 STOP TEST
Slug out - 1020
1054 STOP TEST

0940 - Billie and Donnie Nash onsite to continue developing well construction
Billie is going to try to complete 615, 618, 619 shallow, and 620

617 Slug In - 1106
- 1137 STOP TEST
Slug out - 1139
1206 STOP TEST

6-19-08 72° Sunny

RETEST 625 Slug in - 1221
- 1258 STOP TEST
Slug out - 1300
1338 STOP TEST

1330 - Gave survey crew the well location map. Surveyor's are going to provide TOC and ground elevations for the newly installed wells (18 total)

1350 - Offsite

7/17/08 72° Sunny

1120 - Forbes onsite to collect water levels from the newly installed wells and existing wells

Loc	DTW	Comments
B-227	10.16	Needs lock
627s	7.90	
627d	(±) 1-inch from top of casing - Needs lock	
626	49.67	Cover was open with cap on top
623	87.67	" "
B-234	60.11	Needs lock
625	44.13	Needs tag - Cover was open with cap on top
622	13.81	
624s	Dry	
624d	31.80	
B-606	75.79	Needs lock
628	55.82	"
MW-12d	14.51	
MW-12s	13.60	
B-609	35.07	Needs lock
MW-14s	33.42	
MW-14d	33.91	Wasp nest inside cover
615	38.95	Needs lock
618	46.75	"
614	43.51	
B-361	58.[illegible]	Lid is rusty and will not close due to PVC sticking out

7/17/08 80° Sunny

Water levels Continued

Loc	DTW	Comments
617	48.62	Cover was open with cap on top
616	15.97	" "
619d	14.97	" "
619s	12.03	" "
620	50.21	Needs lock / Tag was on ground
621	38.00	
B-365	11.58	Needs lock and cap

1520 - Return well keys

1530 - Offsite

8-12-08 75°F Sunny

1050 A. Weisofenning on site to collect water level measurements

Well	DTW (ft)	Comments
MW-4	14.64	
MW-4d	15.71	
MW-5	37.37	
MW-5d	39.25	
MW-6	31.18	
B-364	—	Knocked over and box busted
MW-617	49.16	
B-361	59.31	no well cover, no locke
MW-621	38.14	
MW-620	50.27	No lock
MW-618	46.87	No lock
MW-619s	12.82	
MW-619d	15.38	
MW-615	41.80	No lock
MW-616	16.91	
B-365	—	Couldn't locate
MW-614	44.15	
MW-12	14.19	
MW-12d	15.79	
B-609	35.74	

8-12-08 75° Sunny

Water Levels continued

Well	DTW (ft)
MW-14	34.19
MW-14d	34.53
B-606	75.95
MW-628	57.60
B-409	— no longer exists
MW-625	44.03
MW-622	15.29
MW-624s	dry
MW-624d	35.08
~~MW-626~~	—
MW-627s	9.55 (not a strong signal / may be dry)
MW-627d	0.02 (at top of casing)
MW-623	87.95
BC-127	— Not needed / Not existing
BC-227	10.20
B-234	60.23
626	49.65

1500 Off site

9-10-08 72° Partly Sunny

1135- Forbes onsite to collect water levels

Loc	DTW	Loc	DTW
B-227	10.17	619	15.10
627	8.76	619d	12.51
627d	TOC	620	50.62
626	49.86	621	38.13
623	88.25	B-365	11.70
B-234	60.42		
625	43.58		
622	14.24		
624	Dry		
624d	37.87		
B-606	76.17		
628	58.71		
B-609	35.87		
MW-14	34.16		
MW-14d	34.60		
MW-12	14.14		
MW-12d	15.78		
615	44.08		
618	47.06		
614	44.47		
B-361	59.63		
617	49.57		
616	17.82		

1400 - Offsite

CDM

A Division of Camp Dresser & McKee Inc.

5400 Glenwood Avenue
Suite 300
Raleigh, NC 27612
(919) 787-5620

Test Boring Log

Client: Buncombe County	Drilling Contractor	Boring No.: 614	
Project Name: C&D Landfill Expansion	Company: Caldwell Drilling, Inc.	Page: 1 of	
Project Location: Buncombe County Landfill	Driller: Lee Brown	Total Depth:	Elevation:
Project Number: 6447- -fld.rt	Drilling Method: HSA Type: 8 1/2" OD	N:	E:

Hammer Weight: 140 lbs Hammer Drop Height: 30" Bit size/ Hole size: 11" Spoon Size: 2" OD ( ) Auto ( ) Manual Hammer

Location Sketch	Monitoring Equipment Used:				Elevations / Depths	Logged By: D. Caldwell
	Depth to Water	Depth	Date	Time	Ground Surface:	Title: Geotechnical Eng.
					Top of Casing:	Date Start: 6/2/08
	Total Samples	disturbed	undisturbed		Top of Screen:	Date Finish:
					Bottom of Screen:	

Depth	Sample No.	Blows per 6"	Sample Depth	Advance / Recov.	In Situ Test	Strata Change	Sample Description
1	S-1	WOH WOH 2 3		24/16			dry, v soft, brown, SILT, little f-sand
2							
3							N/A
4	S-2	5 5 7 10		24/24			SAA
5							dry, stiff, light gray + orange mottled, SILT some sand, little clay
6							
7							
8							
9	S-3	50/6		6/6			dry, v. dense, light gray f-m SAND, little silt
0							

Sample Types	Consistency vs. Blowcount / Foot								Burmeister Classification	
	Granular (Sand):				Fine Grained (Clay):					
S -- Split Spoon									and	35-50%
U -- Undisturbed Tube	V. loose:	0-4	Dense:	30-50	V.Soft:	< 2	Stiff:	8-15	some	20-35%
C -- Rock Core	Loose:	4-10	V. Dense:	>50	Soft:	2-4	V. Stiff:	15-30	little	10-20%
A -- Auger Cuttings	M. Dense:	10-30			M. Stiff:	4-8	Hard:	>30	trace	<10%
									Moisture, density, color	

Remarks: CME 750X

Updated On: 04/09/01

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Test Boring Log

Client:	Buncombe County	Project Location:	Buncombe County landfill	Boring No.:	614
Project Name:	C&D Landfill Expansion	Project Number:	6447- -rt.fld	Page:	2 of
		Logged By:	D. Caldwell	Date:	6/2/08

Depth	Sample No.	Blows per 6"	Sample Depth	Advance / Recov.	In Situ Test	Strata Change	Sample Description
							difficult drilling
1							AR @ 11.5'
2							
3							
4							
5							
6							
7							
8							
9							
0							
1							
2							
3							
4							
5							
6							
7							
8							
9							
0							

Remarks:

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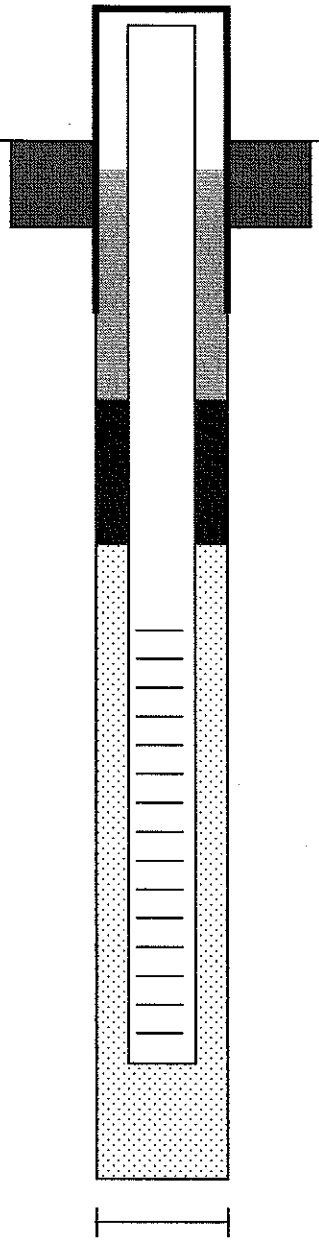
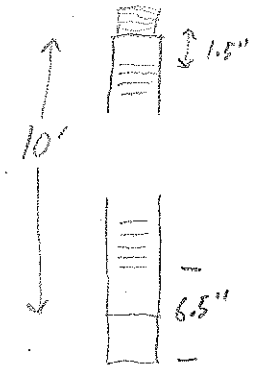
Monitoring Well Installation Log

Client:	Buncombe Co.	Contractor:	Caldwell Drilling	Boring/Well No.:	614
Project Name:		Driller:	Billie	Date Installed:	6/10/08
Project Location:		Ground EL:		Logged By:	DC
Project Number:		Riser EL:		Page:	1 of





SURFACE SEAL: (Thickness & Type)

BACKFILL MATERIAL: (Type)

TOP OF SEAL: 28

SEAL CONSTRUCTION: (Thickness & Type) 2' Bentonite Chips

TOP OF SANDPACK: 30'

RISER CONSTRUCTION: (Type, Diameter & Material) 2" PVC

TOP OF SCREEN: 32.5'

SANDPACK TYPE: #2 Filter (4 bags)

SCREEN MATERIAL: (Type, Slot, Diameter & Material) 2" PVC, Sch. 40, Slot 10

BOTTOM OF SCREEN: 41.5'

BOTTOM OF BOREHOLE: 42'

BOREHOLE DIAMETER: 6"

NOTE: All depths are in feet below ground surface, unless noted otherwise.

Remarks: 4th fracture was water-bearing

Updated On: 04/09/01

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Test Boring Log

Client: Buncombe County	Drilling Contractor		Boring No.: 615
Project Name: C&D Landfill Expansion	Company: Caldwell Drilling, Inc.		Page: 1 of
Project Location: Buncombe County Landfill	Driller:		Total Depth: Elevation:
Project Number: 6447- -fld.rt	Drilling Method:	Type:	N: E:

Hammer Weight: 140 lbs Hammer Drop Height: 30" Bit size/ Hole size: Spoon Size: 2" OD ( ) Auto ( ) Manual Hammer

Location Sketch	Monitoring Equipment Used:				Elevations / Depths	Logged By: D. Caldwell
	Depth to Water	Depth	Date	Time	Ground Surface:	Title: Geotechnical Eng.
					Top of Casing:	Date Start: 6/4
	Total Samples	disturbed	undisturbed		Top of Screen:	Date Finish:
					Bottom of Screen:	

Depth	Sample No.	Blows per 6"	Sample Depth	Advance / Recov.	In Situ Test	Strata Change	Sample Description
1	S-1	5 8 8 9		24/10			dry, m dense, brown, f-c SAND, some silt, trace gravel relict fabric visible
2							
3							
4	S-2	5 7 9 9		24/24			dry, m dense, ltgray/brown/black mottled f-m SAND, some silt
5							
6							
7							
8							
9	S-3	14 20 21 31		24/18			dry, dense, ltgray/dkgray/mottled brown f-c SAND, some silt
0							

Sample Types	Consistency vs. Blowcount / Foot								Burmeister Classification	
	Granular (Sand):				Fine Grained (Clay):					
S -- Split Spoon									and	35-50%
U -- Undisturbed Tube	V. loose:	0-4	Dense:	30-50	V.Soft:	< 2	Stiff:	8-15	some	20-35%
C -- Rock Core	Loose:	4-10	V. Dense:	>50	Soft:	2-4	V. Stiff:	15-30	little	10-20%
A -- Auger Cuttings	M. Dense:	10-30			M. Stiff:	4-8	Hard:	>30	trace	<10%
									Moisture, density, color	

Remarks:

Updated On: 04/09/01

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Test Boring Log

Client:	Buncombe County	Project Location:	Buncombe County landfill	Boring No.:	615
Project Name:	C&D Landfill Expansion	Project Number:	6447- -rt.fld	Page:	2 of
		Logged By:	D. Caldwell	Date:	6/4

Depth	Sample No.	Blows per 6"	Sample Depth	Advance / Recov.	In Situ Test	Strata Change	Sample Description
	S-3						
1							
2							
3							ST from 13.5-15.5
4		5		24/24			dry, loose, yellowish brown, f-m SAND
5	S-4	3 5 8				T	some silt
6						B	SA S-3 but loose
7							
8							
9		50/4		4/4			dry, v dense, gray, GRAVEL, some sand, little silt
0	S-5						
1							AR @ 21.5'
2							
3							
4							
5							
6							
7							
8							
9							
0							

Remarks:

Updated On: 04/09/01

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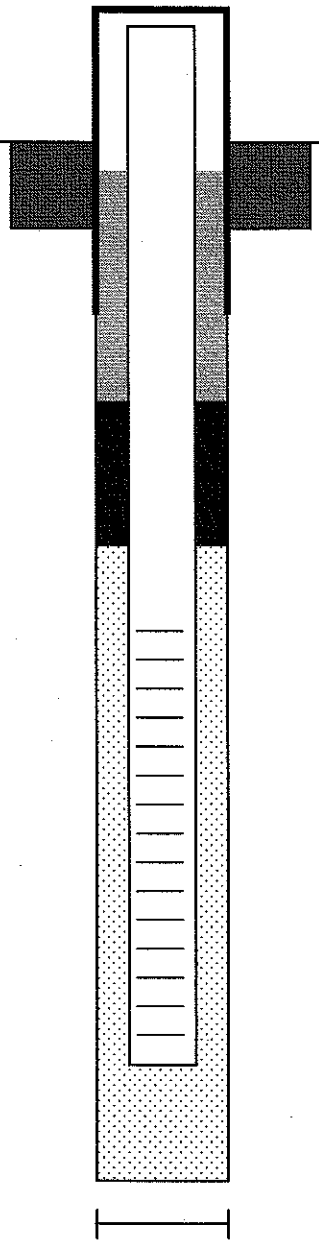
Monitoring Well Installation Log

Client:		Contractor:		Boring/Well No.:	615
Project Name:		Driller:		Date Installed:	8/12
Project Location:		Ground EL:		Logged By:	
Project Number:		Riser EL:		Page:	of



GROUND SURFACE

LOCKED PROTECTIVE CASING

SURFACE SEAL: _____
(Thickness & Type)

BACKFILL MATERIAL: _____
(Type)

TOP OF SEAL: _____

SEAL CONSTRUCTION: _____
(Thickness & Type)

TOP OF SANDPACK: 40'

RISER CONSTRUCTION: _____
(Type, Diameter & Material)

TOP OF SCREEN: 41.75'

SANDPACK TYPE: #2 (3½ bags)

SCREEN MATERIAL: _____
(Type, Slot, Diameter & Material)

BOTTOM OF SCREEN: 50.75'

BOTTOM OF BOREHOLE: 51.25'

BOREHOLE DIAMETER: 6"

NOTE: All depths are in feet below ground surface, unless noted otherwise.

Remarks:

Updated On: 04/09/01

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Test Boring Log

Client:	Buncombe County	Drilling Contractor		Boring No.:	6/6
Project Name:	C&D Landfill Expansion	Company:	Caldwell Drilling, Inc.	Page:	1 of
Project Location:	Buncombe County Landfill	Driller:	Lee	Total Depth: / Elevation:	
Project Number:	6447- -fld.rt	Drilling Method:	HSA Type:	N:	E:

Hammer Weight: 140 lbs Hammer Drop Height: 30" Bit size/ Hole size: Spoon Size: 2" OD (✓) Auto ( ) Manual Hammer

Location Sketch	Monitoring Equipment Used:				Elevations / Depths	Logged By:	D. Caldwell
	Depth to Water	Depth	Date	Time	Ground Surface:	Title:	Geotechnical Eng.
					Top of Casing:	Date Start:	6/2
	Total Samples	disturbed	undisturbed		Top of Screen:	Date Finish:	
					Bottom of Screen:		

Depth	Sample No.	Blows per 6"	Sample Depth	Advance / Recov.	In Situ Test	Strata Change	Sample Description
1	S-1	1 1 1 2		24/18			moist, v.soft-soft, brown, SILT & f. SAND few roots trace clay
2							
3							☆ good material for ST from 2.5-4.5 ☆
4		1			PP 2.5		
5	S-2	9 18 32		24/24	PP 1.5		SAA
6							dry, m dense, gray & orange, f. SAND, some silt
7							
8							
9	S-3	16 20 50/4		16/15			dry, v dense, lt. & dark gray mottled, f-c SAND little silt
0							

Sample Types	Consistency vs. Blowcount / Foot								Burmeister Classification	
S -- Split Spoon	Granular (Sand):				Fine Grained (Clay):				and	35-50%
U -- Undisturbed Tube	V. loose:	0-4	Dense:	30-50	V.Soft:	< 2	Stiff:	8-15	some	20-35%
C -- Rock Core	Loose:	4-10	V. Dense:	>50	Soft:	2-4	V. Stiff:	15-30	little	10-20%
A -- Auger Cuttings	M. Dense:	10-30			M. Stiff:	4-8	Hard:	>30	trace	<10%
									Moisture, density, color	

Remarks:

Updated On: 04/09/01

CDM

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Test Boring Log

Client:	Buncombe County	Project Location:	Buncombe County landfill	Boring No.:	6/6
Project Name:	C&D Landfill Expansion	Project Number:	6447- -rt.fld	Page:	2 of 2
		Logged By:	D. Caldwell	Date:	6/2/08

Depth	Sample No.	Blows per 6"	Sample Depth	Advance / Recov.	In Situ Test	Strata Change	Sample Description
	S-3						
1							
2							ARO 12' BGS
3							
4							
5							
6							
7							
8							
9							
0							
1							
2							
3							
4							
5							
6							
7							
8							
9							
0							

Remarks:

Updated On: 04/09/01

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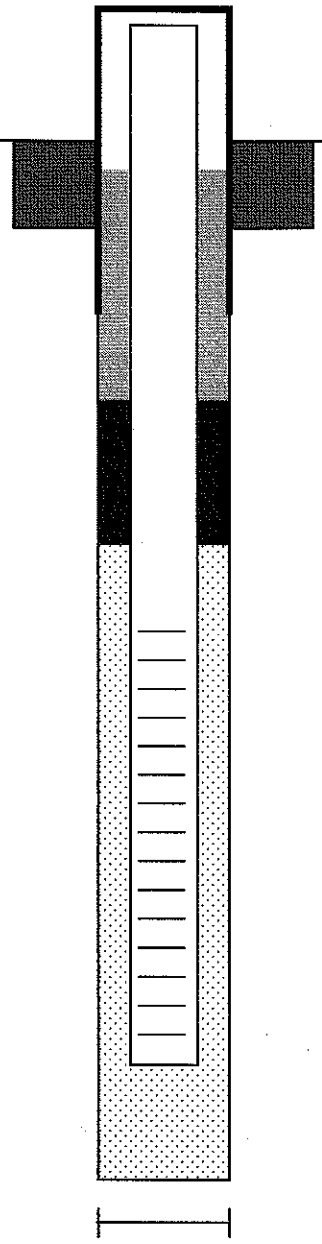
Monitoring Well Installation Log

Client:		Contractor:		Boring/Well No.:	6/6
Project Name:		Driller:		Date Installed:	6/11/09
Project Location:		Ground EL:		Logged By:	DC
Project Number:		Riser EL:		Page:	1 of



LOCKED PROTECTIVE CASING

SURFACE SEAL: _____
(Thickness & Type)

BACKFILL MATERIAL: _____
(Type)

TOP OF SEAL: 18.5

SEAL CONSTRUCTION: 2' Bentonite
(Thickness & Type)

TOP OF SANDPACK: 20.5

RISER CONSTRUCTION: _____
(Type, Diameter & Material)

TOP OF SCREEN: 21.5'

SANDPACK TYPE: #2 (4 bags)

SCREEN MATERIAL: 2" PVC, 10 slot
(Type, Slot, Diameter & Material)

BOTTOM OF SCREEN: 30.5'

BOTTOM OF BOREHOLE: 31'

BOREHOLE DIAMETER: 6"

NOTE: All depths are in feet below ground surface, unless noted otherwise.

Remarks:

Updated On: 04/09/01

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(919) 787-5620

Test Boring Log

Client: Buncombe County	Drilling Contractor	Boring No.: 617	
Project Name: C&D Landfill Expansion	Company: Caldwell Drilling, Inc.	Page: 1 of	
Project Location: Buncombe County Landfill	Driller:	Total Depth:	Elevation:
Project Number: 6447- -fld.rt	Drilling Method: HSA Type: 8½" OD	N:	E:

Hammer Weight: 140 lbs Hammer Drop Height: 30" Bit size/ Hole size: 11" Spoon Size: 2" OD . (X) Auto ( ) Manual Hammer

Location Sketch	Monitoring Equipment Used:				Elevations / Depths	Logged By: D. Caldwell
	Depth to Water	Depth	Date	Time	Ground Surface:	Title: Geotechnical Eng.
					Top of Casing:	Date Start: 6/2
	Total Samples	disturbed	undisturbed		Top of Screen:	Date Finish:
					Bottom of Screen:	

Depth	Sample No.	Blows per 6"	Sample Depth	Advance / Recov.	In Situ Test	Strata Change	Sample Description
1	S-1	1 5 15 25		24/17			dry, m dense, gray/blk/yellow mottled f-c SAND little silt, tr. gravel
4	S-2	17 35 50/6		18/18			dry, v dense, gray/blk/yellow mottled f-c SAND, little gravel, tr. clay/silt
9	S-3	17 49 50/3		15/15			dry, v dense, gray/orange mottled f-c SAND, little gravel, tr. clay/silt

Sample Types	Consistency vs. Blowcount / Foot								Burmeister Classification	
	Granular (Sand):				Fine Grained (Clay):					
S -- Split Spoon									and	35-50%
U -- Undisturbed Tube	V. loose:	0-4	Dense:	30-50	V.Soft:	< 2	Stiff:	8-15	some	20-35%
C -- Rock Core	Loose:	4-10	V. Dense:	>50	Soft:	2-4	V. Stiff:	15-30	little	10-20%
A -- Auger Cuttings	M. Dense:	10-30			M. Stiff:	4-8	Hard:	>30	trace	<10%
									Moisture, density, color	

Remarks:

Updated On: 04/09/01

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Test Boring Log

Client:	Buncombe County	Project Location:	Buncombe County landfill	Boring No.:	617
Project Name:	C&D Landfill Expansion	Project Number:	6447- -rt.fld	Page:	2 of 2
		Logged By:	D. Caldwell	Date:	6/2

Depth	Sample No.	Blows per 6"	Sample Depth	Advance / Recov.	In Situ Test	Strata Change	Sample Description
1							
2							
13							
4	S-4	50/3		3/3			dry v. dense dk gray/black GRAVEL some f-c sand
15							AR @ 13.5'
6							
7							
8							
9							
0							
1							
2							
3							
4							
5							
6							
7							
8							
9							
0							

Remarks:

Updated On: 04/09/01

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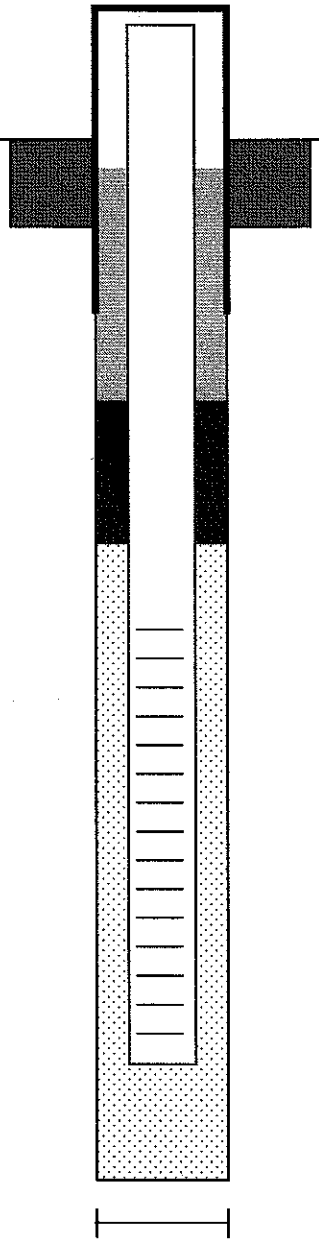
Monitoring Well Installation Log

Client:		Contractor:		Boring/Well No.:	617
Project Name:		Driller:		Date Installed:	6/12
Project Location:		Ground EL:		Logged By:	
Project Number:		Riser EL:		Page:	1 of



LOCKED PROTECTIVE CASING

SURFACE SEAL: _____
(Thickness & Type)

BACKFILL MATERIAL: _____
(Type)

TOP OF SEAL: 47

SEAL CONSTRUCTION: 2' Bentonite
(Thickness & Type)

TOP OF SANDPACK: 49'

RISER CONSTRUCTION: _____
(Type, Diameter & Material)

TOP OF SCREEN: 51.5'

SANDPACK TYPE: #2 Filter (4 bags)

SCREEN MATERIAL: _____
(Type, Slot, Diameter & Material)

BOTTOM OF SCREEN: 60.5'

BOTTOM OF BOREHOLE: 61'

BOREHOLE DIAMETER: 6"

NOTE: All depths are in feet below ground surface, unless noted otherwise.

Remarks:

Updated On: 04/09/01

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Test Boring Log

Client: Buncombe County	Drilling Contractor	Boring No.: 618	
Project Name: C&D Landfill Expansion	Company: Caldwell Drilling, Inc.	Page: 1 of	
Project Location: Buncombe County Landfill	Driller:	Total Depth:	Elevation:
Project Number: 6447- -fld.rt	Drilling Method: Type:	N:	E:

Hammer Weight: 140 lbs Hammer Drop Height: 30" Bit size/ Hole size: Spoon Size: 2" OD ( ) Auto ( ) Manual Hammer

Location Sketch	Monitoring Equipment Used:				Elevations / Depths	Logged By: D. Caldwell
	Depth to Water	Depth	Date	Time	Ground Surface:	Title: Geotechnical Eng.
					Top of Casing:	Date Start: 6/4
	Total Samples	disturbed	undisturbed		Top of Screen:	Date Finish:
					Bottom of Screen:	

Depth	Sample No.	Blows per 6"	Sample Depth	Advance / Recov.	In Situ Test	Strata Change	Sample Description
1	S-1	3 4 5 6		24/14		T	moist stiff grayish brown SILT, some sand few roots relict fabric visible
2						B	dry loose light brown f-m SAND some silt
3							
4		5					SAA
5	S-2	6 8 9		24/16			dry orange white/light gray/orange mottled f-m SAND, some silt
6							
7							
8	ST-1						
9							
0	S-3	4 5 6 10		24/16			SAA

Sample Types	Consistency vs. Blowcount / Foot								Burmeister Classification	
S -- Split Spoon	Granular (Sand):				Fine Grained (Clay):				and	35-50%
U -- Undisturbed Tube	V. loose:	0-4	Dense:	30-50	V.Soft:	< 2	Stiff:	8-15	some	20-35%
C -- Rock Core	Loose:	4-10	V. Dense:	>50	Soft:	2-4	V. Stiff:	15-30	little	10-20%
A -- Auger Cuttings	M. Dense:	10-30			M. Stiff:	4-8	Hard:	>30	trace	<10%
									Moisture, density, color	

Remarks:

Updated On: 04/09/01

6 13 21 26

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Test Boring Log

Client:	Buncombe County	Project Location:	Buncombe County landfill	Boring No.:	618
Project Name:	C&D Landfill Expansion	Project Number:	6447- -rt.fld	Page:	2 of
		Logged By:	D. Caldwell	Date:	

Depth	Sample No.	Blows per 6"	Sample Depth	Advance / Recov.	In Situ Test	Strata Change	Sample Description
1							
2							
3							
4		6					dry dense gray f-c SAND, little silt
5	S-4	13 21 26		24/15			
6							
7							
8							
9		50/3		3/3			dry v dense gray-brown f-c SAND, little silt (trace gravel)
0	S-5						
1							
2							
3							
4		12					SAA
5	S-6	13 50/5		17/17			
6							
7							
8							
9							AR @ 29'
0							

Remarks:

Updated On: 04/09/01

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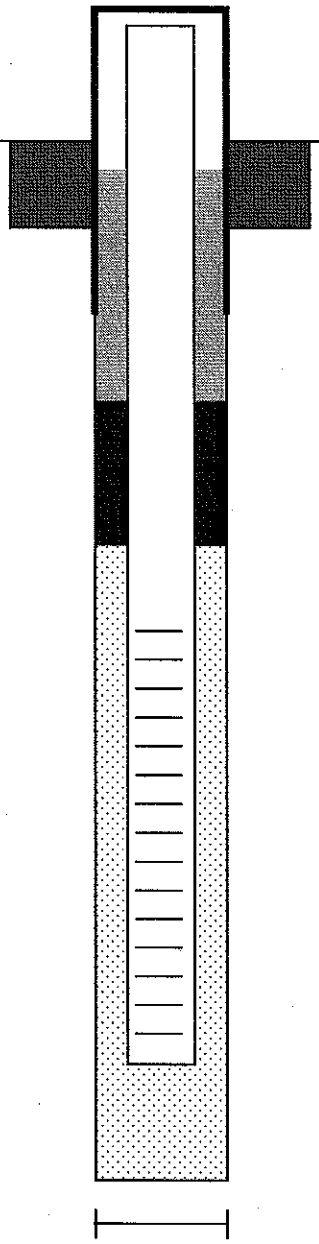
Monitoring Well Installation Log

Client:		Contractor:		Boring/Well No.:	618
Project Name:		Driller:		Date Installed:	6/12
Project Location:		Ground EL:		Logged By:	
Project Number:		Riser EL:		Page:	of



LOCKED PROTECTIVE CASING

SURFACE SEAL: (Thickness & Type)

BACKFILL MATERIAL: (Type)

TOP OF SEAL: 36.5

SEAL CONSTRUCTION: (Thickness & Type) 2' Bentonite

TOP OF SANDPACK: 38.5

RISER CONSTRUCTION: (Type, Diameter & Material)

TOP OF SCREEN: 40.5

SANDPACK TYPE: #2 (4½ bags)

SCREEN MATERIAL: (Type, Slot, Diameter & Material)

BOTTOM OF SCREEN: 49.5'

BOTTOM OF BOREHOLE: 50'

BOREHOLE DIAMETER:

NOTE: All depths are in feet below ground surface, unless noted otherwise.

Remarks: Well elevation is 4-6' above level of original boring due to bulldozer work for air rig.

WL@ 45' 6/12/08 14:40

Updated On: 04/09/01

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Test Boring Log

Client: Buncombe County	Drilling Contractor	Boring No.: 619	
Project Name: C&D Landfill Expansion	Company: Caldwell Drilling, Inc.	Page: 1 of	
Project Location: Buncombe County Landfill	Driller: Lee	Total Depth:	Elevation:
Project Number: 6447- -fld.rt	Drilling Method: HSA Type: 8½ OD	N:	E:

Hammer Weight: 140 lbs Hammer Drop Height: 30" Bit size/ Hole size: 11 Spoon Size: 2" OD (✓) Auto ( ) Manual Hammer

Location Sketch	Monitoring Equipment Used:				Elevations / Depths	Logged By: D. Caldwell
	Depth to Water	Depth	Date	Time	Ground Surface:	Title: Geotechnical Eng.
					Top of Casing:	Date Start: 6/3
	Total Samples	disturbed	undisturbed		Top of Screen:	Date Finish:
					Bottom of Screen:	

Depth	Sample No.	Blows per 6"	Sample Depth	Advance / Recov.	In Situ Test	Strata Change	Sample Description
							No sample at top, material was moved into place with bulldozer start sampling @ 3' BGS
1							
2							
3							
4		3		24/24	3.5	T	moist, stiff, brown, SILT some f-c sand trace gravel
5	S-1	6 8 9				B	dry, m dense, brown/tan/gray, f-c SAND some silt, relict fabric visible
6							
7							
8							
9		14		24/24			dry, m dense, brown/gray/orange mottled f-c SAND, little gravel & silt relict fabric visible
0	S-2	9 10 14					

Sample Types	Consistency vs. Blowcount / Foot								Burmeister Classification	
S -- Split Spoon	Granular (Sand):				Fine Grained (Clay):				and	35-50%
U -- Undisturbed Tube	V. loose:	0-4	Dense:	30-50	V.Soft:	< 2	Stiff:	8-15	some	20-35%
C -- Rock Core	Loose:	4-10	V. Dense:	>50	Soft:	2-4	V. Stiff:	15-30	little	10-20%
A -- Auger Cuttings	M. Dense:	10-30			M. Stiff:	4-8	Hard:	>30	trace	<10%
									Moisture, density, color	

Remarks: Deep well installed in this boring. Shallow well went in next to it

Updated On: 04/09/01

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Test Boring Log

Client:	Buncombe County	Project Location:	Buncombe County landfill	Boring No.:	619
Project Name:	C&D Landfill Expansion	Project Number:	6447- -rt.fld	Page:	2 of 2
		Logged By:	D. Caldwell	Date:	6/3

Depth	Sample No.	Blows per 6"	Sample Depth	Advance / Recov.	In Situ Test	Strata Change	Sample Description
1							
2							
3							NO RECOVERY
4	S-3	50/1		1/0			AR @ 14.5' BGS
5							
6							
7							
8							
9							
0							
1							
2							
3							
4							
5							
6							
7							
8							
9							
0							

Remarks:

Updated On: 04/09/01

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919-781-5730

Core Boring Log

Client:	Buncombe County	Drilling Contractor		Boring No.:	619
Project Name:	C&D LF Expansion	Company:	Caldwell Drilling, Inc	Page:	1 of 1
Project Location:	Buncombe Co. LF	Driller:	Lee	Logged By:	D. Caldwell
Project Number:	6447-	Drilling Method:			

Core Barrel Type: NQ Core Barrel Diameter:

Sample Depth (ft)	Drill Rate min/ft	Core Number / Depth Range	Recovery in.	Recovery %	Weath.	Strata Change	Sample Description
14.5		12"	10.5"	87			RQD=0
15.5	1:10		REC 53"				Hard, Fresh - C.W., gray/pink/black
	2:10						aphanitic - coarse GRANITIC GNEISS
	3:10	C-1					heavily foliated. horizontal to mod dipping
	4:20	60"	RQD 33.5"				extremely close
	6:20						joint set horizontal, very close - medrate
20.5	1:00		REC 57"				rough, stepped, open
	2:00						
	3:10	C-2					SAA, more gray/blk than pink
	4:15	60"	RQD 51"				
	5:45						
25.5							

Field Hardness		
Very Hard	-	Knife can't scratch
Hard	-	Scractches with difficulty
Med. Hard	-	Scratches readily
Medium	-	Grooves or gouges with diff.
Soft	-	Grooves or gouges readily
Very Soft	-	Carves with knife

Weathering	
Fresh	Mod. Severe
Very Slight	Severe
Slight	Very Severe
Moderate	Complete

Bedding	Joints	Spacing (in.)
Very Thin	Very Close	less than 2.
Thin	Close	2-12
Medium	Mod. Close	12-36
Thick	Wide	36-128
Very Thick	Very Wide	more than 128

Attitude	Angle
Horizontal	0 to 5
Shallow or Low Angle	5 to 35
Moderatly Dipping	35 to55
Steep or High Angle	55 to 85
Vertical	85 to 90

Rock Continuity	
Extremely Fractured	Drill core stem less than 1 inch
Moderately Fractured	Drill core stem 1 to 4 inches
Slightly Fractured	Drill core stem 4 to 8 inches
Sound	Drill core stem more than 8 inches

Remarks:

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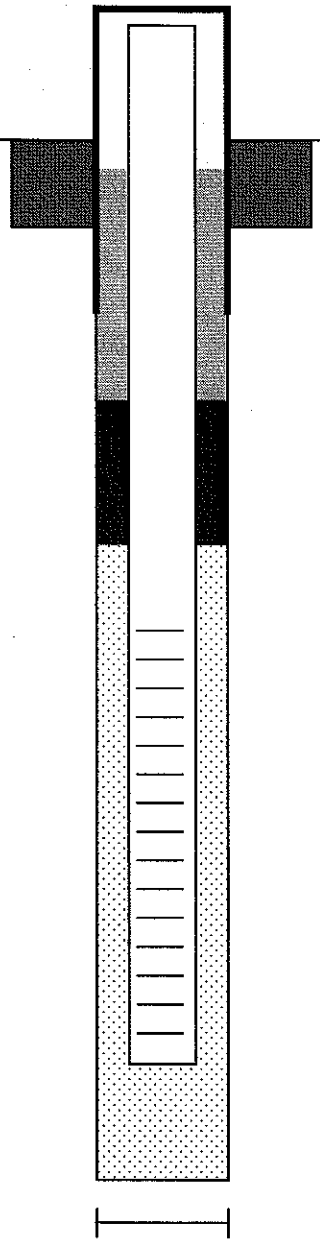
Monitoring Well Installation Log

Client:		Contractor:		Boring/Well No.:	619 Shallow
Project Name:		Driller:		Date Installed:	6/10/08
Project Location:		Ground EL:		Logged By:	DC
Project Number:		Riser EL:		Page:	1 of



LOCKED PROTECTIVE CASING

SURFACE SEAL: (Thickness & Type)

BACKFILL MATERIAL: (Type)

TOP OF SEAL: 2'

SEAL CONSTRUCTION: (Thickness & Type) 2' Bentonite Chips

TOP OF SANDPACK: 4'

RISER CONSTRUCTION: (Type, Diameter & Material)

TOP OF SCREEN: 4.5'

SANDPACK TYPE: #2 Filter (3½ bags)

SCREEN MATERIAL: (Type, Slot, Diameter & Material)

BOTTOM OF SCREEN: 13.5'

BOTTOM OF BOREHOLE: 14'

BOREHOLE DIAMETER: 6"

NOTE: All depths are in feet below ground surface, unless noted otherwise.

Remarks: Part of nested pair @ 619
No sampling in this boring

Updated On: 04/09/01

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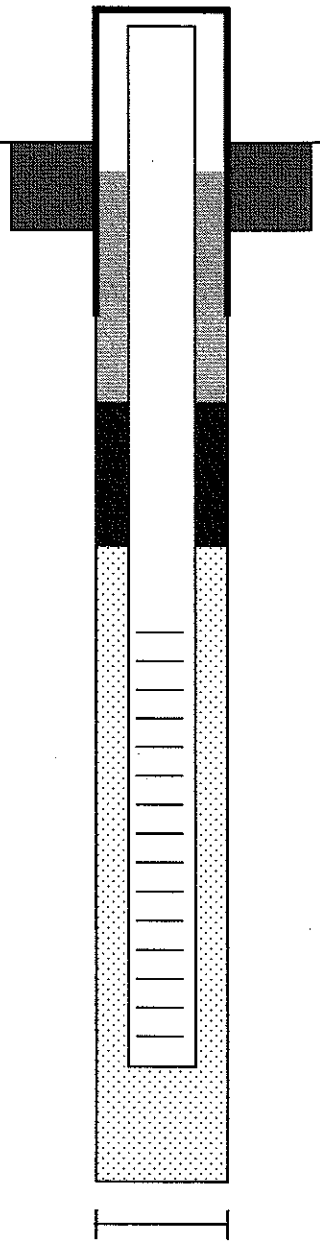
Monitoring Well Installation Log

Client:		Contractor:		Boring/Well No.:	619 Deep
Project Name:		Driller:		Date Installed:	6/10/08
Project Location:		Ground EL:		Logged By:	DC
Project Number:		Riser EL:		Page:	1 of



LOCKED PROTECTIVE CASING

SURFACE SEAL: (Thickness & Type)

BACKFILL MATERIAL: (Type)

TOP OF SEAL: 15'

SEAL CONSTRUCTION: (Thickness & Type) 2' Bentonite

TOP OF SANDPACK: 17'

RISER CONSTRUCTION: (Type, Diameter & Material)

TOP OF SCREEN: 20.5'

SANDPACK TYPE: #2 Filter (3 bags)

SCREEN MATERIAL: (Type, Slot, Diameter & Material) 2" PVC, Sch. 40 10-slot

BOTTOM OF SCREEN: 29.5'

BOTTOM OF BOREHOLE: 30'

BOREHOLE DIAMETER: 6"

NOTE: All depths are in feet below ground surface, unless noted otherwise.

Remarks: Part of nested pair @ 619
Installed in boring that was sampled

Updated On: 04/09/01

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Test Boring Log

Client: Buncombe County	Drilling Contractor	Boring No.: 620	
Project Name: C&D Landfill Expansion	Company: Caldwell Drilling, Inc.	Page: 1 of	
Project Location: Buncombe County Landfill	Driller:	Total Depth:	Elevation:
Project Number: 6447- -fld.rt	Drilling Method: Type:	N:	E:

Hammer Weight: 140 lbs Hammer Drop Height: 30" Bit size/ Hole size: Spoon Size: 2" OD ( ) Auto ( ) Manual Hammer

Location Sketch	Monitoring Equipment Used:				Elevations / Depths	Logged By: D. Caldwell
	Depth to Water	Depth	Date	Time	Ground Surface:	Title: Geotechnical Eng.
					Top of Casing:	Date Start: 6/3
	Total Samples	disturbed	undisturbed		Top of Screen:	Date Finish:
					Bottom of Screen:	

Depth	Sample No.	Blows per 6"	Sample Depth	Advance / Recov.	In Situ Test	Strata Change	Sample Description
	S-1	1 2 2 3		24/12			moist, v. loose-loose, brown, f-c SAND some silt
1							
2							AR @ 3.5' on second try
3							
4							
5							
6							
7							
8							
9							
0							

Sample Types	Consistency vs. Blowcount / Foot								Burmeister Classification	
	Granular (Sand):				Fine Grained (Clay):				and	35-50%
S -- Split Spoon	V. loose:	0-4	Dense:	30-50	V.Soft:	< 2	Stiff:	8-15	some	20-35%
U -- Undisturbed Tube	Loose:	4-10	V. Dense:	>50	Soft:	2-4	V. Stiff:	15-30	little	10-20%
C -- Rock Core	M. Dense:	10-30			M. Stiff:	4-8	Hard:	>30	trace	<10%
A -- Auger Cuttings									Moisture, density, color	

Remarks: AR @ 3' on first try, offset ~20' south for second try

Updated On: 04/09/01

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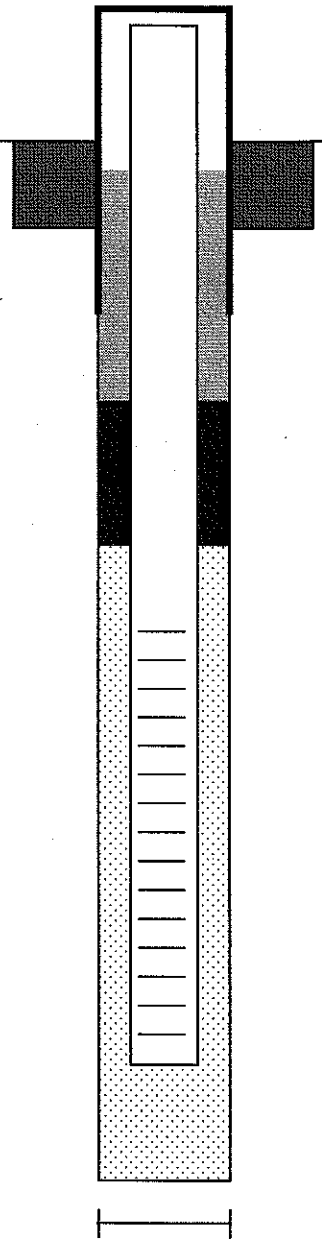
Monitoring Well Installation Log

Client:		Contractor:		Boring/Well No.:	620
Project Name:		Driller:		Date Installed:	6/11/08
Project Location:		Ground EL:		Logged By:	DC
Project Number:		Riser EL:		Page:	1 of



SURFACE SEAL: _____
(Thickness & Type)

BACKFILL MATERIAL: _____
(Type)

TOP OF SEAL: 39

SEAL CONSTRUCTION: 2' Bentonite
(Thickness & Type)

TOP OF SANDPACK: 41'

RISER CONSTRUCTION: _____
(Type, Diameter & Material)

TOP OF SCREEN: 42'

SANDPACK TYPE: #2 (4 bags)

SCREEN MATERIAL: 2" PVC, 10 slot
(Type, Slot, Diameter & Material)

BOTTOM OF SCREEN: 51'

BOTTOM OF BOREHOLE: 51.5'

BOREHOLE DIAMETER: 6"

NOTE: All depths are in feet below ground surface, unless noted otherwise.

Remarks:

Updated On: 04/09/01

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Test Boring Log

Client: Buncombe County	Drilling Contractor	Boring No.: 621	
Project Name: C&D Landfill Expansion	Company: Caldwell Drilling, Inc.	Page: 1 of 1	
Project Location: Buncombe County Landfill	Driller:	Total Depth:	Elevation:
Project Number: 6447- -fld.rt	Drilling Method: Type:	N:	E:

Hammer Weight: 140 lbs Hammer Drop Height: 30" Bit size/ Hole size: Spoon Size: 2" OD ( ) Auto ( ) Manual Hammer

Location Sketch	Monitoring Equipment Used:				Elevations / Depths	Logged By: D. Caldwell
	Depth to Water	Depth	Date	Time	Ground Surface:	Title: Geotechnical Eng.
					Top of Casing:	Date Start: 6/3
	Total Samples	disturbed	undisturbed		Top of Screen:	Date Finish:
					Bottom of Screen:	

Depth	Sample No.	Blows per 6"	Sample Depth	Advance / Recov.	In Situ Test	Strata Change	Sample Description
1	S-1	4 5 6 6		24/16			dry, m dense, brown/orange/blk mottled f-c SAND, some silt relict fabric visible
4		9 16		16/16			dry, v dense, brown/orange/blk mottled f-m SAND, some silt
5	S-2	50/4					
9	S-3	50/6		6/6			dry, v dense, gray/red/blk mottled f-m SAND, little silt AR @ 11.5'

Sample Types	Consistency vs. Blowcount / Foot								Burmeister Classification	
S -- Split Spoon	Granular (Sand):				Fine Grained (Clay):				and	35-50%
U -- Undisturbed Tube	V. loose:	0-4	Dense:	30-50	V.Soft:	< 2	Stiff:	8-15	some	20-35%
C -- Rock Core	Loose:	4-10	V. Dense:	>50	Soft:	2-4	V. Stiff:	15-30	little	10-20%
A -- Auger Cuttings	M. Dense:	10-30			M. Stiff:	4-8	Hard:	>30	trace	<10%
									Moisture, density, color	

Remarks:

Updated On: 04/09/01

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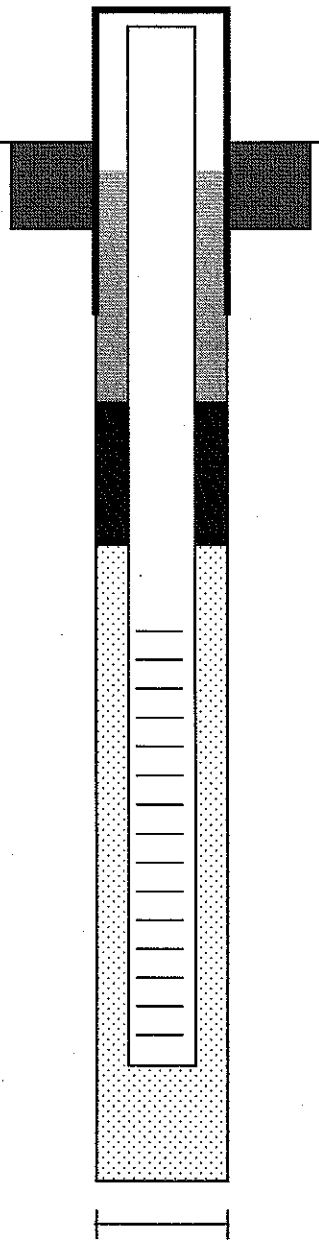
Monitoring Well Installation Log

Client:		Contractor:		Boring/Well No.:	621
Project Name:		Driller:		Date Installed:	6/11
Project Location:		Ground EL:		Logged By:	DC
Project Number:		Riser EL:		Page:	1 of



GROUND SURFACE

LOCKED PROTECTIVE CASING

SURFACE SEAL: _____
(Thickness & Type)

BACKFILL MATERIAL: _____
(Type)

TOP OF SEAL: 32

SEAL CONSTRUCTION: 2' Bentonite
(Thickness & Type)

TOP OF SANDPACK: 34

RISER CONSTRUCTION: _____
(Type, Diameter & Material)

TOP OF SCREEN: 35.5'

SANDPACK TYPE: #2 Filter (3½ bags)

SCREEN MATERIAL: _____
(Type, Slot, Diameter & Material)

BOTTOM OF SCREEN: 44.5'

BOTTOM OF BOREHOLE: 45'

BOREHOLE DIAMETER: 6"

NOTE: All depths are in feet below ground surface, unless noted otherwise.

Remarks:

Updated On: 04/09/01

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Test Boring Log

Client: Buncombe County	Drilling Contractor	Boring No.: 622	
Project Name: C&D Landfill Expansion	Company: Caldwell Drilling, Inc.	Page: 1 of	
Project Location: Buncombe County Landfill	Driller:	Total Depth:	Elevation:
Project Number: 6447- -fld.rt	Drilling Method: Type:	N:	E:

Hammer Weight: 140 lbs Hammer Drop Height: 30" Bit size/ Hole size: Spoon Size: 2" OD ( ) Auto ( ) Manual Hammer

Location Sketch	Monitoring Equipment Used:				Elevations / Depths	Logged By: D. Caldwell
	Depth to Water	Depth	Date	Time	Ground Surface:	Title: Geotechnical Eng.
					Top of Casing:	Date Start: 6/4
	Total Samples	disturbed	undisturbed		Top of Screen:	Date Finish:
					Bottom of Screen:	

Depth	Sample No.	Blows per 6"	Sample Depth	Advance / Recov.	In Situ Test	Strata Change	Sample Description
1	S-1	2 3 3 3		24/17			dry loose brown f-c SAND, some silt, trace gravel, few roots
2							ST from 1'-3'
3							
4		4 10 8 7		24/20			moist, m dense, brown/yellow mottled f-c SAND, some silt, little gravel
5	S-2						
6							
7							
8							
9							
0	S-3	50/5		5/5			dry, v. dense, gray/black/orange mottled f-c SAND, little silt, trace gravel AR @ 12'

Sample Types	Consistency vs. Blowcount / Foot								Burmeister Classification	
	Granular (Sand):				Fine Grained (Clay):					
S -- Split Spoon									and	35-50%
U -- Undisturbed Tube	V. loose:	0-4	Dense:	30-50	V.Soft:	< 2	Stiff:	8-15	some	20-35%
C -- Rock Core	Loose:	4-10	V. Dense:	>50	Soft:	2-4	V. Stiff:	15-30	little	10-20%
A -- Auger Cuttings	M. Dense:	10-30			M. Stiff:	4-8	Hard:	>30	trace	<10%
									Moisture, density, color	

Remarks:

Updated On: 04/09/01

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Test Boring Log

Client: Buncombe County	Drilling Contractor	Boring No.: 623	
Project Name: C&D Landfill Expansion	Company: Caldwell Drilling, Inc.	Page: 1 of	
Project Location: Buncombe County Landfill	Driller:	Total Depth:	Elevation:
Project Number: 6447- -fld.rt	Drilling Method: Type:	N:	E:

Hammer Weight: 140 lbs Hammer Drop Height: 30" Bit size/ Hole size: Spoon Size: 2" OD ( ) Auto ( ) Manual Hammer

Location Sketch	Monitoring Equipment Used:				Elevations / Depths	Logged By: D. Caldwell
	Depth to Water	Depth	Date	Time	Ground Surface:	Title: Geotechnical Eng.
					Top of Casing:	Date Start: 6/5
	Total Samples	disturbed	undisturbed		Top of Screen:	Date Finish:
					Bottom of Screen:	

Depth	Sample No.	Blows per 6"	Sample Depth	Advance / Recov.	In Situ Test	Strata Change	Sample Description
1	S-1	1 3 5 4		24/16			moist, loose, brown, fm SAND some silt
2							
3							
4	S-2	4 4 5 6		24/24	1.25 ave		moist, loose, reddish brown, f SAND some silt, micaceous relict fabric visible
5							
6							
7							
8							
9	S-3	6 7 7 12		24/24			SAA moist, m dense, yellow/blk/gray mottled f sand, some silt
0							

Sample Types	Consistency vs. Blowcount / Foot								Burmeister Classification	
S -- Split Spoon	Granular (Sand):				Fine Grained (Clay):				and	35-50%
U -- Undisturbed Tube	V. loose:	0-4	Dense:	30-50	V.Soft:	< 2	Stiff:	8-15	some	20-35%
C -- Rock Core	Loose:	4-10	V. Dense:	>50	Soft:	2-4	V. Stiff:	15-30	little	10-20%
A -- Auger Cuttings	M. Dense:	10-30			M. Stiff:	4-8	Hard:	>30	trace	<10%
									Moisture, density, color	

Remarks:

Updated On: 04/09/01

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Test Boring Log

Client:	Buncombe County	Project Location:	Buncombe County landfill	Boring No.:	623
Project Name:	C&D Landfill Expansion	Project Number:	6447- -rt.fld	Page:	2 of
		Logged By:	D. Caldwell	Date:	6/5

Depth	Sample No.	Blows per 6"	Sample Depth	Advance / Recov.	In Situ Test	Strata Change	Sample Description
1							
2							
3							
4							
15	S-4	8 19 21 34		24/20			moist dense, gray/reddish brown/blk mottled f-m SAND some silt
6							
7							
8							
9							
20	S-5	16 26 35 50/5		23/22			dry, v. dense, white/gray/yellow mottled f-m SAND, some silt
1							
2							
3							
4							
25	S-6	50/4		5/5			SAA
6							
7							
8							
9							
30	S-7	50/4		4/2			dry, very dense, black/white f-c SAND some gravel, tr. silt
							AR @ 29.5

Remarks:

Updated On: 04/09/01

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919-781-5730

Core Boring Log

Client:	Buncombe County	Drilling Contractor		Boring No.:	623
Project Name:	C&D LF Expansion	Company:	Caldwell Drilling, Inc	Page:	1 of 1
Project Location:	Buncombe Co. LF	Driller:		Logged By:	D. Caldwell
Project Number:	6447-	Drilling Method:			6/5/08

Core Barrel Type: _____ Core Barrel Diameter: _____

Sample Depth (ft)	Drill Rate min/ft	Core Number / Depth Range	Recovery in.	Recovery %	Weath.	Strata Change	Sample Description
31.5	0:35	C-1	24"	40			mod hard, slightly-completely weathered
	1:20						white/black/gray, f-m grained, quartz/biotite GNEISS
	2:15	60"	RQD 6"	10			foliated, horizontal to mod. dipping, very close-close
	3:05						joint set horizontal, very close to close
	4:20						rough, undulating, discolored to disintegrated, open
36.5	1:00	C-2	41"	68			
	2:15						SAA
	3:30	60"	RQD 22"	37			
	4:30						
	5:35						
41.5							

Field Hardness		Weathering		Bedding	Joints	Spacing (in.)
Very Hard	- Knife can't scratch					
Hard	- Scratches with difficulty	Fresh	Mod. Severe	Very Thin	Very Close	less than 2.
Med. Hard	- Scratches readily	Very Slight	Severe	Thin	Close	2-12
Medium	- Grooves or gouges with diff.	Slight	Very Severe	Medium	Mod. Close	12-36
Soft	- Grooves or gouges readily	Moderate	Complete	Thick	Wide	36-128
Very Soft	- Carves with knife			Very Thick	Very Wide	more than 128

Attitude	Angle	Rock Continuity	
Horizontal	0 to 5		
Shallow or Low Angle	5 to 35	Extremely Fractured	Drill core stem less than 1 inch
Moderatly Dipping	35 to55	Moderately Fractured	Drill core stem 1 to 4 inches
Steep or High Angle	55 to 85	Slightly Fractured	Drill core stem 4 to 8 inches
Vertical	85 to 90	Sound	Drill core stem more than 8 inches

Remarks:

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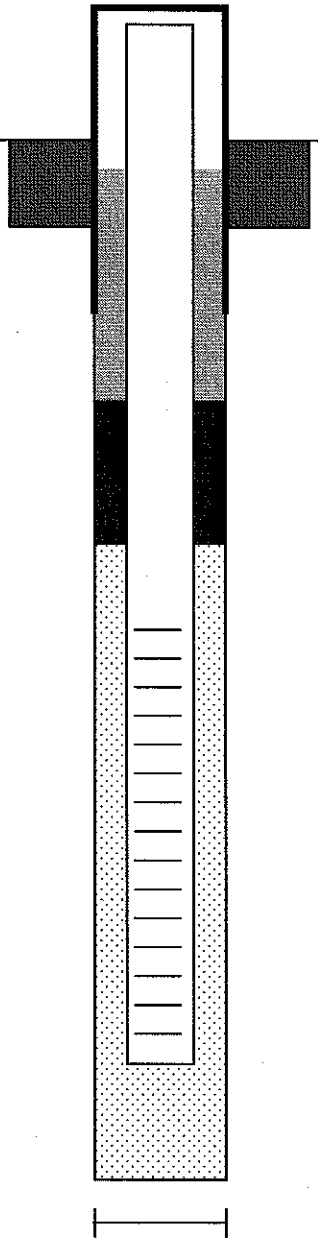
Monitoring Well Installation Log

Client:		Contractor:		Boring/Well No.:	623
Project Name:		Driller:		Date Installed:	6/13/08
Project Location:		Ground EL:		Logged By:	DC
Project Number:		Riser EL:		Page:	of



LOCKED PROTECTIVE CASING

SURFACE SEAL: _____
(Thickness & Type)

BACKFILL MATERIAL: _____
(Type)

TOP OF SEAL: 86'

SEAL CONSTRUCTION: 2' Bentonite
(Thickness & Type)

TOP OF SANDPACK: 88'

RISER CONSTRUCTION: _____
(Type, Diameter & Material)

TOP OF SCREEN: 89.5'

SANDPACK TYPE: #2 (4 bags)

SCREEN MATERIAL: _____
(Type, Slot, Diameter & Material)

BOTTOM OF SCREEN: 98.5'

BOTTOM OF BOREHOLE: 99'

BOREHOLE DIAMETER: _____

NOTE: All depths are in feet below ground surface, unless noted otherwise.

Remarks:

Updated On: 04/09/01

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Test Boring Log

Client: Buncombe County	Drilling Contractor	Boring No.: 624	
Project Name: C&D Landfill Expansion	Company: Caldwell Drilling, Inc.	Page: 1 of	
Project Location: Buncombe County Landfill	Driller:	Total Depth:	Elevation:
Project Number: 6447- -fld.rt	Drilling Method: Type:	N:	E:

Hammer Weight: 140 lbs Hammer Drop Height: 30" Bit size/ Hole size: Spoon Size: 2" OD ( ) Auto ( ) Manual Hammer

Location Sketch	Monitoring Equipment Used:				Elevations / Depths	Logged By: D. Caldwell
	Depth to Water	Depth	Date	Time	Ground Surface:	Title: Geotechnical Eng.
					Top of Casing:	Date Start: 6/5
	Total Samples	disturbed	undisturbed		Top of Screen:	Date Finish:
					Bottom of Screen:	

Depth	Sample No.	Blows per 6"	Sample Depth	Advance / Recov.	In Situ Test	Strata Change	Sample Description
1	S-1	1 1 5 3		24/18			moist, loose, reddish brown, f-c SAND some silt, trace gravel
2							difficult drilling
3							
4		16 50/4		16/12			dry, v dense, orange/brown mottled f-c SAND some gravel, little silt relict fabric visible
5	S-2						
6							difficult drilling
7							
8							difficult drilling
9		50/1		1/1			rock fragments
0	S-3						AR @ 9.5

Sample Types	Consistency vs. Blowcount / Foot								Burmeister Classification	
	Granular (Sand):				Fine Grained (Clay):					
S -- Split Spoon									and	35-50%
U -- Undisturbed Tube	V. loose:	0-4	Dense:	30-50	V.Soft:	< 2	Stiff:	8-15	some	20-35%
C -- Rock Core	Loose:	4-10	V. Dense:	>50	Soft:	2-4	V. Stiff:	15-30	little	10-20%
A -- Auger Cuttings	M. Dense:	10-30			M. Stiff:	4-8	Hard:	>30	trace	<10%
									Moisture, density, color	

Remarks: First try AR @ 3.5', moving forward 5'
Second try AR @ 3', moving back 10'
Third try AR @ 5', took samples S-1, 2, moving back 40'

Updated On: 04/09/01

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Test Boring Log

Client: Buncombe County	Drilling Contractor	Boring No.: 625	
Project Name: C&D Landfill Expansion	Company: Caldwell Drilling, Inc.	Page: 1 of	
Project Location: Buncombe County Landfill	Driller:	Total Depth:	Elevation:
Project Number: 6447- -fld.rt	Drilling Method: HSA Type:	N:	E:

Hammer Weight: 140 lbs Hammer Drop Height: 30" Bit size/ Hole size: Spoon Size: 2" OD ( ) Auto ( ) Manual Hammer

Location Sketch	Monitoring Equipment Used:				Elevations / Depths	Logged By: D. Caldwell
	Depth to Water	Depth	Date	Time	Ground Surface:	Title: Geotechnical Eng.
					Top of Casing:	Date Start: 6/9/08
	Total Samples	disturbed	undisturbed		Top of Screen:	Date Finish:
					Bottom of Screen:	

Depth	Sample No.	Blows per 6"	Sample Depth	Advance / Recov.	In Situ Test	Strata Change	Sample Description
							Material at surface deposited by dozer
1							start sampling at 4'
2							Very powdery, dry
3			A				dry, v dense, brown, f-c SAND
4		10	38	16/14		T	little gravel, silt
	S-1	50/4	32 35 50/2		20/20	B	
5				B			dry, v dense, brownish gray f-c SAND little gravel, silt
6							AR @ 7.5' on second try
7							
8							
9							
0							

Sample Types	Consistency vs. Blowcount / Foot								Burmeister Classification	
	Granular (Sand):				Fine Grained (Clay):					
S -- Split Spoon									and	35-50%
U -- Undisturbed Tube	V. loose:	0-4	Dense:	30-50	V.Soft:	< 2	Stiff:	8-15	some	20-35%
C -- Rock Core	Loose:	4-10	V. Dense:	>50	Soft:	2-4	V. Stiff:	15-30	little	10-20%
A -- Auger Cuttings	M. Dense:	10-30			M. Stiff:	4-8	Hard:	>30	trace	<10%
									Moisture, density, color	

Remarks: AR @ 5.5' first try, moving east 20'

Updated On: 04/09/01

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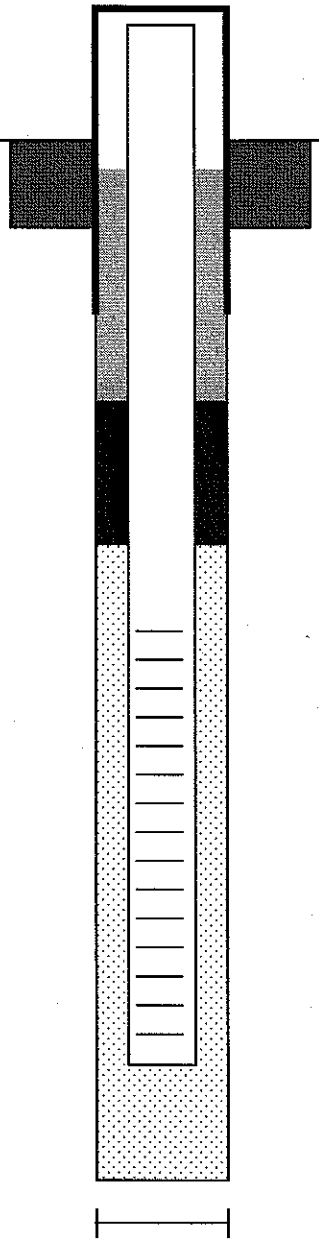
Monitoring Well Installation Log

Client:		Contractor:		Boring/Well No.:	625
Project Name:		Driller:		Date Installed:	6/13
Project Location:		Ground EL:		Logged By:	DC
Project Number:		Riser EL:		Page:	1 of



GROUND SURFACE

LOCKED PROTECTIVE CASING

SURFACE SEAL: _____
(Thickness & Type)

BACKFILL MATERIAL: _____
(Type)

TOP OF SEAL: 49.5'

SEAL CONSTRUCTION: 2' Bentonite
(Thickness & Type)

TOP OF SANDPACK: 51.5'

RISER CONSTRUCTION: _____
(Type, Diameter & Material)

TOP OF SCREEN: 52.5'

SANDPACK TYPE: #2 (3½ bags)

SCREEN MATERIAL: _____
(Type, Slot, Diameter & Material)

BOTTOM OF SCREEN: 61.5'

BOTTOM OF BOREHOLE: 62'

BOREHOLE DIAMETER: _____

NOTE: All depths are in feet below ground surface, unless noted otherwise.

Remarks:

Updated On: 04/09/01

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Test Boring Log

Client: Buncombe County	Drilling Contractor	Boring No.: 626	
Project Name: C&D Landfill Expansion	Company: Caldwell Drilling, Inc.	Page: 1 of	
Project Location: Buncombe County Landfill	Driller:	Total Depth:	Elevation:
Project Number: 6447- -fld.rt	Drilling Method: HSA Type:	N:	E:

Hammer Weight: 140 lbs Hammer Drop Height: 30" Bit size/ Hole size: Spoon Size: 2" OD ( ) Auto ( ) Manual Hammer

Location Sketch	Monitoring Equipment Used:				Elevations / Depths	Logged By: D. Caldwell
	Depth to Water	Depth	Date	Time	Ground Surface:	Title: Geotechnical Eng.
					Top of Casing:	Date Start: 6/9/08
	Total Samples	disturbed	undisturbed		Top of Screen:	Date Finish:
					Bottom of Screen:	

Depth	Sample No.	Blows per 6"	Sample Depth	Advance / Recov.	In Situ Test	Strata Change	Sample Description
	S-1	2 3 2 3		24/16		T	moist loose brown f-m SAND, some silt, trace gravel
1							
2						B	dry, loose, grayish brown, f-c SAND some silt relict fabric visible
3							
4	S-2	9 9 11 15		24/18			SAA, but medium dense
5							
6							
7							AR@ 7.5'
8							
9							
0							

Sample Types	Consistency vs. Blowcount / Foot								Burmeister Classification	
	Granular (Sand):				Fine Grained (Clay):					
S -- Split Spoon									and	35-50%
U -- Undisturbed Tube	V. loose:	0-4	Dense:	30-50	V.Soft:	< 2	Stiff:	8-15	some	20-35%
C -- Rock Core	Loose:	4-10	V. Dense:	>50	Soft:	2-4	V. Stiff:	15-30	little	10-20%
A -- Auger Cuttings	M. Dense:	10-30			M. Stiff:	4-8	Hard:	>30	trace	<10%
									Moisture, density, color	

Remarks:

Updated On: 04/09/01

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Test Boring Log

Client: Buncombe County	Drilling Contractor	Boring No.: 627	
Project Name: C&D Landfill Expansion	Company: Caldwell Drilling, Inc.	Page: 1 of	
Project Location: Buncombe County Landfill	Driller:	Total Depth:	Elevation:
Project Number: 6447- -fld.rt	Drilling Method: Type:	N:	E:

Hammer Weight: 140 lbs Hammer Drop Height: 30" Bit size/ Hole size: Spoon Size: 2" OD ( ) Auto ( ) Manual Hammer

Location Sketch	Monitoring Equipment Used:				Elevations / Depths	Logged By: D. Caldwell
	Depth to Water	Depth	Date	Time	Ground Surface:	Title: Geotechnical Eng.
					Top of Casing:	Date Start: 6/6
	Total Samples	disturbed	undisturbed		Top of Screen:	Date Finish:
					Bottom of Screen:	

Depth	Sample No.	Blows per 6"	Sample Depth	Advance / Recov.	In Situ Test	Strata Change	Sample Description
	S-1	4 6 4 4		24/6			moist, loose-m dense, brown, f-c SAND some silt, little gravel
1							
2							
3							
4		5 8		24/18			SAA, but m.dense
5	S-2	6 5					
6							
7							
8							
9	S-3	12 50/4		10/10			moist, v dense, black/brown mottled f-m SAND; some silt rock fragments in shoe AR@11'
0							

Sample Types	Consistency vs. Blowcount / Foot								Burmeister Classification	
	Granular (Sand):				Fine Grained (Clay):					
S -- Split Spoon									and	35-50%
U -- Undisturbed Tube	V. loose:	0-4	Dense:	30-50	V.Soft:	< 2	Stiff:	8-15	some	20-35%
C -- Rock Core	Loose:	4-10	V. Dense:	>50	Soft:	2-4	V. Stiff:	15-30	little	10-20%
A -- Auger Cuttings	M. Dense:	10-30			M. Stiff:	4-8	Hard:	>30	trace	<10%
									Moisture, density, color	

Remarks: First try, AR@1', moving down ravine towards B-227
Second try, AR@3' moving up ravine again
Lots of cobble, small boulders in silty/sandy matrix

Updated On: 04/09/01

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60
100
300
360

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Core Boring Log

Client:	Buncombe County	Drilling Contractor		Boring No.:	627
Project Name:	C&D LF Expansion	Company:	Caldwell Drilling, Inc	Page:	of
Project Location:	Buncombe Co. LF	Driller:		Logged By:	D. Caldwell
Project Number:	6447-	Drilling Method:			

Core Barrel Type: _____ Core Barrel Diameter: _____

Sample Depth (ft)	Drill Rate min/ft	Core Number / Depth Range	Recovery in.	Recovery %	Weath.	Strata Change	Sample Description
11.5	1:45	C-1 60" RQD	60	100			hard, fr-conc, light to dark gray, f-m grained mica hornblende GNEISS, foliated, high angle, ex close; joint set hor-low angle, ex close-close, rough, stepped, fr-disjoint, open
	3:40						
	6:05		35	60			
	8:45						
	11:40						
16.5	1:15	C-2 60" RQD	48	80			SAA, but joints low-high angle
	2:30						
	3:40						
	5:00		43	72			
	6:20						
21.5							

Field Hardness			Weathering		Bedding	Joints	Spacing (in.)
Very Hard	-	Knife can't scratch					
Hard	-	Scratches with difficulty	Fresh	Mod. Severe	Very Thin	Very Close	less than 2.
Med. Hard	-	Scratches readily	Very Slight	Severe	Thin	Close	2-12
Medium	-	Grooves or gouges with diff.	Slight	Very Severe	Medium	Mod. Close	12-36
Soft	-	Grooves or gouges readily	Moderate	Complete	Thick	Wide	36-128
Very Soft	-	Carves with knife			Very Thick	Very Wide	more than 128

Attitude	Angle	Rock Continuity	
Horizontal	0 to 5		
Shallow or Low Angle	5 to 35	Extremely Fractured	Drill core stem less than 1 inch
Moderatly Dipping	35 to55	Moderately Fractured	Drill core stem 1 to 4 inches
Steep or High Angle	55 to 85	Slightly Fractured	Drill core stem 4 to 8 inches
Vertical	85 to 90	Sound	Drill core stem more than 8 inches

Remarks: Bottom of casing @ 11.5'

Updated On: 04/09/01

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Test Boring Log

Client: Buncombe County	Drilling Contractor	Boring No.: 628	
Project Name: C&D Landfill Expansion	Company: Caldwell Drilling, Inc.	Page: 1 of	
Project Location: Buncombe County Landfill	Driller:	Total Depth:	Elevation:
Project Number: 6447- -fld.rt	Drilling Method: Type:	N:	E:

Hammer Weight: 140 lbs Hammer Drop Height: 30" Bit size/ Hole size: Spoon Size: 2" OD ( ) Auto ( ) Manual Hammer

Location Sketch	Monitoring Equipment Used:				Elevations / Depths	Logged By: D. Caldwell
	Depth to Water	Depth	Date	Time	Ground Surface:	Title: Geotechnical Eng.
					Top of Casing:	Date Start: 6/10/08
	Total Samples	disturbed	undisturbed		Top of Screen:	Date Finish:
					Bottom of Screen:	

Depth	Sample No.	Blows per 6"	Sample Depth	Advance / Recov.	In Situ Test	Strata Change	Sample Description
1	S-1	2 4 4 6		24/10			dry, loose, brown, f-m SAND, some gravel + silt
5	S-2	15 50/5		17/10			dry, v dense, brown + gray, f-c SAND some gravel + silt relict fabric visible
9	S-3	50/3		3/2			dry, v dense, brown/gray/light orange mottled f-c SAND, some gravel, little silt AR @ 11.5'

Sample Types	Consistency vs. Blowcount / Foot								Burmeister Classification	
	Granular (Sand):				Fine Grained (Clay):					
S -- Split Spoon									and	35-50%
U -- Undisturbed Tube	V. loose:	0-4	Dense:	30-50	V.Soft:	< 2	Stiff:	8-15	some	20-35%
C -- Rock Core	Loose:	4-10	V. Dense:	>50	Soft:	2-4	V. Stiff:	15-30	little	10-20%
A -- Auger Cuttings	M. Dense:	10-30			M. Stiff:	4-8	Hard:	>30	trace	<10%
									Moisture, density, color	

Remarks: AR @ 6' on first try, moving east 20'

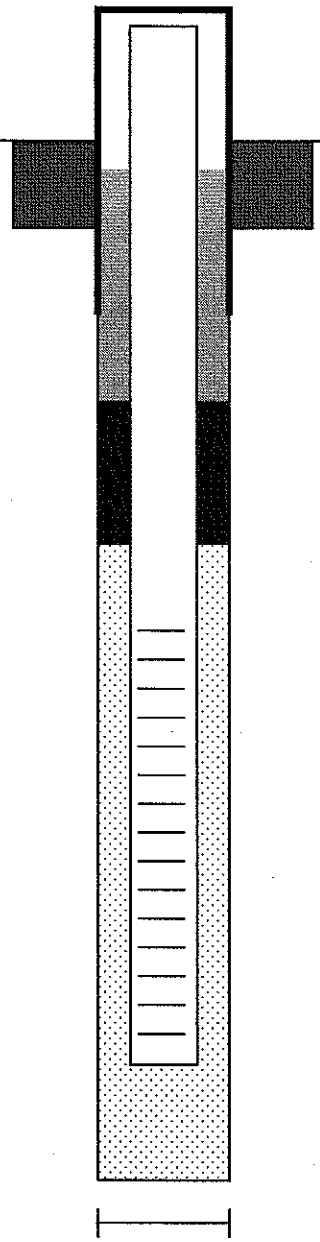
Updated On: 04/09/01

CDM

5400 Glenwood Avenue
Suite 300
Raleigh, NC 27612
(919) 787-5620

Monitoring Well Installation Log

Client:		Contractor:		Boring/Well No.:	628
Project Name:		Driller:		Date Installed:	6/12
Project Location:		Ground EL:		Logged By:	
Project Number:		Riser EL:		Page:	of



LOCKED PROTECTIVE CASING

SURFACE SEAL: _____
(Thickness & Type)

BACKFILL MATERIAL: _____
(Type)

TOP OF SEAL: 50'

SEAL CONSTRUCTION: 2' Bentonite
(Thickness & Type)

TOP OF SANDPACK: 52'

RISER CONSTRUCTION: _____
(Type, Diameter & Material)

TOP OF SCREEN: 54.0'

SANDPACK TYPE: #2 (4 bags)

SCREEN MATERIAL: _____
(Type, Slot, Diameter & Material)

BOTTOM OF SCREEN: 63.0'

BOTTOM OF BOREHOLE: 63.5'

BOREHOLE DIAMETER: _____

NOTE: All depths are in feet below ground surface, unless noted otherwise.

Remarks:

Updated On: 04/09/01

Appendix D

NCDENR DWR/USGS Hydrographs

North Carolina Department of Environment and Natural Resources

Division of Water Resources

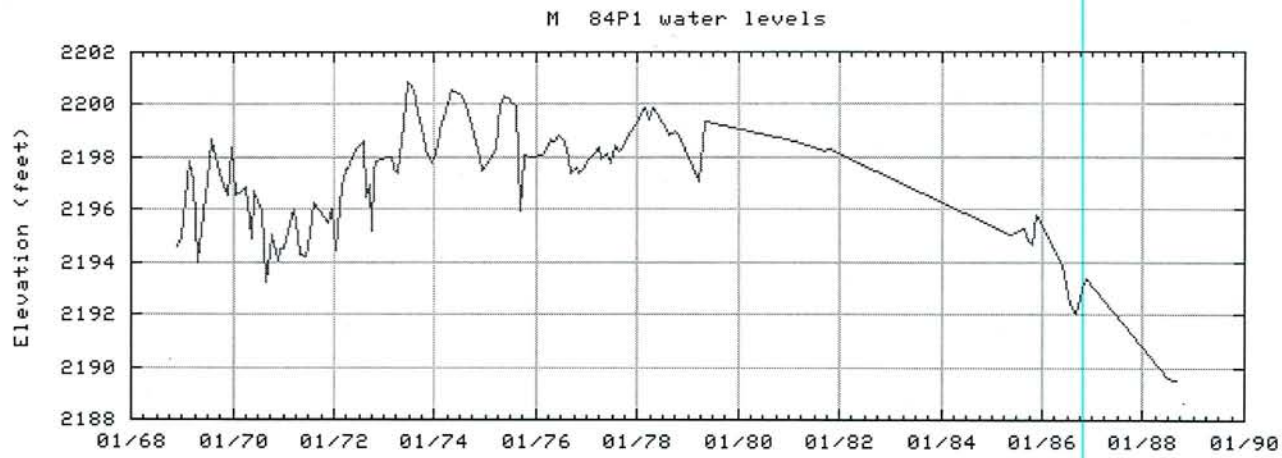
DWR Monitoring Database Detail for M 84P1

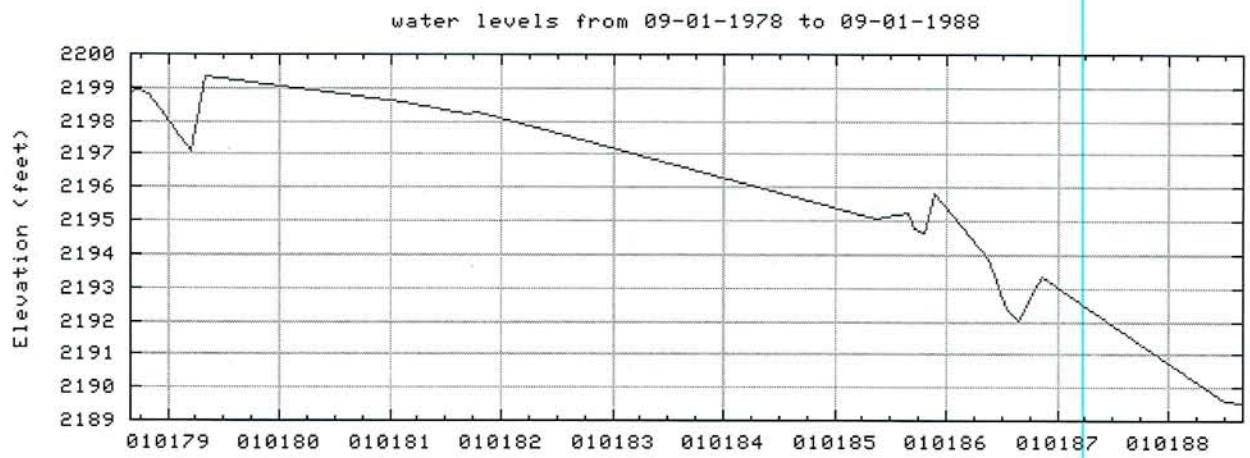
Show Map -- Monthly Statistics Plot -- Station Levels (may include USGS data)

Field	Data
County	Buncombe
Quad	M 84P1
Name	Swannanoa
Latitude	35.606667
Longitude	-82.410556
Location Accuracy	Map
Netname (link to USGS data)	
USGS ID	
Aquifer	Bedrock
Land Surface	2,244.25
Date Constructed	
Stickup,	
Depth	99.00
Diameter	6.00
Yield	0.00
Exists?	y
Recorder Box?	n
Top of Screen	0.00
Bottom of Screen	0.00
Number of Water Levels {date * feet below land surface * elevation}	124
11/22/1968 to 09/01/1988	** 999.99 feet below land surface value indicates dry well

output file is tab-delimited text

return to well table





Start Date: 09 - 01 - 1978 End Date: 09 - 01 - 1988 Replot

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Phone: (919)733-4064 - Fax: (919)733-3558

Last Modified: 07.14.2008

North Carolina Department of Environment and Natural Resources

Division of Water Resources

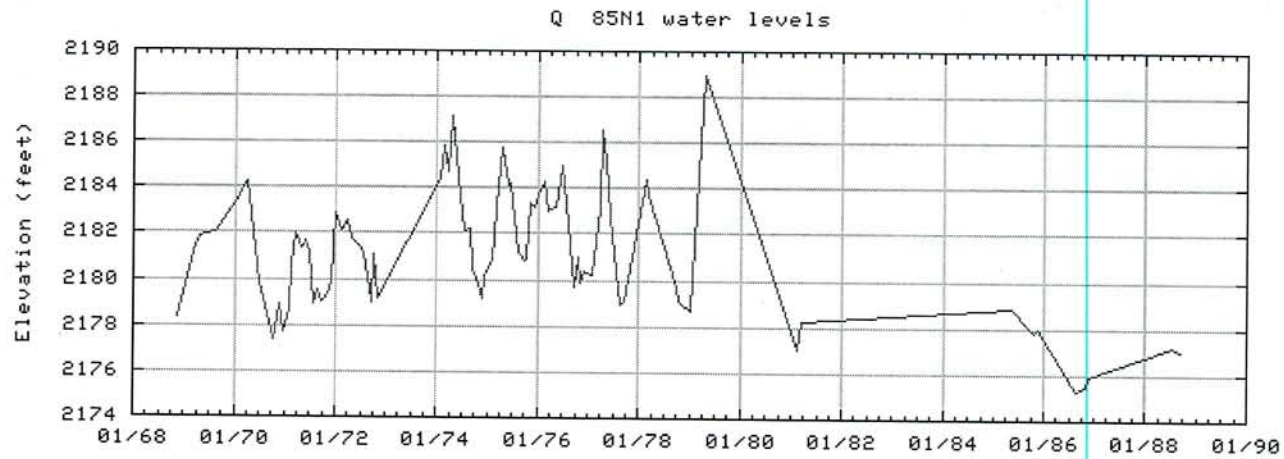
DWR Monitoring Database Detail for Q 85N1

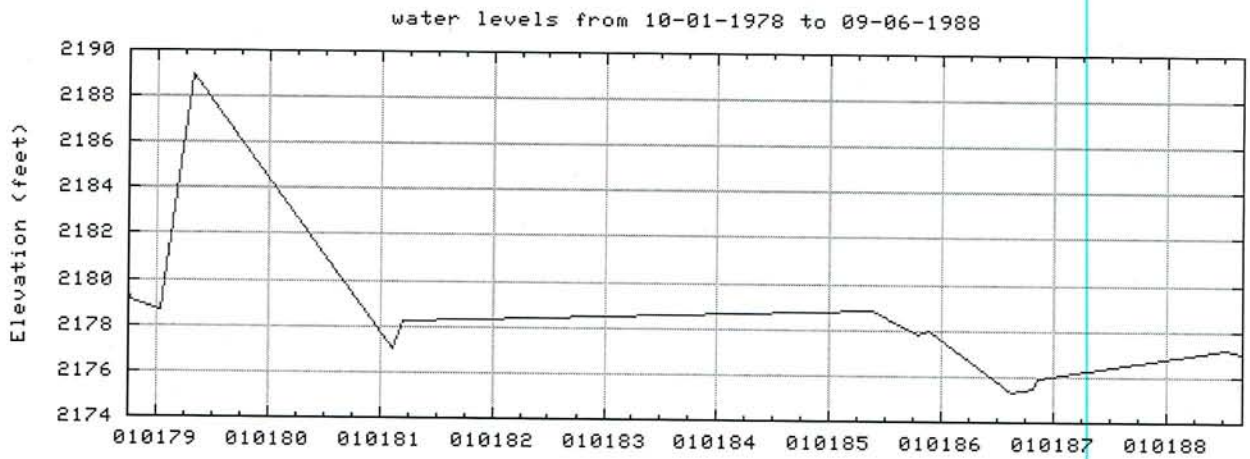
Show Map -- Monthly Statistics Plot -- Station Levels (may include USGS data)

Field	Data
County	Henderson
Quad	Q 85N1
Name	Hendersonville
Latitude	35.284167
Longitude	-82.481389
Location Accuracy	Map
Netname (link to USGS data)	
USGS ID	
Aquifer	Bedrock
Land Surface	2,199.00
Date Constructed	
Stickup,	
Depth	48.00
Diameter	6.00
Yield	15.00
Exists?	?
Recorder Box?	n
Top of Screen	0.00
Bottom of Screen	0.00
Number of Water Levels {date * feet below land surface * elevation} 11/14/1968 to 09/06/1988	90 ** 999.99 feet below land surface value indicates dry well

output file is tab-delimited text

return to well table





Start Date: 10 - 01 - 1978 End Date: 09 - 06 - 1988 Replot

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Last Modified: 07.14.2008

North Carolina Department of Environment and Natural Resources

Division of Water Resources

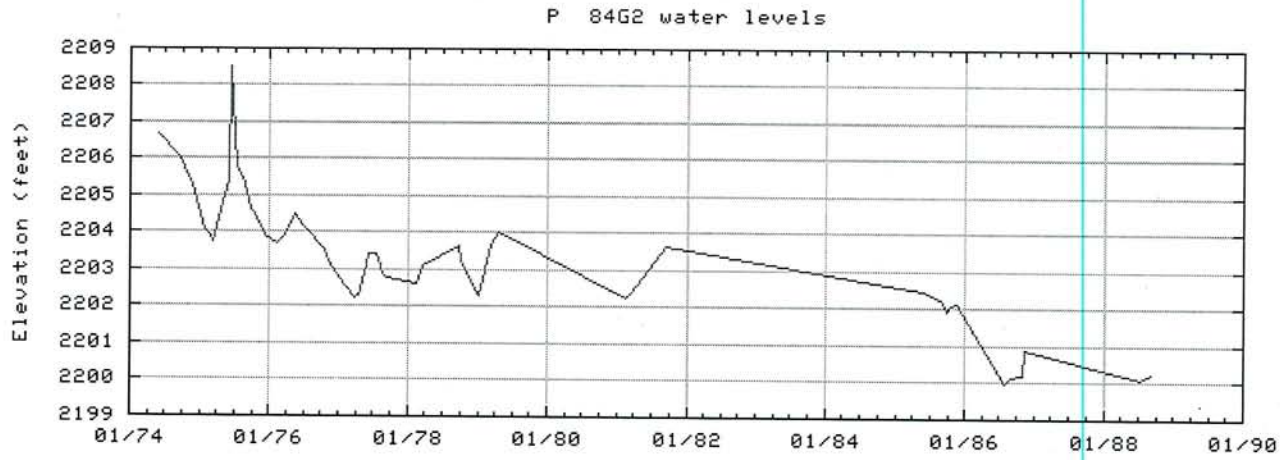
DWR Monitoring Database Detail for P 84G2

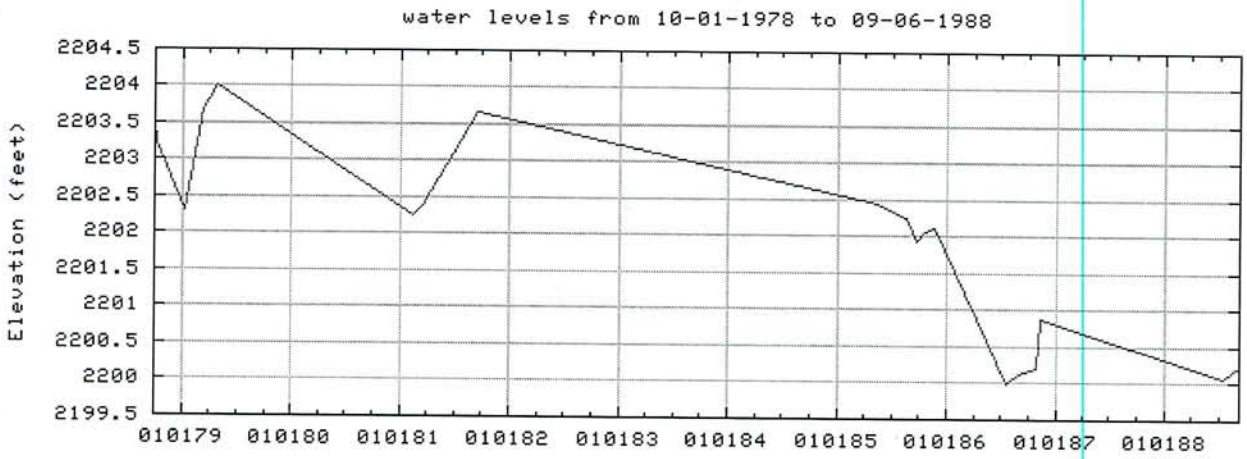
Show Map -- Monthly Statistics Plot -- Station Levels (may include USGS data)

Field	Data
County	Henderson
Quad	P 84G2
Name	Hendersonville
Latitude	35.397778
Longitude	-82.390000
Location Accuracy	Map
Netname (link to USGS data)	
USGS ID	
Aquifer	Saprolite
Land Surface	2,239.50
Date Constructed	05/29/1974
Stickup, 05/29/1974	0.50
Depth	44.00
Diameter	24.00
Yield	0.00
Exists?	y
Recorder Box?	n
Top of Screen	0.00
Bottom of Screen	0.00
Number of Water Levels {date * feet below land surface * elevation} 05/29/1974 to 09/06/1988	52 ** 999.99 feet below land surface value indicates dry well

output file is tab-delimited text

return to well table





Start Date: 10 - 01 - 1978 End Date: 09 - 06 - 1988 Replot

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North Carolina Department of Environment and Natural Resources

Division of Water Resources

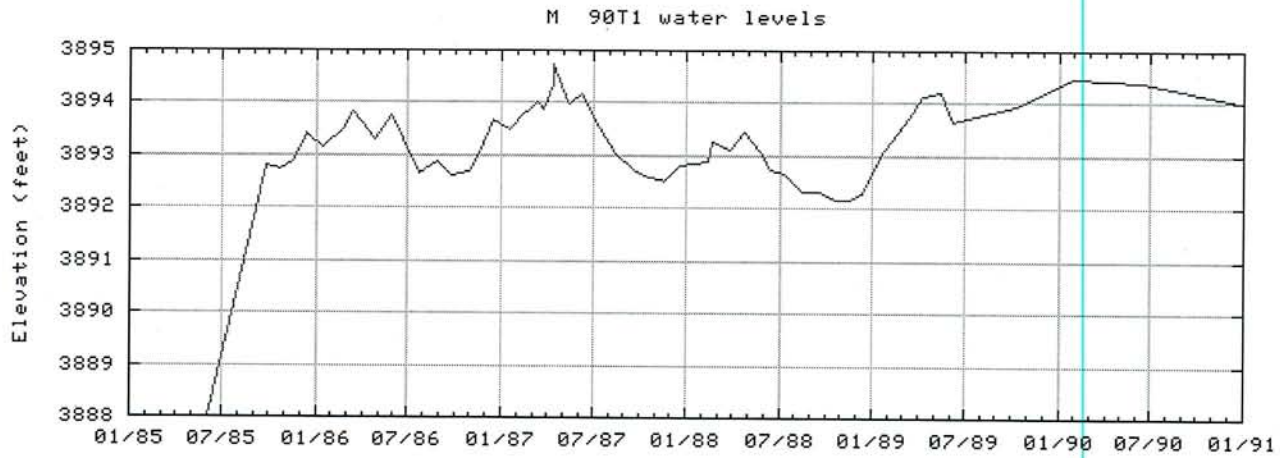
DWR Monitoring Database Detail for M 90T1

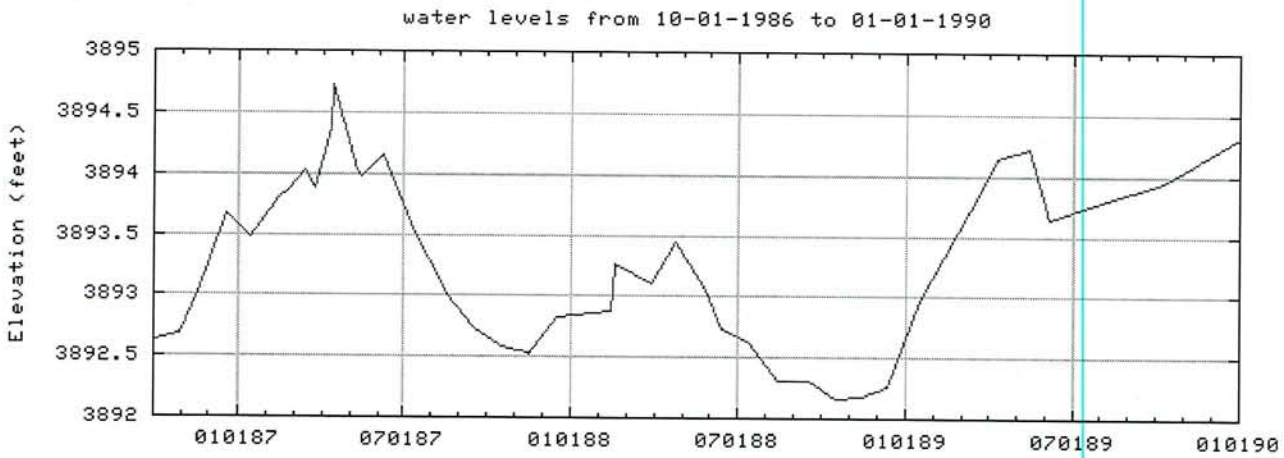
Show Map -- Monthly Statistics Plot -- Station Levels (may include USGS data)

Field	Data
County	Haywood
Quad	M 90T1
Name	Canton Watershed RS 1
Latitude	35.603611
Longitude	-82.843611
Location Accuracy	Map
Netname (link to USGS data)	
USGS ID	
Aquifer	Saprolite
Land Surface	3,897.00
Date Constructed	06/04/1985
Stickup, 11/16/1987	3.00
Depth	35.00
Diameter	4.00
Yield	0.00
Exists?	y
Recorder Box?	n
Top of Screen	13.00
Bottom of Screen	35.00
Number of Water Levels {date * feet below land surface * elevation} 06/04/1985 to 12/26/1990	59 ** 999.99 feet below land surface value indicates dry well

output file is tab-delimited text

return to well table





Start Date: 10 - 01 - 1986 End Date: 01 - 01 - 1990 Replot

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North Carolina Department of Environment and Natural Resources

Division of Water Resources

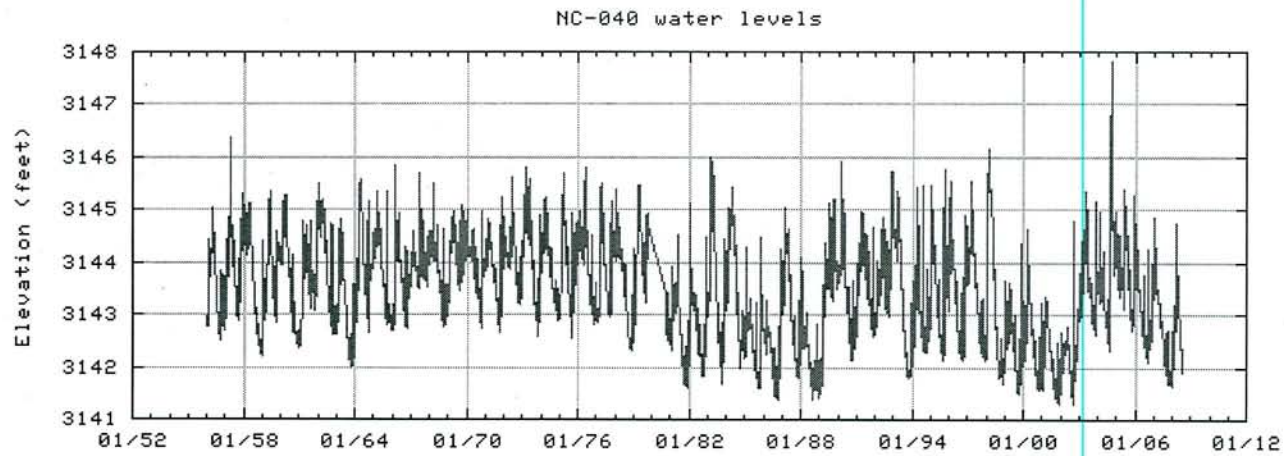
USGS Monitoring Database Detail for NC-040

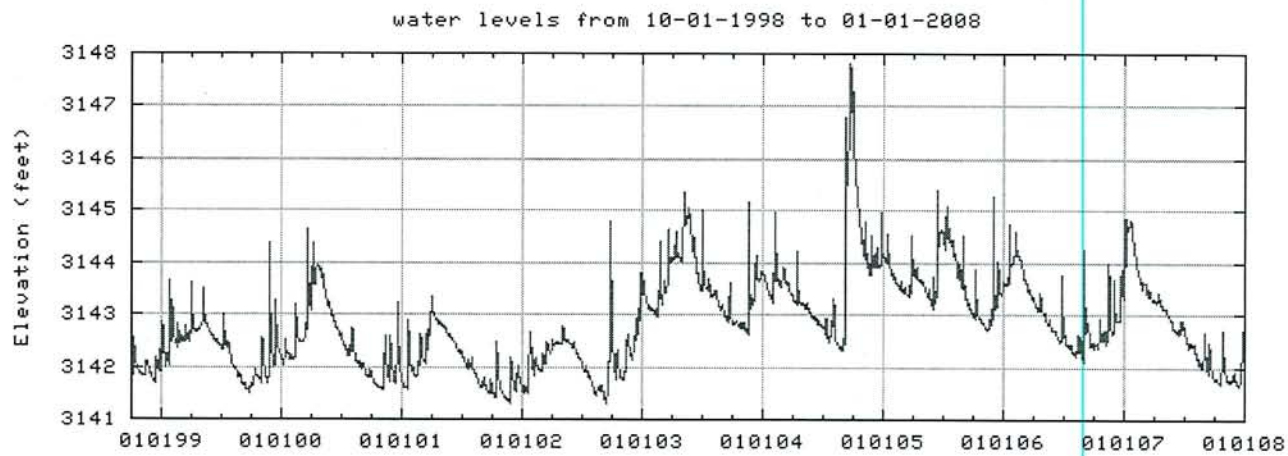
Show Map -- Monthly Statistics Plot

Field	Data
County	Haywood
Quad	
Name	HW-047 (NC-40) CHAMPION
Latitude	35.387500
Longitude	-82.812222
Netname (link to USGS data)	NC-040
USGS ID Real-time Data	352315082484401
Aquifer	Bedrock
Land Surface	3,148.26
Date Constructed	12/08/1955
Stickup	1.00
Depth	18.50
Diameter	12.00
Top of Screen	0.00
Bottom of Screen	0.00
Number of Water Levels {date * feet below land surface * elevation} 01/01/1956 to 08/03/2008	18,409

output file is tab-delimited text

return to well table





Start Date: 10 - 01 - 1998 End Date: 01 - 01 - 2008 Replot

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Last Modified: 07.14.2008

North Carolina Department of Environment and Natural Resources

Division of Water Resources

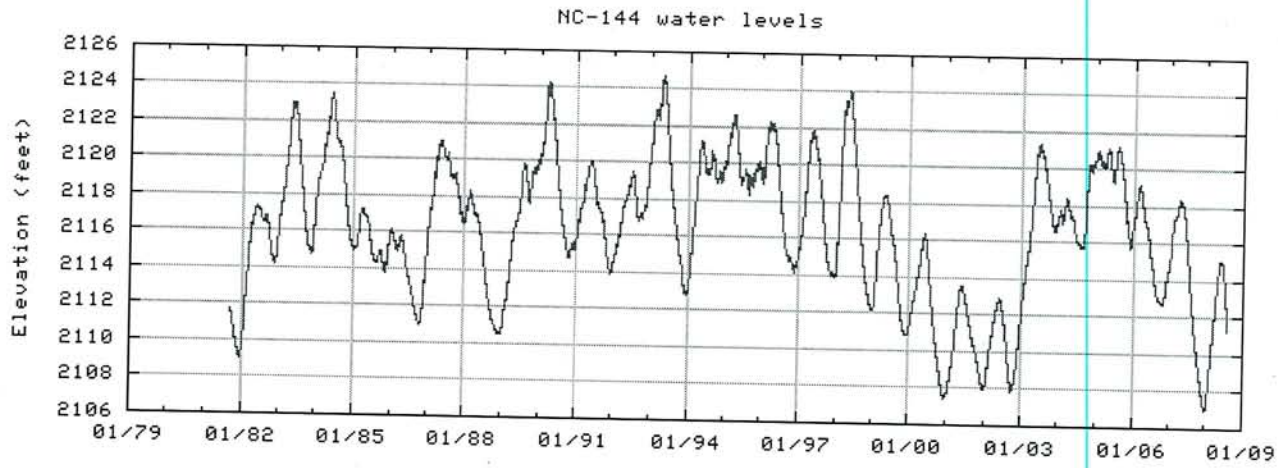
USGS Monitoring Database Detail for NC-144

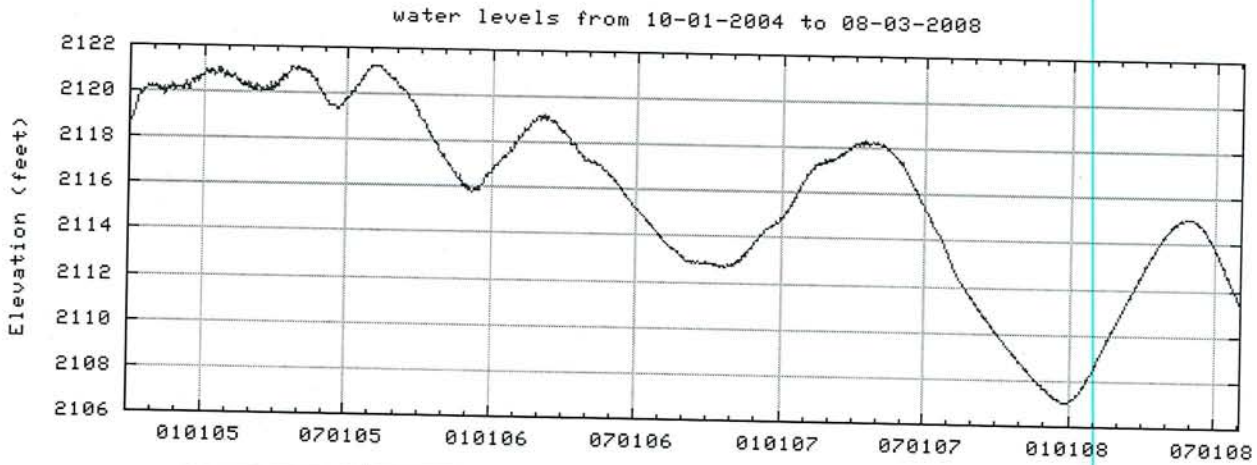
Show Map -- Monthly Statistics Plot

Field	Data
County	Transylvania
Quad	
Name	TR-065 (NC-144) BLANTYRE
Latitude	35.302222
Longitude	-82.628611
Netname (link to USGS data)	NC-144
USGS ID Real-time Data	351808082374302
Aquifer	Saprolite
Land Surface	2,147.00
Date Constructed	09/10/1981
Stickup	1.30
Depth	58.00
Diameter	4.00
Top of Screen	15.00
Bottom of Screen	58.00
Number of Water Levels {date * feet below land surface * elevation}	9,674
09/16/1981 to 08/03/2008	

output file is tab-delimited text

return to well table





Start Date: 10 - 01 - 2004 End Date: 08 - 03 - 2008 Replot

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Last Modified: 07.14.2008

Appendix E

Slug Test Raw Data and Calculations

Slug Test Calculations
Buncombe County Construction and Demolition Landfill Expansion
Site Hydrogeologic Investigation
Buncombe County

Well ID	Boring Depth (ft)	Boring Depth (inches)	Aquifer Monitored Interval	Lw	r_w	A	B	C	H	Le	1.1/ln(Lw/rw)	A+B	ln((H-lw)/rw) or C	$\ln(R_e/r_w)$	r_c	t	y_o	y_t	K (in/sec)	K (ft/min)	K (ft/day)	K (cm/sec)
B-615 Slug In	51	612	Bedrock	205	3	2.7	0.5	2.3	2400	120	0.260392151	3.2	2.3	3.1457	1	220	2.82	0.01	3.4E-04	1.68E-03	2.42	8.5E-04
B-615 Slug Out	51	612	Bedrock	205	3	2.7	0.5	2.3	2400	120	0.260392151	3.2	2.3	3.1457	1	410	2.8	0.01	1.8E-04	9.01E-04	1.30	4.6E-04
B-617 Slug In	61	732	Bedrock	192	3	2.7	0.5	2.3	2400	120	0.264494091	3.2	2.3	3.1056	1	1910	2.75	0.01	3.8E-05	1.90E-04	0.27	9.7E-05
B-617 Slug Out	61	732	Bedrock	192	3	2.7	0.5	2.3	2400	120	0.264494091	3.2	2.3	3.1056	1	720	2.21	0.01	9.7E-05	4.85E-04	0.70	2.5E-04
B-619d Slug In	30	360	Bedrock	221	3	2.7	0.5	2.3	2400	120	0.255840703	3.2	2.3	3.1914	1	1185	3.05	0.1	3.8E-05	1.92E-04	0.28	9.7E-05
B-619d Slug Out	30	360	Bedrock	221	3	2.7	0.5	2.3	2400	120	0.255840703	3.2	2.3	3.1914	1	2225	1.87	0.01	3.1E-05	1.56E-04	0.23	7.9E-05
B-625 Slug In	62	744	Bedrock	178	3	2.7	0.5	2.3	2400	120	0.269398448	3.2	2.3	2.2056	1	115	1.8	0.01	4.1E-04	2.07E-03	2.99	1.1E-03
B-625 Slug Out	62	744	Bedrock	178	3	2.7	0.5	2.3	2400	120	0.269398448	3.2	2.3	2.2056	1	130	0.5	0.01	2.8E-04	1.38E-03	1.99	7.0E-04
B-625re Slug In	62	744	Bedrock	178	3	2.7	0.5	2.3	2400	120	0.269398448	3.2	2.3	3.0591	1	315	1.2	0.01	1.9E-04	9.69E-04	1.39	4.9E-04
B-625re Slug Out	62	744	Bedrock	178	3	2.7	0.5	2.3	2400	120	0.269398448	3.2	2.3	3.0591	1	210	0.81	0.01	2.7E-04	1.33E-03	1.92	6.8E-04
B-627s Slug In	18	216	Saprolite/Bedrock	157	3	2.7	0.5	2.3	2400	120	0.277943876	3.2	2.3	2.1648	1	118	2.7	0.01	4.3E-04	2.14E-03	3.08	1.1E-03
B-627s Slug Out	18	216	Saprolite/Bedrock	157	3	2.7	0.5	2.3	2400	120	0.277943876	3.2	2.3	2.1648	1	105	2	0.01	4.6E-04	2.28E-03	3.28	1.2E-03

Notes:

Equation used for partially penetrating piezometers:

$$\ln R_e/r_w = [1.1/\ln (Lw/r_w) + (A+B \ln[(H-Lw)/r_w]/(L_e/r_w)]^{-1}$$

$$K = (r_c^2 \ln(R_e/r_w)/2Le) (1/t) (\ln y_o/y_t)$$

Equation used for fully penetrating deep piezometers (screened at top of bedrock):

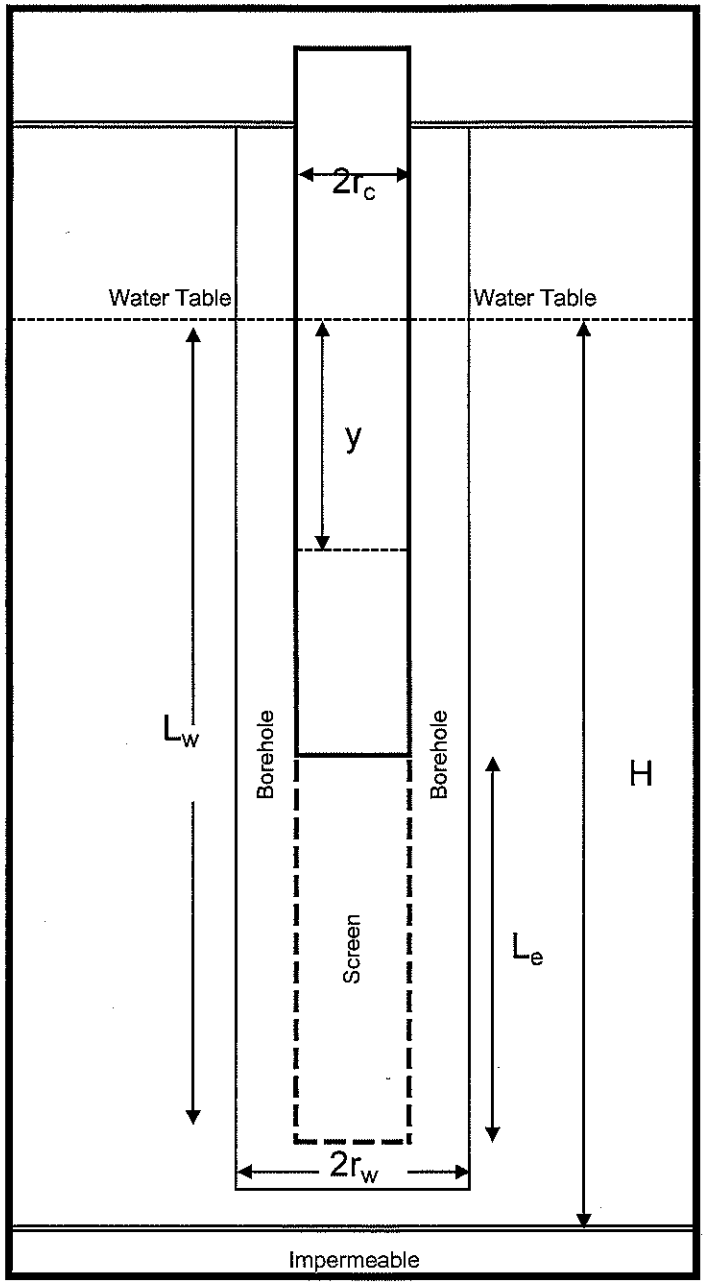
$$\ln Re/rw = [1.1/\ln (Lw/rw) + C/(Le/rw)]-1$$

$$K = (rc2 \ln(Re/rw)/2Le) (1/t) (\ln yo/yt)$$

Where:

r_c = radius of the unscreened part of the well where the head is rising
r_w = horizontal distance from well center to undisturbed aquifer
R_e = radial distance over which the difference in head, ho, is dissipated in the flow system of the aquifer
L_e = length of the saturated gravel pack or open section of the well
y_o = displacement in the well at time to = 0
y_t = dispacement in the well at time t > to
Lw = head in the well before slug test
A = dimensionless parameter which is a function of d/rw
B = dimensionless parameter which is a function of d/rw
C = dimensionless parameter which is a function of d/rw
H = saturated thickness of the aquifer
t = time (seconds)
K = hydraulic conductivity (units given above)

All measurements of length (e.g., radius, distance, head, thickness) are in inches unless specified otherwise.



Input Data		
Term	Units	
$2r_c$	Inches	2
$2r_W$	Inches	6
L_w	Feet	17.1
L_e	Feet	10
H*	Feet	200
y_0	Feet	2.82
t_0	Seconds	0
y_t	Feet	0.01
t	Seconds	220

Solutions
Hydraulic Conductivity in Feet/Second
2.79E-05
Hydraulic Conductivity in Feet/Minute
1.68E-03
Hydraulic Conductivity in Feet/Day
2.41E+00

* - Assumed value

Calculations			
Term	Units		3.137
L_e/r_W	Feet/Foot	40.00	$\ln(R_e/r_W)_{\text{partial penetration}}$ =
A	None	2.780	2.496
B	None	0.430	$\ln(R_e/r_W)_{\text{full penetration}}$ =
C	None	2.336	3.137

General Equations

$$K = \frac{r_c^2 \ln(R_e/r_W)}{2L_e} \quad \frac{1}{t} \ln \frac{y_0}{y_t}$$

Where

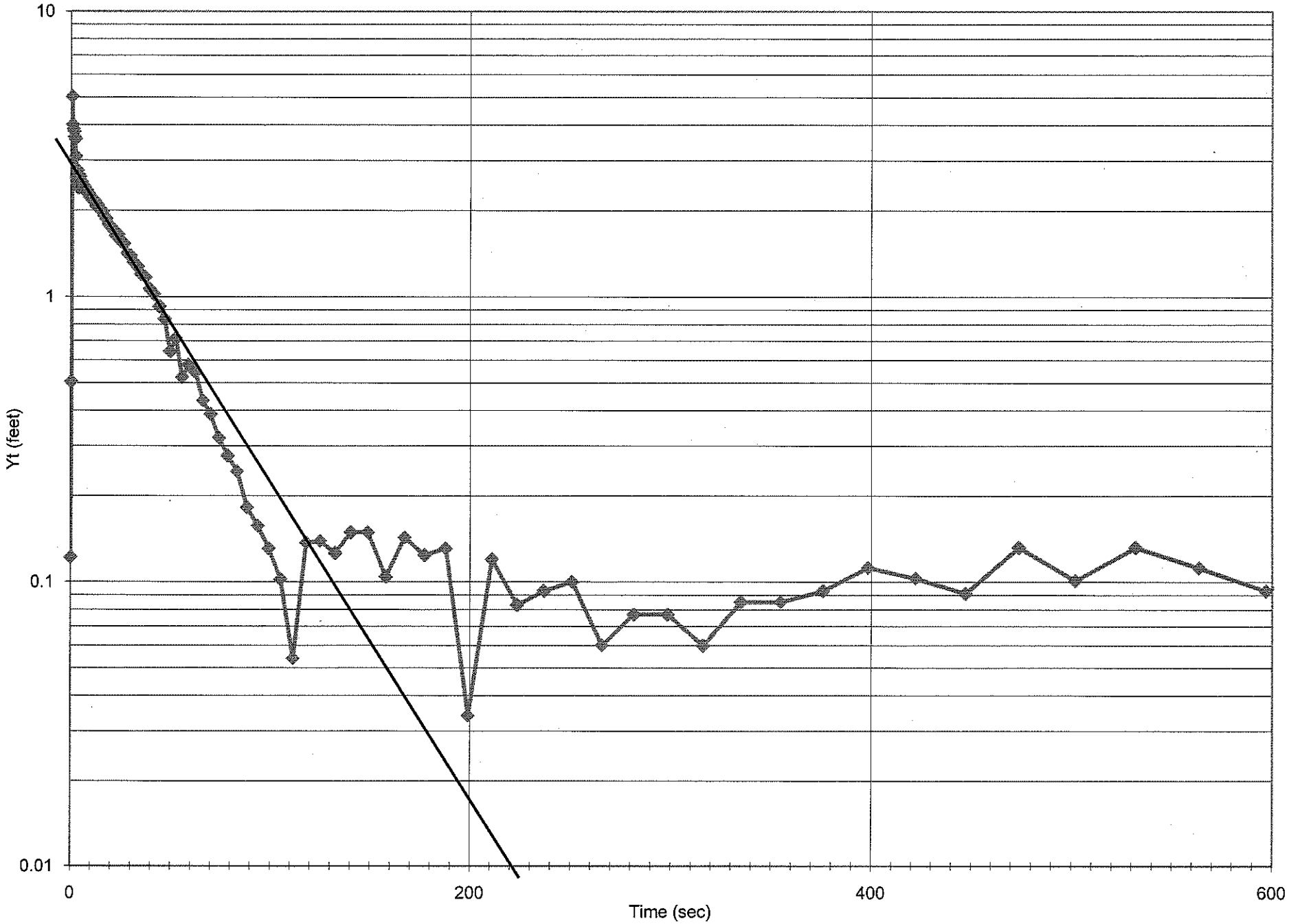
$$\ln(Re/r_W) = \left\{ \frac{1.1}{\ln(L_W/r_W)} + \frac{A + B \ln[(H - L_W)/r_W]}{L_e/r_W} \right\}^{-1}$$

For partial penetration or the equation below for full penetration

$$\ln(Re/r_W) = \left\{ \frac{1.1}{\ln(L_W/r_W)} + \frac{C}{L_e/r_W} \right\}^{-1}$$

615 Slug In
Buncombe County C&D Facility Expansion
Site Hydrogeologic Investigation

CDM



615 Slug In
Buncombe County C&D Facility Expansion
Site Hydrogeologic Investigation

CDM

In-Situ Inc. MiniTroll Pro

Report gene 6/20/2008 13:15:51
Report from ...\SN07633 2008-06-19 083040 615 Slug In.bin
Win-Situ® V 4.57.0.0

Serial numbe 7633
Firmware Ve 3.09
Unit name: Buncombe

Test name: 615 Slug In

Test defined 6/19/2008 8:29:39
Test started 6/19/2008 8:30:40
Test stoppec 6/19/2008 9:02:03

Data gathered using Logarithmic testing
Maximum Seconds.
Number of 120

TOTAL DAT 120

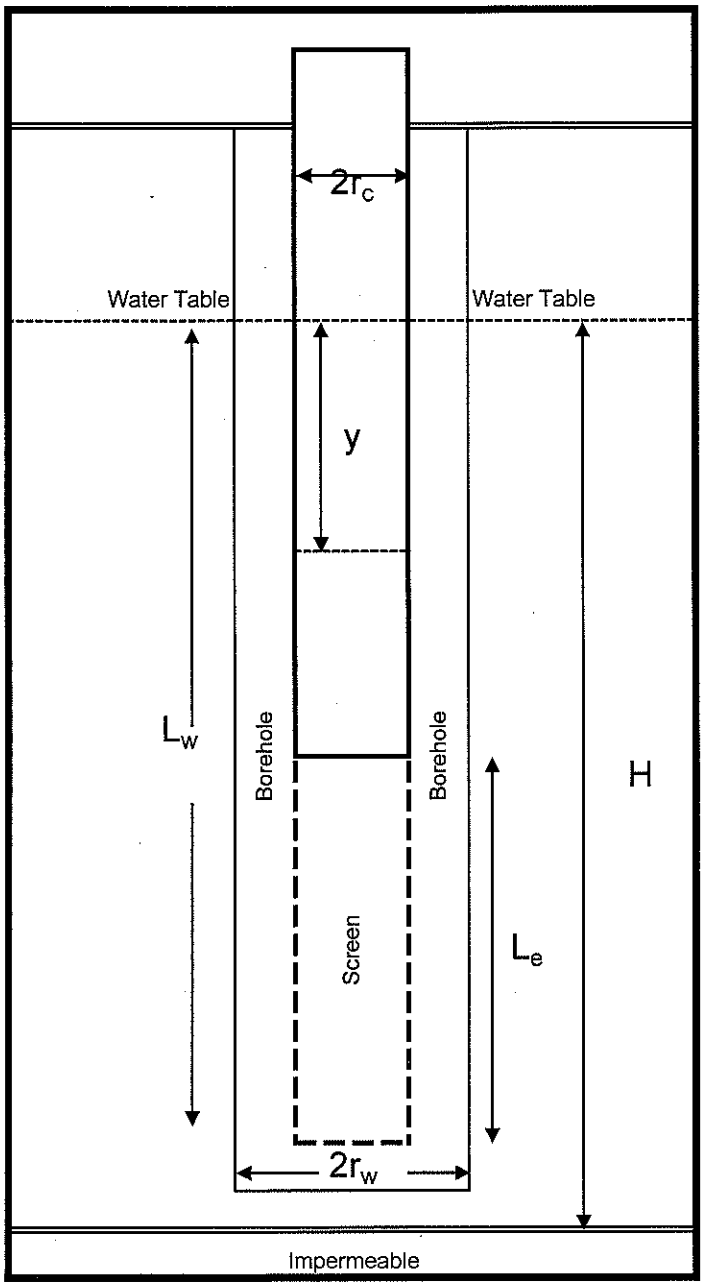
Channel number [1]
Measureme Temperature
Channel name:

Channel number [2]
Measureme Pressure
Channel name:
Sensor Rar 30 PSIG.
Sensor Off 0.000 psi
Specific gra 1

Date	Time	ET (sec	Chan[1] Temperat Fahrenhei	Chan[2] Pressure Feet H2O	Yt
6/19/2008	8:30:40	0	56.18	15.322	0.122
6/19/2008	8:30:40	0.3	56.23	15.705	0.505
6/19/2008	8:30:40	0.6	56.23	20.228	5.028
6/19/2008	8:30:41	0.9	56.25	19.207	4.007
6/19/2008	8:30:41	1.2	56.25	19.074	3.874
6/19/2008	8:30:41	1.5	56.28	18.999	3.799
6/19/2008	8:30:42	1.8	56.28	18.828	3.628
6/19/2008	8:30:42	2.1	56.28	18.767	3.567
6/19/2008	8:30:42	2.4	56.28	18.292	3.092
6/19/2008	8:30:42	2.7	56.28	17.796	2.596
6/19/2008	8:30:43	3	56.28	17.689	2.489
6/19/2008	8:30:43	3.3	56.28	17.965	2.765
6/19/2008	8:30:43	3.6	56.28	17.607	2.407
6/19/2008	8:30:44	3.9	56.3	17.873	2.673
6/19/2008	8:30:44	4.2	56.3	17.603	2.403
6/19/2008	8:30:44	4.5	56.3	17.823	2.623
6/19/2008	8:30:45	4.8	56.3	17.613	2.413

6/19/2008	8:30:45	5.1	56.3	17.722	2.522
6/19/2008	8:30:45	5.4	56.3	17.611	2.411
6/19/2008	8:30:45	5.7	56.3	17.669	2.469
6/19/2008	8:30:46	6	56.3	17.646	2.446
6/19/2008	8:30:46	6.4	56.3	17.638	2.438
6/19/2008	8:30:47	6.7	56.3	17.618	2.418
6/19/2008	8:30:47	7.1	56.3	17.601	2.401
6/19/2008	8:30:47	7.5	56.3	17.56	2.36
6/19/2008	8:30:48	8	56.3	17.546	2.346
6/19/2008	8:30:48	8.4	56.3	17.496	2.296
6/19/2008	8:30:49	8.9	56.3	17.5	2.3
6/19/2008	8:30:49	9.5	56.3	17.43	2.23
6/19/2008	8:30:50	10	56.28	17.418	2.218
6/19/2008	8:30:50	10.6	56.28	17.37	2.17
6/19/2008	8:30:51	11.3	56.28	17.383	2.183
6/19/2008	8:30:52	11.9	56.28	17.36	2.16
6/19/2008	8:30:52	12.6	56.28	17.265	2.065
6/19/2008	8:30:53	13.4	56.28	17.29	2.09
6/19/2008	8:30:54	14.2	56.25	17.22	2.02
6/19/2008	8:30:55	15	56.25	17.212	2.012
6/19/2008	8:30:56	15.9	56.25	17.193	1.993
6/19/2008	8:30:57	16.8	56.25	17.111	1.911
6/19/2008	8:30:58	17.8	56.25	17.067	1.867
6/19/2008	8:30:59	18.9	56.25	16.985	1.785
6/19/2008	8:31:00	20	56.25	16.952	1.752
6/19/2008	8:31:01	21.2	56.25	16.911	1.711
6/19/2008	8:31:02	22.4	56.25	16.835	1.635
6/19/2008	8:31:04	23.8	56.25	16.845	1.645
6/19/2008	8:31:05	25.2	56.25	16.755	1.555
6/19/2008	8:31:06	26.7	56.25	16.73	1.53
6/19/2008	8:31:08	28.2	56.25	16.613	1.413
6/19/2008	8:31:10	29.8	56.25	16.588	1.388
6/19/2008	8:31:11	31.5	56.25	16.518	1.318
6/19/2008	8:31:13	33.3	56.25	16.475	1.275
6/19/2008	8:31:15	35.2	56.25	16.401	1.201
6/19/2008	8:31:17	37.3	56.25	16.37	1.17
6/19/2008	8:31:19	39.5	56.25	16.263	1.063
6/19/2008	8:31:22	41.8	56.25	16.218	1.018
6/19/2008	8:31:24	44.3	56.25	16.125	0.925
6/19/2008	8:31:27	46.9	56.25	16.037	0.837
6/19/2008	8:31:29	49.7	56.25	15.843	0.643
6/19/2008	8:31:32	52.6	56.25	15.913	0.713
6/19/2008	8:31:35	55.7	56.25	15.724	0.524
6/19/2008	8:31:39	59	56.25	15.777	0.577
6/19/2008	8:31:42	62.5	56.25	15.744	0.544
6/19/2008	8:31:46	66.2	56.25	15.633	0.433
6/19/2008	8:31:50	70.1	56.25	15.588	0.388
6/19/2008	8:31:54	74.3	56.25	15.52	0.32
6/19/2008	8:31:58	78.7	56.23	15.477	0.277
6/19/2008	8:32:03	83.4	56.23	15.444	0.244
6/19/2008	8:32:08	88.4	56.25	15.382	0.182
6/19/2008	8:32:13	93.7	56.23	15.357	0.157
6/19/2008	8:32:19	99.3	56.23	15.331	0.131
6/19/2008	8:32:25	105.2	56.23	15.302	0.102
6/19/2008	8:32:31	111.5	56.23	15.254	0.054

6/19/2008	8:32:38	118.1	56.23	15.337	0.137
6/19/2008	8:32:45	125.1	56.23	15.339	0.139
6/19/2008	8:32:52	132.6	56.23	15.326	0.126
6/19/2008	8:33:00	140.5	56.23	15.349	0.149
6/19/2008	8:33:09	148.9	56.23	15.349	0.149
6/19/2008	8:33:18	157.8	56.23	15.304	0.104
6/19/2008	8:33:27	167.2	56.23	15.343	0.143
6/19/2008	8:33:37	177.2	56.23	15.324	0.124
6/19/2008	8:33:48	187.8	56.23	15.331	0.131
6/19/2008	8:33:59	199	56.23	15.234	0.034
6/19/2008	8:34:11	210.9	56.23	15.32	0.12
6/19/2008	8:34:23	223.5	56.23	15.283	0.083
6/19/2008	8:34:37	236.8	56.23	15.293	0.093
6/19/2008	8:34:51	250.9	56.23	15.3	0.1
6/19/2008	8:35:06	265.8	56.21	15.26	0.06
6/19/2008	8:35:21	281.6	56.21	15.277	0.077
6/19/2008	8:35:38	298.4	56.21	15.277	0.077
6/19/2008	8:35:56	316.2	56.21	15.26	0.06
6/19/2008	8:36:15	335	56.21	15.285	0.085
6/19/2008	8:36:35	354.9	56.21	15.285	0.085
6/19/2008	8:36:56	376	56.21	15.293	0.093
6/19/2008	8:37:18	398.4	56.21	15.312	0.112
6/19/2008	8:37:42	422.1	56.21	15.303	0.103
6/19/2008	8:38:07	447.2	56.21	15.291	0.091
6/19/2008	8:38:34	473.8	56.21	15.332	0.132
6/19/2008	8:39:02	502	56.21	15.301	0.101
6/19/2008	8:39:32	531.9	56.21	15.332	0.132
6/19/2008	8:40:03	563.5	56.21	15.312	0.112
6/19/2008	8:40:37	597	56.21	15.293	0.093
6/19/2008	8:41:12	632.5	56.21	15.318	0.118
6/19/2008	8:41:50	670.1	56.21	15.262	0.062
6/19/2008	8:42:30	709.9	56.18	15.299	0.099
6/19/2008	8:43:12	752.1	56.18	15.289	0.089
6/19/2008	8:43:57	796.8	56.18	15.293	0.093
6/19/2008	8:44:44	844.2	56.18	15.287	0.087
6/19/2008	8:45:34	894.4	56.18	15.231	0.031
6/19/2008	8:46:27	947.5	56.18	15.229	0.029
6/19/2008	8:47:24	1003.8	56.18	15.235	0.035
6/19/2008	8:48:23	1063.4	56.18	15.301	0.101
6/19/2008	8:49:26	1126.6	56.18	15.334	0.134
6/19/2008	8:50:33	1193.5	56.18	15.207	0.007
6/19/2008	8:51:44	1264.4	56.18	15.225	0.025
6/19/2008	8:52:59	1339.5	56.18	15.34	0.14
6/19/2008	8:54:19	1419	56.18	15.305	0.105
6/19/2008	8:55:43	1503.3	56.18	15.207	0.007
6/19/2008	8:57:12	1592.6	56.16	15.268	0.068
6/19/2008	8:58:47	1687.1	56.16	15.35	0.15
6/19/2008	9:00:27	1787.2	56.16	15.253	0.053



Input Data		
Term	Units	
$2r_c$	Inches	2
$2r_W$	Inches	6
L_w	Feet	17.1
L_e	Feet	10
H^*	Feet	200
y_0	Feet	2.8
t_0	Seconds	0
y_t	Feet	0.01
t	Seconds	410

Solutions
Hydraulic Conductivity in Feet/Second
1.50E-05
Hydraulic Conductivity in Feet/Minute
8.98E-04
Hydraulic Conductivity in Feet/Day
1.29E+00

* - Assumed value

Calculations			
Term	Units		3.137
L_e/r_W	Feet/Foot	40.00	$\ln(R_e/r_W)_{\text{partial penetration}}$ =
A	None	2.780	2.496
B	None	0.430	$\ln(R_e/r_W)_{\text{full penetration}}$ =
C	None	2.336	3.137

General Equations

$$K = \frac{r_c^2 \ln(R_e/r_W)}{2L_e} \quad \frac{1}{t} \ln \frac{y_0}{y_t}$$

Where

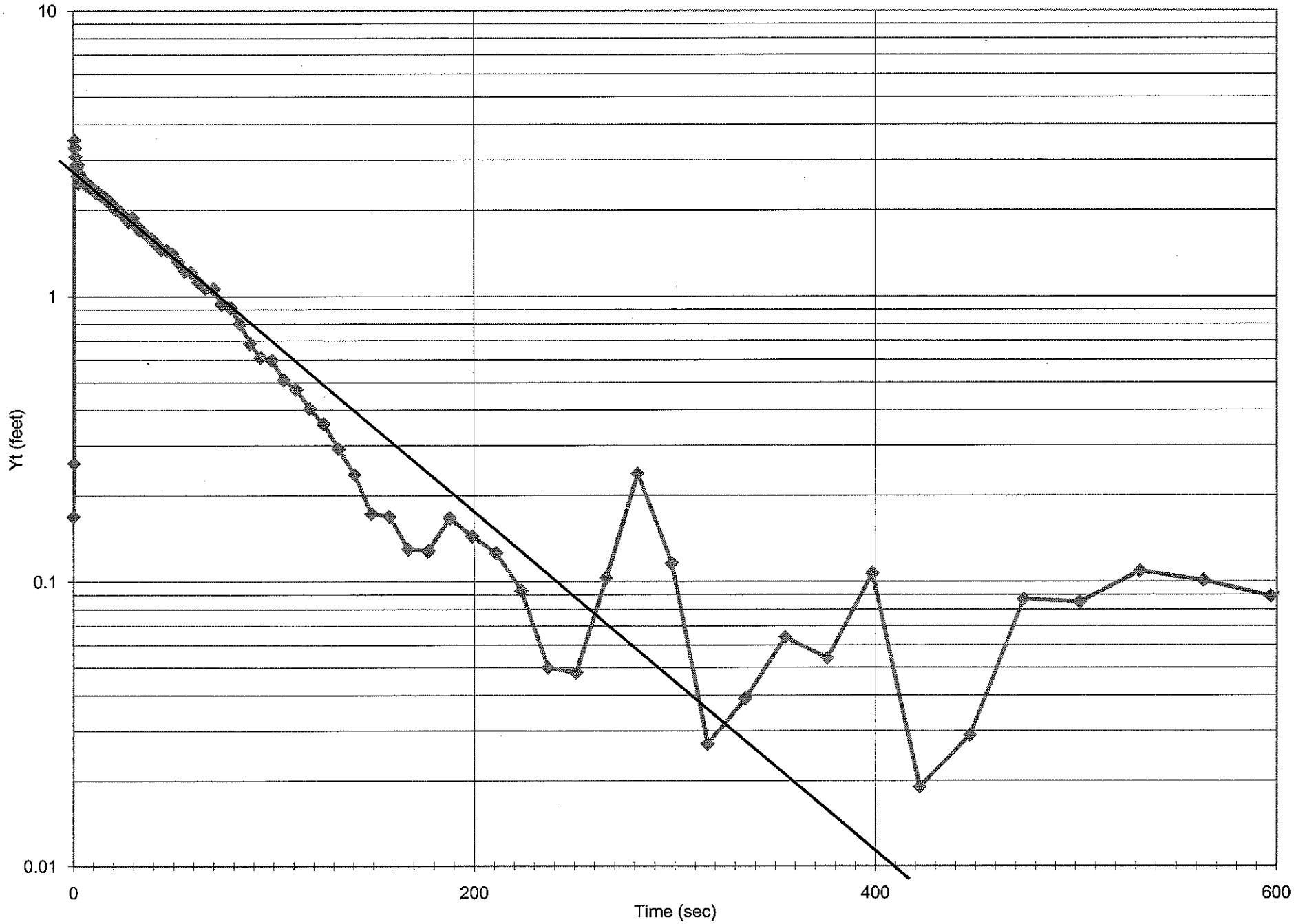
$$\ln(Re/r_W) = \left\{ \frac{1.1}{\ln(L_W/r_W)} + \frac{A + B \ln[(H - L_W)/r_W]}{L_e/r_W} \right\}^{-1}$$

For partial penetration or the equation below for full penetration

$$\ln(Re/r_W) = \left\{ \frac{1.1}{\ln(L_W/r_W)} + \frac{C}{L_e/r_W} \right\}^{-1}$$

615 Slug Out
Buncombe County C&D Facility Expansion
Site Hydrogeologic Investigation

CDM



615 Slug Out
Buncombe County C&D Facility Expansion
Site Hydrogeologic Investigation

CDM

In-Situ Inc. MiniTroll Pro

Report gen 6/20/2008 13:16:48
Report fron ...\SN07633 2008-06-19 090332 615 Slug Out.bin
Win-Situ® ' 4.57.0.0

Serial numl 7633
Firmware V 3.09
Unit name: Buncombe

Test name: 615 Slug Out

Test define 6/19/2008 9:02:40
Test startec 6/19/2008 9:03:32
Test stoppe 6/19/2008 9:28:02

Data gathered using Logarithmic testing
Maximum Seconds.
Number c 116

TOTAL DA' 116

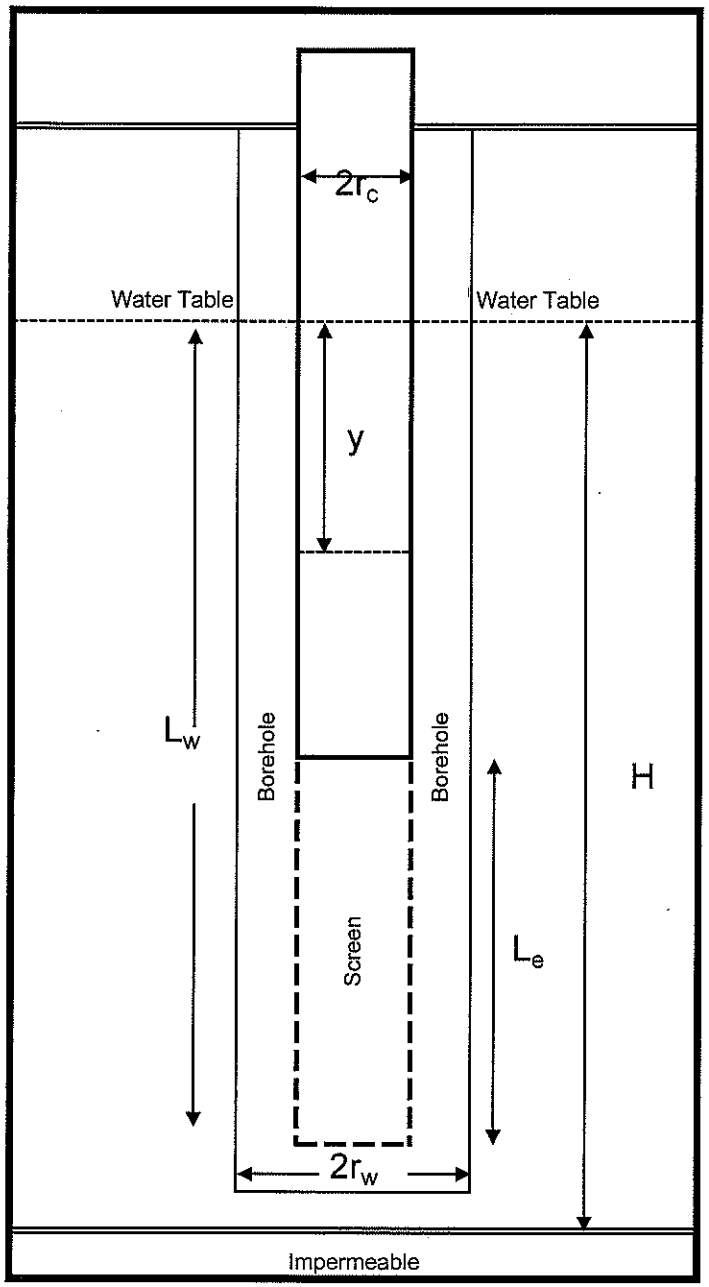
Channel number [1]
Measuren Temperature
Channel name:

Channel number [2]
Measuren Pressure
Channel name:
Sensor Ra 30 PSIG.
Sensor Of 0.000 psi
Specific g 1

Date	Time	ET (sec)	Chan[1] Temperatu Fahrenheit	Chan[2] Pressure Feet H2O	
6/19/2008	9:03:32	0	56.16	15.181	0.169
6/19/2008	9:03:32	0.3	56.21	15.09	0.26
6/19/2008	9:03:32	0.6	56.21	11.828	3.522
6/19/2008	9:03:33	0.9	56.23	12.036	3.314
6/19/2008	9:03:33	1.2	56.23	12.261	3.089
6/19/2008	9:03:33	1.5	56.23	12.466	2.884
6/19/2008	9:03:33	1.8	56.25	12.533	2.817
6/19/2008	9:03:34	2.1	56.25	12.693	2.657
6/19/2008	9:03:34	2.4	56.25	12.465	2.885
6/19/2008	9:03:34	2.7	56.25	12.862	2.488
6/19/2008	9:03:35	3	56.25	12.732	2.618
6/19/2008	9:03:35	3.3	56.25	12.677	2.673
6/19/2008	9:03:35	3.6	56.28	12.821	2.529
6/19/2008	9:03:36	3.9	56.28	12.747	2.603
6/19/2008	9:03:36	4.2	56.28	12.813	2.537
6/19/2008	9:03:36	4.5	56.28	12.807	2.543
6/19/2008	9:03:36	4.8	56.28	12.786	2.564
6/19/2008	9:03:37	5.1	56.28	12.813	2.537
6/19/2008	9:03:37	5.4	56.28	12.841	2.509
6/19/2008	9:03:37	5.7	56.28	12.872	2.478
6/19/2008	9:03:38	6	56.28	12.85	2.5
6/19/2008	9:03:38	6.4	56.28	12.848	2.502
6/19/2008	9:03:38	6.7	56.28	12.909	2.441
6/19/2008	9:03:39	7.1	56.28	12.885	2.465
6/19/2008	9:03:39	7.5	56.28	12.885	2.465

6/19/2008	9:03:40	8	56.28	12.93	2.42
6/19/2008	9:03:40	8.4	56.28	12.934	2.416
6/19/2008	9:03:41	8.9	56.3	12.93	2.42
6/19/2008	9:03:41	9.5	56.3	12.967	2.383
6/19/2008	9:03:42	10	56.28	12.955	2.395
6/19/2008	9:03:42	10.6	56.25	13.002	2.348
6/19/2008	9:03:43	11.3	56.25	13.039	2.311
6/19/2008	9:03:44	11.9	56.25	13.035	2.315
6/19/2008	9:03:44	12.6	56.25	13.035	2.315
6/19/2008	9:03:45	13.4	56.25	13.063	2.287
6/19/2008	9:03:46	14.2	56.25	13.094	2.256
6/19/2008	9:03:47	15	56.23	13.121	2.229
6/19/2008	9:03:48	15.9	56.23	13.131	2.219
6/19/2008	9:03:49	16.8	56.23	13.178	2.172
6/19/2008	9:03:50	17.8	56.23	13.213	2.137
6/19/2008	9:03:51	18.9	56.23	13.228	2.122
6/19/2008	9:03:52	20	56.23	13.257	2.093
6/19/2008	9:03:53	21.2	56.23	13.335	2.015
6/19/2008	9:03:54	22.4	56.23	13.345	2.005
6/19/2008	9:03:55	23.8	56.23	13.376	1.974
6/19/2008	9:03:57	25.2	56.23	13.421	1.929
6/19/2008	9:03:58	26.7	56.23	13.483	1.867
6/19/2008	9:04:00	28.2	56.23	13.538	1.812
6/19/2008	9:04:01	29.8	56.23	13.473	1.877
6/19/2008	9:04:03	31.5	56.23	13.573	1.777
6/19/2008	9:04:05	33.3	56.23	13.645	1.705
6/19/2008	9:04:07	35.2	56.23	13.668	1.682
6/19/2008	9:04:09	37.3	56.23	13.724	1.626
6/19/2008	9:04:11	39.5	56.23	13.759	1.591
6/19/2008	9:04:13	41.8	56.21	13.83	1.52
6/19/2008	9:04:16	44.3	56.21	13.896	1.454
6/19/2008	9:04:19	46.9	56.21	13.904	1.446
6/19/2008	9:04:21	49.7	56.21	13.939	1.411
6/19/2008	9:04:24	52.6	56.21	14.032	1.318
6/19/2008	9:04:27	55.7	56.21	14.127	1.223
6/19/2008	9:04:31	59	56.21	14.137	1.213
6/19/2008	9:04:34	62.5	56.21	14.227	1.123
6/19/2008	9:04:38	66.2	56.18	14.285	1.065
6/19/2008	9:04:42	70.1	56.18	14.287	1.063
6/19/2008	9:04:46	74.3	56.18	14.41	0.94
6/19/2008	9:04:50	78.7	56.18	14.437	0.913
6/19/2008	9:04:55	83.4	56.18	14.548	0.802
6/19/2008	9:05:00	88.4	56.18	14.665	0.685
6/19/2008	9:05:05	93.7	56.18	14.739	0.611
6/19/2008	9:05:11	99.3	56.16	14.751	0.599
6/19/2008	9:05:17	105.2	56.16	14.84	0.51
6/19/2008	9:05:23	111.5	56.16	14.877	0.473
6/19/2008	9:05:30	118.1	56.16	14.945	0.405
6/19/2008	9:05:37	125.1	56.16	14.992	0.358
6/19/2008	9:05:44	132.6	56.16	15.058	0.292
6/19/2008	9:05:52	140.5	56.14	15.113	0.237
6/19/2008	9:06:01	148.9	56.14	15.177	0.173
6/19/2008	9:06:09	157.8	56.14	15.181	0.169
6/19/2008	9:06:19	167.2	56.14	15.22	0.13
6/19/2008	9:06:29	177.2	56.14	15.222	0.128
6/19/2008	9:06:39	187.8	56.14	15.183	0.167
6/19/2008	9:06:51	199	56.14	15.206	0.144
6/19/2008	9:07:03	210.9	56.14	15.224	0.126
6/19/2008	9:07:15	223.5	56.12	15.257	0.093
6/19/2008	9:07:28	236.8	56.12	15.3	0.05
6/19/2008	9:07:43	250.9	56.12	15.302	0.048
6/19/2008	9:07:57	265.8	56.12	15.247	0.103
6/19/2008	9:08:13	281.6	56.12	15.111	0.239
6/19/2008	9:08:30	298.4	56.12	15.234	0.116

6/19/2008	9:08:48	316.2	56.12	15.323	0.027
6/19/2008	9:09:07	335	56.12	15.311	0.039
6/19/2008	9:09:27	354.9	56.12	15.286	0.064
6/19/2008	9:09:48	376	56.12	15.296	0.054
6/19/2008	9:10:10	398.4	56.12	15.243	0.107
6/19/2008	9:10:34	422.1	56.12	15.331	0.019
6/19/2008	9:10:59	447.2	56.12	15.321	0.029
6/19/2008	9:11:25	473.8	56.12	15.263	0.087
6/19/2008	9:11:54	502	56.12	15.265	0.085
6/19/2008	9:12:24	531.9	56.12	15.241	0.109
6/19/2008	9:12:55	563.5	56.12	15.249	0.101
6/19/2008	9:13:29	597	56.12	15.261	0.089
6/19/2008	9:14:04	632.5	56.12	15.241	0.109
6/19/2008	9:14:42	670.1	56.12	15.237	0.113
6/19/2008	9:15:22	709.9	56.12	15.218	0.132
6/19/2008	9:16:04	752.1	56.12	15.274	0.076
6/19/2008	9:16:48	796.8	56.12	15.21	0.14
6/19/2008	9:17:36	844.2	56.12	15.247	0.103
6/19/2008	9:18:26	894.4	56.12	15.208	0.142
6/19/2008	9:19:19	947.5	56.12	15.23	0.12
6/19/2008	9:20:15	1003.8	56.12	15.232	0.118
6/19/2008	9:21:15	1063.4	56.12	15.241	0.109
6/19/2008	9:22:18	1126.6	56.12	15.212	0.138
6/19/2008	9:23:25	1193.5	56.12	15.273	0.077
6/19/2008	9:24:36	1264.4	56.12	15.29	0.06
6/19/2008	9:25:51	1339.5	56.12	15.236	0.114
6/19/2008	9:27:11	1419	56.12	15.216	0.134



Input Data		
Term	Units	
$2r_c$	Inches	2
$2r_W$	Inches	6
L_w	Feet	16
L_e	Feet	10
H*	Feet	200
y_0	Feet	2.75
t_0	Seconds	0
y_t	Feet	0.01
t	Seconds	1910

Solutions
Hydraulic Conductivity in Feet/Second
3.16E-06
Hydraulic Conductivity in Feet/Minute
1.90E-04
Hydraulic Conductivity in Feet/Day
2.73E-01

* - Assumed value

Calculations			
Term	Units		3.097
L_e/r_W	Feet/Foot	40.00	$\ln(R_e/r_W)_{\text{partial penetration}}$ =
A	None	2.780	2.470
B	None	0.430	$\ln(R_e/r_W)_{\text{full penetration}}$ =
C	None	2.336	3.097

General Equations

$$K = \frac{r_c^2 \ln(R_e/r_W)}{2L_e} \quad \frac{1}{t} \ln \frac{y_0}{y_t}$$

Where

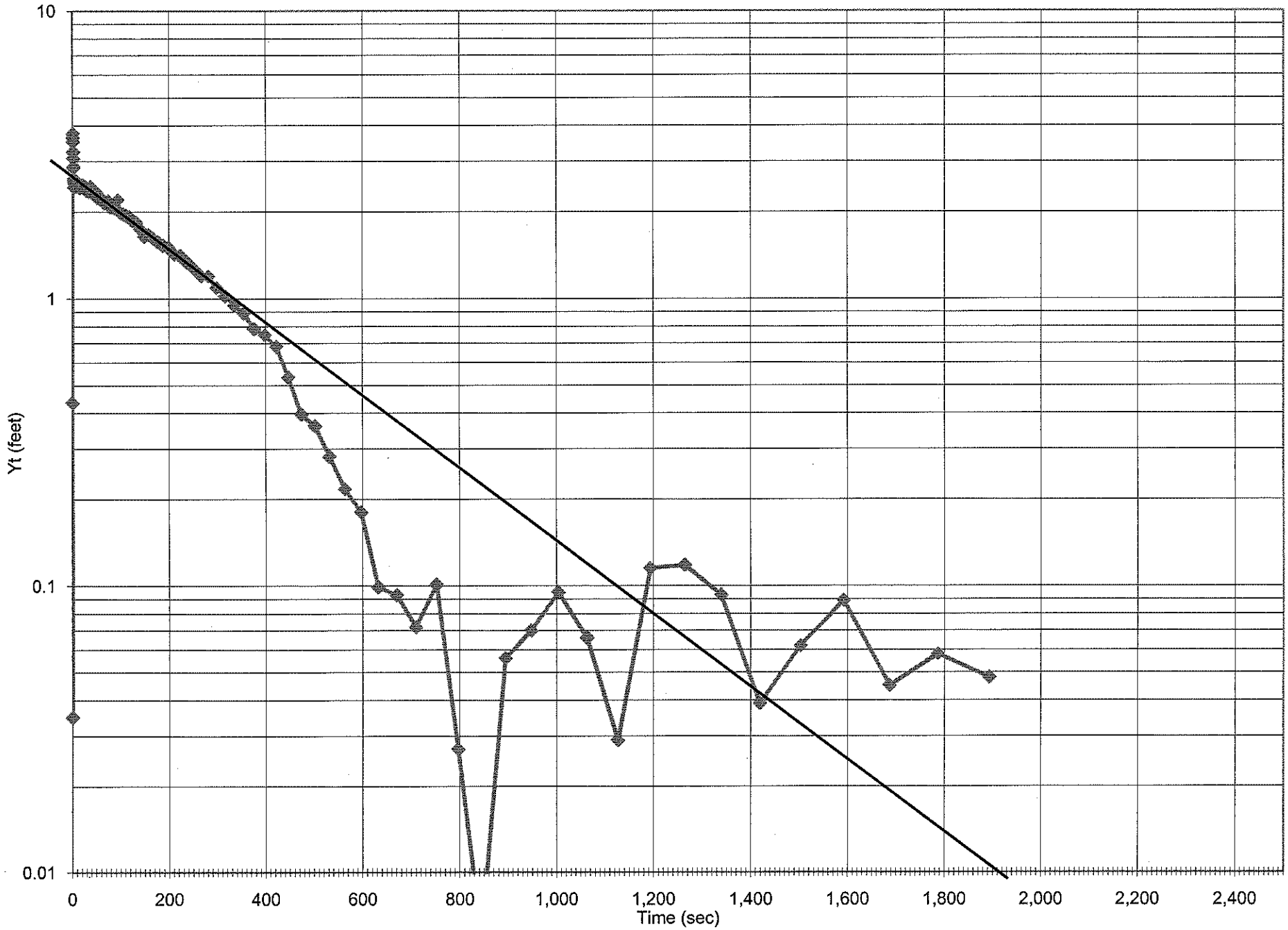
$$\ln(Re/r_W) = \left\{ \frac{1.1}{\ln(L_W/r_W)} + \frac{A + B \ln[(H - L_W)/r_W]}{L_e/r_W} \right\}^{-1}$$

For partial penetration or the equation below for full penetration

$$\ln(Re/r_W) = \left\{ \frac{1.1}{\ln(L_W/r_W)} + \frac{C}{L_e/r_W} \right\}^{-1}$$

CDM

617 Slug In
Buncombe County C&D Facility Expansion
Site Hydrogeologic Investigation



617 Slug In
Buncombe County C&D Facility Expansion
Site Hydrogeologic Investigation

CDM

In-Situ Inc. MiniTroll Pro

Report gen 6/20/2008 13:19:40
Report fron ...\SN07633 2008-06-19 110603 617 Slug In.bin
Win-Situ® '4.57.0.0

Serial numl 7633
Firmware V 3.09
Unit name: Buncombe

Test name: 617 Slug In

Test define 6/19/2008 11:05:04
Test startec 6/19/2008 11:06:03
Test stoppe 6/19/2008 11:37:57

Data gathered using Logarithmic testing
Maximum Seconds.
Number c 121

TOTAL DA' 121

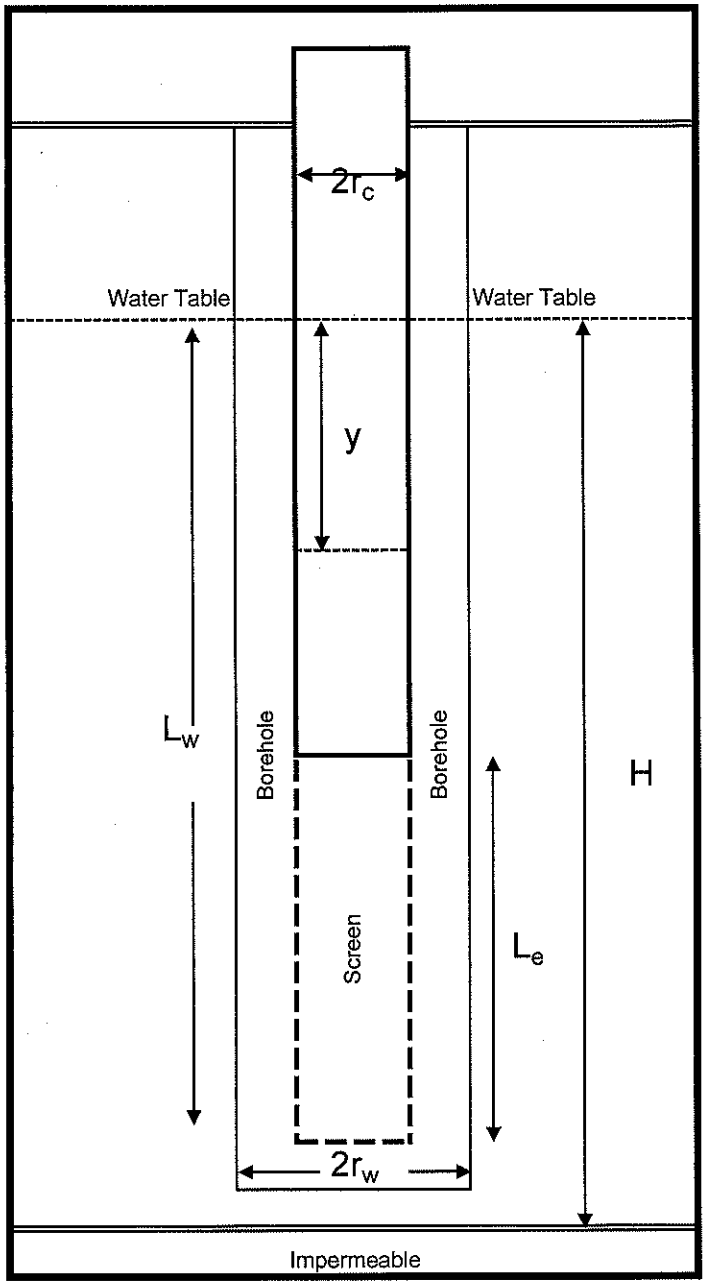
Channel number [1]
Measuren Temperature
Channel name:

Channel number [2]
Measuren Pressure
Channel name:
Sensor Ra 30 PSIG.
Sensor Of 0.000 psi
Specific g 1

Date	Time	ET (sec)	Chan[1] Temperatu Fahrenheit	Chan[2] Pressure Feet H2O	yt
6/19/2008	11:06:03	0	54.94	13.995	0.035
6/19/2008	11:06:03	0.3	54.96	14.395	0.435
6/19/2008	11:06:03	0.6	54.98	17.716	3.756
6/19/2008	11:06:04	0.9	54.98	17.588	3.628
6/19/2008	11:06:04	1.2	55.01	17.476	3.516
6/19/2008	11:06:04	1.5	55.01	17.195	3.235
6/19/2008	11:06:05	1.8	55.01	17.034	3.074
6/19/2008	11:06:05	2.1	55.03	16.837	2.877
6/19/2008	11:06:05	2.4	55.03	16.815	2.855
6/19/2008	11:06:06	2.7	55.03	16.805	2.845
6/19/2008	11:06:06	3	55.03	16.577	2.617
6/19/2008	11:06:06	3.3	55.03	16.396	2.436
6/19/2008	11:06:06	3.6	55.03	16.529	2.569
6/19/2008	11:06:07	3.9	55.03	16.529	2.569
6/19/2008	11:06:07	4.2	55.03	16.482	2.522
6/19/2008	11:06:07	4.5	55.03	16.507	2.547
6/19/2008	11:06:08	4.8	55.05	16.503	2.543
6/19/2008	11:06:08	5.1	55.05	16.486	2.526
6/19/2008	11:06:08	5.4	55.05	16.495	2.535
6/19/2008	11:06:09	5.7	55.05	16.482	2.522
6/19/2008	11:06:09	6	55.05	16.476	2.516
6/19/2008	11:06:09	6.4	55.05	16.472	2.512
6/19/2008	11:06:10	6.7	55.05	16.482	2.522

6/19/2008	11:06:10	7.1	55.05	16.478	2.518
6/19/2008	11:06:10	7.5	55.05	16.456	2.496
6/19/2008	11:06:11	8	55.05	16.466	2.506
6/19/2008	11:06:11	8.4	55.05	16.416	2.456
6/19/2008	11:06:12	8.9	55.05	16.468	2.508
6/19/2008	11:06:12	9.5	55.05	16.468	2.508
6/19/2008	11:06:13	10	55.03	16.461	2.501
6/19/2008	11:06:13	10.6	55.03	16.461	2.501
6/19/2008	11:06:14	11.3	55.03	16.451	2.491
6/19/2008	11:06:15	11.9	55.03	16.447	2.487
6/19/2008	11:06:15	12.6	55.03	16.437	2.477
6/19/2008	11:06:16	13.4	55.03	16.416	2.456
6/19/2008	11:06:17	14.2	55.01	16.395	2.435
6/19/2008	11:06:18	15	55.01	16.408	2.448
6/19/2008	11:06:19	15.9	55.01	16.395	2.435
6/19/2008	11:06:20	16.8	55.01	16.404	2.444
6/19/2008	11:06:21	17.8	55.01	16.439	2.479
6/19/2008	11:06:22	18.9	55.01	16.434	2.474
6/19/2008	11:06:23	20	55.01	16.42	2.46
6/19/2008	11:06:24	21.2	55.01	16.443	2.483
6/19/2008	11:06:25	22.4	55.01	16.434	2.474
6/19/2008	11:06:27	23.8	55.01	16.383	2.423
6/19/2008	11:06:28	25.2	55.01	16.383	2.423
6/19/2008	11:06:30	26.7	55.01	16.402	2.442
6/19/2008	11:06:31	28.2	55.01	16.391	2.431
6/19/2008	11:06:33	29.8	55.01	16.34	2.38
6/19/2008	11:06:34	31.5	55.01	16.34	2.38
6/19/2008	11:06:36	33.3	55.01	16.315	2.355
6/19/2008	11:06:38	35.2	55.01	16.325	2.365
6/19/2008	11:06:40	37.3	55.01	16.41	2.45
6/19/2008	11:06:42	39.5	55.01	16.317	2.357
6/19/2008	11:06:45	41.8	55.01	16.309	2.349
6/19/2008	11:06:47	44.3	55.01	16.292	2.332
6/19/2008	11:06:50	46.9	55.01	16.262	2.302
6/19/2008	11:06:53	49.7	54.98	16.296	2.336
6/19/2008	11:06:55	52.6	54.98	16.2	2.24
6/19/2008	11:06:59	55.7	54.98	16.208	2.248
6/19/2008	11:07:02	59	54.98	16.195	2.235
6/19/2008	11:07:05	62.5	54.98	16.167	2.207
6/19/2008	11:07:09	66.2	54.98	16.117	2.157
6/19/2008	11:07:13	70.1	54.98	16.121	2.161
6/19/2008	11:07:17	74.3	54.98	16.144	2.184
6/19/2008	11:07:22	78.7	54.98	16.045	2.085
6/19/2008	11:07:26	83.4	54.98	16.041	2.081
6/19/2008	11:07:31	88.4	54.96	16.024	2.064
6/19/2008	11:07:37	93.7	54.96	16.158	2.198
6/19/2008	11:07:42	99.3	54.96	15.948	1.988
6/19/2008	11:07:48	105.2	54.96	15.928	1.968
6/19/2008	11:07:54	111.5	54.96	15.901	1.941
6/19/2008	11:08:01	118.1	54.96	15.885	1.925
6/19/2008	11:08:08	125.1	54.96	15.823	1.863
6/19/2008	11:08:15	132.6	54.96	15.794	1.834
6/19/2008	11:08:23	140.5	54.96	15.705	1.745
6/19/2008	11:08:32	148.9	54.96	15.599	1.639
6/19/2008	11:08:41	157.8	54.96	15.625	1.665
6/19/2008	11:08:50	167.2	54.96	15.582	1.622
6/19/2008	11:09:00	177.2	54.96	15.533	1.573
6/19/2008	11:09:11	187.8	54.94	15.487	1.527
6/19/2008	11:09:22	199	54.94	15.464	1.504
6/19/2008	11:09:34	210.9	54.94	15.388	1.428
6/19/2008	11:09:46	223.5	54.94	15.368	1.408
6/19/2008	11:10:00	236.8	54.94	15.298	1.338

6/19/2008	11:10:14	250.9	54.94	15.234	1.274
6/19/2008	11:10:29	265.8	54.94	15.16	1.2
6/19/2008	11:10:44	281.6	54.94	15.154	1.194
6/19/2008	11:11:01	298.4	54.94	15.053	1.093
6/19/2008	11:11:19	316.2	54.94	14.981	1.021
6/19/2008	11:11:38	335	54.94	14.909	0.949
6/19/2008	11:11:58	354.9	54.94	14.851	0.891
6/19/2008	11:12:19	376	54.94	14.746	0.786
6/19/2008	11:12:41	398.4	54.94	14.709	0.749
6/19/2008	11:13:05	422.1	54.94	14.642	0.682
6/19/2008	11:13:30	447.2	54.94	14.493	0.533
6/19/2008	11:13:57	473.8	54.94	14.356	0.396
6/19/2008	11:14:25	502	54.94	14.321	0.361
6/19/2008	11:14:55	531.9	54.94	14.242	0.282
6/19/2008	11:15:26	563.5	54.94	14.177	0.217
6/19/2008	11:16:00	597	54.94	14.14	0.18
6/19/2008	11:16:35	632.5	54.94	14.059	0.099
6/19/2008	11:17:13	670.1	54.94	14.053	0.093
6/19/2008	11:17:53	709.9	54.94	14.032	0.072
6/19/2008	11:18:35	752.1	54.94	14.061	0.101
6/19/2008	11:19:20	796.8	54.94	13.987	0.027
6/19/2008	11:20:07	844.2	54.91	13.966	0.006
6/19/2008	11:20:57	894.4	54.94	14.016	0.056
6/19/2008	11:21:50	947.5	54.91	14.03	0.07
6/19/2008	11:22:47	1003.8	54.91	14.055	0.095
6/19/2008	11:23:46	1063.4	54.91	14.026	0.066
6/19/2008	11:24:49	1126.6	54.91	13.989	0.029
6/19/2008	11:25:56	1193.5	54.91	14.075	0.115
6/19/2008	11:27:07	1264.4	54.94	14.078	0.118
6/19/2008	11:28:22	1339.5	54.91	14.053	0.093
6/19/2008	11:29:42	1419	54.91	13.999	0.039
6/19/2008	11:31:06	1503.3	54.91	14.022	0.062
6/19/2008	11:32:35	1592.6	54.91	14.049	0.089
6/19/2008	11:34:10	1687.1	54.91	14.005	0.045
6/19/2008	11:35:50	1787.2	54.91	14.018	0.058
6/19/2008	11:37:36	1893.3	54.91	14.008	0.048



Input Data		
Term	Units	
$2r_c$	Inches	2
$2r_W$	Inches	6
L_w	Feet	16
L_e	Feet	10
H*	Feet	200
y_0	Feet	2.21
t_0	Seconds	0
y_t	Feet	0.01
t	Seconds	720

Solutions
Hydraulic Conductivity in Feet/Second
8.06E-06
Hydraulic Conductivity in Feet/Minute
4.84E-04
Hydraulic Conductivity in Feet/Day
6.97E-01

* - Assumed value

Calculations			
Term	Units		3.097
L_e/r_W	Feet/Foot	40.00	$\ln(R_e/r_W)_{partial\ penetration}$ =
A	None	2.780	2.470
B	None	0.430	$\ln(R_e/r_W)_{full\ penetration}$ =
C	None	2.336	3.097

General Equations

$$K = \frac{r_c^2 \ln(R_e/r_W)}{2L_e} \quad \frac{1}{t} \ln \frac{y_0}{y_t}$$

Where

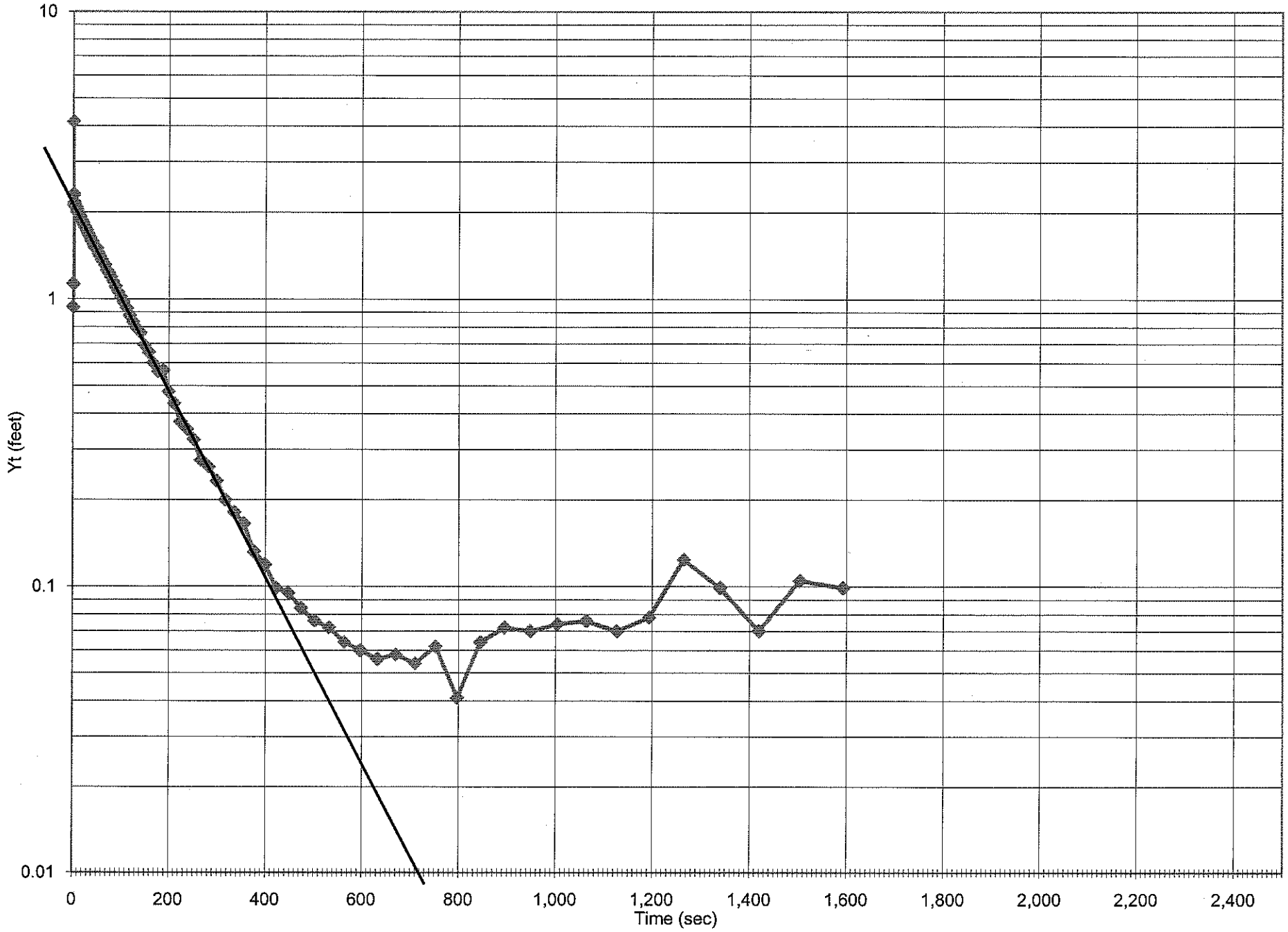
$$\ln(Re/r_W) = \left\{ \frac{1.1}{\ln(L_W/r_W)} + \frac{A + B \ln[(H - L_W)/r_W]}{L_e/r_W} \right\}^{-1}$$

For partial penetration or the equation below for full penetration

$$\ln(Re/r_W) = \left\{ \frac{1.1}{\ln(L_W/r_W)} + \frac{C}{L_e/r_W} \right\}^{-1}$$

CDM

617 Slug Out
Buncombe County C&D Facility Expansion
Site Hydrogeologic Investigation



617 Slug Out
Buncombe County C&D Facility Expansion
Site Hydrogeologic Investigation

CDM

In-Situ Inc. MiniTroll Pro

Report gen 6/20/2008 13:20:33
Report fron ...\SN07633 2008-06-19 113900 617 Slug Out.bin
Win-Situ® '4.57.0.0

Serial numl 7633
Firmware V 3.09
Unit name: Buncombe

Test name: 617 Slug Out

Test define 6/19/2008 11:38:34
Test startec 6/19/2008 11:39:00
Test stoppe 6/19/2008 12:06:57

Data gathered using Logarithmic testing
Maximum Seconds.
Number c 118

TOTAL DA 118

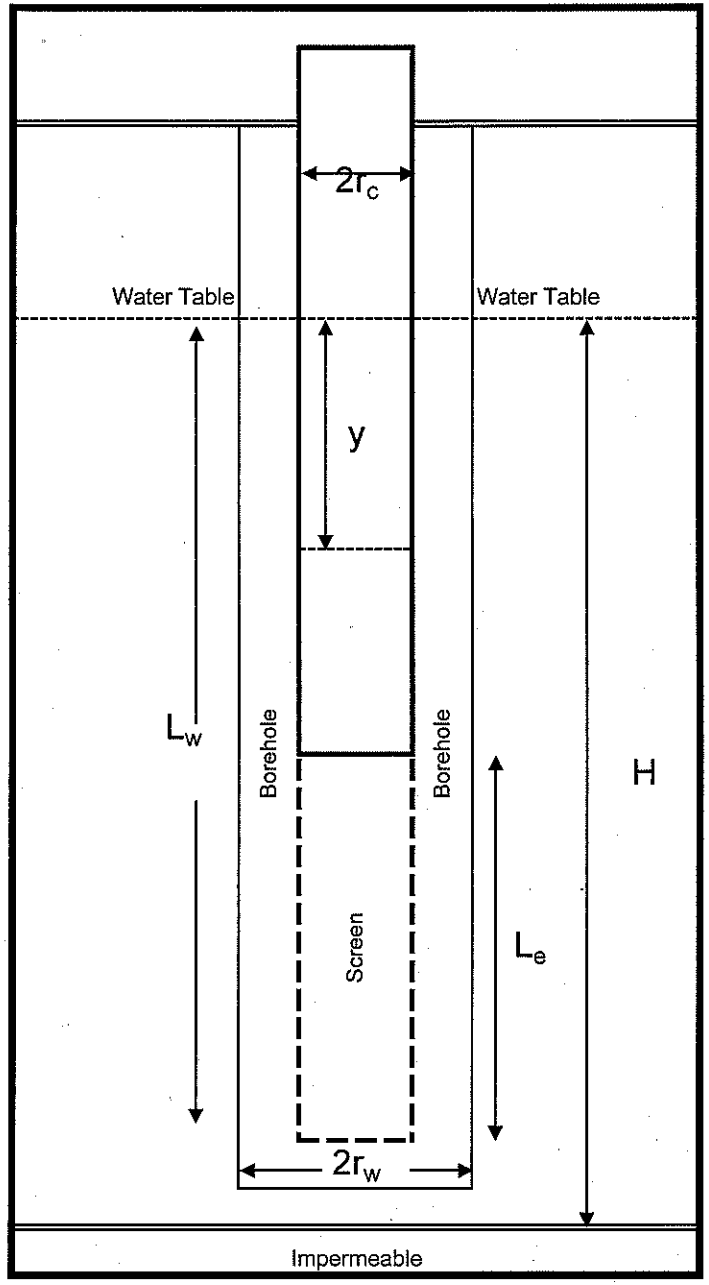
Channel number [1]
Measuren Temperature
Channel name:

Channel number [2]
Measuren Pressure
Channel name:
Sensor Ra 30 PSIG.
Sensor Of 0.000 psi
Specific g 1

Date	Time	ET (sec)	Chan[1] Temperatu Fahrenheit	Chan[2] Pressure Feet H2O	
6/19/2008	11:39:00	0	54.94	13.014	0.936
6/19/2008	11:39:00	0.3	54.96	9.807	4.143
6/19/2008	11:39:00	0.6	54.96	12.821	1.129
6/19/2008	11:39:00	0.9	54.98	11.651	2.299
6/19/2008	11:39:01	1.2	54.98	11.628	2.322
6/19/2008	11:39:01	1.5	55.01	11.832	2.118
6/19/2008	11:39:01	1.8	55.01	11.801	2.149
6/19/2008	11:39:02	2.1	55.01	11.781	2.169
6/19/2008	11:39:02	2.4	55.01	11.807	2.143
6/19/2008	11:39:02	2.7	55.01	11.803	2.147
6/19/2008	11:39:03	3	55.01	11.828	2.122
6/19/2008	11:39:03	3.3	55.03	11.83	2.12
6/19/2008	11:39:03	3.6	55.03	11.826	2.124
6/19/2008	11:39:03	3.9	55.03	11.839	2.111
6/19/2008	11:39:04	4.2	55.03	11.849	2.101
6/19/2008	11:39:04	4.5	55.03	11.851	2.099
6/19/2008	11:39:04	4.8	55.03	11.857	2.093
6/19/2008	11:39:05	5.1	55.03	11.861	2.089

6/19/2008	11:39:05	5.4	55.03	11.88	2.07
6/19/2008	11:39:05	5.7	55.03	11.878	2.072
6/19/2008	11:39:06	6	55.03	11.863	2.087
6/19/2008	11:39:06	6.4	55.03	11.892	2.058
6/19/2008	11:39:06	6.7	55.03	11.898	2.052
6/19/2008	11:39:07	7.1	55.03	11.9	2.05
6/19/2008	11:39:07	7.5	55.03	11.908	2.042
6/19/2008	11:39:07	8	55.05	11.936	2.014
6/19/2008	11:39:08	8.4	55.03	11.946	2.004
6/19/2008	11:39:08	8.9	55.05	11.948	2.002
6/19/2008	11:39:09	9.5	55.05	11.952	1.998
6/19/2008	11:39:10	10	55.03	11.946	2.004
6/19/2008	11:39:10	10.6	55.03	11.962	1.988
6/19/2008	11:39:11	11.3	55.01	11.974	1.976
6/19/2008	11:39:11	11.9	55.01	11.988	1.962
6/19/2008	11:39:12	12.6	55.01	11.993	1.957
6/19/2008	11:39:13	13.4	55.01	12.013	1.937
6/19/2008	11:39:14	14.2	55.01	12.023	1.927
6/19/2008	11:39:15	15	55.01	12.052	1.898
6/19/2008	11:39:15	15.9	55.01	12.052	1.898
6/19/2008	11:39:16	16.8	55.01	12.063	1.887
6/19/2008	11:39:17	17.8	55.01	12.079	1.871
6/19/2008	11:39:18	18.9	55.01	12.097	1.853
6/19/2008	11:39:20	20	54.98	12.122	1.828
6/19/2008	11:39:21	21.2	54.98	12.128	1.822
6/19/2008	11:39:22	22.4	54.98	12.153	1.797
6/19/2008	11:39:23	23.8	54.98	12.165	1.785
6/19/2008	11:39:25	25.2	54.98	12.184	1.766
6/19/2008	11:39:26	26.7	54.98	12.204	1.746
6/19/2008	11:39:28	28.2	54.98	12.221	1.729
6/19/2008	11:39:29	29.8	54.98	12.245	1.705
6/19/2008	11:39:31	31.5	54.98	12.272	1.678
6/19/2008	11:39:33	33.3	54.98	12.297	1.653
6/19/2008	11:39:35	35.2	54.98	12.315	1.635
6/19/2008	11:39:37	37.3	54.98	12.352	1.598
6/19/2008	11:39:39	39.5	54.98	12.367	1.583
6/19/2008	11:39:41	41.8	54.98	12.408	1.542
6/19/2008	11:39:44	44.3	54.98	12.441	1.509
6/19/2008	11:39:46	46.9	54.98	12.451	1.499
6/19/2008	11:39:49	49.7	54.98	12.453	1.497
6/19/2008	11:39:52	52.6	54.98	12.509	1.441
6/19/2008	11:39:55	55.7	54.98	12.546	1.404
6/19/2008	11:39:58	59	54.96	12.58	1.37
6/19/2008	11:40:02	62.5	54.96	12.613	1.337
6/19/2008	11:40:06	66.2	54.96	12.638	1.312
6/19/2008	11:40:10	70.1	54.96	12.691	1.259
6/19/2008	11:40:14	74.3	54.96	12.722	1.228
6/19/2008	11:40:18	78.7	54.96	12.757	1.193
6/19/2008	11:40:23	83.4	54.96	12.801	1.149
6/19/2008	11:40:28	88.4	54.96	12.846	1.104
6/19/2008	11:40:33	93.7	54.96	12.891	1.059
6/19/2008	11:40:39	99.3	54.96	12.934	1.016
6/19/2008	11:40:45	105.2	54.96	12.975	0.975
6/19/2008	11:40:51	111.5	54.94	13.02	0.93
6/19/2008	11:40:58	118.1	54.94	13.074	0.876
6/19/2008	11:41:05	125.1	54.94	13.117	0.833
6/19/2008	11:41:12	132.6	54.94	13.158	0.792

6/19/2008	11:41:20	140.5	54.94	13.187	0.763
6/19/2008	11:41:28	148.9	54.94	13.259	0.691
6/19/2008	11:41:37	157.8	54.94	13.296	0.654
6/19/2008	11:41:47	167.2	54.94	13.35	0.6
6/19/2008	11:41:57	177.2	54.94	13.389	0.561
6/19/2008	11:42:07	187.8	54.94	13.384	0.566
6/19/2008	11:42:18	199	54.94	13.473	0.477
6/19/2008	11:42:30	210.9	54.94	13.516	0.434
6/19/2008	11:42:43	223.5	54.94	13.574	0.376
6/19/2008	11:42:56	236.8	54.91	13.596	0.354
6/19/2008	11:43:10	250.9	54.91	13.625	0.325
6/19/2008	11:43:25	265.8	54.91	13.674	0.276
6/19/2008	11:43:41	281.6	54.91	13.689	0.261
6/19/2008	11:43:58	298.4	54.91	13.717	0.233
6/19/2008	11:44:16	316.2	54.91	13.75	0.2
6/19/2008	11:44:34	335	54.91	13.769	0.181
6/19/2008	11:44:54	354.9	54.91	13.785	0.165
6/19/2008	11:45:15	376	54.91	13.818	0.132
6/19/2008	11:45:38	398.4	54.91	13.831	0.119
6/19/2008	11:46:02	422.1	54.91	13.851	0.099
6/19/2008	11:46:27	447.2	54.91	13.855	0.095
6/19/2008	11:46:53	473.8	54.91	13.866	0.084
6/19/2008	11:47:21	502	54.91	13.874	0.076
6/19/2008	11:47:51	531.9	54.91	13.878	0.072
6/19/2008	11:48:23	563.5	54.91	13.886	0.064
6/19/2008	11:48:56	597	54.91	13.89	0.06
6/19/2008	11:49:32	632.5	54.91	13.894	0.056
6/19/2008	11:50:10	670.1	54.91	13.892	0.058
6/19/2008	11:50:49	709.9	54.91	13.896	0.054
6/19/2008	11:51:32	752.1	54.91	13.888	0.062
6/19/2008	11:52:16	796.8	54.91	13.909	0.041
6/19/2008	11:53:04	844.2	54.91	13.886	0.064
6/19/2008	11:53:54	894.4	54.91	13.878	0.072
6/19/2008	11:54:47	947.5	54.91	13.88	0.07
6/19/2008	11:55:43	1003.8	54.91	13.876	0.074
6/19/2008	11:56:43	1063.4	54.91	13.874	0.076
6/19/2008	11:57:46	1126.6	54.91	13.88	0.07
6/19/2008	11:58:53	1193.5	54.91	13.872	0.078
6/19/2008	12:00:04	1264.4	54.91	13.826	0.124
6/19/2008	12:01:19	1339.5	54.91	13.851	0.099
6/19/2008	12:02:38	1419	54.91	13.88	0.07
6/19/2008	12:04:03	1503.3	54.91	13.845	0.105
6/19/2008	12:05:32	1592.6	54.91	13.851	0.099



Input Data		
Term	Units	
$2r_c$	Inches	2
$2r_W$	Inches	6
L_w	Feet	18.4
L_e	Feet	10
H*	Feet	200
y_0	Feet	3.05
t_0	Seconds	0
y_t	Feet	0.1
t	Seconds	1185

Solutions
Hydraulic Conductivity in Feet/Second
3.19E-06
Hydraulic Conductivity in Feet/Minute
1.91E-04
Hydraulic Conductivity in Feet/Day
2.75E-01

* - Assumed value

Calculations			
Term	Units		3.182
L_e/r_W	Feet/Foot	40.00	$\ln(R_e/r_W)_{\text{partial penetration}}$ =
A	None	2.780	2.524
B	None	0.430	$\ln(R_e/r_W)_{\text{full penetration}}$ =
C	None	2.336	3.182

General Equations

$$K = \frac{r_c^2 \ln(R_e/r_W)}{2L_e} \quad \frac{1}{t} \ln \frac{y_0}{y_t}$$

Where

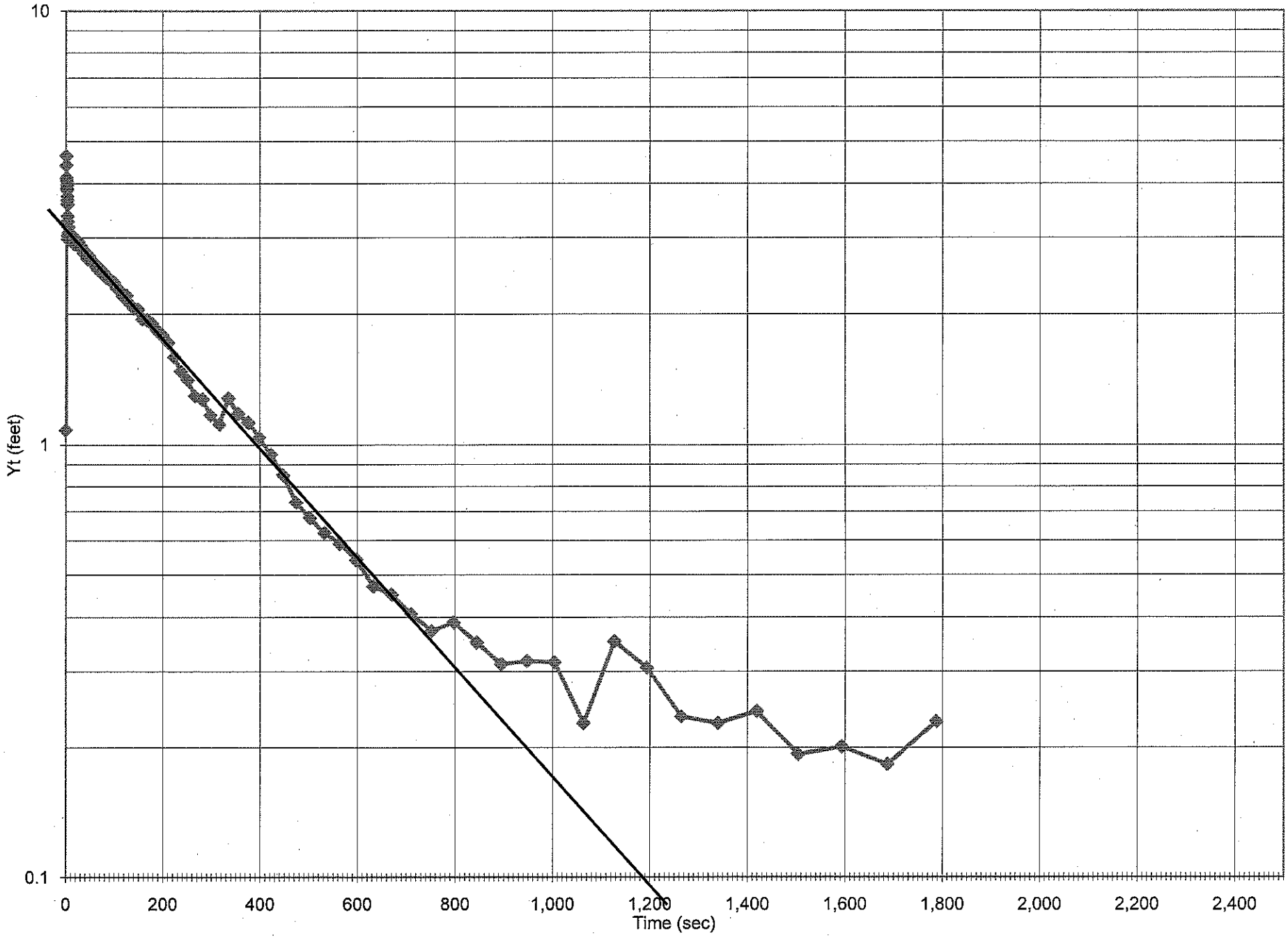
$$\ln(Re/r_W) = \left\{ \frac{1.1}{\ln(L_W/r_W)} + \frac{A + B \ln[(H - L_W)/r_W]}{L_e/r_W} \right\}^{-1}$$

For partial penetration or the equation below for full penetration

$$\ln(Re/r_W) = \left\{ \frac{1.1}{\ln(L_W/r_W)} + \frac{C}{L_e/r_W} \right\}^{-1}$$

619d Slug In
Buncombe County C&D Facility Expansion
Site Hydrogeologic Investigation

CDM



619d Slug In
Buncombe County C&D Facility Expansion
Site Hydrogeologic Investigation

CDM

In-Situ Inc. MiniTroll Pro

Report gen 6/20/2008 13:17:51
Report fron ...\SN07633 2008-06-19 094831 619d Slug In.bin
Win-Situ® '4.57.0.0

Serial numl 7633
Firmware V 3.09
Unit name: Buncombe

Test name: 619d Slug In

Test define 6/19/2008 9:47:27
Test startec 6/19/2008 9:48:31
Test stoppe 6/19/2008 10:19:16

Data gathered using Logarithmic testing
Maximum Seconds.
Number c 120

TOTAL DA 120

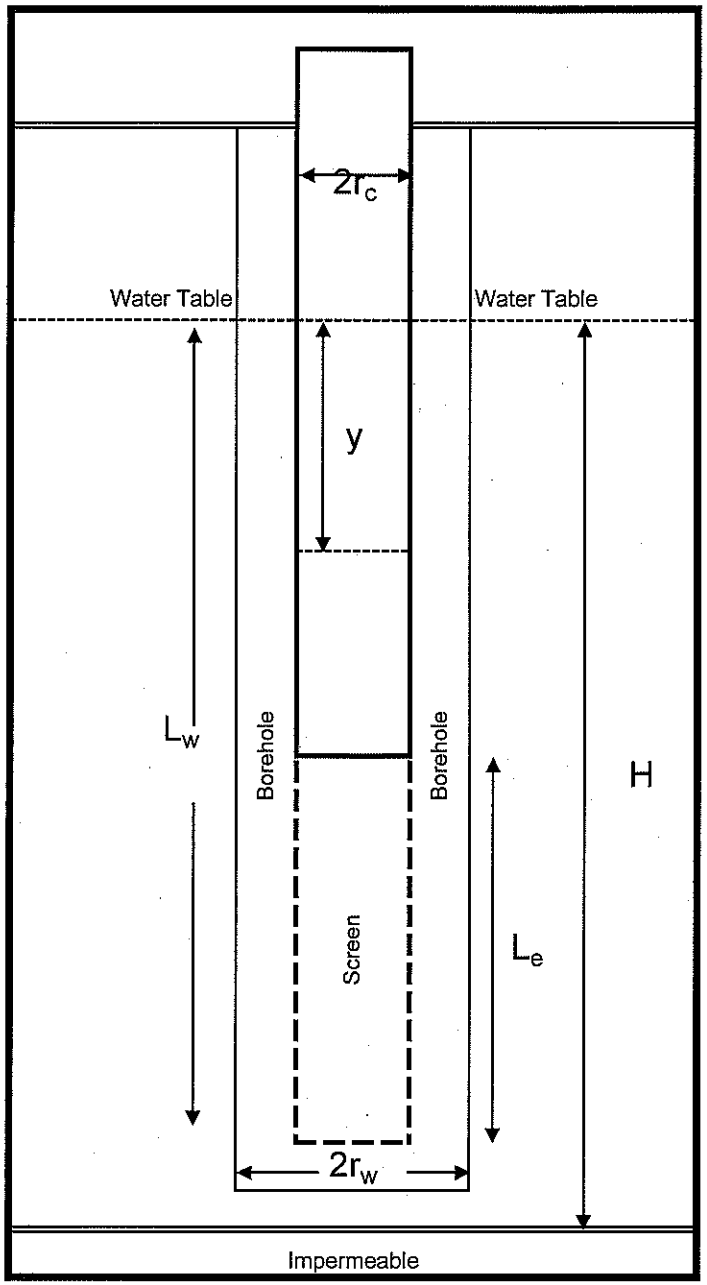
Channel number [1]
Measuren Temperature
Channel name:

Channel number [2]
Measuren Pressure
Channel name:
Sensor Ra 30 PSIG.
Sensor Of 0.000 psi
Specific g 1

Date	Time	ET (sec)	Chan[1] Temperatu Fahrenheit	Chan[2] Pressure Feet H2O	yt
6/19/2008	9:48:31	0	53.87	16.883	1.083
6/19/2008	9:48:31	0.3	53.92	20.209	4.409
6/19/2008	9:48:32	0.6	53.92	20.437	4.637
6/19/2008	9:48:32	0.9	53.94	19.934	4.134
6/19/2008	9:48:32	1.2	53.94	19.902	4.102
6/19/2008	9:48:32	1.5	53.96	19.849	4.049
6/19/2008	9:48:33	1.8	53.96	19.766	3.966
6/19/2008	9:48:33	2.1	53.96	19.702	3.902
6/19/2008	9:48:33	2.4	53.96	19.67	3.87
6/19/2008	9:48:34	2.7	53.96	19.538	3.738
6/19/2008	9:48:34	3	53.98	19.463	3.663
6/19/2008	9:48:34	3.3	53.96	19.388	3.588
6/19/2008	9:48:35	3.6	53.96	19.16	3.36
6/19/2008	9:48:35	3.9	53.96	19.073	3.273
6/19/2008	9:48:35	4.2	53.98	18.771	2.971
6/19/2008	9:48:35	4.5	53.98	18.833	3.033
6/19/2008	9:48:36	4.8	53.98	18.979	3.179
6/19/2008	9:48:36	5.1	53.98	18.851	3.051

6/19/2008	9:48:36	5.4	53.98	18.817	3.017
6/19/2008	9:48:37	5.7	53.98	18.884	3.084
6/19/2008	9:48:37	6	53.98	18.86	3.06
6/19/2008	9:48:37	6.4	53.98	18.817	3.017
6/19/2008	9:48:38	6.7	53.98	18.831	3.031
6/19/2008	9:48:38	7.1	53.98	18.866	3.066
6/19/2008	9:48:39	7.5	53.98	18.841	3.041
6/19/2008	9:48:39	8	53.98	18.845	3.045
6/19/2008	9:48:39	8.4	53.98	18.837	3.037
6/19/2008	9:48:40	8.9	53.98	18.841	3.041
6/19/2008	9:48:40	9.5	53.98	18.814	3.014
6/19/2008	9:48:41	10	53.96	18.789	2.989
6/19/2008	9:48:42	10.6	53.96	18.814	3.014
6/19/2008	9:48:42	11.3	53.96	18.755	2.955
6/19/2008	9:48:43	11.9	53.96	18.816	3.016
6/19/2008	9:48:44	12.6	53.94	18.793	2.993
6/19/2008	9:48:44	13.4	53.94	18.765	2.965
6/19/2008	9:48:45	14.2	53.94	18.787	2.987
6/19/2008	9:48:46	15	53.94	18.779	2.979
6/19/2008	9:48:47	15.9	53.94	18.812	3.012
6/19/2008	9:48:48	16.8	53.94	18.697	2.897
6/19/2008	9:48:49	17.8	53.94	18.795	2.995
6/19/2008	9:48:50	18.9	53.94	18.729	2.929
6/19/2008	9:48:51	20	53.94	18.754	2.954
6/19/2008	9:48:52	21.2	53.94	18.74	2.94
6/19/2008	9:48:53	22.4	53.92	18.735	2.935
6/19/2008	9:48:55	23.8	53.94	18.727	2.927
6/19/2008	9:48:56	25.2	53.94	18.707	2.907
6/19/2008	9:48:58	26.7	53.94	18.725	2.925
6/19/2008	9:48:59	28.2	53.92	18.688	2.888
6/19/2008	9:49:01	29.8	53.92	18.672	2.872
6/19/2008	9:49:02	31.5	53.92	18.659	2.859
6/19/2008	9:49:04	33.3	53.92	18.612	2.812
6/19/2008	9:49:06	35.2	53.92	18.62	2.82
6/19/2008	9:49:08	37.3	53.92	18.561	2.761
6/19/2008	9:49:10	39.5	53.92	18.579	2.779
6/19/2008	9:49:13	41.8	53.92	18.561	2.761
6/19/2008	9:49:15	44.3	53.92	18.478	2.678
6/19/2008	9:49:18	46.9	53.92	18.524	2.724
6/19/2008	9:49:21	49.7	53.92	18.495	2.695
6/19/2008	9:49:24	52.6	53.89	18.472	2.672
6/19/2008	9:49:27	55.7	53.89	18.447	2.647
6/19/2008	9:49:30	59	53.89	18.42	2.62
6/19/2008	9:49:33	62.5	53.89	18.373	2.573
6/19/2008	9:49:37	66.2	53.89	18.326	2.526
6/19/2008	9:49:41	70.1	53.89	18.34	2.54
6/19/2008	9:49:45	74.3	53.89	18.315	2.515
6/19/2008	9:49:50	78.7	53.89	18.285	2.485
6/19/2008	9:49:54	83.4	53.87	18.231	2.431
6/19/2008	9:49:59	88.4	53.87	18.218	2.418
6/19/2008	9:50:05	93.7	53.87	18.181	2.381
6/19/2008	9:50:10	99.3	53.87	18.171	2.371
6/19/2008	9:50:16	105.2	53.87	18.099	2.299
6/19/2008	9:50:22	111.5	53.87	18.066	2.266
6/19/2008	9:50:29	118.1	53.87	17.998	2.198
6/19/2008	9:50:36	125.1	53.85	18.006	2.206
6/19/2008	9:50:44	132.6	53.87	17.912	2.112

6/19/2008	9:50:51	140.5	53.85	17.862	2.062
6/19/2008	9:51:00	148.9	53.85	17.85	2.05
6/19/2008	9:51:09	157.8	53.85	17.751	1.951
6/19/2008	9:51:18	167.2	53.85	17.743	1.943
6/19/2008	9:51:28	177.2	53.85	17.704	1.904
6/19/2008	9:51:39	187.8	53.83	17.638	1.838
6/19/2008	9:51:50	199	53.83	17.588	1.788
6/19/2008	9:52:02	210.9	53.83	17.524	1.724
6/19/2008	9:52:14	223.5	53.83	17.397	1.597
6/19/2008	9:52:28	236.8	53.83	17.278	1.478
6/19/2008	9:52:42	250.9	53.83	17.212	1.412
6/19/2008	9:52:57	265.8	53.83	17.097	1.297
6/19/2008	9:53:13	281.6	53.83	17.074	1.274
6/19/2008	9:53:29	298.4	53.83	16.971	1.171
6/19/2008	9:53:47	316.2	53.83	16.915	1.115
6/19/2008	9:54:06	335	53.83	17.082	1.282
6/19/2008	9:54:26	354.9	53.83	16.981	1.181
6/19/2008	9:54:47	376	53.8	16.927	1.127
6/19/2008	9:55:09	398.4	53.8	16.841	1.041
6/19/2008	9:55:33	422.1	53.83	16.749	0.949
6/19/2008	9:55:58	447.2	53.8	16.65	0.85
6/19/2008	9:56:25	473.8	53.8	16.535	0.735
6/19/2008	9:56:53	502	53.8	16.477	0.677
6/19/2008	9:57:23	531.9	53.8	16.426	0.626
6/19/2008	9:57:54	563.5	53.8	16.391	0.591
6/19/2008	9:58:28	597	53.8	16.343	0.543
6/19/2008	9:59:03	632.5	53.8	16.271	0.471
6/19/2008	9:59:41	670.1	53.8	16.251	0.451
6/19/2008	10:00:21	709.9	53.8	16.207	0.407
6/19/2008	10:01:03	752.1	53.78	16.172	0.372
6/19/2008	10:01:48	796.8	53.8	16.189	0.389
6/19/2008	10:02:35	844.2	53.8	16.15	0.35
6/19/2008	10:03:25	894.4	53.78	16.112	0.312
6/19/2008	10:04:18	947.5	53.8	16.117	0.317
6/19/2008	10:05:15	1003.8	53.78	16.115	0.315
6/19/2008	10:06:14	1063.4	53.78	16.028	0.228
6/19/2008	10:07:18	1126.6	53.78	16.152	0.352
6/19/2008	10:08:24	1193.5	53.78	16.106	0.306
6/19/2008	10:09:35	1264.4	53.78	16.036	0.236
6/19/2008	10:10:50	1339.5	53.78	16.028	0.228
6/19/2008	10:12:10	1419	53.78	16.043	0.243
6/19/2008	10:13:34	1503.3	53.78	15.993	0.193
6/19/2008	10:15:04	1592.6	53.78	16.001	0.201
6/19/2008	10:16:38	1687.1	53.78	15.983	0.183
6/19/2008	10:18:18	1787.2	53.78	16.03	0.23



Input Data		
Term	Units	
$2r_c$	Inches	2
$2r_W$	Inches	6
L_w	Feet	18.4
L_e	Feet	10
H*	Feet	200
y_0	Feet	1.87
t_0	Seconds	0
y_t	Feet	0.01
t	Seconds	2225

Solutions
Hydraulic Conductivity in Feet/Second
2.60E-06
Hydraulic Conductivity in Feet/Minute
1.56E-04
Hydraulic Conductivity in Feet/Day
2.24E-01

* - Assumed value

Calculations			
Term	Units		3.182
L_e/r_W	Feet/Foot	40.00	$\ln(R_e/r_W)_{\text{partial penetration}}$ =
A	None	2.780	2.524
B	None	0.430	$\ln(R_e/r_W)_{\text{full penetration}}$ =
C	None	2.336	3.182

General Equations

$$K = \frac{r_c^2 \ln(R_e/r_W)}{2L_e} \quad \frac{1}{t} \ln \frac{y_0}{y_t}$$

Where

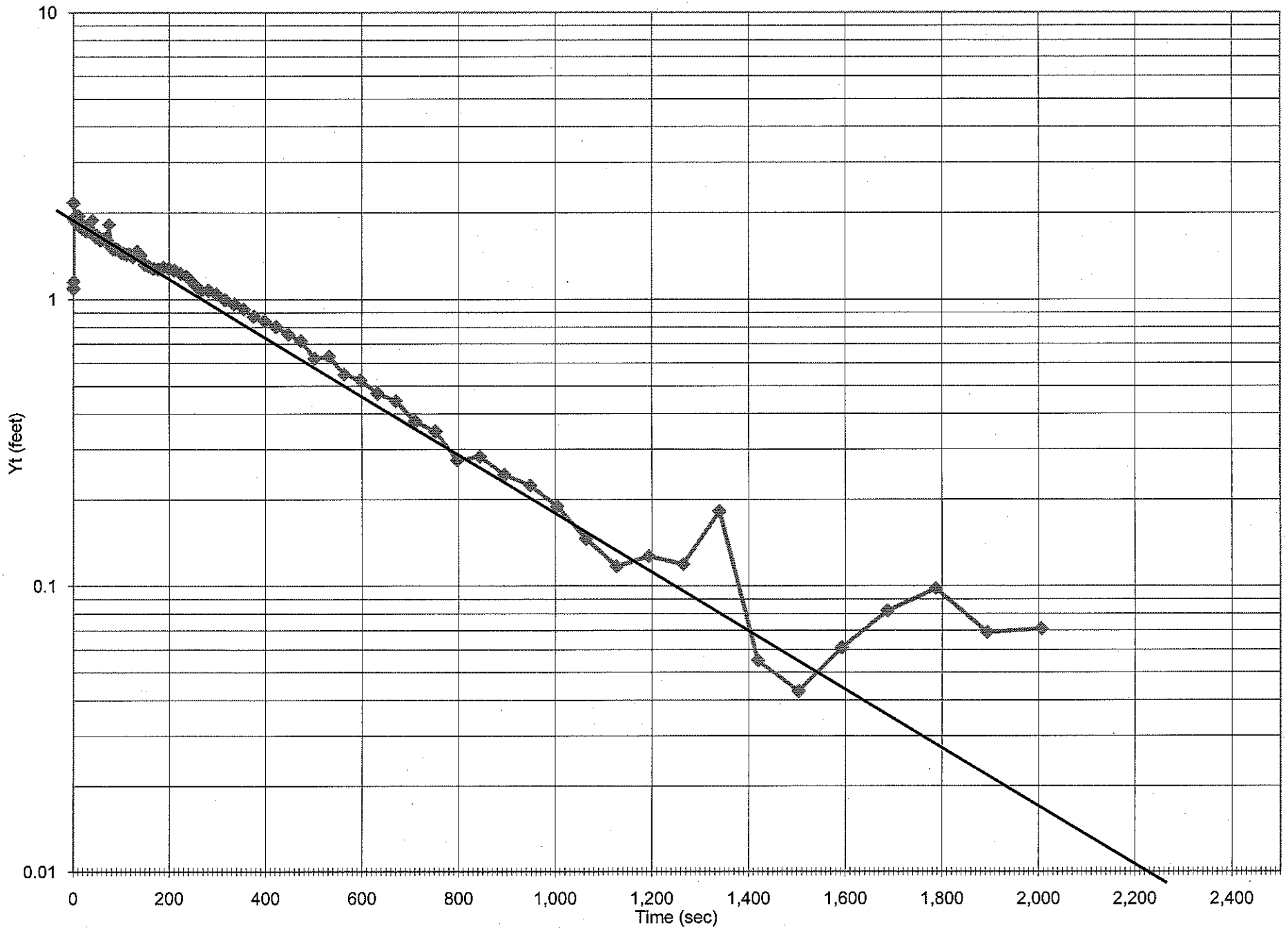
$$\ln(Re/r_W) = \left\{ \frac{1.1}{\ln(L_W/r_W)} + \frac{A + B \ln[(H - L_W)/r_W]}{L_e/r_W} \right\}^{-1}$$

For partial penetration or the equation below for full penetration

$$\ln(Re/r_W) = \left\{ \frac{1.1}{\ln(L_W/r_W)} + \frac{C}{L_e/r_W} \right\}^{-1}$$

CDM

619d Slug Out
Buncombe County C&D Facility Expansion
Site Hydrogeologic Investigation



619d Slug Out
Buncombe County C&D Facility Expansion
Site Hydrogeologic Investigation

CDM

In-Situ Inc. MiniTroll Pro

Report gen 6/20/2008 13:18:46
Report fron ...\SN07633 2008-06-19 102047 619d Slug Out.bin
Win-Situ® ' 4.57.0.0

Serial numl 7633
Firmware V 3.09
Unit name: Buncombe

Test name: 619d Slug Out

Test define 6/19/2008 10:19:59
Test startec 6/19/2008 10:20:47
Test stoppe 6/19/2008 10:54:25

Data gathered using Logarithmic testing
Maximum Seconds.
Number c 122

TOTAL DA 122

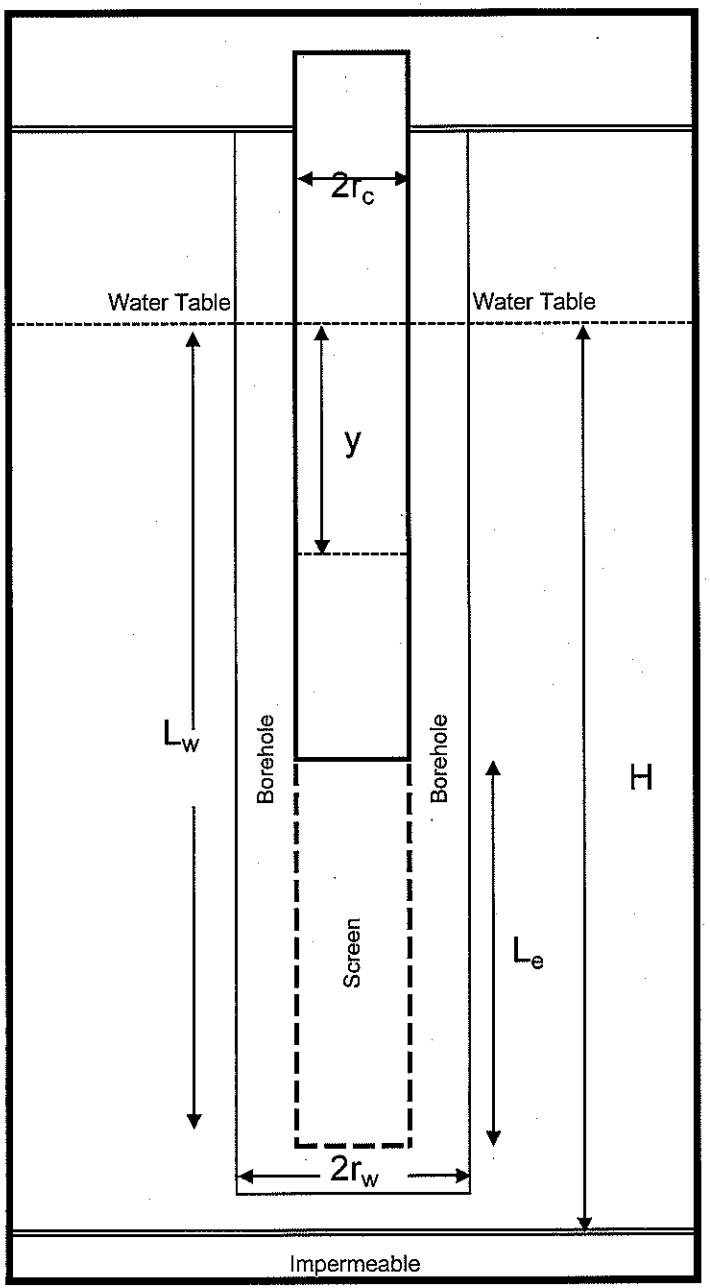
Channel number [1]
Measuren Temperature
Channel name:

Channel number [2]
Measuren Pressure
Channel name:
Sensor Ra 30 PSIG.
Sensor Of 0.000 psi
Specific g 1

Date	Time	ET (sec)	Chan[1] Temperatu Fahrenheit	Chan[2] Pressure Feet H2O	yt
6/19/2008	10:20:47	0	53.78	14.808	1.092
6/19/2008	10:20:47	0.3	53.8	14.749	1.151
6/19/2008	10:20:48	0.6	53.83	13.731	2.169
6/19/2008	10:20:48	0.9	53.85	13.99	1.91
6/19/2008	10:20:48	1.2	53.85	14.001	1.899
6/19/2008	10:20:49	1.5	53.85	13.972	1.928
6/19/2008	10:20:49	1.8	53.85	13.997	1.903
6/19/2008	10:20:49	2.1	53.87	13.993	1.907
6/19/2008	10:20:50	2.4	53.87	13.999	1.901
6/19/2008	10:20:50	2.7	53.87	13.98	1.92
6/19/2008	10:20:50	3	53.87	13.997	1.903
6/19/2008	10:20:50	3.3	53.87	14.003	1.897
6/19/2008	10:20:51	3.6	53.87	14.028	1.872
6/19/2008	10:20:51	3.9	53.87	14.009	1.891
6/19/2008	10:20:51	4.2	53.87	14.009	1.891
6/19/2008	10:20:52	4.5	53.87	13.999	1.901
6/19/2008	10:20:52	4.8	53.87	13.974	1.926
6/19/2008	10:20:52	5.1	53.89	13.946	1.954

6/19/2008	10:20:53	5.4	53.89	14.005	1.895
6/19/2008	10:20:53	5.7	53.89	13.989	1.911
6/19/2008	10:20:53	6	53.89	14.005	1.895
6/19/2008	10:20:53	6.4	53.89	14.011	1.889
6/19/2008	10:20:54	6.7	53.89	13.997	1.903
6/19/2008	10:20:54	7.1	53.89	14.015	1.885
6/19/2008	10:20:55	7.5	53.89	14.022	1.878
6/19/2008	10:20:55	8	53.89	13.976	1.924
6/19/2008	10:20:56	8.4	53.89	14.022	1.878
6/19/2008	10:20:56	8.9	53.89	14.044	1.856
6/19/2008	10:20:57	9.5	53.89	14.04	1.86
6/19/2008	10:20:57	10	53.87	14.036	1.864
6/19/2008	10:20:58	10.6	53.87	13.951	1.949
6/19/2008	10:20:58	11.3	53.87	14.052	1.848
6/19/2008	10:20:59	11.9	53.87	14.058	1.842
6/19/2008	10:21:00	12.6	53.87	14.089	1.811
6/19/2008	10:21:00	13.4	53.85	14.064	1.836
6/19/2008	10:21:01	14.2	53.85	14.072	1.828
6/19/2008	10:21:02	15	53.85	14.079	1.821
6/19/2008	10:21:03	15.9	53.85	14.095	1.805
6/19/2008	10:21:04	16.8	53.85	14.124	1.776
6/19/2008	10:21:05	17.8	53.85	14.085	1.815
6/19/2008	10:21:06	18.9	53.85	14.138	1.762
6/19/2008	10:21:07	20	53.85	14.114	1.786
6/19/2008	10:21:08	21.2	53.85	14.12	1.78
6/19/2008	10:21:10	22.4	53.85	14.145	1.755
6/19/2008	10:21:11	23.8	53.85	14.105	1.795
6/19/2008	10:21:12	25.2	53.85	14.126	1.774
6/19/2008	10:21:14	26.7	53.85	14.171	1.729
6/19/2008	10:21:15	28.2	53.85	14.157	1.743
6/19/2008	10:21:17	29.8	53.85	14.145	1.755
6/19/2008	10:21:19	31.5	53.85	14.153	1.747
6/19/2008	10:21:20	33.3	53.85	14.177	1.723
6/19/2008	10:21:22	35.2	53.85	14.171	1.729
6/19/2008	10:21:24	37.3	53.85	14.188	1.712
6/19/2008	10:21:27	39.5	53.85	14.015	1.885
6/19/2008	10:21:29	41.8	53.85	14.212	1.688
6/19/2008	10:21:31	44.3	53.85	14.219	1.681
6/19/2008	10:21:34	46.9	53.83	14.253	1.647
6/19/2008	10:21:37	49.7	53.85	14.231	1.669
6/19/2008	10:21:40	52.6	53.83	14.247	1.653
6/19/2008	10:21:43	55.7	53.83	14.296	1.604
6/19/2008	10:21:46	59	53.83	14.29	1.61
6/19/2008	10:21:50	62.5	53.83	14.278	1.622
6/19/2008	10:21:53	66.2	53.83	14.276	1.624
6/19/2008	10:21:57	70.1	53.83	14.292	1.608
6/19/2008	10:22:01	74.3	53.83	14.08	1.82
6/19/2008	10:22:06	78.7	53.83	14.377	1.523
6/19/2008	10:22:11	83.4	53.83	14.405	1.495
6/19/2008	10:22:16	88.4	53.83	14.403	1.497
6/19/2008	10:22:21	93.7	53.8	14.415	1.485
6/19/2008	10:22:26	99.3	53.8	14.448	1.452
6/19/2008	10:22:32	105.2	53.8	14.453	1.447
6/19/2008	10:22:39	111.5	53.8	14.469	1.431
6/19/2008	10:22:45	118.1	53.8	14.463	1.437
6/19/2008	10:22:52	125.1	53.8	14.496	1.404
6/19/2008	10:23:00	132.6	53.8	14.43	1.47

6/19/2008	10:23:08	140.5	53.8	14.477	1.423
6/19/2008	10:23:16	148.9	53.8	14.578	1.322
6/19/2008	10:23:25	157.8	53.8	14.597	1.303
6/19/2008	10:23:34	167.2	53.8	14.621	1.279
6/19/2008	10:23:44	177.2	53.8	14.629	1.271
6/19/2008	10:23:55	187.8	53.8	14.607	1.293
6/19/2008	10:24:06	199	53.78	14.619	1.281
6/19/2008	10:24:18	210.9	53.8	14.638	1.262
6/19/2008	10:24:31	223.5	53.78	14.67	1.23
6/19/2008	10:24:44	236.8	53.78	14.699	1.201
6/19/2008	10:24:58	250.9	53.78	14.765	1.135
6/19/2008	10:25:13	265.8	53.78	14.825	1.075
6/19/2008	10:25:29	281.6	53.78	14.825	1.075
6/19/2008	10:25:46	298.4	53.78	14.858	1.042
6/19/2008	10:26:03	316.2	53.78	14.905	0.995
6/19/2008	10:26:22	335	53.78	14.936	0.964
6/19/2008	10:26:42	354.9	53.78	14.975	0.925
6/19/2008	10:27:03	376	53.78	15.028	0.872
6/19/2008	10:27:26	398.4	53.78	15.059	0.841
6/19/2008	10:27:49	422.1	53.78	15.096	0.804
6/19/2008	10:28:14	447.2	53.78	15.144	0.756
6/19/2008	10:28:41	473.8	53.78	15.183	0.717
6/19/2008	10:29:09	502	53.78	15.277	0.623
6/19/2008	10:29:39	531.9	53.78	15.267	0.633
6/19/2008	10:30:11	563.5	53.78	15.351	0.549
6/19/2008	10:30:44	597	53.78	15.376	0.524
6/19/2008	10:31:20	632.5	53.78	15.429	0.471
6/19/2008	10:31:57	670.1	53.78	15.456	0.444
6/19/2008	10:32:37	709.9	53.78	15.524	0.376
6/19/2008	10:33:19	752.1	53.78	15.553	0.347
6/19/2008	10:34:04	796.8	53.78	15.625	0.275
6/19/2008	10:34:51	844.2	53.78	15.617	0.283
6/19/2008	10:35:42	894.4	53.78	15.656	0.244
6/19/2008	10:36:35	947.5	53.78	15.676	0.224
6/19/2008	10:37:31	1003.8	53.78	15.711	0.189
6/19/2008	10:38:31	1063.4	53.78	15.754	0.146
6/19/2008	10:39:34	1126.6	53.76	15.783	0.117
6/19/2008	10:40:41	1193.5	53.78	15.773	0.127
6/19/2008	10:41:52	1264.4	53.78	15.781	0.119
6/19/2008	10:43:07	1339.5	53.78	15.718	0.182
6/19/2008	10:44:26	1419	53.76	15.845	0.055
6/19/2008	10:45:50	1503.3	53.76	15.857	0.043
6/19/2008	10:47:20	1592.6	53.76	15.839	0.061
6/19/2008	10:48:54	1687.1	53.76	15.818	0.082
6/19/2008	10:50:34	1787.2	53.76	15.802	0.098
6/19/2008	10:52:20	1893.3	53.78	15.831	0.069
6/19/2008	10:54:13	2005.7	53.78	15.829	0.071



Input Data		
Term	Units	
$2r_c$	Inches	2
$2r_W$	Inches	6
L_w	Feet	14.9
L_e	Feet	10
H*	Feet	200
y_0	Feet	1.8
t_0	Seconds	0
y_t	Feet	0.01
t	Seconds	115

Solutions
Hydraulic Conductivity in Feet/Second
4.79E-05
Hydraulic Conductivity in Feet/Minute
2.87E-03
Hydraulic Conductivity in Feet/Day
4.14E+00

* - Assumed value

Calculations			
Term	Units		3.053
L_e/r_W	Feet/Foot	40.00	$\ln(R_e/r_W)_{\text{partial penetration}}$ =
A	None	2.780	2.442
B	None	0.430	$\ln(R_e/r_W)_{\text{full penetration}}$ =
C	None	2.336	3.053

General Equations

$$K = \frac{r_c^2 \ln(R_e/r_W)}{2L_e} \quad \frac{1}{t} \ln \frac{y_0}{y_t}$$

Where

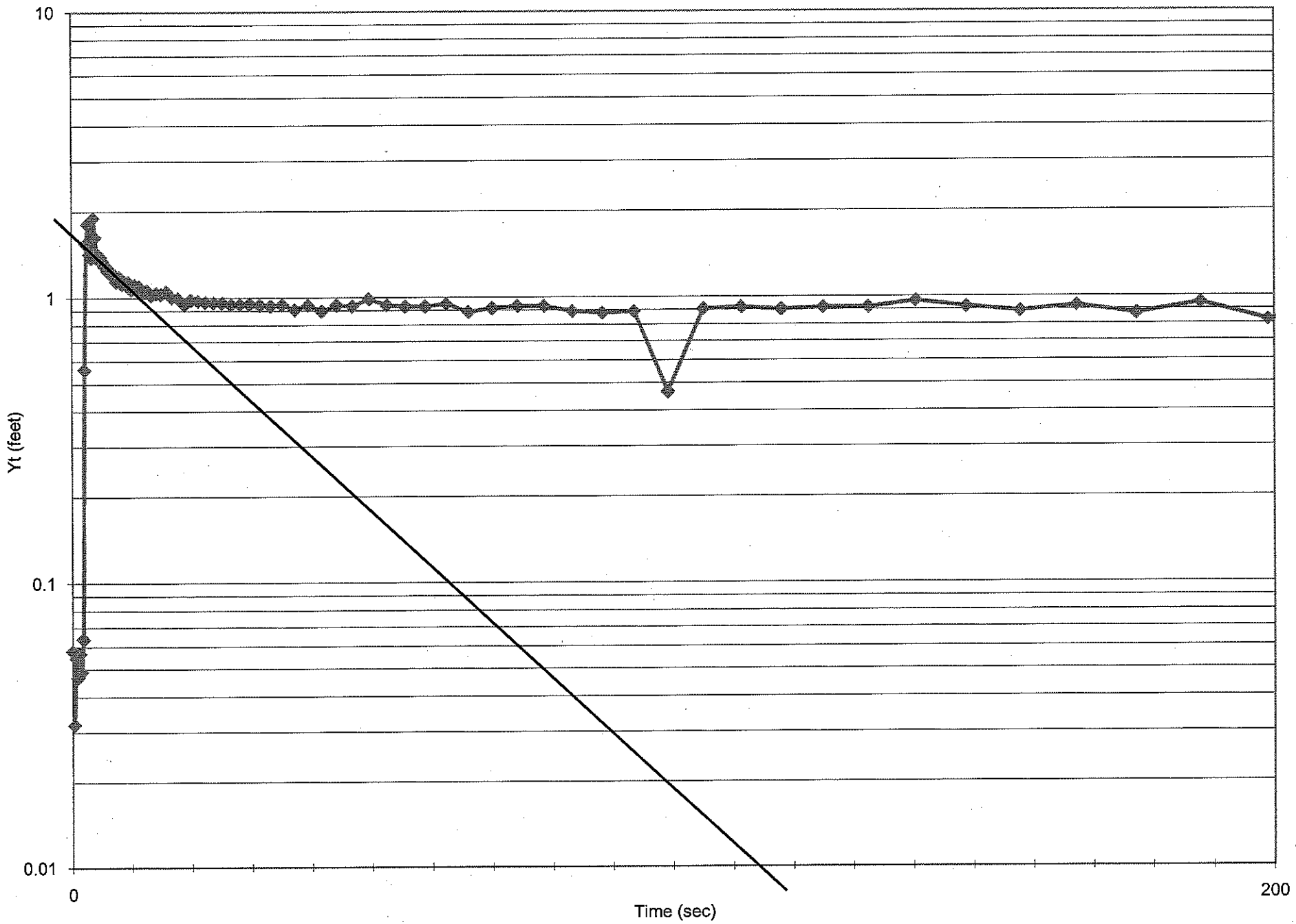
$$\ln(Re/r_W) = \left\{ \frac{1.1}{\ln(L_W/r_W)} + \frac{A + B \ln[(H - L_W)/r_W]}{L_e/r_W} \right\}^{-1}$$

For partial penetration or the equation below for full penetration

$$\ln(Re/r_W) = \left\{ \frac{1.1}{\ln(L_W/r_W)} + \frac{C}{L_e/r_W} \right\}^{-1}$$

625 Slug In
Buncombe County C&D Facility Expansion
Site Hydrogeologic Investigation

CDM



625 Slug In
Buncombe County C&D Facility Expansion
Site Hydrogeologic Investigation

CDM

In-Situ Inc. MiniTroll Pro

Report gen 6/20/2008 13:04:19
Report fron ...\SN07633 2008-06-18 145022 625 Slug In.bin
Win-Situ® '4.57.0.0

Serial numl 7633
Firmware V 3.09
Unit name: Buncombe

Test name: 625 Slug In

Test define 6/18/2008 14:48:49
Test startec 6/18/2008 14:50:22
Test stoppe 6/18/2008 15:24:15

Data gathered using Logarithmic testing
Maximum Seconds.
Number c 122

TOTAL DA' 122

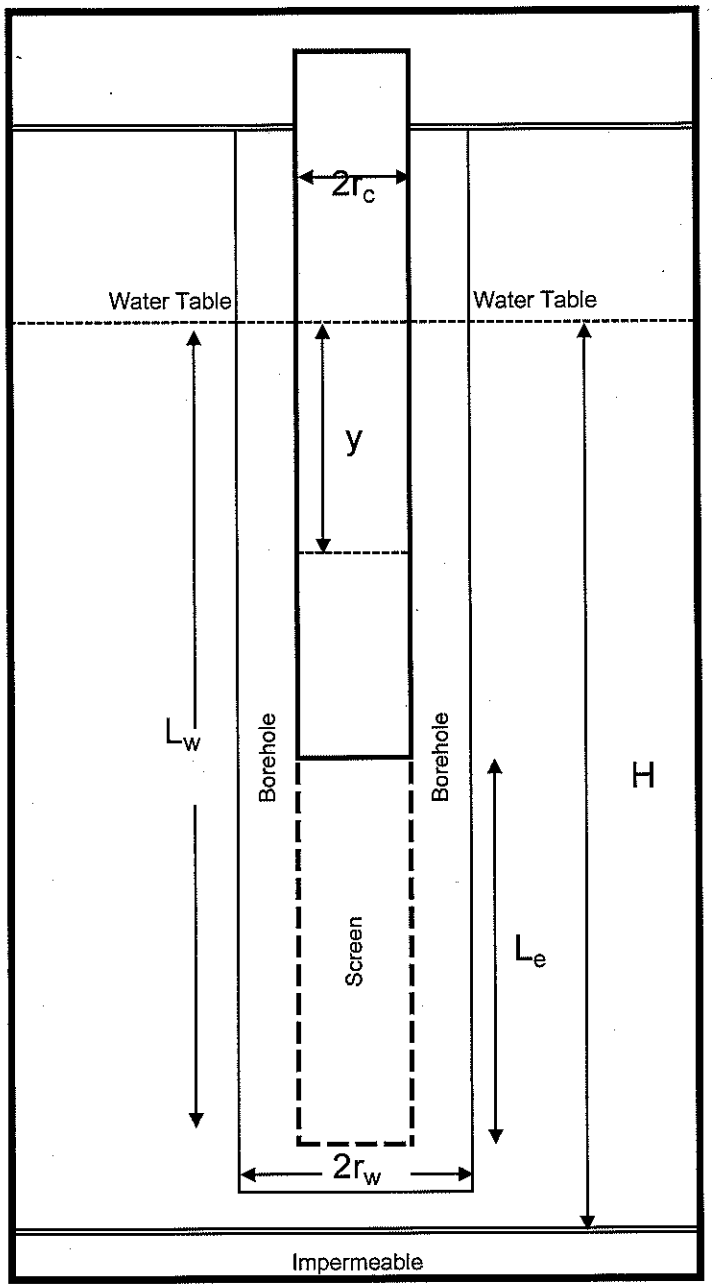
Channel number [1]
Measuren Temperature
Channel name:

Channel number [2]
Measuren Pressure
Channel name:
Sensor Ra 30 PSIG.
Sensor Of 0.000 psi
Specific g 1

Date	Time	ET (sec)	Chan[1] Temperatu Fahrenheit	Chan[2] Pressure Feet H2O	yt
6/18/2008	14:50:22	0	55.62	13.158	0.058
6/18/2008	14:50:22	0.3	55.66	13.132	0.032
6/18/2008	14:50:23	0.6	55.69	13.155	0.055
6/18/2008	14:50:23	0.9	55.69	13.147	0.047
6/18/2008	14:50:23	1.2	55.69	13.157	0.057
6/18/2008	14:50:24	1.5	55.71	13.149	0.049
6/18/2008	14:50:24	1.8	55.71	13.164	0.064
6/18/2008	14:50:24	2.1	55.71	13.662	0.562
6/18/2008	14:50:24	2.4	55.71	14.643	1.543
6/18/2008	14:50:25	2.7	55.73	14.909	1.809
6/18/2008	14:50:25	3	55.73	14.524	1.424
6/18/2008	14:50:25	3.3	55.73	14.485	1.385
6/18/2008	14:50:26	3.6	55.73	15.001	1.901
6/18/2008	14:50:26	3.9	55.73	14.73	1.63
6/18/2008	14:50:26	4.2	55.73	14.485	1.385
6/18/2008	14:50:27	4.5	55.73	14.514	1.414
6/18/2008	14:50:27	4.8	55.73	14.491	1.391
6/18/2008	14:50:27	5.1	55.73	14.45	1.35

6/18/2008	14:50:27	5.4	55.73	14.4	1.3
6/18/2008	14:50:28	5.7	55.73	14.394	1.294
6/18/2008	14:50:28	6	55.73	14.347	1.247
6/18/2008	14:50:28	6.4	55.73	14.353	1.253
6/18/2008	14:50:29	6.7	55.73	14.328	1.228
6/18/2008	14:50:29	7.1	55.73	14.285	1.185
6/18/2008	14:50:30	7.5	55.75	14.24	1.14
6/18/2008	14:50:30	8	55.75	14.281	1.181
6/18/2008	14:50:30	8.4	55.75	14.22	1.12
6/18/2008	14:50:31	8.9	55.75	14.234	1.134
6/18/2008	14:50:32	9.5	55.75	14.234	1.134
6/18/2008	14:50:32	10	55.73	14.17	1.07
6/18/2008	14:50:33	10.6	55.71	14.211	1.111
6/18/2008	14:50:33	11.3	55.71	14.196	1.096
6/18/2008	14:50:34	11.9	55.71	14.143	1.043
6/18/2008	14:50:35	12.6	55.71	14.161	1.061
6/18/2008	14:50:35	13.4	55.71	14.122	1.022
6/18/2008	14:50:36	14.2	55.71	14.139	1.039
6/18/2008	14:50:37	15	55.71	14.129	1.029
6/18/2008	14:50:38	15.9	55.71	14.151	1.051
6/18/2008	14:50:39	16.8	55.69	14.102	1.002
6/18/2008	14:50:40	17.8	55.69	14.097	0.997
6/18/2008	14:50:41	18.9	55.69	14.046	0.946
6/18/2008	14:50:42	20	55.69	14.081	0.981
6/18/2008	14:50:43	21.2	55.69	14.073	0.973
6/18/2008	14:50:45	22.4	55.69	14.065	0.965
6/18/2008	14:50:46	23.8	55.69	14.06	0.96
6/18/2008	14:50:47	25.2	55.69	14.06	0.96
6/18/2008	14:50:49	26.7	55.69	14.046	0.946
6/18/2008	14:50:50	28.2	55.69	14.048	0.948
6/18/2008	14:50:52	29.8	55.69	14.05	0.95
6/18/2008	14:50:54	31.5	55.69	14.042	0.942
6/18/2008	14:50:55	33.3	55.69	14.036	0.936
6/18/2008	14:50:57	35.2	55.69	14.044	0.944
6/18/2008	14:50:59	37.3	55.69	14.007	0.907
6/18/2008	14:51:02	39.5	55.69	14.042	0.942
6/18/2008	14:51:04	41.8	55.69	13.997	0.897
6/18/2008	14:51:06	44.3	55.69	14.04	0.94
6/18/2008	14:51:09	46.9	55.69	14.032	0.932
6/18/2008	14:51:12	49.7	55.69	14.087	0.987
6/18/2008	14:51:15	52.6	55.66	14.04	0.94
6/18/2008	14:51:18	55.7	55.66	14.029	0.929
6/18/2008	14:51:21	59	55.66	14.029	0.929
6/18/2008	14:51:25	62.5	55.66	14.048	0.948
6/18/2008	14:51:28	66.2	55.66	13.988	0.888
6/18/2008	14:51:32	70.1	55.66	14.015	0.915
6/18/2008	14:51:36	74.3	55.66	14.031	0.931
6/18/2008	14:51:41	78.7	55.64	14.029	0.929
6/18/2008	14:51:45	83.4	55.64	13.992	0.892
6/18/2008	14:51:50	88.4	55.64	13.98	0.88
6/18/2008	14:51:56	93.7	55.64	13.988	0.888
6/18/2008	14:52:01	99.3	55.64	13.566	0.466
6/18/2008	14:52:07	105.2	55.64	14.008	0.908
6/18/2008	14:52:14	111.5	55.64	14.019	0.919
6/18/2008	14:52:20	118.1	55.64	14.002	0.902
6/18/2008	14:52:27	125.1	55.62	14.016	0.916
6/18/2008	14:52:35	132.6	55.62	14.018	0.918

6/18/2008	14:52:43	140.5	55.62	14.064	0.964
6/18/2008	14:52:51	148.9	55.62	14.02	0.92
6/18/2008	14:53:00	157.8	55.62	13.988	0.888
6/18/2008	14:53:09	167.2	55.62	14.027	0.927
6/18/2008	14:53:19	177.2	55.62	13.969	0.869
6/18/2008	14:53:30	187.8	55.62	14.047	0.947
6/18/2008	14:53:41	199	55.62	13.924	0.824
6/18/2008	14:53:53	210.9	55.59	14.002	0.902
6/18/2008	14:54:06	223.5	55.59	13.882	0.782
6/18/2008	14:54:19	236.8	55.59	13.979	0.879
6/18/2008	14:54:33	250.9	55.59	14.01	0.91
6/18/2008	14:54:48	265.8	55.59	13.963	0.863
6/18/2008	14:55:04	281.6	55.59	13.958	0.858
6/18/2008	14:55:20	298.4	55.59	14.035	0.935
6/18/2008	14:55:38	316.2	55.59	13.975	0.875
6/18/2008	14:55:57	335	55.59	13.993	0.893
6/18/2008	14:56:17	354.9	55.57	14.02	0.92
6/18/2008	14:56:38	376	55.57	13.901	0.801
6/18/2008	14:57:00	398.4	55.57	13.987	0.887
6/18/2008	14:57:24	422.1	55.57	13.94	0.84
6/18/2008	14:57:49	447.2	55.57	13.971	0.871
6/18/2008	14:58:16	473.8	55.57	13.94	0.84
6/18/2008	14:58:44	502	55.57	14.008	0.908
6/18/2008	14:59:14	531.9	55.57	13.919	0.819
6/18/2008	14:59:46	563.5	55.55	13.958	0.858
6/18/2008	15:00:19	597	55.55	13.962	0.862
6/18/2008	15:00:55	632.5	55.55	13.966	0.866
6/18/2008	15:01:32	670.1	55.55	13.976	0.876
6/18/2008	15:02:12	709.9	55.55	13.974	0.874
6/18/2008	15:02:54	752.1	55.55	13.911	0.811
6/18/2008	15:03:39	796.8	55.55	13.917	0.817
6/18/2008	15:04:26	844.2	55.55	13.931	0.831
6/18/2008	15:05:16	894.4	55.53	13.958	0.858
6/18/2008	15:06:10	947.5	55.53	13.894	0.794
6/18/2008	15:07:06	1003.8	55.53	13.941	0.841
6/18/2008	15:08:05	1063.4	55.53	13.931	0.831
6/18/2008	15:09:09	1126.6	55.53	13.958	0.858
6/18/2008	15:10:16	1193.5	55.53	13.923	0.823
6/18/2008	15:11:26	1264.4	55.53	13.912	0.812
6/18/2008	15:12:42	1339.5	55.5	13.972	0.872
6/18/2008	15:14:01	1419	55.5	13.963	0.863
6/18/2008	15:15:25	1503.3	55.5	13.904	0.804
6/18/2008	15:16:55	1592.6	55.5	13.926	0.826
6/18/2008	15:18:29	1687.1	55.5	13.883	0.783
6/18/2008	15:20:09	1787.2	55.5	13.937	0.837
6/18/2008	15:21:55	1893.3	55.5	13.881	0.781
6/18/2008	15:23:48	2005.7	55.48	14.091	0.991



Input Data		
Term	Units	
$2r_c$	Inches	2
$2r_W$	Inches	6
L_w	Feet	14.9
L_e	Feet	10
H*	Feet	200
y_0	Feet	1.2
t_0	Seconds	0
y_t	Feet	0.01
t	Seconds	315

Solutions
Hydraulic Conductivity in Feet/Second
1.61E-05
Hydraulic Conductivity in Feet/Minute
9.67E-04
Hydraulic Conductivity in Feet/Day
1.39E+00

* - Assumed value

Calculations			
Term	Units		3.053
L_e/r_W	Feet/Foot	40.00	$\ln(R_e/r_W)_{\text{partial penetration}}$ =
A	None	2.780	2.442
B	None	0.430	$\ln(R_e/r_W)_{\text{full penetration}}$ =
C	None	2.336	3.053

General Equations

$$K = \frac{r_c^2 \ln(R_e/r_W)}{2L_e} \quad \frac{1}{t} \ln \frac{y_0}{y_t}$$

Where

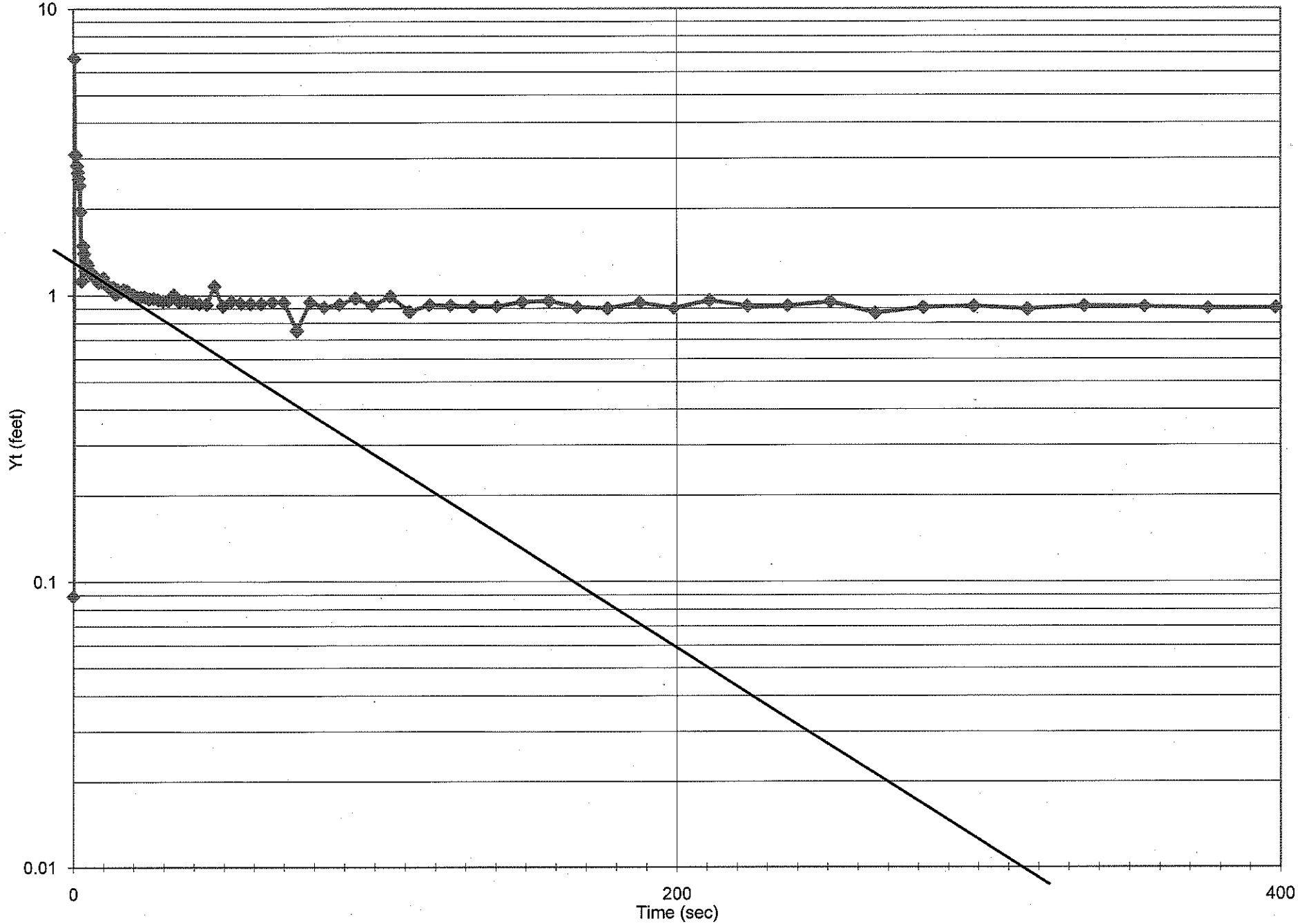
$$\ln(Re/r_W) = \left\{ \frac{1.1}{\ln(L_W/r_W)} + \frac{A + B \ln[(H - L_W)/r_W]}{L_e/r_W} \right\}^{-1}$$

For partial penetration or the equation below for full penetration

$$\ln(Re/r_W) = \left\{ \frac{1.1}{\ln(L_W/r_W)} + \frac{C}{L_e/r_W} \right\}^{-1}$$

625 re-test Slug In
Buncombe County C&D Facility Expansion
Site Hydrogeologic Investigation

CDM



625 re-test Slug In
Buncombe County C&D Facility Expansion
Site Hydrogeologic Investigation

CDM

In-Situ Inc. MiniTroll Pro

Report gen 6/20/2008 13:21:28
Report fron ...\SN07633 2008-06-19 122103 625re Slug In.bin
Win-Situ® '4.57.0.0

Serial numl 7633
Firmware V 3.09
Unit name: Buncombe

Test name: 625re Slug In

Test define 6/19/2008 12:19:50
Test startec 6/19/2008 12:21:03
Test stoppe 6/19/2008 12:58:56

Data gathered using Logarithmic testing
Maximum Seconds.
Number c 124

TOTAL DA 124

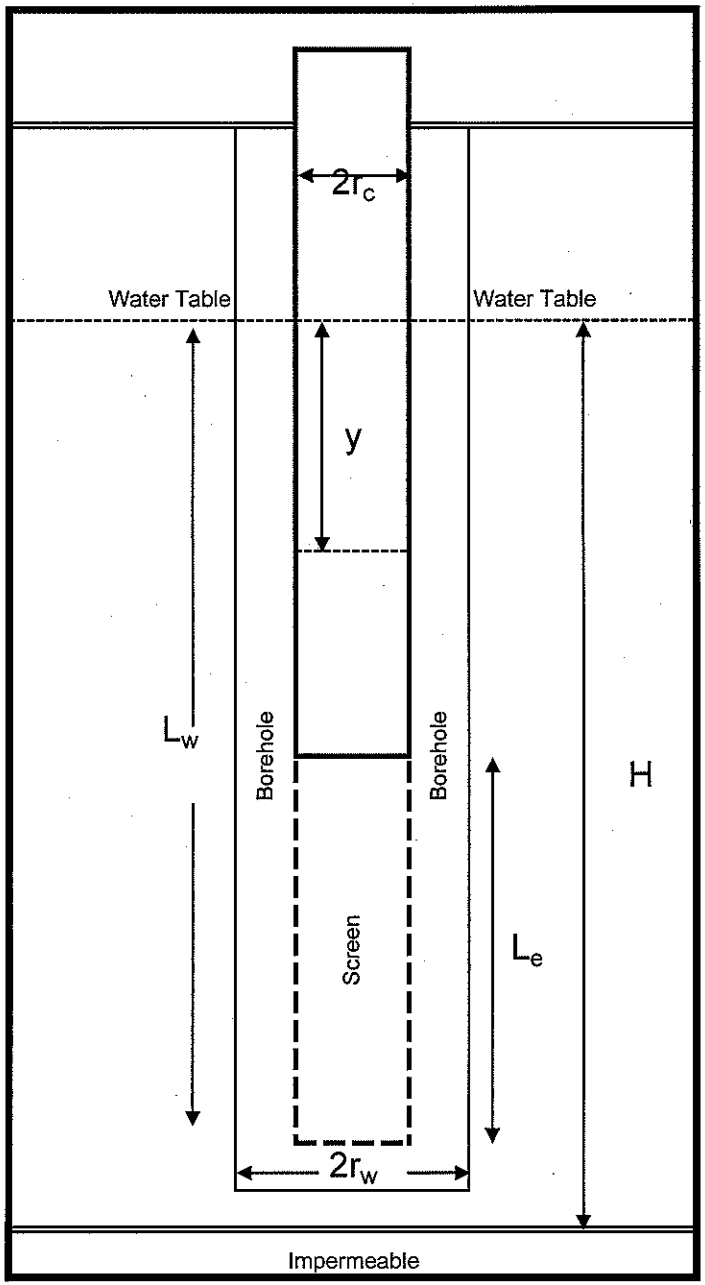
Channel number [1]
Measuren Temperature
Channel name:

Channel number [2]
Measuren Pressure
Channel name:
Sensor Ra 30 PSIG.
Sensor Ol 0.000 psi
Specific g 1

Date	Time	ET (sec)	Chan[1] Temperatu Fahrenheit	Chan[2] Pressure Feet H2O	yt
6/19/2008	12:21:03	0	55.57	13.989	0.089
6/19/2008	12:21:03	0.3	55.62	20.609	6.709
6/19/2008	12:21:03	0.6	55.62	16.992	3.092
6/19/2008	12:21:03	0.9	55.64	16.984	3.084
6/19/2008	12:21:04	1.2	55.64	16.733	2.833
6/19/2008	12:21:04	1.5	55.66	16.584	2.684
6/19/2008	12:21:04	1.8	55.66	16.457	2.557
6/19/2008	12:21:05	2.1	55.66	16.321	2.421
6/19/2008	12:21:05	2.4	55.66	15.865	1.965
6/19/2008	12:21:05	2.7	55.66	15.019	1.119
6/19/2008	12:21:06	3	55.66	15.027	1.127
6/19/2008	12:21:06	3.3	55.69	15.389	1.489
6/19/2008	12:21:06	3.6	55.69	15.301	1.401
6/19/2008	12:21:06	3.9	55.69	15.13	1.23
6/19/2008	12:21:07	4.2	55.69	15.188	1.288
6/19/2008	12:21:07	4.5	55.69	15.198	1.298
6/19/2008	12:21:07	4.8	55.69	15.176	1.276
6/19/2008	12:21:08	5.1	55.69	15.118	1.218

6/19/2008	12:21:08	5.4	55.69	15.106	1.206
6/19/2008	12:21:08	5.7	55.69	15.101	1.201
6/19/2008	12:21:09	6	55.69	15.103	1.203
6/19/2008	12:21:09	6.4	55.69	15.091	1.191
6/19/2008	12:21:09	6.7	55.69	15.064	1.164
6/19/2008	12:21:10	7.1	55.69	15.058	1.158
6/19/2008	12:21:10	7.5	55.69	15.054	1.154
6/19/2008	12:21:11	8	55.69	15.042	1.142
6/19/2008	12:21:11	8.4	55.69	15.005	1.105
6/19/2008	12:21:12	8.9	55.69	15.029	1.129
6/19/2008	12:21:12	9.5	55.69	15.015	1.115
6/19/2008	12:21:13	10	55.66	15.05	1.15
6/19/2008	12:21:13	10.6	55.66	14.996	1.096
6/19/2008	12:21:14	11.3	55.66	14.982	1.082
6/19/2008	12:21:14	11.9	55.66	14.969	1.069
6/19/2008	12:21:15	12.6	55.66	14.963	1.063
6/19/2008	12:21:16	13.4	55.66	14.969	1.069
6/19/2008	12:21:17	14.2	55.64	14.912	1.012
6/19/2008	12:21:18	15	55.64	14.944	1.044
6/19/2008	12:21:18	15.9	55.64	14.932	1.032
6/19/2008	12:21:19	16.8	55.64	14.945	1.045
6/19/2008	12:21:20	17.8	55.64	14.938	1.038
6/19/2008	12:21:21	18.9	55.64	14.907	1.007
6/19/2008	12:21:23	20	55.64	14.907	1.007
6/19/2008	12:21:24	21.2	55.64	14.887	0.987
6/19/2008	12:21:25	22.4	55.64	14.885	0.985
6/19/2008	12:21:26	23.8	55.64	14.887	0.987
6/19/2008	12:21:28	25.2	55.64	14.873	0.973
6/19/2008	12:21:29	26.7	55.62	14.876	0.976
6/19/2008	12:21:31	28.2	55.64	14.866	0.966
6/19/2008	12:21:32	29.8	55.62	14.856	0.956
6/19/2008	12:21:34	31.5	55.62	14.858	0.958
6/19/2008	12:21:36	33.3	55.62	14.903	1.003
6/19/2008	12:21:38	35.2	55.62	14.847	0.947
6/19/2008	12:21:40	37.3	55.62	14.858	0.958
6/19/2008	12:21:42	39.5	55.62	14.843	0.943
6/19/2008	12:21:44	41.8	55.62	14.837	0.937
6/19/2008	12:21:47	44.3	55.62	14.831	0.931
6/19/2008	12:21:49	46.9	55.62	14.977	1.077
6/19/2008	12:21:52	49.7	55.59	14.818	0.918
6/19/2008	12:21:55	52.6	55.59	14.855	0.955
6/19/2008	12:21:58	55.7	55.59	14.839	0.939
6/19/2008	12:22:02	59	55.59	14.835	0.935
6/19/2008	12:22:05	62.5	55.59	14.835	0.935
6/19/2008	12:22:09	66.2	55.59	14.847	0.947
6/19/2008	12:22:13	70.1	55.59	14.845	0.945
6/19/2008	12:22:17	74.3	55.59	14.654	0.754
6/19/2008	12:22:21	78.7	55.57	14.845	0.945
6/19/2008	12:22:26	83.4	55.59	14.81	0.91
6/19/2008	12:22:31	88.4	55.57	14.831	0.931
6/19/2008	12:22:36	93.7	55.57	14.876	0.976
6/19/2008	12:22:42	99.3	55.57	14.822	0.922
6/19/2008	12:22:48	105.2	55.57	14.892	0.992
6/19/2008	12:22:54	111.5	55.55	14.777	0.877
6/19/2008	12:23:01	118.1	55.55	14.826	0.926
6/19/2008	12:23:08	125.1	55.55	14.822	0.922
6/19/2008	12:23:15	132.6	55.55	14.814	0.914

6/19/2008	12:23:23	140.5	55.55	14.816	0.916
6/19/2008	12:23:31	148.9	55.53	14.848	0.948
6/19/2008	12:23:40	157.8	55.53	14.855	0.955
6/19/2008	12:23:50	167.2	55.53	14.809	0.909
6/19/2008	12:24:00	177.2	55.53	14.801	0.901
6/19/2008	12:24:10	187.8	55.53	14.844	0.944
6/19/2008	12:24:22	199	55.5	14.801	0.901
6/19/2008	12:24:33	210.9	55.5	14.86	0.96
6/19/2008	12:24:46	223.5	55.5	14.819	0.919
6/19/2008	12:24:59	236.8	55.5	14.819	0.919
6/19/2008	12:25:13	250.9	55.5	14.85	0.95
6/19/2008	12:25:28	265.8	55.5	14.768	0.868
6/19/2008	12:25:44	281.6	55.48	14.807	0.907
6/19/2008	12:26:01	298.4	55.5	14.815	0.915
6/19/2008	12:26:19	316.2	55.48	14.794	0.894
6/19/2008	12:26:38	335	55.48	14.819	0.919
6/19/2008	12:26:57	354.9	55.48	14.813	0.913
6/19/2008	12:27:19	376	55.48	14.801	0.901
6/19/2008	12:27:41	398.4	55.48	14.805	0.905
6/19/2008	12:28:05	422.1	55.48	14.799	0.899
6/19/2008	12:28:30	447.2	55.48	14.84	0.94
6/19/2008	12:28:56	473.8	55.46	14.835	0.935
6/19/2008	12:29:25	502	55.46	14.809	0.909
6/19/2008	12:29:54	531.9	55.48	14.745	0.845
6/19/2008	12:30:26	563.5	55.46	14.804	0.904
6/19/2008	12:31:00	597	55.46	14.786	0.886
6/19/2008	12:31:35	632.5	55.46	14.819	0.919
6/19/2008	12:32:13	670.1	55.46	14.78	0.88
6/19/2008	12:32:52	709.9	55.46	14.664	0.764
6/19/2008	12:33:35	752.1	55.46	14.557	0.657
6/19/2008	12:34:19	796.8	55.46	14.712	0.812
6/19/2008	12:35:07	844.2	55.46	14.778	0.878
6/19/2008	12:35:57	894.4	55.46	14.994	1.094
6/19/2008	12:36:50	947.5	55.46	14.808	0.908
6/19/2008	12:37:46	1003.8	55.46	14.767	0.867
6/19/2008	12:38:46	1063.4	55.46	14.761	0.861
6/19/2008	12:39:49	1126.6	55.44	14.761	0.861
6/19/2008	12:40:56	1193.5	55.44	14.734	0.834
6/19/2008	12:42:07	1264.4	55.44	14.769	0.869
6/19/2008	12:43:22	1339.5	55.44	14.771	0.871
6/19/2008	12:44:42	1419	55.44	14.718	0.818
6/19/2008	12:46:06	1503.3	55.44	14.749	0.849
6/19/2008	12:47:35	1592.6	55.44	14.654	0.754
6/19/2008	12:49:10	1687.1	55.44	14.784	0.884
6/19/2008	12:50:50	1787.2	55.44	14.687	0.787
6/19/2008	12:52:36	1893.3	55.44	14.72	0.82
6/19/2008	12:54:28	2005.7	55.44	14.738	0.838
6/19/2008	12:56:27	2124.7	55.44	14.718	0.818
6/19/2008	12:58:33	2250.8	55.44	14.742	0.842



Input Data		
Term	Units	
$2r_c$	Inches	2
$2r_W$	Inches	6
L_w	Feet	14.9
L_e	Feet	10
H*	Feet	200
y_0	Feet	0.5
t_0	Seconds	0
y_t	Feet	0.01
t	Seconds	130

Solutions
Hydraulic Conductivity in Feet/Second
3.19E-05
Hydraulic Conductivity in Feet/Minute
1.91E-03
Hydraulic Conductivity in Feet/Day
2.76E+00

* - Assumed value

Calculations			
Term	Units		3.053
L_e/r_W	Feet/Foot	40.00	$\ln(R_e/r_W)_{\text{partial penetration}}$ =
A	None	2.780	2.442
B	None	0.430	$\ln(R_e/r_W)_{\text{full penetration}}$ =
C	None	2.336	3.053

General Equations

$$K = \frac{r_c^2 \ln(R_e/r_W)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

Where

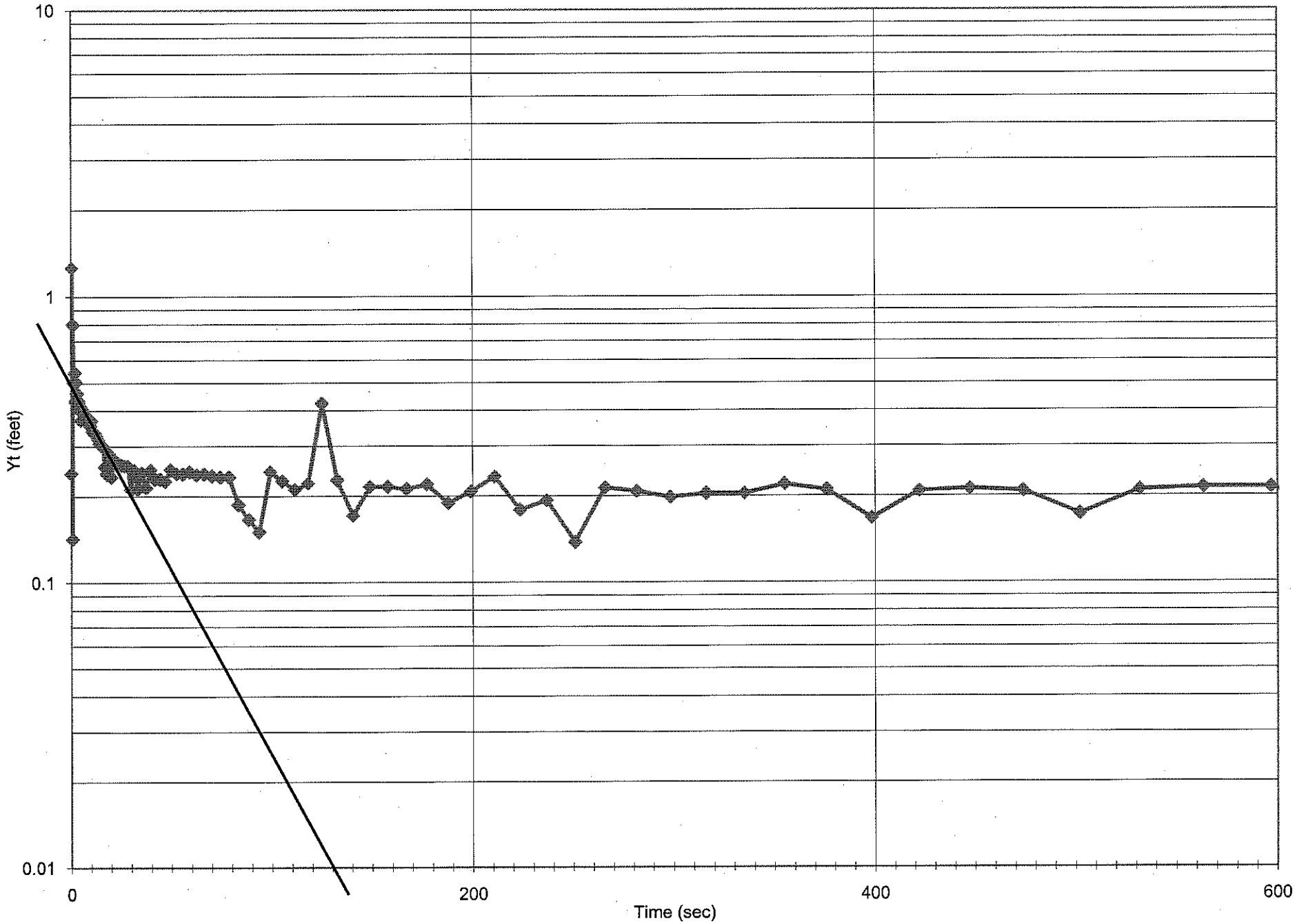
$$\ln(Re/r_W) = \left\{ \frac{1.1}{\ln(L_W/r_W)} + \frac{A + B \ln[(H - L_W)/r_W]}{L_e/r_W} \right\}^{-1}$$

For partial penetration or the equation below for full penetration

$$\ln(Re/r_W) = \left\{ \frac{1.1}{\ln(L_W/r_W)} + \frac{C}{L_e/r_W} \right\}^{-1}$$

CDM

625 Slug Out
Buncombe County C&D Facility Expansion
Site Hydrogeologic Investigation



625 Slug Out
Buncombe County C&D Facility Expansion
Site Hydrogeologic Investigation

CDM

In-Situ Inc. MiniTroll Pro

Report gen 6/20/2008 13:12:11
Report fron ...\SN07633 2008-06-18 152633 625 Slug Out.bin
Win-Situ® ' 4.57.0.0

Serial numl 7633
Firmware V 3.09
Unit name: Buncombe

Test name: 625 Slug Out

Test define 6/18/2008 15:25:40
Test startec 6/18/2008 15:26:33
Test stoppe 6/18/2008 15:55:15

Data gathered using Logarithmic testing
Maximum Seconds.
Number c 119

TOTAL DA' 119

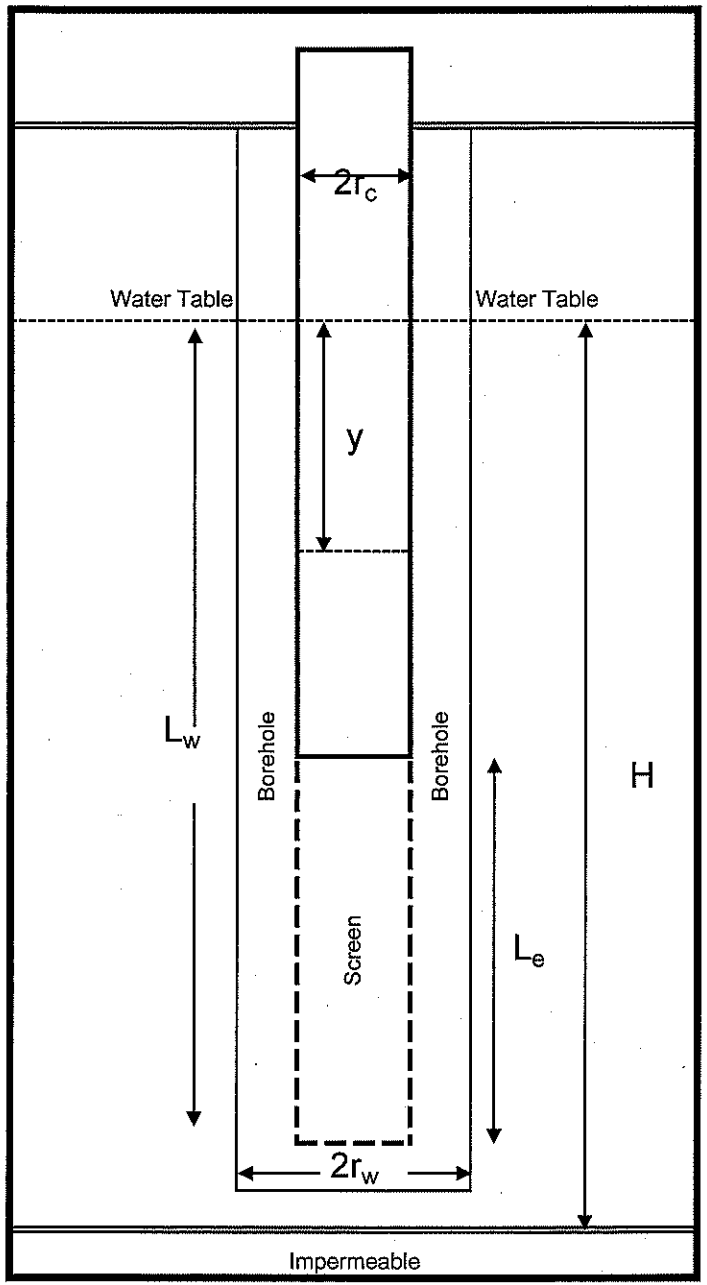
Channel number [1]
Measuren Temperature
Channel name:

Channel number [2]
Measuren Pressure
Channel name:
Sensor Ra 30 PSIG.
Sensor Of 0.000 psi
Specific g 1

Date	Time	ET (sec)	Chan[1] Temperatu Fahrenheit	Chan[2] Pressure Feet H2O	
6/18/2008	15:26:33	0	55.48	12.959	0.241
6/18/2008	15:26:34	0.3	55.53	11.943	1.257
6/18/2008	15:26:34	0.6	55.53	13.058	0.142
6/18/2008	15:26:34	0.9	55.55	12.4	0.8
6/18/2008	15:26:35	1.2	55.55	12.697	0.503
6/18/2008	15:26:35	1.5	55.55	12.697	0.503
6/18/2008	15:26:35	1.8	55.57	12.656	0.544
6/18/2008	15:26:35	2.1	55.57	12.769	0.431
6/18/2008	15:26:36	2.4	55.57	12.695	0.505
6/18/2008	15:26:36	2.7	55.57	12.738	0.462
6/18/2008	15:26:36	3	55.57	12.74	0.46
6/18/2008	15:26:37	3.3	55.59	12.792	0.408
6/18/2008	15:26:37	3.6	55.59	12.765	0.435
6/18/2008	15:26:37	3.9	55.59	12.773	0.427
6/18/2008	15:26:38	4.2	55.59	12.782	0.418
6/18/2008	15:26:38	4.5	55.59	12.786	0.414
6/18/2008	15:26:38	4.8	55.59	12.829	0.371
6/18/2008	15:26:38	5.1	55.59	12.798	0.402

6/18/2008	15:26:39	5.4	55.59	12.794	0.406
6/18/2008	15:26:39	5.7	55.59	12.808	0.392
6/18/2008	15:26:39	6	55.59	12.804	0.396
6/18/2008	15:26:40	6.4	55.59	12.808	0.392
6/18/2008	15:26:40	6.7	55.59	12.819	0.381
6/18/2008	15:26:40	7.1	55.59	12.827	0.373
6/18/2008	15:26:41	7.5	55.59	12.825	0.375
6/18/2008	15:26:41	8	55.59	12.825	0.375
6/18/2008	15:26:42	8.4	55.59	12.831	0.369
6/18/2008	15:26:42	8.9	55.59	12.837	0.363
6/18/2008	15:26:43	9.5	55.62	12.846	0.354
6/18/2008	15:26:43	10	55.59	12.831	0.369
6/18/2008	15:26:44	10.6	55.59	12.86	0.34
6/18/2008	15:26:45	11.3	55.57	12.866	0.334
6/18/2008	15:26:45	11.9	55.57	12.868	0.332
6/18/2008	15:26:46	12.6	55.57	12.874	0.326
6/18/2008	15:26:47	13.4	55.57	12.882	0.318
6/18/2008	15:26:48	14.2	55.57	12.892	0.308
6/18/2008	15:26:48	15	55.57	12.897	0.303
6/18/2008	15:26:49	15.9	55.57	12.899	0.301
6/18/2008	15:26:50	16.8	55.55	12.946	0.254
6/18/2008	15:26:51	17.8	55.55	12.96	0.24
6/18/2008	15:26:52	18.9	55.55	12.917	0.283
6/18/2008	15:26:53	20	55.55	12.966	0.234
6/18/2008	15:26:55	21.2	55.55	12.935	0.265
6/18/2008	15:26:56	22.4	55.55	12.935	0.265
6/18/2008	15:26:57	23.8	55.55	12.939	0.261
6/18/2008	15:26:59	25.2	55.55	12.942	0.258
6/18/2008	15:27:00	26.7	55.55	12.944	0.256
6/18/2008	15:27:02	28.2	55.55	12.944	0.256
6/18/2008	15:27:03	29.8	55.55	12.989	0.211
6/18/2008	15:27:05	31.5	55.55	12.952	0.248
6/18/2008	15:27:07	33.3	55.55	12.987	0.213
6/18/2008	15:27:09	35.2	55.55	12.958	0.242
6/18/2008	15:27:11	37.3	55.55	12.985	0.215
6/18/2008	15:27:13	39.5	55.55	12.952	0.248
6/18/2008	15:27:15	41.8	55.55	12.97	0.23
6/18/2008	15:27:18	44.3	55.55	12.97	0.23
6/18/2008	15:27:20	46.9	55.55	12.974	0.226
6/18/2008	15:27:23	49.7	55.55	12.952	0.248
6/18/2008	15:27:26	52.6	55.55	12.96	0.24
6/18/2008	15:27:29	55.7	55.53	12.96	0.24
6/18/2008	15:27:32	59	55.53	12.956	0.244
6/18/2008	15:27:36	62.5	55.53	12.962	0.238
6/18/2008	15:27:40	66.2	55.53	12.96	0.24
6/18/2008	15:27:43	70.1	55.53	12.964	0.236
6/18/2008	15:27:48	74.3	55.53	12.966	0.234
6/18/2008	15:27:52	78.7	55.53	12.966	0.234
6/18/2008	15:27:57	83.4	55.53	13.013	0.187
6/18/2008	15:28:02	88.4	55.53	13.034	0.166
6/18/2008	15:28:07	93.7	55.53	13.05	0.15
6/18/2008	15:28:13	99.3	55.53	12.956	0.244
6/18/2008	15:28:19	105.2	55.53	12.974	0.226
6/18/2008	15:28:25	111.5	55.53	12.989	0.211
6/18/2008	15:28:31	118.1	55.5	12.978	0.222
6/18/2008	15:28:38	125.1	55.5	12.776	0.424
6/18/2008	15:28:46	132.6	55.5	12.972	0.228

6/18/2008	15:28:54	140.5	55.5	13.029	0.171
6/18/2008	15:29:02	148.9	55.5	12.984	0.216
6/18/2008	15:29:11	157.8	55.5	12.984	0.216
6/18/2008	15:29:21	167.2	55.5	12.988	0.212
6/18/2008	15:29:31	177.2	55.5	12.98	0.22
6/18/2008	15:29:41	187.8	55.5	13.011	0.189
6/18/2008	15:29:52	199	55.5	12.992	0.208
6/18/2008	15:30:04	210.9	55.5	12.966	0.234
6/18/2008	15:30:17	223.5	55.5	13.021	0.179
6/18/2008	15:30:30	236.8	55.48	13.007	0.193
6/18/2008	15:30:44	250.9	55.48	13.062	0.138
6/18/2008	15:30:59	265.8	55.48	12.986	0.214
6/18/2008	15:31:15	281.6	55.48	12.992	0.208
6/18/2008	15:31:32	298.4	55.48	13.002	0.198
6/18/2008	15:31:50	316.2	55.48	12.996	0.204
6/18/2008	15:32:08	335	55.48	12.996	0.204
6/18/2008	15:32:28	354.9	55.48	12.98	0.22
6/18/2008	15:32:49	376	55.48	12.99	0.21
6/18/2008	15:33:12	398.4	55.48	13.033	0.167
6/18/2008	15:33:35	422.1	55.48	12.992	0.208
6/18/2008	15:34:01	447.2	55.48	12.988	0.212
6/18/2008	15:34:27	473.8	55.46	12.992	0.208
6/18/2008	15:34:55	502	55.46	13.027	0.173
6/18/2008	15:35:25	531.9	55.46	12.99	0.21
6/18/2008	15:35:57	563.5	55.46	12.986	0.214
6/18/2008	15:36:30	597	55.46	12.986	0.214
6/18/2008	15:37:06	632.5	55.46	13.023	0.177
6/18/2008	15:37:43	670.1	55.46	13.01	0.19
6/18/2008	15:38:23	709.9	55.46	13.012	0.188
6/18/2008	15:39:05	752.1	55.46	13.031	0.169
6/18/2008	15:39:50	796.8	55.46	12.887	0.313
6/18/2008	15:40:38	844.2	55.46	12.984	0.216
6/18/2008	15:41:28	894.4	55.46	13.037	0.163
6/18/2008	15:42:21	947.5	55.46	13.021	0.179
6/18/2008	15:43:17	1003.8	55.46	12.994	0.206
6/18/2008	15:44:17	1063.4	55.44	12.992	0.208
6/18/2008	15:45:20	1126.6	55.46	13.008	0.192
6/18/2008	15:46:27	1193.5	55.44	13	0.2
6/18/2008	15:47:38	1264.4	55.44	13.014	0.186
6/18/2008	15:48:53	1339.5	55.44	12.987	0.213
6/18/2008	15:50:12	1419	55.44	12.971	0.229
6/18/2008	15:51:37	1503.3	55.44	12.981	0.219
6/18/2008	15:53:06	1592.6	55.44	12.971	0.229
6/18/2008	15:54:40	1687.1	55.44	12.983	0.217



Input Data		
Term	Units	
$2r_c$	Inches	2
$2r_W$	Inches	6
L_w	Feet	14.9
L_e	Feet	10
H*	Feet	200
y_0	Feet	0.81
t_0	Seconds	0
y_t	Feet	0.01
t	Seconds	210

Solutions
Hydraulic Conductivity in Feet/Second
2.22E-05
Hydraulic Conductivity in Feet/Minute
1.33E-03
Hydraulic Conductivity in Feet/Day
1.92E+00

* - Assumed value

Calculations			
Term	Units		3.053
L_e/r_W	Feet/Foot	40.00	$\ln(R_e/r_W)_{\text{partial penetration}}$ =
A	None	2.780	2.442
B	None	0.430	$\ln(R_e/r_W)_{\text{full penetration}}$ =
C	None	2.336	3.053

General Equations

$$K = \frac{r_c^2 \ln(R_e/r_W)}{2L_e} \quad \frac{1}{t} \ln \frac{y_0}{y_t}$$

Where

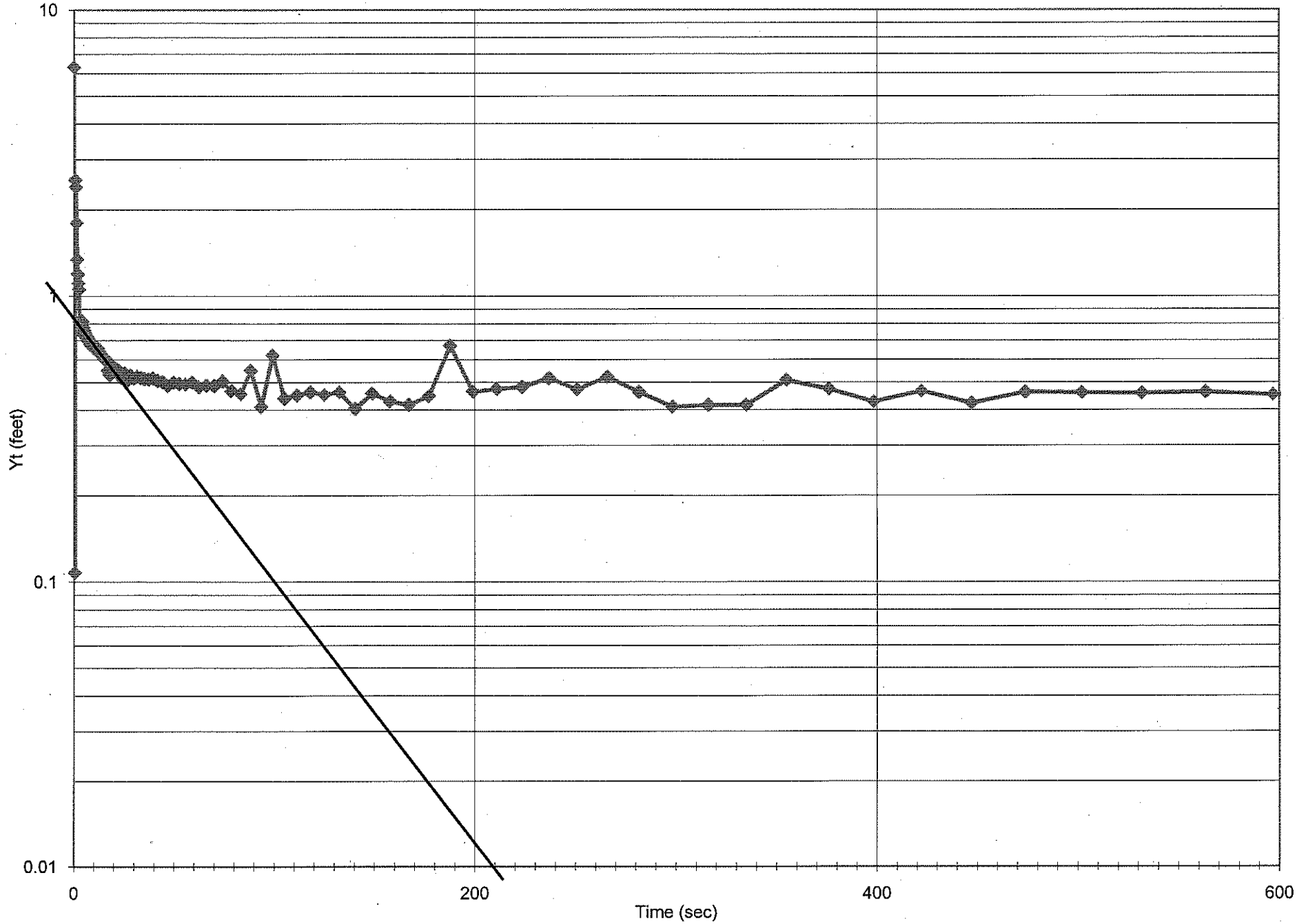
$$\ln(Re/r_W) = \left\{ \frac{1.1}{\ln(L_W/r_W)} + \frac{A + B \ln[(H - L_W)/r_W]}{L_e/r_W} \right\}^{-1}$$

For partial penetration or the equation below for full penetration

$$\ln(Re/r_W) = \left\{ \frac{1.1}{\ln(L_W/r_W)} + \frac{C}{L_e/r_W} \right\}^{-1}$$

CDM

625 re-test Slug Out
Buncombe County C&D Facility Expansion
Site Hydrogeologic Investigation



625 re-test Slug Out
Buncombe County C&D Facility Expansion
Site Hydrogeologic Investigation

CDM

In-Situ Inc. MiniTroll Pro

Report gen 6/20/2008 13:22:29
Report from ...\SN07633 2008-06-19 130020 625re Slug Out.bin
Win-Situ® ' 4.57.0.0

Serial numl 7633
Firmware V 3.09
Unit name: Buncombe

Test name: 625re Slug Out

Test define 6/19/2008 12:59:46
Test startec 6/19/2008 13:00:20
Test stoppe 6/19/2008 13:38:52

Data gathered using Logarithmic testing
Maximum Seconds.
Number c 124

TOTAL DA 124

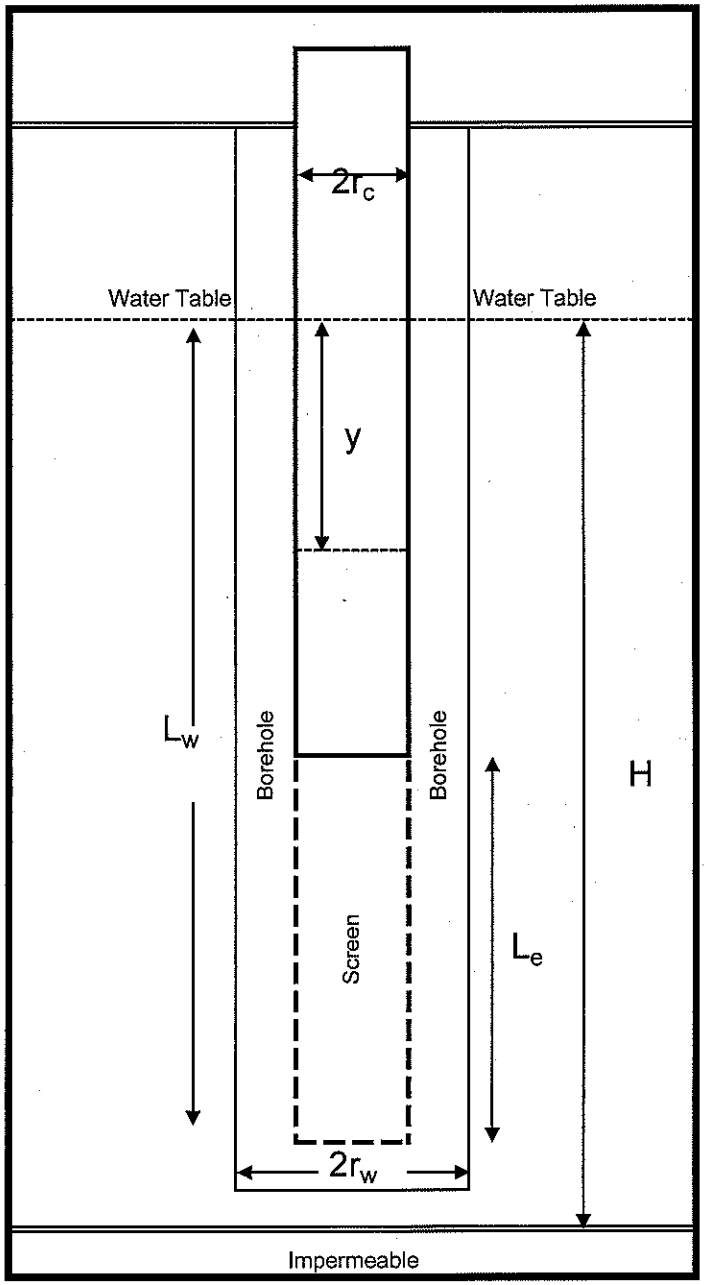
Channel number [1]
Measuren Temperature
Channel name:

Channel number [2]
Measuren Pressure
Channel name:
Sensor Ra 30 PSIG.
Sensor Of 0.000 psi
Specific g 1

Date	Time	ET (sec)	Chan[1] Temperatu Fahrenheit	Chan[2] Pressure Feet H2O	yt
6/19/2008	13:00:20	0	55.44	7.25	6.3
6/19/2008	13:00:20	0.3	55.46	13.442	0.108
6/19/2008	13:00:21	0.6	55.48	11.006	2.544
6/19/2008	13:00:21	0.9	55.5	11.149	2.401
6/19/2008	13:00:21	1.2	55.5	11.75	1.8
6/19/2008	13:00:21	1.5	55.5	12.21	1.34
6/19/2008	13:00:22	1.8	55.5	12.357	1.193
6/19/2008	13:00:22	2.1	55.5	12.441	1.109
6/19/2008	13:00:22	2.4	55.53	12.493	1.057
6/19/2008	13:00:23	2.7	55.53	12.738	0.812
6/19/2008	13:00:23	3	55.53	12.736	0.814
6/19/2008	13:00:23	3.3	55.53	12.721	0.829
6/19/2008	13:00:24	3.6	55.53	12.76	0.79
6/19/2008	13:00:24	3.9	55.53	12.733	0.817
6/19/2008	13:00:24	4.2	55.53	12.797	0.753
6/19/2008	13:00:24	4.5	55.53	12.816	0.734
6/19/2008	13:00:25	4.8	55.53	12.773	0.777
6/19/2008	13:00:25	5.1	55.53	12.793	0.757

6/19/2008	13:00:25	5.4	55.55	12.804	0.746
6/19/2008	13:00:26	5.7	55.55	12.814	0.736
6/19/2008	13:00:26	6	55.55	12.826	0.724
6/19/2008	13:00:26	6.4	55.55	12.832	0.718
6/19/2008	13:00:27	6.7	55.55	12.828	0.722
6/19/2008	13:00:27	7.1	55.55	12.851	0.699
6/19/2008	13:00:27	7.5	55.55	12.853	0.697
6/19/2008	13:00:28	8	55.55	12.87	0.68
6/19/2008	13:00:28	8.4	55.55	12.87	0.68
6/19/2008	13:00:29	8.9	55.55	12.876	0.674
6/19/2008	13:00:29	9.5	55.55	12.869	0.681
6/19/2008	13:00:30	10	55.53	12.89	0.66
6/19/2008	13:00:31	10.6	55.53	12.896	0.654
6/19/2008	13:00:31	11.3	55.53	12.902	0.648
6/19/2008	13:00:32	11.9	55.5	12.894	0.656
6/19/2008	13:00:33	12.6	55.5	12.91	0.64
6/19/2008	13:00:33	13.4	55.5	12.924	0.626
6/19/2008	13:00:34	14.2	55.5	12.931	0.619
6/19/2008	13:00:35	15	55.5	12.947	0.603
6/19/2008	13:00:36	15.9	55.5	12.945	0.605
6/19/2008	13:00:37	16.8	55.5	12.999	0.551
6/19/2008	13:00:38	17.8	55.5	13.019	0.531
6/19/2008	13:00:39	18.9	55.5	12.98	0.57
6/19/2008	13:00:40	20	55.5	12.988	0.562
6/19/2008	13:00:41	21.2	55.5	12.994	0.556
6/19/2008	13:00:42	22.4	55.5	13.001	0.549
6/19/2008	13:00:44	23.8	55.5	13.031	0.519
6/19/2008	13:00:45	25.2	55.5	13.011	0.539
6/19/2008	13:00:47	26.7	55.5	13.044	0.506
6/19/2008	13:00:48	28.2	55.5	13.021	0.529
6/19/2008	13:00:50	29.8	55.5	13.033	0.517
6/19/2008	13:00:51	31.5	55.5	13.025	0.525
6/19/2008	13:00:53	33.3	55.5	13.031	0.519
6/19/2008	13:00:55	35.2	55.5	13.036	0.514
6/19/2008	13:00:57	37.3	55.5	13.038	0.512
6/19/2008	13:00:59	39.5	55.5	13.033	0.517
6/19/2008	13:01:02	41.8	55.48	13.043	0.507
6/19/2008	13:01:04	44.3	55.48	13.048	0.502
6/19/2008	13:01:07	46.9	55.48	13.064	0.486
6/19/2008	13:01:10	49.7	55.48	13.05	0.5
6/19/2008	13:01:13	52.6	55.48	13.056	0.494
6/19/2008	13:01:16	55.7	55.48	13.058	0.492
6/19/2008	13:01:19	59	55.48	13.05	0.5
6/19/2008	13:01:22	62.5	55.48	13.068	0.482
6/19/2008	13:01:26	66.2	55.48	13.062	0.488
6/19/2008	13:01:30	70.1	55.48	13.064	0.486
6/19/2008	13:01:34	74.3	55.48	13.046	0.504
6/19/2008	13:01:39	78.7	55.48	13.083	0.467
6/19/2008	13:01:43	83.4	55.46	13.095	0.455
6/19/2008	13:01:48	88.4	55.46	13	0.55
6/19/2008	13:01:54	93.7	55.46	13.14	0.41
6/19/2008	13:01:59	99.3	55.46	12.928	0.622
6/19/2008	13:02:05	105.2	55.46	13.111	0.439
6/19/2008	13:02:11	111.5	55.46	13.099	0.451
6/19/2008	13:02:18	118.1	55.46	13.088	0.462
6/19/2008	13:02:25	125.1	55.46	13.097	0.453
6/19/2008	13:02:33	132.6	55.46	13.088	0.462

6/19/2008	13:02:40	140.5	55.46	13.146	0.404
6/19/2008	13:02:49	148.9	55.46	13.093	0.457
6/19/2008	13:02:58	157.8	55.46	13.121	0.429
6/19/2008	13:03:07	167.2	55.44	13.133	0.417
6/19/2008	13:03:17	177.2	55.44	13.103	0.447
6/19/2008	13:03:28	187.8	55.44	12.878	0.672
6/19/2008	13:03:39	199	55.44	13.086	0.464
6/19/2008	13:03:51	210.9	55.44	13.076	0.474
6/19/2008	13:04:03	223.5	55.44	13.068	0.482
6/19/2008	13:04:17	236.8	55.44	13.033	0.517
6/19/2008	13:04:31	250.9	55.44	13.078	0.472
6/19/2008	13:04:46	265.8	55.44	13.027	0.523
6/19/2008	13:05:02	281.6	55.44	13.088	0.462
6/19/2008	13:05:18	298.4	55.44	13.14	0.41
6/19/2008	13:05:36	316.2	55.44	13.134	0.416
6/19/2008	13:05:55	335	55.44	13.133	0.417
6/19/2008	13:06:15	354.9	55.44	13.041	0.509
6/19/2008	13:06:36	376	55.44	13.076	0.474
6/19/2008	13:06:58	398.4	55.44	13.123	0.427
6/19/2008	13:07:22	422.1	55.44	13.084	0.466
6/19/2008	13:07:47	447.2	55.44	13.127	0.423
6/19/2008	13:08:14	473.8	55.44	13.088	0.462
6/19/2008	13:08:42	502	55.41	13.09	0.46
6/19/2008	13:09:12	531.9	55.44	13.092	0.458
6/19/2008	13:09:43	563.5	55.44	13.088	0.462
6/19/2008	13:10:17	597	55.44	13.098	0.452
6/19/2008	13:10:52	632.5	55.41	13.102	0.448
6/19/2008	13:11:30	670.1	55.41	13.106	0.444
6/19/2008	13:12:10	709.9	55.41	13.115	0.435
6/19/2008	13:12:52	752.1	55.41	13.113	0.437
6/19/2008	13:13:37	796.8	55.41	13.121	0.429
6/19/2008	13:14:24	844.2	55.41	13.111	0.439
6/19/2008	13:15:14	894.4	55.41	13.131	0.419
6/19/2008	13:16:07	947.5	55.41	13.125	0.425
6/19/2008	13:17:04	1003.8	55.41	13.135	0.415
6/19/2008	13:18:03	1063.4	55.41	13.15	0.4
6/19/2008	13:19:07	1126.6	55.41	13.144	0.406
6/19/2008	13:20:13	1193.5	55.41	13.193	0.357
6/19/2008	13:21:24	1264.4	55.41	13.096	0.454
6/19/2008	13:22:39	1339.5	55.41	13.1	0.45
6/19/2008	13:23:59	1419	55.41	13.162	0.388
6/19/2008	13:25:23	1503.3	55.41	13.189	0.361
6/19/2008	13:26:53	1592.6	55.41	13.176	0.374
6/19/2008	13:28:27	1687.1	55.41	13.154	0.396
6/19/2008	13:30:07	1787.2	55.41	13.181	0.369
6/19/2008	13:31:53	1893.3	55.41	13.183	0.367
6/19/2008	13:33:46	2005.7	55.41	13.201	0.349
6/19/2008	13:35:45	2124.7	55.41	13.17	0.38
6/19/2008	13:37:51	2250.8	55.41	13.201	0.349



Input Data		
Term	Units	
$2r_c$	Inches	2
$2r_W$	Inches	6
L_w	Feet	13.1
L_e	Feet	10
H*	Feet	200
y_0	Feet	2.7
t_0	Seconds	0
y_t	Feet	0.01
t	Seconds	118

Solutions
Hydraulic Conductivity in Feet/Second
4.90E-05
Hydraulic Conductivity in Feet/Minute
2.94E-03
Hydraulic Conductivity in Feet/Day
4.23E+00

* - Assumed value

Calculations			
Term	Units		2.974
L_e/r_W	Feet/Foot	40.00	$\ln(R_e/r_W)_{\text{partial penetration}}$ =
A	None	2.780	2.390
B	None	0.430	$\ln(R_e/r_W)_{\text{full penetration}}$ =
C	None	2.336	2.974

General Equations

$$K = \frac{r_c^2 \ln(R_e/r_W)}{2L_e} \quad \frac{1}{t} \ln \frac{y_0}{y_t}$$

Where

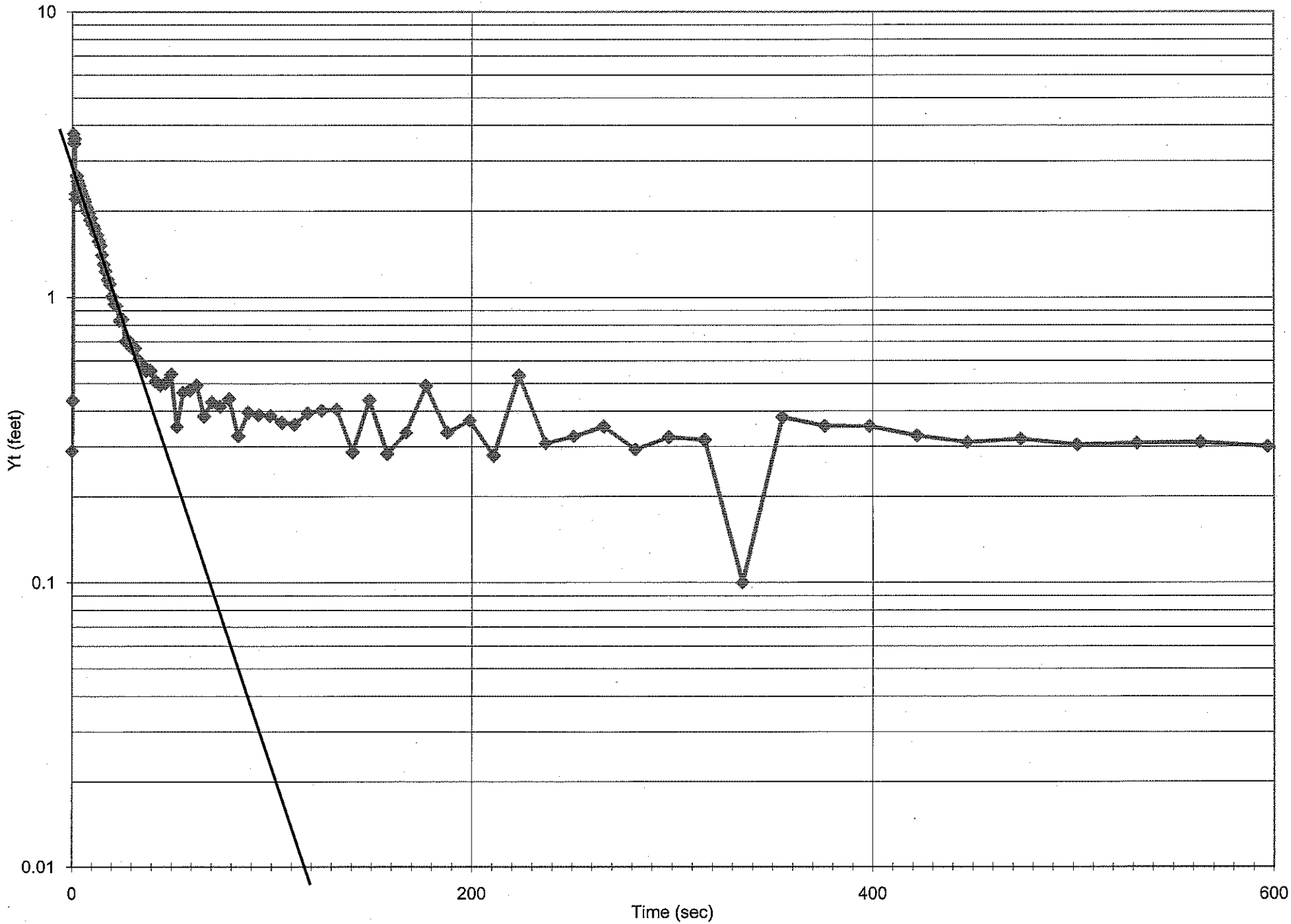
$$\ln(Re/r_W) = \left\{ \frac{1.1}{\ln(L_W/r_W)} + \frac{A + B \ln[(H - L_W)/r_W]}{L_e/r_W} \right\}^{-1}$$

For partial penetration or the equation below for full penetration

$$\ln(Re/r_W) = \left\{ \frac{1.1}{\ln(L_W/r_W)} + \frac{C}{L_e/r_W} \right\}^{-1}$$

627s Slug In
Buncombe County C&D Facility Expansion
Site Hydrogeologic Investigation

CDM



627s Slug In
Buncombe County C&D Facility Expansion
Site Hydrogeologic Investigation

CDM

In-Situ Inc. MiniTroll Pro

Report gen 6/20/2008 13:13:31
Report fron ...\SN07633 2008-06-18 162142 627s Slug In.bin
Win-Situ® '4.57.0.0

Serial numl 7633
Firmware V 3.09
Unit name: Buncombe

Test name: 627s Slug In

Test define 6/18/2008 16:21:06
Test startec 6/18/2008 16:21:42
Test stoppe 6/18/2008 17:03:59

Data gathered using Logarithmic testing
Maximum Seconds.
Number c 126

TOTAL DA 126

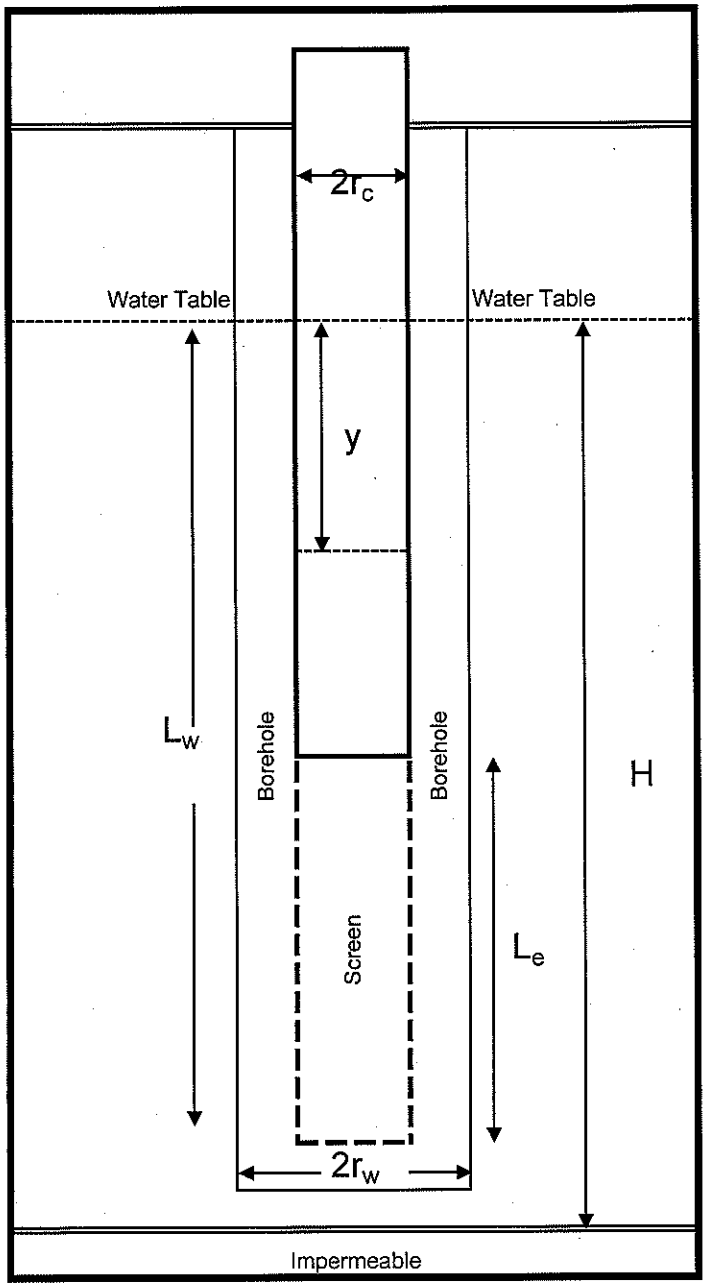
Channel number [1]
Measuren Temperature
Channel name:

Channel number [2]
Measuren Pressure
Channel name:
Sensor Ra 30 PSIG.
Sensor Of 0.000 psi
Specific g 1

Date	Time	ET (sec)	Chan[1] Temperatu Fahrenheit	Chan[2] Pressure Feet H2O	yt
6/18/2008	16:21:42	0	53.21	12.139	0.289
6/18/2008	16:21:42	0.3	53.26	12.286	0.436
6/18/2008	16:21:42	0.6	53.26	15.591	3.741
6/18/2008	16:21:43	0.9	53.28	15.32	3.47
6/18/2008	16:21:43	1.2	53.28	15.44	3.59
6/18/2008	16:21:43	1.5	53.3	14.06	2.21
6/18/2008	16:21:44	1.8	53.3	14.164	2.314
6/18/2008	16:21:44	2.1	53.3	14.529	2.679
6/18/2008	16:21:44	2.4	53.3	14.5	2.65
6/18/2008	16:21:44	2.7	53.3	14.409	2.559
6/18/2008	16:21:45	3	53.3	14.368	2.518
6/18/2008	16:21:45	3.3	53.3	14.315	2.465
6/18/2008	16:21:45	3.6	53.33	14.311	2.461
6/18/2008	16:21:46	3.9	53.33	14.237	2.387
6/18/2008	16:21:46	4.2	53.33	14.214	2.364
6/18/2008	16:21:46	4.5	53.33	14.169	2.319
6/18/2008	16:21:47	4.8	53.33	14.134	2.284
6/18/2008	16:21:47	5.1	53.33	14.111	2.261

6/18/2008	16:21:47	5.4	53.33	14.074	2.224
6/18/2008	16:21:47	5.7	53.33	14.062	2.212
6/18/2008	16:21:48	6	53.33	14.006	2.156
6/18/2008	16:21:48	6.4	53.33	14.006	2.156
6/18/2008	16:21:48	6.7	53.33	13.939	2.089
6/18/2008	16:21:49	7.1	53.33	13.883	2.033
6/18/2008	16:21:49	7.5	53.33	13.893	2.043
6/18/2008	16:21:50	8	53.33	13.829	1.979
6/18/2008	16:21:50	8.4	53.33	13.813	1.963
6/18/2008	16:21:51	8.9	53.33	13.718	1.868
6/18/2008	16:21:51	9.5	53.33	13.735	1.885
6/18/2008	16:21:52	10	53.33	13.653	1.803
6/18/2008	16:21:52	10.6	53.3	13.632	1.782
6/18/2008	16:21:53	11.3	53.3	13.588	1.738
6/18/2008	16:21:54	11.9	53.3	13.521	1.671
6/18/2008	16:21:54	12.6	53.3	13.504	1.654
6/18/2008	16:21:55	13.4	53.3	13.42	1.57
6/18/2008	16:21:56	14.2	53.28	13.366	1.516
6/18/2008	16:21:57	15	53.28	13.255	1.405
6/18/2008	16:21:58	15.9	53.28	13.154	1.304
6/18/2008	16:21:59	16.8	53.28	13.084	1.234
6/18/2008	16:22:00	17.8	53.28	13.004	1.154
6/18/2008	16:22:01	18.9	53.28	12.963	1.113
6/18/2008	16:22:02	20	53.28	12.856	1.006
6/18/2008	16:22:03	21.2	53.28	12.798	0.948
6/18/2008	16:22:04	22.4	53.28	12.784	0.934
6/18/2008	16:22:06	23.8	53.28	12.681	0.831
6/18/2008	16:22:07	25.2	53.28	12.689	0.839
6/18/2008	16:22:08	26.7	53.28	12.551	0.701
6/18/2008	16:22:10	28.2	53.28	12.558	0.708
6/18/2008	16:22:12	29.8	53.28	12.517	0.667
6/18/2008	16:22:13	31.5	53.28	12.514	0.664
6/18/2008	16:22:15	33.3	53.28	12.455	0.605
6/18/2008	16:22:17	35.2	53.28	12.432	0.582
6/18/2008	16:22:19	37.3	53.26	12.405	0.555
6/18/2008	16:22:21	39.5	53.26	12.405	0.555
6/18/2008	16:22:24	41.8	53.26	12.36	0.51
6/18/2008	16:22:26	44.3	53.26	12.343	0.493
6/18/2008	16:22:29	46.9	53.26	12.352	0.502
6/18/2008	16:22:31	49.7	53.26	12.389	0.539
6/18/2008	16:22:34	52.6	53.26	12.202	0.352
6/18/2008	16:22:37	55.7	53.26	12.315	0.465
6/18/2008	16:22:41	59	53.26	12.323	0.473
6/18/2008	16:22:44	62.5	53.26	12.343	0.493
6/18/2008	16:22:48	66.2	53.26	12.234	0.384
6/18/2008	16:22:52	70.1	53.24	12.281	0.431
6/18/2008	16:22:56	74.3	53.24	12.265	0.415
6/18/2008	16:23:00	78.7	53.24	12.292	0.442
6/18/2008	16:23:05	83.4	53.24	12.177	0.327
6/18/2008	16:23:10	88.4	53.24	12.246	0.396
6/18/2008	16:23:15	93.7	53.24	12.238	0.388
6/18/2008	16:23:21	99.3	53.21	12.236	0.386
6/18/2008	16:23:27	105.2	53.21	12.215	0.365
6/18/2008	16:23:33	111.5	53.21	12.209	0.359
6/18/2008	16:23:40	118.1	53.21	12.244	0.394
6/18/2008	16:23:47	125.1	53.21	12.252	0.402
6/18/2008	16:23:54	132.6	53.21	12.256	0.406

6/18/2008	16:24:02	140.5	53.21	12.137	0.287
6/18/2008	16:24:11	148.9	53.21	12.287	0.437
6/18/2008	16:24:20	157.8	53.19	12.133	0.283
6/18/2008	16:24:29	167.2	53.19	12.186	0.336
6/18/2008	16:24:39	177.2	53.19	12.341	0.491
6/18/2008	16:24:50	187.8	53.19	12.186	0.336
6/18/2008	16:25:01	199	53.19	12.221	0.371
6/18/2008	16:25:13	210.9	53.19	12.129	0.279
6/18/2008	16:25:25	223.5	53.17	12.383	0.533
6/18/2008	16:25:39	236.8	53.19	12.158	0.308
6/18/2008	16:25:53	250.9	53.17	12.176	0.326
6/18/2008	16:26:08	265.8	53.17	12.203	0.353
6/18/2008	16:26:23	281.6	53.17	12.143	0.293
6/18/2008	16:26:40	298.4	53.17	12.174	0.324
6/18/2008	16:26:58	316.2	53.17	12.167	0.317
6/18/2008	16:27:17	335	53.17	11.95	0.1
6/18/2008	16:27:37	354.9	53.17	12.231	0.381
6/18/2008	16:27:58	376	53.17	12.205	0.355
6/18/2008	16:28:20	398.4	53.14	12.204	0.354
6/18/2008	16:28:44	422.1	53.17	12.178	0.328
6/18/2008	16:29:09	447.2	53.14	12.161	0.311
6/18/2008	16:29:36	473.8	53.14	12.169	0.319
6/18/2008	16:30:04	502	53.14	12.155	0.305
6/18/2008	16:30:34	531.9	53.14	12.159	0.309
6/18/2008	16:31:05	563.5	53.14	12.161	0.311
6/18/2008	16:31:39	597	53.14	12.151	0.301
6/18/2008	16:32:14	632.5	53.14	12.128	0.278
6/18/2008	16:32:52	670.1	53.14	12.153	0.303
6/18/2008	16:33:32	709.9	53.12	12.153	0.303
6/18/2008	16:34:14	752.1	53.12	12.155	0.305
6/18/2008	16:34:59	796.8	53.12	12.146	0.296
6/18/2008	16:35:46	844.2	53.12	12.214	0.364
6/18/2008	16:36:36	894.4	53.12	12.15	0.3
6/18/2008	16:37:29	947.5	53.12	12.173	0.323
6/18/2008	16:38:26	1003.8	53.1	12.171	0.321
6/18/2008	16:39:25	1063.4	53.1	12.163	0.313
6/18/2008	16:40:28	1126.6	53.1	12.212	0.362
6/18/2008	16:41:35	1193.5	53.1	12.191	0.341
6/18/2008	16:42:46	1264.4	53.1	12.146	0.296
6/18/2008	16:44:01	1339.5	53.1	12.169	0.319
6/18/2008	16:45:21	1419	53.1	12.181	0.331
6/18/2008	16:46:45	1503.3	53.1	12.156	0.306
6/18/2008	16:48:14	1592.6	53.1	12.136	0.286
6/18/2008	16:49:49	1687.1	53.08	12.14	0.29
6/18/2008	16:51:29	1787.2	53.08	12.138	0.288
6/18/2008	16:53:15	1893.3	53.08	12.166	0.316
6/18/2008	16:55:07	2005.7	53.08	12.164	0.314
6/18/2008	16:57:06	2124.7	53.08	12.119	0.269
6/18/2008	16:59:13	2250.8	53.08	12.148	0.298
6/18/2008	17:01:26	2384.4	53.08	12.08	0.23
6/18/2008	17:03:48	2525.9	53.08	12.111	0.261



Input Data		
Term	Units	
$2r_c$	Inches	2
$2r_W$	Inches	6
L_w	Feet	13.1
L_e	Feet	10
H^*	Feet	200
y_0	Feet	2
t_0	Seconds	0
y_t	Feet	0.01
t	Seconds	105

Solutions
Hydraulic Conductivity in Feet/Second
5.21E-05
Hydraulic Conductivity in Feet/Minute
3.13E-03
Hydraulic Conductivity in Feet/Day
4.50E+00

* - Assumed value

Calculations			
Term	Units		2.974
L_e/r_W	Feet/Foot	40.00	$\ln(R_e/r_W)_{\text{partial penetration}}$ =
A	None	2.780	2.390
B	None	0.430	$\ln(R_e/r_W)_{\text{full penetration}}$ =
C	None	2.336	2.974

General Equations

$$K = \frac{r_c^2 \ln(R_e/r_W)}{2L_e} \quad \frac{1}{t} \ln \frac{y_0}{y_t}$$

Where

$$\ln(Re/r_W) = \left\{ \frac{1.1}{\ln(L_W/r_W)} + \frac{A + B \ln[(H - L_W)/r_W]}{L_e/r_W} \right\}^{-1}$$

For partial penetration or the equation below for full penetration

$$\ln(Re/r_W) = \left\{ \frac{1.1}{\ln(L_W/r_W)} + \frac{C}{L_e/r_W} \right\}^{-1}$$

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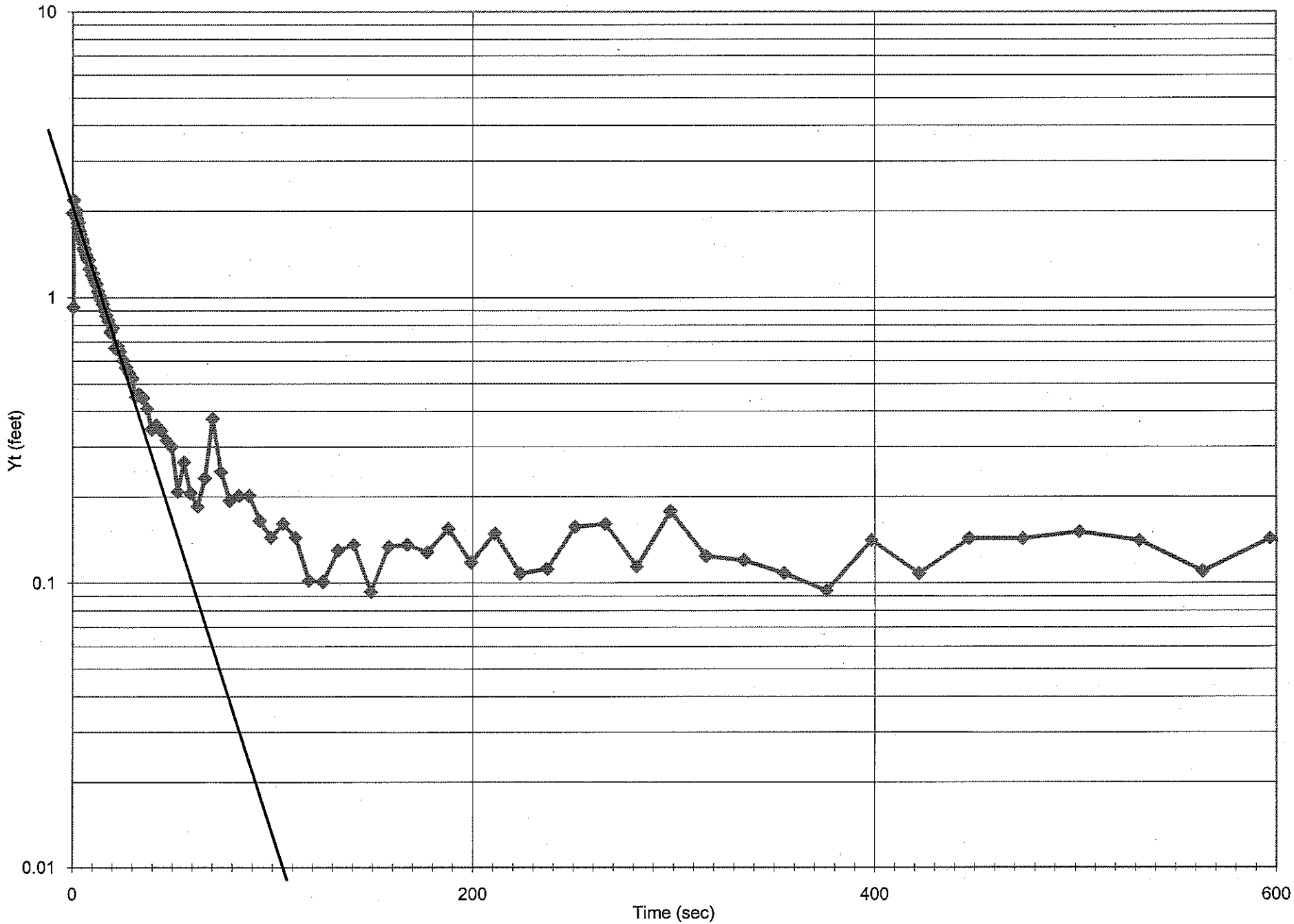
627s Slug Out
Buncombe County C&D Facility Expansion
Site Hydrogeologic Investigation



627s Slug Out
Buncombe County C&D Facility Expansion
Site Hydrogeologic Investigation

CDM

In-Situ Inc. MiniTroll Pro

Report gen 6/20/2008 13:14:51
Report fron ...\SN07633 2008-06-18 170615 627s Slug Out.bin
Win-Situ® '4.57.0.0

Serial numl 7633
Firmware V 3.09
Unit name: Buncombe

Test name: 627s Slug Out

Test define 6/18/2008 17:04:56
Test startec 6/18/2008 17:06:15
Test stoppe 6/18/2008 17:17:59

Data gathered using Logarithmic testing
Maximum Seconds.
Number c 103

TOTAL DA 103

Channel number [1]
Measuren Temperature
Channel name:

Channel number [2]
Measuren Pressure
Channel name:
Sensor Ra 30 PSIG.
Sensor Of 0.000 psi
Specific g 1

Date	Time	ET (sec)	Chan[1] Temperatu Fahrenheit	Chan[2] Pressure Feet H2O	yt
6/18/2008	17:06:15	0	53.08	10.231	1.969
6/18/2008	17:06:15	0.3	53.1	11.274	0.926
6/18/2008	17:06:15	0.6	53.12	10.009	2.191
6/18/2008	17:06:16	0.9	53.12	10.209	1.991
6/18/2008	17:06:16	1.2	53.14	10.232	1.968
6/18/2008	17:06:16	1.5	53.14	10.261	1.939
6/18/2008	17:06:17	1.8	53.14	10.191	2.009
6/18/2008	17:06:17	2.1	53.14	10.31	1.89
6/18/2008	17:06:17	2.4	53.14	10.378	1.822
6/18/2008	17:06:17	2.7	53.17	10.438	1.762
6/18/2008	17:06:18	3	53.17	10.374	1.826
6/18/2008	17:06:18	3.3	53.17	10.483	1.717
6/18/2008	17:06:18	3.6	53.17	10.555	1.645
6/18/2008	17:06:19	3.9	53.17	10.543	1.657
6/18/2008	17:06:19	4.2	53.17	10.6	1.6
6/18/2008	17:06:19	4.5	53.17	10.596	1.604
6/18/2008	17:06:20	4.8	53.17	10.619	1.581
6/18/2008	17:06:20	5.1	53.17	10.652	1.548

6/18/2008	17:06:20	5.4	53.17	10.72	1.48
6/18/2008	17:06:20	5.7	53.19	10.736	1.464
6/18/2008	17:06:21	6	53.17	10.719	1.481
6/18/2008	17:06:21	6.4	53.19	10.79	1.41
6/18/2008	17:06:21	6.7	53.17	10.789	1.411
6/18/2008	17:06:22	7.1	53.19	10.819	1.381
6/18/2008	17:06:22	7.5	53.19	10.841	1.359
6/18/2008	17:06:23	8	53.19	10.849	1.351
6/18/2008	17:06:23	8.4	53.19	10.946	1.254
6/18/2008	17:06:24	8.9	53.19	10.932	1.268
6/18/2008	17:06:24	9.5	53.19	10.999	1.201
6/18/2008	17:06:25	10	53.17	10.985	1.215
6/18/2008	17:06:25	10.6	53.17	11.042	1.158
6/18/2008	17:06:26	11.3	53.17	11.067	1.133
6/18/2008	17:06:27	11.9	53.17	11.088	1.112
6/18/2008	17:06:27	12.6	53.14	11.147	1.053
6/18/2008	17:06:28	13.4	53.14	11.182	1.018
6/18/2008	17:06:29	14.2	53.14	11.221	0.979
6/18/2008	17:06:30	15	53.14	11.252	0.948
6/18/2008	17:06:31	15.9	53.14	11.295	0.905
6/18/2008	17:06:32	16.8	53.14	11.334	0.866
6/18/2008	17:06:33	17.8	53.14	11.369	0.831
6/18/2008	17:06:34	18.9	53.14	11.441	0.759
6/18/2008	17:06:35	20	53.14	11.416	0.784
6/18/2008	17:06:36	21.2	53.14	11.534	0.666
6/18/2008	17:06:37	22.4	53.14	11.523	0.677
6/18/2008	17:06:39	23.8	53.14	11.55	0.65
6/18/2008	17:06:40	25.2	53.14	11.595	0.605
6/18/2008	17:06:41	26.7	53.14	11.628	0.572
6/18/2008	17:06:43	28.2	53.14	11.655	0.545
6/18/2008	17:06:45	29.8	53.14	11.678	0.522
6/18/2008	17:06:46	31.5	53.12	11.751	0.449
6/18/2008	17:06:48	33.3	53.14	11.741	0.459
6/18/2008	17:06:50	35.2	53.12	11.754	0.446
6/18/2008	17:06:52	37.3	53.12	11.791	0.409
6/18/2008	17:06:54	39.5	53.12	11.854	0.346
6/18/2008	17:06:57	41.8	53.12	11.842	0.358
6/18/2008	17:06:59	44.3	53.12	11.858	0.342
6/18/2008	17:07:02	46.9	53.12	11.883	0.317
6/18/2008	17:07:04	49.7	53.12	11.9	0.3
6/18/2008	17:07:07	52.6	53.12	11.992	0.208
6/18/2008	17:07:10	55.7	53.12	11.935	0.265
6/18/2008	17:07:14	59	53.12	11.994	0.206
6/18/2008	17:07:17	62.5	53.12	12.015	0.185
6/18/2008	17:07:21	66.2	53.1	11.967	0.233
6/18/2008	17:07:25	70.1	53.1	11.823	0.377
6/18/2008	17:07:29	74.3	53.1	11.955	0.245
6/18/2008	17:07:33	78.7	53.1	12.006	0.194
6/18/2008	17:07:38	83.4	53.1	11.998	0.202
6/18/2008	17:07:43	88.4	53.1	11.998	0.202
6/18/2008	17:07:48	93.7	53.1	12.035	0.165
6/18/2008	17:07:54	99.3	53.1	12.056	0.144
6/18/2008	17:08:00	105.2	53.08	12.039	0.161
6/18/2008	17:08:06	111.5	53.1	12.056	0.144
6/18/2008	17:08:13	118.1	53.08	12.098	0.102
6/18/2008	17:08:20	125.1	53.08	12.099	0.101
6/18/2008	17:08:27	132.6	53.08	12.07	0.13

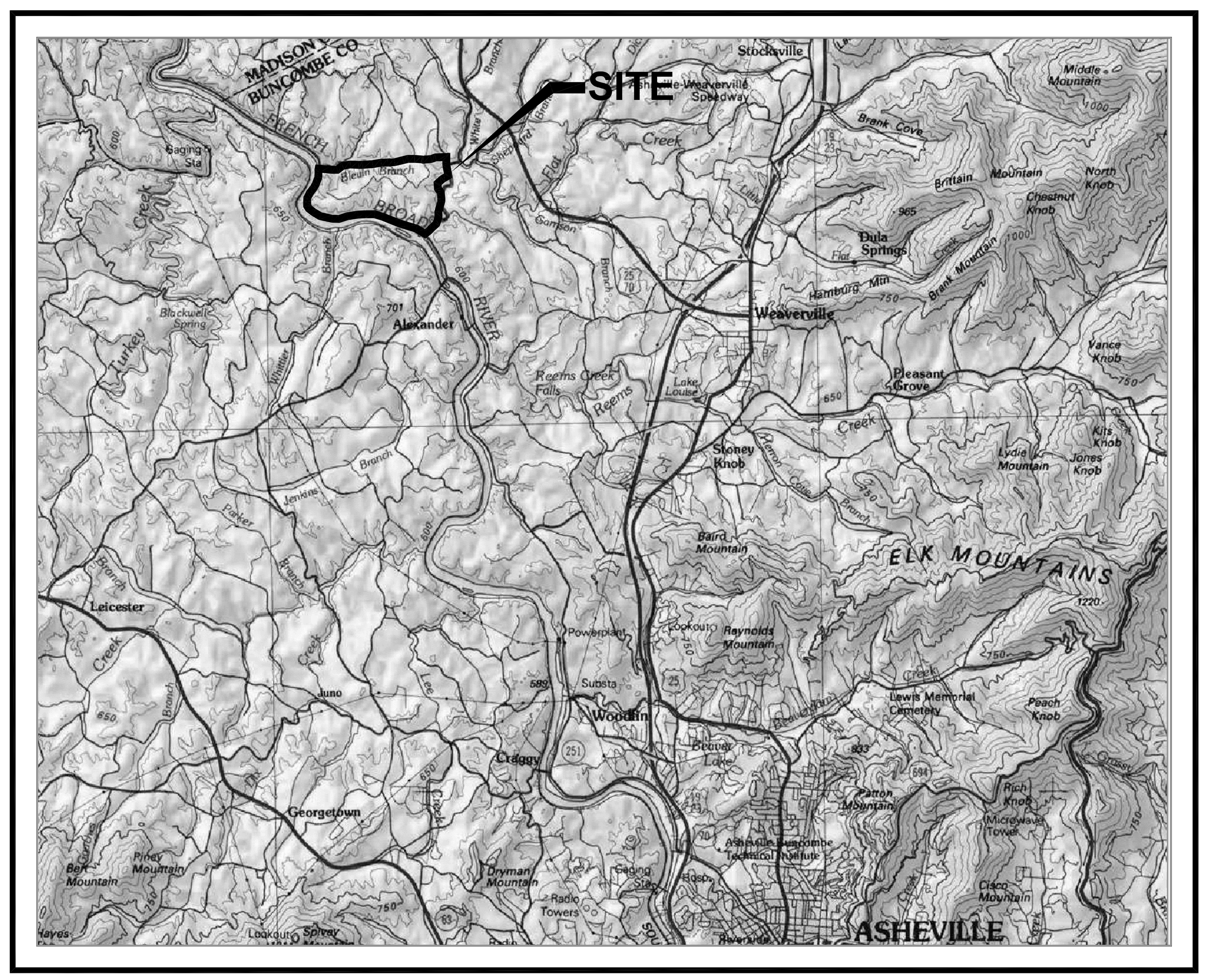
6/18/2008	17:08:35	140.5	53.08	12.064	0.136
6/18/2008	17:08:44	148.9	53.08	12.107	0.093
6/18/2008	17:08:53	157.8	53.08	12.066	0.134
6/18/2008	17:09:02	167.2	53.08	12.064	0.136
6/18/2008	17:09:12	177.2	53.08	12.072	0.128
6/18/2008	17:09:23	187.8	53.05	12.045	0.155
6/18/2008	17:09:34	199	53.05	12.082	0.118
6/18/2008	17:09:46	210.9	53.05	12.051	0.149
6/18/2008	17:09:58	223.5	53.05	12.092	0.108
6/18/2008	17:10:12	236.8	53.05	12.088	0.112
6/18/2008	17:10:26	250.9	53.05	12.043	0.157
6/18/2008	17:10:41	265.8	53.05	12.039	0.161
6/18/2008	17:10:56	281.6	53.05	12.086	0.114
6/18/2008	17:11:13	298.4	53.05	12.022	0.178
6/18/2008	17:11:31	316.2	53.05	12.076	0.124
6/18/2008	17:11:50	335	53.05	12.08	0.12
6/18/2008	17:12:10	354.9	53.05	12.092	0.108
6/18/2008	17:12:31	376	53.05	12.106	0.094
6/18/2008	17:12:53	398.4	53.05	12.059	0.141
6/18/2008	17:13:17	422.1	53.05	12.092	0.108
6/18/2008	17:13:42	447.2	53.05	12.057	0.143
6/18/2008	17:14:09	473.8	53.05	12.057	0.143
6/18/2008	17:14:37	502	53.05	12.049	0.151
6/18/2008	17:15:07	531.9	53.05	12.059	0.141
6/18/2008	17:15:38	563.5	53.05	12.09	0.11
6/18/2008	17:16:12	597	53.05	12.057	0.143
6/18/2008	17:16:47	632.5	53.05	12.074	0.126
6/18/2008	17:17:25	670.1	53.05	11.969	0.231

Part 5
Engineering Report

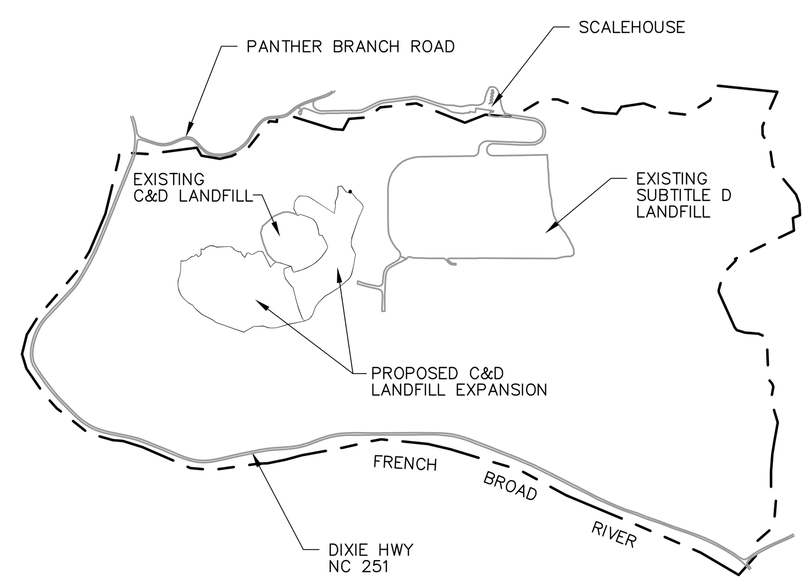
Appendix D
Engineering Drawings

BUNCOMBE COUNTY
NORTH CAROLINA

BUNCOMBE COUNTY C&D LANDFILL PERMIT DRAWINGS



LOCATION MAP



VICINITY MAP

VICINITY MAP
NOT TO SCALE

INDEX OF DRAWINGS

FACILITY PLAN DRAWINGS

SD–1 SITE DEVELOPMENT EXISTING CONDITIONS
SD–2 SITE DEVELOPMENT C&D LANDFILL EXPANSION
SD–3 SITE DEVELOPMENT FINAL CLOSURE
LO–1 LANDFILL OPERATION TRANSITION CONTOURS – PHASE 5 BASEGRADES
LO–2 LANDFILL OPERATION TRANSITION CONTOURS – PHASE 5 CLOSURE / PHASE 6 BASEGRADES
LO–3 LANDFILL OPERATION TRANSITION CONTOURS – PHASE 6 CLOSURE / PHASE 7 BASEGRADES
LO–4 LANDFILL OPERATION TRANSITION CONTOURS – PHASE 7 CLOSURE / PHASE 8 BASEGRADES
LO–5 LANDFILL OPERATION TRANSITION CONTOURS – PHASE 8 CLOSURE

ENGINEERING PLAN DRAWINGS

EP–1 EXISTING CONDITIONS
EP–2 EROSION AND SEDIMENTATION CONTROL PLAN
EP–3 GRADING PLAN
EP–4 BEDROCK SURFACE CONTOUR MAP
EP–5 ESTIMATED SEASONAL HIGH GROUNDWATER SURFACE MAP
EP–6 CLOSURE GRADING PLAN
EP–7 EROSION AND SEDIMENTATION CONTROL DETAILS (1 OF 2)
EP–8 EROSION AND SEDIMENTATION CONTROL DETAILS (2 OF 2)
EP–9 CLOSURE DETAILS

OPERATION PLAN DRAWINGS

OP–1 EXISTING CONDITIONS
OP–2 GRADING PLAN
OP–3 TRANSITION CONTOURS – YEAR 1
OP–4 TRANSITION CONTOURS – YEAR 2
OP–5 TRANSITION CONTOURS – FINAL CLOSURE

APRIL 2009

PREPARED BY

CDM Camp Dresser & McKee

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engineering
construction
operations

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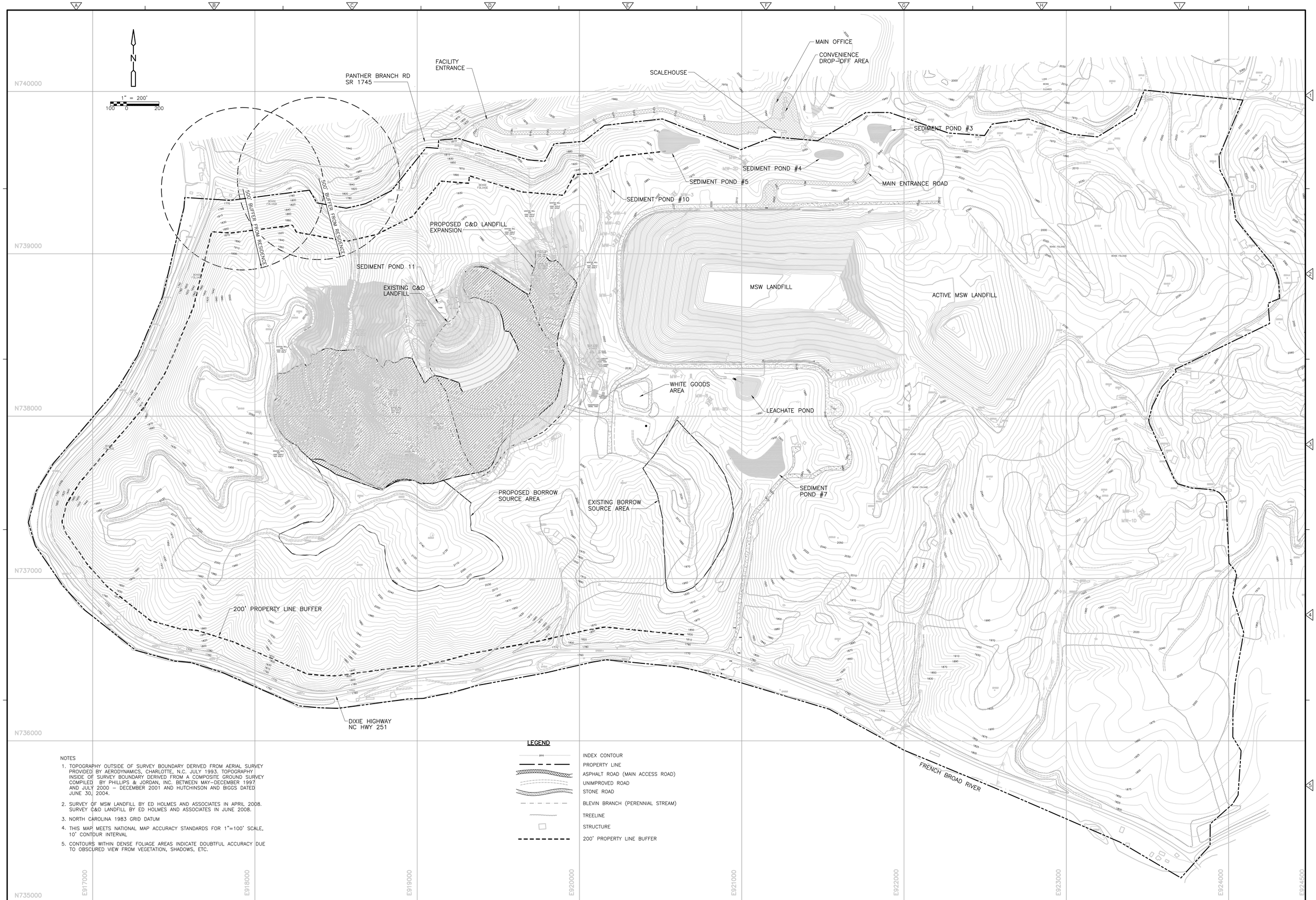
6447–65973



NOTES

1. TOPOGRAPHY OUTSIDE OF SURVEY BOUNDARY DERIVED FROM AERIAL SURVEY PROVIDED BY AERODYNAMICS, CHARLOTTE, N.C. JULY 1993. TOPOGRAPHY INSIDE OF SURVEY BOUNDARY DERIVED FROM A COMPOSITE GROUND SURVEY COMPILED BY PHILLIPS & JORDAN, INC. BETWEEN MAY–DECEMBER 1997 AND JULY 2000 – DECEMBER 2001 AND HUTCHINSON AND BIGGS DATED JUNE 30, 2004.
2. SURVEY OF MSW LANDFILL BY ED HOLMES AND ASSOCIATES IN APRIL 2008. SURVEY C&D LANDFILL BY ED HOLMES AND ASSOCIATES IN JUNE 2008.
3. NORTH CAROLINA 1983 GRID DATUM
4. THIS MAP MEETS NATIONAL MAP ACCURACY STANDARDS FOR 1"=100' SCALE, 10' CONTOUR INTERVAL
5. CONTOURS WITHIN DENSE FOLIAGE AREAS INDICATE DOUBTFUL ACCURACY DUE TO OBSCURED VIEW FROM VEGETATION, SHADOWS, ETC.

LEGEND

- INDEX CONTOUR
- PROPERTY LINE
- ASPHALT ROAD (MAIN ACCESS ROAD)
- UNIMPROVED ROAD
- STONE ROAD
- BLEVIN BRANCH (PERENNIAL STREAM)
- TREELINE
- STRUCTURE
- 200' PROPERTY LINE BUFFER

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: K. YANG
DRAWN BY: J. KILLINGSWORTH
SHEET CHK'D BY: K. YANG
CROSS CHK'D BY: C. GABEL
APPROVED BY: K. YANG
DATE: APRIL 2009

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Raleigh, North Carolina 27612
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BUNCOMBE COUNTY
NORTH CAROLINA

BUNCOMBE COUNTY C&D LANDFILL
ENGINEERING PLAN

EXISTING CONDITIONS

PROJECT NO. 6447–65973
FILE NAME: EP–1.DWG
SHEET NO.
EP-1

NOT FOR CONSTRUCTION

SEDIMENT POND 13 (B/EP-7)
R02
R01
(E/EP-8) POROUS BAFFLE
24-INCH CPP CULVERT
EXISTING ACCESS ROAD - REFINISH PER DETAIL F/EP-8
EARTHEN DIVERSION BERM (G/EP-8)
DB
GRASS LINED CHANNEL (B/EP-8)
GC1
TRANSITION FROM GC1 TO GC2
GC2
SEDIMENT POND 11
EXISTING RISER/BARREL SEDIMENT POND 11 RE-CONSTRUCT PER DETAIL B/EP-7
DISCHARGE RC3 INTO 24-INCH RCP
R03
RC3
GC4
TRANSITION FROM GC5 TO RC3
GC5
PHASE 5 LIMITS
SEDIMENT POND 12 (B/EP-7)
RIPRAP OUTLET STABILIZATION (A/EP-7)
R05
24-INCH CPP CULVERT
GC6
R04
(E/EP-8) POROUS BAFFLE
EXISTING RISER/BARREL SEDIMENT POND 10 RE-CONSTRUCT PER DETAIL B/EP-7
(E/EP-8) POROUS BAFFLE
MW-4
MW-4D
MW-5D
MW-5
MW-6
FC1
(H/EP-8) FABRIC FORMED LINED CHANNEL
TRANSITION FROM RC1 TO FC1
RC2
RC1
(F/EP-8) 20' WIDE STONE ACCESS ROAD
(C/EP-8) RIPRAP CHANNEL
TRANSITION FROM GC3 TO RC2
24-INCH-CPP CULVERT
TRANSITION FROM GC2 TO GC3
GC3
GC32
EXISTING C&D LANDFILL LIMITS
1" = 60'
30 0 60

LEGEND

- EXIST INTERMEDIATE CONTOUR
- EXIST INDEX CONTOUR
- MW-6 MONITORING WELL
- TREELINE
- PROPOSED INTERMEDIATE CONTOUR
- PROPOSED INDEX CONTOUR
- GC5 GRASS-LINED CHANNEL
- RC1 RIPRAP-LINED CHANNEL
- DB EARTHEN DIVERSION BERM
- STONE ACCESS ROAD

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: K. YANG
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BUNCOMBE COUNTY
NORTH CAROLINA

BUNCOMBE COUNTY C&D LANDFILL
ENGINEERING PLAN

EROSION AND SEDIMENTATION CONTROL PLAN

PROJECT NO. 6447-65973
FILE NAME: EP-2.DWG

SHEET NO.
EP-2

NOT FOR CONSTRUCTION

SEDIMENT POND 13

24-INCH CPP CULVERT

EXISTING ACCESS ROAD + REFINISH PER DETAIL F/EP-8

24-INCH CPP CULVERT

SEDIMENT POND 11

DB

RC3

GC4

GC5

PHASE 5 LIMITS

SEDIMENT POND 12

24-INCH CPP CULVERT

SEDIMENT POND 10

GC6

DB

24-INCH CPP CULVERT

FC1

RC2

RC1

F EP-8 20' WIDE STONE ACCESS ROAD

MW-4

MW-4D

MW-5D

MW-5

MW-6

GC1

GC2

GC3

GC3

24-INCH-CPP CULVERT

EXISTING C&D LANDFILL LIMITS

1" = 60'

30 0 60

LEGEND

	EXIST INTERMEDIATE CONTOUR
2010	EXIST INDEX CONTOUR
	MW-6 MONITORING WELL
	TREELINE
	PROPOSED INTERMEDIATE CONTOUR
	PROPOSED INDEX CONTOUR
GC5	GRASS-LINED CHANNEL
RC1	RIPRAP-LINED CHANNEL
DB	EARTHEN DIVERSION BERM
	STONE ACCESS ROAD

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: K. YANG
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SHEET CHK'D BY: K. YANG
CROSS CHK'D BY: C. GABEL
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BUNCOMBE COUNTY
NORTH CAROLINA

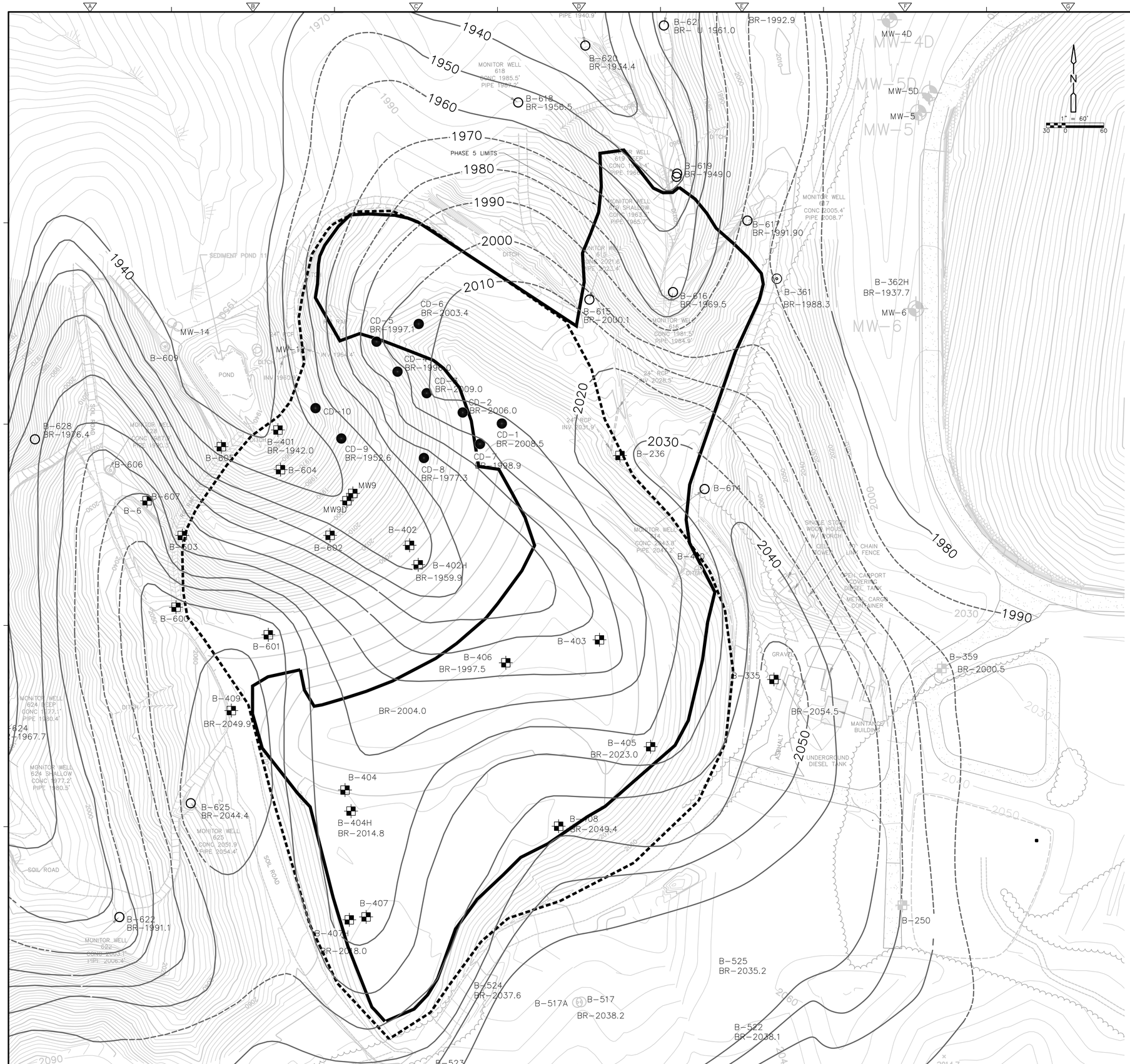
BUNCOMBE COUNTY C&D LANDFILL
ENGINEERING PLAN

GRADING PLAN

PROJECT NO. 6447-65973
FILE NAME: EP-3.DWG

SHEET NO.
EP-3

NOT FOR CONSTRUCTION



REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: K. YANG
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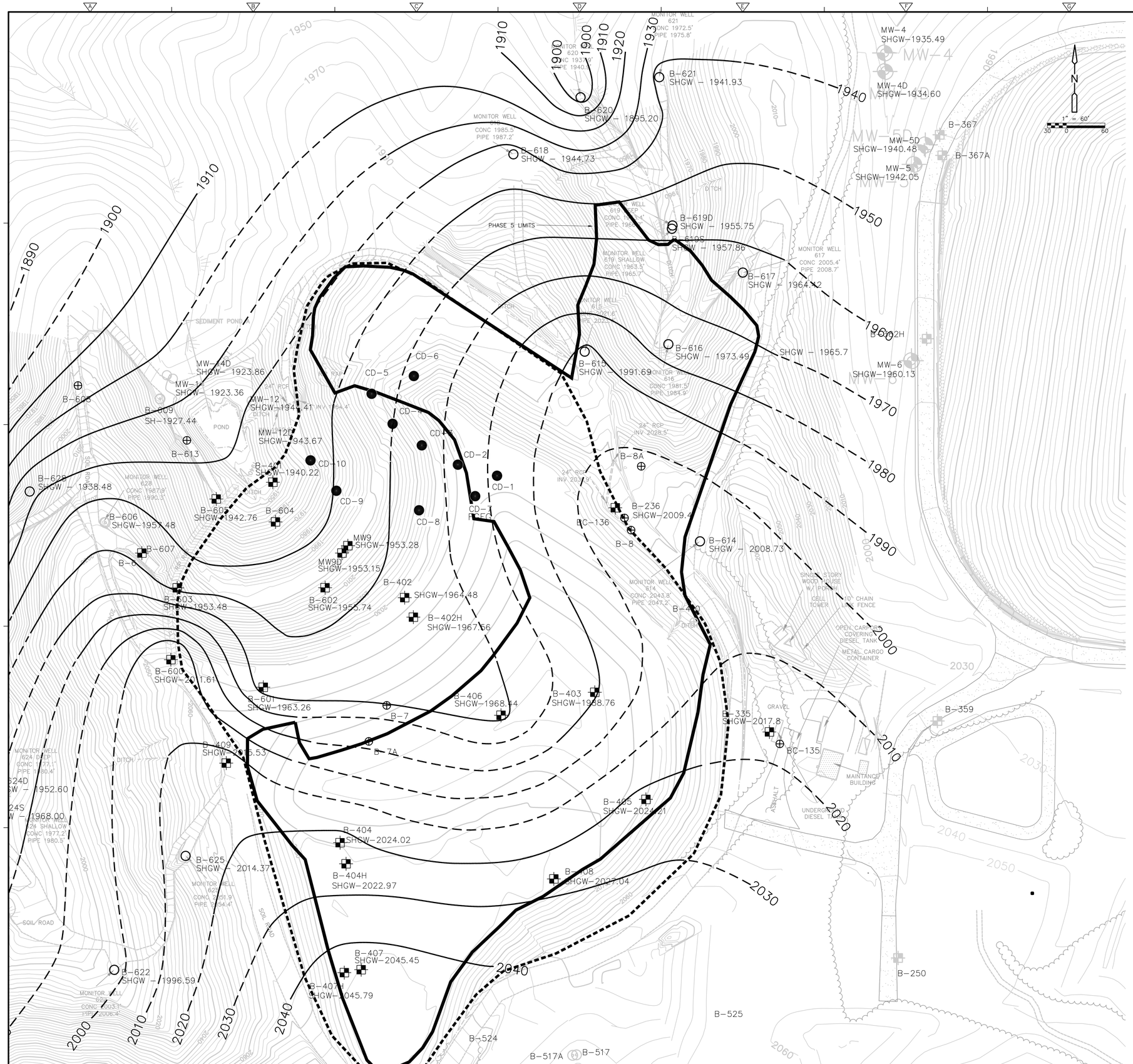
BUNCOMBE COUNTY
NORTH CAROLINA

BUNCOMBE COUNTY C&D LANDFILL
ENGINEERING PLAN

BEDROCK SURFACE CONTOUR MAP

PROJECT NO. 6447-65973
FILE NAME: EP-4.DWG
SHEET NO.
EP-4

NOT FOR CONSTRUCTION



REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: K. YANG
DRAWN BY: J. KILLINGSWORTH
SHEET CHK'D BY: K. YANG
CROSS CHK'D BY: C. GABEL
APPROVED BY: K. YANG
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BUNCOMBE COUNTY
NORTH CAROLINA

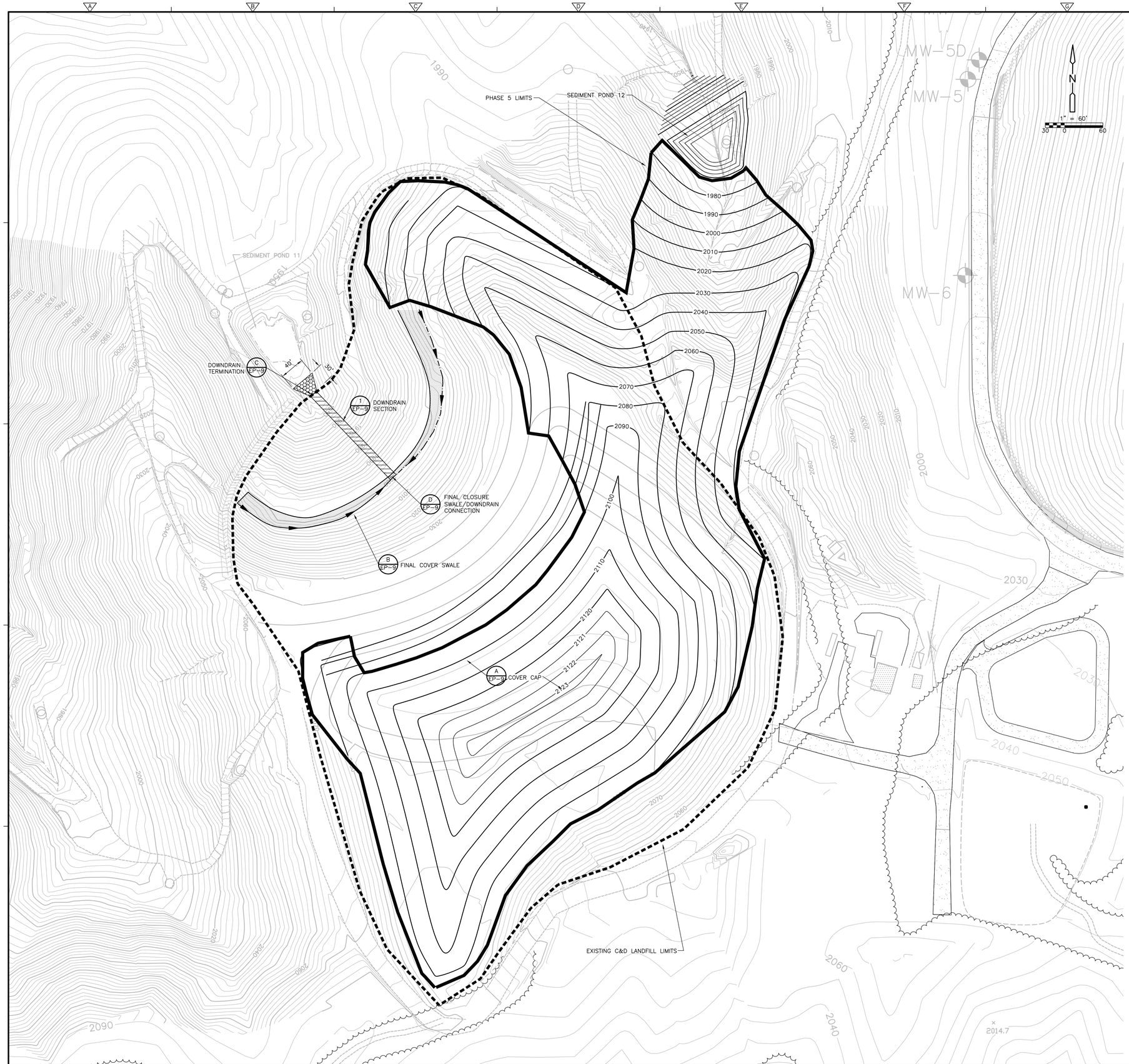
BUNCOMBE COUNTY C&D LANDFILL
ENGINEERING PLAN

ESTIMATED SEASONAL HIGH GROUNDWATER SURFACE MAP

PROJECT NO. 6447-65973
FILE NAME: EP-5.DWG

SHEET NO.
EP-5

NOT FOR CONSTRUCTION



REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: K. YANG
DRAWN BY: J. KILLINGSWORTH
SHEET CHK'D BY: K. YANG
CROSS CHK'D BY: C. GABEL
APPROVED BY: K. YANG
DATE: APRIL 2009

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BUNCOMBE COUNTY
NORTH CAROLINA

BUNCOMBE COUNTY C&D LANDFILL
ENGINEERING PLAN

CLOSURE GRADING PLAN

PROJECT NO. 6447-65973
FILE NAME: EP-6.DWG
SHEET NO.
EP-6

NOT FOR CONSTRUCTION

DEFINITION:

> TEMPORARY SEEDING: PLANTING RAPID–GROWING ANNUAL GRASSES, SMALL GRAINS, OR LEGUMES TO PROVIDE INITIAL, TEMPORARY COVER FOR EROSION CONTROL ON DISTURBED AREAS.

> PERMANENT SEEDING: CONTROLLING RUNOFF AND EROSION ON DISTURBED AREAS BY ESTABLISHING PERENNIAL VEGETATIVE COVER WITH SEED.

PURPOSE:

> TEMPORARY SEEDING: TO TEMPORARILY STABILIZE DENUDED AREAS THAT WILL NOT BE BROUGHT TO FINAL GRADE FOR A PERIOD OF MORE THAN 21 WORKING DAYS. TEMPORARY SEEDING CONTROLS RUNOFF AND EROSION UNTIL PERMANENT VEGETATION CAN BE ESTABLISHED.
> PERMANENT SEEDING: TO REDUCE EROSION AND DECREASE SEDIMENT YIELD FROM DISTURBED AREAS, AND TO PERMANENTLY STABILIZE SUCH AREAS IN A MANNER THAT IS ECONOMICAL, ADAPTS TO SITE CONDITIONS, AND ALLOWS SELECTION OF THE MOST APPROPRIATE PLANT MATERIALS.

SPECIFICATIONS:

> SEEDBED REQUIREMENTS:

ESTABLISHMENT OF VEGETATION SHOULD NOT BE ATTEMPTED ON SITES THAT ARE UNSUITABLE DUE TO INAPPROPRIATE SOIL TEXTURE, POOR DRAINAGE, CONCENTRATED OVERLAND FLOW, OR STEEPNESS OF SLOPE UNTIL MEASURES HAVE BEEN TAKEN TO CORRECT THESE PROBLEMS.

TO MAINTAIN A GOOD STAND OF VEGETATION, THE SOIL MUST MEET CERTAIN MINIMUM REQUIREMENTS AS A GROWTH MEDIUM. THE EXISTING SOIL SHOULD HAVE THESE CRITERIA:

> ENOUGH FINE–GRAINED (SILT AND CLAY) MATERIAL TO MAINTAIN ADEQUATE MOISTURE AND NUTRIENT SUPPLY (AVAILABLE WATER CAPACITY OF AT LEAST .05 INCHES WATER TO 1 INCH OF SOIL).
> SUFFICIENT PORE SPACE TO PERMIT ROOT PENETRATION.
> SUFFICIENT DEPTH OF SOIL TO PROVIDE AN ADEQUATE ROOT ZONE. THE DEPTH TO ROCK OR IMPERMEABLE LAYERS SUCH AS HARDPANS SHOULD BE 12 INCHES OR MORE, EXCEPT ON SLOPES STEEPER THAN 2:1 WHERE THE ADDITION OF SOIL IS NOT FEASIBLE.
> A FAVORABLE PH RANGE FOR PLANT GROWTH, USUALLY 6.0 TO 6.5.
> FREE FROM LARGE ROOTS, BRANCHES, STONES, LARGE CLODS OF EARTH, OR TRASH OF ANY KIND. CLODS AND STONES MAY BE LEFT ON SLOPES STEEPER THAN 3:1 IF THEY ARE TO BE HYDROSEEDED.

IF ANY OF THE ABOVE CRITERIA ARE NOT MET (I.E., IF EXISTING SOIL IS TOO COARSE, DENSE, SHALLOW OR ACIDIC TO FOSTER VEGETATION), SPECIAL AMENDMENTS ARE REQUIRED. THE SOIL CONDITIONERS DESCRIBED BELOW MAY BE BENEFICIAL OR, PREFERABLY, TOPSOIL MAY BE APPLIED.

> SEEDBED PREPARATION:

INSTALL NECESSARY MECHANICAL EROSION AND SEDIMENTATION CONTROL PRACTICES BEFORE SEEDING, AND COMPLETE GRADING ACCORDING TO THE APPROVED PLAN.

LIME AND FERTILIZER NEEDS SHOULD BE DETERMINED BY SOIL TESTS. SOIL TESTING IS PERFORMED FREE OF CHARGE BY THE NORTH CAROLINA DEPARTMENT OF AGRICULTURE SOIL TESTING LABORATORY.

WHEN SOIL TESTS ARE NOT AVAILABLE, FOLLOW RATES SUGGESTED IN THE SEEDING SPECIFICATIONS SHOWN BELOW:

> GROUND AGRICULTURAL LIMESTONE:
LIGHT–TEXTURED, SANDY SOILS: 1 TO 1½ TONS/ACRE
HEAVY–TEXTURED, CLAYEY SOILS: 2 TO 3 TONS/ACRE
> FERTILIZER:
GRASSES: 800 TO 1200 LB/ACRE OF 10–10–10 OR EQUIVALENT
GRASS–LEGUME MIXTURES: 800 TO 1200 LB/ACRE OF 5–10–10 OR EQUIVALENT

APPLY LIME AND FERTILIZER EVENLY AND INCORPORATE INTO THE TOP 4 TO 6 INCHES OF SOIL BY DISKING OR OTHER SUITABLE MEANS. OPERATE MACHINERY ON THE CONTOUR. WHEN USING A HYDROSEEDER, APPLY LIME AND FERTILIZER TO A ROUGH, LOOSE SURFACE.

ROUGHEN SURFACES PRIOR TO SEEDING.

COMPLETE SEEDBED PREPARATION BY BREAKING UP LARGE CLODS AND RAKING INTO A SMOOTH, UNIFORM SURFACE (SLOPES LESS THAN 3:1). FILL IN OR LEVEL DEPRESSIONS THAT CAN COLLECT WATER. BROADCAST SEED INTO A FRESHLY LOOSENED SEEDBED THAT HAS NOT BEEN SEALED BY RAINFALL.

> SEEDING:

SEEDING DATES GIVEN IN THE SEEDING MIXTURE SPECIFICATIONS ARE DESIGNATED AS "BEST" OR "POSSIBLE". SEEDINGS PROPERLY CARRIED OUT WITHIN THE "BEST" DATES HAVE A HIGH PROBABILITY OF SUCCESS. IT IS ALSO POSSIBLE TO HAVE SATISFACTORY ESTABLISHMENT WHEN SEEDING OUTSIDE THESE DATES. HOWEVER, AS YOU DEVIATE FROM THEM, THE PROBABILITY OF FAILURE INCREASES RAPIDLY. SEEDING ON THE LAST DATE SHOWN UNDER "POSSIBLE" MAY REDUCE CHANGES OF SUCCESS BY 30 TO 50 PERCENT. ALWAYS TAKE THIS INTO ACCOUNT IN SCHEDULING LAND–DISTURBING ACTIVITIES.

USE CERTIFIED SEED FOR PERMANENT SEEDING WHENEVER POSSIBLE. CERTIFIED SEED IS INSPECTED BY THE NORTH CAROLINA CROP IMPROVEMENT ASSOCIATION. IT MEETS PUBLISHED NORTH CAROLINA STANDARDS AND SHOULD BEAR AN OFFICIAL "CERTIFIED SEED" LABEL.

LABELING OF NON–CERTIFIED SEED IS ALSO REQUIRED BY LAW. LABELS CONTAIN IMPORTANT INFORMATION ON SEED PURITY, GERMINATION, AND PRESENCE OF WOOD SEEDS. SEEDS MUST MEET STATE STANDARDS FOR CONTENT OF NOXIOUS WEEDS. DO NO ACCEPT SEED CONTAINING "PROHIBITED" NOXIOUS WEED SEED.

INOCULATE LEGUME SEED WITH THE RHIZOBIUM BACTERIA APPROPRIATE TO THE SPECIES OF LEGUME.

APPLY SEED UNIFORMLY WITH A CYCLONE SEEDER, DROP–TYPE SPREADER, DRILL, CULTIPACKER SEEDER, OR HYDROSEEDER ON A FIRM, FRIABLE SEEDBED.

WHEN USING A DRILL OR CULTIPACKER SEEDER, PLANT SMALL GRAINS NO MORE THAN 1 INCH DEEP, GRASSES AND LEGUMES NO MORE THAN 1/2 INCH. EQUIPMENT SHOULD BE CALIBRATED IN THE FIELD FOR THE DESIRED SEEDING RATE.

WHEN USING BROADCAST–SEEDING METHODS, SUBDIVIDE THE AREA INTO WORKABLE SECTIONS AND DETERMINE THE AMOUNT OF SEED NEEDED FOR EACH SECTION. APPLY ONE–HALF THE SEED WHILE MOVING BACK AND FORTH ACROSS THE AREA, MAKING A UNIFORM PATTERN: THEN APPLY THE SECOND HALF IN THE SAME WAY, BUT MOVING AT RIGHT ANGLES TO THE FIRST PASS.

MULCH ALL PLANTINGS IMMEDIATELY AFTER SEEDING.

> HYDROSEEDING:

SURFACE ROUGHENING IS PARTICULARLY IMPORTANT WHEN HYDROSEEDING, AS A ROUGHENED SLOPE WILL PROVIDE SOME NATURAL COVERAGE FOR LIME, FERTILIZER, AND SEED. THE SURFACE SHOULD NOT BE COMPACTED OR SMOOTH. FINE SEEDBED PREPARATION IS NOT NECESSARY FOR HYDROSEEDING OPERATIONS: LARGE CLODS, STONES, AND IRREGULARITIES PROVIDE CAVITIES IN WHICH SEEDS CAN LODGE.

RATE OF WOOD FIBER (CELLULOSE) APPLICATION SHOULD BE AT LEAST 4000 LB/ACRE.

APPLY LEGUME INOCULANTS AT FOUR TIMES THE RECOMMENDED RATE WHEN ADDING INOCULANT TO A HYDROSEEDER SLURRY.

IF A MACHINERY BREAKDOWN OF ½ TO 2 HOURS OCCURS, ADD 50 PERCENT MORE SEED TO THE TANK, BASED ON THE PROPORTION OF THE SLURRY REMAINING. THIS SHOULD COMPENSATE FOR DAMAGE TO SEED. BEYOND 2 HOURS, A FULL RATE OF NEW SEED MAY BE NECESSARY.

LIME IS NOT NORMALLY APPLIED WITH A HYDRAULIC SEEDER BECAUSE IT IS ABRASIVE. IT CAN BE BLOWN ONTO STEEP SLOPES IN DRY FORM.

> MAINTENANCE:

GENERALLY, A STAND OF VEGETATION CANNOT BE DETERMINED TO BE FULLY ESTABLISHED UNTIL SOIL COVER HAS BEEN MAINTAINED FOR ONE FULL YEAR FROM PLANTING, INSPECT SEEDED AREAS FOR FAILURE AND MAKE NECESSARY REPAIRS AND RESEEDINGS WITHIN THE SAME SEASON, IF POSSIBLE.

RESEEDING: IF A STAND HAS INADEQUATE COVER, REEVALUATE CHOICE OF PLANT MATERIALS AND QUANTITIES OF LIME AND FERTILIZER. REESTABLISH THE STAND AFTER SEEDBED PREPARATION OR OVERSEED THE STAND. CONSIDER SEEDING TEMPORARY, ANNUAL SPECIES IF THE TIME OF YEAR IS NOT APPROPRIATE FOR PERMANENT SEEDING.

IF VEGETATION FAILS TO GROW, SOIL MUST BE TESTED TO DETERMINE IF ACIDITY OR NUTRIENT IMBALANCE IS RESPONSIBLE.

FERTILIZATION: ON THE TYPICAL DISTURBED SITE, FULL ESTABLISHMENT USUALLY REQUIRES REFERTILIZATION IN THE SECOND GROWING SEASON. FINE TURF REQUIRES ANNUAL MAINTENANCE FERTILIZATION. USE SOIL TESTS IF POSSIBLE OR FOLLOW THE GUIDELINES GIVEN FOR THE SPECIFIC SEEDING MIXTURE.

> TEMPORARY SEEDING SPECIFICATIONS*:

> SEEDING MIXTURES AND DATES:

FALL (AUG. 15 TO DEC. 30)	RATE (LB/ACRE)
RYE (GRAIN)	120

LATE WINTER TO EARLY SPRING (JAN. 1 TO MAY 1)	RATE (LB/ACRE)
RYE (GRAIN)	120
KOBE LESPEDEZA	50

SUMMER (MAY 1 TO AUG. 15)	RATE (LB/ACRE)
GERMAN MILLET	40

> SOIL AMENDMENTS:

1. FOLLOW RECOMMENDATIONS OF SOIL TESTS; OR
2. APPLY 2000 LB/ACRE GROUND AGRICULTURAL LIMESTONE AND 750 LB/ACRE 10–10–10 FERTILIZER.

> MULCH:

APPLY 4,000 LB/ACRE STRAW. ANCHOR MULCH BY TACKING WITH ASPHALT, ROVING OR A MULCH ANCHORING TOOL. A DISK WITH BLADES SET NEARLY STRAIGHT CAN BE USED AS A MULCH ANCHORING TOOL.

> MAINTENANCE:

REFERTILIZE IF GROWTH IS NOT FULLY ADEQUATE. RESEED, REFERTILIZE AND MULCH IMMEDIATELY FOLLOWING EROSION OR OTHER DAMAGE.

* REF: 6.10 A, B & C, NC EROSION AND SEDIMENT CONTROL PLANNING AND DESIGN MANUAL, 2006

> PERMANENT SEEDING SPECIFICATIONS*:

> SEEDING MIXTURES:

	RATE (LB/ACRE)
TALL FESCUE	100
SERICEA LESPEDEZA	20
KOREAN LESPEDEZA	10
REDTOP	5
KENTUCKY BLUEGRASS	5

NURSE PLANTS:
1. FROM MAY 1 AND AUG. 15, ADD 10 LB/ACRE GERMAN MILLET OR 15 LB/ACRE SUDANGRASS.
2. PRIOR TO MAY 1 OR AFTER AUG. 15, ADD 40 LB/ACRE RYE (GRAIN).

> SEEDING DATES

	BEST	POSSIBLE
FALL	AUG. 15 TO SEPT. 1	JULY 25 TO SEPT. 15
SPRING	MAR. 1 TO APR. 1	MAR. 1 TO MAY 10

> SOIL AMENDMENTS:

1. FOLLOW RECOMMENDATIONS OF SOIL TESTS; OR
2. APPLY 4000 LB/ACRE GROUND AGRICULTURAL LIMESTONE AND 1000 LB/ACRE 5–10–10 FERTILIZER.

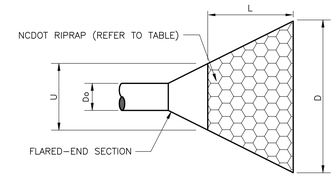
> MULCH:

APPLY 4000 LB/ACRE GRAIN STRAW OR EQUIVALENT COVER OF ANOTHER SUITABLE MULCHING MATERIAL. ANCHOR MULCH BY TACKING WITH ASPHALT, ROVING OR NETTING. NETTING IS THE PREFERRED ANCHORING METHOD ON STEEP SLOPES.

> MAINTENANCE:

REFERTILIZE IN THE SECOND YEAR UNLESS GROWTH IS ADEQUATE. MAY BE MOWED ONCE OR TWICE A YEAR, BUT MOWING IS NOT NECESSARY. RESEED, REFERTILIZE, AND REMULCH DAMAGED AREAS IMMEDIATELY.

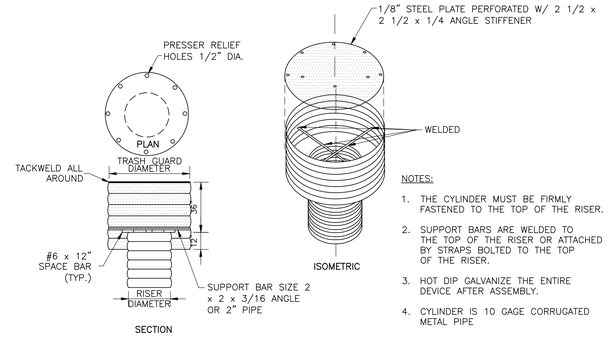
* REF: 6.11C, NC EROSION AND SEDIMENT CONTROL PLANNING AND DESIGN MANUAL, 2006



NOTE: PLACE 8–OZ/SY NONWOVEN GEOTEXTILE (FILTER FABRIC) BENEATH RIPRAP

LOCATION	NO. OF PIPES	PIPE DIA–IN. Do	LENGTH L – (FT)	DEPTH (FT)	UPSTREAM WIDTH – U (FT)	DOWNSTREAM WIDTH – D (FT)	NCDOT RIPRAP CLASS
RO1	1	24	30	2.0	6	36	CLASS I
RO2	1	12	20	2.0	3	23	CLASS I
RO3	1	24	30	2.0	6	36	CLASS I
RO4	1	24	30	2.0	6	36	CLASS I
RO5	1	12	20	2.0	3	23	CLASS I

RIPRAP OUTLET STABILIZATION
DETAIL A
NTS EP–2



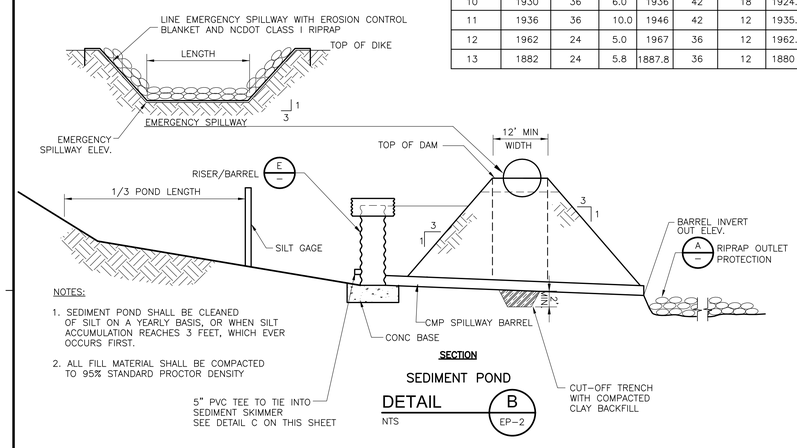
NOTES:

1. THE CYLINDER MUST BE FIRMLY FASTENED TO THE TOP OF THE RISER.
2. SUPPORT BARS ARE WELDED TO THE TOP OF THE RISER OR ATTACHED BY STRAPS BOLTED TO THE TOP OF THE RISER.
3. HOT DIP GALVANIZE THE ENTIRE DEVICE AFTER ASSEMBLY.
4. CYLINDER IS 10 GAGE CORRUGATED METAL PIPE

ANTI–VORTEX DEVICE
DETAIL D
NTS –

SEDIMENT POND DATA

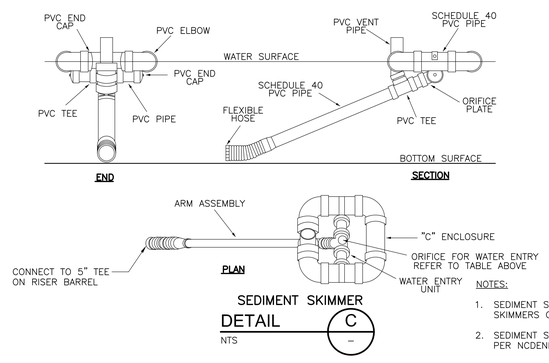
SEDIMENT BASIN NO.	BOTTOM ELEV.	PIPE RISER DIAMETER (IN.)	PIPE RISER HEIGHT (FT)	PIPE RISER CREST ELEV.	PIPE RISER TRASH GUARD DIA. (IN.)	PIPE BARREL DIAMETER (IN.)	PIPE BARREL INVERT IN ELEV.	PIPE BARREL INVERT OUT ELEV.	CONCRETE BASE (CY)	TOP OF DIKE ELEV.	EMERGENCY SPILLWAY ELEV.	EMERGENCY SPILLWAY LENGTH	NO. POROUS BAFFLES
10	1930	36	6.0	1936	42	18	1924.7	1920	3.0	1942	1940	15	3
11	1936	36	10.0	1946	42	12	1935.0	1920	3.0	1952	1950	15	3
12	1962	24	5.0	1967	36	12	1962.0	1950	3.0	1970	1968	15	2
13	1882	24	5.8	1887.8	36	12	1880	1830	3.0	1890	1888.75	15	3



NOTES:

1. SEDIMENT POND SHALL BE CLEANED OF SILT ON A YEARLY BASIS, OR WHEN SILT ACCUMULATION REACHES 3 FEET, WHICH EVER OCCURS FIRST.
2. ALL FILL MATERIAL SHALL BE COMPACTED TO 95% STANDARD PROCTOR DENSITY

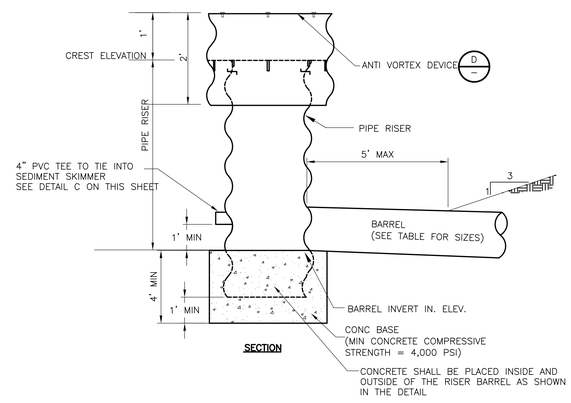
SEDIMENT POND
DETAIL B
NTS EP–2



SEDIMENT SKIMMER
DETAIL C
NTS –

NOTES:

1. SEDIMENT SKIMMER SHALL BE FAIRCLOTH SKIMMERS OR EQUAL.
2. SEDIMENT SKIMMERS SHALL BE INSTALLED PER NCDENR STD PRACTICE



RISER/BARREL
DETAIL E
NTS –

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: K. YANG
DRAWN BY: J. KILLINGSWORTH
SHEET CHK'D BY: K. YANG
CROSS CHK'D BY: C. GABEL
APPROVED BY: K. YANG
DATE: APRIL 2009

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Camp Dresser & McKee
5400 Glenwood Avenue, Suite 300
Raleigh, North Carolina 27612
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consulting • engineering • construction • operations

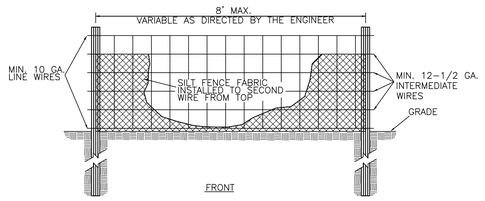
BUNCOMBE COUNTY
NORTH CAROLINA

BUNCOMBE COUNTY C&D LANDFILL
ENGINEERING PLAN

EROSION AND SEDIMENTATION CONTROL DETAILS (1 OF 2)

PROJECT NO. 6447–65973
FILE NAME: EP–7.DWG
SHEET NO.
EP-7

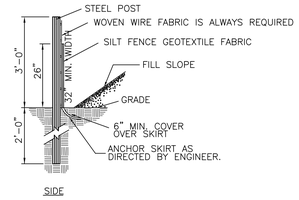
NOT FOR CONSTRUCTION



FRONT

NOTES:

1. END OF SILT FENCE SHOULD BE TURNED UPHILL. SEE NCDENR PRACTICE STANDARDS & SPECIFICATIONS SEDIMENT FENCE SET FOR CONDITIONS WHERE PRACTICE APPLIES; PLANNING CONSIDERATIONS & DESIGN CRITERIA. (HOWEVER FLOW SHALL NOT RUN PARALLEL WITH THE TOE OF THE FENCE).
2. FOR REPAIR OF SILT FENCE FAILURES, USE No. 57 WASHED STONE. IN EACH CASE THE SILT FENCE IS TO BE PROPERLY ENTRENCHED & THE STONE SHALL BE AT A MINIMUM OF 16" ABOVE GRADE AT THE DIRECTION OF FLOW & BETWEEN 60 – 45 DEGREES.



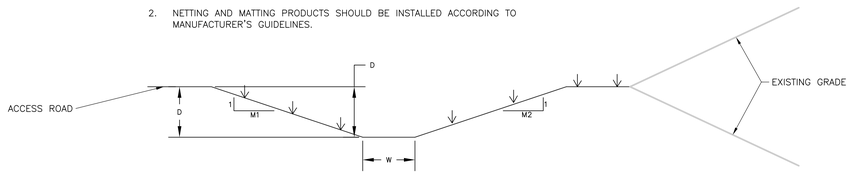
SIDE

SILT FENCE

DETAIL A
NTS –

NOTES:

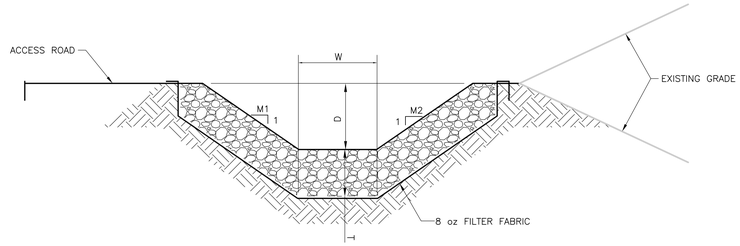
1. CHANNELS ARE TO BE LINED WITH NORTH AMERICAN GREEN MATTING (SEE CHANNEL SCHEDULE) OR APPROVED EQUIVALENT.
2. NETTING AND MATTING PRODUCTS SHOULD BE INSTALLED ACCORDING TO MANUFACTURER'S GUIDELINES.



CHANNEL SCHEDULE					
CHANNEL ID	PROTECTION TYPE	W (FT)	D (FT)	M1	M2
GC1	CURLEX II	3	2	2	2
GC2	CURLEX II	0	2	2	2
GC3	CURLEX II	3	1.5	3	3
GC4	CURLEX II	0	1.5	2	EX. SLOPE
GC5	CURLEX II	0	1.5	2	EX. SLOPE
GC6	CURLEX II	0	1.5	2	EX. SLOPE

GRASS LINED CHANNEL

DETAIL B
NTS EP-2

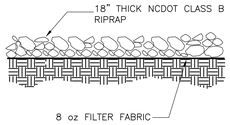


CHANNEL SCHEDULE						
CHANNEL ID	CLASS	W (FT)	T (IN)	D (FT)	M1	M2
RC1	1	3	24	1.5	3	3
RC2	1	3	24	1.5	3	3
RC3	1	3	24	1.5	3	3

SECTION

RIPRAP LINED CHANNEL

DETAIL C
NTS EP-2



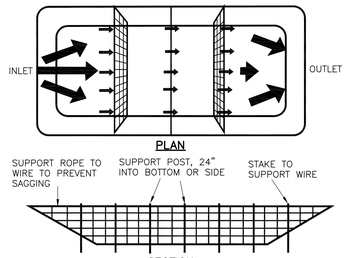
SECTION

RIPRAP STABILIZATION

DETAIL D
NTS –

NOTE:

1. PROVIDE CROSS-SECTION TO THE LIMITS SHOWN IN PLAN VIEW.
2. TOP OF RIPRAP SHALL BE FLUSH WITH THE STRUCTURE INVERT AND FINISHED GRADE.

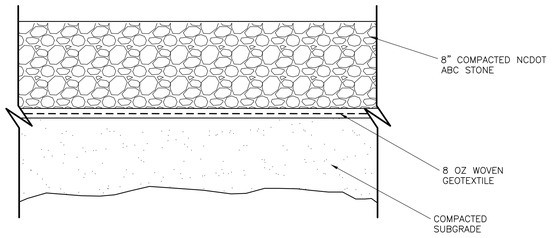


PLAN

SECTION

POROUS BAFFLE IN SEDIMENT BASIN

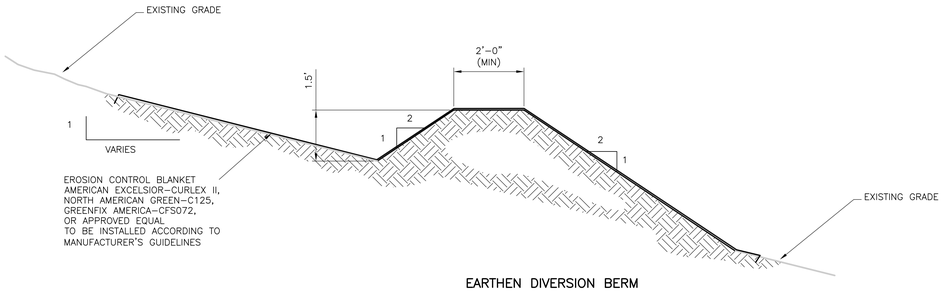
DETAIL E
NTS EP-2



SECTION

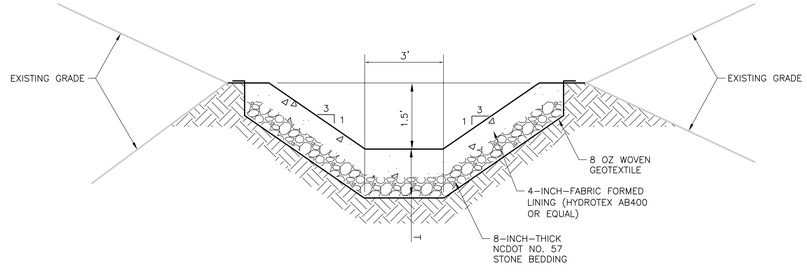
STONE ACCESS ROAD

DETAIL F
NTS EP-2



EARTHEN DIVERSION BERM

DETAIL G
NTS EP-2



SECTION

FABRIC FORMED LINED CHANNEL

DETAIL H
NTS EP-2

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: K. YANG
DRAWN BY: J. KILLINGSWORTH
SHEET CHK'D BY: K. YANG
CROSS CHK'D BY: C. GABEL
APPROVED BY: K. YANG
DATE: APRIL 2009

CDM
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5400 Glenwood Avenue, Suite 300
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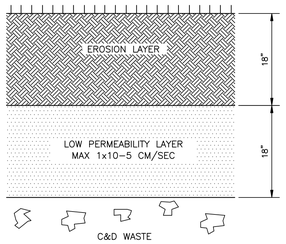
BUNCOMBE COUNTY
NORTH CAROLINA

BUNCOMBE COUNTY C&D LANDFILL
ENGINEERING PLAN

EROSION AND SEDIMENTATION CONTROL DETAILS (2 OF 2)

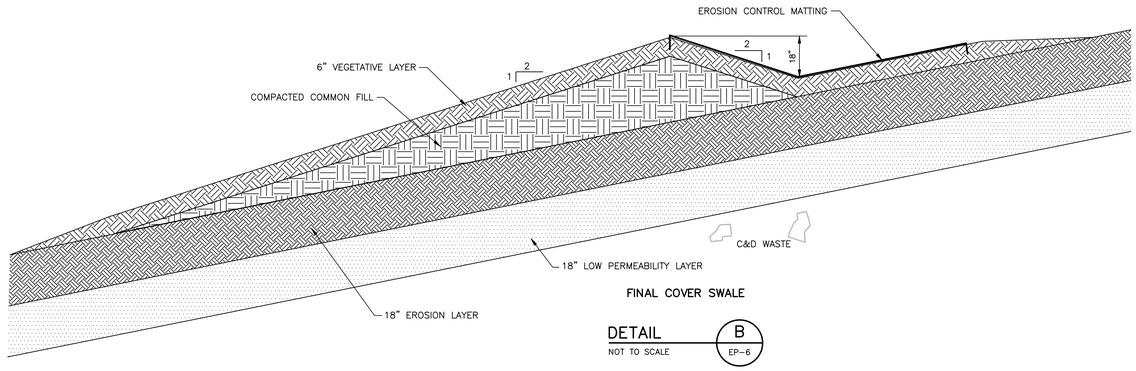
PROJECT NO. 6447-65973
FILE NAME: EP-8.DWG
SHEET NO.
EP-8

NOT FOR CONSTRUCTION



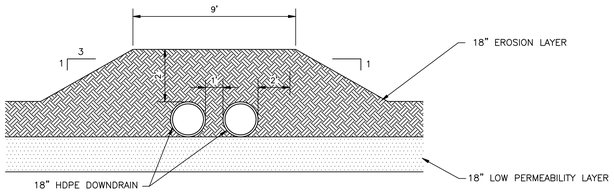
COVER CAP

DETAIL A EP-6



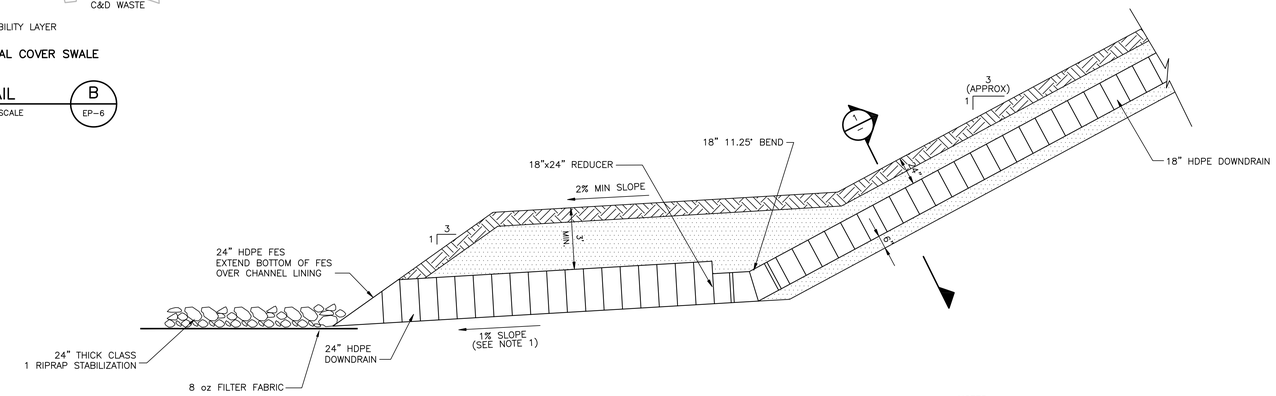
FINAL COVER SWALE

DETAIL B EP-6
NOT TO SCALE



DOWNDDRAIN SECTION

SECTION 1 –
NOT TO SCALE

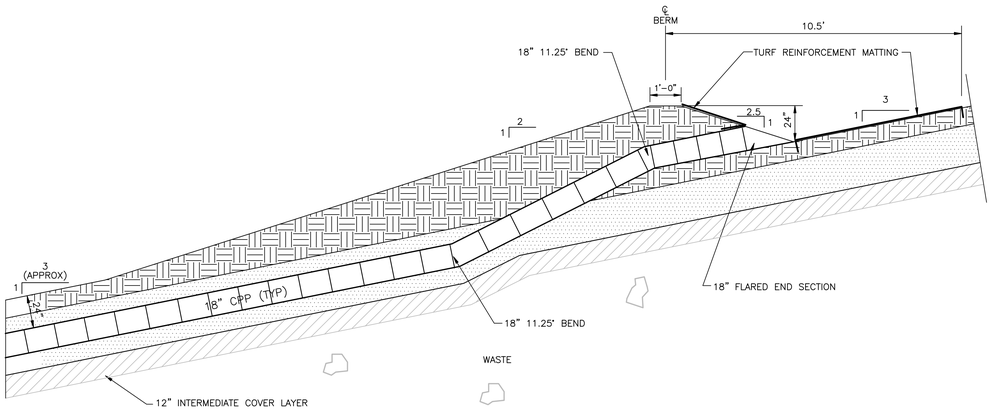


DOWNDRAIN TERMINATION

DETAIL C EP-6
NOT TO SCALE

NOTES:

1. ALL PIPE AND FITTINGS SHALL BE DUAL WALL CORRUGATED HDPE WITH WATER-TIGHT CONNECTIONS.
2. ALL PIPE AND FITTINGS SHALL BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS UNLESS OTHERWISE APPROVED BY ENGINEER.
3. ALL FITTINGS SHALL BE FACTORY FABRICATED.



FINAL COVER SWALE/DOWNDRAIN CONNECTION

DETAIL D EP-6
NOT TO SCALE

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: K. YANG
DRAWN BY: J. KILLINGSWORTH
SHEET CHK'D BY: K. YANG
CROSS CHK'D BY: C. GABEL
APPROVED BY: K. YANG
DATE: APRIL 2009

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BUNCOMBE COUNTY
NORTH CAROLINA

BUNCOMBE COUNTY C&D LANDFILL
ENGINEERING PLAN

CLOSURE DETAILS

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Buncombe County, North Carolina

Buncombe County Solid Waste Management Facility

C&D Landfill Expansion Part 6: Construction Quality Assurance Plan

April 2009

Construction Quality Assurance Plan
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Section 1
Purpose

This Construction Quality Assurance (CQA) Plan is intended to fulfill Rule .0541 that requires a CQA Plan be developed and used as part of the construction for a construction and demolition (C&D) landfill. This plan describes the observations and tests that will be used before, during, and upon completion of construction to ensure that the construction and materials meet the design specifications and the construction and certification requirements set forth in Rule .0540 of the Solid Waste Rules.

1.1 Quality Assurance and Quality Control

In the context of this CQA Plan, quality assurance and quality control are defined as follows:

- ***Quality Assurance:*** A program of tests and observations, executed by a party independent of the contractor, performed in order to confirm that completed work meets contractual and regulatory requirements and will perform satisfactorily in service.

- ***Quality Control:*** Those actions performed by the contractor or an agent of the contractor, which provide a means to monitor the quality of the work being performed.

1.2 References

The CQA Plan includes references to test procedures of the American Society for Testing Materials (ASTM).

1.3 Overview of Manual

Per .0541(b)(1) through (5) this CQA Plan addresses:

1. Responsibilities and authorities. The plan establishes responsibilities and authorities for the construction management organization. This includes a pre-construction meeting conducted prior to beginning construction of the cell. The meeting will include a discussion of the construction management organization, respective duties during construction, and periodic reporting requirements for test results and construction activities. This information is presented in Sections 2 and 3 of the CQA Plan.

2. Inspection activities: A description of all field observations, tests, and equipment that will be used to ensure that the construction meets or exceeds all design criteria established in accordance with Rules .0539, .0540 and .0543(d) is presented in Sections 4 and 5 of the CQA Plan.

3. Sampling strategies. A description of all sampling protocols, sample size, and frequency of sampling is presented in Sections 4 and 5 of the CQA Plan.

4. Documentation. Reporting requirements for CQA activities are described in detail in Sections 3 through 5 of the CQA Plan.

5. Progress and troubleshooting meetings. A plan will be prepared for holding periodic troubleshooting meetings. The proceedings of the meetings will be documented. Meeting information is included in Section 3 of the Plan.

Section 2
Definitions, Responsibilities, and Qualifications of Parties

The parties discussed in this section are associated with the ownership, design, construction, and quality assurance of the landfill subgrade. The definitions, responsibilities, and qualifications of these parties are summarized in Table 2-1 and outlined in the following subsections.

2.1 Contractor

2.1.1 Definition

The Contractor is the company with which the Owner has entered into agreement to construct the project.

2.1.2 Responsibilities

The Contractor is ultimately responsible for meeting the requirements of the Contract Documents and the successful completion of the landfill construction. Some of the Contractor's specific responsibilities include: providing qualified personnel to perform quality control, providing submittals for the various materials as required by the specifications, scheduling and coordinating the work with suppliers and subcontractors, providing a representative at all times during construction activity, provide surveying services, furnish progress and record drawings, attending progress meetings, and notifying the Engineer of design discrepancies.

2.1.3 Qualifications

The Contractor shall be experienced in all aspects of the work required to successfully construct the project. The Contractor shall be registered in the State of North Carolina and shall provide references from previous projects.

2.2 Contractor's Representative (CR)

2.2.1 Definition

The Contractor's Representative is a qualified individual assigned by the Contractor to represent him/her onsite during construction activities.

2.2.2 Responsibilities

The Contractor's Representative is responsible for: communication with the Engineer and Owner, coordinating and supervising his crew, subcontractors, and quality control personnel, ensuring that construction activities are conducted in accordance with the plans and specifications, immediately notifying the Engineer's Field Representative (EFR) of any discrepancies between the plans and specifications and the field conditions, attending all meetings held on the project, and keeping a daily log of all construction activities onsite.

Table 2-1
Project Personnel Responsibilities

PARTY	DEFINITION	RESPONSIBILITIES	QUALIFICATIONS	REPORT TO
Contractor	Company contracted by Owner to construct project in accordance with plans and specifications	Page 2-1	Licensed in North Carolina and similar project experience	Owner, Engineer, and EFR
Contractor's Representative (CR)	Person assigned by the Contractor to act as the Contractor Representative onsite	Pages 2-1 and 2-3	Similar project experience	Contractor and EFR
Engineer	Company contracted by Owner for design of the project and to provide services during construction	Page 2-3	Registered professional engineer in North Carolina	Owner
Engineer's Field Representative (EFR)	Person assigned by the Engineer to perform QA inspection and document construction activities	Pages 2-3 and 2-4	Similar project experience	Engineer and Owner
Quality Assurance Laboratory (QAL)	Lab assigned by Owner or Engineer to conduct materials testing	Page 2-4	Experience in testing in accordance with ASTM.	EFR and Owner

2.2.3 Qualifications

The Contractor's Representative (CR) shall be an individual who demonstrates the capability to direct all tasks required for landfill subgrade construction. The CR shall demonstrate experience similar to the nature of the project and be knowledgeable of all aspects of the work.

2.3 Engineer

2.3.1 Definition

The Engineer is the party with which the Owner has entered into agreement with to provide project design and construction oversight.

2.3.2 Responsibilities

The Engineer is responsible for performing the engineering design and preparing the associated construction drawings and specifications. The Engineer is responsible for approving all design and specification changes, clarifying the design, reviewing and approving shop drawings, and other tasks as required during construction. The Engineer conducts the pre-construction meeting and progress meetings outlined in this manual. The Engineer will certify that the construction was completed in accordance with this CQA manual, the conditions of the permit to construct, the requirements of Rule .0540 and .0541, and acceptable engineering practices.

2.3.3 Qualifications

The Engineer shall be a professional engineer registered by the State of North Carolina. The Engineer shall be familiar with landfill design and construction and all applicable regulatory requirements.

2.4 Engineer's Field Representative

2.4.1 Definition

The Engineering's Field Representative (EFR) is a qualified individual assigned by the Engineer to observe and document activities requiring quality assurance.

2.4.2 Responsibilities

The EFR is responsible for observing and documenting activities related to the quality assurance of the construction of the landfill subgrade. The EFR is responsible for implementation of this CQA Manual and coordination of the Quality Assurance Laboratory (QAL).

The specific duties of the EFR are as follows:

a. Review all construction drawings and specifications.

b. Review other site-specific documentation, including permits.

c. Review all changes to design drawings and specifications as issued by the Engineer.

d. Act as the onsite (resident) representative of the Owner.

e. Attend all quality assurance related meetings, e.g., resolution, pre-construction, daily, weekly, etc.

f. Review all Contractor's Daily Reports, logs, and photographs.

g. Report to the Engineer, and log in the daily report any relevant observations.

h. Prepare daily reports in addition to Contractor's Daily Report.

i. Oversee the marking, packaging, and shipping of all laboratory test samples.

j. Review the results of laboratory testing.

k. Report any unapproved deviations from the CQA Manual.

l. Prepare the final certification report.

m. Monitor, log, photograph, and/or document construction of the landfill subgrade. Photographs shall be taken routinely of critical areas during construction.

2.4.3 Qualifications

EFR shall be experienced with the implementation and preparation of quality assurance documentation including: quality assurance forms, reports, certifications, and manuals; and shall have prior experience with soil liner installation.

2.5 Quality Assurance Laboratory

2.5.1 Definition

The QAL is a firm, independent from the Contractor and Owner responsible for conducting tests on samples of subgrade material obtained from the site.

2.5.2 Responsibilities

The QAL shall be responsible for conducting the appropriate laboratory tests as directed by the Engineer and in accordance with the project plans and specifications. The test procedures shall be done in accordance with the test methods outlined in this CQA Plan.

2.5.3 Qualifications

The QAL shall have experience in soil testing and be familiar with American Society for Testing and Materials (ASTM).

2.5.4 Submittals

The QAL shall deliver all test results to the Engineer in written form. Written test results shall be in an easily readable format and include references to the standard test methods used.

Section 3
Communication Between Involved Parties

Communication is essential to achieve a high level of quality during construction and to assure the final product that meets all project requirements. This section discusses the necessary lines of communication.

3.1 Lines of Communication

All communication between parties shall go through the Engineer's Field Representative (EFR), who, in turn, will direct the communication through the proper channels.

3.2 Pre-Construction Meeting

A pre-construction meeting shall be held before construction activity begins. The meeting shall be conducted by the Engineer and attended by the Owner, EFR, Contractor, Contractor's Representative, and a Solid Waste Section representative.

Per Rule .0541(b)(1), the meeting will include a discussion of the construction management organization, the responsibilities and duties of each party during construction, and a discussion of the procedures for periodic reporting of testing results and construction activities.

3.3 Progress and Troubleshooting Meetings

Progress and troubleshooting meetings shall be conducted by the Engineer and attended by the Owner, EFR, and Contractor's Representative. Progress meetings shall be held as deemed necessary. These meetings shall discuss current progress, planned activities to be accomplished prior to the next progress meeting, issues requiring resolution, and any new business or revisions to the work. The EFR shall log any problems, decisions, or questions arising at this meeting in a weekly report. If any matter remains unresolved at the end of this meeting, the EFR will be responsible for obtaining a resolution of the matter and for forwarding communication of the decision to the appropriate parties.

Section 4
Landfill Subgrade

The materials, construction, and certification requirements presented in this Section are intended to comply with Rule .0540(5).

4.1 Materials

The subgrade shall be adequately free of organic material and consist of in-situ or modified soils, or select fill approved by the Engineer. Per Rule .0540(2)(b), the upper two feet of subgrade shall consist of SC, SM, ML, CL, MH, or CH soils per Unified Soil Classification System.

4.2 Construction

The subgrade shall be graded in accordance with the plans and specifications including but not limited to the following:

- The subgrade shall be compacted to at least 95.0 percent of maximum density as determined by ASTM D698.
- The subgrade surface shall not be smooth rolled. The subgrade surface shall be left in a roughened condition to allow vegetative growth.
- The Engineer shall be notified if bedrock or other unpredicted subsurface conditions are encountered during excavation.
- The EFR will conduct field inspections during the construction of the subgrade and make field notes to document that the subgrade is properly prepared.

4.3 Certification

4.3.1 Field Quality Control

A. The QAL shall conduct the following tests during installation of the landfill subgrade at the specified frequencies.

Test	Method	Frequency
Atterberg Limits	ASTM D4318	Every 3,000 cy
Grain Size	Sieve Only	Every 3,000 cy
Compaction	ASTM D2937 or ASTM D2992	1 test/lift/10,000 sf
Moisture	ASTM D2216 or ASTM D3017	1 test/lift/10,000 sf

B. The Engineer, or qualified geologist by direction of the Engineer, shall visually inspect and approve the subgrade and the survey plan of subgrade elevation submitted by the Contractor. The Engineer will notify the Division's hydrogeologist at least 24 hours before subgrade inspection.

C. The Contractor shall provide ground survey plans certified by a Land Surveyor registered in the State of North Carolina. The plan shall include a topographical survey of the disposal area to verify the subgrade elevation. Shots for this survey shall be taken on a maximum 50-foot grid system.

Section 5
Documentation

This Section is intended to comply with Rules .0540(8) and .0541(b)(4).

Upon completion of construction activities, a Construction Quality Assurance Certification Report will be submitted to the Solid Waste Section in accordance with Rules .0540 and .0541. The report will include, at a minimum:

- all quality assurance services performed during construction;
- field observation inspection reports;
- results of all construction quality assurance and construction quality control testing required by this Plan;
- any failed test results, descriptions of procedures used to correct the improperly installed material and results of all retesting performed;
- record drawings documenting the completed project and noting any deviation from the approved engineering plans; and
- color photographs of major project features.

The CQA Certification report shall bear the seal of a North Carolina Professional Engineer who was involved during the construction and a certification that construction was completed in accordance with:

1. This CQA Plan;
2. The conditions of the Permit to Construct;
3. The requirements of Rules .0540 and .0541; and
4. Good engineering practices.

Buncombe County, North Carolina

Buncombe County Solid Waste Management Facility

Subtitle D Landfill Operation Plan

July 2009
REVISED AUGUST 2015 BY MCGILL ASSOCIATES, P.A.

Part 7: Operation Plan
C&D Landfill
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Section 1
Purpose

The purpose of this Operation Plan is to provide the Buncombe County C&D landfill staff with a manual that will serve as a guide for safe and efficient operation of the C&D landfill, including the current operating phase through the Phase 5 expansion that is proposed for construction. This Operation Plan has been prepared in accordance with the North Carolina Solid Waste Rule 15A NCAC 13B .0542, Operation Plan and Requirements for C&D Landfill Facilities, and therefore addresses the following issues.

- Waste Acceptance and Disposal Requirements
- Cover Material Requirements
- Spreading and Compacting Requirements
- Disease Vector Control
- Air Criteria and Fire Control
- Access and Safety Requirements
- Erosion and Sedimentation Control Requirements
- Drainage Control and Water Protection Requirements
- Survey for Compliance
- Operating Record and Recordkeeping Requirements

Additionally, Table 1 is provided to summarize all required documents or documentation (record keeping) which must be maintained by the County and retained at the facility. The operating record may be inserted into a 3-ring binder located at the scale house or main administration building. It is the intent that Table 1 is clearly and visually posted to ensure direction on record keeping.

1.1 Operation Drawings

In accordance with Rule .0542(b)(1), operation drawings have been prepared and are included in Appendix D.

Table 1
Buncombe County C&D Landfill
Operating Record Requirements

Required Record Keeping	Rule	Reference in Ops Plan	Action
INCOMING WASTE			
Attempted disposal of any prohibited wastes	.0542	2.5	Report to NCDENR within 24 hrs
Attempted disposal of any waste from outside the permitted service area	.0542	2.5	Report to NCDENR within 24 hrs
Records of random waste inspections	.0544	11.1	Note date and result
Amounts by weight of solid waste received at the C&D landfill, include county of generation	--	11.1	--
DISPOSAL OPERATIONS			
Placement of cover material at a minimum per 3.1	.0542	3.1	Note date and time and include in Operating Record
Open burning requests	.0542	6.2	Note date of approval and approving DWM personnel and include in Operating Record
Fire and explosion notification	.0542	6.4	Report to NCDENR verbally within 24 hrs and written by 15 days and keep notification on file
METHANE (LFG) MONITORING			
Methane (LFG) monitoring reports	.0544	11.2.1	Quarterly
Exceedance in methane levels – required action within 7 days following detection	.0544	11.2.1	Include in Operating Record detected levels and description of steps to protect human health
Exceedance in methane levels – required action within 60 days following detection	.0544	11.2.1	Include in Operating Record a remediation plan for gas releases
GROUNDWATER AND SURFACE WATER MONITORING			
Groundwater and surface water monitoring reports	.0544	App. A	Semi-annual
TRAINING			
Certifications of training	.0544	11.1	--

Training procedures	.0544	11.1	--
MISCELLANOUS			
Audit records, compliance records and inspection reports	.0542	11.1	--
CLOSURE/POST-CLOSURE (NOT APPLICABLE AS OF OCTOBER 2008)			
Any closure or post-closure monitoring, testing, or analytical data	.0543	11.1	Note date and result and include in Operating Record
REQUIRED APPROVED DOCUMENTS TO BE INCLUDED IN THE OPERATING RECORD			
Current Operations Plan and Monitoring Plan in accordance with Rules .0542 & .0544			
Current Permit to Construct and Permit to Operate			
Current cost estimates and financial assurance documentation			

Section 2
Waste Acceptance and Disposal Requirements

2.1 Waste Definitions

Agricultural Waste - waste material produced from raising of plants and animals, including animal manures, bedding plant stalks, hulls, and vegetative matter.

Asbestos Waste - any waste material that is determined to contain asbestos.

Asphalt - in accordance with G.S. 130-294(m).

Blood Product - all bulk blood and blood products.

Commercial Solid Waste - all types of solid waste generated by retail stores, offices, restaurants, warehouses, and other non-manufacturing activities, excluding residential waste.

Construction or Demolition Debris - solid waste resulting solely from construction, remodeling, repairs or demolition operations on pavement, buildings, or other structures, but does not include inert debris, land-clearing debris or yard debris.

Hazardous Waste - any solid waste that is defined as hazardous in 15A NCAC 13A 261.3 and that is not excluded from regulation as a hazardous waste from conditionally exempt small quantity generators as defined within 15A NCAC 13A 261.5.

Hot Load - when a waste hauling vehicle is transporting solid waste that is burning or smoldering, it is referred to as a hot load.

Household Waste - any solid waste derived from households including hotels and motels, bunkhouses, ranger stations, crew quarters, campgrounds, picnic grounds, and day-use recreation areas.

Industrial Solid Waste - solid waste generated by manufacturing processes that is not a hazardous waste regulated under Subtitle C of RCRA. Such waste may include, but is not limited to, waste resulting from the following manufacturing processes: electric power generation; fertilizer/agricultural chemicals; food and related products/by-products; inorganic chemicals; iron and steel manufacturing; leather and leather products; nonferrous metals manufacturing/foundries; organic chemicals; plastics and resins manufacturing; pulp and paper industry; rubber and miscellaneous plastic products; stone, glass, clay, and concrete products; textile manufacturing; transportation equipment; and water treatment. This term does not include mining waste or oil and gas waste.

Inert Debris - any solid waste which consists solely of material such as concrete, brick, concrete block, uncontaminated soil, rock, and gravel.

Infectious Waste - any solid waste capable of producing an infectious disease. These types of waste include microbiological waste, pathological waste, blood products, and sharps.

Land-Clearing Debris - solid waste which is generated solely from land clearing activities such as stumps and trees trunks.

Liquid Hydrocarbons - as defined under Article 21A of Chapter 143 of the North Carolina General Statutes: except that any such oils or other liquid hydrocarbons that meet the criteria for hazardous waste under the Federal Resource Conservation and Recovery Act (P.L. 94-580) as amended.

Liquid Waste - any waste material that is determined to contain free liquid by Method 9095 (Paint Filter Test).

Microbiological Waste - includes cultures and stocks of etiologic agents. The term includes cultures of specimens from medical, pathological, pharmaceutical, research, commercial, and industrial laboratories.

Oils - As defined under Article 21A of Chapter 143 of the North Carolina General Statutes: except that any such oils that meet the criteria for hazardous waste under the Federal Resource Conservation and Recovery Act (P.L. 94-580) as amended.

Pathological Waste - includes: human tissue, organs, body parts, secretions, and excretions, blood, and body fluids that are removed during surgery and autopsies; the carcasses and body parts of all animals that were exposed to pathogens in research, were used in the production of biological or in the in-vitro testing of pharmaceuticals, or that died of known or suspected infectious disease.

Polychlorinated Biphenyls (PCB) - defined as any of several compounds that are produced by replacing hydrogen atoms in biphenyl with chlorine. PCB's were most frequently used as an additive to oil or other liquid in situations where heat is involved. PCB's have been used in paints and lubricants, however the most common application was in electric transformers.

Radioactive Waste - any waste that contains radioactivity as defined by the North Carolina Radiation Protection Act, G.S. 104E-1 through 104E-23. Radioactivity is defined as the property possessed by some elements of spontaneously emitting alpha or beta rays and sometimes gamma rays by the disintegration of the nuclei of atoms.

Sharps - includes needles, syringes with attached needles, capillary tubes, slides and cover slips, and scalpel blades.

Spoiled Food - any food which has been removed from sale by the United States Department of Agriculture, North Carolina Department of Agriculture, Food and Drug Administration, or any other regulatory agency having jurisdiction in determining that food is unfit for consumption.

Treatment or Processing Waste - any waste that is a residual solid from a wastewater treatment or pretreatment facility.

Tires - rubber tires from vehicles.

White Goods - any inoperative and discarded refrigerators, freezers, ranges, washers, dryers, water heaters, and other large domestic commercial appliances.

Yard Trash - solid waste resulting from landscaping and yard maintenance such as brush, grass, tree limbs, and similar vegetative material.

2.2 Acceptable Waste

In accordance with Rule .0542(c)(1), a C&D landfill shall only accept those solid wastes which it is permitted to dispose of. In accordance with the current Permit to Operate (dated March 5, 2008), the Buncombe County C&D landfill is permitted to dispose of the following using normal operating procedures (as defined previously):

- Construction or Demolition Debris;
- Inert Debris;
- Land-Clearing Debris;
- Asphalt; and
- Asbestos Wastes.

2.3 Acceptable Waste Requiring Special Handling

Asbestos waste is part of the permitted, acceptable waste stream and will require special handling procedures. The County has delineated a defined, isolated area within the C&D landfill footprint of the active phase as shown on Sheets OP-2 through OP-5.

The asbestos waste shall be managed in accordance with 40 CFR 61. In accordance with Rule .0542(c)(2), the regulated asbestos waste shall be covered immediately with soil in a manner that will not cause airborne conditions and must be disposed of separate and apart from other solid wastes.

Hot loads arriving at the site should be dumped immediately in the designated primary hot load area located near the working face. The designated area must be located only on areas containing compacted refuse covered by at least 12 inches of cover material. The location of the primary hot load area will change along with the landfill development so as to always be near the working face. Hot loads should be

extinguished immediately after being dumped by applying water to the burning refuse and by covering the refuse with soil from the stockpile area. If problems are encountered, the local fire department should be called. Once extinguished, the hot load should be observed until it is certain that the fire is out. The remaining refuse should then be compacted and buried at the working face.

2.4 Prohibited Wastes

The following wastes will be prohibited from disposal at the Buncombe County C&D Landfill:

- Wastewater treatment sludge;
- Containers such as tubes, drums, barrels, tanks, cans, and bottles unless they are empty and perforated to ensure that no liquid, hazardous or municipal solid waste is contained within;
- Garbage;
- Hazardous waste;
- Industrial solid waste;
- Liquid waste;
- Medical waste;
- Municipal solid waste;
- Polychlorinated biphenyls (PCB) wastes;
- Radioactive waste;
- Septage;
- Sludge;
- Special wastes;
- White goods; and
- Yard trash.

The following wastes cannot be received if separate from C&D landfill waste:

- Lamps or bulbs including but not limited to halogen, incandescent, neon or fluorescent;
- Lighting ballast or fixtures;
- Thermostats and light switches;
- Batteries including but not limited to those from exit and emergency lights and smoke detectors;
- Lead pipes;

- Lead roof flashing;
- Transformers;
- Capacitors; and
- Copper chrome arsenate (CCA) and creosote treated woods.

Waste accepted for disposal in the C&D landfill shall be readily identifiable as C&D waste and shall not have been shredded, pulverized, or processed to such an extent that the composition of the original waste cannot be readily ascertained.

The County shall not knowingly dispose any type or form of C&D waste that is generated within the boundaries of a unit of local government that by ordinance:

- Prohibits generators or collectors of C&D waste from disposing that type or form of C&D waste.
- Requires generators or collectors of C&D waste to recycle that type or form of C&D waste.

2.5 Receiving Prohibited Waste

The Buncombe County C&D landfill shall only accept those solid wastes that it is permitted to receive. The County will notify the North Carolina Department of Environment and Nature Resources Division of Waste Management (NCDENR DWM) within 24 hours of attempted disposal of any waste the C&D and Subtitle D landfills are not permitted to receive.

A report shall be prepared of any attempted delivery of waste of which the landfill is not permitted to receive, including waste from outside the permitted landfill service area. The report will be forwarded to:

Department of Environment and Natural Resources
Division of Waste Management
Solid Waste Section
1646 Mail Service Center
Raleigh, North Carolina 27699-1646

Section 3
Cover Material Requirements

3.1 Operational Cover

In accordance with Rule .0542(f), the County shall cover disposed C&D waste with six inches of earthen material (or alternative cover material (ACM) approved by the Solid Waste Section (SWS)) when the waste disposal area exceeds one-half acre and at least once weekly. Soil cover shall be used once monthly at a minimum. Cover shall be placed at more frequent intervals if necessary, to control disease vectors, fires, odors, blowing litter, and scavenging. A notation of the date and time of the cover placement must be recorded in the operating record.

In accordance with Rule .0542(f)(2), areas which will not have additional wastes placed on them for three months or more, but where final termination of disposal operations has not occurred, shall be covered and stabilized with vegetative ground cover or other stabilizing material.

3.1.1 Wet Weather Operations

During wet weather, the County will develop a wet weather working face. The wet weather working face will be kept as small as possible. At the end of disposal operations, the County will cover in accordance with Section 3.1.

3.2 Alternative Cover Material

ACM methods are described in this section for Posi-Shell and soil/mulch mixture. Each ACM shall provide control for disease vectors, fires, odor, blowing litter, and scavenging. The ACM approval letter is included in Appendix B.

3.2.1 Posi-Shell

The Posi-Shell Cover System is proposed as an ACM (see Appendix C for Manufacturer's Usage Guide) on waste disposed at the C&D landfill. Posi-Shell provides a thin cover that hardens over the covered waste surface.

3.2.1.1 Properties of Posi-Shell

The properties of each component of Posi-Shell are presented in the Manufacturer's Usage Guide in Appendix C.

3.2.1.2 Cover System Description

As described in the Manufacturer's Usage Guide, the application rate for short-term coverage (overnight cover for daily cover operations) is approximately 8 to 10 square feet per gallon. Assuming the working face is less than one acre (100 feet wide and 400 feet long), the desired load size would be approximately 4,000 gallons. At a minimum, the Posi-Shell material quantities for daily use should be the following:

- 3,200 gallons of liquid (water or leachate),

- 8 bags (15 lbs each) of Posi-Pak,
- 40 bags (50 lbs each) of PSM-200 setting agent, and
- 80 bags (94 lb each) of optional Portland cement.

Posi-Pak is a specially designed plastic fiber with a proprietary finish that provides the reinforcement matrix for the finished cover. PSM-200 setting agent is a blend of clay, polymers, and adhesives that provides thickening, lubrication, and adhesion. Portland cement can be used as a binder component which will help neutralize odors and enhances the durability of the cover system.

3.2.1.3 Cover System Application Procedures

Application Procedure

Application of the Posi-shell will generally follow the manufacturer's recommendation and will employ the following minimum procedures:

- The Posi-shell will be applied in two different directions to avoid spray shadow or wind dispersion;
- The Posi-shell will be applied at the end of each working day;
- The Posi-shell surface will be visually inspected on a daily basis for exposed waste and/or inadequate coverage. Inadequate coverage is generally defined as a thickness of less than 1/8 of an inch.

Areas of exposed waste and/or inadequate coverage will receive an additional application prior to operations ending for that day.

Maximum Daily Area Coverage

Based on the July 2008 Airspace Analysis Report:

- Annual 2007 waste disposal rate (C&D only) = 66,400 tons
- Operating days per year = 284 days
- Approximate daily waste disposal rate = 230 tons
- In-place density = 0.65 tons of C&D per cubic yard
- Daily cubic yards disposed = daily waste disposal rate / in-place density = 350 yd^3 or 9,500 ft^3

The working face will be restricted to the smallest area feasible. The working lift is typically 4 feet high. Based on a working lift thickness of 4 feet, the working face area is 5,400 square feet (daily cubic yards disposed / working lift thickness), which is less than the daily coverage area.

Daily Depth and Quantity to be Applied

N/A

Average Monthly Volume of Daily Cover

N/A

List of Equipment

Equipment required for the Posi-Shell consists of a standard hydroseeding unit and a towing unit.

Material and Equipment Storage

The material components of Posi-Shell will be housed in the machine shop to minimize the risk of hydration. The spraying equipment will be parked in a County designated area which will not impede daily operations.

Wet Weather Operation

See Section 3.1.1 of this section.

Contingency Plans

If, for any reason, the County cannot use Posi-Shell as ACM material, soil or a soil/mulch mixture will be used.

Screening Criteria

N/A

3.2.2 Soil/Mulch Mixture

A mulch (30% maximum by volume) and soil mixture is proposed as another ACM material. Mulch will be hauled from the on-site mulching operations and soil will be provided from the County's on-site borrow area. The soil/mulch mixture will be free of petroleum contaminated soils. The materials will be mixed at the borrow area or the working face.

3.2.2.1 Properties of Soil/Mulch Mixture

At the Buncombe County facility, waste segregation occurs at the scale house to prevent the mulch processing of any unacceptable material. Unacceptable material includes construction and demolition debris, potentially contaminated debris, etc. Since waste segregation occurs prior to the waste processing into mulch, the resulting mulch is considered inert.

3.2.2.2 Cover System Application Procedures

Application Procedure

Application of the soil/mulch mixture will employ the following minimum

procedures:

- The mixure will be prepared by combining three (3) loads of mulch and seven (7) loads of soil;
- Mix soil and mulch load and visually verify that the mixture is adequately commingled, ensure that there are no large clumps (3 inches in diameter or larger) of either soil or mulch in the mixture;
- Load and haul soil/mulch mixture to active working face using an articulating truck; and
- Use dozer to cover working face with six inches of soil/mulch mixture.

The surface will be visually inspected on a daily basis for exposed waste and/or inadequate coverage. Areas of exposed waste and/or inadequate coverage will receive additional cover.

Maximum Daily Area Coverage

See Section 3.2.1.3.

Daily Depth and Quantity to be Applied

As stated above, **6 inches** of the soil/mulch mixture will be applied to the daily coverage area of 5,400 square feet. Therefore; the required daily quantity of soil/mulch mixture placed is approximately **100 yd^3** (Assuming no other daily cover is used).

Average Monthly Volume of Daily Cover

As stated above, approximately 100 yd^3 per day of soil/mulch mixture will be used. Assuming 24 working days per month, the average monthly volume of daily cover required for normal operating conditions is **2,400 yd^3**.

List of Equipment

An articulating truck and dozer will be used for the application process.

Material and Equipment Storage

Any soil/mulch mixture requiring storage will be stored at the borrow area. Mulch stock pile sizes shall not exceed 30 feet in width and 15 feet in height to avoid spontaneous combustion and to maintain a manageable pile size in the event of a fire. Landfill equipment used for ACM procedures will be stored at County designated areas.

Wet Weather Operation

See Section 3.1.1 of this section.

Contingency Plans

If, for any reason, the County cannot obtain mulch for the on-site processing area for use as ACM material, soil or Posi-shell will be used.

Screening Criteria

Each soil/mulch mixture load will be visually inspected prior to transport to the working face to determine if the material is adequately mixed. The load will not be placed if the mixture is not commingled adequately or if foreign material is observed.

Section 4
Spreading and Compacting of Waste

The primary goals of waste placement are to (1) maximize the mass of waste landfilled through compaction, (2) minimize erosion and sedimentation impact to the surrounding and disposal areas, and (3) comply with all operating rules and regulations of the North Carolina Solid Waste Section for C&D landfills.

4.1 Working Area

In accordance with Rule .0542(g)(1), the County shall restrict solid waste into the smallest area feasible (working face). The working face is defined as where waste is unloaded, inspected, spread, compacted, and ultimately covered with cover material. The working face shall be wide enough to prevent a backlog of vehicles waiting to unload and to allow adequate working space for landfill equipment. At a maximum, the width of the working face shall not exceed 100 feet.

4.2 Compaction

Per Rule .0542(g)(2), solid waste shall be compacted as densely as practical into cells. Proper waste spreading and compaction is necessary both to conserve the capacity of the disposal areas and to minimize future settlement. C&D waste will be unloaded, inspected for unacceptable items, and spread on the working face. Each layer shall be compacted with a dozer.

4.3 Controlling Wind Blown Material

In accordance with Rule .0542(g)(3), appropriate methods such as fencing and diking shall be provided as needed within the landfill area to confine solid waste which is subject to be blown by the wind. At the conclusion of each day of operation, all windblown material at the landfill site shall be collected and returned to the working face.

4.4 Filling Sequence

Yearly operational grades are provided per Rule .0542(b)(1)(B) on Sheets OP-2 to OP-5.

[1]Final Grades for the original Phase 5 and the 0.48 acre expansion are shown on C-103.

[1] Revision for Phase 5 Expansion prepared by McGill Associates, P.A. in August 2015.

Section 5
Disease Vector Control

In accordance with Rule .0542(h), the County shall prevent or control on-site populations of disease vectors using techniques appropriate for the protection of human health and the environment. Disease vectors are defined as any rodent, flies, mosquitoes, or other animals or insects, capable of transmitting disease to humans.

Effective vector control measures shall be applied when necessary. Control of vectors will be maintained by application of well-compacted cover material over the compacted solid waste. This will protect against migration of vectors into and from the landfill. Stagnant ponding water should be prevented to control mosquito breeding. Filling in low spots should be performed regularly, and if necessary, County mosquito control or a licensed exterminator shall be employed to control vectors.

Section 6
Air Criteria and Fire Control

6.1 State Implementation Plan

In accordance with Rule .0542(i)(1), the County shall ensure that units do not violate any applicable requirements developed under a State Implementation Plan (SIP) approved or promulgated by the U.S. EPA Administrator pursuant to Section 110 of the Clean Air Act, as amended.

The Western North Carolina Regional Air Quality Agency was contacted during September 2008 and they indicated that two air quality regulations, which are in the local code, apply to the C&D landfill. They are as follows:

- Chapter 4.0540 – Particulates from Fugitive Non-Process Dust Emission Sources
- Chapter 4.1806 – Control and Prohibition of Odorous Emissions

Chapter 4.0540 states that the C&D landfill shall not cause, permit, suffer or allow particulate matter to become airborne in the ambient air as a result of storage, transportation, processing, or handling of materials or refuse without taking reasonable precautions, approved by the Board, for the prevention of such particulate matter from becoming airborne. Additionally, the C&D landfill shall not cause, permit, suffer or allow particulate matter to become airborne in the ambient air as a result of the construction, alteration, maintenance, repair or demolition of any road, bridge, tunnel, railroad track right of way, vehicle, equipment, machinery, building or structure without taking reasonable precautions, approved by the board, for the prevention of such particulate matter from becoming airborne. As described in Section 7.4 of this plan, dust control measures are used throughout the facility and will be continuously used during the construction and operation of any phase of the C&D landfill.

Chapter 4.1806 states that the C&D landfill shall not operate the facility without implementing management practices or installing and operating odor control equipment sufficient to prevent odorous emissions from the facility from causing or contributing to objectionable odors beyond the facility's boundary. Any potential odors resulting from the C&D landfill are control by the use of operational cover. Additionally, the working face is kept to the smallest feasible area and disposal occurs in areas that are protected from the prevailing winds.

6.2 Open Burning of Waste

Per Rule .0542(i)(2), open burning of solid waste, except for the approved burning of land clearing debris generated on-site or debris from emergency clean-up operations, is prohibited at the C&D landfill. Prior to any burning, a request shall be sent to the NCDENR DWM for review. The DWM will determine if the burning to be approved is one of the two types of burning as described above. A notation of the date of

approval and the name of the Division personnel who approved the burning shall be included in the operating record.

6.3 Fire Protection Equipment

In accordance with Rule .0542(i)(3), equipment shall be provided to control accidental fires and arrangements shall be made with the local fire protection agency to immediately provide fire-fighting services when needed. Fires that break out close to the surface of the fill area should be dug out and smothered with cover material. Deep fires should be smothered out by placing moist soil on the surface and by constructing soil barriers around the fire. Where the smothering technique fails, the burning material shall be excavated and smothered or quenched with water once the burning material is brought to the surface. Water is usually not effective unless it can be directly applied to the burning material.

6.4 Fire and Explosion Notification

Per Rule .0542(i)(4), fires and explosions that occur at a C&D landfill require verbal notice to the DWM within 24 hours and written notification within 15 days. Written notification shall include the suspected cause of fire or explosion, the response taken to manage the incident, and the action(s) to be taken to prevent the future occurrence of fire or explosion. Verbal and written notification shall be submitted to:

Department of Environment and Natural Resources
Division of Waste Management
Solid Waste Section
1646 Mail Service Center
Raleigh, North Carolina 27699-1646
(919) 733-4810

Section 7
Access and Safety Requirements

7.1 Landfill Access and Security

In accordance with Rule .0542(j)(1), the Buncombe County C&D Landfill must be adequately secured by means of gates, chains, berms, fences and other security measures approved by the DWM to prevent unauthorized entry.

All vehicles disposing of waste at the facility enter and leave through the access control gate. All waste entering the landfill must be weighed at the scale where a full-time Scale Operator verifies compliance with operation requirements. Unauthorized vehicle access to the site is prevented around the remaining portion of the landfill property by fencing, steep gradient, woods, wetlands, gates, and storm water ditches.

7.2 Attendant

Per Rule .0542(j)(2), an attendant shall be on duty at the site at all times while the facility is open for public use to ensure compliance with operational requirements.

A full-time Scale Operator will be located in the scale house during operating hours. The Scale Operator will verify compliance with operation requirements. In addition, a Facility Supervisor will be present on-site at all times during operation.

7.3 Access Road

In accordance with Rule .0542(j)(3), the access road to the site and access roads to monitoring locations shall be of all-weather construction and maintained in good condition. Potholes, ruts, and debris on the roads will receive immediate attention in order to avoid damage to vehicles. Access roads will be regraded as necessary to maintain positive slope for adequate drainage.

7.4 Dust Control

Per Rule .0542(j)(4), dust control measures shall be implemented when necessary. Minimum dust control will include a water truck for wetting of dusty roads. Sprinklers are also used along some portions of the landfill perimeter access road. Petroleum products shall not be used for dust control.

7.5 Signs

In accordance with Rule .0542(j)(5), a sign providing information on disposal procedures, the hours during which the site is open for public use, the permit number and other pertinent information specified in the permit conditions is posted at the site entrance.

In accordance with Rule .0542(j)(6), signs are clearly posted stating that no liquid, hazardous and municipal solid waste can be disposed in the C&D landfill.

In accordance with Rule .0542(j)(7), traffic signs or markers are provided to promote an orderly traffic pattern to and from the discharge area and to maintain efficient operating conditions.

7.6 Waste Removal Scavenging Policy

Per Rule .0542(j)(8), the removal of solid waste from the C&D landfill is prohibited. A recycling program can be implemented which would allow removal of solid waste if program is approved by DWM. Currently, the County does not have a recycling program.

Section 8
Erosion and Sedimentation Control Requirements

8.1 Control of Sediment

In accordance with Rule .0542(k)(1), adequate sediment control measures shall be utilized to capture and control sediment in order to prevent sediment from impacting wetlands and off-site properties.

Surface water runoff passing through the C&D landfill site shall be diverted to the sediment ponds by the use of ditches, berms, and pipes as shown on the Operation Drawings. Existing Sediment Pond 11 was constructed in accordance with the approved Sediment and Erosion Control Plan for control of onsite stormwater run-off and sediment transport from landfill operations. Sediment Pond 12 is proposed for control of Phase 5 expansion stormwater. Additionally, existing Sediment Ponds 10 and 11 will be modified.

The sediment ponds have been designed in such a manner that releases will not overload downstream drainage features or damage adjacent property. Sediment accumulated in the ponds shall be removed as specified in the approved Sediment and Erosion Control permit. Silt gages shall be installed in all ponds as shown on the Detail Sheets in the Engineering Plan. Ditches require frequent inspection for sediment buildup. At a minimum, the sediment buildup should be assessed after all significant rain events.

8.2 On-Site Erosion Control

Per Rule .0542(k)(2), adequate erosion control measures consisting of vegetative cover, materials, structures or devices shall be utilized to prevent excessive on-site erosion of the C&D landfill.

Erosion control measures shall include:

A. Disturbing as little area as practical at any one time for landfilling operations.

B. Seeding/Mulching of all disturbed areas commencing as soon as practically possible. Employing erosion netting or sod on steep slopes and other erosion prone areas.

C. Use of earthen berms, hay bales, silt fences, riprap or equivalent devices down-gradient of disturbed areas, stockpiles, drainage pipes inlets and outlets and at intervals along grassed waterways, until such time as permanent vegetation is established.

D. Placement of riprap at the inlets and outlets of stormwater piping.

8.3 Vegetative Cover

In accordance with Rule .0542(k)(3), vegetative ground cover sufficient to restrain erosion shall be accomplished as directed by appropriate state or local agency upon completion of any phase of C&D landfill development consistent with Rule .0543(c)(5).

Riprap, haybales, or other acceptable temporary methods of erosion control may be required until permanent cover is established. Mulching, until a vegetative cover is established, can stabilize areas where final grade has been reached. Soil mulching can be achieved using wood chips, straw, hay, asphalt emulsion, jute matting, and synthetic fibers. Mulches allow for greater water retention; reduce the amount of runoff; retain seeds, fertilizer, and lime in place; and, improve soil moisture and temperature conditions.

Temporary seeding shall be applied in accordance with the NC Erosion and Sediment Control Planning and Design Manual, June 2006.

Section 9
Drainage Control and Water Protection Requirements

9.1 Surface Water Diverted From Operational Area

In accordance with Rule .0542(l)(1), surface water shall be diverted from the operational area. Excessive surface water at the working face creates difficulties for maneuvering equipment and prevents the operator from achieving maximum compaction of the waste. To divert surface runoff away from the working face, temporary diversion berms shall be installed on the current lift, up-gradient from the working face and in other locations as dictated by the direction of grade. The area between the temporary berm and the working face should be limited to one acre to prevent excessive ponding. The soil cover in the areas beyond the diversion berms shall be uniformly graded and compacted to prevent the formation of erosion channels. In the event that channels do form, the cover shall be promptly repaired. During the formation of the initial lift of each phase area additional measures shall be employed to divert surface water. Existing phases were graded with a high point located within each phase. The high point will separate each phase into two distinct areas from the perspective of stormwater control. Initial disposal operations for each phase will begin on only one side of the high point.

9.2 Surface Water Shall Not Be Impounded Over Waste

Per Rule .0542(l)(2), surface water shall not be impounded over or in waste. Completed areas shall be adequately sloped at a minimum of 5% to allow surface water runoff in a controlled manner.

9.3 Waste Shall Not Be Disposed Of In Water

In accordance with Rule .0542(l)(3), solid waste shall not be disposed of in water. The minimum four-foot separation between waste and the seasonal high groundwater table along with the drainage controls described in Section 8 will prevent waste from being disposed of in water.

9.4 Leachate Containment

Operational cover is placed on the C&D landfill working face to minimize leachate generation. Any leachate generated is contained by existing and proposed stormwater control devices per Rule .0542(l)(4).[2]

9.5 Pollutant Discharge

Operations shall not cause discharge pollutants or discharge of nonpoint source of pollution in accordance with Rule .0542(l)(5).[2]

[2]Revision for Phase 5 Expansion prepared by McGill Associates, PA in August 2015.

Section 10
Survey for Compliance

In accordance with Rule .0542(m), within 60 days of the County's receipt of the DWM's written request, the County shall conducted a survey of the active or closed portions of the C&D landfill in order to determine whether operations are being conducted in accordance with the approved design and operational plans. The County shall report the results of such survey, including a map produced by the survey, to the DWM within 90 days of receipt of the DWM's request. The survey shall be performed by a land surveyor registered in North Carolina.

Section 11
Operating Record and Record Keeping Requirements

11.1 Regulatory Requirements

In accordance with Rule .0542(n)(1), the county shall record and retain at the facility the following information as it becomes available:

- Records of random waste inspections, monitoring results, certifications of training, and training procedures required by Rule .0544;
- Amounts by weight of solid waste received at the C&D landfill, include county of generation;
- Any demonstration, certification, finding, monitoring, testing, or analytical data required by Rules .0544 through .0545;
- Any closure or post-closure monitoring, testing, or analytical data as required by Rule .0543;
- Any cost estimates and financial assurance documentation required by Rule .0546;
- Notation of date and time of placement of cover material; and
- All audit records, compliance records and inspection reports.

11.2 Operating Record

Per Rule .0542(n)(2), all information contained in the operating record must be furnished to the Division according to the permit or upon request, or be made available for inspection by the Division.

The operating record must also include:

(A) A copy of the approved operation plan required by this Rule and the engineering plan required by Rule .0539;

(B) A copy of the current Permit to Construct and Permit to Operate; and

(C) The Monitoring Plan, in accordance with Rule .0544 of this Section, included as appendices to the Operation Plan.

11.2.1 Monitoring Plan

In accordance with Rule .0542(n)(3)(C), a monitoring plan per Rule .0544 shall be included as appendices to the Operation Plan.

The groundwater and surface water monitoring plan was prepared per Rules .0544(b) and (c) and is included as Appendix A.

Rule .0544(d) requires a gas control plan and is included as Appendix B.

Rule .0544(e) requires a waste acceptability program. Currently, this program is in place with the MSW landfill and was approved in the aforementioned Permit submittal. Since both landfills are integral parts of the solid waste management facility, the previously approved waste acceptability plan covers the C&D landfill as well.

Part 7
Operation Plan

Appendix A
Groundwater and Surface Water Monitoring Plan

CERTIFICATION OF EFFECTIVENESS

The following statement is based on existing site conditions as of March 24, 2009 and data currently available on subsurface conditions and groundwater flow at the Buncombe County Solid Waste Management Facility C&D landfill site. Additionally, it is our professional opinion that construction of a landfill may alter subsurface conditions.

In accordance with North Carolina Solid Waste Management Rule .0544(h), I hereby state to the best of my knowledge, information and belief and in my professional opinion as a geological professional, that the water quality monitoring system will be effective in providing detection of a release of hazardous constituents from the Buncombe County Solid Waste Management Facility Construction and Demolition Landfill to the uppermost aquifer, provided the system is operated and maintained properly.

NORTH CAROLINA
LICENSED
SEAL
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GEOLOGIST
MATTHEW F. COLOFF

3/24/2009

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Appendix A
Water Quality Monitoring Plan

Rules .0544(b) and (c) of the North Carolina Solid Waste Management Rules require that groundwater and surface water monitoring plans be prepared for all C&D landfill units. This document is intended to fulfill all of the specified criteria delineated in this rules.

1 Purpose and Scope

The purpose of this Water Quality Monitoring Plan is to address the requirements in Rule .0544 (b) and (c), and to present a plan for groundwater and surface water monitoring for the proposed Buncombe County C&D Landfill Phase 5 expansion. The Water Quality Monitoring Plan includes information on the expansion of the existing groundwater monitoring network, surface water monitoring plan, sampling and analysis requirements, and detection monitoring requirements. The groundwater monitoring network was designed based on information obtained from recent and previous subsurface investigations and a review of literature pertaining to regional geology and groundwater resources. A detailed discussion of the geologic and hydrogeologic conditions at the Phase 5 C&D expansion is presented in both the Site Plan Application and the Design Hydrogeologic Report for the C&D expansion area.

The Water Quality Monitoring Plan includes the elements necessary to address the groundwater monitoring plan, including information on the existing and proposed groundwater monitoring system, sampling and analysis requirements, and detection monitoring requirements in accordance with Rule .0544(b)(1)(A) through (E). In addition, the Plan discusses provisions necessary to meet the requirements of a surface water monitoring plan as described in Rule .0544(c).

2 Geologic Setting

The Buncombe County Landfill site is located in the Blue Ridge Mountains approximately 9 miles north of Asheville, North Carolina. The landfill site consists of 557 acres bounded by the French Broad River to the south and west, Blevin Branch to the north, and Flat Creek to the east. The site consists of moderate to steep slopes separating narrow hills and ridges from small incised secondary drainages.

2.1 Site Geology

Detailed discussions of the site geology are provided in the Site Hydrogeologic Report and Phase 5 Expansion Design Hydrogeologic Report. The following section provides a summary of the site geology for the purposes of this Plan.

The Geologic Map of North Carolina shows the site to be underlain by a Precambrian Migmatitic biotite-hornblende gneiss unit (NCGS 1985). The site vicinity was mapped as primarily granite and undifferentiated gneiss (Weiner 1970 and GRAM 1999).

Small localized areas of alluvium and/or colluvium were encountered near the base of the secondary drainage features. These soils generally consisted of clays to silty

sand with rock fragments. Typically, the uppermost layer consisted of residuum soils (saprolite) which generally consist of stiff sandy silts and dense clayey. The saprolite grades into partially weathered rock (PWR). PWR was encountered in the borings as indicated by a blow count greater than 50 blows per six inch interval. The thickness of saprolite and PWR was greatest in upland areas, and least in the bottom of secondary drainage features. Depth to bedrock in the Phase 5 C&D Expansion area, defined as depth to auger refusal, ranges from 3.5 feet in B-620 up to 29 feet in B-618. The average bedrock depth was approximately 15 feet over the proposed Landfill expansion area. The top of bedrock is typically a reflection of surface topography, with shallow bedrock in the secondary drainage features, and deeper bedrock in upland areas.

2.2 Site Hydrogeology

As with bedrock, the potentiometric surface is a subdued reflection of surface topography. As discussed in Design Hydrogeologic Report, groundwater flow in the Phase 5 expansion area is to the North towards Blevin Branch. Groundwater is rarely present above the bedrock surface; groundwater was present in the shallower lithological units only in one location in the bottom of secondary drainage feature within the area, at B-619. The bedrock fracture flow system behaves similar to an anisotropic porous media, based on the potentiometric mapping for the Phase 5 area and results of pumping tests conducted during previous investigations at the Buncombe County site (CDM, 1995, 2002).

The depth of groundwater circulation beneath the area is estimated at approximately 100 feet below ground surface (bgs), based on analysis of the regional flow system as discussed in the previous Design Hydrogeologic Reports (CDM, 1995). Thus, groundwater monitoring can be focused on depths of less than 100 feet bgs. As discussed in the Phase 5 C&D landfill expansion Design Hydrogeologic Report, groundwater flow converges into the secondary drainage feature; therefore this drainage feature is an important target for groundwater monitoring.

3 Proposed Groundwater Monitoring Network

This section presents the proposed groundwater monitoring network for the Phase 5 expansion area. Section 3.1 presents proposed monitoring well locations, Section 3.2 discusses monitoring well installation and construction specifications, Section 3.3 discusses hydraulic conductivity testing of the monitoring wells, and Section 3.4 discusses the surface water quality monitoring plan. Existing and proposed monitoring well locations are provided on Sheet 1.

3.1 Monitoring Well Locations

The SWS regulations require that upgradient monitoring well(s) be located so that groundwater samples collected from the uppermost aquifer provide an indication of background groundwater quality. Upgradient wells MW-1 and MW-1d have already been installed to monitor background water quality for the entire site. No additional

background wells are proposed for the area. The downgradient monitoring wells must represent groundwater quality at the relevant point of compliance. The wells must be located in similar geologic units so that upgradient and downgradient groundwater quality data can be compared.

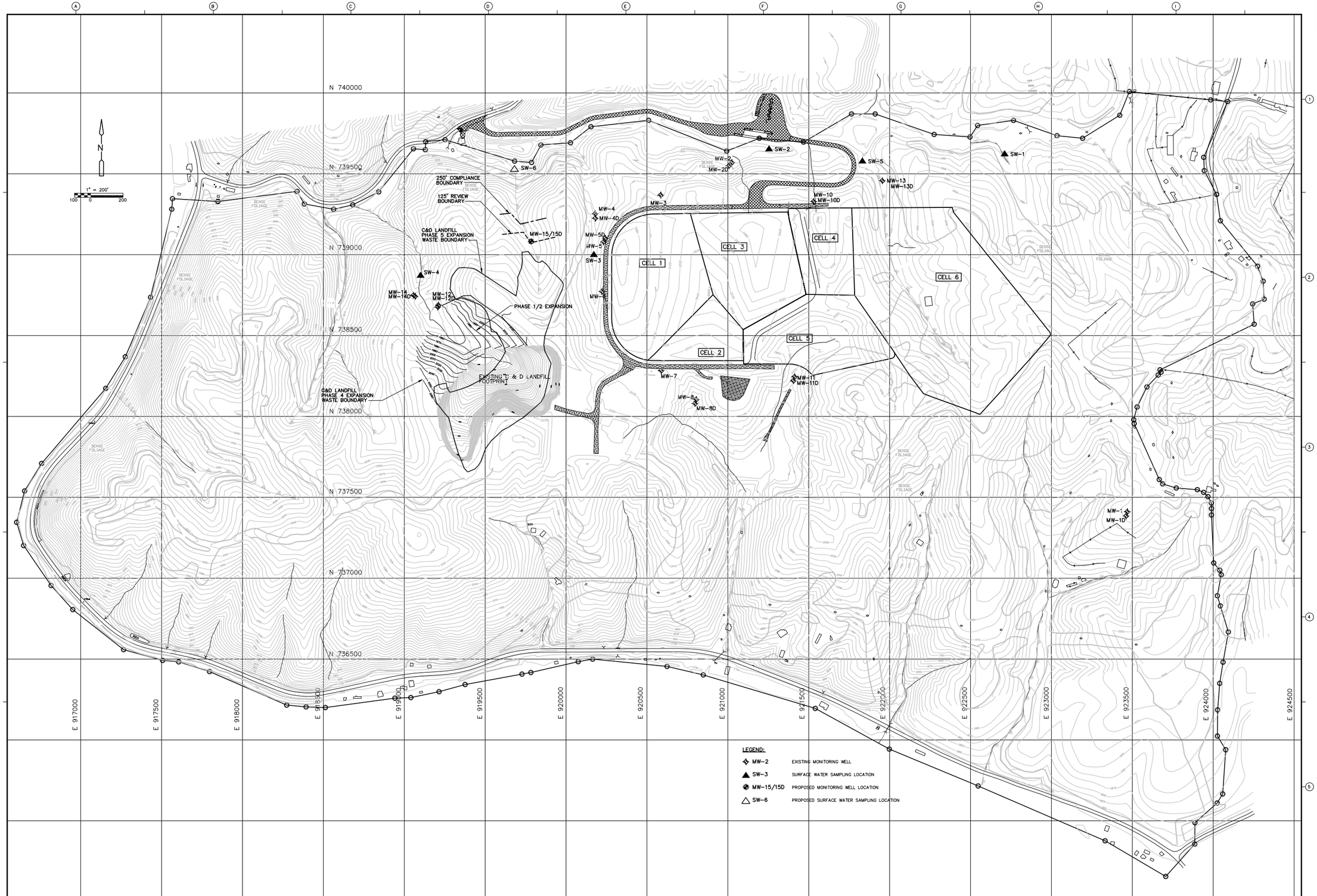
The current groundwater monitoring system is shown in Sheet 1. This sheet shows the Subtitle D Landfill Cells 1-6 and the existing C&D Landfill and the relationship of the monitor wells to the cells. Monitoring wells MW-2/2d, MW-3/3d, MW-4/4d, MW-5/5d, MW-6/6d, MW-7, MW-8/8d, MW-10/10d, MW-11/11d, and MW-13/13d are located around Cells 1-6 of the Subtitle D landfill. Monitoring well nests MW-12/12d and MW-14/14d are located downgradient of the existing C&D landfill. The location of the background well nest (MW-1/1d) is shown on Sheet 1. Table 1 lists the existing monitoring well network, the proposed monitoring well nest for the Phase 5 area, the approximate depth of completion for the proposed wells, and the rationale for each location.

As the groundwater beneath the site is a three dimensional system, nested point of compliance wells are proposed for the Phase 5 expansion. In locations in which saturation occurs above the bedrock surface, the shallow monitoring well will be completed in the saprolite or PWR. If a sufficient thickness of saturated saprolite/PWR zone is found, then the well will be installed in this zone. The zone should be of sufficient thickness to account for seasonal fluctuations in the water table. If a sufficient saturated thickness is not present, then the boring will be advanced into the bedrock and the well will be screened across the saprolite and bedrock contact. As discussed in the Design Hydrogeologic Report, saturated conditions above bedrock do not appear to be found in the bottom of secondary drainage feature. In locations in which no saturation is encountered above the bedrock surface, the shallowest completion will be in bedrock. The bedrock monitoring wells at each location will target the shallowest water-bearing fracture zones encountered. Drilling observations and air lift yield tests will be utilized to identify fractured zones.

The following nomenclature will be used for the Phase 5 C&D expansion nested monitoring wells:

MW-15
Proposed shallow monitoring well at location # 15. Within the secondary drainage feature, downgradient of the proposed Phase 5 C&D landfill, with the screened interval in the saprolite/ bedrock contact, if present, or across the first encountered water-bearing fracture.

MW-15d
Proposed deep monitoring well at location # 15, with the screened interval in the next deepest conductive fracture zone in the bedrock aquifer.



REV. NO.	DATE	DRWN	CHKD	REMARKS

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BUNCOMBE COUNTY
NORTH CAROLINA

CONSTRUCTION AND DEMOLITION LANDFILL
PHASE 5 EXPANSION

WATER QUALITY MONITORING PLAN

PROJECT NO. 6447-65973
FILE NAME: bunc-wq-mp.dwg

SHEET NO.
1

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Table 1
Groundwater Monitoring System Details
Buncombe County Solid Waste Management Facility

EXISTING WELLS FOR SUBTITLE D LANDFILL

Monitoring Well I.D	TOC Elevation (feet AMSL)	Ground Elevation (feet AMSL)	Borehole Depth (feet)	Screened Interval (feet bgs)	Sand Pack (feet bgs)	Bentonite Seal Interval (feet bgs)	Surface Casing Depth (feet bgs)	Surface Casing Borehole Diameter (inches)	Surface Casing Diameter (inches)	Well Borehole Diameter (inches)	Well Casing Diameter (inches)
MW-1	2021.22	2019.28	76.00	76.00-61.00	76.00-59.00	59.00-57.00	NA	NA	NA	8.00	2.00
MW-1D	2021.57	2019.97	200.00	95.00-85.00	97.00-81.00	81.00-78.00 200.00-97.00	80.00	10.00	6.00	8.00	2.00
MW-2	1920.86	1918.54	20.00	20.00-5.00	20.00-3.00	3.00-1.00	NA	NA	NA	8.00	2.00
MW-2D	1920.51	1918.63	55.00	55.00-45.00	55.00-42.00	42.00-39.00	NA	NA	NA	8.00	2.00
MW-3	1987.66	1985.48	38.00	38.00-23.00	38.00-21.00	21.00-18.5	NA	NA	NA	8.00	2.00
MW-4	1944.35	1942.48	25.00	24.00-9.00	24.00-7.00	7.00-5.00	NA	NA	NA	8.00	2.00
MW-4D	1944.64	1942.79	55.00	55.00-45.00	55.00-43.00	43.00-40.00	NA	NA	NA	8.00	2.00
MW-5	1977.12	1975.39	50.00	50.00-35.00	50.00-33.00	33.00-31.00	NA	NA	NA	8.00	2.00
MW-5D	1976.92	1975.31	81.00	81.00-71.00	81.00-68.50	68.50-66.50	50.00	10.00	6.00	8.00	2.00
MW-6	1987.34	1985.39	50.00	50.00-35.00	50.00-27.00	27.00-24.5	NA	NA	NA	8.00	2.00
MW-7	2022.83	2020.72	61.00	57.00-42.00	61.00-40.00	40.00-38.00	NA	NA	NA	8.00	2.00
MW-8	1962.06	1959.85	70.00	70.00-55.00	70.00-53.00	53.00-51.00	NA	NA	NA	8.00	2.00
MW-8D	1962.47	1960.57	95.00	95.00-85.00	95.00-82.50	82.50-79.00	NA	NA	NA	8.00	2.00
MW-10	2010.54	2007.5	73.00	73.00-58.00	73.00-56.00	56.00-54.00	NA	NA	NA	6.00	2.00
MW-10D	2010.56	2007.5	117.00	117.00-102.00	117.00-100.00	100.00-98.00	NA	NA	NA	6.00	2.00
MW-11	1966.71	1963.7	50.00	50.00-35.00	50.00-33.00	33.00-31.00	NA	NA	NA	6.00	2.00
MW-11D	1966.15	1963.2	70.00	70.00-60.00	70.00-58.00	58.00-56.00	NA	NA	NA	6.00	2.00
MW-13	1953.92	1951.3	17.00	17.00-7.00	17.00-5.00	5.00-3.00	NA	NA	NA	6.00	2.00
MW-13D	1953.82	1951.4	37.00	37.00-27.00	37.00-25.00	25.00-23.00	NA	NA	NA	6.00	2.00

EXISTING WELLS FOR C&D LANDFILL

MW-9	*1966.54*	*1963.70*	*25.80*	*25.80-10.80*	*10.80-8.80*	*8.80-6.80*	*NA*	*NA*	*NA*	*6.00*	*2.00*
MW-9D	*1966.34*	*1963.60*	*39.50*	*39.50-34.50*	*34.50-31.50*	*31.50-29.50*	*NA*	*NA*	*NA*	*6.00*	*2.00*
MW-12	1947.39	1944.71	17.00	17.00-7.00	17.00-5.00	5.00-3.00	NA	NA	NA	6.00	2.00
MW-12D	1947.10	1944.28	37.00	37.00-27.00	37.00-25.00	25.00-23.00	NA	NA	NA	6.00	2.00
MW-14	1952.78	1949.8	49.00	49.00-39.00	49.00-35.50	35.50-33.00	35.00	10.00	6.00	6.00	2.00
MW-14D	1953.77	1950.5	88.00	88.00-78.00	78.00-74.50	74.50-71.50	53.00	10.00	6.00	6.00	2.00

-MW-9/9d were abandoned during Phase IV Expansion of C&D Landfill.

PROPOSED WELLS FOR PHASE 5 C&D EXPANSION

Nest	Well	Drilling Method	Screen Interval Depth (feet) **	Rationale
MW-15	MW-15	Air Rotary	*25-15*	Downgradient of expansion within drainage feature; screened in PWR/bedrock contact.
	MW-15D	Air Rotary	*55-45*	Downgradient of expansion within drainage feature; screened interval in conductive fracture zone of bedrock.

Notes:

* Well will be installed using hollow stem augers only if a sufficient thickness of saturated saprolite/PWR is found. If not, then boring will be advanced into bedrock using air rotary drilling and the well will be screened across the saprolite and bedrock contact.

** The screen interval depths are estimated. Actual depths will depend on subsurface conditions.

AMSL- Above Mean Sea Level

TOC - Top of Casing

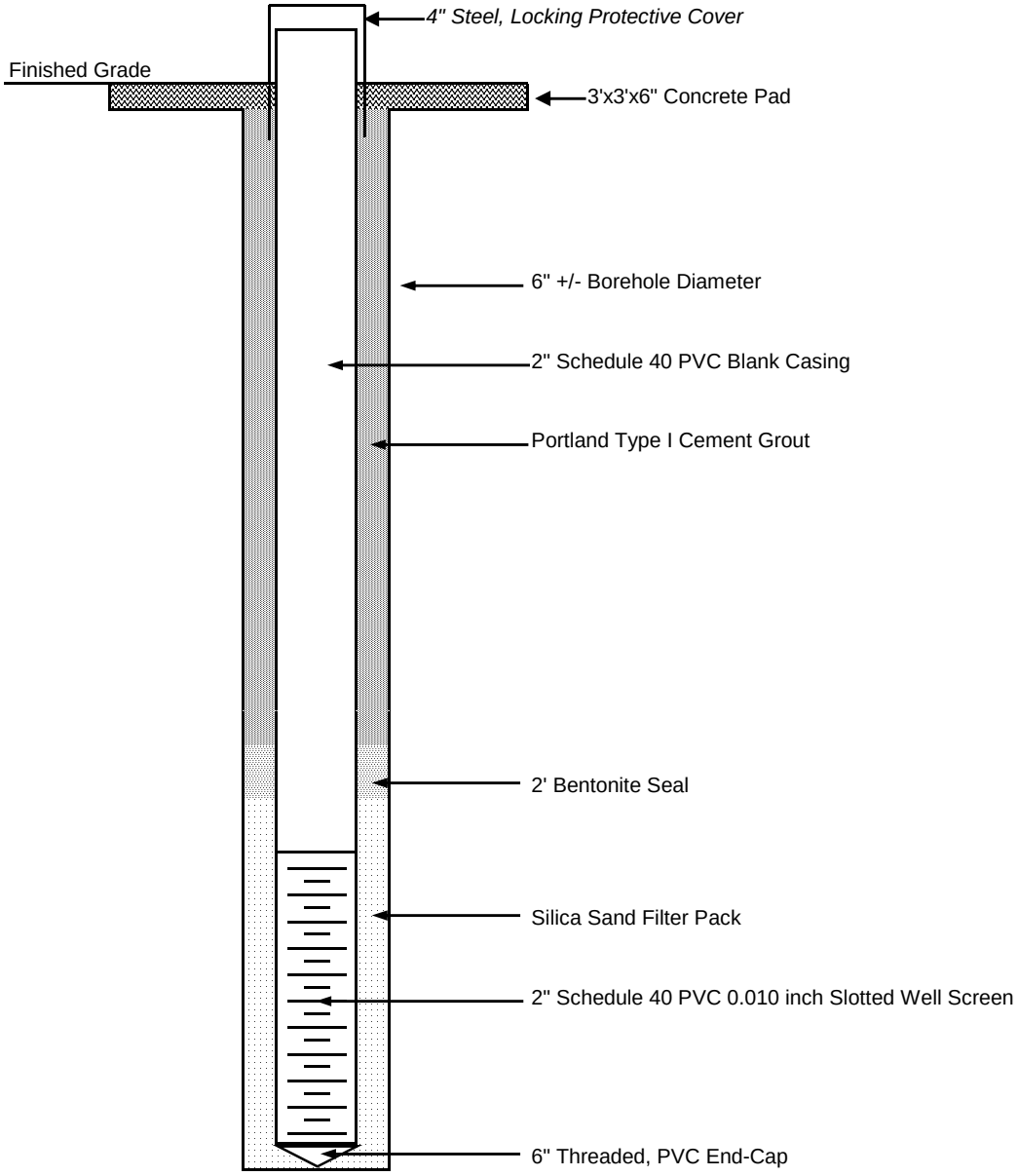
3.2 Monitoring Well Installation and Construction

The monitoring wells will be constructed in accordance with standard industry procedures and will meet the requirements of 15A NCAC 2C. An example of a monitoring well nest is shown on Figures 1a and 1b. The monitoring wells at locations of potentially saturated saprolite or PWR will be installed by advancing the borehole through the water table using hollow-stem augering techniques. Soil samples will be collected at five-foot intervals with a split spoon sampler in accordance with ASTM D-1586. Soil lithology will be described in the field by an onsite geologist to develop a borehole log. If saturation conditions are not evident upon refusal of hollow stem auger drilling, then a temporary well screen will be placed in the hole for a period up to 48 hours to determine whether the well will yield water.

If no saturation is expected or encountered during hollow stem auger drilling, then the shallowest well will be installed in the upper portion of the bedrock aquifer utilizing air rotary drilling techniques. During air rotary drilling, drilling observations will be recorded by an onsite geologist, including observed fractures and lithologic descriptions from cuttings. Drilling will proceed until the first water-bearing fracture is encountered. Upon observing a fracture (an evident drop of the drill rod and/or a change in drill chatter), then an air lift yield test will be conducted. The drill rod will be raised at least 10 feet, and operations will cease for a period of 30 minutes. After the 30 minute period, the drill rod will be lowered to the bottom of the hole, and air will be blown for a period of 10 minutes. The amount of water coming from the hole at this time (if any) will be estimated in gallons per minute. If the borehole is dry, then the drill rig will be moved approximately 20 feet, and the above procedure repeated.

At locations in which a deeper well is desired, the deep well will be drilled after the shallow well, and installed at least 10 feet deeper than the bottom of the shallow borehole. The deeper well will target the next conductive fracture zones encountered at depth. The above procedure for observing fractures and performing air lift yield tests will be applied. If no evident fractures are encountered at a depth between 20 and 35 feet below the bottom of the shallow well, then drilling will continue to until a fracture zone is encountered. Since the wells will be located between the landfill and the groundwater discharge feature, it is anticipated that most wells will be completed within 100 feet of ground surface. Also, based on observed subsurface conditions, it appears that the more conductive fracture zones will be encountered within the upper 100 feet of the bedrock. However, if subsurface conditions dictate that a deeper completion is required, then the wells will be installed at that depth. All the deeper monitoring wells will target the most conductive fracture zones, regardless of depth.

Buncombe County C&D Landfill Expansion
Water Quality Monitoring Plan

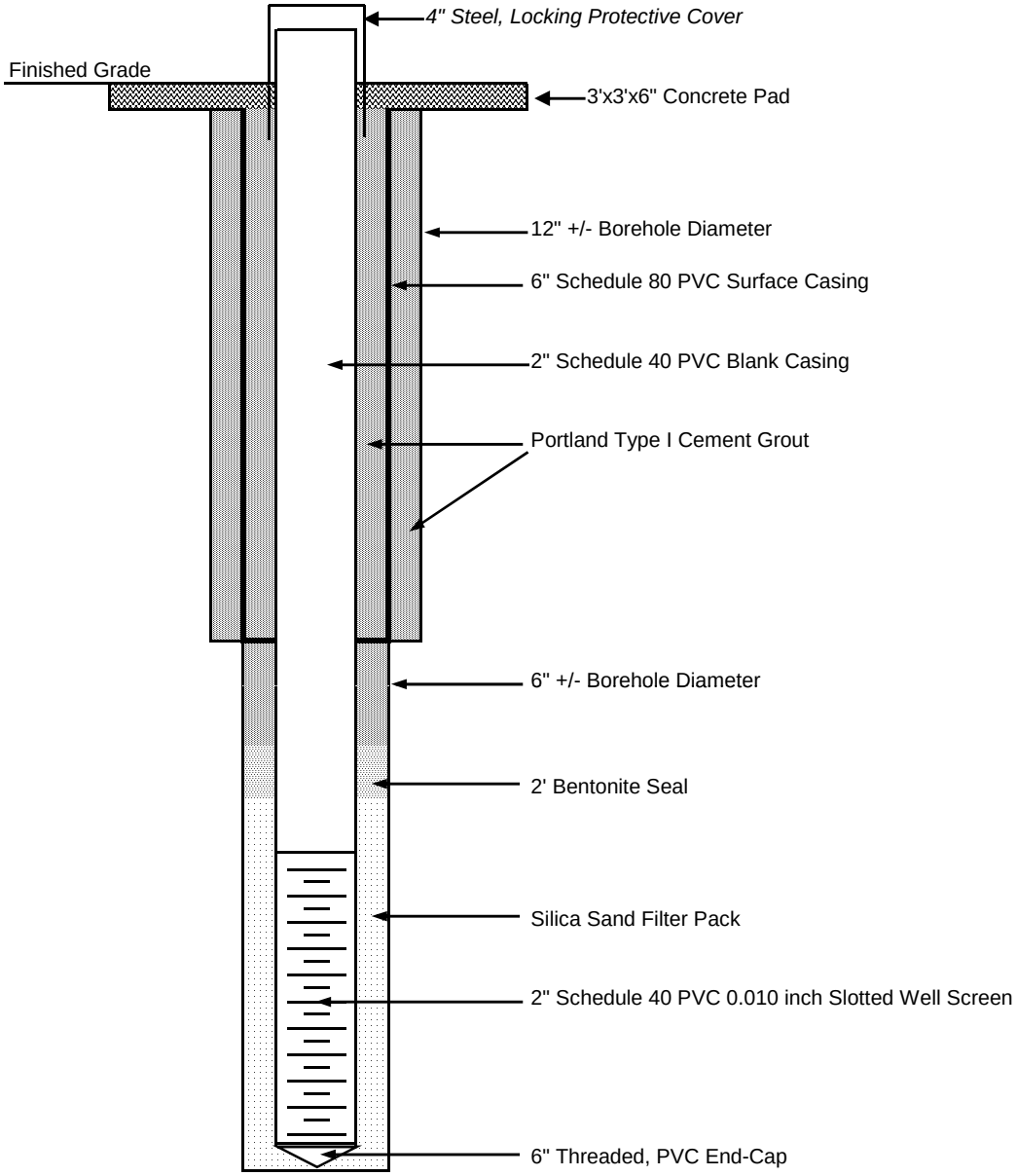


Notes:
Stick-up will extend between 2.5 and 3 feet above finished grade.
Silica sand filter pack will extend at least 2 feet above top of screen elevation.
Screen length will vary according to groundwater elevation, bedrock elevation, or fracture frequency.

CDM

Figure 1a
Typical Type II Groundwater Monitoring Well

Buncombe County C&D Landfill Expansion
Water Quality Monitoring Plan



Notes:
Stick-up will extend between 2.5 and 3 feet above finished grade.
Silica sand filter pack will extend at least 2 feet above top of screen elevation.
Screen length will vary according to groundwater elevation, bedrock elevation, or fracture frequency.
Length of 6" surface casing will vary depending on bedrock elevation and fracture frequency.

CDM

Figure 1b
Typical Type III Groundwater Monitoring Well

The monitoring wells will be constructed using 2-inch ID PVC well casing with threaded flush joints. The shallow monitoring well will be constructed with five to ten feet of 0.010-inch slot screen at the end of the casing string placed so that it brackets the water table. This actual length of screen will be chosen to dependent upon depth to the water table and bedrock. The deeper monitoring well will be constructed with an outer casing extending from the ground surface into the bedrock beyond the bottom of the shallower monitoring well screen. A five foot screen interval will be used to monitor the targeted fracture.

The PVC casing string in each well will extend approximately three feet above ground surface. A sand pack will be placed around the screen interval to a maximum of two feet above the top of the screen. A two foot thick bentonite seal consisting of hydrated bentonite pellets will be placed on top of the sand to hydraulically seal the completion interval. The remainder of the annulus will be sealed with a bentonite-Portland cement grout to ground surface. A protective outer casing with a lockable cap will be placed over the PVC casing and into the grout, extending 2.5 to 3 feet below ground surface.

Following completion, the monitor wells will be developed to remove the residual effects of drilling. The wells will be developed using a combination of surging and over-pumping. All drilling and down-hole equipment will be decontaminated by steam cleaning between borings. Well development equipment will be decontaminated by washing in a non-phosphate detergent solution followed by a potable water rinse, then a distilled water rinse, and allowed to air dry.

The horizontal location of all new monitor wells will be surveyed in State Plane Coordinates by a Registered Land Surveyor to the nearest 0.1 foot. The vertical control or elevation of the top of PVC casing (the well measuring point) will be surveyed to the nearest 0.01 foot accuracy to mean sea level (msl). The height of the well measuring point above ground surface will be measured.

3.3 Hydraulic Conductivity Testing

Following installation and development of the new monitor wells, the hydraulic conductivity of the aquifer material surrounding each well will be determined by conducting slug falling head and/or recovery tests on each well. During drilling operations, where possible, saturated saprolite samples will be collected for laboratory testing of porosity.

3.4 Surface Water Quality Monitoring Plan

Five surface water sampling stations already exist to monitor the effects of landfill operations on surface water quality in Blevin Branch. Two sampling stations (SW-1 and SW-2) are located both upstream and downstream of the disposal Cells 1-6 of the Subtitle D landfill. Surface water sampling location, SW-3, is located at the outfall for the spring capture system located west of Cell 1. Surface water sampling location, SW-5, is located at the outfall for the spring capture system located north of Cell 6.

SW-4 is located within the drainage feature downgradient of MW-14/14d at the existing C&D landfill. Surface water sampling station SW-6 is proposed for Blevin Branch, north of the Phase 5 area. The existing and proposed sampling locations are shown on Sheet 1.

4 Sampling and Analysis Plan

4.1 Introduction

Rule .0544 specifies that the owner/operator must provide, as part of the groundwater monitoring program, a groundwater and surface water sampling and analysis (S&A) plan. The S&A plan should be designed to provide accurate results of groundwater quality at the upgradient and downgradient sampling locations. The S&A plan will address the following subjects:

- Groundwater and surface water sample collection
- Sample preservation and shipment
- Analytical procedures
- Chain-of-custody
- Quality assurance/quality control (QA/QC)

4.2 Groundwater and Surface Water Sample Collection

Groundwater samples will be collected from each monitoring well and surface water sampling location. Samples from each monitoring well and surface water sampling location will be sampled on a semi-annual basis. One sample from the new monitoring wells (MW-15/15d) and surface water sampling location (SW-6) will be collected prior to the Phase 5 expansion receiving waste.

4.2.1 Static Water Level Measurements

Static water level elevations will be measured at each monitoring well prior to any purging or sampling activities. Static water level data will be used to monitor changes in site hydrogeologic conditions. The following measurements will be recorded in a dedicated field book prior to sample collection:

- Height of the well measuring point above ground surface,
- Depth of water in the well from the TOC measuring point (to the nearest 0.01 foot),
- Total depth of the well,
- Height of the water column in the well casing.

An electronic water level indicator will be used to accurately measure water elevations to within 0.01 foot within the same day in as short a period of time as possible. Each well will have a permanent, easily identified reference point from which all water level measurements will be taken. The reference point will be marked and the elevation surveyed by a North Carolina Registered Land Surveyor.

4.2.2 Detection of Immiscible Layers

USEPA's Technical Manual for Solid Waste Disposal Facility Criteria outlines specifications for groundwater sampling and analysis. One of these specifications outlines the establishment of provisions for detecting immiscible fluids, if applicable. Typically, immiscible fluids are categorized as either, (1) light, non-aqueous phase liquids (L-NAPLs), or (2) dense, non-aqueous phase liquids (D-NAPLs). L-NAPLs are more commonly referred to as "floaters" due to their relatively lighter specific gravity, while D-NAPLs are typically referred to as "sinkers" due to their relatively denser specific gravity.

In most instances, the probability of immiscible fluids being present and subsequently detected in groundwater monitoring wells surrounding C&D landfills is somewhat remote because chemical products (such as industrial solvents) are not accepted for storage or disposal at C&D waste management facilities. However, for those rare instances where a separate immiscible phase is believed to be present, EPA suggests that provisions for detecting these types of fluids should be developed.

The following procedure is proposed to address these concerns in the event that the SWS ever requires this test to be performed. In those instances where the monitoring well screened interval encompasses the water table surface, the ability to detect and sample light non-aqueous phase liquids (LNAPLs) prior to implementation of routine groundwater sampling activities may exist. To accomplish this objective, a transparent Teflon bailer will be lowered into the well to just below the water table surface. The bailer will then be removed from the well and the contents examined to identify if any immiscible fluids are present. If any immiscible fluids are determined to be potentially present, an interface probe is proposed to be used. The depth of the light phase immiscible layer as determined by the interface probe, will then be recorded in a field logbook. The interface probe will continue to be lowered until it intersects the groundwater table surface. The depth of the fluid/water interface zone also will be recorded. From these two measurements, the thickness of the light phase immiscible layer can be readily determined.

The potential presence of dense phase immiscible layer will be determined by the examination of laboratory analytical results. Analytical results above a percentage of a given chemicals solubility limit can indicate the potential presence of DNAPLs.

As mentioned above, monitoring for immiscible phase fluids is not envisioned to be performed during typical sampling events, but is provided here to document how the test will be performed if the SWS requires it at a future date.

4.2.3 Monitoring Well Evacuation

Following measurement of the static water level in all of the wells, individual wells will be purged of all stagnant water. The stagnant water, which is not representative of true aquifer conditions, will be removed to ensure that fresh formation water can be sampled. A minimum of three well casing volumes will be removed prior to sampling the well. The well volume for 2-inch diameter wells will be calculated using the following equation: One well volume in gallons equals the height of the water column (in feet) times 0.1632 (slightly less than 0.5 gallons per foot water for 3 casing volumes). Because aquifer formations onsite are relatively low-yield, the well will be purged in such a way that water is removed from the bottom of the screened interval.

During the well purging process, field measurements (pH, temperature, specific conductance, dissolved oxygen, oxidation/reduction potential and turbidity) will be collected at regular intervals, and reported in a tabular format. The well will be purged until field measurements stabilize within approximately 10 percent between subsequent readings or until the well is dry. Stabilization of these measurements will indicate that fresh formation water is present in the well. Field measurements of pH, temperature, conductivity, dissolved oxygen, and ORP will be obtained by using a YSI-600 series multi-parameter meter or equivalent and turbidity readings will be collected with Lamont turbidity meter or equivalent. Field measurements collected during purging activities will be recorded in the field logbook. If the well is purged to dryness, the samples will be collected after a sufficient volume of water has entered the well to allow collection of the sample.

Wells will be purged using a decontaminated Teflon bailer with new nylon rope or an acceptable pumping device approved by the SWS. Teflon bailers will be pre-decontaminated by the manufacturer. No field decontamination of bailers will be performed.

4.2.4 Sample Collection

After purging activities are complete, groundwater samples will be collected for laboratory analysis. The wells will be sampled using disposable laboratory decontaminated Teflon bailers equipped with new nylon rope. Bailers will be used for one well only. Field decontamination of bailers will not be permitted. The bailers will be lowered slowly into the well to minimize sample agitation. Sample water will be placed directly into sample bottles provided by the analytical laboratory, using the following method:

1. Retrieve bailer and slowly transfer sample water to the appropriate sample container. The bailer should not be allowed to touch the sample container.

2. The sample container for the volatile organic compounds should be filled first, leaving no headspace or air bubbles. The container should then be tightly sealed. The sample containers will be pre-preserved. No field preservation will be performed.

3. The sample container for the metals should then be filled. This container should be filled to the bottle shoulder.

Surface water samples will be obtained from areas of minimal turbulence and aeration. The following procedure will be implemented regarding sampling of surface waters:

1. Hold the bottle near the bottom with one hand, and with the other, remove the cap.

2. Push the sample container slowly into the water and tilt up towards the current to fill. A depth of about six inches is satisfactory. Avoid breaching the surface while filling the container.

3. The container should be moved slowly, in a lateral direction, if there is little current movement.

4. If the stream depths are too shallow to allow submersion of the sample container, a pool may be scooped out of the channel bottom and allowed to clear prior to sampling.

5. Lift the container from the water and place the uncontaminated cap on the container.

The wells and surface water stations will be sampled in the order of potential for increasing contamination levels beginning with the upgradient (background) sampling locations. The individual water samples for C&D landfill wells (MW-12/12d, MW-14/14d, and proposed MW-15/15d) will be collected in the order of parameter volatility. The collection order for the samples will be as follows:

- Volatile organic compounds (VOCs),
- Chloride,
- Sulfate,
- Alkalinity,
- Total Dissolved Solids (TDS),
- Total metals (including manganese, mercury and iron).

The samples will be transferred from the sampling equipment directly into a prepared sample container provided by the laboratory. Field filtering of samples is not permitted. There will be a specific size and type of container provided for each constituent to be analyzed. For VOC analysis, the containers provided will be pre-preserved 40-ml glass vials. For metals analysis, the samples will be collected in pre-

preserved 500-ml HDPE bottles. Chloride, sulfate, alkalinity and TDS will be collected in unpreserved 500-ml HDPE bottles. Extra containers will be provided in case of accidental breakage. All field personnel will wear protective latex disposable gloves in order to prevent extrinsic contamination from clothing, body oils, dirt, and other various contaminants. Sample documentation requirements to ensure sample integrity, will include sample locations, date and time of sample collection, proper analysis, and preservative (if applicable).

4.3 Sample Preservation and Shipment

In order to ensure sample integrity, preservation and shipment procedures will be carefully monitored. Generally, ice and chemical additives will be used as sample preservatives, as recommended by the commercial laboratory. For VOC analysis, hydrochloric acid will be used as the preservation method as well as maintaining the samples at a temperature of 4°C. Nitric acid will be used as the preservative for samples needing metals analysis.

If the analytical laboratory is located some distance from the site, samples shall be shipped via a 24-hour delivery service to ensure holding times are not exceeded. Shipment of samples will be coordinated with the laboratory. Proper storage and transport conditions must be maintained in order to preserve the integrity of the sample. Once collected, samples will be placed on ice and cooled to a temperature of 4°C. Samples are to be packed in coolers so as to inhibit breakage or accidental spills.

Custody seals will be placed on the outside of the cooler, in a manner to detect tampering of the samples. The laboratory shall immediately notify the owner/operator of any samples that arrive with custody seals broken.

4.4 Analytical Procedures

The samples taken from each monitoring well at the C&D landfill facility will be analyzed for the constituents listed in 40 CFR Part 258, Appendix I plus mercury, chloride, manganese, sulfate, iron, alkalinity, and Total Dissolved Solids. The surface water samples collected at the C&D landfill will be analyzed for Appendix I constituents only. The analytical procedures for the indicated parameters will be conducted using the following methods:

Analysis	EPA Method Number
Volatile organic compounds	8260
Total metals	6010
Mercury	7470
Chloride	300.0

Sulfate	300.0
Alkalinity	SM 2320B
Total Dissolved Solids	SM 2540C

4.5 Chain of Custody

It is imperative that an accurate record of sample collection, transport, analysis, and disposal be maintained and documented. Therefore, chain-of-custody procedures will be instituted and followed throughout the sampling program. It is necessary to establish documentation to trace sample possession from the time of collection until disposal. The chain-of-custody program shall include the following requirements:

- Samples shall be accompanied by a chain-of-custody record that notes the date and time of collection as well as sampling personnel.
- All samples shall be properly labeled to prevent misidentification of samples.
- A sample analysis sheet shall accompany all samples to the laboratory.
- Sample custody seals shall be used to indicate any tampering of samples.
- All records pertaining to the shipment of a sample shall be retained (freight bills, post office receipts, and bills of lading).

The laboratory shall not accept samples for analysis without a correctly prepared chain-of-custody form. The laboratory shall be responsible for maintaining chain-of-custody of the sample(s) from time of receipt to disposal. The chain-of-custody form shall be signed by each individual who possesses the samples.

To prevent sample misidentification, a label will be affixed to each sample container in a manner as to prevent the label from becoming dislodged during transport which will contain the following information:

- Sample identification number,
- Name and signature of sample collector,
- Date and time of collection,
- Place of collection,
- Parameters requested, and
- Preservative.

In addition the container itself should be labeled with the sample identification number, at a minimum, to allow for identification should the label fall off.

4.6 Quality Assurance/Quality Control

The reliability and validity of the field and analytical laboratory data will be monitored as part of the QA/QC program used in the laboratory. Field duplicates and sample blanks will be collected to check sampling protocol and to account for any changes that occur after sampling. The QA/QC program will stipulate the use of standards, laboratory blanks, and duplicates for identification of matrix interferences.

4.6.1 Field Duplicates

Field duplicates provide a measure of field and laboratory precision. Field duplicates will be collected from identical locations using proper sampling procedures. The duplicate samples will be collected at a frequency of one per day per sampling event.

4.6.2 Equipment Rinsate Blanks

To evaluate the effectiveness of the decontamination procedures, equipment rinsate blanks will be collected. The sample will be collected by passing distilled water through the sampling equipment after decontamination has been completed. Equipment blanks will be collected at a minimum of one per day of groundwater sampling activities.

4.6.3 Trip Blanks

A trip blank shall be prepared to account for any sample contamination that may occur during transport to and from the site. The sample will be prepared in the laboratory with deionized or distilled water and shall accompany the sample shipping container to the field. The trip blank shall remain unopened until receipt by the lab for analysis. One trip blank per sampling event will be collected.

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Part 7
Operation Plan

Appendix B
NCDENR ACM Approval Letter

NCDENR

North Carolina Department of Environment and Natural Resources
Division of Waste Management

Beverly Eaves Purdue
Governor

Dexter R. Matthews
Director

Dee Freeman
Secretary

STATE OF NORTH CAROLINA
DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF WASTE MANAGEMENT
SOLID WASTE SECTION

MUNICIPAL SOLID WASTE LANDFILL FACILITY
Permit No. 11-07

BUNCOMBE COUNTY
is hereby issued a

PERMIT to OPERATE
A
MUNICIPAL SOLID WASTE LANDFILL UNIT, Cells 1-6,
CONSTRUCTION AND DEMOLITION DEBRIS LANDFILL UNIT, Phase 4
And A HOUSEHOLD HAZARDOUS WASTE COLLECTION FACILITY

Located on Panther Branch Road, North Carolina State Road 1745, Buncombe County, in accordance with Article 9, Chapter 130A, of the General Statutes of North Carolina and all rules promulgated there under and subject to the conditions set forth in this permit.

Edward F. Mussler III, P.E.
cn=Edward F. Mussler III, P.E., c=US, o=Division of Waste Management, ou=Solid Waste Section, email=ed.mussler@ncmail.net
I have reviewed this document and am approving this document
2009.05.01 11:09:03 -04'00'

Edward F. Mussler, III, P.E.,
Permitting Branch Supervisor
Solid Waste Section

ATTACHMENT 3

PART I: PERMITTING HISTORY

MSWLF FACILITY PERMIT NO: 11-07	**ISSUANCE DATE**
Original Facility Permit to Construct	November 7, 1995
Original Permit to Operate - Cell 2:	November 15, 1996
MSWLF Cell 1:	January 9, 1998
MSWLF Cell 3:	January 27, 2000
MSWLF Cells 4 & 5:	November 14, 2002
XL Leachate Recirculation Modification:	March 27, 2003.
MSWLF Phase 3 (Phase 1 of Cell 6)	October 12, 2005
MSWLF Cells 1-6:	March 14, 2006
MSWLF Bioreactor Phase I:	March 14, 2006
Modification-Gas Collection System Cell 6	September 12, 2006
Modification – Leachate Breakout Operations Plan Update	July 15, 2008
Modification – Alternative Cover Materials	**May 1, 2009**
C&DLF Phase 1:	January 21, 1998
C&DLF Phase 2:	March 5, 1999
C&DLF Phase 1 Expansion:	November 14, 2002
C&DLF Phase 4	June 12, 2006
Modification-Asbestos Disposal	March 04, 2008
Household Hazardous Waste Collection:	March 9, 2001

PART II: LIST OF DOCUMENTS FOR THE APPROVED PLAN

GENERAL FACILITY

1. *Buncombe County Solid Waste Management Facility, Permit to Construct Application, Volume 1 of 2*, dated March, 1995, as revised.

2. *Buncombe County Solid Waste Management Facility, Permit to Construct Application, Volume 2 of 2*, dated March, 1995, as revised.

3. Plans entitled *Engineering Plan, Buncombe County Solid Waste Management Facility*, dated March, 1995, sheets EP-1 through EP-6, D-1 through D-4, as revised.

4. Plans entitled *Facility Plan, Buncombe County Solid Waste Management Facility*, dated March, 1995, sheets SD-1, SD-2, LC-1 through LC-4, LO-1 through LO-9, as revised.

5. Plans entitled *Construction Plan, Cells 1 through 3, Buncombe County Solid Waste Management Facility*, dated September, 1995, sheets C-1 through C-9, D-1 through D-4, E-1 and E-2, latest revision.

6. *Response to Technical Review Design Hydrogeologic Report/Water Quality Monitoring Report, Buncombe County Solid Waste Management Facility*, dated June, 1995.

7. *Response to Technical Review Design Hydrogeologic Report/Water Quality Monitoring Report, Buncombe County Solid Waste Management Facility*, dated August, 1995.

8. *Modification to Permit, Construction Plans - Cells 1 through 3, Proposed Buncombe County Solid Waste Management Facility*, dated October 6, 1995.

9. Camp Dresser & McKee letter, dated November 2, 1995, subject: Alternate Monitoring System.

10. *Buncombe County Solid Waste Management Facility, Permit to Construct Application, Cell 3 Permit Modifications*, dated October 1998, as revised, prepared by Camp Dresser & McKee.

11. *Buncombe County Subtitle D Landfill Cell No. 3 Point-of Compliance Equivalence evaluation for Proposed Alternative Base Liner*, dated June 10, 1998, as revised, prepared by Camp Dresser & McKee.

MUNICIPAL SOLID WASTE LANDFILL

Documents 1-15 contained in previous permits.

16. *Permit Application for the US EPA Project XL Bioreactor at the Buncombe County Solid Waste Management Facility*. Prepared by: Camp Dresser and McKee, Raleigh, NC. December 2002.

17. Plans entitled *US EPA Project XL Bioreactor Plan Permit Application, Buncombe County Solid Waste Management Facility*. Prepared by: Camp Dresser and McKee, Raleigh, NC. December 2002.

18. *Buncombe County Solid Waste Management Facility, Permit to Construction Application*. Prepared by: Camp Dresser and McKee, Raleigh, NC. December 2004. Volume 1 of 2.

19. *Buncombe County Solid Waste Management Facility, Permit to Construction Application*. Prepared by: Camp Dresser and McKee, Raleigh, NC. December 2004. Volume 2 of 2.

20. Drawings entitled *Engineering Plan - Phase 3 (Cell 6), Buncombe County Solid Waste Management Facility*. Prepared by: Camp Dresser and McKee, Raleigh, NC. December 2004.

21. Response To Comment. *Application for Permit to Construct, Phase III, Buncombe County Landfill, Design Hydrogeologic Study - Preliminary Review Comments, Permit No. 11-07*. Prepared by: Camp Dresser and McKee, Raleigh, NC. January 7, 2005.

22. Response To Comments. *Application for Permit to Construct, Phase III, Buncombe County Landfill, Design Hydrogeologic Study - Additional Review Comments, Permit No. 11-07*. Prepared by: Camp Dresser and McKee, Raleigh, NC. January 18, 2005.

23. *Buncombe County North Carolina, Buncombe County Solid Waste Management Facility, Permit to Construct Application for Phase III, CDM Project No. 6447-45139, Response to Comments*. Prepared by: Camp Dresser and McKee, Raleigh, NC. March 9, 2005.

24. *Buncombe County North Carolina, Buncombe County Solid Waste Management Facility, Permit to Construct Application for Phase III, CDM Project No. 6447-45139, Operations Plan Response to Comments*. Prepared by: Camp Dresser and McKee, Raleigh, NC. April 25, 2005.

25. *Buncombe County, North Carolina, Solid Waste Management Facility, Phase 1 of Cell 6, Construction Quality Assurance Report*. Prepared by: Camp Dresser and McKee, Raleigh, NC. June 24, 2005. Volume 1.

26. *Buncombe County, North Carolina, Solid Waste Management Facility, Phase 1 of Cell 6, Construction Quality Assurance Report*. Prepared by: Camp Dresser and McKee, Raleigh, NC. June 24, 2005. Volume 2.

27. *Buncombe County, North Carolina, Solid Waste Management Facility, Phase 1 of Cell 6, Construction Quality Assurance Report, Additional Documentation*. Prepared by: Camp Dresser and McKee, Raleigh, NC. July 25, 2005.

28. *Buncombe County, North Carolina, Solid Waste Management Facility, Cell 6 Construction Quality Assurance Report*. Prepared by Camp Dresser and McKee, Raleigh, NC. January 20, 2006, Volume 1.

29. *Buncombe County, North Carolina, Solid Waste Management Facility, Cell 6 Construction Quality Assurance Report*. Prepared by Camp Dresser and McKee, Raleigh, NC. January 20, 2006, Volume 2.

30. *Buncombe County, North Carolina, USEPA Project XL Bioreactor Phase I, Buncombe County Solid Waste Management Facility, Construction Quality Assurance Report.* Prepared by: Camp Dresser and McKee. Raleigh, NC. January 27, 2006.

31. *Buncombe County Solid Waste Management Facility, Cell 6 Gas Collection System.* Prepared by CDM, Raleigh, NC. Prepared for Buncombe County. May 25, 2006.

32. *Buncombe County Solid Waste Management Facility Cell 6 Gas Collection System, CQA Report.* Prepared by CDM, Raleigh, NC. Prepared for Buncombe County. August 2006

33. *Compliance Order, Buncombe County Landfill, Permit #11-07.* Prepared by: Paul Crissman. Prepared for: The Division of Waste Management, Solid Waste Section. September 7, 2007. Document ID Number 3005.

34. *Leachate Spill Assessment Plan, Buncombe County Subtitle D Landfill, Alexander, North Carolina, Permit #11-07.* Prepared by: CDM. Prepared for: Buncombe County. September 19, 2007. Document ID Number 3086.

35. *Conditions for Compliance, Buncombe County Subtitle D Landfill, Alexander, North Carolina, Permit #11-07.* Prepared by: CDM. Prepared for: Buncombe County. October 11, 2007. Document ID Number 3223.

36. *Leachate Spill Assessment, Buncombe County Subtitle D Landfill, Alexander, North Carolina, Permit #11-07.* Prepared by: CDM. Prepared for: Buncombe County. November 13, 2007. Document ID Number 3789.

37. *Review Letter, Buncombe County MSWLF, Permit No. 11-07, Buncombe County.* Prepared by: Larry Frost. Prepared for: The Division of Waste Management, Solid Waste Section. December 10, 2007. Document ID Number 3526.

38. *Buncombe County, North Carolina, Buncombe County MSWLF – Permit No. 11-07, Response to Comments.* Prepared by: CDM. Prepared for: Buncombe County. April 14, 2008. Document ID Number 4391.

39. *Buncombe County Solid Waste Management Facility Permit No. 11-07, Permit Modification Revised Operations Plan.* Prepared by: CDM. Prepared for: Buncombe County. June 9, 2008. Document ID Number 4856.

40. *Alternative Cover Material – Posi-Shell and Tarps Demonstration Report and Revised Operation Plan.* Prepared by: CDM. Prepared for: Buncombe County. June 13, 2008. Document ID Number 5156.

41. *Alternative Cover Material – Posi-Shell and Tarps Demonstration Report and Revised Operation Plan.* Prepared by: CDM. Prepared for: Buncombe County. November 10, 2008. Document ID Number 6221.

42. *Response to Comments: Alternative Cover Material Demonstration Report and Revised Operation Plan.* Prepared by: CDM. Prepared for: Buncombe County. February 23, 2009. Document ID Number 6904.

CONSTRUCTION AND DEMOLITION LANDFILL

Documents 1-6 contained in previous permits.

7. *Buncombe County North Carolina Buncombe County Solid Waste Management Facility, Construction and Demolition Debris Landfill Phase 4 Expansion, Permit Application.* Prepared by Camp Dresser & McKee, Raleigh, NC. Prepared for Buncombe County. June 2, 2005 as amended through October 28, 2005.

8. *Inspection and Certification of Sub-grade Condition, Buncombe County C&D Landfill Phase 4 Expansion.* Prepared by CDM, Raleigh, NC. Prepared for Buncombe County. April 12, 2006.

9. *Monitoring Well Installation and Initial Sampling Report, Buncombe County C&D Landfill Phase 4 Expansion.* Prepared by CDM, Raleigh, NC. Prepared for Buncombe County. April 26, 2006.

10. *Construction Certification Phase 4 C&D Landfill Expansion Project.* Prepared by CDM, Raleigh, NC. Prepared for Buncombe County. May 31, 2006.

11. *Buncombe County North Carolina Buncombe County Solid Waste Management Facility, Permit No. 11-07, C&D Operation Plan Modification – Asbestos Disposal.* Prepared by CDM, Raleigh, NC. Prepared for Buncombe County. December 2007. Document ID# 3848.

LAND CLEARING AND INERT DEBRIS LANDFILL

MISCELLANEOUS FACILITIES

HOUSEHOLD HAZARDOUS WASTE PERMANENT COLLECTION FACILITY

1. *Permit Application (operation plan, contingency plan and closure plan) for Buncombe County Household Hazardous Waste Permanent Collection Facility.* Prepared by Buncombe County for Buncombe County. October 9, 2000 and amended through February 2001.

ATTACHMENT 4
CONDITIONS OF PERMIT

PART I: GENERAL FACILITY CONDITIONS

1. This permit shall expire September 12, 2011. Pursuant to 15A NCAC 13B .0201(e), no later than March 12, 2011, the owner or operator must submit an application for amendment or modification to the permit for review to the North Carolina Department of Environment and Natural Resources, Division of Waste Management, Solid Waste Section (hereinafter "Section"). The application must be prepared in accordance with 15A NCAC 13B .1603 (a)(2) or 15A NCAC 13B .1603 (a)(3), as applicable.

2. The persons to whom this permit is issued ("permittee") are the owners and operators of the solid waste management facility.

3. [Intentionally Blank]

4. [Intentionally Blank]

5. By receiving waste at this facility the permittee shall be considered to have accepted the terms and conditions of this permit.

6. Operation of this solid waste management facility shall be in accordance with the Solid Waste Management Rules, 15A NCAC 13B, Article 9 of the Chapter 130A of the North Carolina General Statutes (NCGS 130A-290, et seq.), the conditions contained in this permit; and the approved plan. Should the approved plan and the rules conflict, the Solid Waste Management Rules shall take precedence unless specifically addressed by permit condition.

7. This permit is issued based on the documents submitted in support of the application for permitting the facility including those identified in Attachment 3, "List of Documents for the Approved Plan," and which constitute the approved plan for the facility. Where discrepancies exist, the most recent submittals and the Conditions of Permit shall govern.

8. This permit may be transferred only with the approval of the Section and through the issuance of a new or substantially amended permit in accordance with applicable statutes and rules.

9. The permittee is responsible for obtaining all permits and approvals necessary for the development of this project including approval from appropriate agencies for a General or Individual NPDES Stormwater Discharge Permit. Issuance of this permit does not remove the permittee's responsibilities for compliance with any other local, state or federal rule, regulation or statute.

10. This facility is permitted for an average annual disposal rate of approximately 170,000 tons. This tonnage corresponds to an approximate disposal rate of 545 tons per day based on 312 operating days per year, as set forth in Part II, Document 18, Attachment 3. The landfill is permitted to receive solid waste generated by and in Buncombe County, consistent with local government waste management plans(s), with local government approval and contract, the franchise agreement, and as defined in G.S. 130A-290(a) (35), except where prohibited by the North Carolina General Statutes Article 9 of Chapter 130A, and the rules adopted by the Commission for Health Services.

11. In the event of conflicts between this Permit to Operate and previously issued conditions, the conditions of this Permit to Operate shall supersede previously issued conditions.

12. The solid waste management units within this facility shall conform to all operating procedures described in the approved plans, 15A NCAC 13B, and the conditions specified herein.

13. Additional conditions and revision of the approved documents or changes during the operation of the landfill require approval by the North Carolina Solid Waste Section.

14. Ground water quality at this facility is subject to the "Classifications and Water Quality Standards Applicable to the Groundwater of North Carolina", 15A NCAC 2L. This includes, but is not limited to, provisions for detection monitoring, assessment, and corrective action.

PART II: MUNICIPAL LANDFILL UNIT SPECIFIC CONDITIONS

OPERATIONAL CONDITIONS

15. This permit approves the continued operation of Phases 1 and 2, Cells 1-5 and operation of Cell 6 of the municipal solid waste landfill unit as well as the on-site environmental management and protection facilities as described in the approved plans.

16. This permit is for operational approval of a five-year permitted disposal capacity of approximately 3,255,999 cubic yards, consistent with the configuration as shown on Sheet EP-3 and contours as shown on Sheet EP-5 of Document 20, Attachment 3, Part II in the approved plans. The landfill will be constructed in four additional phases, Phases 4-7. Construction of cells within each phase shall be in accordance with the Division approved plans. This permit to operate does not approve operation of phases or cells outside of Cell 6.

17. The owner or operator of the landfill facility must not knowingly dispose of any type or form of municipal solid waste that is generated within the boundaries of a unit of local government that by ordinance:

a. Prohibits generators or collectors of municipal solid waste from disposing of any type or form of municipal solid waste.

b. Requires generators or collectors of municipal solid waste to recycle that type or form of municipal solid waste.

18. The facility operator must complete an approved operator training course in compliance with G.S. 130A-309.25.

    a. A responsible individual certified in landfill operations must be on-site during all operating hours of the facility at all times while open for public use to ensure compliance with operational requirements.

    b. All pertinent landfill-operating personnel must receive training and supervision necessary to properly operate the landfill units in accordance with G.S. 130A-309.25 and addressed by memorandum dated November 29, 2000.

19. All sedimentation/erosion control activities must be conducted in accordance with the Sedimentation Control Act codified at 15A NCAC 4.

20. The primary access road to the facility is N. C. State Highway 55 Bypass. Any changes to this primary access to the site shall require a new facility permit.

21. The use of alternative daily cover requires approval, prior to implementation, by the Section. Requests for alternative daily cover approval must include a plan detailing the comprehensive use and a demonstration of the effectiveness of the alternative daily cover. The plan shall be developed according to Section guidelines. Plans which are approved by the Section will be incorporated into, and made a part of, the approved documents listed in Attachment 3. Even with approval of alternative cover materials, soil cover shall be applied at a minimum of one time per week in accordance with Rule .1626 (2). Soil shall be applied more frequently, if needed, to control disease vectors, fires, odors, blowing litter and scavenging.

    a. The use of a fabric reinforced tarp as an alternate daily cover is approved and subject to the terms and conditions of operation as set forth in the plan.
    b. The use of Posi-shell as an alternate daily cover is approved and subject to the terms and conditions of operation as set forth in the plan.
    c. The use of a 30/70 mulch/soil mixture as an alternate daily cover is approved and subject to the terms and conditions of operation as set forth in the plan.

22. Leachate recirculation system construction and operation is approved as per the approved documents. Leachate recirculation system on going construction quality assurance (CQA) documentation shall be maintained by the owner/operator at the facility. Monitoring information gathered in accordance with the leachate recirculation monitoring plan shall be submitted to the Division. Additional moisture

(water) source shall be the French Broad River. Additional moisture shall be added to the leachate lagoon in accordance with Section 3 of the approved application.

23. Prior to disposal in a new cell previously separated from the active disposal cell by rainwater and leachate separation devices involving rainwater flaps welded to the liner and/or disconnected leachate lines, a construction certification shall be placed in the facility operating record. The certification must describe the proper removal of temporary rainwater devices and reconnection of leachate collection lines in accordance with Attachment 3, Part II, Document No. 8 of this permit. The document must also contain a statement of certification by the facility's trained landfill operator, N. C. registered professional engineer, or other person approved by the Section, that the construction was properly completed according to the approved plans.

24. The proper removal of geotextile covering the gravel column, occurring with the progression of fill, shall be documented by the facility's trained landfill operator, or other person approved by the Section, in accordance with Attachment 3, Part II, Document No. 8 of this permit, and the documentation shall be placed in the facility's operating record.

25. The facility is permitted to co-dispose of wastewater treatment sludge generated within the facility's approved service area, and subject to the terms and procedures of the approved plan.

26. Closure or partial closure of any MSWLF unit shall be in accordance with the Closure Plans described in the approved plans and 15A NCAC 13B .1629. Final Closure Plans shall be submitted to the Division at least 90 days prior to implementation. Closure and Post-Closure cost estimates and financial instruments shall be updated annually pursuant to 15A NCAC 13B .1628.

MONITORING AND REPORTING

27. Groundwater, surface water, and methane monitoring locations must be established and monitored as identified in the approved plans.

28. A licensed geologist must be present to supervise the installation of groundwater monitoring wells. The exact locations, screened intervals, and nesting of the wells must be established after consultation with the SWS Hydrogeologist at the time of well installation.

29. The owner or operator must sample the groundwater monitoring wells and surface water sampling locations semi-annually or as otherwise directed in writing by the Solid Waste Section Hydrogeologist.

30. Reports of the analytical data for each monitoring event shall be submitted to the Section within 60 days of the respective sampling event. Analytical data shall be submitted in a manner prescribed by the Section. Records of all groundwater, surface water, and leachate analytical data shall be kept as part of the permanent facility record.

31. The four independent samples which comprise the initial baseline sampling event shall be collected from each groundwater monitoring well and the report shall be submitted to the Section within six months after issuance of the Permit to Operate.

32. Untreated leachate shall be sampled and analyzed at least semi-annually concurrently with the groundwater water and surface water sampling. The leachate shall be analyzed for all Appendix I constituents, pH, specific conductance, BOD, COD, nitrates, sulfates, and phosphates. Test results shall be submitted to the Section along with groundwater and surface water test results. In the event leachate is recirculated, additional leachate sampling may be required.

33. A readily accessible unobstructed path shall be cleared and maintained so that four-wheel vehicles may access monitoring well locations at all times.

34. A field log book which details all development, sampling, repair, and all other pertinent activities associated with each monitoring well and all sampling activities associated with each surface water and leachate sampling location shall be kept as part of the permanent facility record.

35. All well construction records and soil boring logs for new wells must be submitted to the Solid Waste Section Hydrogeologist for review within 30 days of completion.

36. Copies of this permit, the approved plans, and all records required to be maintained by the permittee must be maintained at the facility and made available to the Section upon request during normal business hours.

37. The owner or operator must maintain a record of the amount of solid waste received at the landfill unit, compiled on a monthly basis. Scales must be used to weigh the amount of waste received.

38. On or before August 1 annually, the Permittee must submit an annual facility report to the Solid Waste Section, on forms prescribed by the Section.

    a. The reporting period shall be for the previous year beginning July 1 and ending June 30.

    b. The annual facility report must list the amount of waste received and landfilled in tons and be compiled:
        i) On a monthly basis.
        ii) By county, city or transfer station of origin.
        iii) By specific waste type.
        iv) By disposal location within the facility.
        v) By diversion to alternative management facilities.

    c. A measurement of volume utilized in the landfill cells must be performed during the second quarter of the calendar year. The date and volumes, in cubic yards, must be included in the report.

d. The amount of waste, in tons from scale records, disposed in landfill cells from the initial placement of waste through the date of the annual volume survey must be included in the report.

e. The completed report must be forwarded to the Regional Waste Management Specialist for the facility by the date due on the prescribed annual facility report form.

f. A copy of the completed report must be forwarded to each county manager for each county from which waste was received at the facility. Documentation that a copy of the report has been forwarded to the county managers must be sent to the Regional Waste Management Specialist by the date due on the prescribed annual facility report form.

PART III: CONSTRUCTION AND DEMOLITION DEBRIS UNIT SPECIFIC CONDITIONS

39) This permit is for the operational approval of Phase 4 of the C&DLF unit, an approximate five year disposal capacity consisting of an additional 340,000 cubic yards, consistent with the approved contours as shown on the approved plans as described in Attachment 3, Part II, Document No. 7.

40) The permittee must not knowingly dispose of C&D waste that is generated within the boundaries of a unit of local government that by ordinance:

a) Prohibits generators or collectors of C&D waste from disposing of that type or form of C&D waste.

b) Requires generators or collectors of C&D waste to recycle that type or form of C&D waste.

41) The facility operator must complete an approved operator training course in compliance with G.S. 130A-309.25.

a) A responsible individual certified in landfill operations must be on-site during all operating hours of the facility at all times while open for public use to ensure compliance with operational requirements.

b) All pertinent landfill-operating personnel must receive training and supervision necessary to properly operate the C&D landfill unit in accordance with G.S. 130A-309.25 and addressed by memorandum dated November 29, 2000.

42) The C&D landfill units are permitted to receive the following waste types:

a) "Construction or demolition debris" as defined in G.S. 130A-290 (a)(4) means solid waste resulting solely from construction, remodeling, repair or demolition operations on pavement,

buildings, or other structures, but does not include inert debris, land-clearing debris or yard debris.

b) "Inert debris" as defined in G.S. 130A-290 (a)(14) means solid waste that consists solely of material such as concrete, brick, concrete block, uncontaminated soil, rock, and gravel.

c) "Land-clearing debris" as defined in G.S. 130A-290 (a)(15) means solid waste that is generated solely from land-clearing activities, such as stumps and tree trunks.

d) "Asphalt" in accordance with G.S. 130-294(m).

43) Those wastes listed in 15A NCAC 13B .0542 (e), must not be accepted for disposal including, but not limited to, municipal solid waste, liquid or industrial wastes, and yard trash.

44) Asbestos waste must be managed in accordance with 40 CFR 61. Disposal of asbestos waste must be in accordance with 15 NCAC 13B .0542 (c).

45) The Permittee must actively employ a training and screening program at the facility prepared in accordance with Section .0544(e) for detecting and preventing the disposal of excluded or unauthorized wastes. At a minimum, the program must include:

a) Random inspections of incoming loads or other comparable procedures.

b) Records of any inspections.

c) Training of personnel to recognize hazardous, liquid, and other excluded waste types.

d) Development of a contingency plan to properly manage any identified hazardous, liquid, MSW, or other excluded or unauthorized wastes. The plan must address identification, removal, storage, and final disposition of these wastes.

46) All sedimentation/erosion control activities must be conducted in accordance with the Sedimentation Control Act N.C.G.S. 113A-50, et seq., and rules promulgated there under at 15A NCAC 4.

47) A closure and post-closure plan must be submitted for approval at least 90 days prior to closure or partial closure of any landfill unit. The plan must include all steps and measures necessary to close and maintain the C&D unit in accordance with all rules in effect at that time. At a minimum, the plan must address the following:

a) Design of a final cover system in accordance with 15 NCAC 13B .0543(c), or the solid waste management rules in effect at the time of closure;

b) Construction and maintenance/operation of the final cover system and erosion control structures; and

c) Surface water, ground water, and explosive gas monitoring.

Monitoring and Reporting Requirements

48) The following are groundwater monitoring requirements for the C&D landfill facility:

a) Groundwater and surface water monitoring locations must be established and monitored as identified in the approved plans (reference Attachment 3, Part II, Document No. 21).

b) The owner or operator must sample the monitoring wells semi-annually or as otherwise directed in writing by the Solid Waste Section Hydrogeologist.

c) A licensed geologist must be present to supervise the installation of groundwater monitoring wells. The exact locations, screened intervals, and nesting of the wells must be established after consultation with the SWS Hydrogeologist at the time of well installation.

d) All well construction records and soil boring logs for new wells must be submitted to the Solid Waste Section Hydrogeologist for review within 30 days of completion.

49) Copies of this permit, the approved plans, and all records required to be maintained by the permittee must be maintained at the facility and made available to the Section upon request during normal business hours.

50) The permittee must maintain a record of the amount of solid waste received at the C&D units, compiled on a monthly basis. Scales must be used to weigh the amount of waste received.

51) On or before August 1 annually, the Permittee must submit an annual facility report to the Solid Waste Section, on forms prescribed by the Section.

a) The reporting period shall be for the previous year beginning July 1 and ending June 30.

b) The annual facility report must list the amount of waste received and landfilled in tons and be compiled:
   i) On a monthly basis.
   ii) By county, city or transfer station of origin.
   iii) By specific waste type.
   iv) By disposal location within the facility.
   v) By diversion to alternative management facilities.

c) A measurement of volume utilized in the C&D cells must be performed during the second quarter of the calendar year. The date and volumes, in cubic yards, must be included in the report.

d) The amount of C&D waste, in tons from scale records, disposed in landfill cells since October 1, 2003, through the date of the annual volume survey must be included in the report.

e) The completed report must be forwarded to the Regional Waste Management Specialist for the facility by the date due on the prescribed annual facility report form.

f) A copy of the completed report must be forwarded to each county manager for each county from which waste was received at the facility. Documentation that a copy of the report has been forwarded to the county managers must be sent to the Regional Waste Management Specialist by the date due on the prescribed annual facility report form.

PART IV: LAND CLEARING AND INERT DEBRIS UNIT SPECIFIC CONDITIONS

Not Applicable

PART V: YARD WASTE UNIT SPECIFIC CONDITIONS

Not Applicable

PART VI: MISCELLANEOUS UNIT SPECIFIC CONDITIONS

HOUSEHOLD HAZARDOUS WASTE PERMANENT COLLECTION FACILITY

OPERATION

52. The permit is for the construction and operation of a Permanent Household Hazardous Waste Collection Facility. Revisions to the approved plans shall be approved by the North Carolina Division of Waste Management (DWM), Solid Waste Section.

53. This permanent household hazardous waste collection facility is permitted to receive household hazardous waste (HHW) from homeowners and conditionally exempt small quantity generators. Unacceptable HHW that shall not be collected at this facility includes radioactive waste, explosives, and infectious waste.

54. Attachment 3, "Approved Documents", is included in the approved plan.

55. This facility shall conform to all operating procedures in the approved plan, 15A NCAC 13B .0400, and the Guidance Document for HHW Facilities.

56. Household hazardous waste permanent ID No. NCPH01101011 shall be used for shipment of collected materials off-site.

REPORTING REQUIREMENTS

56. Buncombe County shall maintain records for the amount of HHW received at the facility and the amounts shipped off-site for recycling, reuse, and / or disposal. Records must be compiled on a monthly basis and maintained at the facility for inspection upon request by Solid Waste Section personnel.

57. On or before August 1 of each year, Buncombe County shall report to the Solid Waste Section, the amount of HHW waste (in pounds) received at this facility and the amounts shipped off-site for recycling, reuse, and / or disposal. The reporting period shall be for the previous year, beginning July and ending June 30.

58. Copies of this permit and copies of the approved plan shall be forwarded to the local fire department, local hospitals, and other appropriate emergency agencies.

- End of Section -

Part 7
Operation Plan

Appendix C
Posi-shell Manufacturer's Usage Guide

2183 Pennsylvania Avenue
Apalachin, NY 13732
Ph: 800-800-7671
Fx: 607-625-2689
www.landfill.com

ADVANCED FORMULATION USAGE GUIDE

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This guide gives you specific, easy to follow instructions for the safe and efficient usage of Landfill Service Corporation's Posi-Shell® Cover System Advanced Formulation. For best results and to ensure safety, please follow the instructions carefully.

1.0 Definition of Posi-Shell Cover System Advanced Formulation

The Posi-Shell Cover System is a low-cost alternative to the conventional six inches of soil used as daily cover at most landfills. Posi-Shell Advanced Formulation is a noncombustible blend of materials providing a thin cover (approximately one-quarter inch) that hardens over the surface of the material to be covered, such as the working face of the landfill. Non-toxic, the stucco-like coating performs all functions of landfill daily and intermediate cover. Applied with a standard hydroseeding unit, this system provides increased landfill capacity while providing a more environmentally effective cover system for the landfill.

1.1 Background and Concept

Landfilled solid waste must be covered each day to control vectors, fires, odors, blowing litter, and scavenging. Cover material is generally defined as a six inch soil layer or other suitable material, or a combination of same, that is used to cover compacted solid waste in a landfill.

The Posi-Shell Cover System Advanced Formulation is an alternative to traditional landfill daily cover materials. The coating is a spray-on slurry composed of water, Posi-Pak Type P-100, PSM-200 Setting Agent, and optional Portland cement that forms an approximately one-quarter-inch coating for various types of landfill cover. The Posi-Shell Cover System Advanced Formulation is designed for use by a landfill operator at the close of each operating day for compliance with cover regulations. The material meets and exceeds regulatory requirements for the control of landfill vectors, fires, odors, blowing litter, and scavenging.

Posi-Shell Advanced Formulation (AF) provides cover ranging from 4 to 10 square feet per gallon of slurry. The coverage area is dependent upon the desired thickness and the actual texture of the covered surface. Application of the Posi-Shell AF is a one-man operation.

1.2 Environmental and Economic Benefits

The Posi-Shell Cover System conserves natural resources. Additionally, use of the Posi-Shell Cover System conserves energy and improves air quality by eliminating the use of heavy earth-moving equipment for the transporting, laying, and reworking of daily soil cover. Traffic congestion to and from the landfill site, vehicle exhaust, and fugitive dust emissions are also reduced proportionately to the reduction of landfill soil hauling for daily cover.

Soil, a valuable natural resource, is conserved by the Posi-Shell Cover System AF. In many areas, soil is an expensive natural resource that is in short supply. Use of the Posi-Shell Cover System AF can eliminate the waste of this precious commodity.

The major benefit of the use of the Posi-Shell Cover System AF is the conservation of extremely valuable landfill capacity, commonly known as "air space". Landfill air space is a valuable asset and the need to conserve capacity is paramount to achieve environmental and economic objectives for both landfill operators and regulatory agencies. Efficient use of air space today can directly translate into longer landfill life, decreased operating costs, and increased revenue generation. An increase in air space efficiency can delay or even eliminate the need for the siting and construction of new facilities that ultimately may have severe environmental and economic impacts.

For comparison purposes using daily cover for a working face area of 5,000 square feet for a period of one year with Posi-Shell AF as opposed to six inches of top soil will realize an air space savings of about 24,000 cubic yards. Use of Posi-Shell AF as opposed to soil will result in a direct increase in the amount of airspace available in a landfill.

1.3 Equipment

The equipment used for the Posi-Shell Cover System AF consists of a standard hydroseeding unit, a towing unit, and a water source. The towing unit is used for moving the hydroseeding unit around the landfill site. If a nearby hydrant or other water source is not available, then a water trailer or truck is required.

1.4 Personnel

One operator is required for the Posi-Shell Cover System AF. This operator must be capable of operating heavy equipment and be familiar with the mechanics of all equipment used. The operator will be trained by Landfill Service Corporation in the use of Posi-Shell AF. If preferred, a two man operation may be used to expedite coverage time.

1.5 Materials

1.5.1 Water

Potable water, non-potable water and landfill leachate can be used as the liquid portion of the Posi-Shell Cover System AF. Use of leachate requires a site-specific regulatory approval to assure proper health and safety practices are implemented.

Approximately 1,600 gallons of water is used for each 2000 gallon load of Posi-Shell AF. The water can either be supplied by a hydrant, pumped from a nearby pond, or brought to and stored adjacent to the hydroseeding unit by water truck or trailer. The sizing of the specific water supply method should be adequate to ensure that the filling of the hydroseeding unit occurs within a few minutes' time.

As stated, leachate can be used as a water source if specific regulatory approval is obtained. It is not recommended that a high-strength leachate be used due to odor concerns and the added safety precautions required to assure worker safety. However, use of relatively dilute leachate is an effective method for reducing a portion of a landfill's total leachate production. The inherent odor-neutralizing properties of Posi-Shell AF mitigate the potential odor problems of leachate when it is used as a water source.

1.5.2 Posi-Paks

Posi-Paks are an important constituent of Posi-Shell AF and give the cover its fiber reinforced rigidity and weather resistance. Posi-Paks are lightweight, easy to handle, and ready to use. Posi-Pak is a specially designed plastic fiber with a proprietary finish that provides the reinforcement matrix for the finished cover. Four Posi-Paks are used for each 2000 gallon load. See the back of this manual for a material safety data sheet for this material.

1.5.3 Dye

Optional dyes can be added to the Posi-Shell AF mixture to create a soil-like brown coloring or a grass-like green coloring.

1.5.4 PSM 200 Setting Agent

A proprietary blend of natural bentonite clay, synthetic polymers, and adhesives provide thickening, lubrication, and adhesion in the Posi-Shell AF mixture. See the back of this manual for a Material Safety Data Sheet for this material.

1.5.5 Portland Cement

Optional Portland cement can be used as the cementitious mineral binder component of Posi-Shell AF. On average, approximately 4,000 lbs. of this material is used for each 2000 gallon Posi-Shell AF load. The Portland Cement further helps neutralize odors and contaminants found in leachate and enhances the durability of the Posi-Shell.

2.0 Safety

Posi-Shell AF is nonhazardous and is composed of nonhazardous materials. Certain safety measures are recommended during different aspects of Posi-Shell AF use. **Follow safety procedures specific to your hydroseeding unit, towing unit, or other equipment used.**

3.0 Operator Attire

The operator should, at all times, wear appropriate protective clothing. Jewelry and loose fitting clothing should be avoided. Recommended protective clothing includes the following:

- Safety glasses with side shields
- Leather gloves
- Industrial grade work coveralls
- Leather steel-toed shoes
- Dust particulate mask

If leachate is being used as the liquid portion of the Posi-Shell AF mixture, protective clothing in accordance with site regulations should be worn.

4.0 Towing Units

See table on page 11 for Posi-Shell AF total material weights. To determine the total load weight, add the Posi-Shell AF total material weight to the weight of your hydroseeding unit. Ensure that the towing unit and hitch arrangement are capable of handling the total of these weights.

5.0 Loading and Mixing Procedure

It is important to add the Posi-Shell Advanced Formulation materials in the order specified.

5.1 Liquid Addition (Step 1)

Before placing any dry material in the mixing tank, the tank must be filled with the appropriate amount of liquid (water or leachate). See chart on page 11. If your hydroseeding unit has a reserve water tank, fill at this time with clean water. It is not recommended to use leachate as the clean out water.

All bags of material (Posi-Pak Type P-100, PSM-200 Setting Agent, Portland cement) can be loaded through the side rails of hydroseeding unit onto mixing deck from the ground. Ensure that they do not obstruct the ladder area. Never attempt to carry up or down ladders. To avoid back injuries, always use proper lifting practices when handling bags. Wet or frozen materials should not be used.

5.2 Posi-Pak Addition (Step 2)

With mixer paddles of hydroseeding unit turning slowly open the Posi-Pak, Type P-100 bag and dump contents into inlet hopper (discard bag). Posi-Paks are designed such that the plastic covering may be torn away with the bare hands. If a knife is used take care not to drop into mixing tank. See chart on page 11 for Posi-Pak, Type P-100 quantities.

5.3 Optional Dye (Step 3)

Various dyes are available for Posi-Shell Advanced Formulation to alter the color of the finished product to best suit the application. Most commonly used are brown and green. Brown and green dye is available in powder form and comes in dissolvable "Mix Ready" bags which can be placed directly in the mixing tank. Green is also available in liquid form that can be poured in the tank.

Powdered Dye

Liquid Dye

5.4 PSM-200 Setting Agent (Step 4)

When handling PSM-200 Setting Agent or Portland cement a dust mask is recommended to prevent inhalation, and coveralls and gloves to prevent skin contact. Safety glasses should be worn to keep dust from entering the eyes. Should eyes or skin come in physical contact any Posi-Shell AF ingredients thoroughly rinse with water.

With mixer paddles running at medium speed add PSM-200 Setting Agent material by cutting open bag and dumping contents into the mixing tank (discard bag). See chart on page 14 for quantities. Allow PSM-200 Setting Agent and Posi-Pak to mix at medium speed for about 5 minutes until a gravy-like consistency is achieved and no clumps are visible (see photo below at left).

5.5 Optional Portland Cement Addition (Step 5)

With mixer paddles still running at medium speed add Type I Portland cement material **(regular Portland cement, NOT concrete.)** by cutting open bag and dumping contents into the mixing tank (discard bag). See chart on page 11 for quantities. Posi-Shell AF material is now ready to be applied (see photo below at right).

After Adding PSM-200 Setting Agent

After Adding Portland Cement

6.0 Transporting

Close inlet hopper lid prior to transportation and leave mixer paddles turning at medium speed.

6.1 Cold Weather Transport

To prevent freezing during extremely cold weather (below 20°F), with discharge gun attached to recirculation fitting, run pump in low-speed forward to circulate slurry from mixing tank, through pumping and discharge system, and back to mixing tank.

6.2 Traversing Slopes

The proper procedure for traversing slopes is to approach the slope with machine parallel with fall line of slope. Machine should always be backed down the slope and towed up. Following this procedure eliminates any possibility of the machine "jack-knifing" around the towing unit.

7.0 Application of Posi-Shell AF

Conventional end-of-day waste surface preparation and grooming are normally adequate prior to Posi-Shell AF application. A smoother surface will require less slurry due to reduced surface area. Also, the functional performance of the coating is enhanced by a smoother receiving surface. Therefore, it may be desirable to spread available materials such as sludge, ash, or processed wastes at the end of the day to function as surface leveling agents to economize on Posi-Shell AF slurry consumption. Each gallon of slurry will coat approximately 4 to 10 square feet depending on surface roughness and application thickness.

Methods of application and the desired appearance of daily coatings are shown on the photographs which follow. In general, the operator should position the Applicator upwind, and should select the spray nozzle appropriate to the distance from the waste pile. A uniform coating of approximately one-quarter-inch thickness will normally accomplish the daily cover functional criteria. In some cases, it will be necessary to spray a given area from two directions to compensate for "spray shadow" effects or wind dispersion.

The most effective method of coverage will vary with each site, but generally, spraying the working face from the bottom of the waste slope, toward the top, is most effective. A minimal amount of "shadowing" occurs if applied in this manner.

Application of Posi-Shell AF cover is not typically affected by weather conditions. Normal operations can be performed during windy, rainy, or cold weather conditions. During cold weather periods, the hydroseeding unit tank and pump must be drained at the end of the day to avoid freezing. It is desirable, but not necessary, to bring the machinery into a building for overnight storage. The application process is typically not affected by severe cold weather.

When high winds are encountered, it may be necessary to position the hydroseeding unit in an upwind position. Since the hydroseeding unit pumps emit a high pressure stream of slurry, it is not generally affected by light winds; however, wind direction should always be considered with respect to airborne dispersion of overspray.

During light rains, Posi-Shell AF will not wash away and will retain its stucco consistency. However, during extremely heavy rains, some washing of the material may occur prior to its curing. During extremely cold weather, Posi-Shell AF will freeze before curing. After a thaw the material will cure. Cured Posi-Shell AF material typically can retain integrity up to one year or longer depending upon its initial application thickness.

Application of Posi-Shell AF via
Deck -Mounted Discharge Wand

Application of Posi-Shell AF via
Extension Hose

Daily and Intermediate Cover

Close-Up View of Cured Posi-Shell AF Coating

7.1 Odor Control

The Posi-Shell AF formulation has an inherent capability to suppress odors. By applying the material as a daily cover, typical landfill odors will be reduced by the thick layer of Posi-Shell that is applied. Additionally, if Portland Cement is used the calcium oxide (lime) applied to putrid waste further suppresses odors by sealing the outer face of the waste with an alkaline surface layer.

Posi-Shell AF allows an opportunity for the optional addition of approved odor-masking agents where excessive odors warrant such action.

7.2 Vector Control

Application of Posi-Shell AF to the working face of waste piles is an extremely effective vector deterrent. Shortly after the Posi-Shell AF coating is applied, temperatures within the waste pile will increase due to initial aerobic and subsequent anaerobic decomposition. The Posi-Shell AF layer forms a seal that inhibits flies from laying additional larvae.

Other vectors such as rodents and birds are discouraged by the Posi-Shell AF seal. Posi-Shell AF cover has proven effective in inhibiting the attraction of vectors to waste piles.

7.3 Scavenging

General animal scavenging is reduced since the Posi-Shell Cover System AF seals in odors and hides the visible food source beneath the covering shell. Scavenging by humans is inhibited by the complete visual coverage of the waste pile and by the viscid coating of slurry applied upon all available surface objects.

7.4 Litter Control

Posi-Shell AF cover is highly effective for litter control. Due to the sticky consistency of the material, a shell is formed over the garbage which prevents litter from being blown away by high winds. A thin layer of Posi-Shell AF cover is recommended for preventing litter generation.

In extremely windy situations, Posi-Shell AF coating can be applied to waste as it is being unloaded from garbage trucks. This technique has been proven highly effective.

7.5 Fire Control

Posi-Shell AF cover is an extremely effective fire control material. Independent laboratory testing of Posi-Shell AF by D-4982 method has certified that Posi-Shell AF is non-fuel contributing, non-smoke producing, and non-combustible. When an acetylene torch is applied directly to the Posi-Shell AF cover, ignition of the Posi-Shell AF cover or underlying waste does not occur.

In addition to the non-flammable characteristic of Posi-Shell AF cover, your hydroseeding unit can be used to fight landfill fires. Direct application of Posi-Shell AF material to an open flame will smother it. If a subterranean landfill fire occurs, Posi-Shell AF coating can be applied to the waste pile's surface and will form a fire smothering seal.

7.6 Additional Applications

Posi-Shell AF cover fulfills the relevant performance criteria for various additional applications including erosion control, ditch lining, coating of sludge piles, contaminated soil piles, compost piles and temporary waste piles and excavations of various types. If has been successfully applied to coal piles, salt piles, cement clinker piles and used at remediation sites to suppress volatile emissions. Posi-Shell AF may also be used as the tackifier in hydroseeding mixtures.

Ditch Lining

Finished Appearance of Posi-Shell AF Intermediate and Daily Cover at a Major Municipal Landfill

Erosion Control

Odor Control

Posi-Shell Cover System AF
Application Minimum Requirements

	SHORT TERM COVER OVERNIGHT COVER	MEDIUM TERM COVER INTERMEDIATE COVER, EROSION CONTROL, ODOR CONTROL, ETC.	LONG TERM COVER EROSION CONTROL, COMPOST COVER, STOCKPILE COVER, ETC.
SLURRY MIXTURE	See chart below.	See chart below. Additional Portland cement may be necessary.	See chart below. Additional Portland cement may be necessary.
APPLICATION RATE	Approx. 8-10 sq.ft./gal.	Approx. 6-8 sq.ft./gal.	Approx. 4-6 sq.ft./gal.
COVERAGE METHOD	Apply from two directions to eliminate spray shadow.	Apply from two directions to eliminate spray shadow.	Apply from two directions to eliminate spray shadow. For slope coverage extend cover 3-4 feet beyond crest of slope.
COVERAGE THICKNESS	Finished cover should be 1/8-3/16 inch.	Finished cover should be 3/16-1/4 inch.	Finished cover should be 1/4-5/16 inch.
COVERAGE APPEARANCE	No waste/soil visible from any angle.	No waste/soil visible from any angle. Cover should have a "stucco-like" texture.	No waste/soil visible from any angle. Cover should have a "stucco-like" texture.
COVERAGE MAINTENANCE	None. Waste is placed over cover next working day.	Cover should be inspected daily and touched up if waste/soil becomes visible.	Cover should be inspected daily and touched up if waste/soil becomes visible.

Posi-Shell Cover System AF Material Quantities

Materials	***Desired Load Size***			
	500 GAL	1000 GAL	1500 GAL	2000 GAL
Water or Leachate	400 gals	800 gals	1200 gals	1600 gals
Posi-Pak, Type P-100 (15 lb bags)	1 bag	2 bags	3 bags	4 bags
Optional Brown Dye (5 lb bags)	2 bags	4 bags	6 bags	8 bags
Optional Green Dye (1 qt bottles)	.5 bottle	1 bottle	1.5 bottle	2 bottles
PSM-200 Setting Agent (50 lb bags)	5 bags	10 bags	15 bags	20 bags
Optional Portland cement (94 lb bags)	10 bags	20 bags	30 bags	40 bags
Total Material Weight	5,355 lbs	10,710 lbs	16,065 lbs	21,420 lbs

7.7 Discharge Nozzle Selection

While other nozzles may be used, Landfill Service Corporation offers three types of discharge nozzles providing the capability of effectively spraying Posi-Shell AF at a variety of ranges. Experience and operator discretion will determine which nozzle to use in each situation.

Long Range
for Distances of 75ft -150ft

Medium Range
for Distances of 25ft -75ft

Short Range
for Distances of 5ft -25ft

7.8 Handling the Discharge Spray Boom

Care must be taken to use the proper discharge nozzle in order to attain the desired spray range, as being too close to the surface will cause the Posi-Shell AF stream to overturn waste on contact. At long range distances the Posi-Shell AF stream will break up, causing the desired spray effect. At ranges under 75 ft. the medium or short nozzle should be used and are designed to spray in a wide ribbon pattern.

Blockages may occur in nozzles due to foreign objects in the raw materials. Refer to Section 11.1 for procedure on removing foreign object from discharge nozzle.

With the desired nozzle securely in place, firmly grasp discharge spray handle in one hand and point discharge nozzle in desired direction of spray. With the other hand move pump control lever to full speed forward and begin covering area. For desired spray effect operator may adjust pump/throttle speed.

Never disconnect nozzles when pump is running. Never engage pump with discharge spray boom left unattended. Never put hands in front of discharge nozzles.

Do not spray at or near other persons. Spray exits nozzle at a high velocity and could cause injury.

Do not spray toward power lines, transformers or other high voltage conductors. Avoid spraying into wind. When unavoidable, be sure to keep direction of spray near to ground. Safety glasses should be worn during spraying operation.

7.9 Coverage of Large Area

Coverage of a large area will require moving the hydroseeding unit to several spray locations. Inspect the area from several perspectives to ensure that the spray has covered all areas.

7.10 Thicker Coats

Thicker coats may be applied by letting the first coat partially dry before recoating the area. Several thin applications provide a more durable shell than a single very thick application.

8.0 Cleaning

It is recommended that you clean the hydroseeding unit after each load. Due to the variety of hydroseeding units on the market a generic procedure for cleaning follows. Some steps may need to be altered to apply to your hydroseeding unit.

1. When all Posi-Shell AF is removed from mixing tank, immediately bring pump and mixer control levers to neutral position. Engine should remain at full throttle.
2. Open all inlet lids on hydroseeding unit.
3. Firmly grasp clean-off hose in one hand and turn on water.
4. With both hands on hose perform initial rinse down of all inlets and any residue visible in mixing tank. This process should take approximately one minute and use about 50-100 gallons of water depending on the size of the mixing tank.
5. Turn water off.
6. With a spray nozzle in place (to retain cam and groove gasket) run pump control lever full speed forward for 5 seconds. Return to neutral when complete. Repeat with all nozzles used during application.
7. Close all inlet lids and bring mixer control lever to full speed reverse and allow to run for at least one minute.
8. Return mixer control lever to neutral then to full speed forward for at least one minute.
9. With mixer control lever in full speed forward, climb down ladder and remove drain cap and allow initial rinse water to completely drain.
10. Replace pump drain cap.
11. Return to deck of unit and move mixer control lever to neutral and repeat steps 2-9. During this secondary rinse make sure all external surfaces are thoroughly rinsed.

A properly cleaned hydroseeding unit will remain free of any built-up product internally and externally, and all decals and labels remain clearly readable.

9.0 Winter Care

In extreme cold it is imperative that engines and hydraulic systems are thoroughly warmed before introducing a load. Refer to the operations manual for your hydroseeding unit for proper winter usage and care.

9.1 Posi-Shell AF Winterizing Procedure

1. After cleanout, drain the mixing tank thoroughly. DO NOT REPLACE DRAIN CAP.
2. If your hydroseeding unit is equipped with a reserve water tank and/or pump, drain thoroughly. DO NOT REPLACE DRAIN CAPS.
3. Pour approximately one half gallon of anti-freeze into pump or tank and slowly run through pump and lines to prevent freezing.

10.0 Materials Storage

All materials are inert, and can be stored on, or off, the boundaries of lined landfill cells.

10.1 Posi-Shell Material Storage

10.1.1 Posi-Paks

Posi-Paks should be kept dry, particularly when freezing is possible. The Gaylord boxes are water-resistant, but not waterproof. Boxes can be easily covered with a tarp or plastic to keep the Posi-Paks dry.

10.1.2 PSM-200 Setting Agent

PSM-200 Setting Agent should be kept dry. Stretch wrapped pallets can be easily covered with a tarp or plastic.

10.1.3 Optional Portland Cement & Dye

Portland Cement & dye should be kept dry. Stretch wrapped pallets can be easily covered with a tarp or plastic.

11.0 Troubleshooting (may not apply to all hydroseeding units)

11.1 Removing Foreign Object from Discharge Nozzle

1. Immediately move pump control lever to neutral position.
2. Move pump control lever to *slow speed reverse.*
3. Run pump in reverse for 5 seconds to relieve pressure in discharge line.
4. Return pump control lever to neutral position.
5. Remove nozzle and clear obstruction.
6. Reconnect nozzle and continue spraying.

11.2 Removing Foreign Object from Mixing Tank

1. Move throttle, mixer, pump, control levers to slow/neutral position.
2. Shut engine off.
3. Move hydroseeding unit to area appropriate for dumping load.
4. Remove pump cleanout plug and allow load to drain.
5. Visually inspect pump for foreign object. Remove if found, replace plug and return to operations.
6. If object is not found in pump, remove exit pipe cleanout cap.
7. Inspect this section of pump for object. Remove if found, replace cap and pump cleanout plug and return to operations.
8. If object is not found in this section, remove two pipe couplers and removable section of tank exit pipe.
9. Visually inspect flange section of pump and mixing tank (flashlight may be necessary). Remove object if found, replace removable pipe and cleanout cap, pump cleanout plug, and return to operations.
10. If object is in mixing tank use appropriate length grapple through tank exit pipe.

11.3 Clearing Clogged Mixing Tank

1. If Posi-Shell AF slurry has thickened in the mixing tank to the point that the mixer paddles will not turn, move mixer control lever to neutral. Trying to force mixer shaft back and forth at this point will only result in possible damage to the mixer shaft components. If the pump was not running, immediately connect the recirculation hose and move the pump control lever to slow speed forward (slightly above neutral). Slowly running the pump will prevent the Posi-Shell AF from setting up in the pump. If Posi-Shell AF is so thick that it is not flowing freely to pump, then the slurry must be liquefied at the mixing tank outlet to the pump in order to establish pump flow.
2. A reserve of 300-500 gallons of water should be available while mixing loads of Posi-Shell AF. In the event of a clogged mixing tank, water should immediately be introduced through the liquid inlets to the Posi-Shell AF mixture to thin the slurry and establish pump flow. By injecting water through a 2-3" diameter hose and directing the flow at the surface of the slurry it may be possible to loosen the product enough to free the mixing shaft. While trying to free the mixing shaft, gently move the mixer control lever from slow speed forward to slow speed reverse. Abrupt movements to full speed forward and full speed reverse could cause damage.
3. **Use a slurry pump and water pick hose to loosen stiffened mixture.** This can be attached on the spray tower in the same manner as a spray nozzle and used as a high-pressure, high-volume water pick which will cut the slurry away from the mixing shaft and liquefy it as it goes through the pump system. This spraying should be performed through the inlet hoppers. Excess slurry can be discharged out of the tank and new water introduced as required. Continue cutting away and liquefying with the water pick hose until mixer is free. Care should be taken as the water exits this hose at a high rate of speed. Also safety goggles and rain gear should be worn as splashing will occur. Immediately rinse any slurry off skin.
4. If the slurry will not flow through the pump, then water may be injected directly into pump drain and moved through the hydroseeding unit's pumping system and sprayed back into the mixing tank. To prevent cavitation of the pump, water must be injected at a rate equal or greater than the discharge rate. Once pump flow is established, then proceed with Step 3 above.
5. If the mixture is so hardened that the water pick will not cut it, move mixer and pump control levers to neutral and the throttle control lever to low, and shut off engine. Remove key from ignition and lock out control panel enclosure. Remove deck plates starting with right rear section. After removing all sections, thickened slurry will need to be removed from around mixing shaft using shovels and hoes. Rubber boots, goggles, gloves, and coveralls should be worn if entry into the tank is necessary. It may not be necessary to remove all of the slurry from the tank. First, simply free the mixing shaft and if the Posi-Shell AF is still soft, add water and after replacing deck plates, mix rapidly in tank to loosen and drain out the cleanout. Never allow mixed Posi-Shell AF to set in tank more than one hour.

11.4 Clearing Clogged Discharge Pipe/Hose

1. Immediately move pump control lever to neutral position. Move pump control lever to *slow speed reverse.*
2. Run pump in reverse for 10 seconds to relieve pressure in discharge line.
3. Return pump control lever to neutral position.
4. Disconnect discharge hose quick-connect from discharge elbow and allow discharge pipe and hose to drain.
5. To ensure that obstruction is not in pump and exit piping, move throttle and pump control levers to very slow speed forward for 5 seconds. If product is discharging at top of discharge elbow, obstruction is not in pump.
6. If pump and exit piping are clear, disconnect discharge hose from discharge pipe and visually inspect discharge hose for obstruction. Clear if found, reconnect hose and return to operations.
7. If discharge hose is clear, it will be necessary to snake out discharge piping.
8. When obstruction is found and cleared, reconnect discharge hose and return to operations.

11.5 Clearing Obstruction from Pump

1. Immediately move pump and throttle control levers to neutral position.
2. Shut engine off.
3. Move hydroseeding unit to area appropriate for dumping load.
4. Remove pump cleanout plug and allow load to drain.
5. Visually inspect pump for foreign object. Remove if found, replace plug and return to operations.
6. If object cannot be removed via pump cleanout, disassembly of stator will be required. See hydroseeding unit operations manual for procedure.

12.0 Contingency Soil Supply

In the event that you are unable to apply Posi-Shell AF, the landfill operator should have a three-day supply of soil for daily cover material available on-site.

MATERIAL SAFETY DATA SHEET

MATERIAL: **OSHA 29CFR 1910.1200**

POSI-PAK® TYPE P-100 **DATE OF PREPARATION:** **SEPTEMBER 2004**

SECTION I -- IDENTITY

Distributor's Name and Address:	Landfill Service Corporation 2183 Pennsylvania Avenue Apalachin, NY 13732
Emergency Telephone:	(607) 625-3050
Chemical Name and Synonyms:	
Generic Name:	Polyester Staple
Trade Name:	Posi-Pak® Type P-100

SECTION II -- HAZARDOUS INGREDIENTS

Ingredient:	Polyethylene terephthalate polymer and one or more surface finishes (organic lubricants).
CAS No.:	25038-59-9
Hazard:	No known physical or health hazards associated with this product.
Note:	Polyester Staple is a family of fiber products having similar hazard and physical property characteristics. The polymer immobilizes the constituents of the polymer system (delusterants, catalyst residues, etc.) which, therefore, present no likelihood of exposure under normal conditions of processing and handling. However, exposure to chemical substances may occur as a result of processing these fibers. Processing may release and aerosolize the residual moisture and surface finishes. Heating the fibers may volatilize the finishes or produce a chemical change. Landfill Service Corporation recommends a 3 mg/m³ 8-hour TWA exposure limit on finish mists.

SECTION III -- PHYSICAL DATA

Melting Point:	Approx. 500º F (260º C)

SECTION IV -- CHEMICAL DATA

Polyethylene terephthalate is chemically stable and resistant to attack by oils, solvents, weak acids, and weak alkalis.

SECTION V -- FIRE AND EXPLOSION HAZARD DATA

Polyester Staple will burn if exposed to flame. Decomposition products generated from molten polymer may be subject to autoignition. Combustion products will be comprised of carbon, hydrogen, and oxygen. The exact composition will depend on the conditions of combustion.

SECTION VI -- HEALTH HAZARD DATA

This product has not been fully evaluated for toxicological properties. Preliminary evaluation of chemical components used in the finish and toxicological testing of the polymer have given no indication that health problems would occur in normal handling and use.

Similar products have given no indication that health problems would occur in normal handling and use.

SECTION VII -- REACTIVITY DATA

N/A

SECTION VIII -- SPILL PROCEDURES

N/A

SECTION IX -- EXPOSURES OF CONCERN

Inhalation of finish mist above the recommended 3 mg/m³ 8-hour TWA would be an exposure of concern.

SECTION X -- HANDLING AND USE PRECAUTIONS

Personal hygiene measures, such as washing hands and face immediately after working with the fibers and before eating, smoking, or using lavatory facilities, are recommended.

SECTION XI -- INDUSTRIAL HYGIENE CONTROL MEASURES

Adequate ventilation is recommended to maintain finish mist levels below 3 mg/m³ 8-hour TWA and minimize exposure.

Fire fighters should protect themselves from decomposition and combustion products that may include carbon monoxide and other toxic gases.

SECTION XII -- SPECIAL PRECAUTIONS

N/A

SECTION XIII -- DISPOSAL AND SHIPPING INFORMATION

These products are not classified as hazardous wastes under the Resource Conservation and Recovery Act, and unless prohibited by state or local regulation, can be disposed of in a municipal landfill or incinerated. Any finish oils contained in plant wastewater should be biodegradable in conventional biological wastewater treatment systems.

These fibers are not classified by the Department of Transportation as a hazardous material.

N/A = Not Applicable. **N/D = Not Determined

All information presented herein is believed to be accurate; however, it is the user's responsibility to determine in advance of need that the information is current and suitable for their circumstances.
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MATERIAL SAFETY DATA SHEET

MATERIAL:		**OSHA 29CFR 1910.1200**
EARTHTONE DYE	**DATE OF PREPARATION:**	**SEPTEMBER 1997**

SECTION I -- IDENTITY

Distributor's Name and Address:	Landfill Service Corporation 2183 Pennsylvania Avenue Apalachin, NY 13732
Emergency Telephone:	(607) 625-3050
Chemical Name and Synonyms:	Brown ferrous oxide
Generic Name:	Earthtone Coloring Agent
Trade Name:	Earthtone Dye

SECTION II -- HAZARDOUS INGREDIENTS

N/A

SECTION III -- PHYSICAL DATA

Boiling Point (ºF):	N/A
Vapor Pressure (mm. Hg):	N/A
Vapor Density (Air=1):	N/A
Solubility in Water:	Slight (0.1 - 1.0%)

Specific Gravity (H2O=1):	4.4 - 4.8
Evaporation Rate:	N/A
Appearance and Odor:	Brown, odorless dry powder

SECTION IV -- CHEMICAL DATA

Chemical Family:	Metal oxide
Formula:	Fe2O3; Balance MnO2 and silicates
Product Class:	CAS# 1317-61-9, 51274-00-1, 1309-37-1
Bulk Density:	0.5 - 0.8 g/ml

SECTION V -- FIRE AND EXPLOSION HAZARD DATA

Nonexplosive; Nonflammable

SECTION VI -- HEALTH HAZARD DATA

Threshold Limit Value:	N/D
Effects of Overexposure:	None observed.
Emergency and First Aid Procedures:	Irrigate eyes with water, consult eye physician. Wash exposed skin areas with soap and water.

SECTION VII -- REACTIVITY DATA

Stability:	Product is stable.
Hazardous Polymerization:	Will not occur.
Incompatibility:	None known.
Hazardous Decomposition Products:	None known.

SECTION VIII -- SPILL PROCEDURES

Steps to be Taken if Material is Released or Spilled:	Handle as normal solid waste. Minimum fugitive dust release.

SECTION IX -- EXPOSURES OF CONCERN

N/A

SECTION X -- HANDLING AND USE PRECAUTIONS

Store dry at ambient temperature away from food and drink.

SECTION XI -- INDUSTRIAL HYGIENE CONTROL MEASURES

Ventilation Requirements:	Local exhaust may be used.
Respiratory Protection:	A NIOSH approved respirator is recommended during mixing procedure.
Eye Protection:	Use of safety glasses is recommended.
Skin Protection:	Wear leather, plastic, or cloth gloves.

SECTION XII -- SPECIAL PRECAUTIONS

N/A

SECTION XIII -- DISPOSAL AND SHIPPING INFORMATION

Shipping Name:	Earthtone Dye is not hazardous under US Dept. of Transportation (DOT) regulations.
Hazardous Substance:	N/A
Hazard Class:	N/A
Caution Labeling:	N/A

Identification Number:	N/A
Disposal Method:	Dispose at approved facility.

N/A = Not Applicable. **N/D = Not Determined

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MATERIAL SAFETY DATA SHEET

MATERIAL:

GREEN DYE **DATE OF PREPARATION: JUNE 2002**

SECTION I -- IDENTITY

Distributor's Name and Address:	Landfill Service Corporation 2183 Pennsylvania Avenue Apalachin, NY 13732
Emergency Telephone:	(607) 625-3050
Chemical Name and Synonyms:	Organic Colorants
Generic Name:	Color Additive
Trade Name:	Blue Vail

SECTION II -- HAZARDOUS INGREDIENTS

N/A

SECTION III -- PHYSICAL DATA

Boiling Point (ºF):	212°F
Vapor Pressure (mm. Hg):	20
Vapor Density (Air=1):	ND
Solubility in Water:	Soluble

Specific Gravity (H2O=1):	1.2
Evaporation Rate:	<1
Appearance and Odor:	Dark blue colored solution with bland odor.

SECTION IV -- FIRE AND EXPLOSION HAZARD DATA

Nonexplosive; Nonflammable

SECTION V -- HEALTH HAZARD DATA

Permissable concentrations (air):	N/A
Effects of Overexposure:	ND
Emergency and First Aid Procedures:	Irrigate eyes with water, consult eye physician. Wash exposed skin areas with soap and water.

SECTION VI -- REACTIVITY DATA

Stability:	Under normal storage and handling conditions; this is a stable material when kept in a closed container.
Hazardous Polymerization:	Will not occur.
Incompatibility:	None known.
Hazardous Decomposition Products:	None known.

SECTION VII -- SPILL PROCEDURES

Steps to be Taken if Material is Released or Spilled:	If dry, shovel vacuum or sweep color up for disposal. Wet surfaces may become slippery or sticky. Mop, sweep, or absorb, and hold for disposal. Spills should be thoroughly flushed with soapy water until all apparent color is removed.

SECTION IX -- EXPOSURES OF CONCERN

N/A

SECTION X -- HANDLING AND USE PRECAUTIONS

Keep away from children. Store in tightly stored container.

SECTION XI -- INDUSTRIAL HYGIENE CONTROL MEASURES

Respiratory Protection:	No respiratory protection required, but dust masks are suggested.
Eye Protection:	Use of safety glasses is recommended.
Skin Protection:	Non required. To minimize clean-up, wear gloves when handling materil. Some dyes may temporarily stain skin.

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MATERIAL SAFETY DATA SHEET

MATERIAL: **OSHA 29CFR 1910.1200**

PSM 200 SETTING AGENT **DATE OF PREPARATION:** **JUNE 2005**

SECTION I -- IDENTITY

Distributor's Name and Address:	Landfill Service Corporation 2183 Pennsylvania Avenue Apalachin, NY 13732
Emergency Telephone:	(607) 625-3050
Chemical Name and Synonyms:	Sodium Montmorillonite Clay (SMC) (CAS No. 1318-93-0)
Generic Name:	SMC with proprietary additives (CAS No. 1318-93-0)
Trade Name:	Posi-Shell® PSM 200 Setting Agent

SECTION II -- HAZARDOUS INGREDIENTS

Ingredient:	Crystalline Silica (SiOz) as Quartz
CAS No.:	14808-60-7
Hazard:	Low concentrations of crystalline silica in the form of quartz may be present in airborne SMC dust. See Section VI for discussion of health hazard.
Note:	Although the typical quartz content of western SMC is in the range of 2 to 6% most of the quartz particles are larger than the 10µ respirable threshold size. The actual respirable quartz concentration in airborne SMC dust will depend upon SMC source, fineness of product, moisture content of product, local humidity and wind condition at point of use and other use specific factors.

SECTION III -- PHYSICAL DATA

Boiling Point (ºF):	N/A
Vapor Pressure (mm. Hg):	N/A
Vapor Density (Air=1):	N/A
Solubility in Water:	Insoluble, forms colloidal suspension
Density (at 20º C):	55 lbs/cu ft as product
Specific Gravity (H2O=1):	2.45-2.55
Melting Point:	Approx. 1450º C
Evaporation Rate (Butyl Acetate=1):	N/A
pH:	8-10 (5% aqueous suspension)

SECTION IV -- CHEMICAL DATA

N/A

SECTION V -- FIRE AND EXPLOSION HAZARD DATA

Flash Point:	N/A
Special Fire Fighting Procedures:	N/A
Unusual Fire and Explosion Hazards:	None. Product will not support combustion.
Extinguishing Media:	None for product. Any media can be used for the packaging. Product becomes slippery when wet.
Flammable Limits:	LEL: N/A UEL: N/A

SECTION VI -- HEALTH HAZARD DATA

Routes of Exposure and Effects:

Skin:	Possible drying resulting in dermatitis.
Eyes:	Mechanical irritant.
Inhalation:	*Acute (short term) exposure to dust levels exceeding the PEL may cause irritation of respiratory tract resulting in a dry cough.* *Chronic (long term) exposure to airborne SMC dust containing respirable size (=10µ) quartz particles, where respirable quartz particle levels are higher than TLVs, may lead to development of silicosis or other respiratory prolems. Persistent dry cough and labored breathing upon exertion may be symptomatic.*
Ingestion:	No adverse effects.

Permissible Exposure Limits:
(for air contaminants)

	OSHA PEL (8 HR. TWA)	ACGIH TLV
SMC as "Particulates not otherwise regulated" (formerly nuisance dust)		
Total dust	15mg/m³	N/D
Respirable dust	5mg/m³	N/D
Crystalline Quartz (respirable)	0.1mg/m³	0.1mg/m³

Carcinogenicity: SMC is not listed by ACGIH, IARC, NTP, or OSHA. IARC, 1997, concludes that there is sufficient evidence in humans for the carcinogenicity of inhaled crystalline silica from occupational sources (IARC Class 1), that carcinogenicity was not detected in all industrial circumstances studied and that carcinogenicity may depend on characteristics of the crystalline silica or on external factors affecting its biological activity. NTP classifies respirable crystalline silica as "known to be a human carcinogen" (NTP 9th Report on Carcinogens - 2000). ACGIH classifies crystalline silica quartz as a suspected human carcinogen (A2).

Acute Oral LD50:	N/D
Acute Dermal LD50:	N/D
Aquatic Toxicology LC50:	N/D

Emergency and First Aid Procedures:

Skin:	Wash with soap and water until clean.
Eyes:	Flush with water until irritation ceases.
Inhalation:	Move to area free from dust. If symptoms of irritation persist, contact physician. Inhalation may aggravate existing respiratory illness.

SECTION VII -- REACTIVITY DATA

Stability:	Stable
Hazardous Polymerization:	None
Incompatibility:	None
Hazardous Decomposition Products:	None

SECTION VIII -- SPILL PROCEDURES

Steps to be Taken if Material is Released or Spilled:	Avoid breathing dust; wear respirator approved for silica bearing dust. Vacuum up to avoid generating airborne dust. Avoid using water. Product slippery when wetted.

SECTION IX -- EXPOSURES OF CONCERN

N/A

SECTION X -- HANDLING AND USE PRECAUTIONS

Waste Disposal Methods:	Product should be disposed of in acordance with applicable local, state, and federal regulations.
Handling and Storage Precautions:	Use NIOSH/MSHA respirators approved for silica bearing dust when free silica containing airborne SMC dust levels exceed PEL/TLVs. Clean up spills promptly to avoid making dust. Storage area floors may become slippery if wetted.

SECTION XI -- INDUSTRIAL HYGIENE CONTROL MEASURES

Ventilation Requirements:	Mechanical, general room ventilation. Use local ventilation to maintain PELs/TLVs.
Respirator:	Use respirators approved by NIOSH/MSHA for silica bearing dust.
Eye Protection:	Generally not necessary. Personal preference.
Gloves:	Generally not necessary. Personal preference.
Other Protective Clothing or Equipment:	None.

ECTION XII -- SPECIAL PRECAUTIONS

Avoid prolonged inhalation of airborne dust.

SECTION XIII -- DISPOSAL AND SHIPPING INFORMATION

Shipping Name:	N/A (Not Regulated)
Hazardous Substance:	N/A
Hazard Class:	N/A
Caution Labeling:	N/A

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MATERIAL SAFETY DATA SHEET

MATERIAL: **OSHA 29CFR 1910.1200**

PORTLAND CEMENT **DATE OF PREPARATION:** **MARCH 2006**

SECTION I -- IDENTITY

Distributor's Name and Address:	Landfill Service Corporation 2183 Pennsylvania Avenue Apalachin, NY 13732
Emergency Telephone:	(607) 625-3050
Chemical Name and Synonyms:	Portland Cement
Generic Name:	Also known as hydraulic cement
Trade Name:	Portland Cement Type I, IA, II III, V

SECTION II -- HAZARDOUS INGREDIENTS

Component (percentage)	CAS No.	OSHA PEL (8-hour TWA)	ACGIH TLV-TWA (2002)
Tri-calcium silicate (20-70)	12168-85-3	see Nuisance Dust PEL	see Nuisance Dust TLV
Di-calcium silicate (10-60)	10034-77-2	see Nuisance Dust PEL	see Nuisance Dust TLV
Tetra-calcium-alumino-ferrite (5-15)	12068-35-8	see Nuisance Dust PEL	see Nuisance Dust TLV
Calcium sulfate (2-10)	N/D	see Nuisance Dust PEL	see Nuisance Dust TLV
Tri-calcium Aluminate (1-15)	12042-78-3	see Nuisance Dust PEL	see Nuisance Dust TLV
Magnesium oxide (0-4)	1309-48-4	see Nuisance Dust PEL	see Nuisance Dust TLV
Nuisance Dusts	N/D	15 mg/m³ (total dust) 5 mg/m³ (respirable dust)	10 mg/m³ (total dust) 3 mg/m³ (respirable dust)
Crystalline Silica (Quartz)* (0-1)	14808-60-7	10mg/m³ /percent silica + 2 (respirable dust) 30 mg total dust/m³/percent silica + 2 (total dust)	0.10 mg/m³
Hexavalent Chromium (measured as chromic acid and chromates)	18540-29-9	(100 mg/m³)	N/D

***Trace Constituents:** Portland cement has a variable composition depending upon the cementitious products produced in the cement kiln. Small amounts of naturally occurring, but potentially harmful, chemical compounds might be detected during chemical analysis. These trace compounds might include free crystalline silica, potassium, and sodium compounds; heavy metals, including cadmium, chromium, nickel, and lead; and organic compounds. Other trace constituents may include calcium oxide (also known as free lime or quick lime).*

SECTION III -- PHYSICAL DATA

Boiling Point (ºF) (Aqueous Portion):	N/A
Vapor Pressure (mm. Hg):	N/A
Vapor Density (Air=1):	N/A
Solubility in Water:	Slight (0.1-1.0%)
pH (in water):	12-13
Specific Gravity (H2O=1):	2.9-3.15
Evaporation Rate:	N/A
Appearance and Odor:	Gray or white powder, no distinct odor

SECTION IV -- CHEMICAL DATA

N/A

SECTION V -- FIRE AND EXPLOSION HAZARD DATA

Portland cement is non-combustible and not explosive.
Special firefighting procedures are not applicable. (Although Portland cement poses no fire-related hazards, a self-contained breathing apparatus is recommended to limit exposure to combustion products when fighting any fire.)

SECTION VI -- HEALTH HAZARD DATA

Threshold Limit Value: N/A

Effects of Overexposure:

Acute: Wet cement on unprotected skin, whether direct or through saturated clothing, can cause severe, third-degree caustic burns.
NOTE: Portland cement burns skin with little warning; discomfort or pain cannot be relied upon to alert a person to a hazardous skin exposure. The severity of the burn may not be detected until several hours after the damage begins.
Dry Portland cement can produce mild irritation to severe burns of the eye; it can irritate the upper respiratory system.

Chronic: Dry Portland cement can cause inflammation of the lining of the nose and the cornea. Repeated exposure to Portland cement may result in drying of the skin and may lead to thickening, cracking, or fissuring, of the skin. Hypersensitive individuals may develop an allergic dermatitis (possibly due to trace amounts of hexavalent chromium at less than 0.005%). This reaction may appear in several forms including a mild rash to severe skin ulcers. Persons already sensitized may react to their first contact with the product. Other persons may experience this effect after years of exposure to Portland cement products.
While Portland cement typically has less than 0.2% crystalline silica, other additives to Portland cement and those components (e.g. aggregates) added to produce Portland cement concrete may significantly increase the amount of crystalline silica that is present. Exposure to respirable crystalline silica without the use of a respirator can cause silicosis and may aggravate other lung conditions.

Signs and Symptoms of Exposure: Burning sensation around moist tissue areas (i.e., eyes, nose, upper respiratory system); painful burning on exposed skin that can develop with little warning. *Exposure of sufficient duration to wet Portland cement can cause serious, potentially irreversible tissue (skin or eye) destruction in the form of chemical (caustic) burns, including third-degree burns. The same kind of destruction can occur if wet or moist areas of the body are exposed for sufficient duration to dry Portland cement.*
Do not allow wet Portland cement to get inside boots, shoes, or gloves, and do not allow wet, saturated clothing to remain against the skin.

Emergency and First Aid Procedures:	● Irrigate eyes immediately and repeatedly with large amount of clean water for at least 15 minutes and get prompt medical attention. ● Wash exposed skin areas with pH-neutral soap and clean water. ● Apply sterile dressings; seek medical treatment in all cases of prolonged exposure to wet Portland cement, Portland cement mixtures, liquids from fresh Portland cement products, or prolonged wet skin exposure to dry Portland cement. ● If ingested, consult a physician immediately. ● Do not induce vomiting. If conscious, have the victim drink plenty of water and call a physician immediately. ● In the event of inhalation, remove to fresh air. ● Seek medical attention if coughing and other symptoms do not subside. ● Inhalation of gross amounts of Portland cement requires immediate medical attention.

SECTION VII -- REACTIVITY DATA

Stability:	Product is stable. Keep dry until used.
Hazardous Polymerization:	Will not occur.
Incompatibility:	Aluminum powder and other alkali and alkaline earth elements will react in wet mortar or concrete, liberating hydrogen gas. Portland cement is highly alkaline and will react with acids to produce a violent, heat-generating reaction. Toxic gases or vapors may be given off, depending on the acid involved.
Hazardous Decomposition Products:	None known.

SECTION VIII -- SPILL PROCEDURES

Steps to be Taken if Material is Released or Spilled:	Use dry cleanup methods that do not disperse the dust into the air. Avoid breathing the dust. Emergency procedures are not required.

SECTION IX -- EXPOSURES OF CONCERN

Medical Conditions Generally Aggravated by Exposure:	Pre-existing skin conditions may be worsened. Silicosis may aggravate other chronic pulmonary conditions and may increase the risk of pulmonary tuberculosis infection.

Chemical Listed as Carcinogenic or Potential Carcinogen:	Portland cements are not considered carcinogenic. However, the International Agency for Research on Cancer (IARC) has determined, primarily through animal studies, that silica is a known human carcinogen. The National Toxicology Program (NTP) has characterized respirable quartz silica as reasonably anticipated to be a carcinogen. OSHA does not regulate silica as a carcinogen.

SECTION X -- HANDLING AND USE PRECAUTIONS

Portland cement should only be used by knowledgeable persons. While the information provided in the material safety data sheet is believed to provide a useful summary of the hazards of Portland cement, as it is commonly used, the sheet cannot anticipate and provide all of the information that might be needed in every situation. Inexperienced product users should obtain proper training before using this product.

A key to using the product safely requires the user to recognize that Portland cement chemically reacts with water, and that some of the intermediate products of this reaction (that is, those present while a Portland cement product is "setting") pose a more severe hazard than does Portland cement itself. These hazards include potential injuries to eyes and skin.

The data furnished in this sheet do not address hazards that may be posed by other materials mixed with Portland cement to produce Portland cement products. Users should review other relevant material safety data sheets before working with this Portland cement or with Portland cement products, including, for example, Portland cement concrete.

SECTION XI -- INDUSTRIAL HYGIENE CONTROL MEASURES

Ventilation Requirements:	Local exhaust can be used to control airborne dust levels.
Respiratory Protection:	Avoid actions that cause dust to become airborne. Use local or general ventilation to control exposures below applicable exposure limits. Use NIOSH/MSHA-approved (under 30 CFR 11) or NIOSH-approved (under 42 CFR 84) respirators in poorly ventilated areas, or if an applicable exposure limit is exceeded, or when dust causes discomfort or irritation. *(Advisory: Respirators and filters purchased after July 10, 1998, must be certified under 42 CFR 84.)*
Eye Protection:	When engaged in activities where Portland cement dust or wet Portland cement or concrete could contact the eye, wear goggles or safety glasses with side shields. In extremely dusty environments and unpredictable environments, wear unvented or indirectly vented goggles to avoid eye irritation or injury. Contact lenses should not be worn when working with Portland cement or wet Portland cement products.

Skin Protection:	Prevention is essential to avoiding potentially severe skin injury. Avoid contact with unhardened (wet) Portland cement products. If contact occurs, promptly wash affected area with soap and water. *Do Not Allow Wet Portland Cement to Get Inside Boots, Shoes, or Gloves; and Do Not Allow Wet, Saturated Clothing to Remain Against the Skin.* *Do not rely on barrier creams. Barrier creams should not be used in place of gloves. Use impervious, abrasion- and alkali-resistant gloves, boots, and protective clothing to protect the skin from prolonged contact with wet Portland cement in plastic concrete, mortar, or slurries.*

SECTION XII -- SPECIAL PRECAUTIONS

Work/Hygienic Practices:	● Periodically wash areas contacted by dry Portland cement, or by wet Portland cement, or concrete fluids with a pH neutral soap and clean, uncontaminated water. ● Wash again at the end of the work. ● If irritation occurs, immediately wash the affected area and seek treatment. ● If clothing becomes saturated with wet Portland cement or concrete, it should be removed and replaced with clean, dry clothing. ● Follow listed precautions as appropriate, during repair or maintenance work on contaminated equipment.

SECTION XIII -- DISPOSAL AND SHIPPING INFORMATION

Shipping Name:	Portland cement is not hazardous under US Dept. of Transportation (DOT) regulations.
Hazardous Substance:	N/A
Hazard Class:	N/A
Caution Labeling:	N/A
Identification Number:	N/A
Disposal Method:	Small amounts of material can be returned to the container for later use if it is not contaminated. Dispose of waste material in accordance with Federal, State, and Local requirements. Portland cement is not a hazardous waste as defined by the Resource Conservation and Recovery Act (40 CFR 261).

SECTION XIV -- OTHER REGULATORY INFORMATION

Status under USDOL--OSHA Hazard Communication Standard (29 CFR 1910.1200):

Portland cement is considered a "hazardous chemical" under this regulation and should be a part of any Hazard Communication Program.

Status under CERCLA / Superfund (40 CFR 117 and 302):

Not listed.

Status under SARA (Title III, Sections 311 and 312):

Portland cement qualifies as a "hazardous substance" with delayed health effects.

Status under SARA (Title III, Section 313):

This product may contain constituents listed under SARA (Title III, Section 313,) but not in amounts requiring supplier notification under 40 CFR Part 372 Subpart C.

Status under TSCA (as of May 1997):

Portland cement and some of the substances in Portland cement are on the TSCA inventory list.

Status under the Federal Hazardous Substances Act:

Portland cement is a "hazardous substance" subject to statutes promulgated under the subject act.

Status under California Proposition 65:

Portland cement contains chemicals (trace metals) including silica and hexavalent chromium, known to the State of California to cause cancer, birth defects or other reproductive harm. California law requires the manufacturer to give the above warning in the absence of definitive testing to prove that the defined risks do not exist.

Status under the Canadian Environmental Protection Act:

Not listed.

Workplace Hazardous Material Information System (Canada):

Portland cment is considered to be a hazardous material under the Hazardous Product Act as defined by the Controlled Products Regulations (Class E - Corrosive Material), and is therefore, subject to the labeling and MSDS requirements of the Workplace Hazardous Materials Information System (WHMIS).

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MATERIAL SAFETY DATA SHEET

MATERIAL:		**OSHA 29CFR 1910.1200**
POSI-SHELL® SYNTHETIC COVER ADVANCED FORMULATION	**DATE OF PREPARATION:**	**APRIL 2006**

SECTION I -- IDENTITY

Distributor's Name and Address:	Landfill Service Corporation 2183 Pennsylvania Avenue Apalachin, NY 13732
Emergency Telephone:	(607) 625-3050
Chemical Name and Synonyms:	Aqueous alkaline slurry
Generic Name:	N/A
Trade Name:	Posi-Shell® Synthetic Cover Advanced Formulation

SECTION II -- HAZARDOUS INGREDIENTS

N/A

SECTION III -- PHYSICAL DATA

Boiling Point (ºF) (Aqueous Portion):	212
Vapor Pressure (mm. Hg):	N/A
Vapor Density (Air=1):	N/A

Solubility in Water:	N/A
Percent Volatile by Volume (%):	N/A
Specific Gravity (H2O=1):	1.21
Evaporation Rate:	N/A
Appearance and Odor:	Brown viscid liquid slurry with a smell similar to wet Portland cement and liquid clay.

SECTION IV -- CHEMICAL DATA

Chemical family:	N/A
Formula:	The major constituents are water, Portland cement, and PSM-200 Setting Agent, a blend of sodium montmorillinite clay with synthetic polymers and a processed starch. The slurry also contains P.E.T. fibers, water (or landfill leachate), and optional iron oxide coloring agent.
Hazardous mixtures of other liquids, solids, or gases:	N/A

SECTION V -- FIRE AND EXPLOSION HAZARD DATA

Non-explosive, Non-flammable

SECTION VI -- HEALTH HAZARD DATA

Threshold Limit Value: N/A

Effects of Overexposure:

Acute:	Can dry skin and cause alkali burns. May cause eye and skin irritation to those with sensitive skin.
Chronic:	Non-observed, if properly handled. If cured material is pulverized and dispersed, fugitive dust can cause inflammation of the lining tissue of the interior of the nose and inflammation of the cornea. Hypersensitive individuals may develop an allergic dermatitis.

Emergency and First Aid Procedures: Irrigate eyes with water. Wash exposed skin areas with soap and water.

SECTION VII -- REACTIVITY DATA

Stability:	Product is stable.
Hazardous Polymerization:	Will not occur.
Incompatibility:	None known.
Hazardous Decomposition Products:	None known.

SECTION VIII -- SPILL PROCEDURES

Steps to be Taken if Material is Released or Spilled:	Handle as normal non-hazardous solid waste.

SECTION IX -- EXPOSURES OF CONCERN

N/A

SECTION X -- HANDLING AND USE PRECAUTIONS

Waste Disposal Methods:	Material can be disposed of as common waste in approved landfill.

SECTION XI -- INDUSTRIAL HYGIENE CONTROL MEASURES

Ventilation Requirements:	Local exhaust may be used.
Respiratory Protection:	A dust mask is recommended during mixing procedures.
Eye Protection:	Use of tight-fitting goggles is recommended.
Skin Protection:	Avoid skin contact with wet slurry. Wear rubber or plastic gloves.
Other Protective Clothing or Equipment:	Use barrier creams; wear coveralls; shower with soap and water.

SECTION XII -- SPECIAL PRECAUTIONS

No special precautions need to be taken in handling and storing.

SECTION XIII -- DISPOSAL AND SHIPPING INFORMATION

Shipping Name:	N/A (Not Regulated)
Hazardous Substance:	N/A
Hazard Class:	N/A
Caution Labeling:	N/A

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FLI FRIEND LABORATORY INC

32 ITHACA STREET
TELEPHONE (607) 565-3500

WAVERLY, NY 14892 - 1532
FAX (607) 565 - 4083

NY 10252 NJ 73168
PA 68180 EPA NY00033

Certificate of Analysis

Landfill Service Corp.
2183 Pennsylvania Ave
Apalachin, NY 13732
Attn: Nancy Crane

Order Number: 0607-01218
Date Reported: 7/26/2006
Date Received: 7/25/2006
Invoice Number: 32761
Customer Number: L083
Customer PO:
Certification Date: 7/26/2006

Subject:
Flamabilitiy

SMP	Analysis Performed	Result	Units	Detection Limit	Method	Analysis Information
001	**Posi-Shell Advanced Formulation**	**7/11/2006 13:00**	**Client**			
	Flamability Potential	negative			ASTM D 4982	7/25/06, 14:22, JHR

RECEIVED JUL 31 2006

Approved By: Richard Hammer, Managing Director

Key: E = estimated value
ND or U = analyte not detected
B = analyte was detected in the method or trip blank
< = less than the indicated value
ug/L = micrograms per liter (equivalent to parts per billion)
mg/L = milligrams per liter (equivalent to parts per million)
mg/Kg = milligrams per kilogram (equivalent to parts per million)

The information in this report is accurate to the best of our knowledge and ability. In no event shall our liability exceed the cost of these services. Your sample will be discarded after 14 days unless we are advised otherwise.

Adirondack Environmental Services, Inc.
Experience is the solution
314 North Pearl Street ♦ Albany, New York 12207
(800) 848-4983 ♦ (518) 434-4546 ♦ Fax (518) 434-0891

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July 13, 2006

Joel E. Lanz
Landfill Service Corporation
2183 Pennsylvania Avenue
Apalachin, NY 13732

Work Order No: 060630045

TEL: (607) 625-3050
FAX: (607) 625-2689

RE: Product testing

Dear Joel E. Lanz:

Adirondack Environmental Services, Inc received 3 samples on 6/30/2006 for the analyses presented in the following report.

There were no problems with the analyses and all associated QC met EPA or laboratory specifications, except if noted.

If you have any questions regarding these tests results, please feel free to call.

Sincerely,

ELAP#: 10709
AIHA#: 100307

Tara Daniels
Laboratory Manager

Qualifiers:		
	ND - Not Detected at the Reporting Limit	S - Spike Recovery outside accepted recovery limits
	J - Analyte detected below quanititation limits	R - RPD outside accepted recovery limits
	B - Analyte detected in the associated Method Blank	T - Tentitively Identified Compound-Estimated Conc.
	X - Value exceeds Maximum Contaminant Level	E - Value above quantitation range

Adirondack Environmental Services, Inc

Date: *13-Jul-06*

CLIENT: Landfill Service Corporation
Work Order: 060630045
Project: Product testing
PO#:

Client Sample ID: Posi-AF Petri#2
Collection Date:
Lab Sample ID: 060630045-002
Matrix: SOLID

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
TCLP ICP METALS SW6010B/1311 (Prep: SW1311 - 7/5/2006)						Analyst: **SM**
Aluminum-TCLP	< 1.0	1.0		mg/L	1	7/13/2006 1:18:00 PM
Antimony-TCLP	< 0.60	0.60		mg/L	1	7/13/2006 1:18:00 PM
Arsenic-TCLP	< 0.050	0.050		mg/L	1	7/13/2006 1:18:00 PM
Barium-TCLP	1.3	0.10		mg/L	1	7/13/2006 1:18:00 PM
Beryllium-TCLP	< 0.050	0.050		mg/L	1	7/13/2006 1:18:00 PM
Boron-TCLP	< 0.50	0.50		mg/L	1	7/13/2006 1:18:00 PM
Cadmium-TCLP	< 0.050	0.050		mg/L	1	7/13/2006 1:18:00 PM
Chromium-TCLP	0.16	0.050		mg/L	1	7/13/2006 1:18:00 PM
Cobalt-TCLP	< 0.50	0.50		mg/L	1	7/13/2006 1:18:00 PM
Copper-TCLP	< 0.050	0.050		mg/L	1	7/13/2006 1:18:00 PM
Iron-TCLP	< 0.50	0.50		mg/L	1	7/13/2006 1:18:00 PM
Lead-TCLP	< 0.050	0.050		mg/L	1	7/13/2006 1:18:00 PM
Magnesium-TCLP	< 0.50	0.50		mg/L	1	7/13/2006 1:18:00 PM
Manganese-TCLP	< 0.20	0.20		mg/L	1	7/13/2006 1:18:00 PM
Molybdenum-TCLP	< 0.10	0.10		mg/L	1	7/13/2006 1:18:00 PM
Nickel-TCLP	< 0.20	0.20		mg/L	1	7/13/2006 1:18:00 PM
Selenium-TCLP	< 0.050	0.050		mg/L	1	7/13/2006 1:18:00 PM
Silver-TCLP	< 0.10	0.10		mg/L	1	7/13/2006 1:18:00 PM
Thallium-TCLP	< 0.10	0.10		mg/L	1	7/13/2006 1:18:00 PM
Titanium-TCLP	< 0.10	0.10		mg/L	1	7/13/2006 1:18:00 PM
Vanadium-TCLP	< 0.20	0.20		mg/L	1	7/13/2006 1:18:00 PM
Zinc-TCLP	< 0.10	0.10		mg/L	1	7/13/2006 1:18:00 PM
Zirconium-TCLP	< 0.50	0.50		mg/L	1	7/13/2006 1:18:00 PM

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quanititation limits
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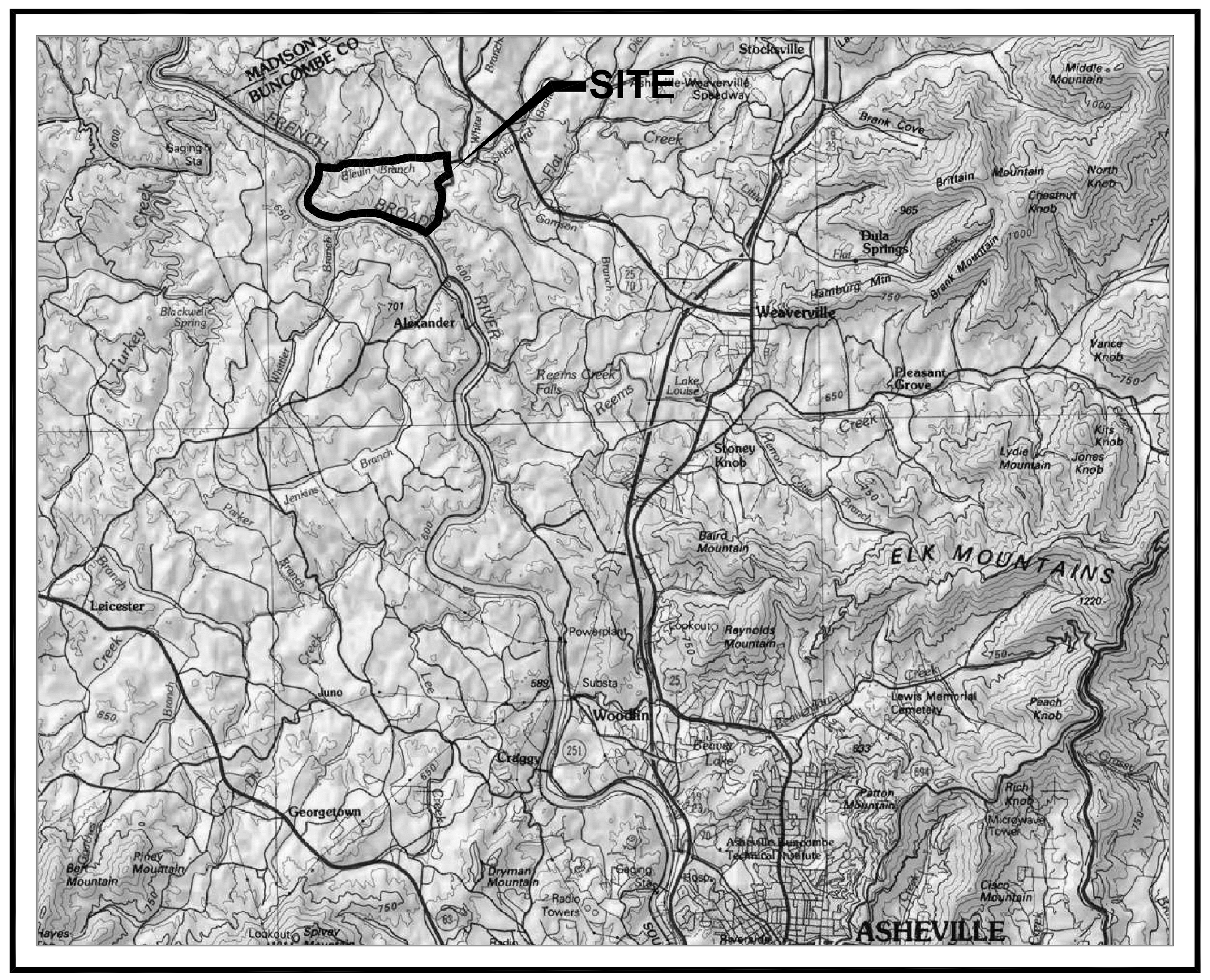
E - Value above quantitation range

Part 7
Operation Plan

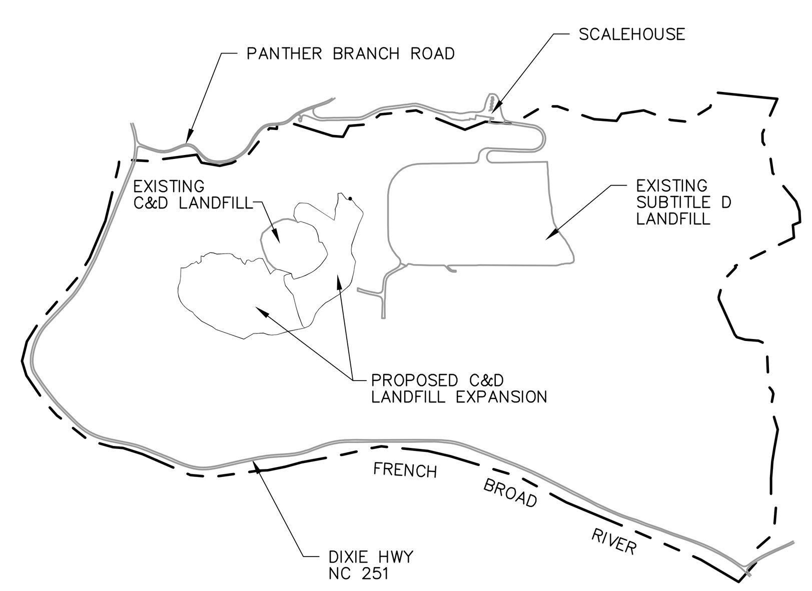
Appendix D
Operation Drawings

BUNCOMBE COUNTY
NORTH CAROLINA

BUNCOMBE COUNTY C&D LANDFILL PERMIT DRAWINGS



LOCATION MAP



VICINITY MAP

VICINITY MAP
NOT TO SCALE

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SD–2 SITE DEVELOPMENT C&D LANDFILL EXPANSION
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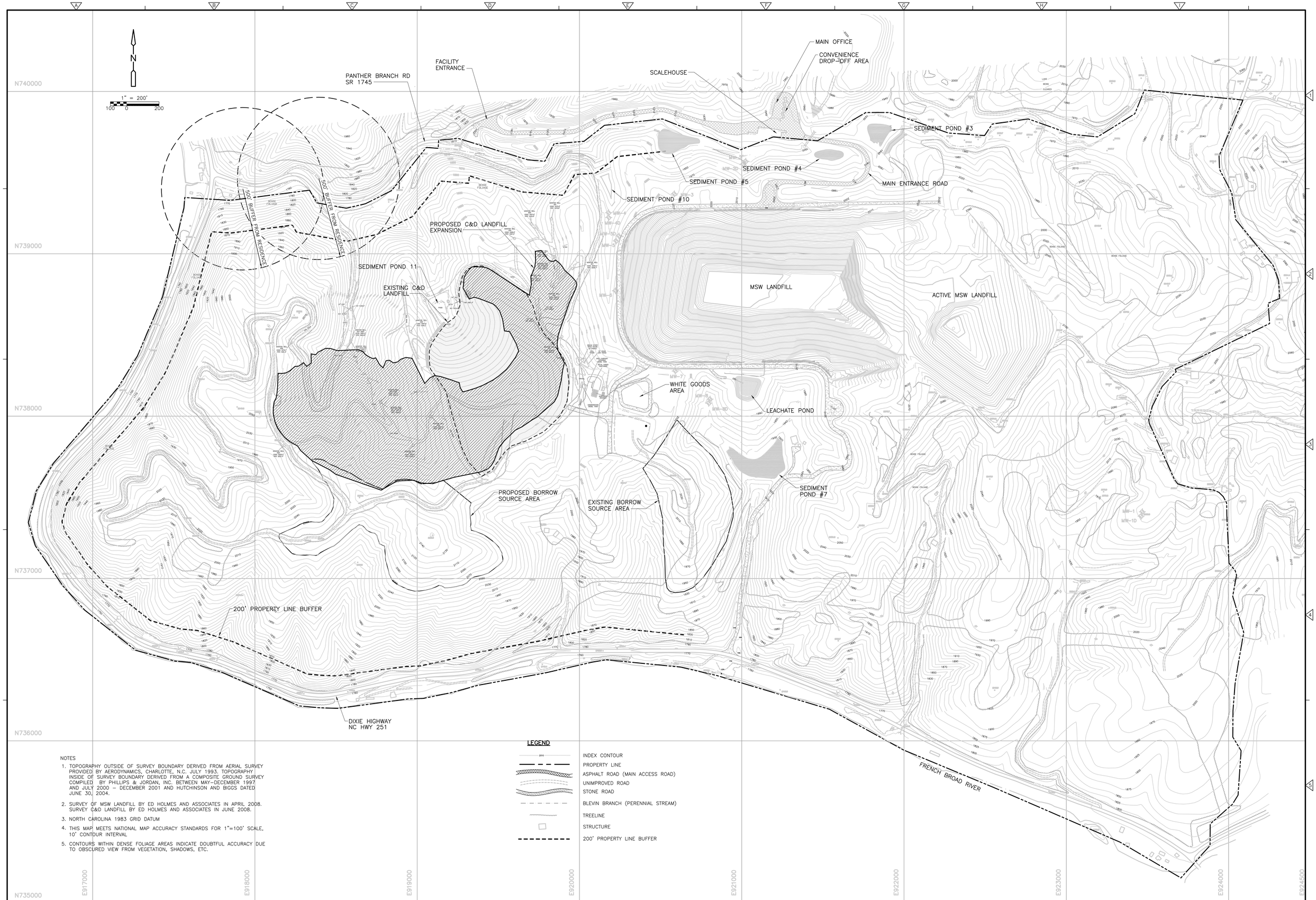
APRIL 2009

PREPARED BY

CDM Camp Dresser & McKee
consulting engineering construction operations
5400 Glenwood Avenue, Suite 300
Raleigh, North Carolina 27612
Tel: 919–787–5620 Fax: 919–781–5730

6447–65973



NOTES

1. TOPOGRAPHY OUTSIDE OF SURVEY BOUNDARY DERIVED FROM AERIAL SURVEY PROVIDED BY AERODYNAMICS, CHARLOTTE, N.C. JULY 1993. TOPOGRAPHY INSIDE OF SURVEY BOUNDARY DERIVED FROM A COMPOSITE GROUND SURVEY COMPILED BY PHILLIPS & JORDAN, INC. BETWEEN MAY–DECEMBER 1997 AND JULY 2000 – DECEMBER 2001 AND HUTCHINSON AND BIGGS DATED JUNE 30, 2004.
2. SURVEY OF MSW LANDFILL BY ED HOLMES AND ASSOCIATES IN APRIL 2008. SURVEY C&D LANDFILL BY ED HOLMES AND ASSOCIATES IN JUNE 2008.
3. NORTH CAROLINA 1983 GRID DATUM
4. THIS MAP MEETS NATIONAL MAP ACCURACY STANDARDS FOR 1"=100' SCALE, 10' CONTOUR INTERVAL
5. CONTOURS WITHIN DENSE FOLIAGE AREAS INDICATE DOUBTFUL ACCURACY DUE TO OBSCURED VIEW FROM VEGETATION, SHADOWS, ETC.

LEGEND

- INDEX CONTOUR
- PROPERTY LINE
- ASPHALT ROAD (MAIN ACCESS ROAD)
- UNIMPROVED ROAD
- STONE ROAD
- BLEVIN BRANCH (PERENNIAL STREAM)
- TREELINE
- STRUCTURE
- 200' PROPERTY LINE BUFFER

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: K. YANG
DRAWN BY: J. KILLINGSWORTH
SHEET CHK'D BY: K. YANG
CROSS CHK'D BY: C. GABEL
APPROVED BY: K. YANG
DATE: APRIL 2009

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Raleigh, North Carolina 27612
Tel: (919) 787-5620
consulting • engineering • construction • operations

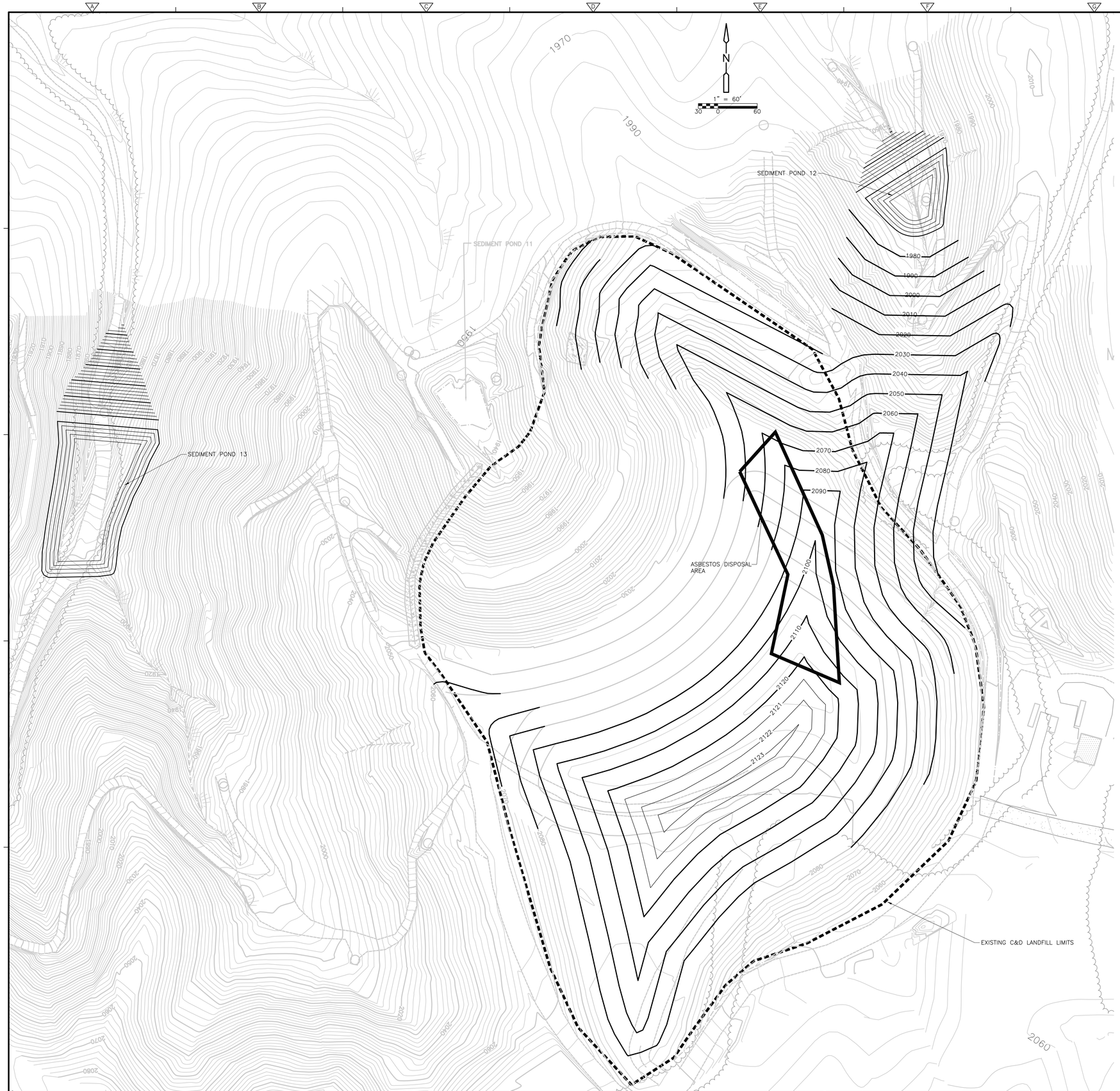
BUNCOMBE COUNTY
NORTH CAROLINA

BUNCOMBE COUNTY C&D LANDFILL
OPERATION PLAN

EXISTING CONDITIONS

PROJECT NO. 6447-65973
FILE NAME: OP-1.DWG
SHEET NO.
OP-1

NOT FOR CONSTRUCTION



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BUNCOMBE COUNTY
NORTH CAROLINA

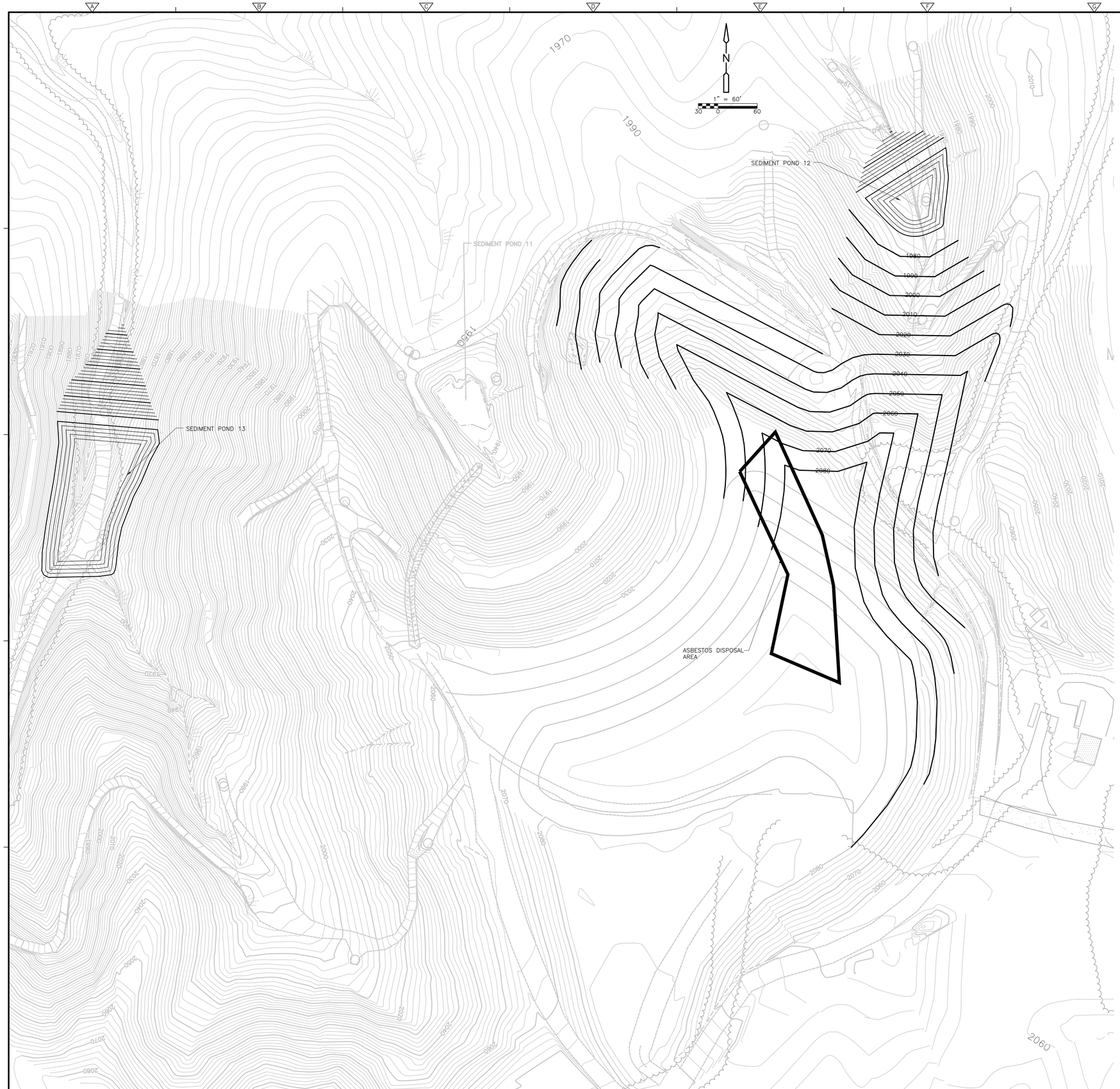
BUNCOMBE COUNTY C&D LANDFILL
OPERATION PLAN

GRADING PLAN

PROJECT NO. 6447-65973
FILE NAME: OP-2.DWG

SHEET NO.
OP-2

NOT FOR CONSTRUCTION



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BUNCOMBE COUNTY
NORTH CAROLINA

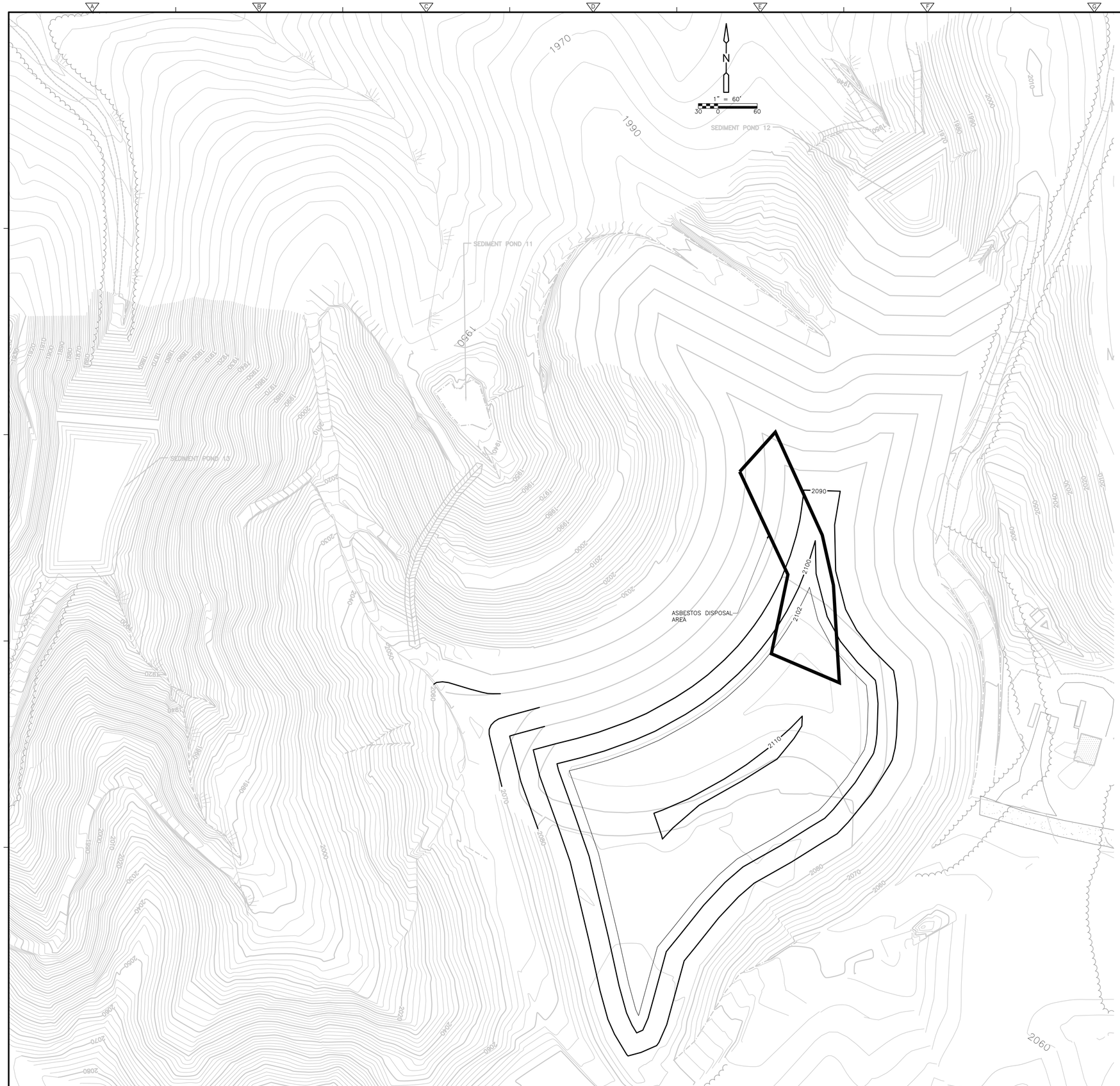
BUNCOMBE COUNTY C&D LANDFILL
OPERATION PLAN

TRANSITION CONTOURS - YEAR 1

PROJECT NO. 6447-65973
FILE NAME: OP-3.DWG

SHEET NO.
OP-3

NOT FOR CONSTRUCTION



REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: K. YANG
DRAWN BY: J. KILLINGSWORTH
SHEET CHK'D BY: K. YANG
CROSS CHK'D BY: C. GABEL
APPROVED BY: K. YANG
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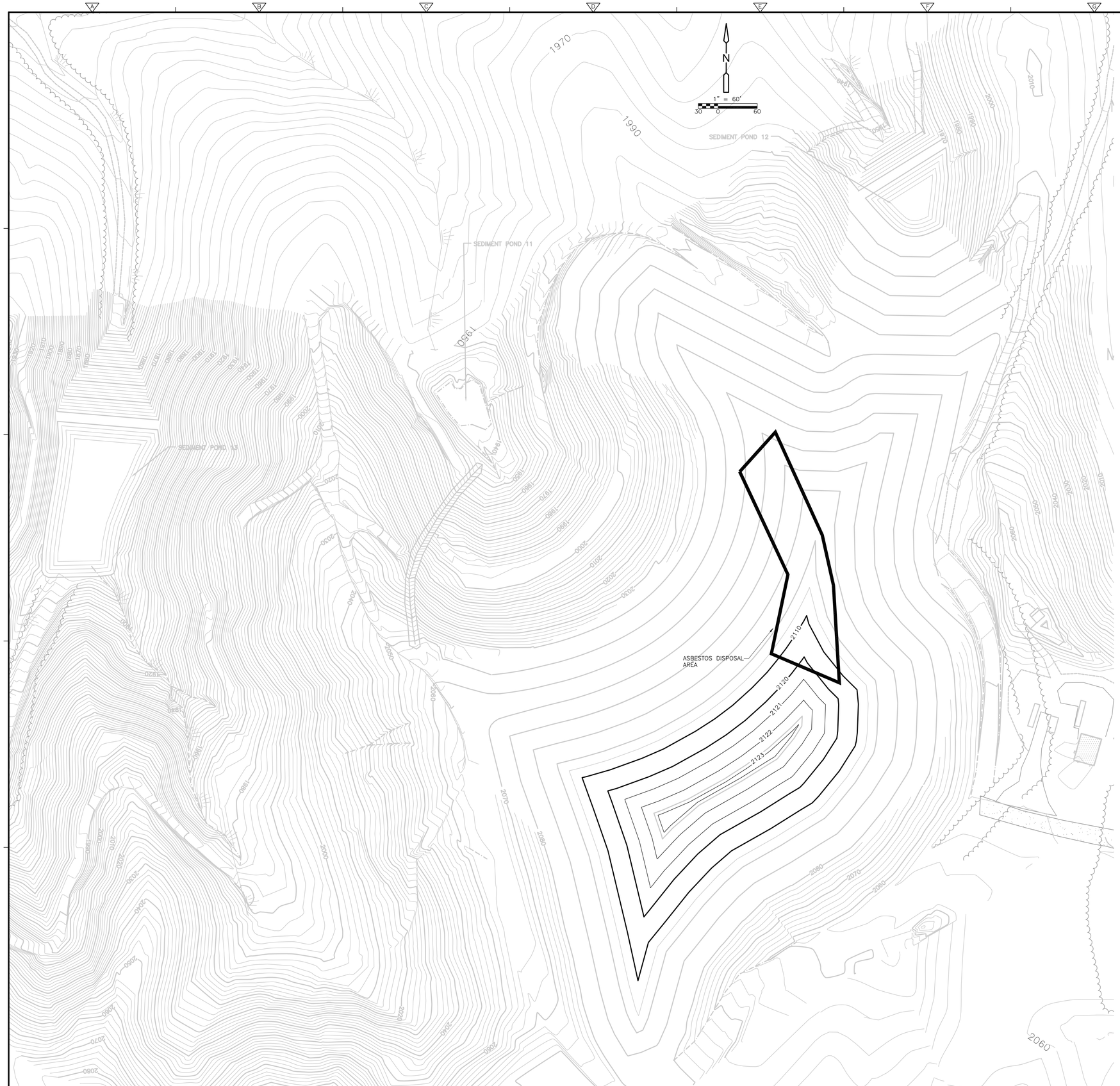
BUNCOMBE COUNTY
NORTH CAROLINA

BUNCOMBE COUNTY C&D LANDFILL
OPERATION PLAN

TRANSITION CONTOURS - YEAR 2

PROJECT NO. 6447-65973
FILE NAME: OP-4.DWG
SHEET NO.
OP-4

NOT FOR CONSTRUCTION



REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: K. YANG
DRAWN BY: J. KILLINGSWORTH
SHEET CHK'D BY: K. YANG
CROSS CHK'D BY: C. GABEL
APPROVED BY: K. YANG
DATE: APRIL 2009

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BUNCOMBE COUNTY
NORTH CAROLINA

BUNCOMBE COUNTY C&D LANDFILL
OPERATION PLAN

TRANSITION CONTOURS - FINAL CLOSURE

PROJECT NO. 6447-65973
FILE NAME: OP-5.DWG
SHEET NO.
OP-5

NOT FOR CONSTRUCTION

Buncombe County, North Carolina

Buncombe County Solid Waste Management Facility

C&D Landfill Expansion
Part 8: Closure/Post-Closure Plan

April 2009
REVISED AUGUST 2015 BY MCGILL ASSOCIATES P.A.

Closure/Post-Closure Plan
C&D Landfill
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Section 2
Closure Plan

The North Carolina Solid Waste Regulation Section Rule 15A NCAC 13B .0543(a) and (d) requires construction and demolition (C&D) landfill owners/operators to prepare a closure plan that describes the steps necessary to close a C&D landfill at any point during its active life. This closure plan includes:

- Design of the cap system and the methods and procedures to be used to install the cap;
- An estimate of the largest area of the C&D landfill requiring the specified cap system at any time during the active life;
- An estimate of the maximum inventory of wastes on-site over the active life of the C&D landfill;
- A schedule for completing all activities necessary to satisfy the closure criteria; and
- The cost estimate for closure activities.

2.1 Construction of Cap System

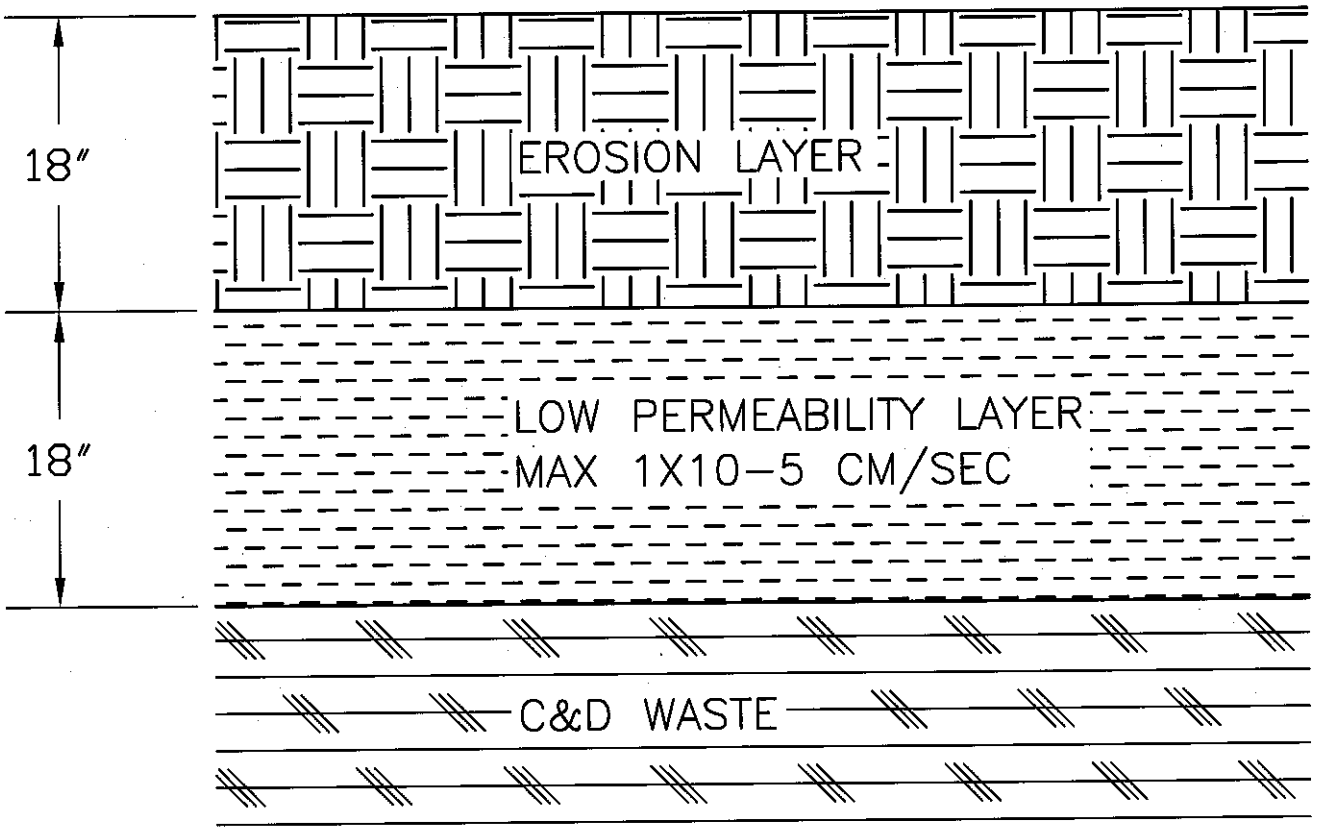
2.1.1 Final Cover System

The final cover system has been designed to minimize the amount of stormwater infiltration into the landfill and to resist erosive forces. The final cover system consists of the following layers (listed from top to bottom), which meet the requirements of Rule 0.543(c)(1):

- An 18-inch erosion layer consisting of earthen material that is capable of sustaining native plant growth; and
- An 18-inch low permeability barrier of earthen material with a permeability no greater than 1.0×10^{-5} cm per second.

The post-settlement grades of the top surface slopes will not be less than 5 percent (to prevent ponding). Figure No. 2-1 provides a section detail of the proposed final cover system.

Closure side slopes are designed at 3:1 (Horizontal: Vertical) for Phase 5 as provided in Part 5: Engineering Report, Appendix B – Design Geotechnical Evaluation. Post-settlement slopes are expected to be less than 3:1. Rule 0.543(c)(3)(C) allows for alternative side slopes (those greater than 25%) to be approved by the North Carolina Department of Environment and Natural Resources Solid Waste Section (NCDENR SWS) if the design is certified (by a licensed professional engineer in the State of North Carolina) to be stable, encourage runoff, and be safe to construct, operate and maintain.



DATE 5-22-2008

FINAL COVER SYSTEM

FIGURE NO.

2-1

CDM Camp Dresser & McKee

For the existing phases, the certified post-settlement slope design memorandum dated June 1, 2005 and included in the Phase 4 Expansion Permit Application demonstrates these requirements. Although the previous post-settlement slope design analysis assumed a 2-foot earthen cap, as opposed to what is described above, the additional 12 inches of cap material has been determined to be inconsequential with regard to slope stability.

2.1.2 Gas Collection System

The placement of a low-permeability final cover system will prevent the release of landfill gas generated during the post-closure period. To minimize pressures exerted on the barrier, passively vented gas wells will be used. The exact location of the vertical gas wells will be determined at the time of closure. Generally, one vertical well per acre is anticipated to be installed. A bentonite seal and synthetic boot will be installed around the vertical gas well to prevent stormwater infiltration. The depth of the vertical gas wells will extend from final grade to less than 10 feet into waste. Figure No. 2-2 provides a section detail of the proposed vertical gas well design.

2.2 Estimate of Largest Closure

[1]The construction of the landfill has occurred in four phases (includes 15.6 acres), with Phase 5 being the proposed expansion. Phase 5 is approximately 2.4 acres and Phase 5 Expansion is 0.5 acres of newly constructed disposal area, resulting in approximately 18.5 acre C&D landfill being the largest closure area.

2.3 Estimate of Maximum Inventory of Waste On-Site

[2]The maximum amount of waste that is expected to be disposed at the C&D landfill was calculated using the AutoCAD Civil 3D. The total gross airspace available between the proposed top of final cover and top of base grade is approximately 704,800 cubic yards (cy) and 435,500 cy, existing C&D landfill and Phase 5, respectively. The total gross airspace is approximately 1,140,300 cy.

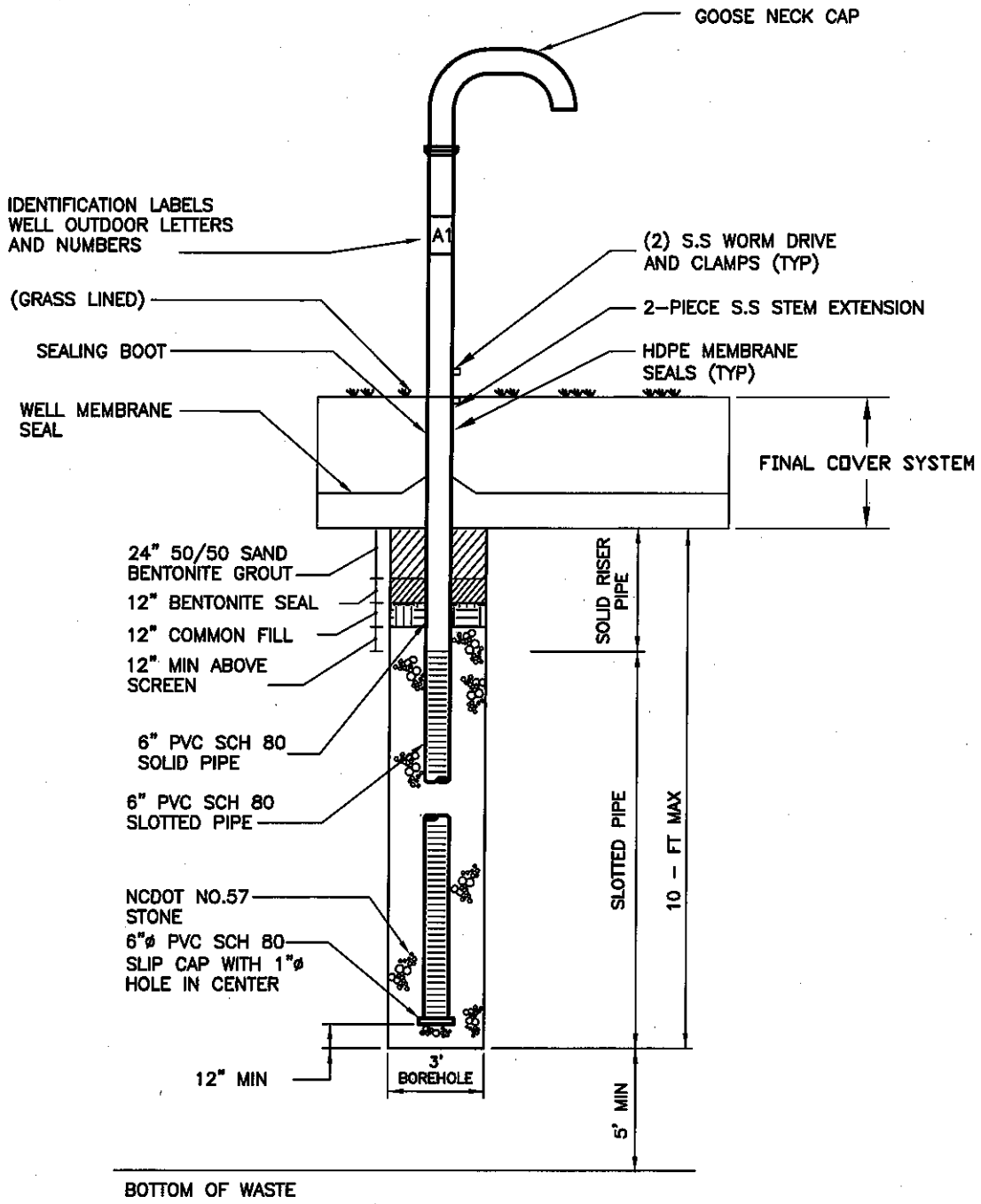
[3]The final cover material required to construct the 3-foot thick cover system for the C&D landfill (18.5 acres total surface area) is 89,540 cy.

It is anticipated that the County will use soil cover weekly, and that this will not be a substantial amount of soil. Operational soil thusly is not accounted for in this calculation.

[4]Deducting the volume of the final cover system (89,540 cy) from the total gross airspace, the maximum available net airspace for waste to be disposed is projected to be 1,050,760 cy.

[1,2,3,4]Revision for Phase 5 Expansion prepared by McGill Associates, P.A. in August 2015.

Based on the July 2008 Airspace Analysis Report prepared by CDM, the County is achieving an in-place density of 0.65 tons per cy. Using this density indicates that the 682,994 tons is the estimated waste on-site over the active life of the C&D landfill.



DATE 5-21-2008

VERTICAL GAS WELL

FIGURE NO.

2-2

CDM Camp Dresser & McKee

2.4 Landfill Closure Sequence

The landfill closure sequence is summarized in the following table and described in the following sections.

CLOSURE SEQUENCE	
Activity	***Process Date***
Determination of Closure Area and Initiate Closure Process	No later than 30 days after the final receipt of waste
Notification of Intent to Close	Once an area has been determined to be closed
Develop Closure Schedule for Closure Activities	
Prepare Construction Contract Documents	
Develop Final Closure Schedule	Once the Division has commented on the closure schedule
Select a General Contractor	After receiving sealed bids
Closure Construction	Closure activities must be completed within 180 days of beginning closure activities or as otherwise approved
Certification of Closure Construction	At completion of construction
Record Notation to Deed	After final closure of property

2.4.1 Determination of Closure Area

The County will determine the location and acreage of areas to be closed. The County will begin closure activities for the C&D landfill no later than 30 days after the date on which the C&D landfill receives the known final receipt of waste;

Extensions beyond the deadline for beginning closure may be granted by the Division if the County has taken and will continue to take all steps necessary to prevent threats to human health and the environment.

2.4.2 Notification of Intent to Close

Once the County has determined that an area will be closed, a Notice of Intent to Close must be placed in the operating record and the Division must be notified of the action per Rule .0543(c)(4). The final cover design, area to be closed, and scheduling of closure activities presented in this Permit Amendment Application shall be reviewed and updated as necessary.

2.4.3 Develop Closure Schedule

The County will prepare a schedule for bidding and construction of the closure activities. Closure activities must be completed within 180 days of beginning closure activities unless the County obtains approval from the Division by demonstrating that the construction period, by necessity, will require an extended schedule and that measures to protect human health and the environment have been implemented in the interim.

2.4.4 Prepare Construction Contract Documents

For the purpose of bidding, construction documents will be prepared for the area to be closed. The bidding documents will allow contractors to estimate the quantity of materials needed to properly implement the closure plan, as well as estimating the construction costs.

The closure will be completed per the Closure Construction Quality Assurance Plan as provided in Appendix A.

2.4.5 Develop Final Closure Schedule

Once the Division has reviewed and commented on the closure schedule, the County will prepare a final schedule for bidding and construction of the closure activities.

2.4.6 Selecting a General Contractor

After receiving sealed bids, a contractor will be awarded the job of constructing the final cover according to the approved closure plan. The contractor will be required to complete all closure activities within 180 days of beginning such activities, or as otherwise approved by the Division.

2.4.7 Securing Borrow Material for Landfill Cover

The material to be used for construction of the closure cap system will be obtained primarily from on-site sources. Off-site sources, as needed, will be selected based on proximity to the site, ability to provide material according to project specifications, and price.

2.4.8 Certification of Closure Construction

Following completion of the closure construction, a certification verifying that the closure construction was performed in accordance with the closure plan and signed by a registered professional engineer licensed in the State of North Carolina will be made part of the operating record. The County will notify the Division that the certification has been placed in the operating record.

2.4.9 Record Notation to Deed

After final closure of the property, a notation will be placed on the deed to the property stating that the property was used as a C&D landfill facility, and its use is restricted under the closure plan approved by the Division.

2.5 Financial Assurance

A detailed cost estimate based on current costs has been prepared for closure of the largest active area of the landfill facility at any time during the life of the facility and is provided in Table 2-1. A copy of the cost estimate has been placed in the operating record. The cost estimate will be annually adjusted to account for inflation and any changes in conditions at the facility or in the design. If conditions call for a reduction in the amount to be financially assured, approval of the Division shall be obtained prior to officially reducing the amount.

Per Rule 13B .0546(c)(1)(B), the County will annually adjust the closure cost estimate for inflation within 60 days prior to the anniversary date of the establishment of the financial instrument. Buncombe County uses the local financial government test, and therefore is required to update the closure cost estimate for inflation within 30 days after the close of the fiscal year and before submission of updated information to the Division.

Table 2-1
Closure Cost Estimate
Buncombe County C&D Landfill Buncombe County, North Carolina
Apr-15

	Quantity	Unit	Cost	Total
Final Cover System				
Grade Intermediate Cover/Strip Existing Vegetation	18.5		$1,500.00	$27,750
Cap System Components:				
a. 18″ Erosion Layer	44770	cy	$13.30	$595,441
b. 18″ Low-Permeability Layer	44770	cy	$13.30	$595,441
Seeding, Fertilizing & Mulching	18.5	ac	$1,850.00	$34,225
Temporary Erosion Control	18.5	ac	$4,000.00	$74,000
Permanent Erosion Control				
Diversion Berms/Downdrains	18.5	ac	$33,300.00	$616,050
Landfill Gas Management				
Vertical Gas Vents (18 @ Avg. Depth of 10′)	180	vf	$108. 0	$19,440
Gas Monitoring Wells (7 @ Avg. Depth of 15′)	105	vf	$50.00	$5,250
Surveys	18.0	ac	$333.33	$6,000
Final Landscaping				
Seeding, Fertilizing & Mulching	18.5	ac	$1,850.00	$34,225
Indemnification	1	ls	$5,000.00	$5,000
Subtotal				$2,012,822.00
Bonds and Mobilization/Demobilization (5% of Subtotal)				$100,641.10
Engineering Services, CQA/CQC (12% of Subtotal)				$241,538.64
Contingency (15% of Subtotal)				$301,923.30

TOTAL	**$2,656,925.04**
COST PER ACRE	**$143,617.57**

1. Revision for Phase 5 Expansion prepared by McGill Associates, P.A. in August 2015.

Section 3
Post-Closure Plan

The North Carolina Solid Waste Regulation Section Rule 15A NCAC 13B .0543(a) requires owners/operators of C&D landfills to prepare a post-closure plan. The purpose of the plan is to provide the necessary information for preserving the integrity of the landfill facility in its post-closure life.

This post-closure plan includes:

- a description of the monitoring and maintenance activities
- the frequency of these activities;
- the responsible party;
- a description of the planned uses of the property during the post-closure period; and
- the cost estimate for post-closure activities.

Post-closure care will begin immediately following final closure of the landfill. Post-closure care may be decreased from the minimum time period of 30 years specified in the regulations if the County can demonstrate that the reduced period will pose no threat to human health or the environment. However, the Division reserves the right to increase the post-closure care period if it is deemed necessary to protect human health and the environment.

3.1 Maintenance and Monitoring Activities

Post-closure maintenance and monitoring activities for the C&D landfill are described in the following sections.

3.1.1 Final Cover System

Inspection of the final cover system will take place quarterly and encompass the entire landfill. Items of concern to be noted by the inspector include but are not limited to: signs of erosion (ruts, sediment deposits, etc.), patches of stressed or dead vegetation, animal burrows, recessed areas or ponding, upheaving, cracks in the cap, damaged gas vents and tree saplings (especially species with tap roots).

Following each inspection, a summary report of the condition of the cover and the items of concern should be recorded in the post-closure log book of the facility. Areas that require further attention should be photographed and delineated on a map of the facility. These items should also be entered in the log book. Since post-closure inspection personnel will most likely change during the post-closure period, the post-closure log book should be kept in a standardized format that allows for new inspection personnel to easily review the results of past post-closure inspections of the site.

Action should be taken immediately to address any items of concern identified during the inspection. Obvious repair items should be performed under the supervision of the post-closure maintenance manager. If an item of concern requires further study to determine a course of action, the engineering firm responsible for closure design should be contacted for consultation.

As part of general maintenance, the vegetative cover should be mowed at least twice a year to suppress weed and brush growth. If vegetative cover is not adequate in any particular area, soil amendments should be applied as necessary and the area re-seeded in order to re-establish vegetation. Insecticides may be used to eliminate insect populations that are detrimental to the vegetation. Animal burrows and eroded or depressed areas should be filled in with compacted soil and reseeded.

3.1.2 Groundwater Monitoring

Inspection and monitoring of the groundwater monitoring wells will take place semi-annually. The inspection will consist of verifying the condition of the monitoring wells to ensure that they are providing representative samples of the groundwater being collected. The inspector should note the following:

1) The total depth of the well should be recorded every time a water sample is collected or a water level reading is taken to check if sediment has accumulated at the bottom. If sediment build-up has occurred, the sediment should be removed by pumping or bailing.
2) If turbid samples are collected from a well, redevelopment of the well will be necessary.
3) The above-ground protective casing should be inspected for damage. The protective casing should be of good structural integrity and free of any cracks or corrosion. The lockable cover and lock should also be checked at this time.
4) The surface seals should be inspected for settling and cracking. If the seal is damaged in any way, the seal should be replaced.
5) The well casing and cap should be inspected. The casing and cap should be of good structural integrity and free of any cracks or corrosion. Any debris should be removed from around the cap to prevent it from entering the well.

The condition of the groundwater monitoring system should be recorded in the post-closure log book following each sampling event.

3.1.3 Surface Water Quality Monitoring

Surface water quality monitoring will take place semi-annually concurrent with the groundwater monitoring.

3.1.4 Landfill Gas System Monitoring

Inspection of the landfill gas system should take place at least quarterly. The inspection should consist of verifying the condition and operation of the passive gas vents and gas monitoring wells (existing groundwater wells as stated in the Gas Control Plan included in the Operation Plan). The full depth of all vents and monitoring wells should be checked for blockage that may be caused by settlement or cracks in the casing. At least once a year, all vents and wells should be tested with an air pump to ensure they are free-flowing. The summary of each inspection of the landfill gas system should be recorded in the post-closure log book along with photographs of any items of concern.

Testing of the gas monitoring wells shall be conducted quarterly, or as otherwise approved by the Division.

If any vents or wells are not properly working, they should be flushed and pressure cleaned. If all attempts to repair a vent or well are unsuccessful, a replacement will be installed.

3.2 Erosion and Sedimentation Control System

Inspection of the erosion and sedimentation control system should occur semi-annually and after major storm events. During each inspection, the elements of the system including drainage ditches, drainage pipes, sedimentation ponds, and inlet/outlet structures should be checked for obstructions and damage. The drainage ditches should be inspected for obstructions, erosion of side slopes, loss of vegetative cover, shifting of riprap, excessive buildup of sediment, or any other item that may prevent the proper functioning of the ditch. Drainage piping should be checked for blockages and the inlets/outlets should be inspected for undercutting and rutting. The sediment level in the sedimentation ponds should be measured to determine if removal is required. The condition of the riser/barrel should be checked to ensure that adequate gravel surrounds the riser and that the barrel is not filled with sediment. The berms of each pond should be inspected for stability. Following each inspection, a summary report should be entered in the post-closure log book along with photographs of any items of concern.

Maintenance and/or repairs should be performed immediately as prescribed by the inspectors review.

3.3 Certification of Post-Closure

Following completion of the post-closure care period, a certification verifying that post-closure care was performed in accordance with the post-closure plan and signed by a registered professional engineer licensed in the State of North Carolina will be made part of the operating record. The County will notify the Division that the certification has been placed in the operating record.

3.4 Name of Individual Responsible for Post-Closure Maintenance of the Site

Mr. Jon Creighton of Buncombe County is currently responsible for operations and maintenance of the site. Mr. Creighton can be reached at the following address:

Mr. Jon Creighton, Assistant County Manager
Buncombe County
46 Valley Street
Asheville, North Carolina 28801

Mr. Creighton most likely will not be employed with Buncombe County throughout the entire 30 year post-closure period. A new individual will be appointed at the time Mr. Creighton's employment with the County ends.

3.5 Planned Use of Landfill After Closure

There are no current planned uses for the landfill site after closure. The property will remain County property, maintained by the County, with public access prohibited.

3.6 Financial Assurance

Buncombe County will submit a financial assurance package to the Division in accordance with the criteria set forth under Rule .0546. A detailed cost estimate for post-closure care has been prepared and is provided herein (Table 3-1) and a copy has been placed in the operating record. The cost estimate is based on 30 years of post-closure care.

Per Rule 13B .0546(c)(3)(B), the County will annually adjust the post-closure cost estimate for inflation within 60 days prior to the anniversary date of the establishment of the financial instrument. Buncombe County uses the local financial government test, and therefore is required to update the post-closure cost estimate for inflation within 30 days after the close of the fiscal year and before submission of updated information to the Division.

Table 3-1

Post-Closure Cost Estimate
Buncombe County C&D Landfill
Buncombe County, North Carolina
April 2009

	Quantity	Unit	Cost	Total
Administration	30	yr	$5,000	$150,000
Engineering	30	yr	$10,000	$300,000
Monitoring				
7 Groundwater Monitoring Well and QA/QC Samples Analyzed Semi-Annually for 30 years	60	events	$2,475	$148,500
1 Surface Water Sample Analyzed Semi-Annually for 30 years	60	events	$325	$19,500
2 Landfill Gas Wells Sampled and Analyzed Quarterly for 30 years	120	events	$400	$48,000
Maintenance				
Fencing, Gates, Signs, etc.	30	yr	$1,000	$30,000
Access Roads	30	yr	$3,000	$90,000
Mowing	30	yr	$5,000	$150,000
Stormwater Structures	30	yr	$3,000	$90,000
Final Cover System Inspection & Repair	30	yr	$9,000	$270,000
Groundwater and Gas Monitoring Wells	30	yr	$4,000	$120,000
Subtotal				$1,416,000
Contingency (15%)				$212,400

TOTAL	**$1,628,400**
ANNUAL COST	**$54,280**

Table 3-2

FINANCIAL ASSURANCE
Buncombe County C&D Landfill
Buncombe County, North Carolina

Total Closure Cost	**$**	**2,656,925.04**
Total Post-Closure Cost	**$**	**1,628,400.00**
Potential Assessment and Corrective Action	**$**	**1,000,000.00**
(Minimum Required by G.S. 130A-295.2(h1)		
Total Financial Assurance	**$**	**5,285,325.04**

Appendix A

Part 8: Closure/Post-Closure Plan

CQA Plan for Closure Cap

Construction Quality Assurance Plan
Closure Cap
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Section 1
Introduction

1.1 Purpose

The Construction Quality Assurance (CQA) Plan is intended to fulfill Rule .0541, which requires that a CQA Plan be developed to ensure that the design materials meet the design specifications and the construction and certification requirements set forth in Rule.0540 for the closure of C&D landfills. This plan describes the observations and tests that will be used before, during, and upon completion of closure construction to ensure that the construction materials and workmanship meet the design specifications and the requirements set forth in Rule .0543.

1.2 Quality Assurance and Quality Control

In the context of this CQA Plan, quality assurance and quality control are defined as follows:

- ***Quality Assurance:*** A program of tests and observations, executed by a party independent of the contractor, performed in order to confirm that completed work meets contractual and regulatory requirements and will perform satisfactorily in service.

- ***Quality Control:*** Those actions performed by the contractor or an agent of the contractor which provide a means to monitor the quality of the work being performed.

1.3 Units

In this CQA Plan, all properties and dimensions are expressed in U.S. units, with "equivalent" SI units in parentheses. It should be noted that the conversion is typically only accurate within ten percent. In cases of conflict or clarification, the U.S. units shall be deemed to govern.

1.4 References

The CQA Plan includes references to test procedures of the American Society for Testing Materials (ASTM).

1.5 Overview of Manual

Per .0541(b)(1) through (5) this CQA Plan addresses:

1. Responsibilities and authorities. The plan establishes responsibilities and authorities for the construction management organization. This includes a pre-construction meeting conducted prior to beginning construction of the closure cap. The meeting shall include a discussion of the construction management organization, respective duties during construction, and periodic reporting requirements for test results and construction activities. This information is presented in subsequent sections.

2. Inspection activities: A description of all field observations, tests, and equipment that will be used to ensure that the construction meets or exceeds all design criteria established in accordance with Rule .0543(c) is presented in Sections 4 through 6 of the CQA Plan.

3. Sampling strategies. A description of all sampling protocols, sample size, methods for determining sample locations and frequency of sampling is presented in Sections 4 and 5.

4. Documentation. Reporting requirements for CQA activities are described in detail in Sections 3 through 6

5. Progress and troubleshooting meetings. A plan will be prepared for holding periodic troubleshooting meetings. The proceedings of the meetings will be documented. Meeting information is included in Section 3 of the Plan.

Section 2
Definitions, Responsibilities, and Qualifications of Parties

The parties discussed in this section are associated with the ownership, design, construction, and quality assurance of the landfill closure cap. The definitions, responsibilities, and qualifications of these parties are summarized in Table 2-1 and outlined in the following subsections.

2.1 Contractor

2.1.1 Definition

The Contractor is the company with which the Owner has entered into agreement to construct the project.

2.1.2 Responsibilities

The Contractor is ultimately responsible for meeting the requirements of the Contract Documents and the successful completion of the landfill closure cap construction. Some of the Contractor's specific responsibilities include: providing qualified personnel to perform quality control, providing submittals for the various materials as required by the specifications, scheduling and coordinating the work with suppliers and subcontractors, providing a representative at all times during construction activity, provide surveying services, furnish progress and record drawings, attending progress meetings, and notifying the Engineer of design discrepancies.

2.1.3 Qualifications

The Contractor shall be experienced in all aspects of the work required to successfully construct the project. The Contractor shall be registered in the State of North Carolina and shall provide references from previous projects.

2.2 Contractor's Representative

2.2.1 Definition

The Contractor's Representative (CR) is a qualified individual assigned by the Contractor to represent him/her onsite during construction activities.

2.2.2 Responsibilities

The CR is responsible for: communication with the Engineer and Owner, coordinating and supervising his crew, subcontractors, and quality control personnel, ensuring that construction activities are conducted in accordance with the plans and specifications, immediately notifying the Engineer's Field Representative (EFR) of any discrepancies between the plans and specifications and the field conditions, attending all meetings held on the project, and keeping a daily log of all construction activities onsite.

Table 2-1
Project Personnel Responsibilities

PARTY	DEFINITION	RESPONSIBILITIES	QUALIFICATIONS	REPORT TO
Contractor	Company contracted by Owner to construct project in accordance with plans and specifications	Page 2-1	Licensed in North Carolina and similar project experience	Owner, Engineer, and EFR
Contractor's Representative (CR)	Person assigned by the Contractor to act as the CR onsite	Pages 2-1 and 2-3	Similar project experience	Contractor and EFR
Engineer	Company contracted by Owner for design of the project and to provide services during construction	Page 2-3	Registered professional engineer in North Carolina	Owner
Engineer's Field Representative (EFR)	Person assigned by the Engineer to perform QA inspection and document construction activities	Pages 2-3 and 2-4	Similar project experience	Engineer and Owner
Quality Assurance Laboratory (QAL)	Lab assigned by Owner or Engineer to conduct materials testing	Page 2-4	Experience in testing in accordance with ASTM.	EFR and Owner

2.2.3 Qualifications

The CR shall be an individual who demonstrates the capability to direct all tasks required for landfill closure cap construction. The CR shall demonstrate experience similar to the nature of the project and be knowledgeable of all aspects of the work.

2.3 Engineer

2.3.1 Definition

The Engineer is the party with which the Owner has entered into agreement with to provide project design and construction oversight.

2.3.2 Responsibilities

The Engineer is responsible for performing the engineering design and preparing the associated construction drawings and specifications. The Engineer is responsible for approving all design and specification changes, clarifying the design, reviewing and approving shop drawings, and other tasks as required during construction. The Engineer conducts the pre-construction meeting and progress meetings outlined in this plan. The Engineer will certify that the construction was completed in accordance with this CQA plan and the conditions of the closure plan in accordance with the requirements of Rule .0543 (c)(7), and acceptable engineering practices.

2.3.3 Qualifications

The Engineer shall be a professional engineer registered by the State of North Carolina. The Engineer shall have a working knowledge of landfill closure cap design and construction and all applicable regulatory requirements.

2.4 Engineer's Field Representative

2.4.1 Definition

The EFR is a qualified individual assigned by the Engineer to observe and document activities requiring quality assurance.

2.4.2 Responsibilities

The EFR is responsible for observing and documenting activities related to the quality assurance of the construction of the landfill closure cap. The EFR is responsible for implementation of this CQA Plan and coordination of the Quality Assurance Laboratory (QAL).

The specific duties of the EFR are as follows:

a. Review all construction drawings and specifications.

b. Review other site-specific documentation, including permits.

c. Review all changes to design drawings and specifications as issued by the Engineer.

d. Act as the Owner's representative.

e. Attend all quality assurance related meetings, e.g., resolution, pre-construction, progress, trouble-shooting, etc.

f. Review Contractor's Daily Reports, logs, and photographs.

g. Report to the Engineer, and log any relevant observations.

h. Review the results of laboratory testing.

i. Report any unapproved deviations from the CQA Plan.

j. Prepare the final certification report.

2.4.3 Qualifications

The EFR shall be experienced with the implementation and preparation of quality assurance documentation including: quality assurance forms, reports, certifications, and manuals; and shall have prior experience with soil liner installation.

2.5 Quality Assurance Laboratory

2.5.1 Definition

The QAL is a firm, independent from the Contractor and Owner, responsible for conducting tests on samples of materials for the closure cap construction.

2.5.2 Responsibilities

The QAL shall be responsible for conducting the appropriate laboratory tests as directed by the Engineer and in accordance with the project plans and specifications. The test procedures shall be done in accordance with the test methods outlined in this CQA Plan.

2.5.3 Qualifications

The QAL shall have experience in soil testing and be familiar with American Society for Testing and Materials (ASTM).

2.5.4 Submittals

The QAL shall deliver all test results to the Engineer in written form. Written test results shall be in an easily readable format and include references to the standard test methods used.

Section 3
Communication Between Involved Parties

Communication is essential to achieve a high level of quality during construction and to assure the final product that meets all project requirements. This section discusses the necessary lines of communication.

3.1 Lines of Communication

All communication between parties shall go through the EFR, who, in turn, will direct the communication through the proper channels.

3.2 Pre-Construction Meeting

A pre-construction meeting shall be held before construction activity begins. The meeting shall be conducted by the Engineer and attended by the Owner, EFR, Contractor, CR, and a Solid Waste Section representative.

Per Rule .0541(b)(1), the meeting will include a discussion of the construction management organization, the responsibilities and duties of each party during construction, and periodic reporting requirements for testing results and construction activities.

3.3 Progress and Troubleshooting Meetings

Per Rule .0541(b)(5) progress and troubleshooting meetings shall be conducted by the Engineer and attended by the Owner, EFR, and CR. Progress meetings shall be held as deemed necessary, but at a minimum frequency of one per month. These meetings shall discuss current progress, planned activities to be accomplished prior to the next progress meeting, issues requiring resolution, and any new business or revisions to the work. The EFR shall log any problems, decisions, or questions arising at this meeting. If any matter remains unresolved at the end of this meeting, the EFR will be responsible for obtaining a resolution of the matter and for forwarding communication of the decision to the appropriate parties.

Section 4
Low Permeability Soil Liner

The materials, construction and certification requirements in this Section are intended to comply with Rule .0543 (c)(1)(A) and (B).

4.1 Materials

A. Low permeability soil liner materials shall conform to the following properties:

■ Passing the 1-inch Sieve	ASTM D422	100 percent
■ Passing the 200 Sieve	ASTM D1140	45 percent minimum*
■ Liquid Limit	ASTM D4318	30 minimum*
■ Plasticity Index	ASTM D4318	7 minimum*
■ Soil Classification	ASTM D2488	SC, CH, CL, CH, ML, MH
■ Hydraulic Conductivity	ASTM D5084	1.0×10^{-5} cm/s maximum
■ Internal Friction Angle	ASTM D4767	19° minimum
■ Organic Content	ASTM D2974	5% maximum

* The Engineer may modify these conformance test properties based on the results of initial conformance testing, provided modification of these results does not compromise the hydraulic conductivity or internal friction angle test results.

B. A soil-bentonite mixture can be used for the low permeability soil liner provided it achieves the specified hydraulic conductivity and internal friction angles as presented in Section 4.1 A. Both onsite and offsite soils may by used for soil-bentonite mix. Soil to be used for the soil-bentonite mix shall conform to the following properties:

■ Passing the 1-inch Sieve	ASTM D422	100 percent
■ Soil Classification	ASTM D2488	SC, SM, CL, CH, ML, MH

■ Soils with organic materials of any kind, particularly leaves and roots, shall not be used in the mixture.

C. The soil-bentonite mixture shall consist of an acceptable soil described in Section 4.1 B containing a sealant consisting of free flowing, high swelling sodium-based Wyoming type bentonite. The bentonite sealant shall conform to all items of this specification with all supporting test data certified, submitted to, and approved by the Engineer, prior to bid, as follows:

- The bentonite shall be covered by the Manufacturer's warranty against defects in material and workmanship and shall have a useful life of 30 years under normal weathering and normal use conditions.

D. The low permeability soil liner or soil-bentonite mixture material used for cap construction shall be uniform in character, and after compaction, shall have an in-place saturated hydraulic conductivity of 1.0×10^{-5} cm/s or less.

E. The Contractor shall use adequate construction quality control (CQC) to verify the conformance of materials according to this section. The Contractor shall submit to the Engineer, within 30 days of the effective date of the agreement, representative samples from the soil source(s). In the case that the submitted samples fail to conform to the required criteria, the Contractor may locate another source, and upon approval of that source by the Engineer, submit samples from the new source for conformance testing at the cost of the Contractor.

F. If the Contractor plans to use any blending of soils as low permeability soil liner material, the Contractor shall submit the blended soil for the Engineer's approval in accordance with the requirements.

4.2 Conformance Testing

A. Initial conformance testing shall be performed by the quality assurance laboratory (QAL) on samples from the soil source to assure compliance with the Specifications. The samples will be obtained from multiple test pits to be dug by the Contractor under the direction of the QAL. The following tests shall be performed on the samples. For soil to be used in a soil-bentonite mix, test 8 will not be performed.

1. Soil Classification (ASTM D2487)
2. Sieve Analysis (ASTM D422) (including hydrometer analysis)
3. Atterberg Limits (ASTM 4318)
4. Moisture-Density Curves (ASTM D698)
5. Specific Gravity (ASTM D854)
6. Laboratory Hydraulic Conductivity (ASTM D5084)
7. Natural Moisture (ASTM D2216)
8. Shear Tests (ASTM D4767 or as approved by the Engineer)

B. For natural low permeability soil sources, the QAL shall determine an acceptable zone of moisture contents, dry unit weights and compaction for which hydraulic

conductivities are less than or equal to 1.0×10^{-5} cm/s by performing the following testing and analysis procedures:

1. Using the samples extracted from the proposed source, perform Modified and Standard Proctor compaction tests to develop at least two moisture-density curves. For each of the compaction tests use up to five specimens at incremental moisture contents to develop a compaction curve showing dry density for each molding water content.

2. Permeate each compacted specimen to determine its hydraulic conductivity in accordance with ASTM D5084.

3. On the graph of dry density vs. moisture content, identify the samples which have hydraulic conductivities less than or equal to 1×10^{-5} cm/s.

4. Draw an "acceptable zone" of water content and dry density around the passing samples.

5. Perform Internal Shear Tests on one specimen from the high and low ends of the acceptable zone and plot the friction angles as a function of molding water content.

6. Based on the shear test results and other pertinent factors such as constructibility, shrink/swell potential, dessication cracks, and consolidation, the QAL shall modify the acceptable zone as required.

C. For soil-bentonite mixes, prior to constructing the test pad, the QAL shall determine an acceptable zone of moisture contents and dry unit weights in which the hydraulic conductivity is less than or equal to 1.0×10^{-5} cm/sec by following the procedures described above in Section 4.2.B (with the exception that samples will be extracted from the pug mill operation). The samples will be taken from a soil-bentonite mix once the bentonite percentage for production has been firmly established. The Contractor shall be responsible for performing preliminary hydraulic conductivity tests on initial mix ratios (based on manufacturer's recommendation and adjusted based on Contractor's experience) in order to establish the percentage of bentonite to be used in production.

D. For each delivery of material from the borrow source, the quality control laboratory (QCL) personnel of the Contractor shall note, on an approved form, the color of the material, date, time, and approximate quantity of material brought onsite and submit copies of completed forms to the Engineer . The soil source shall be conformance tested by the QCL during the excavation and stockpiling operation at the following frequency.

Test	Method	Frequency
Grain Size w/hydrometer	(ASTM D422)	Every 2,000 cy
Atterberg Limits	(ASTM D4318)	Every 2,000 cy
Moisture/Density	(ASTM D698)	Every 5,000 cy
Natural Moisture	(ASTM D2216)	Every 2,000 cy

Results of the tests will be submitted to the Engineer within 24 hours of test completion. The Engineer reserves the right to reject material based on the results of the conformance tests.

4.3 Construction

4.3.1 Test Pad

A. A test pad of a dimension of no less than 40-ft by 60-ft and 18-inch thickness shall be constructed onsite using the same equipment, processing and installation procedures that will be used during full-scale liner construction. The low permeability soil or the soil-bentonite mixture to be used for the test pad shall be the same material that the Contractor proposes to use for construction of the base liner. If approved by the Engineer, the test pad may be installed within the cap limits and incorporated in the work, provided the pad passes all testing requirements.

B. The construction of the pad shall be directed by the QCL. The QCL shall use the acceptable zone established by the QAL to set moisture contents and percent compaction. The QCL may perform tests as needed to assist in the construction of the test pad. However, only the results of the QAL's test will be recognized for determining the performance of the pad.

C. For each lift, the QAL shall perform testing of moisture content and density at a minimum of three test locations. The QAL shall record moisture content, compaction procedures, and density throughout the construction of the test pad. Two Shelby Tube Samples shall be obtained per lift by the QAL. One tube will be used to perform a hydraulic conductivity test. The second tube will be kept as a backup in case of damage to the first sample or dispute of test results.

D. For soil-bentonite mixtures, the bentonite content used for the test pad shall be set by the Contractor and written notification of the mix ratio will be submitted to the Engineer prior to constructing the test pad.

E. One triaxial type hydraulic conductivity test (ASTM D5084) will be performed on each test pad per lift.

H. The cap thickness shall be determined from four locations selected by the QAL per test pad using a method that is approved by the Engineer, which will be determined prior to test pad construction.

4.3.2 Soil Liner Installation

A. The QCL shall supervise the soil liner installation. Work shall not be performed by the Contractor without the QCL onsite. The QCL shall perform field tests (ie. moisture content, densities, etc.) as required to ensure proper installation. The QAL shall perform tests as described in Section 4.4 to determine acceptance of the soil liner.

B. The placement moisture content shall be within the acceptable zone of moisture content as determined by the QAL during the conformance testing of the low permeability soil described in Section 4.2. The acceptable zone may be modified by the Engineer based on results and observations of the test pad.

C. Water for Compaction

1. The Contractor shall provide water as required to guarantee constructability and proper condition of the inplace and stockpiled material.

2. The water shall be of potable quality.

3. Prior to installing the soil liner, the Contractor shall inspect the subgrade to ensure that it has been sufficiently wetted to prevent excessive absorption of moisture from the installed material.

4. Should the material be stockpiled for any length of time the Contractor shall slope and compact the stockpile to prevent erosion and oversaturation.

5. Should the material become oversaturated, the Contractor shall spread and dry the material as needed to adjust the moisture to the proper level.

D. The materials shall be uniformly compacted to no less than the minimum dry density of the acceptable zone that corresponds to the placement moisture content. The acceptable zone shall be as specified by the QAL in accordance with the procedures outlined in Section 4.2. This minimum density shall be uniformly obtained throughout the entire thickness of the liner. The cap shall be constructed in lifts with a maximum compacted thickness of 6 inches per lift to assure achievement of the specified compaction in the lower part of the cap. However, the initial lift may be placed at 8 inches to prevent mixing with the existing operational cover during compaction.

E. Soil liner material which has been contaminated with clusters of rock or gravel, sand lenses, organic debris or other deleterious material shall be removed and replaced with uncontaminated low permeability soil materials.

F. The Contractor shall use a pugmill to produce the soil-bentonite mix at the required moisture content to achieve an in-place compacted minimum 18-inch thick layer of material with a hydraulic conductivity less than or equal 1×10^{-5} cm/sec. Based on the soil material to be used, the Engineer may direct the Contractor to screen the soils prior to placement in the pugmill. The pugmill must be approved by the Engineer prior to its arrival on site.

G. No low permeability soil liner material shall be placed, spread, or compacted while the existing operational cover or soil liner material is frozen/thawing, saturated, desiccated, nor during unfavorable weather conditions or periods of precipitation. The cap surface must be made smooth and free from ruts or indentations at the end of any working day when significant precipitation is forecast and/or at the completion of the compaction operations in that area in order to prevent saturation of the soil liner material. Any regrading due to the above conditions or final preparation should be retested at those locations for liner thickness prior to placement of the next lift or erosion control layer. Thickness measurements should be performed as indicated in Section 4.4.1.

H. Work shall be limited to an area where a lift can be completed in one working day and shall continue in that area until three lifts have been placed. Completion of an area shall be defined as the construction of a cap of a minimum 18-inches that is homogenously installed at a moisture content and density within the acceptable zone, free rocks larger than 1-inch diameter, and possessing a smooth rolled surface.

I. If a lift is not to receive a subsequent lift within 16 hours of its completion, the lift shall be sealed with a smooth wheel compactor at the end of each day's work to protect the material from desiccation. Should desiccation cracks develop, soil liner material shall be scarified, disked, rewetted, rehomogenized and recompacted in accordance with the Specifications to the depth of any such cracks or as instructed by the Engineer. If desiccation extends below half of the lift thickness, the lift shall be removed and replaced.

J. During construction, the Contractor shall make all necessary provisions to deal with inclement weather conditions. The Contractor shall be fully responsible for control of stormwater during installation of the cap system and for moisture control and protection of the low permeability soil liner.

M. After final grading and smooth rolling is completed, the compacted soil liner thickness shall not be less than 18-inches. Soil liner will be tested by the QAL on the final lift at a frequency as specified in Section 4.4.1 using a method of hand augering or push tube sampling (minimum 3/4" sample). Each test shall penetrate all underlying lifts to disposed waste. The thickness shall be measured from top of waste to top of low permeability soil liner. Areas not meeting the thickness requirements shall be augmented with additional low permeability soil

material at the expense of the Contractor. Any additional testing or CQA services associated with corrective action for achieving the 18-inch cap thickness requirement will be at the cost of the Contractor. The added material shall be worked into the in-place liner to ensure homogeneity and proper bonding. This shall be done by scarification of the surface prior to addition of the new material. As a minimum, the top 4-in of the soil liner shall be wetted, kneaded, compacted and reworked with the additional material to obtain the required thickness.

4.4 Certification

4.4.1 Field Quality Control

A. The QAL shall conduct the following tests during installation of the low permeability soil or soil-bentonite liner at the specified frequencies.

Test	Method	Frequency
Atterberg Limits	(ASTM D4318)	2/acre/lift
Moisture of Undisturbed Hydraulic Conductivity Sample	(ASTM D2216)	1/two acres/lift
Undisturbed Hydraulic Conductivity	(ASTM D5084)	1/two acres/lift
Density	(ASTM D2937 or ASTM D2992)	4/acre/lift
Moisture	(ASTM D2216 or ASTM D3017)	4/acre/lift
Liner thickness	(Hand Auger or push tube)	4/acre
Grain Size	(Sieve Only)	2/acre/lift

B. All holes made as a result of depth measurements, hydraulic conductivity samples, density tests, grade stakes or other means shall be completely filled by the Contractor with bentonite or soil-bentonite mix, as instructed by the Engineer.

C. The Engineer shall have the authority to request additional hydraulic conductivity tests in areas that, in the Engineer's judgement, may be suspect or deficient. Hydraulic conductivity tests shall be conducted in accordance with ASTM D5084. For each sample tested, one back-up sample will be extracted in the proximity of the sample location. These samples will be held in a controlled environment at the QAL laboratory as a precautionary measure. If adequate demonstration is presented that a sample was not representative of the low permeability soil liner

or that an error in testing occurred, the backup samples will be tested and the original test will be disregarded.

D. Any sample or area tested shall be rejected, removed and replaced if it does not meet the requirements of the technical specifications. Reconstructed areas shall have feathered, overlapping edges that tie into adjacent liner areas.

E. Grade stakes for soil liner construction shall be numbered by the Contractor and located on an inventory map. The inventory map shall be submitted to the Engineer. Upon completion of an area, the removed stakes will be compared to the inventory map to ensure that none were left inplace.

F. The Contractor shall submit a survey plan with final elevation of top of low permeability soil liner for Engineer's approval.

4.4.2 Corrective Action

If soil has been desiccated to a depth less than or equal to the thickness of a single lift, the desiccated lift may be disked, moistened, and recompacted. However, disking may produce large, hard clods that will require pulverization. Also, it should be recognized that if the soil is wetted, time must be allowed for water to be absorbed into the clods and hydration to take place uniformly. For this reason it may be necessary to remove the desiccated soil from the construction area, process the lift in a separate processing area, and replace the soil accordingly.

Section 5
Vegetative Cover Materials

The materials, construction and certification requirements in this Section are intended to comply with Rule .0543 (c)(1)(C).

5.1 Materials

A. Vegetative Cover Material

1. Vegetative cover material shall be capable of sustaining native plant growth. Vegetative cover soil shall not be compacted except by tracking during spreading operations.

B. Erosion Control Blanket

1. If needed, erosion control blankets shall consist of wood excelsior with 80% 6-inch fibers or greater fiber length with the top of the blanket covered with photo-degradable or biodegradable netting. Blanket shall be of consistent thickness with fibers evenly distributed throughout the entire area of the blanket. Blanket shall be recommended by manufacturer for use on slopes up to 1.5H:1V, stormwater channel velocities up to 5 feet per second, and flow shear stresses up to 2 pounds per square foot.

5.2 Conformance Testing

A. Vegetative cover material shall be tested for nutrient fertilizer requirements and pH requirements at a frequency of once per 5,000 cubic yards.

1. The pH value shall be between pH 6.0 and 7.0.

2. Fertilizer and lime shall be spread and incorporated as per soil test recommendations after the vegetative cover material is spread but prior to fine grading.

5.3 Construction

A. The Contractor shall be responsible for identifying earthen material to be used for vegetative cover material and adding amendments to create suitable vegetative cover material. Stockpiled material may be used in areas disturbed by Contractor's activities as approved by the Engineer.

B. Commercial fertilizer, lime, peat, humus, sand or other additives shall be used to counter act soil deficiencies as recommended by the soil analysis and as directed by the Engineer.

5.4 Certification

A. Vegetative cover material thickness will be tested by the QAL on the final lift at a frequency four per acre using a method approved by the Engineer prior to construction of the vegetative cover construction. Each test shall penetrate to the low permeability soil liner material. The thickness shall be measured from top of vegetative cover to top of low permeability soil liner. Areas not meeting the thickness requirements shall be augmented with additional vegetative cover material.

Section 6
Documentation

This Section is intended to comply with Rules .0540(8) and .0541(b)(4) and .0543(c)(7).

Upon completion of construction activities, a Construction Quality Assurance Certification Report will be submitted to the Solid Waste Section in accordance with Rules .0541 and .0543. The report will summarize all quality assurance services performed during construction of the C&D landfill cap and will include, at a minimum the following:

- Field observation inspection reports;
- The results of all construction quality assurance and construction quality control testing required by this Plan;
- Documentation of any failed test results, descriptions of procedures used to correct the improperly installed material and results of all retesting performed;
- Record drawings documenting the completed project and noting any deviation from the approved engineering plans; and
- A comprehensive narrative including, but not limited to, daily reports from the project engineer and a series of color photographs of major project features.

The CQA Certification report shall bear the seal of a North Carolina Professional Engineer who was involved during the construction and a certification that construction was completed in accordance with:

1. This CQA Plan;
2. The conditions of the Permit to Construct;
3. The requirements of Rules .0540 through .0543; and
4. Good engineering practices.