55-04

Permit No.	Scan Date	DIN
5504	**March 15, 2011**	**13296**

Rec'd 3/19/10

CONSTRUCTION PLAN APPLICATION
CONSTRUCTION AND DEMOLITION LANDFILL
LAKE NORMAN LANDFILL, INC.
LINCOLN COUNTY, NORTH CAROLINA
S&ME PROJECT NO. 1356-97-394

Prepared for:

North Carolina Department
of Environment and Natural Resources
Solid Waste Section

Prepared by:

S&ME, Inc.
Charlotte, North Carolina

February 20,1998

S&ME

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North Carolina Department of Environment and Natural Resources
Division of Waste Management
Solid Waste Section
401 Oberlin Road
Raleigh, North Carolina 27605

ATTENTION: Mr. Edward F. Mussler, III, P.E.

Reference: Construction Plan Application
Construction and Demolition Landfill
Lake Norman Landfill, Inc.
Lincoln County, North Carolina
S&ME Project No. 1356-97-394

Dear Mr. Mussler:

On behalf of Lake Norman Landfill, Inc., S&ME, Inc. presents the Construction Plan Application for the above referenced landfill. The proposed landfill is to be located in the southeastern portion of Lincoln County. Included in this application are the items to satisfy the North Carolina Solid Waste Management Rules, Sections .0503 and .0504 for the proposed C&D Landfill. A cross reference guide to the applicable Solid Waste Management Rules is also included.

S&ME, Inc. 9751 Southern Pine Boulevard, Charlotte, North Carolina 28273, (704) 523-4726, Fax (704) 525-3953
Mailing address: P.O. Box 7668, Charlotte, North Carolina 28241-7668

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Please contact us if you have any questions or need additional information concerning this application.

Respectfully Submitted,

S&ME, Inc.

Scott R. Nordgren, E.I.T.
Staff Professional

Christopher J.L. Stahl, P.E.
Project Manager
N.C. Registration No. 023224

Al Quarles, P.G.
Senior Hydrogeologist
N.C. Registration No. 1133
(Sealed for Sections 2.0 and 6.0)

Jack J. Amar, P.E.
Branch Manager/Senior Vice President
N.C. Registration No. 10861

cc: Mr. Chris Barrett, Lake Norman Landfill, Inc. (1)

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Construction Plan Application
Lake Norman Landfill, Inc. C&D Landfill
Lincoln County, North Carolina

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.0503 (1)(b)	Appendix III and IV
.0503 (1)(c)	Appendix VII, Sheet 3
.0503 (1)(d)	Appendix VI, Calculations
.0503 (2)(a)	Section 5.6
.0503 (2)(b)	Section 5.2
.0503 (2)(c)	Appendix VIII, Erosion and Sedimentation Control Plan
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.0503 (2)(e)	Section 5.5
.0503 (2)(f)	Appendix VII, Drawings
.0503 (2)(g)	Appendix VIII, Erosion and Sedimentation Control Plan
.0504 (1)(a) and (b)	Appendix VII, Sheet 1, 2 and 3
.0504 (1)(c)	Section 2.0, Appendix I and II
.0504 (1)(d), (f)	Appendix VII, Drawings
.0504 (1)(e)	Appendix V, Local Government Approval
.0504 (1)(g)(i), (ii), (iii) .0504 (1)(g)(iv) .0504 (1)(g)(v)	Section 4.0 Section 6.0 Section 2.0
.0504 (2)(a)	Appendix VII, Sheet 5
.0504 (2)(b)	Appendix VII, Sheet 1, 2 and 3
.0504 (2)(c)	Appendix II, Sheet 5
.0504 (2)(d)	Appendix VIII, Sheet 10
.0504 (2)(e)	Appendix VIII, Sheets 11 and 12
.0504 (2)(f)	Appendix VII, Sheets 7 and 8
.0504 (2)(g)	Section 4.2
.0504 (2)(h)	Sections 3.0, 4.0 and 5.0, and Appendix VI, VIII and IX

1.0 INTRODUCTION

1.1 Project Description

S&ME has completed the hydrogeological evaluation and Construction Plan Application for the Lake Norman Landfill, Inc.. The proposed C&D landfill is located in the southeastern portion of Lincoln County off North Carolina Highway 16 and Quarry Lane in Catawba Springs Township.

This application presents the design, operation, hydrogeological data, and monitoring plans for the proposed C&D landfill as required by the North Carolina Solid Waste Management Rules.

1.2 Site Conditions

The proposed C&D landfill site is approximately 117 acres, with the actual Phase 1 landfill area encompassing approximately 31 acres. The site is bordered by Lake Norman Quarry property to the west and southwest, by Forney Creek to the north, and by a railroad to the east and southeast. The site is located in an Industrial General (I-G) Zone area in Lincoln County. The surrounding area and nearby properties consist of two asphalt plants, a rock quarry, a railroad spur and right-of-ways, gas line right-of-ways, power line right-of-ways, Lincoln County WWTP, and a combustion turbine power plant. The nearest residence is over 900 feet away from the proposed C&D landfill.

The proposed landfill area consists mainly of clear-cut wooded lands with light to moderate underbrush. Ground surface elevations range from 670 feet along the northern side of the proposed landfill to 750 feet near the railroad. Two small drainage features provide drainage toward Forney Creek. Surface water flow generally follows the topography, draining to the tributaries that eventually drain to Forney Creek. The topography slopes gradually to the north in the proposed landfill area and steepens as it nears the two drainage features.

2.0 HYDROGEOLOGIC EVALUATION

2.1 Background

The proposed C&D landfill will be located in the southeastern portion of Lincoln County. Lake Norman Landfill, Inc., owns the area of the proposed landfill. The property meets the site suitability requirements of the North Carolina Solid Waste Management Rule .1618 for Municipal Solid Waste Landfill Facilities.

General hydrogeologic information used to design the proposed C&D landfill is included in this Section. The Water Quality Monitoring Plan is presented in Section 6.0.

2.2 Subsurface Conditions

The proposed landfill is located in the Charlotte Belt of the Piedmont Physiographic Province, less than a mile east of Boogertown Shear Zone. The Kings Mountain Belt is located west of this shear zone.

This region of North Carolina is predominately underlain by igneous and metamorphic rock which is covered by a thick layer of residual soil and weathered rock (collectively termed regolith) that was formed during the Late Proterozoic to Middle Paleozoic Eras. Native rock consists largely of the metamorphosed quartz diorite (foliated to massive) complex (Geologic Map of North Carolina, 1985). The site soils are derived from the chemical weathering of the parent bedrock, consisting of massive metamorphosed quartz diorite.

Fifteen (15) soil test borings OW-1, B-2, OW-2, OW-4, OW-5, OW-5A, OW-6, OW-6A, OW-7, OW-7A, OW-8, OW-9, B-10, OW-11 and OW-12 were advanced in the area of the proposed C&D landfill. Thirteen (13) borings were completed as observation wells, with three locations consisting of nested wells (i.e., shallow and deeper wells). The locations of these borings and observation wells in the proposed C&D landfill area, are shown on the Potentiometric Surface Map (Sheet 4). Appendix I contains the soil boring and well logs.

Generally, the upper 15 to 50 feet of soil consist of interlayered silty sands, clayey sands, sandy silts and silty clays. These soils overly partially weathered rock (PWR) that ranges in depth from 15 feet to 50 feet below surface. Th thickness of PWR ranges from 0 (OW-5A) to over 16 feet (OW-12). Across the site, the groundwater surface occurs within the soil, PWR and bedrock.

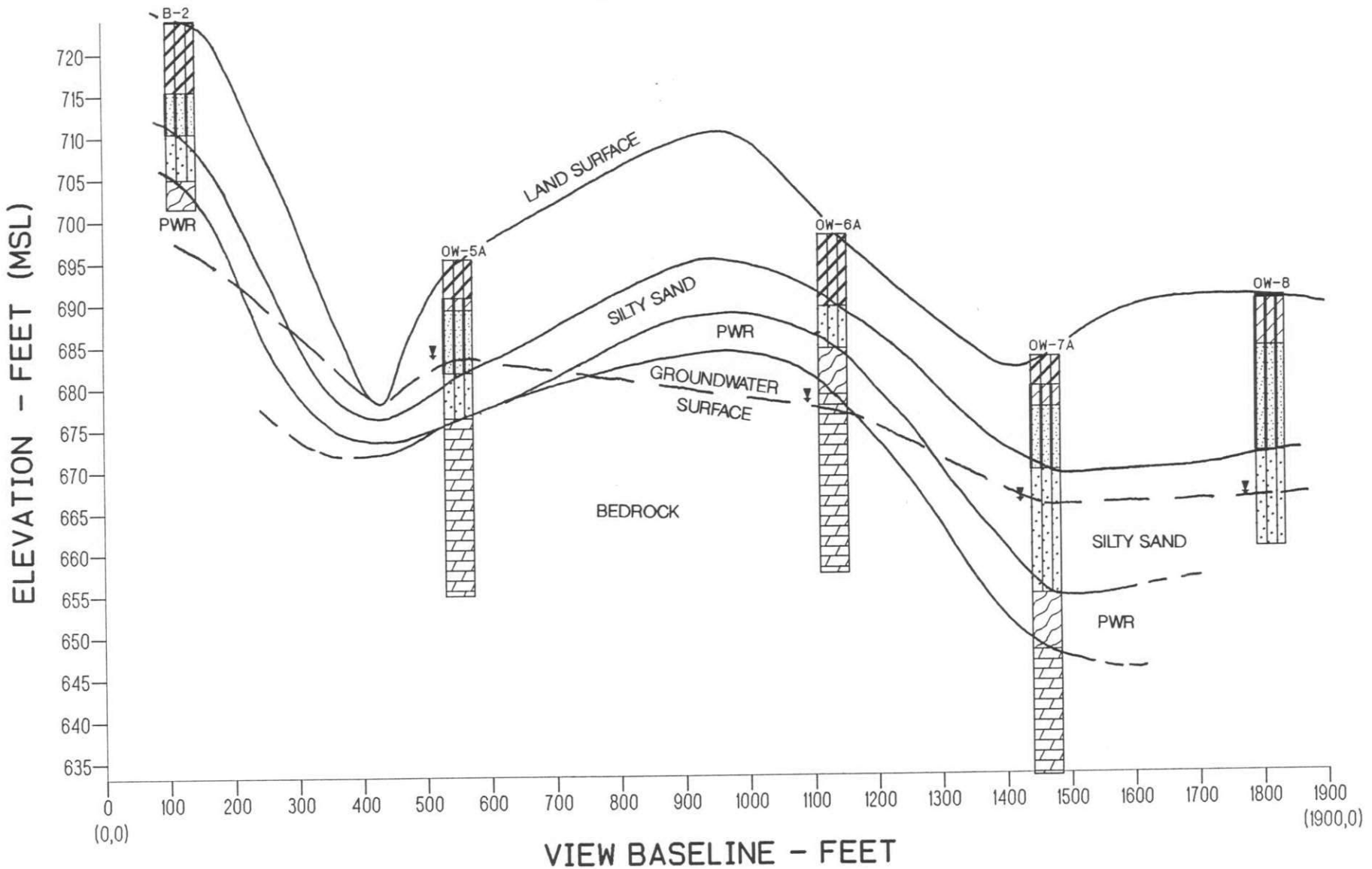
Standard penetration tests were performed at designated intervals in each soil test boring in accordance with ASTM D 1586-84 to provide an index for estimating soil strength and relative density. Split spoon soil samples were recovered for classification and laboratory testing. These values are indicated on the soil boring and well logs (Appendix I).

The soil test boring records were used to produce generalized subsurface cross sections. Actual subsurface conditions may vary from those shown on the cross sections. Generally, the transition between the material types is gradual (in the vertical and horizontal dimensions) and not an abrupt change as indicated on the soil test boring records and cross sections. The cross sections (C-C', D-D', and E-E') are presented as Figures 1 through 3.

Soil classification laboratory tests included natural moisture content, unit weight, grain size distribution with hydrometers, Atterberg limits and specific gravity tests. Results of the laboratory tests are presented on Table 1. Laboratory testing procedures along with the laboratory test data sheets are included in Appendix II.

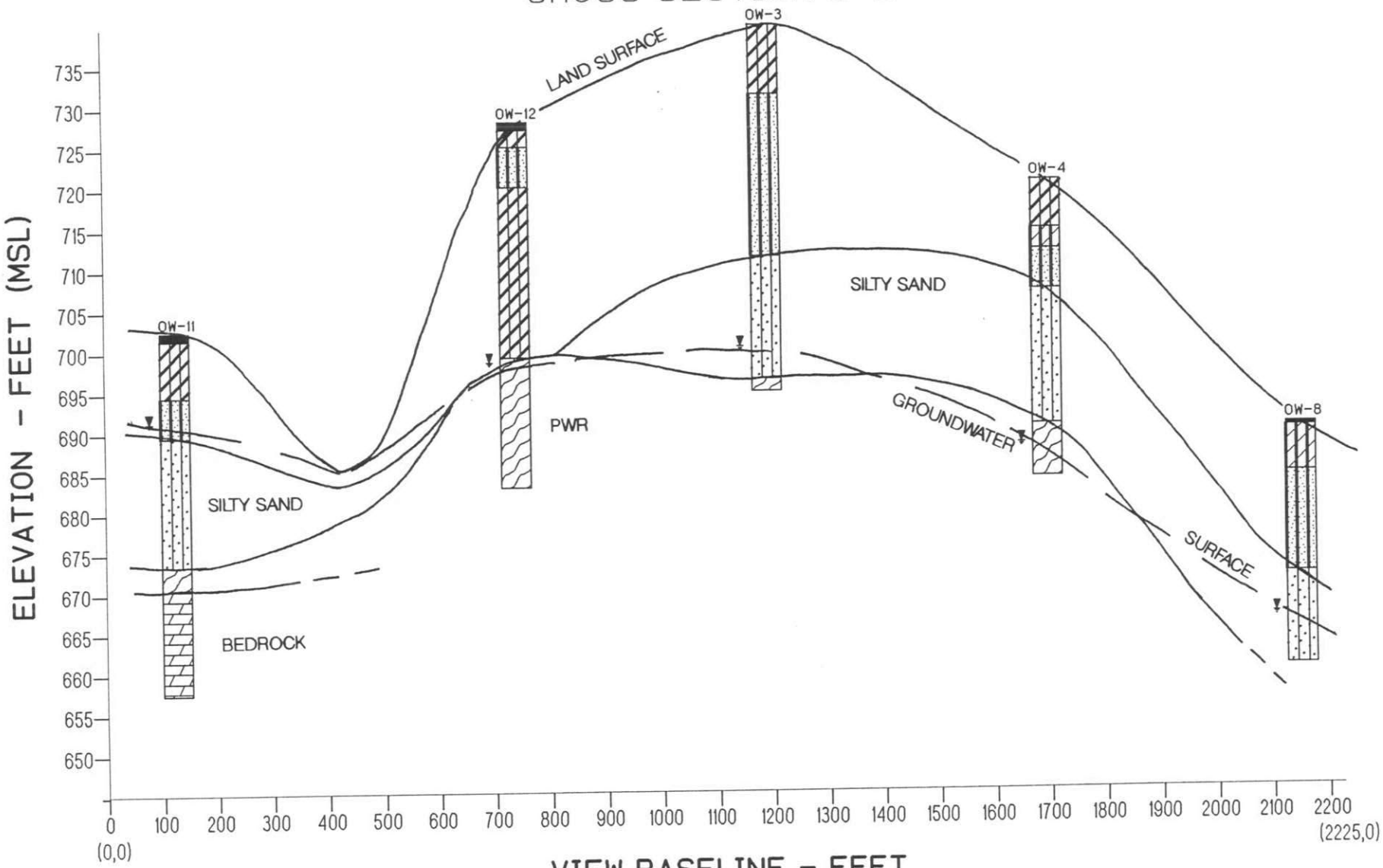
S&ME tested undisturbed (UD) soil samples obtained during the field exploration to determine in-situ permeability of subsurface soil layers. S&ME conducted laboratory vertical permeability testing on the UD samples obtained from borings OW-6A and OW-7A. Laboratory results, as shown in Table 2, indicate that the vertical permeability of the UD samples ranged from $1x10^{-4}$ to $2x10^{-4}$ cm/sec. S&ME performed in-situ permeability tests within several of the observation wells. Those results are discussed in the following section.

CROSS SECTION C-C'



Topsoil	Clayey Sand	Sandy Clay	Cored Rock	REVISION:	
Organic	Sandy Silt	Silty Clay	Water Level at T.O.B.	SCALE: AS SHOWN	S&ME
Silty Sand	Clayey Silt	Partially Weathered Rock	Water Level after 24Hrs.	APPROVED BY:	
				DRAWN BY:	
				DATE: 02/17/1998	JOB NUMBER: 1356-97-394 FIGURE NO: 1

CROSS SECTION D-D'



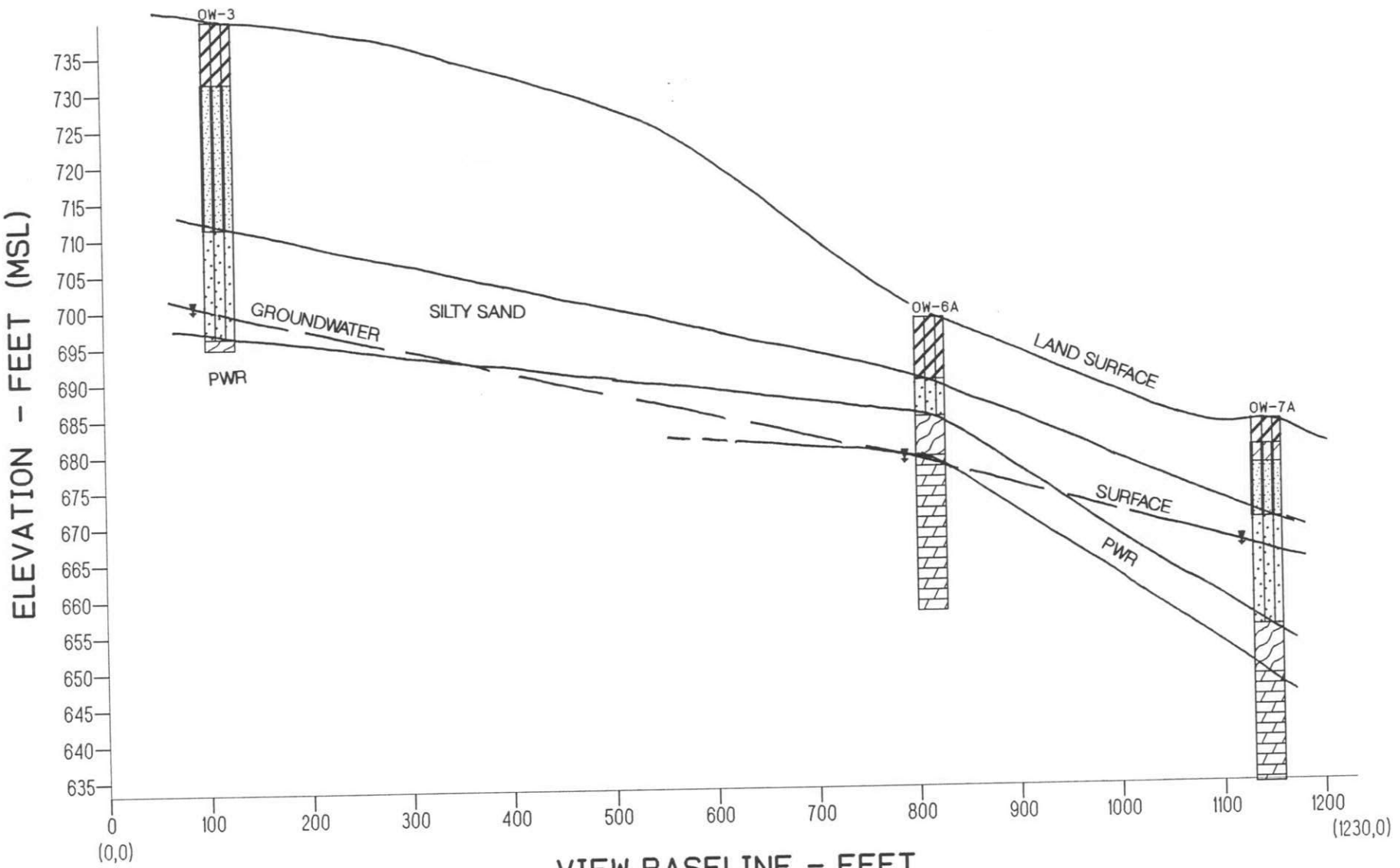
Topsoil	Clayey Sand	Sandy Clay	Cored Rock	
Organic	Sandy Silt	Silty Clay	Water Level at T.O.B.	
Silty Sand	Clayey Silt	Partially Weathered Rock	Water Level after 24Hrs.	

REVISION:	
SCALE: AS SHOWN	
APPROVED BY:	
DRAWN BY:	
DATE: 02/17/1998	JOB NUMBER: 1356-97-394

S&ME

FIGURE NO: 2

CROSS SECTION E-E'



Topsoil	Clayey Sand	Sandy Clay	Cored Rock
Organic	Sandy Silt	Silty Clay	Water Level at T.O.B.
Silty Sand	Clayey Silt	Partially Weathered Rock	Water Level after 24Hrs.

REVISION:	
SCALE: AS SHOWN	
APPROVED BY:	
DRAWN BY:	
DATE: 02/17/1998	JOB NUMBER: 1356-97-394

S&ME

FIGURE NO: 3

TABLE 1
SUMMARY OF LABORATORY TEST DATA
Hydrogeologic Evaluation
Lake Norman Landfill
Lincoln County, North Carolina
S&ME Project No. 1356-97-394

Boring No.	Sample Depth (Ft)	Sample Type*	USCS Classification	Natural Moisture Content (%)	% Finer No. 200	Atterberg Limits		Proctor Data		Remolded Conditions				Hydraulic Conductivity k (cm/sec)
						LL	PI	Max. Dry Density (pcf)	Opt. Moisture Content (%)	Specific Gravity	Porosity	Dry Density (pcf)	Moisture Content (%)	
OW-1	18.5 - 20	SS	SM	40.7	45.4					2.76				
OW-2	3.5 - 5	SS	CH	34.3	74.3	77	47			2.62				
OW-3	33.5 - 35	SS	SM	19.7	46.7					2.72				
OW-3	3.5 - 5	SS												
OW-4	28.5 - 30	SS	SM	24.7	33.7	NP	NP			2.73				
OW-5	8.5 - 10	SS	SM	30.4	45.2					2.67				
OW-6	3.5 - 5	SS	CL			39	22							
OW-6	13.5 - 15	SS												
OW-6A	9.0-11	UD	SM		46.2					2.78		85.4	24.1	1.8E-04
OW-7	25.5 - 28	SS	SM	35.1	39.2					2.74				
OW-7	8.5 - 10	SS	SM	22.8	37.7									
OW-7A	22-24	UD	SM		34.9					2.80		85.0	36.5	2.7E-04
OW-8	23.5 - 25	SS	SM	23.2	37.2					2.69				
OW-9	18.5 - 20	SS	SM	36.3	35.8					2.78				
OW-9	6 - 7.5	SS	SM	27.1	36.9									

K:\Shared...\97394\Sumlab2.xls

** Modified Proctor

* SS = Split Spoon Sample (ASTM D-1586)
UD = Undisturbed Sample (ASTM D-1587)
BAG = Bulk Sample

Job Name: Lake Norman Landfill
Location: Lincoln County, North Carolina
Job Number: 1356-97-394 Page 1 of 1

2.3 Groundwater

Across the site, the groundwater surface occurs in the regolith (soils, PWR) and bedrock under unconfined aquifer conditions. The soils typically have high porosity, but low permeability. These soils will, therefore, store precipitation and gradually recharge the bedrock aquifer via infiltration. Partially weathered rock acts as a transition zone between the residuum and bedrock, and typically is more permeable than the overlying soils.

Groundwater also occurs within fractures and joints of the bedrock. These fractures and joints are caused by physical weathering. Aquatards, which act as semi-confining layers separating underlying bedrock from overlying soils and PWR, do not typically exist in the Piedmont. Therefore, the soil units and bedrock are hydraulically connected.

Groundwater fluctuations are typically the result of changes in precipitation and evaporation through the seasons. Groundwater levels generally begin to decline in April or May due to the effects of increased evapotranspiration. Groundwater levels are typically the highest in the late winter-early spring due to decreased evapotranspiration rates and longer duration, frontal-type rainfall events occurring during the winter months. Exceptions to these typical trends in groundwater levels may occur due to unseasonably heavy rainfall events.

Groundwater levels were measured in the observation wells located within the vicinity of the proposed C&D landfill for the time period from September 12, 1997 through January 30, 1998. Groundwater data are provided in Table 2.

The highest water levels generally occurred during the January 30, 1998 monitoring event. The estimated seasonal high groundwater levels are projected to be 2 feet higher than the January 30, 1998 water levels. Monthly water levels will be recorded through the spring months to further evaluate seasonal high groundwater levels. Due to the unseasonably high precipitation during the winter of 1997-1998, water levels are expected to be above seasonal high water levels during the normal high water level months of April and May. Sheet 4 of the drawings illustrates the Potentiometric Surface Map based on January 30, 1998 water level data.

TABLE 2
SUMMARY OF GROUNDWATER LEVELS IN OBSERVATION WELLS

Lake Norman Landfill, Inc.
Mooresville, North Carolina
S&ME Job No. 1356-97-394

Date Measured	OW-1		OW-3		OW-4		OW-5		OW-5A		OW-6		OW-6A	
	TOC=	738.49	TOC=	742.67	TOC=	722.99	TOC=	698.13	TOC=	697.42	TOC=	699.76	TOC=	700.34
	DTW	WLE	DTW	WLE	DTW	WLE	DTW	WLE	DTW	WLE	DTW	WLE	DTW	WLE
Time of Boring**	21.50	716.99	41.40	701.27	31.70	691.29	11.60	685.82	NM		20.50	679.26	NM	
24-hour Reading**	22.00	716.49	40.50	702.17	33.00	689.99	15.60	681.82	15.80	681.62	NM		NM	
September 12, 1997	22.07	716.42	40.10	702.57	33.10	689.89	15.90	681.52	15.99	681.43	24.25	675.51	24.48	675.86
September 30, 1997	23.00	715.49	40.22	702.45	33.01	689.98	16.01	681.41	16.50	680.92	24.26	675.50	24.50	675.84
October 27, 1997	22.82	715.67	40.20	702.47	33.00	689.99	16.03	681.39	16.51	680.91	24.26	675.50	24.52	675.82
November 26, 1997	23.11	715.38	40.30	702.37	NM		15.51	681.91	15.87	681.55	dry		24.50	675.84
January 8, 1998	22.99	715.50	40.37	702.30	33.70	689.29	14.85	682.57	15.31	682.11	23.77	675.99	23.52	676.82
January 21, 1998	22.75	715.74	40.58	702.09	33.51	689.48	14.36	683.06	14.58	682.84	22.97	676.79	22.68	677.66
January 30, 1997	22.40	716.09	40.47	702.20	32.96	690.03	13.88	683.54	14.61	682.81	21.62	678.14	21.65	678.69
Maximum Water Level Variation #	1.04	--	0.48	--	0.74	--	2.15	--	1.93	--	2.64	--	2.87	--
Depth of Highest Stabilized Groundwater Level	22.07	716.42	40.10	702.57	32.96	690.03	13.88	683.54	14.58	682.84	21.62	678.14	21.65	678.69
Estimated Seasonal High Water Level		718.4		704.6		692.0		685.5		684.8		680.1		680.7

NOTES:
(1) All depths indicated in table are from Top of Casing (TOC)
(2) Elevations provided by Suttles Surveying, Inc. September, 1997
(3) Groundwater levels from January 30, 1998 were used for the Groundwater Contour Map.
(4) DTW: Depth To Water from top of casing (feet).
(5) WLE: Calculated Water Level Elevation (feet-NGVD).
(6) "NM" - No Measurement taken on this date.
(7) "WD" - Well Destroyed or no longer useable.
(8) "#" - Refers to variation between the minimum depth and maximum depth to stabilized groundwater measured in the field.
(9)** For well installation dates refer to the Boring Logs in Appendix I.

TABLE 2
SUMMARY OF GROUNDWATER LEVELS IN OBSERVATION WELLS

Lake Norman Landfill, Inc.
Mooresville, North Carolina
S&ME Job No. 1356-97-394

Date Measured	OW-7		OW-7A		OW-8		OW-9		OW-11		OW-12	
	TOC=	687.45	TOC=	685.72	TOC=	693.18	TOC=	680.59	TOC=	706.19	TOC=	731.48
	DTW	WLE	DTW	WLE	DTW	WLE	DTW	WLE	DTW	WLE	DTW	WLE
Time of Boring**	20.00	660.59	NM		23.00	670.18	19.00	661.59	NM		NM	
24-hour Reading**	23.20	657.39	NM		23.20	669.98	17.60	662.99	15.37	690.82	32.31	699.17
September 12, 1997	22.58	658.01	21.64	658.95	23.30	669.88	17.45	663.14				
September 30, 1997	22.66	664.79	20.67	665.05	23.40	669.78	17.51	663.08				
October 27, 1997	22.70	664.75	20.71	665.01	23.39	669.79	17.56	663.03				
November 26, 1997	21.36	666.09	19.36	666.36	23.46	669.72	16.62	663.97				
January 8, 1998	20.70	666.75	18.59	667.13	22.78	670.40	15.95	664.64				
January 21, 1998	20.09	667.36	17.99	667.73	22.45	670.73	15.66	664.93	15.28	690.91	32.36	699.12
January 30, 1997	19.55	667.90	17.43	668.29	22.00	671.18	15.17	665.42	14.23	691.96	32.31	699.17
Maximum Water Level Variation #	3.15	--	4.21	--	1.46	--	2.39	--	1.05	--	0.05	--
Depth of Highest Stabilized Groundwater Level	19.55	667.90	17.43	668.29	22.00	671.18	15.17	665.42	14.23	691.96	32.31	699.17
Estimated Seasonal High Water Level		669.9		670.3		673.2		667.4		694.0		701.2

NOTES:
(1) All depths indicated in table are from Top of Casing (TOC)
(2) Elevations provided by Suttles Surveying, Inc. September, 1997
(3) Groundwater levels from January 30, 1998 were used for the Groundwater Contour Map.
(4) DTW: Depth To Water from top of casing (feet).
(5) WLE: Calculated Water Level Elevation (feet-NGVD).
(6) "NM" - No Measurement taken on this date.
(7) "WD" - Well Destroyed or no longer useable.
(8) "#" - Refers to variation between the minimum depth and maximum depth to stabilized groundwater measured in the field.
(9) See well installation dates on Boring Logs in Appendix I.

Based on the groundwater measurement data, groundwater in the vicinity of the proposed landfill generally flows northwest toward Forney Creek under an average horizontal gradient of 0.38. Locally, flow diverges toward the tributaries located southwest and northeast of the landfill.

Fluctuations in the groundwater surface are the result of seasonal and temporal changes in precipitation and evapotranspiration. Changes in the water level in Forney Creek are not expected to cause any changes in the groundwater surface beneath the proposed C&D landfill footprint. Other features such as off-site private water supply wells are not expected to influence the groundwater surface beneath the site due to the distance of these wells to the site. The nearest wells are located approximately 780 feet southwest of the proposed limit of waste for the C&D landfill cell.

In order to evaluate hydraulic conductivity characteristics of the subsurface materials, S&ME conducted in-situ permeability tests using a rising head technique ("slug test"). The test data were analyzed by the Bouwer and Rice method. Field test data sheets and results are included in Appendix II. Test results are also summarized below:

Well ID	Lithologic Unit	Hydraulic Conductivity (cm/sec)	Effective Porosity	Hydraulic Gradient	Flow Rate (ft/year)
OW-1	Saprolite	2E-4	0.4	0.03	16
OW-4	PWR	6E-5	0.3	0.03	6
OW-5	Saprolite	2E-3	0.4	0.05	260
OW-6A	Bedrock	2E-5	0.05	0.05	20
OW-7	Saprolite	2E-4	0.4	0.02	10
OW-8	Saprolite	1E-4	0.4	0.04	10

Based on hydraulic conductivity values, estimated effective porosity values, and January 30, 1998 hydraulic gradients, groundwater flow rates would range from 6 to 260 feet per year.

Vertical hydraulic gradients were evaluated for the nested well locations. Based on the January 30, 1998 water level data and the well construction details the following hydraulic gradients were observed. Note that the vertical component of groundwater flow is upward at OW-5/5A and downward at OW-6/6A and OW-7/7A. Well nests OW-6/6A and OW-7/7A indicate a discharge area as expected, as Forney Creek is approached. Forney Creek is expected to be the groundwater discharge area for the groundwater flowing beneath the site in the uppermost aquifer.

Well ID	Hydraulic Gradient	Direction
OW-5/5A	0.037	Downward
OW-6/6A	0.023	Upward
OW-7/7A	0.016	Upward

3.0 DESCRIPTION OF LANDFILL COMPONENTS

3.1 Compacted Structural Fill Subgrade and Perimeter Berms

The proposed C&D landfill is designed to achieve a minimum 4-foot separation between the estimated seasonal high groundwater table and C&D waste. Compacted structural fill will be placed as needed to maintain the minimum 4-foot separation to the estimated seasonal high groundwater surface. Proposed grades are shown with a six foot separation on the Potentiometric Surface Plan on Sheet 4 of 12 in Appendix VII. Surface profiles are included on Sheets 6 and 7 in Appendix VII. Perimeter berms and ditches will be constructed to control and direct stormwater runoff.

3.2 Stormwater Collection and Removal

The Erosion and Sedimentation Control Plan (Sheet 10 of 12, Appendix VIII) illustrates a system of silt fencing, permanent diversion ditches, and a sediment basin. Diversion ditches downgradient of the C&D area will divert runoff from the C&D area to the sediment basin. The erosion and sedimentation control devices will remain in place until the final cap vegetation is established.

3.3 Cover Requirements

A six-inch thick layer of native soil will be placed over the waste at a minimum of once per week to control odor, vectors, and litter and to promote surface water runoff. If the exposed working area reaches 1/2 acre in size within a week, the entire 1/2 acre will be covered with six-inches of cover soil.

A 12-inch thick intermediate soil cover shall be placed over a waste area as necessary for vehicular access or on areas where waste placement will be inactive for 12 months or more. The intermediate covers will be placed at frequencies suitable for specific waste management operations.

3.4 Final Cover

The final cover will consist of 24-inches of non-select soil cover capable of supporting vegetation. This final cover shall be compacted when placed to help promote runoff. A grass cover is proposed for the landfill to minimize closure maintenance. The surface will be prepared by fertilizing and seeding in accordance with the North Carolina Erosion and Sediment Control Standards. The design objectives in evaluating the vegetative cover include:

- a drought resistant vegetative cap with a two-foot storage limitation,
- a low maintenance cover,
- cover selection to minimize volunteer vegetation
- reducing erodability of cover soils tolerance of final 3 H: 1 V side slopes with 20-foot wide benches every 50 vertical feet.

The selected vegetative cover is presented on the Erosion & Sedimentation Control Details in Appendix VII.

4.0 LANDFILL OPERATIONS AND MAINTENANCE

The property proposed for C&D landfill development is owned by Lake Norman Landfill, Inc. The landfill will be operated by Lake Norman Landfill, Inc. The Operational Manager responsible for the operations and maintenance of the site will be Mr. Clayton Hartsell of Lake Norman Landfill, Inc.

In general the landfill will service the State of North Carolina and South Carolina. The waste stream will be typically waste resulting from the construction, remodeling, repair or demolition operations on pavement, buildings or other structures. No household solid waste, commercial solid waste, industrial solid waste, hazardous waste, PCB waste, liquid waste or other banned wastes that may pose a threat to the environment and public health will be disposed at this facility.

Fill materials required for construction of perimeter berms, subgrade, and cover will be obtained from excavation of the landfill.

4.1 Landfill Capacity

The development of the landfill will be in one phase as depicted on the Closure Plan presented in Appendix VII.

Based on a yearly disposal rate of 1,000 tons/day and 1,200 lbs/cy (0.6 tons/cy) compaction, the capacity and life span for the first phase is as follows:

Phase	Approximate Net Capacity (cy)	Approximate Life Span (years)
1	2,510,000	5.3

4.2 Landfill Phasing

Phase 1 filling, encompassing 31 acres, will be constructed in its entirety. The erosion control devices shown on the Erosion and Sedimentation Control Plan will be constructed prior to development of Phase 1.

Waste will be placed initially in Phase 1 from the upgradient to the downgradient end of the phase. An initial approximately 10-foot lift of waste will be placed across the phase floor working from upgradient to downgradient areas. After the initial lift has been placed the subsequent lifts will also proceed from the upgradient end toward the downgradient end. This procedure will continue until proposed final contours for Phase 1 are reached. Additional phased filling will proceed after Phase 1 is completed, contingent on future permitting by the State of North Carolina.

4.3 Operating Equipment

The proposed C&D landfill will be operated with equipment owned by Lake Norman Landfill, Inc. Primarily, two Caterpillar 826C waste compactors, Caterpillar D8 dozer, Caterpillar 330 excavator, Caterpillar D50 articulated truck, Caterpillar 623 Pan, Caterpillar 12G grader and a water truck will be used for site operations and maintenance. Additional equipment will be available as necessary during operation of the C&D landfill.

4.4 Stormwater Collection and Removal

Stormwater runoff from the C&D landfill will be directed to a sediment basin through a system of ditches as shown on the drawings. The sediment basin and ditches will be inspected on a regular basis and any necessary repairs will be made as early as practical.

4.5 Waste Placement

Waste placement will be in lifts of approximately 10 to 12 feet in vertical thickness. As mentioned earlier, each lift will begin at the upgradient end of the phase and progress towards the downgradient end.

As higher elevations are reached, the waste may be placed from downgradient to upgradient on the active face slope as long as landfill surfaces are graded to allow proper drainage. Soil berms will be constructed as necessary to divert run-on from entering the working face or allowing run off to escape active areas.

4.6 Waste Acceptance and Disposal Requirements

The proposed C&D landfill is expected to receive a waste stream of the following waste types:

a. Land-clearing debris as defined in G.S. 130A-290, specifically, solid waste that is generated solely from land-clearing activities, such as stumps, trees, etc.;

b. Inert Debris defined as solid waste that consists solely of material that is virtually inert, such as brick, concrete, rock and clean soil;

c. Asphalt in accordance with G.S. 130-294(m);

d. Construction and demolition debris defined as solid waste resulting solely from construction, remodeling, repair of demolition operations on pavement, buildings, or other structures.

The landfill operator shall notify the Division within 24 hours of attempt to dispose of any other waste products. No hazardous, liquid, or infectious waste shall be accepted or disposed of in the C&D Landfill.

5.0 SITE OPERATIONS AND MAINTENANCE

5.1 Erosion/Sedimentation Control Maintenance

Erosion/sedimentation control structures include a sediment basin and diversion ditches. The basin and its spillways shall be checked after periods of significant runoff. The basin should be cleaned of accumulated sediment and returned to their original dimensions when sediment accumulates to one half of the design depth. The basin embankments and emergency spillway shall also be inspected for erosion damage. Necessary repairs shall be made immediately. Any debris within the emergency or principal spillway shall be removed.

Diversion ditches shall be inspected for damage after each runoff event. Damaged areas shall be repaired immediately.

Embankment slopes shall be periodically inspected for erosion. The embankment slopes shall be mowed at least once a year. The embankment slopes shall be refertilized in the second year unless vegetation growth is fully adequate. Damaged areas will be reseeded, fertilized and mulched immediately. Seeding, fertilizing and mulching shall be in accordance with Soil Conservation Service procedures and the local agricultural extension agent.

5.2 Access and Security Requirements

Traffic will enter off NC Highway 16 and Quarry Lane to the site. A security check station and weigh scales will be located at this entrance and will be used to evaluate the waste stream for proper disposal. An attendant will be on duty at the scales at all times the landfill is open for public use to enforce compliance with operational requirements. The access road to the C&D landfill shall be of all weather construction and maintained in good condition.

5.3 Dust, Litter, Odors and Vectors

Dust generated due to landfill activities will be controlled as necessary through the application of water by truck or other approved dust control products, if necessary. Removal of mud and dirt from the roads will also be a part of the dust control measures. Additionally, final cover will be vegetated as soon as practical in order to minimize the blowing of dust on-site.

The potential problem of blowing litter will be reduced by limiting the active working face and using cover material over the active fill area. Other methods, such as the utilization of pickers and portable fencing will be employed to contain loose paper and other wind blown refuse during the landfill operations. The landfill area will be monitored as required to collect airborne materials. Odors generated as a result of landfill activity will be controlled through the application of cover material. If odors cannot be controlled by the soil cover, masking agents or neutralizers will be used.

Control of vectors, such as rodents and flies, is an important environmental control. Control is accomplished by denying them a food source through the use of cover material.

5.4 Landfill Signs

Signs providing information on disposal procedures, the hours that the site is open for public use, the permit number, statements that no hazardous or un-permitted waste can be received without written permission, and other pertinent information is posted at the site entrance. Traffic signs and

markers shall be provided as necessary to promote an orderly traffic pattern to and from the active landfill area and maintain efficient operating conditions.

5.5 Fire Control

No open burning of waste will be permitted in the landfill. Equipment and stockpiled soil shall be provided to control accidental fires. Any fire that occurs at the landfill shall be reported to the Division within 24 hours and a written notification will be submitted within 15 days by the Operations Manager. The removal of waste from the C&D landfill is prohibited unless approved by the Division and the removal is not performed on the working face.

5.6 Methane Gas Monitoring System

Gas monitoring will be performed annually in the groundwater monitoring wells and within on-site manned structures. If methane gas is encountered, surface probing will be performed to determine the extent of gas migration for use in design and installation of a permanent gas monitoring system for on-site facility structures and property boundaries. If the permanent gas monitoring system detects methane above acceptable limits, a remediation plan will be prepared and implemented.

Explosive gases will be controlled such that concentrations of gases will be less than 25 percent of the lower explosive limit (LEL) in site structures and below the LEL of gases in the subgrade at the property boundary.

6.0 WATER QUALITY MONITORING PLAN

The water quality monitoring plan is presented to provide the necessary requirements as indicated in the Solid Waste Management Rules Section .0504(1)(g)(iv) of 15A NCAC 13B. The purpose of the monitoring program is to monitor the quality of the groundwater in the surficial aquifer underlying the facility and surface water adjacent to the facility during operation of the landfill. This monitoring plan is designed to effectively detect a potential release from the landfill into the uppermost aquifer as a release would migrate to areas downgradient of the landfill.

The information in this plan is designed to assist the Division of Solid Waste Management, the Operations Personnel and it's agents in evaluation of potential impact to groundwater quality. Included in this plan are sections concerning monitoring well locations, surface water sampling locations, monitoring well construction, sampling procedures, analytical procedures, reporting requirements and data assessment. Sampling and analytical procedures will be performed in accordance with the Division's rules and policies. The plan is divided into 1) a Groundwater Monitoring Plan and 2) a Surface Water Monitoring Plan.

6.1 GROUNDWATER MONITORING PLAN

6.1.1 Monitoring Well Network

The proposed monitoring well locations for the C&D landfill are shown on the Water Quality Monitoring Plan, Sheet 9 in Appendix VII. The proposed monitoring well network consists of 1 upgradient well (MW-1) and 3 downgradient wells (MW-2, 3 and 4). The well locations were selected for characterization of groundwater quality and to enable the detection of changes in groundwater quality in the vicinity of the C&D area. The proposed downgradient wells are to be located approximately 125 to 150 feet from the proposed waste boundary to enable early detection of constituents potentially released from the landfill. The spacing and locations of the wells were selected based on landfill limits, surface drainage features, geologic conditions and groundwater flow directions.

Monitoring well MW-1 is proposed as an upgradient or background water quality monitoring point. Proposed monitoring wells MW-2, MW-3 and MW-4 are located as downgradient or compliance monitoring points. The proposed monitoring wells are to be constructed to various depths within the surficial aquifer. As indicated previously, the groundwater flow is generally towards Forney Creek that serves as the major discharge boundary for the uppermost aquifer beneath the site. Proposed monitoring wells will be installed to monitor the upper surficial aquifer, downgradient from the proposed landfill. These locations were selected based on groundwater flow directions and proposed site development features.

6.1.2 Monitoring Well Construction

The four proposed monitoring wells will be shallow monitoring wells constructed in accordance with the North Carolina Well Construction Standards (15A NCAC 2C .0108) and the requirements of the North Carolina Water Quality Monitoring Guidance Document for Solid Waste Facilities. A typical monitoring well construction detail for these wells is depicted in Appendix I. The screened intervals were selected based on the minimum depth to groundwater in the vicinity of the well (based on estimated high groundwater levels) such that the wells will be screened across the groundwater surface. For wells where the seasonal high groundwater surface is expected to be within 5 feet of the land surface, the top of screen was selected to be 4 feet below land surface to allow for a minimum surface seal of 3.5 feet. The actual screened intervals will be selected based on site conditions encountered during drilling, such as the top of bedrock.

Proposed Monitoring Monitoring Well	Estimated Seasonal High Depth to Groundwater	Proposed Screened Interval	Approximate Ground Interval
MW-1	22 ft	18 - 33 ft	748.5 ft
MW-2	13 ft	9 - 24 ft	680 ft
MW-3	3 ft	4 - 19 ft	674 ft
MW-4	1 ft	4 - 19 ft	680.5 ft

6.1.3 Well Installation Procedures

Boreholes shall be drilled and the wells constructed by a North Carolina licensed well driller. All equipment used for drilling and completion of the wells will be properly cleaned prior to use at each location. At a minimum, this will consist of high pressure steam cleaning of the downhole drilling equipment prior to performing each boring. Boreholes will be a minimum of 6.25 inches in diameter and will be drilled using either hollow-stem auger, coring or air rotary drilling methods. S&ME anticipates that hollow-stem auger drilling methods will be feasible for the MW-2, MW-3 and MW-4 locations. Shallow bedrock may be encountered at the proposed MW-1 location, that may require coring or air rotary drilling methods.

All monitor wells will be constructed of 2-inch I.D. PVC, schedule 40 flush-joint threaded casing and .01-inch machine slotted screen. Only casing with water-tight joints will be used. All well construction materials will be thoroughly cleaned prior to installation or will be installed directly from factory-sealed packaging.

Once the borehole has been drilled, the project manager will approve the monitoring well construction based on site-specific hydrogeologic conditions and the following general criteria:

1. The upper surficial aquifer monitoring well screen intervals are to be 15 feet in length and located so that the estimated seasonal high water table is approximately 4 feet above the top of the screened interval. The proposed depths of the screen intervals are provided in Section 6.1.2. For areas with high groundwater levels (i.e., less than 5 feet below land surface), the top of screen shall be placed at a depth of 4 feet to allow adequate seal and to allow sufficient grout and concrete collar to secure the protective casing.

2. The annular space between the borehole wall and the well casing will be backfilled with clean, well rounded, washed, high grade silica sand appropriately sized to the formation material and screen. The sand pack shall be placed to two feet above the slotted screen using a tremie pipe. Water used to tremie the sand in place will be analyzed for the parameters listed in Table 3. A minimum of 0.5 feet of sand above the screen may be used

where the depth to groundwater is less than five feet. The filter pack level will be frequently sounded and kept at the base of the augers or temporary casing until the desired length of filter pack is in place. The well will be pre-developed, by bailing, prior to the placement of the bentonite seal. The sand pack will be re-measured and additional sand added as needed to obtain the desired level.

3. A 0.5-foot to 2-foot pelletized bentonite seal will be placed above the filter pack and hydrated with clean water for a minimum of 2 hours. The seal will be placed with a tremie pipe unless conditions prevent such practice. Care will be taken so that the augers or temporary steel casing is withdrawn above the top of the pellets to prohibit the bentonite pellet seal from sticking to the auger or casing.

4. The remainder of the annular space will be filled with a cement/bentonite grout from the top of the bentonite seal to near (approximately 3 feet below) ground surface. The grout will be slowly pumped into the tremie pipe with a side discharge at a constant rate to prevent dilution or differential settling until it flows out at the surface. The cement/bentonite slurry is to be mixed with six gallons of potable water for each 94-pound sack of Type I Portland cement and 3 to 5 pounds of powdered bentonite. The water of the cement slurry should have a low sulfate content and a total dissolved solids content less than 2,000 parts per million and free of organics. No aggregate materials are to be included in the slurry. The temporary casing, if used, should be removed as the grout is placed in the borehole. Subsequent to set up, additional grout may be required for "topping off" the grout seal to near ground surface. After grouting, no work will be permitted on the well for a minimum of 24 hours while the grout is setting.

5. A steel protective casing with a locking cap will be placed over the well's riser pipe. The protective casing will extend no more than 2.5 feet above ground surface. The protective casing will be placed on the well casing following the initial grouting. The protective casing will be sealed and immobilized in a concrete collar placed around the protective casing. A 1/4-inch diameter weep hole will be drilled in the protective casing 6-inches above the concrete pad to prevent water build-up and possible freezing and ice damage (crushing) to

the riser pipe. In addition, a vent will be provided on the 2-inch well casing. The protective casing will be primed, painted, and provided with a permanently affixed name plate with the following information as required in the well standards:

- Well identification number
- Drilling contractor name and registration number.
- Total depth of well.
- Depth of screen interval.
- Depth to groundwater following well completion.
- A warning that the well is not for water supply and that the groundwater may contain hazardous materials.

6. A concrete slab or pad sloping gently away from the well in all directions, will be constructed. The slab will serve as anchorage and to prevent surface water from migrating along the wall of the casing. A typical detail for the monitoring wells is provided in Appendix I.

7. The location, installation methods and construction details of the wells may be modified depending on field conditions (i.e. shallow groundwater). Any modifications, other than for high groundwater conditions, will be discussed with NC Solid Waste Section prior to the construction of the monitoring well requiring modifications.

8. It is the responsibility of the owner/operator of this landfill to insure that the groundwater monitoring system described in these plans is installed under the supervision of a geologist licensed to practice in the State of North Carolina.

The following information shall be recorded during the construction of wells and maintained by the owner:

- Name of driller, identification of drill rig
- Date/Time of construction
- Drilling method
- Well location (±0.5 ft.)
- Borehole diameter and well casing diameter

- Well depth (±0.1 ft.)
- Drilling logs
- Casing materials
- Screen Materials and design
- Casing and screen joint type
- Screen slot size/length
- Filter pack material/size
- Filter pack volume
- Filter pack placement method
- Sealant materials
- Sealant volume
- Sealant placement method
- Surface seal design/construction
- Well development procedures
- Type of protective well casing
- Top of casing and Ground surface elevation (±0.01 ft.)

6.1.4 Well Maintenance

The wells and surrounding area shall be maintained in such a way to ensure access to the wells for sampling and to maintain the integrity of the wells. The monitoring wells shall be accessible by at least a four-wheel drive vehicle. Brush and weeds shall be cleared from around the wells (minimum of 10-foot radius). The well protective casings should be painted with a high visibility color paint. Surface water run-on controls shall be provided, where necessary, to prohibit erosion of or undermining of the concrete pads. The concrete pads shall be monitored at least semi-annually for integrity and repairs performed as needed.

6.1.5 Well Development

Following well installation, the monitoring wells will be developed in order to remove clay, silt and sand and other fines which may have been introduced into the formation or sand pack during drilling and well installation and to establish equilibrium of the well with the aquifer. Well development will be performed as soon as possible after well construction and will continue until the suspended solids are removed from the sand pack and well, and turbidity is reduced to acceptable levels.

6.1.6 Well Purging and Sampling

The laboratory performing the groundwater analysis shall supply all necessary coolers, pre-cleaned containers, trip blanks, chemical preservatives, labels, custody seals, chain-of-custody and shipping forms. Adequate instructions to the laboratory will be given in advance of each monitoring event. Details concerning any changes to the monitoring plan and/or procedures will be given to the laboratory in writing prior to the field sampling personnel arriving on the site. A specific contact person shall be established at both the facility and contract laboratory for communication between the two (2) parties.

Sample containers need to be constructed of a material compatible and non-reactive with the material it is to contain. As noted above, the contract laboratory performing the analysis shall supply all the required containers. In special circumstances when the facility must obtain its own containers, these containers will be purchased from local container distributors with the exception of the septum vials and PTFE (e.g. Teflon™) lined caps required for organic analyses which are available from laboratory supply companies. Metal lids shall not be utilized for any sample containers.

A complete set of precleaned and prelabeled sample bottles will be removed from the cooler, and a groundwater sample from the pump (for each well) will be poured into a fresh container. Preservatives shall be added as necessary (in accordance with EPA Methods SW-846) to the sample bottles either by the laboratory or in the field immediately prior to sampling. One trip blank prepared by the laboratory shall be analyzed for each sampling event. One equipment blank will be prepared in the field at a routine sample collection point during each monitoring event by filling the appropriate sample containers from the field supply of water used to decontaminate field equipment. One field duplicate will also be collected during each monitoring event.

Prior to the initial well sampling, the highest point on the top of casing for each well shall be surveyed by a state registered land surveyor. The casing elevation shall be referenced to the site benchmark in order to calculate the elevation of the groundwater surface. The wells shall also be surveyed for horizontal control.

Prior to the well purging for each sampling event, the depth to water and total well depth shall be determined with the use of an electronic water level indicator. The water level indicator will be decontaminated at each well with a non-phosphate detergent followed by multiple deionized water rinses. The water level shall be measured by turning the instrument on and slowly lowering the instrument probe into the well until the water level indictor contacts the water activating an alarm and then lowering the probe to the base of the well. The depth to the water and well depth from the highest point on the well casing shall be measured and recorded and the amount of water within the well casing shall be calculated. All measurements shall be recorded to the nearest 0.01 foot and within a 48-hour period. In addition to the static water level, a total well depth will be measured at each monitoring well during each sampling event.

The primary objectives during the collection of groundwater samples for analysis are to obtain a representative groundwater sample and to prevent the sample from being altered or contaminated during withdrawal from the well or during sample preparation. Special procedures are often necessary for sampling monitoring wells based on their yield. For the purpose of this plan, a high-yield well will be defined as a well where the water level cannot be drawn down more than 20 percent of the water column by bailing or pumping by hand. Water levels in moderate-yield wells can be drawn down more than 20 percent, however, it cannot be evacuated to dryness. High-yield and moderate-yield wells will be purged a minimum of three well casing volumes prior to sample collection. A low-yield well can be evacuated to dryness and requires a minimum of a few hours to days to fully recover.

Groundwater monitoring wells will be purged with individually-wrapped, laboratory-decontaminated teflon bailers. Field parameters to be measured during each purge event include pH, temperature, and conductivity. In addition to the minimum purge volume described above,

each monitoring well shall be purged until the pH, temperature, and conductivity stabilize. Parameter stabilization is defined as:

- Specific Conductivity = +/- 10% for two consecutive measurements at approximately one well volume increments.
- pH = +/- 0.15 standard pH units for two consecutive measurements at approximately one well volume increments.
- Temperature = +/- 1° C for two consecutive measurements at approximately one well volume increments.

Monitoring of temperature, pH, conductivity, and turbidity for stabilization will be recorded on a field log for each monitoring well.

This section outlines the equipment preparation prior to site arrival for a specific monitoring event. This equipment preparation includes minimum decontamination procedures for water level indicator(s), filter device (if applicable), pH/temperature meter and specific conductivity meter.

- Water Level Indicator(s) - Water level indicator(s) will be decontaminated prior to initial site arrival by hand washing the sensor probe and entire length of tape in a laboratory grade non-phosphate detergent followed by a triple rinse with organic free water. While the tape is reeled back onto the carrying spool, the tape and probe will be wiped down with a clean dry paper towel.

- pH/Temperature Meter - Meters, both primary and back-up sets, will be decontaminated by hand washing the sample cells in a laboratory grade non-phosphate detergent followed by a triple rinse with organic free water. Meters will then be checked for proper calibration and operation. Any malfunctioning meters will be replaced prior to packing.

- Specific Conductivity Meter - Meters, both primary and back-up sets, will be decontaminated by hand washing the probes in a laboratory grade non-phosphate detergent followed by a triple rinse with organic free water.

Meters will then be checked for proper calibration and operation. Any malfunctioning meters will be replaced prior to packing.

In case of equipment failure, at least one back-up instrument is recommended to be in the sample crew's possession. If a back-up instrument is not available, or fails in addition to the primary equipment, sampling will not proceed until the proper equipment is made available.

The monitoring wells shall be sampled as soon as purging is complete if the well has sufficient recharge. In any event, the time interval between completion of well purge and sample collection will not exceed 24 hours. Groundwater samples will be collected with the same bailer used for purging.

The sample containers shall be filled slowly, directly from the bailers. The sample shall be handled in a way to minimize aeration. No air bubbles or "head-space" will be allowed in the containers used for volatile organic compound analyses. Sample and project information will be placed on the container labels prior to sampling.

The filled sample bottles shall then be securely placed into a precleaned cooler and a chain-of-custody form completed and placed with the samples prior to shipping to a North Carolina certified laboratory for analysis. Finally, the well shall be capped and secured.

Hydraulic conductivity tests shall be performed on all new wells prior to the reporting of the initial sampling event to allow the estimation of groundwater flow rate in the vicinity of each well. Porosity values for the permeable portions of the screened aquifer will be estimated based on grain size. Hydraulic conductivity and porosity values will be used with groundwater gradients to estimate groundwater flow rates at each well.

6.1.7 Sampling Frequency

Each monitoring well will be sampled semi-annually which is consistent with the existing sampling requirements. The first semi-annual sampling will be performed following or during construction of the landfill but prior to waste placement into the landfill.

6.1.8 Field Analysis and Reporting Requirements

The sample collector will maintain a field book or log to record all pertinent information regarding the purging and sampling of monitoring wells. The information to be recorded includes, at a minimum, the following:

1. Collectors name, date and time of sampling,
2. Site name and location,
3. Well identification and monitoring well number,
4. Sample preservatives,
5. Laboratory analyses to be performed on each sample,
6. Well depth measured from top of casing,
7. Water level depth measured from top of casing,
8. Well casing inside diameter,
9. Well casing volume,
10. Time and method of purging,
11. Reason for sampling,
12. Sample pH, temperature, specific conductance, with each well volume
13. Sample volume, container type, preservatives,
14. Sample observations, color, turbidity,
15. Weather conditions at the time of sampling,
16. Additional comments

The field data shall be recorded and retained in the project files and copies submitted to the appropriate State agencies. Items 1 through 5 will be placed on the sample tables and chain-of-custody forms.

6.1.9 Laboratory Analysis Parameters

Laboratory analysis parameters listed in Table 3 shall be verified prior to each sampling event. The list of parameters in Table 3 shall be analyzed for all samples and blanks. All groundwater quality monitoring data shall be compared to the North Carolina Standards, 15A NCAC 13B 264.94(a), Appendix IX 265 and 15A NCAC 2L .0202, where applicable.

Sample analyses shall be performed by a North Carolina Department of Environment and Natural Resources "certified" laboratory. All data shall be subjected to a strict quality assurance and quality control protocols. Only analytical methods that are acceptable to the Solid Waste Management Division shall be used by the laboratory selected to perform the analyses. The analytical results will be reported to the practical quantitation limits.

6.1.10 Data Evaluation and Reporting

In order to estimate groundwater flow direction and rate at each monitoring well, the horizontal hydraulic gradient, the hydraulic conductivity, and the effective porosity will be used. The hydraulic gradient and direction will be estimated based on the water level elevations from water level measurements recorded during each sampling event. The hydraulic conductivity for the aquifer interval monitored will be estimated based on a rising-head, in-situ permeability test performed following installation of the monitoring well and prior to the submittal of the initial monitoring report. The effective porosity will be based on tests performed on soil samples from the screened interval collected during the installation of the monitoring well or estimated from soil classification.

All analytical reports will be completed and submitted to the appropriate State agencies with referenced methodologies, QA/QC data, field logs, analysis request forms and chain-of-custody

Table 3
Parameters to Evaluate Water Quality
Proposed Lake Norman Landfill, Inc. C&D Landfill

Constituent	PQL, ug/L	Constituent	PQL, ug/L
Inorganic Constituents			
Arsenic	10	Lead	10
Barium	500	Mercury	1
Cadmium	1	Selenium	20
Chromium	10	Silver	10
Organic Constituents			
Acetone	100	Acrylonitrile	200
Benzene	5	Bromochloromethane	5
Bromodichloromethane	5	Bromoform	5
Carbon disulfide	100	Carbon tetrachloride	10
Chlorobenzene	5	Chloroethane	10
Chloroform	5	Chlorodibromomethane	5
1,2-Dibromo 3-chloropropane; DBCP	25	1,2-Dibromoethane; Ethylene dibromide	5
o-Dichlorobenzene; 1,2-Dichlorobenzene	5	p-Dichlorobenzene; 1,4-Dichlorobenzene	5
trans-1,4-Dichloro-2-butene	100	1,1-Dichloroethane; Ethylidene chloride	5
1,2-Dichloroethane; Ethylene dichloride	5	1,1-Dichloroethylene; 1,1-Dichloroethene;	5
cis-1,2-Dichloroethylene, cis-1,2-Dichloroethene	5	trans-1,2-Dichloroethylene; trans-1,2-Dichloroethene	5
1,2-Dichloropropane; Propylene dichloride	5	cis-1,3-Dichloropropene	10
trans-1,3-Dichloropropene	10	Ethylbenzene	5
2-Hexanone; Methyl butyl ketone	50	Methyl bromide; Bromomethane	10
Methyl chloride; Chloromethane	10	Methylene bromide; Dibromomethane	10
Methylene chloride; Dichloromethane	10	Methyl ethyl ketone; MEK; 2-Butanone	100
Methyl iodide; Iodomethane	10	4-Methyl-2-pentanone; Methyl isobutyl ketone	100
Styrene	10	1,1,1,2-Tetrachloroethane	5
1,1,2,2-Tetrachloroethane	5	Tetrachloroethylene;Tetrachloroethene;Perchloroethylene	5
Toluene	5	1,1,1-Trichloroethane; Methylchloroform	5
1,1,2-Trichloroethane	5	Trichloroethylene, Trichloroethene	5
Trichlorofluoromethane; CFC-11	5	1,2,3-Trichloropropane	15
Vinyl acetate	50	Vinyl Chloride	10
Xylenes	5		

NOTES

1. PQL - Practical Quantitation Limit.

6.2 SURFACE WATER MONITORING PLAN

6.2.1 Surface Water Monitoring Locations

Surface water samples from Forney Creek will be monitored for the parameters listed in Table 3. Monitoring locations SW-1 and SW-2 are illustrated on the attached Water Quality Monitoring Plan (Sheet 9, Appendix VII). SW-1 is located upstream of the proposed C&D landfill and SW-2 is located downstream of the proposed C&D landfill. In the event that monitored constituents are detected in surface water samples from SW-2, additional surface water quality monitoring stations may be established following discussions with the NC Solid Waste Section.

6.2.2 Surface Water Sampling Procedures

The following sampling procedures are referenced from "EPA Standard Operating Procedures", Section 4.8 and "North Carolina Water Quality Monitoring Guidance Document for Solid Waste Facilities", 1987.

The actual sampling point in the stream or creek shall be in an area of minimal turbulence and aeration. The sampling point shall not be located at a constriction (where creek narrows), immediately upstream or downstream of a confluence with a tributary, nor immediately upstream or downstream of any significant structure in the creek that may result in turbulence. To the extent possible, a single grab sample shall be taken at mid-depth, at the center of the channel, in an area that exhibits the greatest degree of cross-sectional homogeneity.

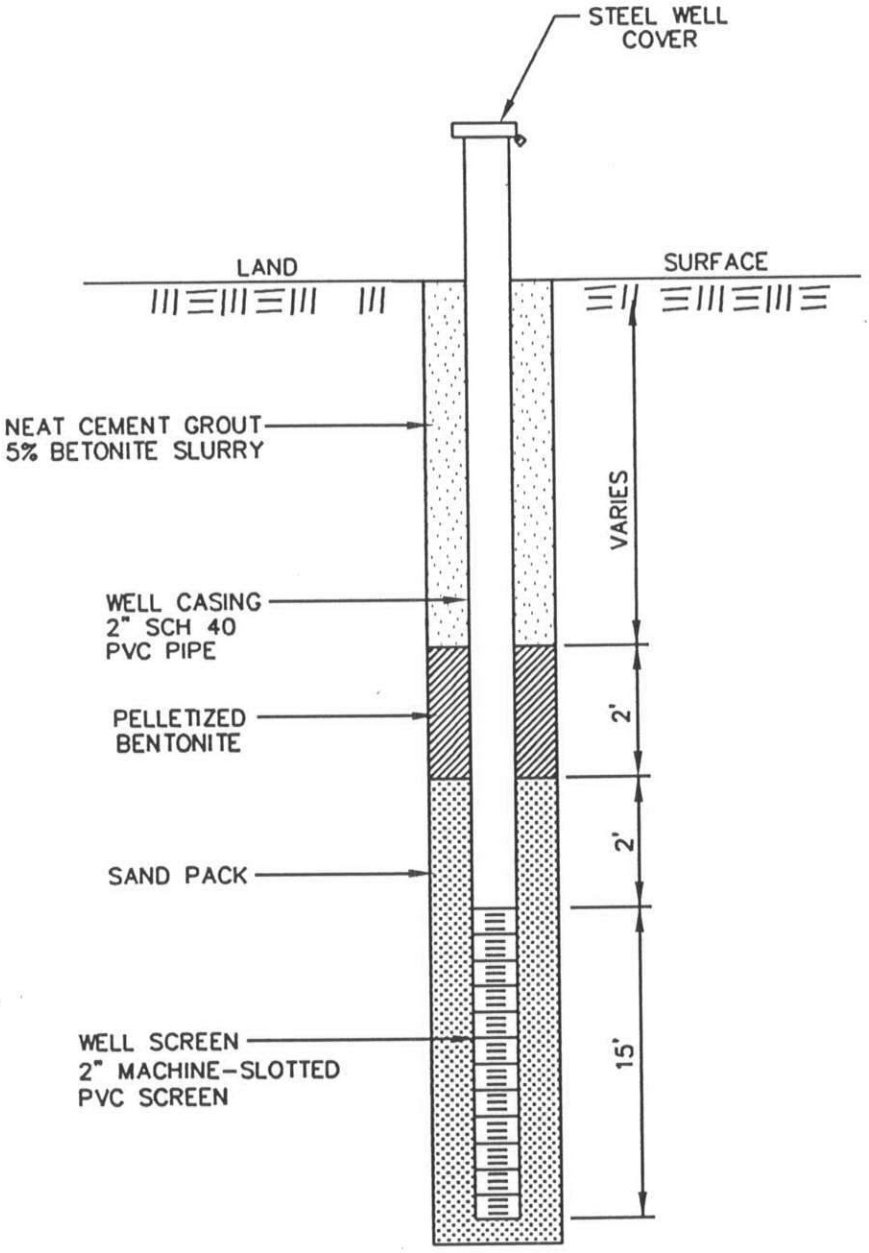
Direct dipping of the sample container into the creek is the most desirable method of collection but a laboratory cleaned Teflon bailer or dipper may be used. The sample container should be rinsed with the water to be sampled prior to filling the container, unless preservatives have been added. The sample container, bailer or dipper shall be lowered to the desired depth in the creek and the sampling device or container removed. Care should be taken not to allow sediment or other debris to enter the sample container. If the stream flow is not deep enough to submerse the sample container in the water, a temporary depression may be created and used to collect the sample.

After the sample has been collected, the sample container should be lifted from the water or the sample poured directly into the sample container (if sample container not used to collect sample). About one-half inch of air space should be left in the container and the uncontaminated cap placed on the container. The containers for volatile organic samples shall be filled to the top without bubbles or headspace. The containers should be placed in protective cooler with ice for shipping.

6.2.3 Quality Control and Reporting Requirements

A primary concern during collection of surface water samples is to insure that samples are not altered or contaminated by sediment or other debris that may affect the analytical results. A set of sample bottles that has been precleaned in the laboratory will be removed from the cooler and the surface water sample poured into a fresh container. Preservatives will be added as necessary to the sample bottles at the laboratory or immediately prior to samples being placed in them. The sample bottles will then be securely placed into a precleaned cooler and a chain-of-custody form completed and placed with the samples.

The surface water sampling frequency, field analysis procedures, laboratory analysis parameters, field reporting requirements, data assessment, evaluation and reporting of the data and results shall be the same as that of the groundwater samples discussed in Section 6.1.



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CHECKED BY:	
DRAWN BY:	MFP
DATE:	2-18-98

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TYPICAL SHALLOW WELL SCHEMATIC
LAKE NORMAN LANDFILL, INC.
LINCOLN COUNTY, NORTH CAROLINA

JOB NO: 1356-97-394

FIGURE NO.

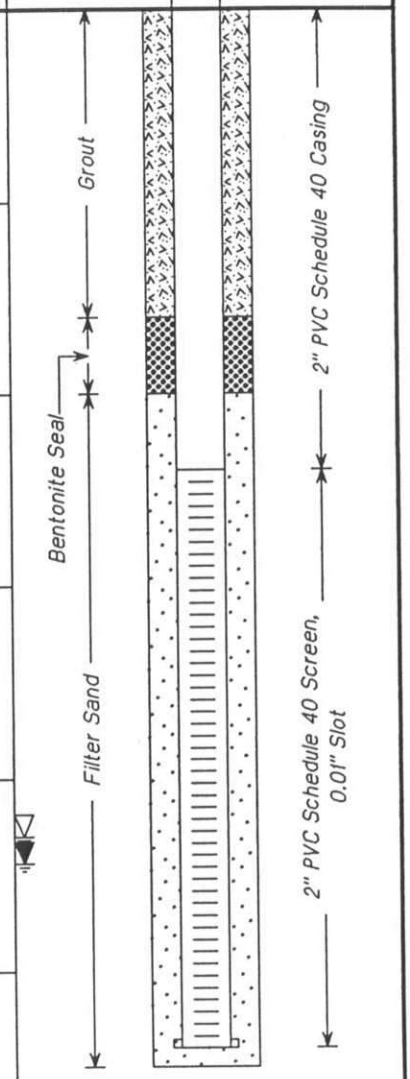
APPENDIX I
BORING LOGS

PROJECT:	LAKE NORMAN LANDFILL, INC. Lincoln County, North Carolina	WELL LOG	OW-1

PROJECT NO. : 1356-97-394	ELEVATION: 735.91 MSL	NOTES: TOC ELEV = 738.49
LOGGED BY: JPR	BORING DEPTH: 27.5 FEET	
DATE DRILLED: 8-19-97	WATER LEVEL: 21.5	
DRILLING METHOD: 4-1/4" HSA	DRILL RIG: ATV B-57	

DEPTH (ft)	GRAPHIC LOG	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.
0		RESIDUUM: Red Brown Micaceous Sandy Silty **CLAY**	1			9	
			2			17	731
5			3			15	
		Red Brown Micaceous Sandy **SILT**	4			11	726
10							
		Brown Tan Micaceous Silty Medium to Fine **SAND** with Manganese	5			11	721
15							
			6			8	716
20							
			7			9	711
25		**Partially Weathered Rock**					
		Boring Refusal at 27.5 feet. *Water level at 21.5 feet at termination.*	8			50/0	706
30							
							701
35							

WELL DIAGRAM



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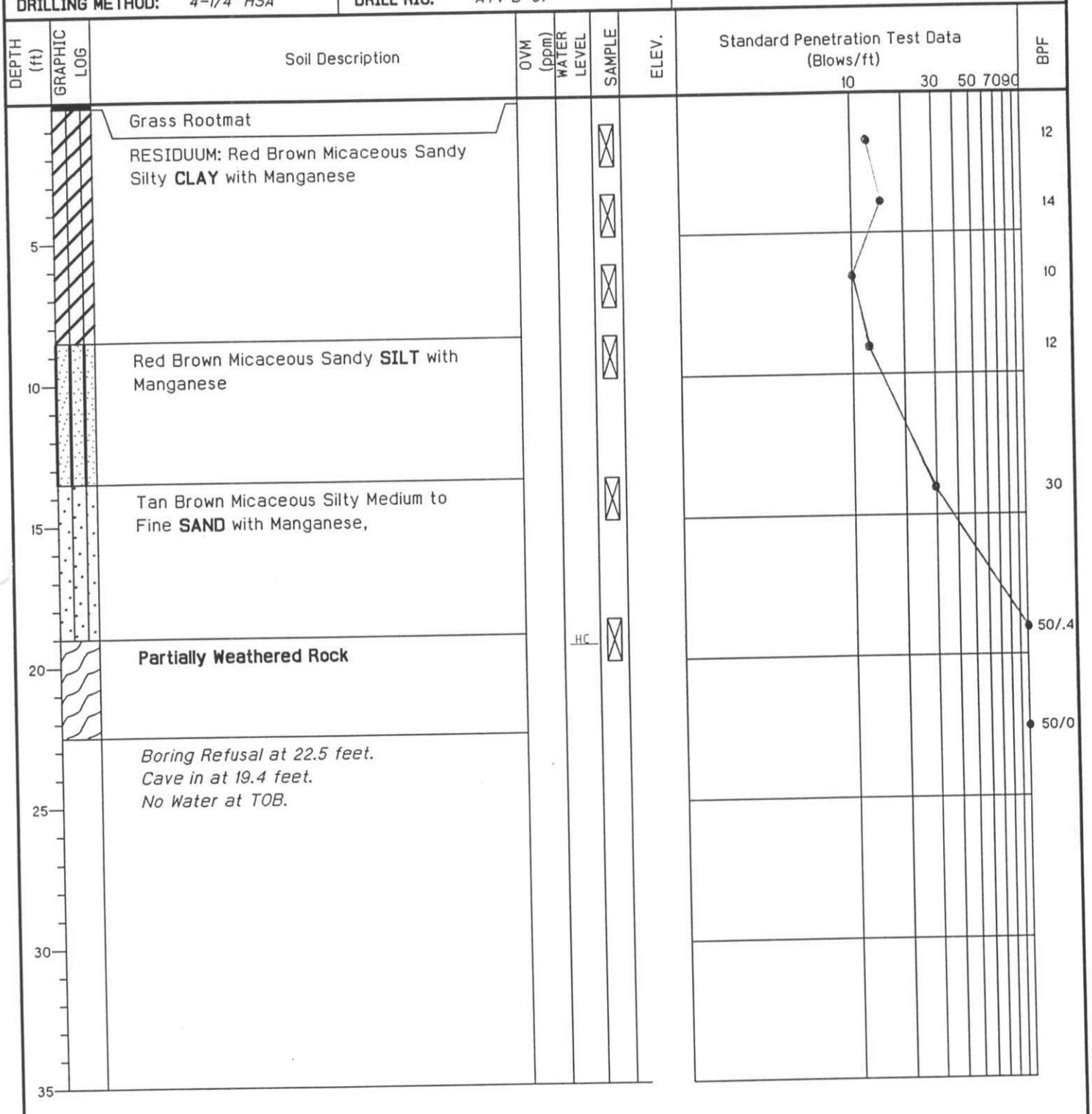
PROJECT:	LAKE NORMAN LANDFILL, INC. Lincoln County, North Carolina	TEST BORING RECORD	B-2
PROJECT NO. :	1356-97-394	ELEVATION:	NOTES: Elevations not surveyed
LOGGED BY:	JPR	BORING DEPTH: 22.5 FEET	
DATE DRILLED:	8-20-97	WATER LEVEL:	
DRILLING METHOD:	4-1/4" HSA	DRILL RIG: ATV B-57	



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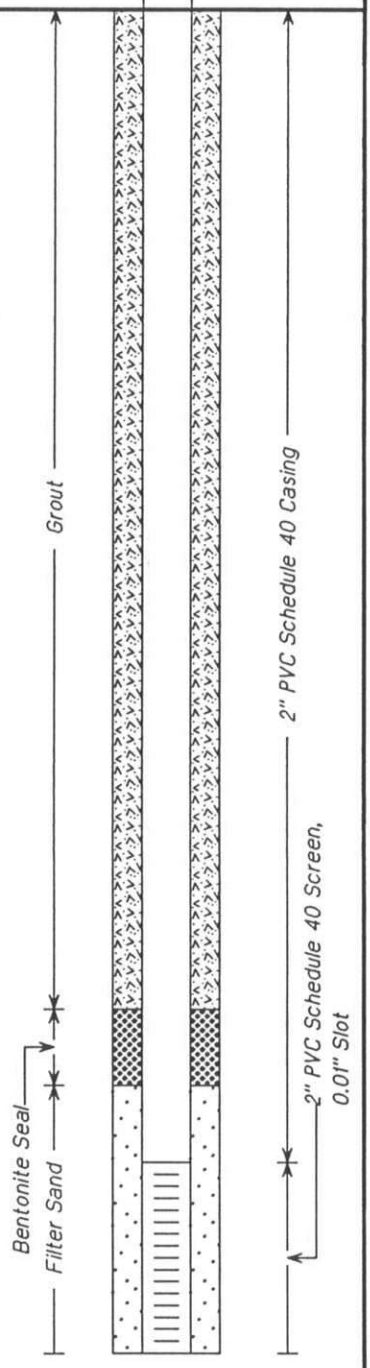
PROJECT:	LAKE NORMAN LANDFILL, INC. Lincoln County, North Carolina	WELL LOG	OW-3

PROJECT NO. : 1356-97-394	ELEVATION: 739.84 MSL	NOTES: TOC ELEV = 742.67
LOGGED BY: SRN	BORING DEPTH: 45.0 FEET	
DATE DRILLED: 8-22-97	WATER LEVEL: 41.4	
DRILLING METHOD: 4-1/4" HSA	DRILL RIG: ATV B-57	

DEPTH (ft)	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.
5	RESIDUUM: Red Micaceous Sandy Silty **CLAY**	1	X		24	
		2	X		20	735
		3	X		16	
10	Reddish White Micaceous Sandy **SILT** with Manganese	4	X		11	730
15		5	X		16	725
20		6	X		20	720
25		7	X		17	715
30	Brown White Micaceous Silty Fine to Medium **SAND** with Manganese	8	X		36	710
35		9	X		27	705

WELL DIAGRAM



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PROJECT:	LAKE NORMAN LANDFILL, INC. Lincoln County, North Carolina	WELL LOG	OW-3
PROJECT NO.: 1356-97-394	ELEVATION: 739.84 MSL	NOTES: TOC ELEV = 742.67	
LOGGED BY: SRN	BORING DEPTH: 45.0 FEET		
DATE DRILLED: 8-22-97	WATER LEVEL: 41.4		
DRILLING METHOD: 4-1/4" HSA	DRILL RIG: ATV B-57		

DEPTH (ft)	GRAPHIC LOG	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.	WELL DIAGRAM
40		Tan White Micaceous Silty Medium to Coarse **SAND** with Manganese, Quartz Vein	10	☒		30	700	Filter Sand; 2" PVC Schedule 40 Screen, 0.01" Slot
		Partially Weathered Rock	11	☒		80/.8		
45		*Boring terminated at 45.0 feet.* *No Water at TOB.*					695	
50							690	
55							685	
60							680	
65							675	
70							670	

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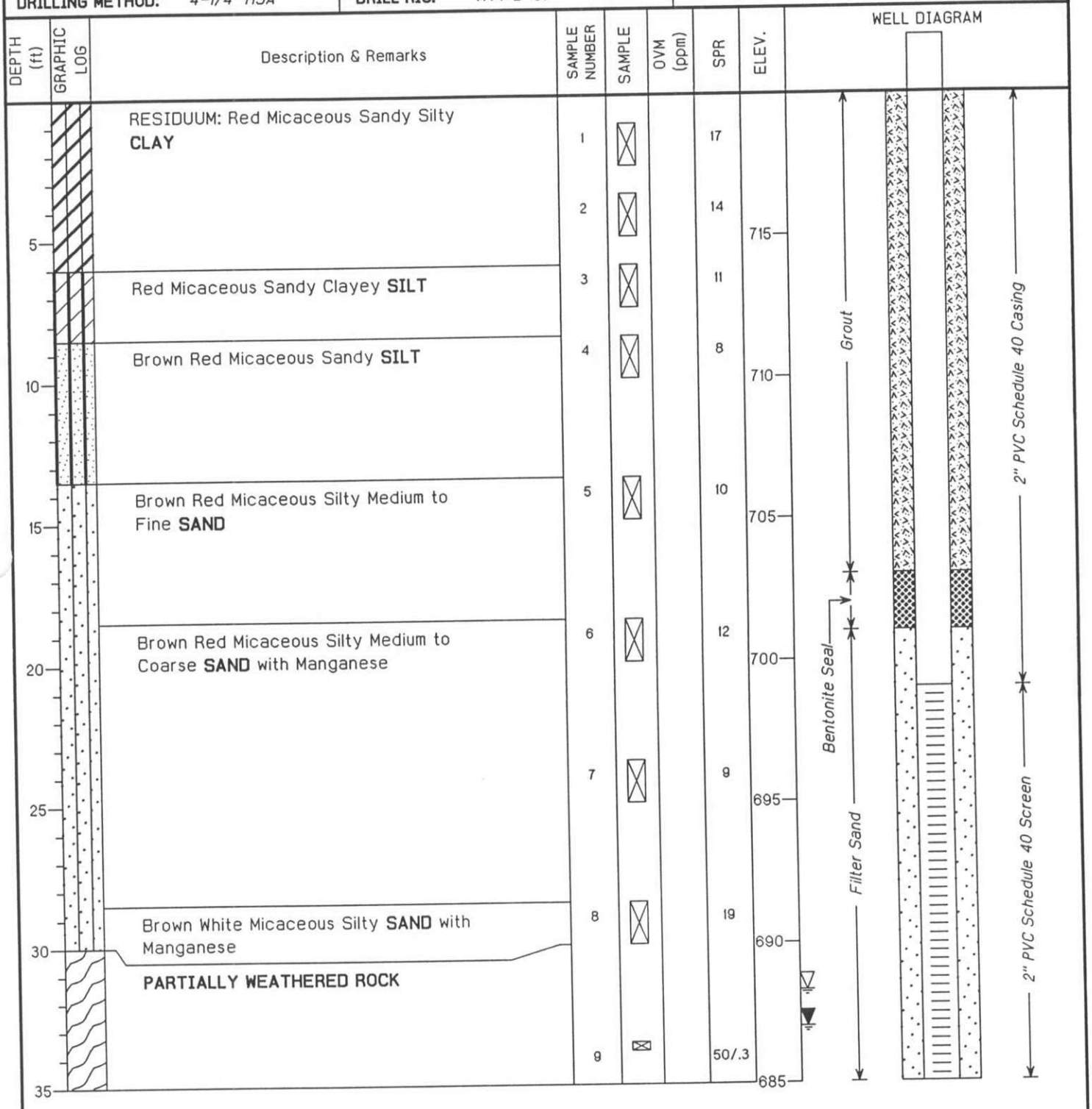
PROJECT:	LAKE NORMAN LANDFILL, INC. Lincoln County, North Carolina	WELL LOG	OW-4
PROJECT NO. : 1356-97-394	ELEVATION: 720.44 MSL	NOTES: TOC ELEV = 722.99	
LOGGED BY: JPR	BORING DEPTH: 36.5 FEET		
DATE DRILLED: 8-21-97	WATER LEVEL: 31.7		
DRILLING METHOD: 4-1/4" HSA	DRILL RIG: ATV B-57		



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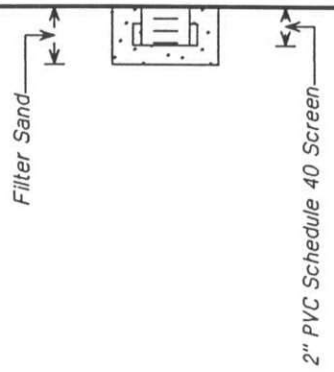
PROJECT:	LAKE NORMAN LANDFILL, INC. Lincoln County, North Carolina	WELL LOG	OW-4

PROJECT NO. : 1356-97-394	ELEVATION: 720.44 MSL	NOTES: TOC ELEV = 722.99
LOGGED BY: JPR	BORING DEPTH: 36.5 FEET	
DATE DRILLED: 8-21-97	WATER LEVEL: 31.7	
DRILLING METHOD: 4-1/4" HSA	DRILL RIG: ATV B-57	

DEPTH (ft)	GRAPHIC LOG	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.	WELL DIAGRAM
			10			50/0		
		Boring Refusal at 36.5 feet. *Water level at 31.7 feet at termination.*						
40							680	
45							675	
50							670	
55							665	
60							660	
65							655	
70							650	



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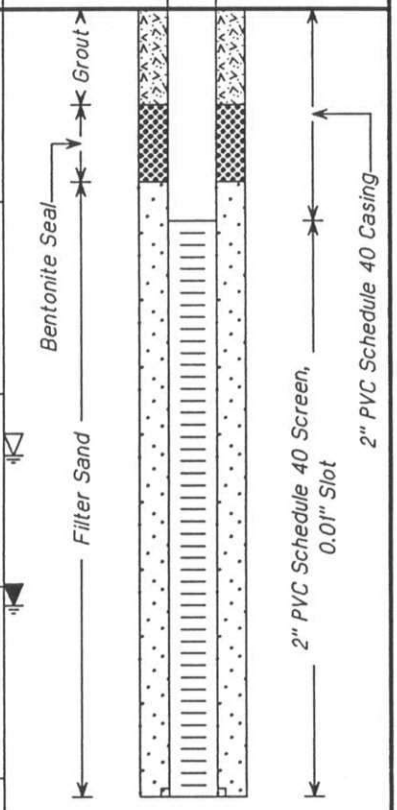
PROJECT:	LAKE NORMAN LANDFILL, INC. Lincoln County, North Carolina	WELL LOG	OW-5

PROJECT NO. : 1356-97-394	ELEVATION: 695.04 MSL	NOTES: TOC ELEV = 698.13
LOGGED BY: JPR	BORING DEPTH: 20.5 FEET	
DATE DRILLED: 8-25-97	WATER LEVEL: 11.6	
DRILLING METHOD: 4-1/4" HSA	DRILL RIG: ATV B-57	

DEPTH (ft)	GRAPHIC LOG	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.
		RESIDUUM: Red Brown Micaceous Sandy Silty **CLAY**	1	X		17	
			2	X		21	
5		Red Brown Micaceous Sandy Clayey **SILT**					690
		Red Brown Micaceous Sandy **SILT** with Manganese	3	X		12	
			4	X		7	
10							685
		Brown White Micaceous Silty Coarse to Medium **SAND**	5	X		11	
15							680
			6	X		61/.8	
20		**Partially Weathered Rock**					675
		Boring Refusal at 20.5 feet. *Water level at 11.6 feet at TOB.*					
25							670
30							665
35							660

WELL DIAGRAM



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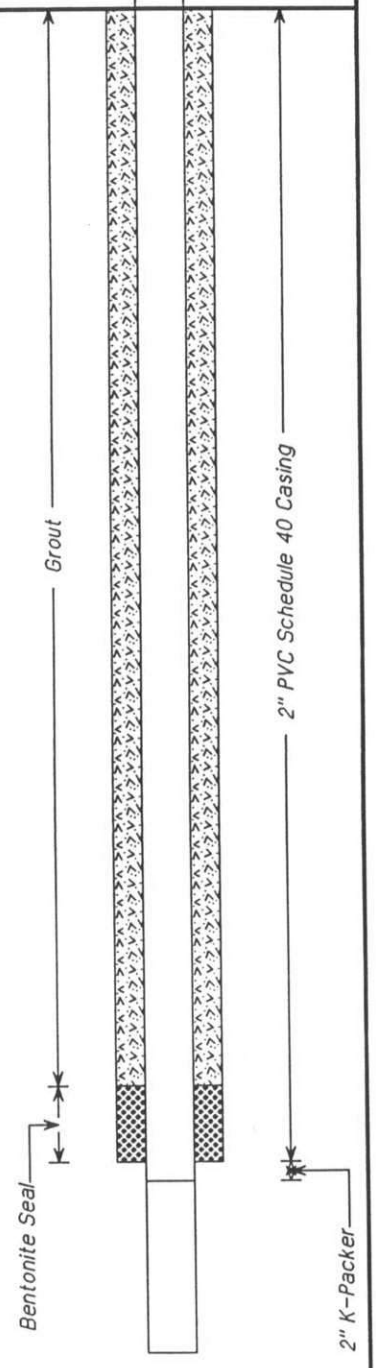
PROJECT:	LAKE NORMAN LANDFILL, INC. Lincoln County, North Carolina	WELL LOG	OW-5A

PROJECT NO. : 1356-97-394	ELEVATION: 695.25 MSL	NOTES: TOC ELEV = 697.42
LOGGED BY: JPR	BORING DEPTH: 40.3 FEET	
DATE DRILLED: 9-3-97	WATER LEVEL: 15.8 feet on 9-4-97	
DRILLING METHOD: 4.25" HSA/NQ Core	DRILL RIG: CME 55	

DEPTH (ft)	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.
0	RESIDUUM: Red Brown Micaceous Sandy Silty **Clay**				17	
5	Red Brown Micaceous Sandy Clayey **SILT**				21	690
	Red Brown Micaceous Sandy **SILT** with Manganese				12	
10					7	685
15	Brown White Micaceous Silty Coarse to Medium **SAND**				11	680
20	*Boring terminated upon **Auger Refusal** at 18.9 feet. Set up to core drill at 18.9 feet.* ROCK: Metamorphosed Quartz Diorite Recovery: 96% Rock Quantity Designation (RQD): 91%				61/.8	675
25						670
30						665
35						660

WELL DIAGRAM



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PROJECT:	LAKE NORMAN LANDFILL, INC. Lincoln County, North Carolina	WELL LOG	OW-5A

PROJECT NO. : *1356-97-394*	**ELEVATION:** *695.25 MSL*	**NOTES:** TOC ELEV = 697.42
LOGGED BY: *JPR*	**BORING DEPTH:** *40.3 FEET*	
DATE DRILLED: *9-3-97*	**WATER LEVEL:** *15.8 feet on 9-4-97*	
DRILLING METHOD: *4.25" HSA/NQ Core*	**DRILL RIG:** *CME 55*	

DEPTH (ft)	GRAPHIC LOG	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.	WELL DIAGRAM
40							655	
45							650	
50							645	
55							640	
60							635	
65							630	
70							625	

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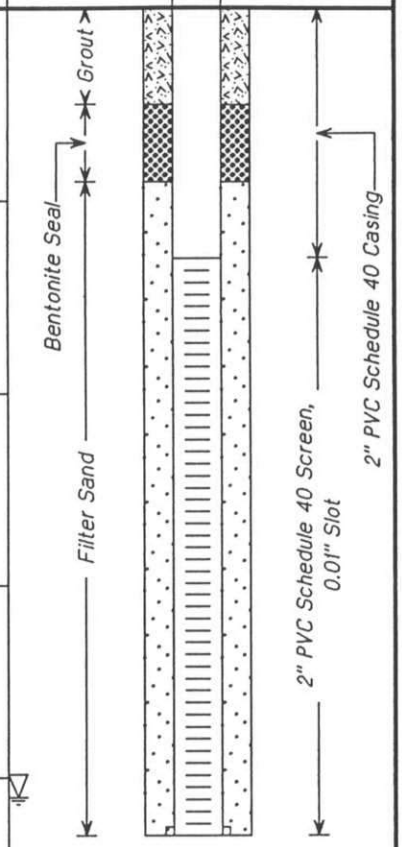
PROJECT:	LAKE NORMAN LANDFILL, INC. Lincoln County, North Carolina	WELL LOG	OW-6

PROJECT NO. : 1356-97-394	ELEVATION: 697.01 MSL	NOTES: TOC ELEV = 699.76
LOGGED BY: JPR	BORING DEPTH: 21.5 FEET	
DATE DRILLED: 8-23-97	WATER LEVEL: 20.5	
DRILLING METHOD: 4-1/4" HSA	DRILL RIG: ATV B-57	

DEPTH (ft)	GRAPHIC LOG	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.
5		RESIDUUM: Brown Red Micaceous Sandy Silty **CLAY** with Manganese	1			19	
			2			15	692
			3			8	
10		Brown Red Micaceous Sandy **SILT** with Manganese	4			8	687
15		**Partially Weathered Rock**	5			50/.4	682
			6			50/.3	
20			7			50/0	677
		Boring Refusal at 21.5 feet. *Water level at 20.5 feet at termination.*					
25							672
30							667
35							662

WELL DIAGRAM



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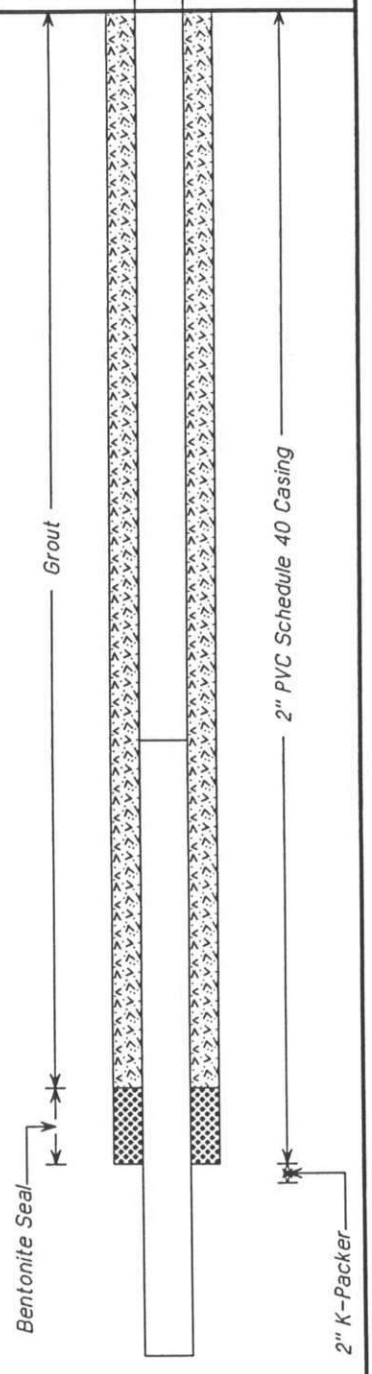
PROJECT:	LAKE NORMAN LANDFILL, INC. Lincoln County, North Carolina	WELL LOG	OW-6A

PROJECT NO. : 1356-97-394	ELEVATION: 697.97 MSL	NOTES: TOC ELEV = 700.34
LOGGED BY: JPR	BORING DEPTH: 40.5 FEET	
DATE DRILLED: 9-4-97	WATER LEVEL: 24.5	
DRILLING METHOD: 4.25" HSA/NQ Core	DRILL RIG: CME 55	

DEPTH (ft)	GRAPHIC LOG	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.	WELL DIAGRAM
5		RESIDUUM: Red Brown Micaceous Sandy Silty **Clay** with Manganese				19 15	693	
10		Red Brown Micaceous Silty **SAND** with Manganese				8 8	688	
15		**PARTIALLY WEATHERED ROCK**				50/.4	683	
20		*Boring terminated upon **Auger Refusal** at 19.0 feet. Set up to core drill at 19.0 feet.* ROCK: Metamorpohsed Quartz Diorite Recovery: 98% Rock Quantity Designation (RQD): 90%				50/.3	678	
25							673	
30							668	
35							663	



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PROJECT:	LAKE NORMAN LANDFILL, INC. Lincoln County, North Carolina	WELL LOG	OW-6A

PROJECT NO. : 1356-97-394	ELEVATION: 697.97 MSL	NOTES: TOC ELEV = 700.34
LOGGED BY: JPR	BORING DEPTH: 40.5 FEET	
DATE DRILLED: 9-4-97	WATER LEVEL: 24.5	
DRILLING METHOD: 4.25" HSA/NQ Core	DRILL RIG: CME 55	

DEPTH (ft)	GRAPHIC LOG	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.	WELL DIAGRAM
40							658	
45							653	
50							648	
55							643	
60							638	
65							633	
70							628	

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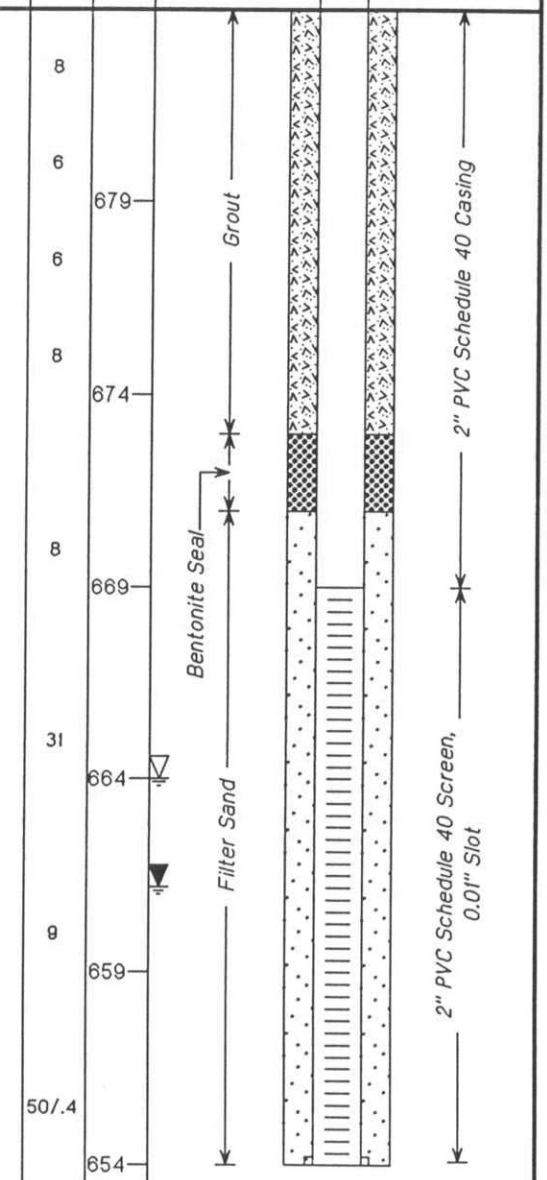
PROJECT:	LAKE NORMAN LANDFILL, INC. Lincoln County, North Carolina	WELL LOG	OW-7

PROJECT NO. : 1356-97-394	ELEVATION: 684.37 MSL	NOTES: TOC ELEV = 687.45
LOGGED BY: SRN	BORING DEPTH: 30.0 FEET	
DATE DRILLED: 8-22-97	WATER LEVEL: 20.0	
DRILLING METHOD: 4-1/4" HSA	DRILL RIG: ATV B-57	

DEPTH (ft)	GRAPHIC LOG	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.
		RESIDUUM: Red Micaceous Sandy Silty **CLAY**	1			8	
5		Reddish Brown Micaceous Sandy Clayey **SILT**	2			6	679
		Brown Tan Micaceous Silty Fine to Medium **SAND** with Manganese	3			6	
			4			8	
10							674
			5			8	
15							669
		Brown White Silty Medium to Coarse **SAND** with Manganese	6			31	
20							664
			7			9	
25							659
		Partially Weathered Rock	8			50/.4	
30		*Boring terminated at 30.0 feet.* *Water level was 20.0 at TOB.*					654
35							649

WELL DIAGRAM



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PROJECT:	LAKE NORMAN LANDFILL, INC. Lincoln County, North Carolina	WELL LOG	OW-7A

PROJECT NO. : 1356-97-394	ELEVATION: 683.22 MSL	NOTES: TOC ELEV = 685.72
LOGGED BY: JPR	BORING DEPTH: 50.3 FEET	
DATE DRILLED: 9-5-97	WATER LEVEL: 20.7	
DRILLING METHOD: 4.25" HSA/NQ Core	DRILL RIG: CME 55	

DEPTH (ft)	GRAPHIC LOG	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.	WELL DIAGRAM
		RESIDUUM: Red Micaceous Sandy Silty **Clay**				8		
5		Reddish Brown Micaceous Sandy Clayey **SILT**				6	678	
		Reddish Brown Micaceous Sandy **SILT** with Manganese				6		
10						8	673	
		Brown Tan Silty Fine to Medium **SAND** with Manganese				8	668	
15								
		Brown White Silty Medium to Coarse **SAND** with Manganese				31	663	
20								
						9	658	
25								
		PARTIALLY WEATHERED ROCK				50/.4	653	
30								
						50/.4	648	
35								

Grout

2" PVC Schedule 40 Casing

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PROJECT:	LAKE NORMAN LANDFILL, INC. Lincoln County, North Carolina	WELL LOG	OW-7A
PROJECT NO.: 1356-97-394	ELEVATION: 683.22 MSL	NOTES: TOC ELEV = 685.72	
LOGGED BY: JPR	BORING DEPTH: 50.3 FEET		
DATE DRILLED: 9-5-97	WATER LEVEL: 20.7		
DRILLING METHOD: 4.25" HSA/NQ Core	DRILL RIG: CME 55		

DEPTH (ft)	GRAPHIC LOG	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.	WELL DIAGRAM
40		*Boring terminated upon **Auger Refusal** at 35.3 feet. Set up to core drill at 35.3 feet.* ROCK: Metamorphosed Quartz Diorite Recovery: 82% Rock Quantity Designation (RQD): 39%					643	Grout Bentonite Seal 2" PVC Schedule 40 Casing 2" K-Packer
45							638	
50							633	
55							628	
60							623	
65							618	
70							613	

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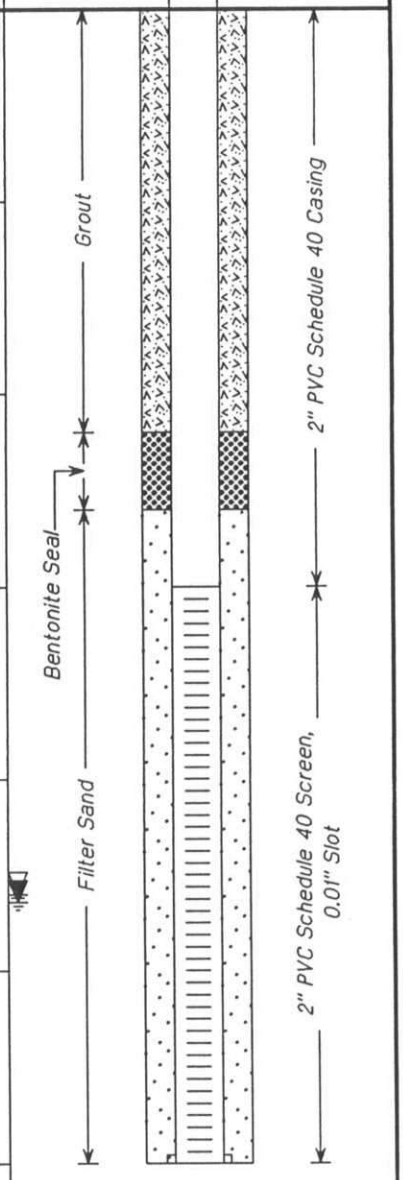
PROJECT:	LAKE NORMAN LANDFILL, INC. Lincoln County, North Carolina	WELL LOG	OW-8

PROJECT NO. : 1356-97-394	ELEVATION: 690.18 MSL	NOTES: TOC ELEV = 693.18
LOGGED BY: JPR	BORING DEPTH: 30.0 FEET	
DATE DRILLED: 8-20-97	WATER LEVEL: 23.0	
DRILLING METHOD: 4-1/4" HSA	DRILL RIG: ATV B-57	

DEPTH (ft)	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.
0	Grass Rootmat					
	RESIDUUM: Red Brown Micaceous Sandy Clayey **SILT**	1			13	
	Red Brown Micaceous Sandy Clayey **SILT** with Manganese	2			17	685
5						
	Red Brown Micaceous Sandy **SILT**, some Root Material	3			18	
		4			11	680
10						
	Brown White Micaceous Sandy **SILT** with Manganese	5			11	675
15						
	Brown White Micaceous Silty Medium to Fine **SAND** with Manganese, br. Quartz Vein at 28.5 feet.	6			7	670
20						
		7			11	665
25						
		8			52	660
30	*Boring terminated at 30.0 feet.* *Water level at 23.0 feet at termination.*					655
35						

WELL DIAGRAM



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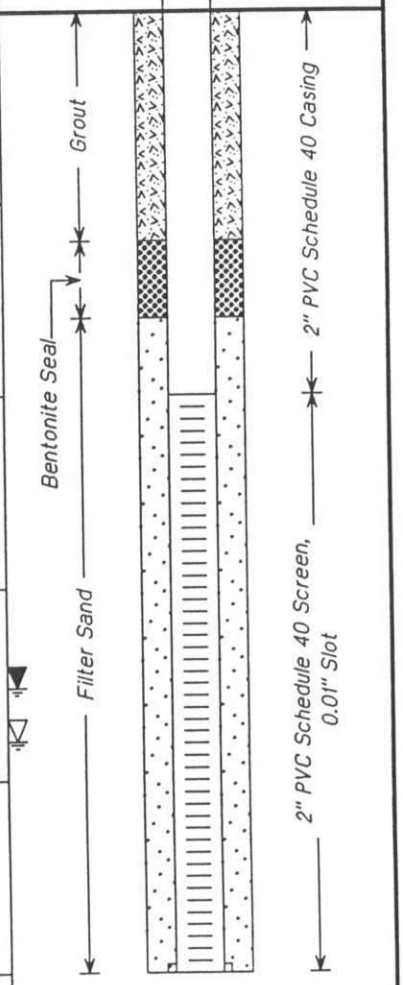
PROJECT:	LAKE NORMAN LANDFILL, INC. Lincoln County, North Carolina	WELL LOG	OW-9

PROJECT NO. : 1356-97-394	ELEVATION: 677.34 MSL	NOTES: TOC ELEV = 680.59
LOGGED BY: JPR	BORING DEPTH: 25.0 FEET	
DATE DRILLED: 8-23-97	WATER LEVEL: 19.0	
DRILLING METHOD: 4-1/4" HSA	DRILL RIG: ATV B-57	

DEPTH (ft)	GRAPHIC LOG	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.
0		RESIDUUM: Red Micaceous Sandy Silty **CLAY**	1			16	
		Brown Red Micaceous Silty Medium to Fine **SAND** with Manganese	2			17	672
5			3			9	
			4			8	667
10							
		Brown White Micaceous Silty Medium to Fine **SAND** with Manganese	5			3	662
15							
			6			6	657
20							
			7			16	652
25		*Boring terminated at 25.0 feet.* *Water level at 19.0 feet at termination.*					
30							647
							642
35							

WELL DIAGRAM



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PROJECT:	LAKE NORMAN LANDFILL, INC. Lincoln County, North Carolina	TEST BORING RECORD	B-10
PROJECT NO. :	1356-97-394	ELEVATION:	NOTES: Elevation not surveyed
LOGGED BY:	JPR	BORING DEPTH: 20.5 FEET	
DATE DRILLED:	9-8-97	WATER LEVEL: Dry	
DRILLING METHOD:	4-1/4" HSA	DRILL RIG: CME 55	

DEPTH (ft)	Soil Description	OVM (ppm)	WATER LEVEL	SAMPLE	ELEV.	Standard Penetration Test Data (Blows/ft) 10 30 50 70 90	BPF
0	RESIDUUM: Red Brown Micaceous Sandy **SILT** with Manganese						14
	Tan Red Brown Micaceous Clayey Sandy **SILT**						43
5	**PARTIALLY WEATHERED ROCK**						50/.4
							50/.4
10	Grey White Micaceous Sandy **SILT**						90/.9
15	**Partially Weathered Rock**		HC				50/.25
20	*Boring Refused at 20.5 feet, with hole cave-in at 18.0 feet. Boring was dry at termination.*						
25							
30							
35							

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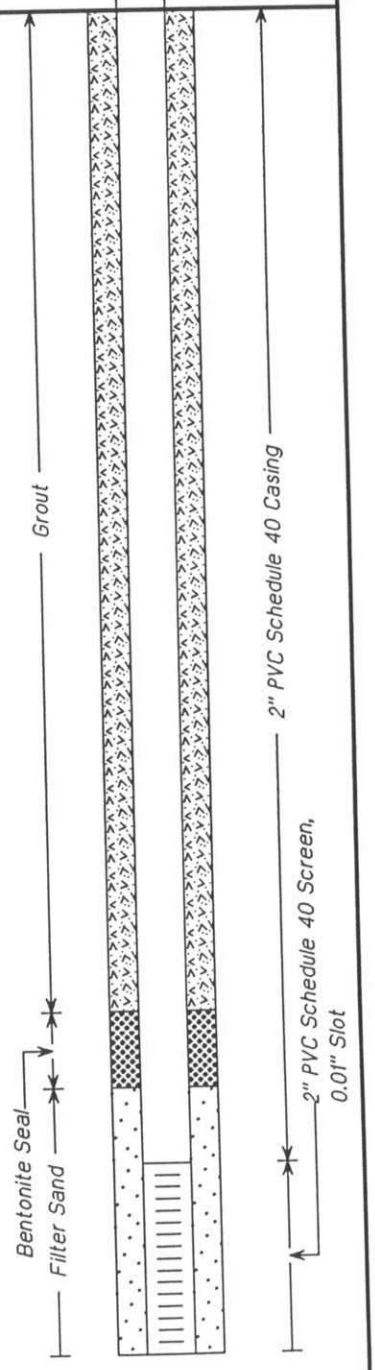
PROJECT:	LAKE NORMAN LANDFILL, INC. Lincoln County, North Carolina	WELL LOG	OW-11
PROJECT NO. : 1356-97-394	ELEVATION: 702.49 MSL	NOTES: TOC ELEV = 706.19	
LOGGED BY: SRN	BORING DEPTH: 45.0 FEET		
DATE DRILLED: 1-13-98	WATER LEVEL: 11.67 feet		
DRILLING METHOD: 3-1/4" HSA	DRILL RIG: ATV B-57-A		

DEPTH (ft)	GRAPHIC LOG	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.
		Grass / Rootmat / Topsoil					
		RESIDUUM: Red Micaceous Fine Sandy Silty **CLAY** (Moderate to Low_ Plasticity)	1			17	
			2			19	698
5			3			23	
		Red to Tan Micaceous Fine Sandy **SILT**	4			16	693
10							
		Tan White Micaceous Silty Medium to Fine **SAND**	5			12	688
15							
			6			22	683
20							
			7			56	678
25							
			8			50/.2	673
30		**Partially Weathered Rock**: When sampled becomes Tan White_ Micaceous Silty Coarse to Fine **Sand** w/ Rock Fragments					
		*Boring terminated upon **Auger Refusal** at 32.0 feet. Set up to_ core drill at 32.0 feet.*					668
35							

WELL DIAGRAM



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PROJECT:	LAKE NORMAN LANDFILL, INC. Lincoln County, North Carolina	WELL LOG	OW-11
PROJECT NO.: 1356-97-394	ELEVATION: 702.49 MSL	NOTES: TOC ELEV = 706.19	
LOGGED BY: SRN	BORING DEPTH: 45.0 FEET		
DATE DRILLED: 1-13-98	WATER LEVEL: 11.67 feet		
DRILLING METHOD: 3-1/4" HSA	DRILL RIG: ATV B-57-A		

DEPTH (ft)	GRAPHIC LOG	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.	WELL DIAGRAM
40		ROCK: Metamorphosed Quartz Diorite Recovery: 98% Rock Quantity Designation (RQD): 83%					663	Filter Sand 2" PVC Schedule 40 Screen, 0.01" Slot
45							658	
50							653	
55							648	
60							643	
65							638	
70							633	

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PROJECT:	LAKE NORMAN LANDFILL, INC. Lincoln County, North Carolina	WELL LOG	OW-12

PROJECT NO. : 1356-97-394	ELEVATION: 728.11 MSL	NOTES: TOC ELEV = 731.48
LOGGED BY: SRN	BORING DEPTH: 45.0 FEET	
DATE DRILLED: 1-14-98	WATER LEVEL: 32.36 feet	
DRILLING METHOD: 3.25" HSA/NQ Core	DRILL RIG: ATV B-57-A	

DEPTH (ft)	GRAPHIC LOG	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.
0		Grass / Rootmat / Topsoil	1			21	
		RESIDUUM: Red Micaceous Fine Grained Sandy Silty **CLAY** (Low_ Plasticity)					
		Red Micaceous Fine Grained Sandy **SILT**	2			12	723
5			3			15	
		Red Tan to Tan White Micaceous Silty Fine **SAND**	4			17	718
10							
			5			19	713
15							
			6			26	708
20							
			7			39	703
25							
			8			69/.3	698
30		**Partially Weathered Rock**: When sampled becomes Tan White_ Micaceous Silty Coarse to Fine **SAND** w/ Rock Fragments					
			9			50/.2	693
35							

WELL DIAGRAM

Grout

Bentonite Seal

Filter Sand

2" PVC Schedule 40 Casing

2" PVC Schedule 40 Screen, 0.01" Slot

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PROJECT:	LAKE NORMAN LANDFILL, INC. Lincoln County, North Carolina	WELL LOG	OW-12

PROJECT NO. : 1356-97-394	ELEVATION: 728.11 MSL	NOTES: TOC ELEV = 731.48
LOGGED BY: SRN	BORING DEPTH: 45.0 FEET	
DATE DRILLED: 1-14-98	WATER LEVEL: 32.36 feet	
DRILLING METHOD: 3.25" HSA/NQ Core	DRILL RIG: ATV B-57-A	

DEPTH (ft)	GRAPHIC LOG	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.	WELL DIAGRAM
40			10				688	Filter Sand
			11					2" PVC Schedule 40 Screen, 0.01" Slot
45		Boring terminated at 45.0 feet.					683	
50							678	
55							673	
60							668	
65							663	
70							658	

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APPENDIX II
SLUG TEST/SOIL LAB DATA

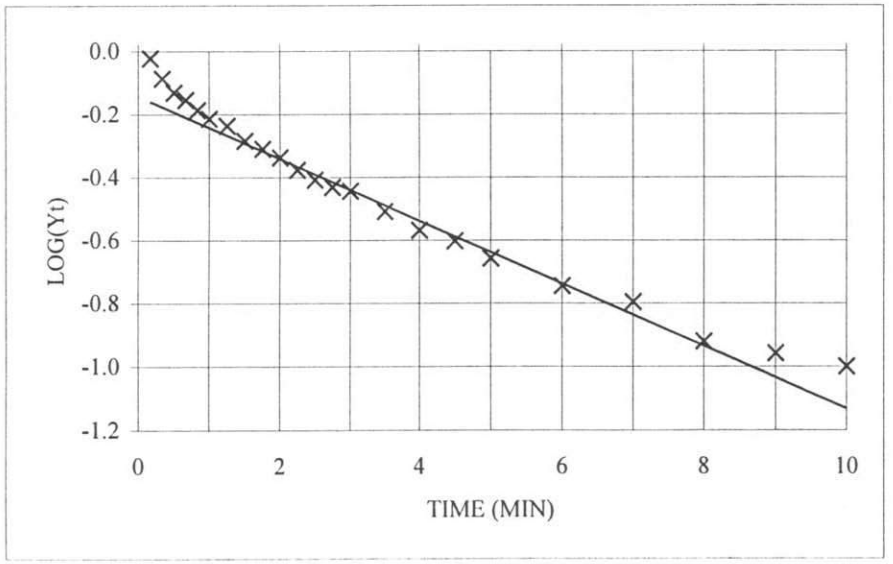
PROJECT NAME: Lake Norman Landfill, Inc.
PROJECT NUMBER: 1356-97-394

WELL ID: OW-1
TEST DATE: 9/15/97

LEVELS MEASURED RELATIVE TO TOP OF CASING OR MEASURING POINT

DEPTH TO BASE OF AQUIFER =	35.1	FT
DEPTH TO WATER =	19.50	FT
DEPTH TO TOP OF SANDPACK =	12.6	FT
DEPTH TO BASE OF SAND PACK =	30.1	FT
CASING DIAMETER =	2.0	IN
BOREHOLE DIAMETER =	6.25	IN
SAND PACK POROSITY =	0.30	

HYDRAULIC CONDUCTIVITY	
FT/MIN =	4.38E-04
FT/DAY =	6.30E-01
GPD/FT2 =	4.71E+00
CM/SEC =	2.22E-04



SLUG TEST DATA

TIME (MIN)	DTW (FT)	Yt (FT)	LOG (Yt)	% Recovery
0.17	20.45	0.95	-0.02	0.0
0.33	20.32	0.82	-0.09	13.7
0.50	20.24	0.74	-0.13	22.1
0.67	20.20	0.70	-0.15	26.3
0.83	20.15	0.65	-0.19	31.6
1.00	20.11	0.61	-0.21	35.8
1.25	20.08	0.58	-0.24	38.9
1.50	20.02	0.52	-0.28	45.3
1.75	19.99	0.49	-0.31	48.4
2.00	19.96	0.46	-0.34	51.6
2.25	19.92	0.42	-0.38	55.8
2.50	19.89	0.39	-0.41	58.9
2.75	19.87	0.37	-0.43	61.1
3.00	19.86	0.36	-0.44	62.1
3.50	19.81	0.31	-0.51	67.4
4.00	19.77	0.27	-0.57	71.6
4.50	19.75	0.25	-0.60	73.7
5.00	19.72	0.22	-0.66	76.8
6.00	19.68	0.18	-0.74	81.1
7.00	19.66	0.16	-0.80	83.2
8.00	19.62	0.12	-0.92	87.4
9.00	19.61	0.11	-0.96	88.4
10.00	19.60	0.10	-1.00	89.5

TIMES FOR LINEAR REGRESSION

INITIAL TIME = 1 MIN
FINAL TIME = 8 MIN

Regression Output:

Constant	-0.144
Std Err of Y Est	0.021
R Squared	0.990
No. of Observations	16
Degrees of Freedom	15
X Coefficient(s)	-0.099
Std Err of Coef.	0.003

METHOD:

BOUWER & RICE

"A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFER WITH COMPLETELY OR PARTIALLY PENETRATING WELLS", 1976

AND

"THE BOUWER AND RICE SLUG TEST - AND UPDATE", 1989

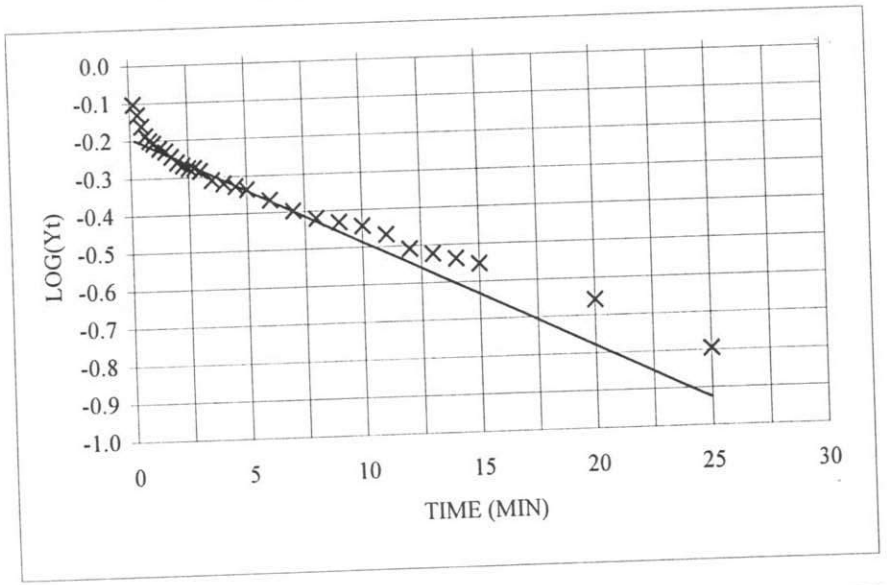
PROJECT NAME: Lake Norman Landfill, Inc.
PROJECT NUMBER: 1356-97-394

WELL ID: OW-4
TEST DATE: 9/15/97

LEVELS MEASURED RELATIVE TO TOP OF CASING OR MEASURING POINT

DEPTH TO BASE OF AQUIFER =	44.1	FT
DEPTH TO WATER =	30.45	FT
DEPTH TO TOP OF SANDPACK =	21.6	FT
DEPTH TO BASE OF SAND PACK =	38.6	FT
CASING DIAMETER =	2.0	IN
BOREHOLE DIAMETER =	6.25	IN
SAND PACK POROSITY =	0.30	

HYDRAULIC CONDUCTIVITY	
FT/MIN =	1.25E-04
FT/DAY =	1.80E-01
GPD/FT2 =	1.35E+00
CM/SEC =	6.36E-05



SLUG TEST DATA

TIME (MIN)	DTW (FT)	Yt (FT)	LOG (Yt)	% Recovery
0.17	31.24	0.79	-0.10	0.0
0.33	31.19	0.74	-0.13	6.3
0.50	31.14	0.69	-0.16	12.7
0.67	31.10	0.65	-0.19	17.7
0.83	31.08	0.63	-0.20	20.3
1.00	31.07	0.62	-0.21	21.5
1.25	31.05	0.60	-0.22	24.1
1.50	31.04	0.59	-0.23	25.3
1.75	31.02	0.57	-0.24	27.8
2.00	31.00	0.55	-0.26	30.4
2.25	30.99	0.54	-0.27	31.6
2.50	30.98	0.53	-0.28	32.9
2.75	30.98	0.53	-0.28	32.9
3.00	30.97	0.52	-0.28	34.2
3.50	30.94	0.49	-0.31	38.0
4.00	30.93	0.48	-0.32	39.2
4.50	30.92	0.47	-0.33	40.5
5.00	30.91	0.46	-0.34	41.8
6.00	30.88	0.43	-0.37	45.6
7.00	30.85	0.40	-0.40	49.4
8.00	30.83	0.38	-0.42	51.9
9.00	30.82	0.37	-0.43	53.2
10.00	30.81	0.36	-0.44	54.4
11.00	30.79	0.34	-0.47	57.0
12.00	30.76	0.31	-0.51	60.8
13.00	30.75	0.30	-0.52	62.0
14.00	30.74	0.29	-0.54	63.3
15.00	30.73	0.28	-0.55	64.6
20.00	30.67	0.22	-0.66	72.2
25.00	30.61	0.16	-0.80	79.7

TIMES FOR LINEAR REGRESSION

INITIAL TIME = 1 MIN
FINAL TIME = 8 MIN

Regression Output:

Constant	-0.194
Std Err of Y Est	0.008
R Squared	0.983
No. of Observations	16
Degrees of Freedom	15
X Coefficient(s)	-0.029
Std Err of Coef.	0.0010

METHOD:

BOUWER & RICE

"A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFER WITH COMPLETELY OR PARTIALLY PENETRATING WELLS", 1976

AND

"THE BOUWER AND RICE SLUG TEST - AND UPDATE", 1989

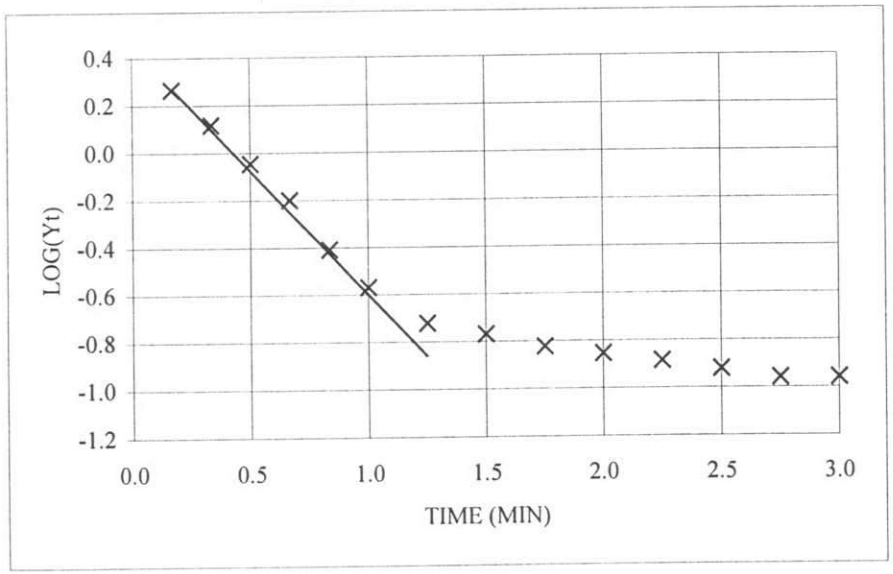
PROJECT NAME: Lake Norman Landfill, Inc.
PROJECT NUMBER: 1356-97-394

WELL ID: OW-5
TEST DATE: 9/15/97

LEVELS MEASURED RELATIVE TO TOP OF CASING OR MEASURING POINT

DEPTH TO BASE OF AQUIFER =	28.6	FT
DEPTH TO WATER =	13.00	FT
DEPTH TO TOP OF SANDPACK =	7.1	FT
DEPTH TO BASE OF SAND PACK =	23.6	FT
CASING DIAMETER =	2.0	IN
BOREHOLE DIAMETER =	6.25	IN
SAND PACK POROSITY =	0.30	

HYDRAULIC CONDUCTIVITY	
FT/MIN =	4.88E-03
FT/DAY =	7.02E+00
GPD/FT2 =	5.25E+01
CM/SEC =	2.48E-03



SLUG TEST DATA

TIME (MIN)	DTW (FT)	Yt (FT)	LOG (Yt)	% Recovery
0.17	14.84	1.84	0.26	0.0
0.33	14.31	1.31	0.12	28.8
0.50	13.90	0.90	-0.05	51.1
0.67	13.63	0.63	-0.20	65.8
0.83	13.39	0.39	-0.41	78.8
1.00	13.27	0.27	-0.57	85.3
1.25	13.19	0.19	-0.72	89.7
1.50	13.17	0.17	-0.77	90.8
1.75	13.15	0.15	-0.82	91.8
2.00	13.14	0.14	-0.85	92.4
2.25	13.13	0.13	-0.89	92.9
2.50	13.12	0.12	-0.92	93.5
2.75	13.11	0.11	-0.96	94.0
3.00	13.11	0.11	-0.96	94.0

TIMES FOR LINEAR REGRESSION

INITIAL TIME = 0.17 MIN
FINAL TIME = 1.75 MIN

Regression Output:

Constant	0.445
Std Err of Y Est	0.035
R Squared	0.992
No. of Observations	7
Degrees of Freedom	6
X Coefficient(s)	-1.045
Std Err of Coef.	0.039

METHOD:

BOUWER & RICE

"A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFER WITH COMPLETELY OR PARTIALLY PENETRATING WELLS", 1976

AND
"THE BOUWER AND RICE SLUG TEST - AND UPDATE", 1989

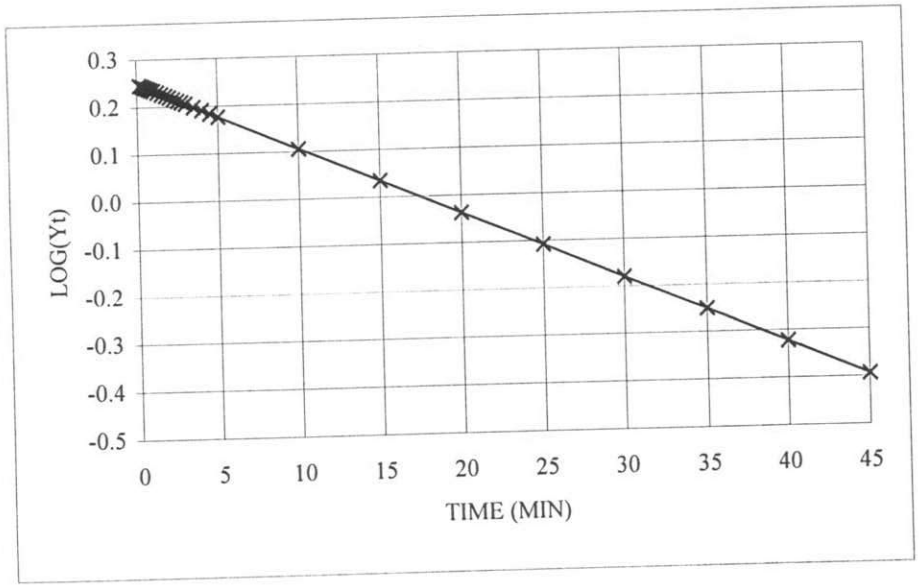
PROJECT NAME: Lake Norman Landfill, Inc.
PROJECT NUMBER: 1356-97-394

WELL ID: OW-6A
TEST DATE: 9/15/97

LEVELS MEASURED RELATIVE TO TOP OF CASING OR MEASURING POINT

DEPTH TO BASE OF AQUIFER =	47.9	FT
DEPTH TO WATER =	22.10	FT
DEPTH TO TOP OF SANDPACK =	21.4	FT
DEPTH TO BASE OF SAND PACK =	42.9	FT
CASING DIAMETER =	2.0	IN
BOREHOLE DIAMETER =	4.00	IN
SAND PACK POROSITY =	0.30	

HYDRAULIC CONDUCTIVITY	
FT/MIN =	3.49E-05
FT/DAY =	5.03E-02
GPD/FT2 =	3.76E-01
CM/SEC =	1.77E-05



SLUG TEST DATA

TIME (MIN)	DTW (FT)	Yt (FT)	LOG (Yt)	% Recovery
0.17	24.06	1.96	0.29	0.0
0.33	24.03	1.93	0.29	1.5
0.50	24.01	1.91	0.28	2.6
0.67	23.97	1.87	0.27	4.6
0.83	23.94	1.84	0.26	6.1
1.00	23.90	1.80	0.26	8.2
1.25	23.88	1.78	0.25	9.2
1.50	23.84	1.74	0.24	11.2
1.75	23.81	1.71	0.23	12.8
2.00	23.78	1.68	0.23	14.3
2.25	23.74	1.64	0.21	16.3
2.50	23.72	1.62	0.21	17.3
2.75	23.69	1.59	0.20	18.9
3.00	23.67	1.57	0.20	19.9
3.50	23.63	1.53	0.18	21.9
4.00	23.60	1.50	0.18	23.5
4.50	23.56	1.46	0.16	25.5
5.00	23.53	1.43	0.16	27.0
10.00	23.32	1.22	0.09	37.8
15.00	23.16	1.06	0.03	45.9
20.00	23.15	1.05	0.02	46.4
25.00	22.88	0.78	-0.11	60.2
30.00	22.76	0.66	-0.18	66.3
35.00	22.66	0.56	-0.25	71.4
40.00	22.56	0.46	-0.34	76.5
45.00	22.46	0.36	-0.44	81.6

TIMES FOR LINEAR REGRESSION

INITIAL TIME = 0.17 MIN
FINAL TIME = 45 MIN

Regression Output:

Constant	0.248
Std Err of Y Est	0.019
R Squared	0.989
No. of Observations	20
Degrees of Freedom	19
X Coefficient(s)	-0.014
Std Err of Coef.	0.0004

METHOD:

BOUWER & RICE

"A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFER WITH COMPLETELY OR PARTIALLY PENETRATING WELLS", 1976

AND

"THE BOUWER AND RICE SLUG TEST - AND UPDATE", 1989

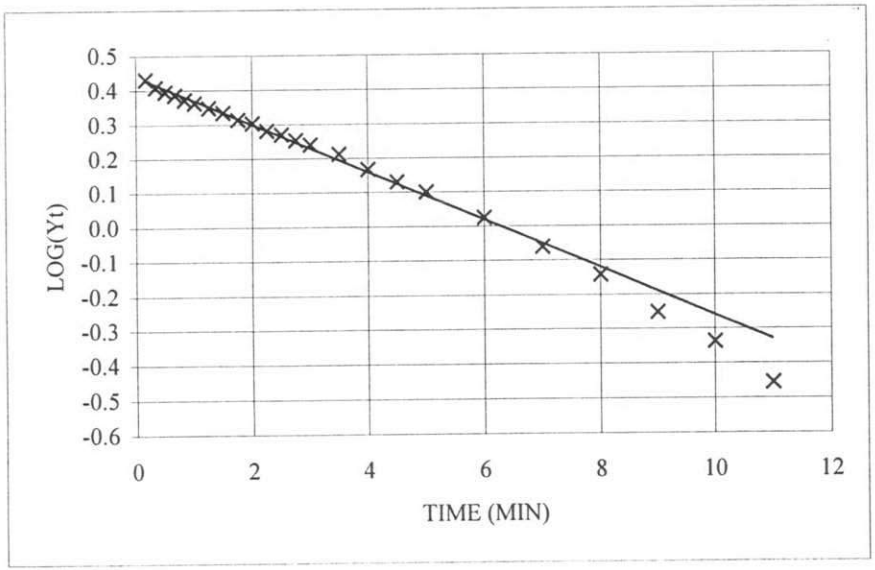
PROJECT NAME: Lake Norman Landfill, Inc.
PROJECT NUMBER: 1356-97-394

WELL ID: OW-7
TEST DATE: 9/15/97

LEVELS MEASURED RELATIVE TO TOP OF CASING OR MEASURING POINT

DEPTH TO BASE OF AQUIFER =	38.1	FT
DEPTH TO WATER =	19.57	FT
DEPTH TO TOP OF SANDPACK =	16.1	FT
DEPTH TO BASE OF SAND PACK =	33.1	FT
CASING DIAMETER =	2.0	IN
BOREHOLE DIAMETER =	6.25	IN
SAND PACK POROSITY =	0.30	

HYDRAULIC CONDUCTIVITY	
FT/MIN =	3.34E-04
FT/DAY =	4.81E-01
GPD/FT2 =	3.60E+00
CM/SEC =	1.70E-04



SLUG TEST DATA

TIME (MIN)	DTW (FT)	Yt (FT)	LOG (Yt)	% Recovery
0.17	22.27	2.70	0.43	0.0
0.33	22.13	2.56	0.41	5.2
0.50	22.05	2.48	0.39	8.1
0.67	22.00	2.43	0.39	10.0
0.83	21.92	2.35	0.37	13.0
1.00	21.87	2.30	0.36	14.8
1.25	21.80	2.23	0.35	17.4
1.50	21.73	2.16	0.33	20.0
1.75	21.63	2.06	0.31	23.7
2.00	21.58	2.01	0.30	25.6
2.25	21.48	1.91	0.28	29.3
2.50	21.43	1.86	0.27	31.1
2.75	21.36	1.79	0.25	33.7
3.00	21.31	1.74	0.24	35.6
3.50	21.20	1.63	0.21	39.6
4.00	21.04	1.47	0.17	45.6
4.50	20.92	1.35	0.13	50.0
5.00	20.83	1.26	0.10	53.3
6.00	20.63	1.06	0.03	60.7
7.00	20.44	0.87	-0.06	67.8
8.00	20.29	0.72	-0.14	73.3
9.00	20.13	0.56	-0.25	79.3
10.00	20.03	0.46	-0.34	83.0
11.00	19.92	0.35	-0.46	87.0

TIMES FOR LINEAR REGRESSION

INITIAL TIME = 0.17 MIN
FINAL TIME = 8 MIN

Regression Output:

Constant	0.439
Std Err of Y Est	0.010
R Squared	0.996
No. of Observations	21
Degrees of Freedom	20
X Coefficient(s)	-0.070
Std Err of Coef.	0.0010

METHOD:

BOUWER & RICE

"A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFER WITH COMPLETELY OR PARTIALLY PENETRATING WELLS", 1976

AND

"THE BOUWER AND RICE SLUG TEST - AND UPDATE", 1989

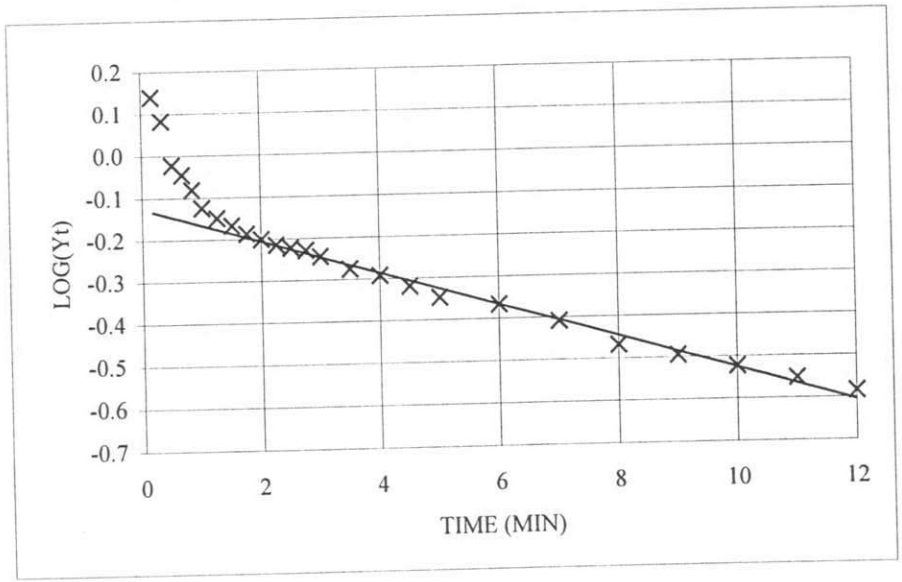
PROJECT NAME: Lake Norman Landfill, Inc.
PROJECT NUMBER: 1356-97-394

WELL ID: OW-8
TEST DATE: 9/15/97

LEVELS MEASURED RELATIVE TO TOP OF CASING OR MEASURING POINT

DEPTH TO BASE OF AQUIFER =	38.0	FT
DEPTH TO WATER =	20.37	FT
DEPTH TO TOP OF SANDPACK =	16.0	FT
DEPTH TO BASE OF SAND PACK =	33.0	FT
CASING DIAMETER =	2.0	IN
BOREHOLE DIAMETER =	6.25	IN
SAND PACK POROSITY =	0.30	

HYDRAULIC CONDUCTIVITY	
FT/MIN =	1.88E-04
FT/DAY =	2.71E-01
GPD/FT2 =	2.03E+00
CM/SEC =	9.55E-05



SLUG TEST DATA

TIME (MIN)	DTW (FT)	Yt (FT)	LOG (Yt)	% Recovery
0.17	21.75	1.38	0.14	0.0
0.33	21.58	1.21	0.08	12.3
0.50	21.32	0.95	-0.02	31.2
0.67	21.27	0.90	-0.05	34.8
0.83	21.20	0.83	-0.08	39.9
1.00	21.12	0.75	-0.12	45.7
1.25	21.08	0.71	-0.15	48.6
1.50	21.05	0.68	-0.17	50.7
1.75	21.02	0.65	-0.19	52.9
2.00	21.00	0.63	-0.20	54.3
2.25	20.98	0.61	-0.21	55.8
2.50	20.97	0.60	-0.22	56.5
2.75	20.96	0.59	-0.23	57.2
3.00	20.94	0.57	-0.24	58.7
3.50	20.90	0.53	-0.28	61.6
4.00	20.88	0.51	-0.29	63.0
4.50	20.85	0.48	-0.32	65.2
5.00	20.82	0.45	-0.35	67.4
6.00	20.80	0.43	-0.37	68.8
7.00	20.76	0.39	-0.41	71.7
8.00	20.71	0.34	-0.47	75.4
9.00	20.69	0.32	-0.49	76.8
10.00	20.67	0.30	-0.52	78.3
11.00	20.65	0.28	-0.55	79.7
12.00	20.63	0.26	-0.59	81.2

TIMES FOR LINEAR REGRESSION

INITIAL TIME = 1.5 MIN
FINAL TIME = 12 MIN

Regression Output:

Constant	-0.126
Std Err of Y Est	0.012
R Squared	0.992
No. of Observations	18
Degrees of Freedom	17
X Coefficient(s)	-0.040
Std Err of Coef.	0.001

METHOD:

BOUWER & RICE

"A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFER WITH COMPLETELY OR PARTIALLY PENETRATING WELLS", 1976

AND

"THE BOUWER AND RICE SLUG TEST - AND UPDATE", 1989

GRAIN SIZE DISTRIBUTION TEST DATA Test No.: 4

Date: 1/2/98
Project No.: 1356-97-394
Project: BARRETT GRADING C&D LANDFILL

Sample Data

Location of Sample: OW-7A, 22.0-24.0'
Sample Description: WHITE TAN GRAY SILTY SAND
USCS Class: SM Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.: O7A

Mechanical Analysis Data

	Initial
Dry sample and tare=	261.96
Tare =	0.00
Dry sample weight =	261.96

Sample split on number 10 sieve
Split sample data:
Sample and tare = 65 Tare = 0 Sample weight = 65
Cumulative weight retained tare= 0
Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
# 4	0.00	100.0
# 10	11.78	95.5
# 20	4.52	88.9
# 40	11.44	78.7
# 60	17.42	69.9
# 100	27.43	55.2
# 200	41.26	34.9

Hydrometer Analysis Data

Separation sieve is number 10
Percent -# 10 based on complete sample= 95.5
Weight of hydrometer sample: 65
Hygroscopic moisture correction:
Moist weight & tare = 34.25
Dry weight & tare = 34.05
Tare = 15.35
Hygroscopic moisture= 1.1 %
Calculated biased weight= 67.34

Table of composite correction values:
Temp, deg C: 21.0 22.0
Comp. corr: - 5.0 - 5.0
Meniscus correction only= 1
Specific gravity of solids= 2.8
Specific gravity correction factor= 0.969
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

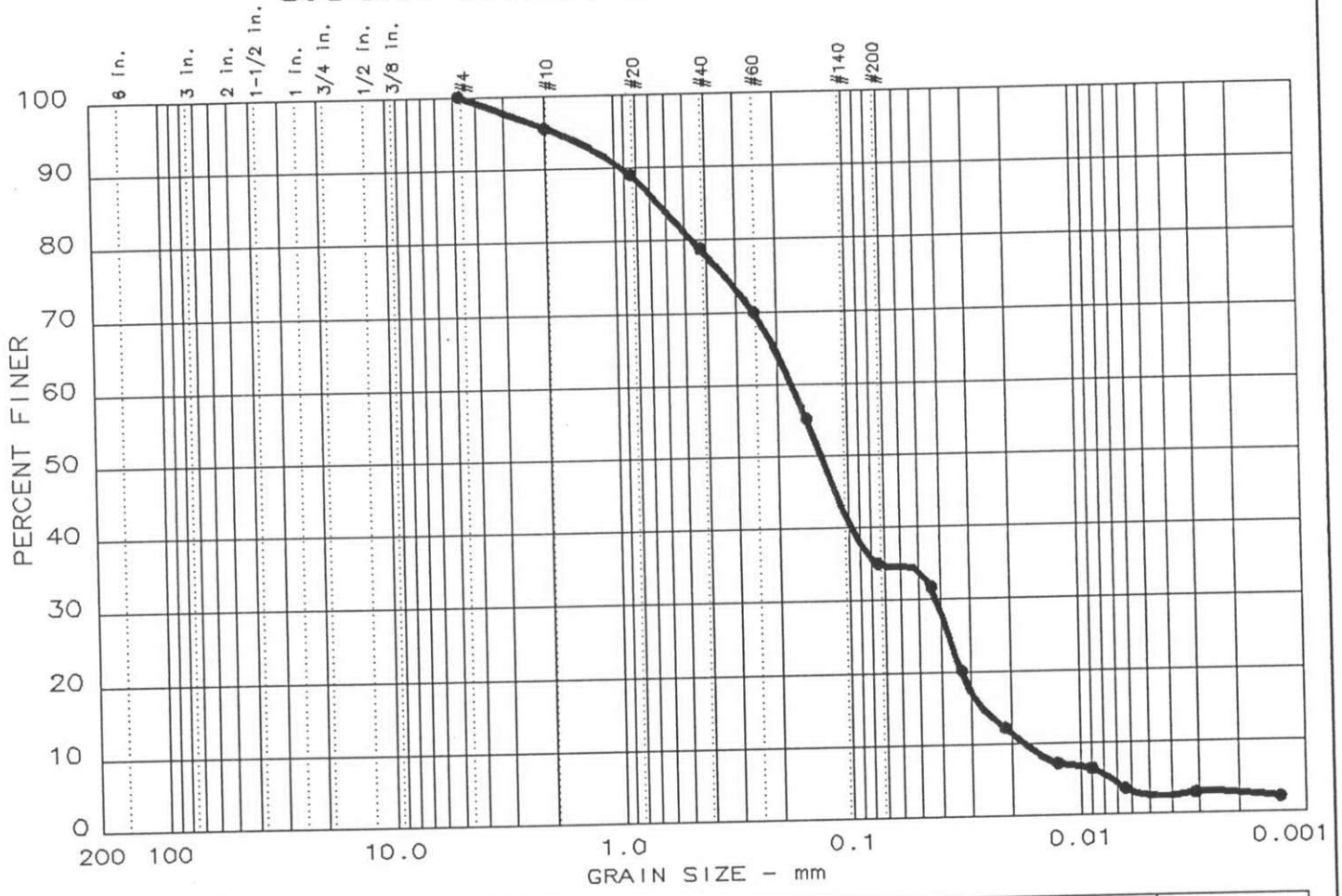
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	21.0	27.0	22.0	0.0129	28.0	11.7	0.0441	31.6
2.0	21.0	19.0	14.0	0.0129	20.0	13.0	0.0329	20.1
5.0	21.0	13.5	8.5	0.0129	14.5	13.9	0.0215	12.2
15.0	21.0	10.0	5.0	0.0129	11.0	14.5	0.0127	7.2
30.0	21.0	9.5	4.5	0.0129	10.5	14.6	0.0090	6.5
60.0	21.0	7.5	2.5	0.0129	8.5	14.9	0.0064	3.6
250.0	22.0	7.0	2.0	0.0127	8.0	15.0	0.0031	2.9
1440.0	22.0	6.5	1.5	0.0127	7.5	15.1	0.0013	2.2

Fractional Components

Gravel/Sand based on #4 sieve
Sand/Fines based on #200 sieve
% + 3 in. = 0.0 % GRAVEL = 0.0 % SAND = 65.1
% SILT = 32.4 % CLAY = 2.5

D85= 0.64 D60= 0.173 D50= 0.130
D30= 0.0419 D15= 0.02676 D10= 0.01768
Cc = 0.5754 Cu = 9.77

GRAIN SIZE DISTRIBUTION



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	65.1	32.4	2.5

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.64	0.17	0.13	0.042	0.0268	0.0177	0.58	9.8

	MATERIAL DESCRIPTION	USCS	AASHTO
●	WHITE TAN GRAY SILTY SAND	SM	

Project No.: 1356-97-394
Project: BARRETT GRADING C&D LANDFILL
● Location: OW-7A, 22.0-24.0'

Date: 1/2/98

Remarks:

GRAIN SIZE DISTRIBUTION

S&ME

Figure No. 07A

GRAIN SIZE DISTRIBUTION TEST DATA Test No.: 5

Date: 1/2/98
Project No.: 1356-97-394
Project: BARRETT GRADING C&D LANDFILL

Sample Data

Location of Sample: OW-6A, 9.0-11.0'
Sample Description: TAN SILTY SAND
USCS Class: SM
AASHTO Class:
Liquid limit:
Plasticity index:

Notes

Remarks:

Fig. No.: O6A

Mechanical Analysis Data

	Initial
Dry sample and tare=	244.68
Tare =	0.00
Dry sample weight =	244.68

Sample split on number 10 sieve
Split sample data:
Sample and tare = 65 Tare = 0 Sample weight = 65
Cumulative weight retained tare= 0
Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
# 4	0.00	100.0
# 10	2.54	99.0
# 20	1.65	96.4
# 40	4.49	92.1
# 60	10.90	82.4
# 100	21.73	65.9
# 200	34.67	46.2

Hydrometer Analysis Data

Separation sieve is number 10
Percent -# 10 based on complete sample= 99.0
Weight of hydrometer sample: 65
Hygroscopic moisture correction:
Moist weight & tare = 33.68
Dry weight & tare = 33.50
Tare = 21.71
Hygroscopic moisture= 1.5 %
Calculated biased weight= 64.69

Table of composite correction values:

Temp, deg C:	21.0	22.0
Comp. corr:	- 5.0	- 5.0

Meniscus correction only= 1

Specific gravity of solids= 2.78

Specific gravity correction factor= 0.972

Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	21.0	32.0	27.0	0.0130	33.0	10.9	0.0428	40.6
2.0	21.0	22.5	17.5	0.0130	23.5	12.4	0.0324	26.3
5.0	21.0	16.0	11.0	0.0130	17.0	13.5	0.0213	16.5
15.0	21.0	13.5	8.5	0.0130	14.5	13.9	0.0125	12.8
30.0	21.0	12.5	7.5	0.0130	13.5	14.1	0.0089	11.3
60.0	21.0	10.0	5.0	0.0130	11.0	14.5	0.0064	7.5
250.0	22.0	8.0	3.0	0.0128	9.0	14.8	0.0031	4.5
1440.0	22.0	7.0	2.0	0.0128	8.0	15.0	0.0013	3.0

Fractional Components

Gravel/Sand based on #4 sieve

Sand/Fines based on #200 sieve

% + 3 in. = 0.0 % GRAVEL = 0.0 % SAND = 53.8

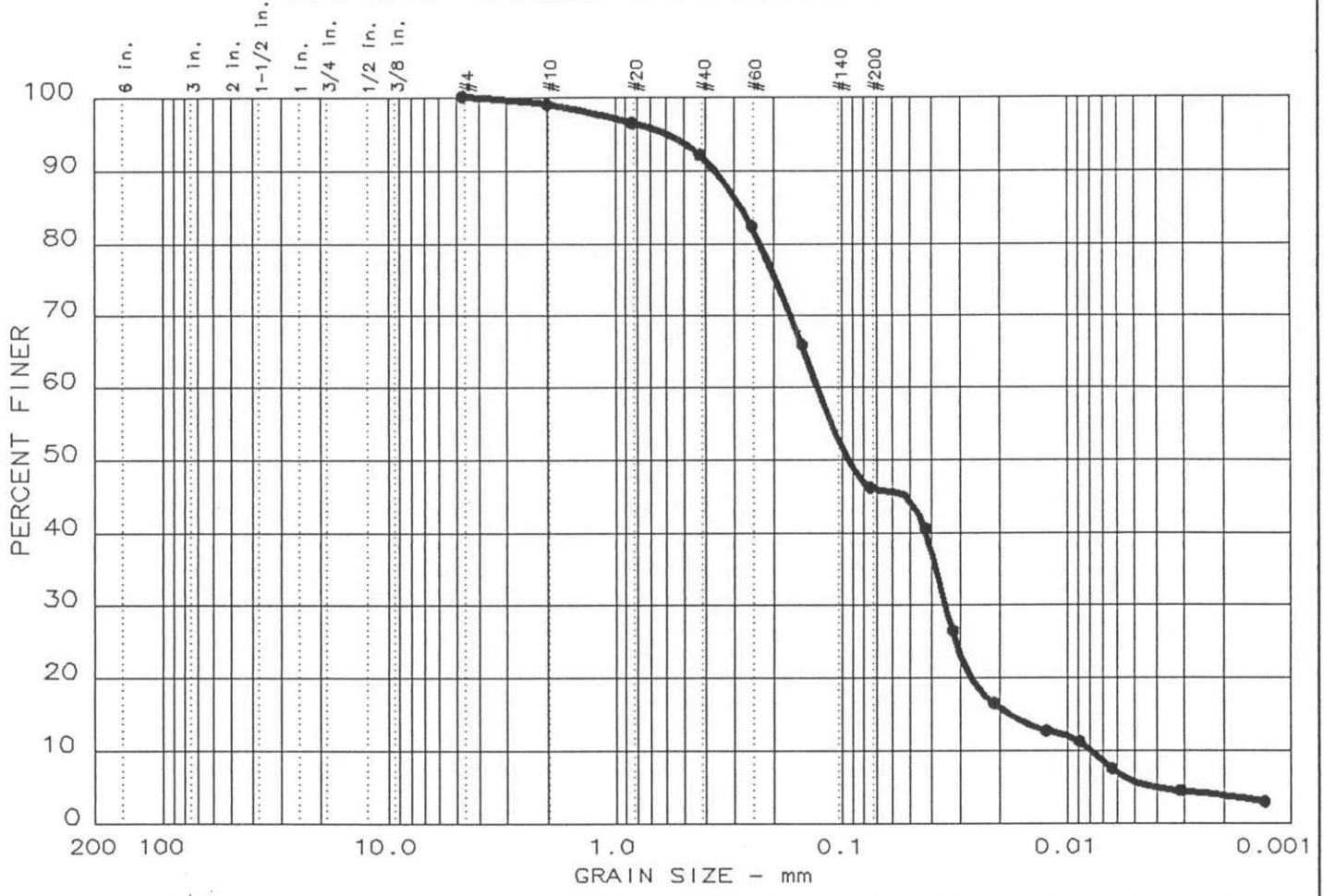
% SILT = 40.5 % CLAY = 5.7

D85= 0.28 D60= 0.128 D50= 0.094

D30= 0.0348 D15= 0.01803 D10= 0.00778

Cc = 1.2148 Cu = 16

GRAIN SIZE DISTRIBUTION



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	53.8	40.5	5.7

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.28	0.13	0.09	0.035	0.0180	0.0078	1.21	16.4

MATERIAL DESCRIPTION	USCS	AASHTO
● TAN SILTY SAND	SM	

Project No.: 1356-97-394
Project: BARRETT GRADING C&D LANDFILL
● Location: OW-6A, 9.0-11.0'

Date: 1/2/98

GRAIN SIZE DISTRIBUTION

S&ME

Remarks:

Figure No. 06A

GRAIN SIZE DISTRIBUTION TEST DATA Test No.: 6

Date: 12/3/97
Project No.: 1356-97-394
Project: BARRETT GRADING C&D LANDFILL

Sample Data

Location of Sample: OW-2, S-2 3.5-5.0'
Sample Description: ORANGE TAN FAT CLAY WITH SAND
USCS Class: CH
AASHTO Class:
Liquid limit: 77
Plasticity index: 47

Notes

Remarks:

Fig. No.: OW2

Mechanical Analysis Data

	Initial
Dry sample and tare=	105.51
Tare =	0.00
Dry sample weight =	105.51

Sample split on number 10 sieve
Split sample data:
Sample and tare = 50 Tare = 0 Sample weight = 50
Cumulative weight retained tare= 0
Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
# 4	0.00	100.0
# 10	0.75	99.3
# 20	1.32	96.7
# 40	3.36	92.6
# 60	5.41	88.5
# 100	9.07	81.3
# 200	12.58	74.3

Hydrometer Analysis Data

Separation sieve is number 10
Percent -# 10 based on complete sample= 99.3
Weight of hydrometer sample: 50
Hygroscopic moisture correction:
Moist weight & tare = 27.17
Dry weight & tare = 26.70
Tare = 15.27
Hygroscopic moisture= 4.1 %
Calculated biased weight= 48.37

Table of composite correction values:
Temp, deg C: 21.5 22.0
Comp. corr: - 6.0 - 6.0
Meniscus correction only= 1
Specific gravity of solids= 2.62
Specific gravity correction factor= 1.007
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

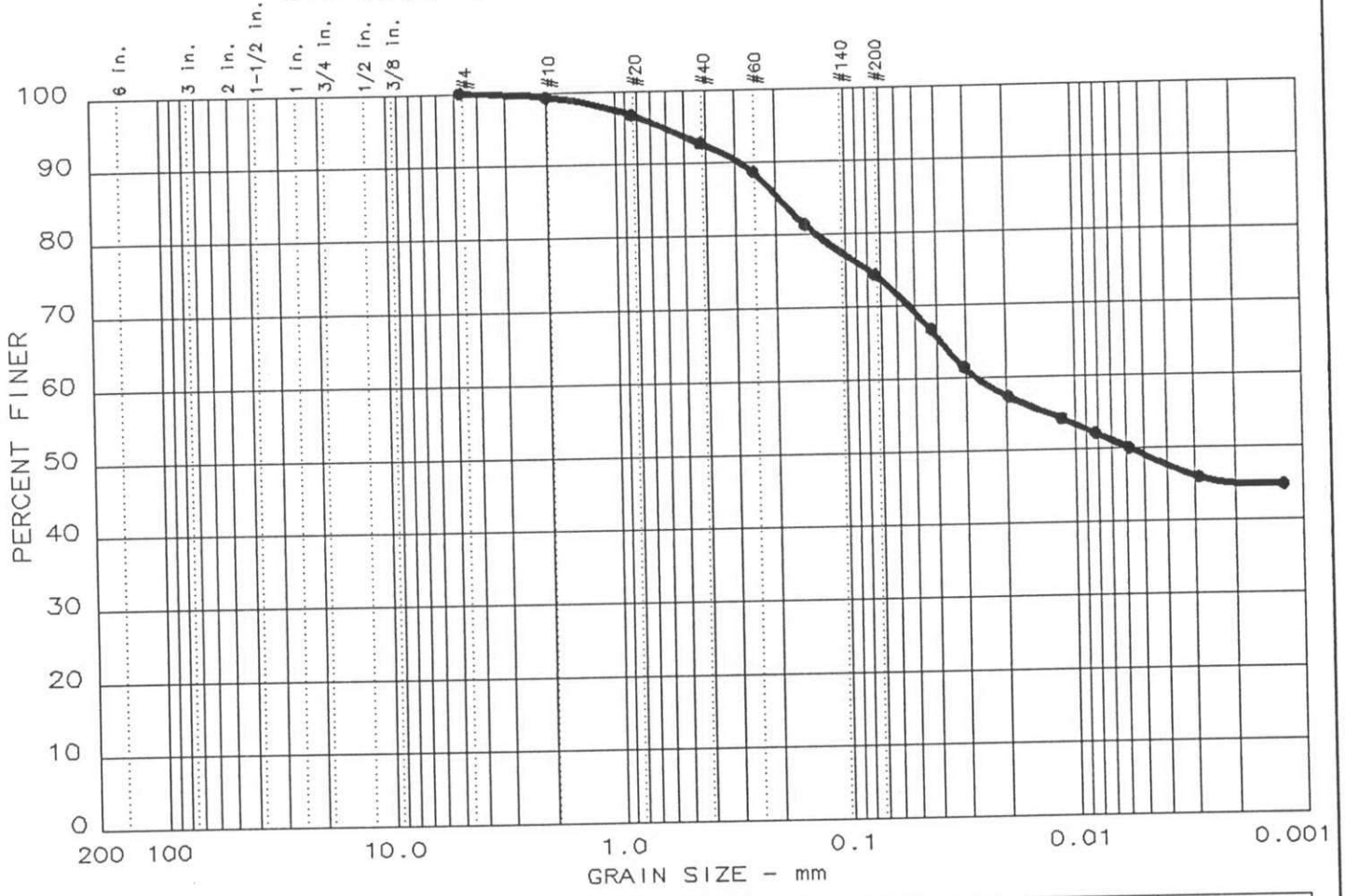
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	21.5	38.0	32.0	0.0135	39.0	9.9	0.0425	66.6
2.0	21.5	35.5	29.5	0.0135	36.5	10.3	0.0307	61.4
5.0	21.5	33.5	27.5	0.0135	34.5	10.6	0.0197	57.3
15.0	21.5	32.0	26.0	0.0135	33.0	10.9	0.0115	54.1
30.0	21.5	31.0	25.0	0.0135	32.0	11.0	0.0082	52.0
60.0	21.5	30.0	24.0	0.0135	31.0	11.2	0.0058	50.0
250.0	22.0	28.0	22.0	0.0134	29.0	11.5	0.0029	45.8
1440.0	21.5	27.5	21.5	0.0135	28.5	11.6	0.0012	44.8

Fractional Components

Gravel/Sand based on #4 sieve
Sand/Fines based on #200 sieve
% + 3 in. = 0.0 % GRAVEL = 0.0 % SAND = 25.7
% SILT = 25.4 % CLAY = 48.9

D85= 0.19 D60= 0.027 D50=

GRAIN SIZE DISTRIBUTION



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	25.7	25.4	48.9

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	77	47	0.19		0.01					

MATERIAL DESCRIPTION	USCS	AASHTO
● ORANGE TAN FAT CLAY WITH SAND	CH	

Project No.: 1356-97-394
Project: BARRETT GRADING C&D LANDFILL
● Location: OW-2, S-2 3.5-5.0'

Date: 12/3/97

GRAIN SIZE DISTRIBUTION

S&ME

Remarks:

Figure No. OW2

GRAIN SIZE DISTRIBUTION TEST DATA Test No.: 7

Date: 12/3/97
Project No.: 1356-97-394
Project: BARRETT GRADING C&D LANDFILL

Sample Data

Location of Sample: OW-4, S-8 28.5-30'
Sample Description: WHITE TAN SILTY SAND
USCS Class: SM Liquid limit: NP
AASHTO Class: Plasticity index: NP

Notes

Remarks:

Fig. No.: OW4

Mechanical Analysis Data

	Initial
Dry sample and tare=	113.74
Tare =	0.00
Dry sample weight =	113.74

Sample split on number 10 sieve
Split sample data:
Sample and tare = 50 Tare = 0 Sample weight = 50
Cumulative weight retained tare= 0
Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
# 4	0.00	100.0
# 10	1.71	98.5
# 20	4.55	89.5
# 40	13.70	71.5
# 60	20.17	58.8
# 100	27.30	44.7
# 200	32.89	33.7

Hydrometer Analysis Data

Separation sieve is number 10
Percent -# 10 based on complete sample= 98.5
Weight of hydrometer sample: 50
Hygroscopic moisture correction:
Moist weight & tare = 28.21
Dry weight & tare = 28.08
Tare = 16.94
Hygroscopic moisture= 1.2 %
Calculated biased weight= 50.18

Table of composite correction values:

Temp, deg C:	21.5	22.0
Comp. corr:	- 6.0	- 6.0

Meniscus correction only= 1

Specific gravity of solids= 2.73

Specific gravity correction factor= 0.983

Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	21.5	23.5	17.5	0.0131	24.5	12.3	0.0458	34.3
2.0	21.5	22.0	16.0	0.0131	23.0	12.5	0.0327	31.3
5.0	21.5	18.0	12.0	0.0131	19.0	13.2	0.0212	23.5
15.0	21.5	15.0	9.0	0.0131	16.0	13.7	0.0125	17.6
30.0	21.5	13.0	7.0	0.0131	14.0	14.0	0.0089	13.7
60.0	21.5	11.5	5.5	0.0131	12.5	14.2	0.0064	10.8
250.0	22.0	10.5	4.5	0.0130	11.5	14.4	0.0031	8.8
1440.0	21.5	10.0	4.0	0.0131	11.0	14.5	0.0013	7.8

Fractional Components

Gravel/Sand based on #4 sieve

Sand/Fines based on #200 sieve

% + 3 in. = 0.0 % GRAVEL = 0.0 % SAND = 66.3

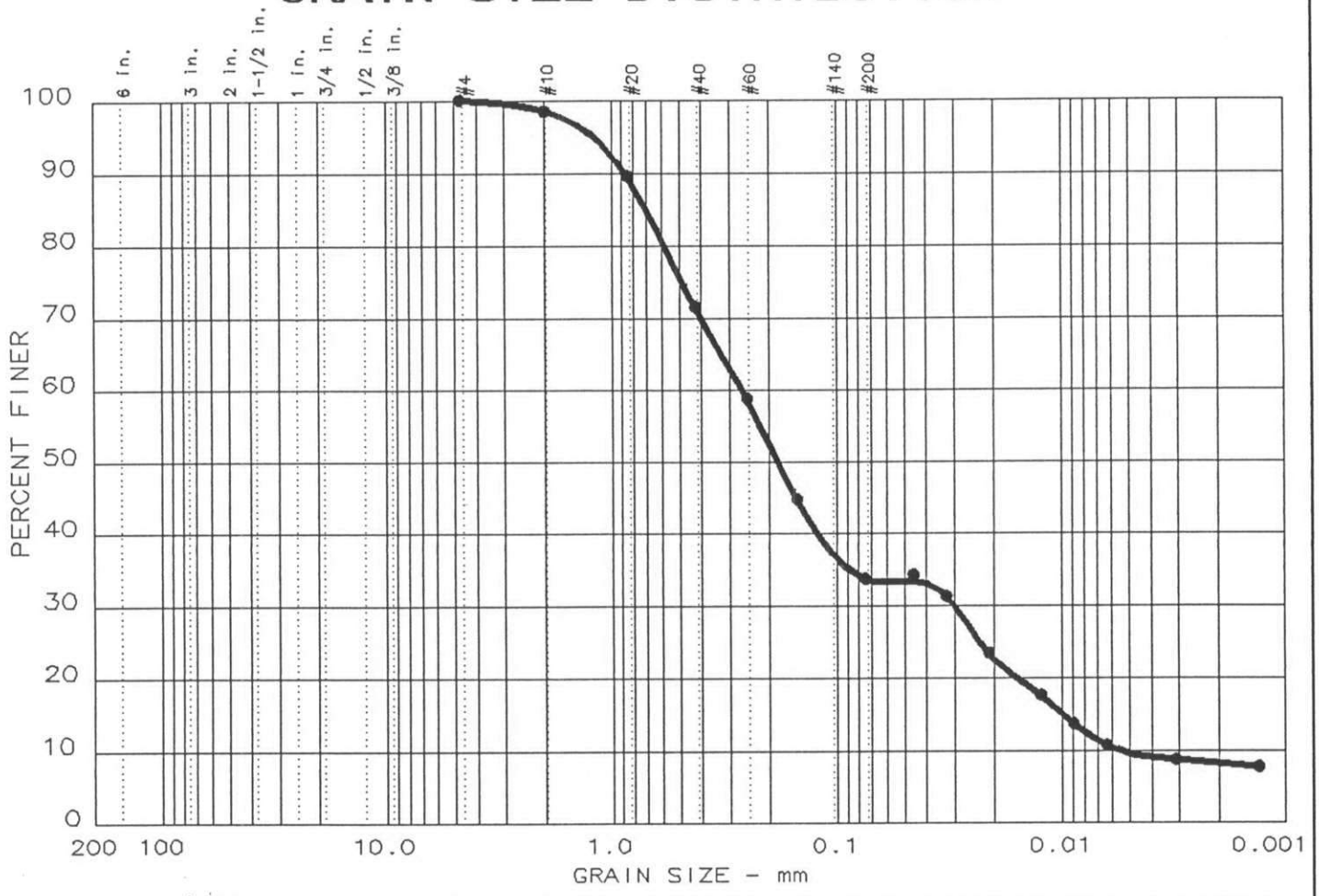
% SILT = 24.1 % CLAY = 9.6

D85= 0.70 D60= 0.262 D50= 0.181

D30= 0.0298 D15= 0.00985 D10= 0.00548

Cc = 0.6166 Cu = 47.86

GRAIN SIZE DISTRIBUTION



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	66.3	24.1	9.6

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NP	NP	0.70	0.26	0.18	0.030	0.0099	0.0055	0.62	47.9

MATERIAL DESCRIPTION	USCS	AASHTO
● WHITE TAN SILTY SAND	SM	

Project No.: 1356-97-394
Project: BARRETT GRADING C&D LANDFILL
● Location: OW-4, S-8 28.5-30'

Date: 12/3/97

GRAIN SIZE DISTRIBUTION

S&ME

Remarks:

Figure No. OW4

GRAIN SIZE DISTRIBUTION TEST DATA Test No.: 8

Date: 12/3/97
Project No.: 1356-97-394
Project: BARRETT GRADING C&D LANDFILL

Sample Data

Location of Sample: OW-7, S-7 23.5-25'
Sample Description: WHITE TAN SILTY SAND
USCS Class: SM
AASHTO Class:
Liquid limit:
Plasticity index:

Notes

Remarks:

Fig. No.: OW7

Mechanical Analysis Data

	Initial
Dry sample and tare=	84.22
Tare =	0.00
Dry sample weight =	84.22

Sample split on number 10 sieve
Split sample data:
Sample and tare = 65 Tare = 0 Sample weight = 65
Cumulative weight retained tare= 0
Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
# 4	0.00	100.0
# 10	2.76	96.7
# 20	4.87	89.5
# 40	11.50	79.6
# 60	17.80	70.2
# 100	26.21	57.7
# 200	38.65	39.2

Hydrometer Analysis Data

Separation sieve is number 10
Percent -# 10 based on complete sample= 96.7
Weight of hydrometer sample: 65
Hygroscopic moisture correction:
Moist weight & tare = 28.06
Dry weight & tare = 27.89
Tare = 16.14
Hygroscopic moisture= 1.4 %
Calculated biased weight= 66.24

Table of composite correction values:
Temp, deg C: 21.5 22.0
Comp. corr: - 6.0 - 6.0
Meniscus correction only= 1
Specific gravity of solids= 2.74
Specific gravity correction factor= 0.980
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

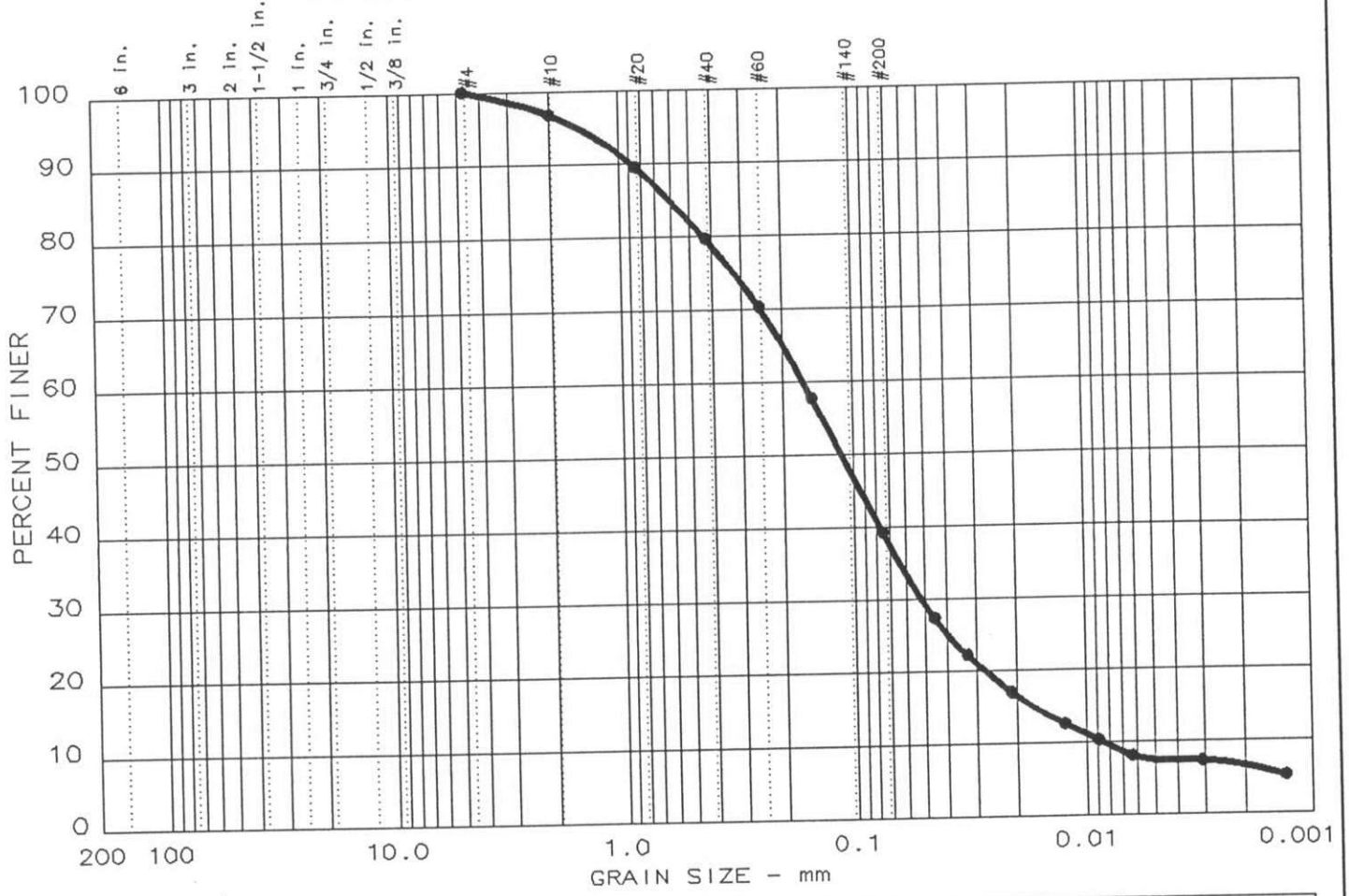
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	21.5	24.5	18.5	0.0130	25.5	12.1	0.0454	27.4
2.0	21.5	21.0	15.0	0.0130	22.0	12.7	0.0329	22.2
5.0	21.5	17.5	11.5	0.0130	18.5	13.3	0.0212	17.0
15.0	21.5	14.5	8.5	0.0130	15.5	13.8	0.0125	12.6
30.0	21.5	13.0	7.0	0.0130	14.0	14.0	0.0089	10.4
60.0	21.5	11.5	5.5	0.0130	12.5	14.2	0.0064	8.1
250.0	22.0	11.0	5.0	0.0130	12.0	14.3	0.0031	7.4
1440.0	21.5	9.5	3.5	0.0130	10.5	14.6	0.0013	5.2

Fractional Components

Gravel/Sand based on #4 sieve
Sand/Fines based on #200 sieve
% + 3 in. = 0.0 % GRAVEL = 0.0 % SAND = 60.8
% SILT = 31.7 % CLAY = 7.5

D85= 0.60 D60= 0.163 D50= 0.112
D30= 0.0511 D15= 0.01673 D10= 0.00838
Cc = 1.9055 Cu = 19.49

GRAIN SIZE DISTRIBUTION



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	60.8	31.7	7.5

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.60	0.16	0.11	0.051	0.0167	0.0084	1.91	19.5

MATERIAL DESCRIPTION	USCS	AASHTO
● WHITE TAN SILTY SAND	SM	

Project No.: 1356-97-394
Project: BARRETT GRADING C&D LANDFILL
● Location: OW-7, S-7 23.5-25'

Date: 12/3/97

GRAIN SIZE DISTRIBUTION

S&ME

Remarks:

Figure No. OW7

GRAIN SIZE DISTRIBUTION TEST DATA — Test No.: 9

Date: 12/3/97
Project No.: 1356-97-394
Project: BARRETT GRADING C&D LANDFILL

Sample Data

Location of Sample: OW-3, S-9 33.5-35.0'
Sample Description: GRAY WHITE SILTY SAND
USCS Class: SM — Liquid limit:
AASHTO Class: — Plasticity index:

Notes

Remarks:

Fig. No.: OW3

Mechanical Analysis Data

	Initial
Dry sample and tare=	108.08
Tare =	0.00
Dry sample weight =	108.08

Sample split on number 10 sieve
Split sample data:
Sample and tare = 65 Tare = 0 Sample weight = 65
Cumulative weight retained tare= 0
Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
# 4	0.00	100.0
# 10	4.86	95.5
# 20	4.25	89.3
# 40	10.64	79.9
# 60	16.57	71.2
# 100	24.55	59.4
# 200	33.21	46.7

Hydrometer Analysis Data

Separation sieve is number 10
Percent -# 10 based on complete sample= 95.5
Weight of hydrometer sample: 65
Hygroscopic moisture correction:
Moist weight & tare = 29.81
Dry weight & tare = 29.72
Tare = 16.85
Hygroscopic moisture= 0.7 %
Calculated biased weight= 67.59

Table of composite correction values:
Temp, deg C: 21.5 22.0
Comp. corr: - 6.0 - 6.0
Meniscus correction only= 1
Specific gravity of solids= 2.72
Specific gravity correction factor= 0.985
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

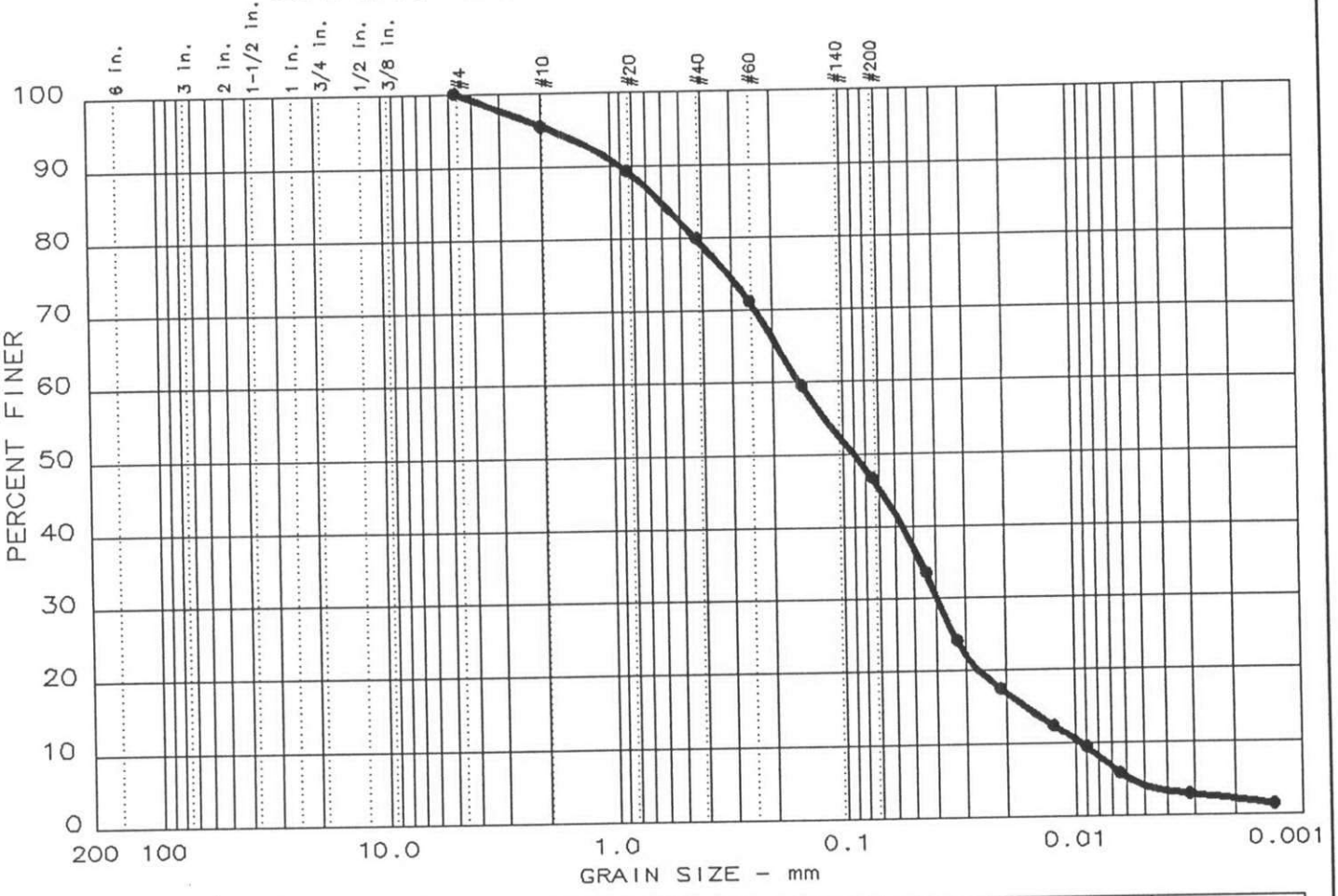
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	21.5	29.0	23.0	0.0131	30.0	11.4	0.0442	33.5
2.0	21.5	22.5	16.5	0.0131	23.5	12.4	0.0327	24.0
5.0	21.5	18.0	12.0	0.0131	19.0	13.2	0.0213	17.5
15.0	21.5	14.5	8.5	0.0131	15.5	13.8	0.0126	12.4
30.0	21.5	12.5	6.5	0.0131	13.5	14.1	0.0090	9.5
60.0	21.5	10.0	4.0	0.0131	11.0	14.5	0.0064	5.8
250.0	22.0	8.0	2.0	0.0130	9.0	14.8	0.0032	2.9
1440.0	21.5	7.0	1.0	0.0131	8.0	15.0	0.0013	1.5

Fractional Components

Gravel/Sand based on #4 sieve
Sand/Fines based on #200 sieve
% + 3 in. = 0.0 % GRAVEL = 0.0 % SAND = 53.3
% SILT = 42.6 % CLAY = 4.1

D85= 0.60 D60= 0.153 D50= 0.089
D30= 0.0398 D15= 0.01658 D10= 0.00943
Cc = 1.0952 Cu = 16

GRAIN SIZE DISTRIBUTION



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	53.3	42.6	4.1

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.60	0.15	0.09	0.040	0.0166	0.0094	1.10	16.2

MATERIAL DESCRIPTION	USCS	AASHTO
● GRAY WHITE SILTY SAND	SM	

Project No.: 1356-97-394
Project: BARRETT GRADING C&D LANDFILL
● Location: OW-3, S-9 33.5-35.0'

Date: 12/3/97

GRAIN SIZE DISTRIBUTION

S&ME

Remarks:

Figure No. OW3

GRAIN SIZE DISTRIBUTION TEST DATA Test No.: 10

Date: 12/3/97
Project No.: 1356-97-394
Project: BARRETT GRADING C&D LANDFILL

Sample Data

Location of Sample: OW-5, S-4 8.5-10.0'
Sample Description: ORANGE BROWN SILTY SAND
USCS Class: SM Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.: OW5

Mechanical Analysis Data

Initial
Dry sample and tare= 75.53
Tare = 0.00
Dry sample weight = 75.53
Sample split on number 10 sieve
Split sample data:
Sample and tare = 50 Tare = 0 Sample weight = 50
Cumulative weight retained tare= 0
Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
# 4	0.00	100.0
# 10	1.37	98.2
# 20	2.25	93.8
# 40	8.39	81.7
# 60	12.96	72.7
# 100	20.02	58.9
# 200	26.97	45.2

Hydrometer Analysis Data

Separation sieve is number 10
Percent -# 10 based on complete sample= 98.2
Weight of hydrometer sample: 50
Hygroscopic moisture correction:
Moist weight & tare = 28.71
Dry weight & tare = 28.56
Tare = 16.04
Hygroscopic moisture= 1.2 %
Calculated biased weight= 50.32

Table of composite correction values:
Temp, deg C: 21.5 22.0
Comp. corr: - 6.0 - 6.0
Meniscus correction only= 1
Specific gravity of solids= 2.67
Specific gravity correction factor= 0.995
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

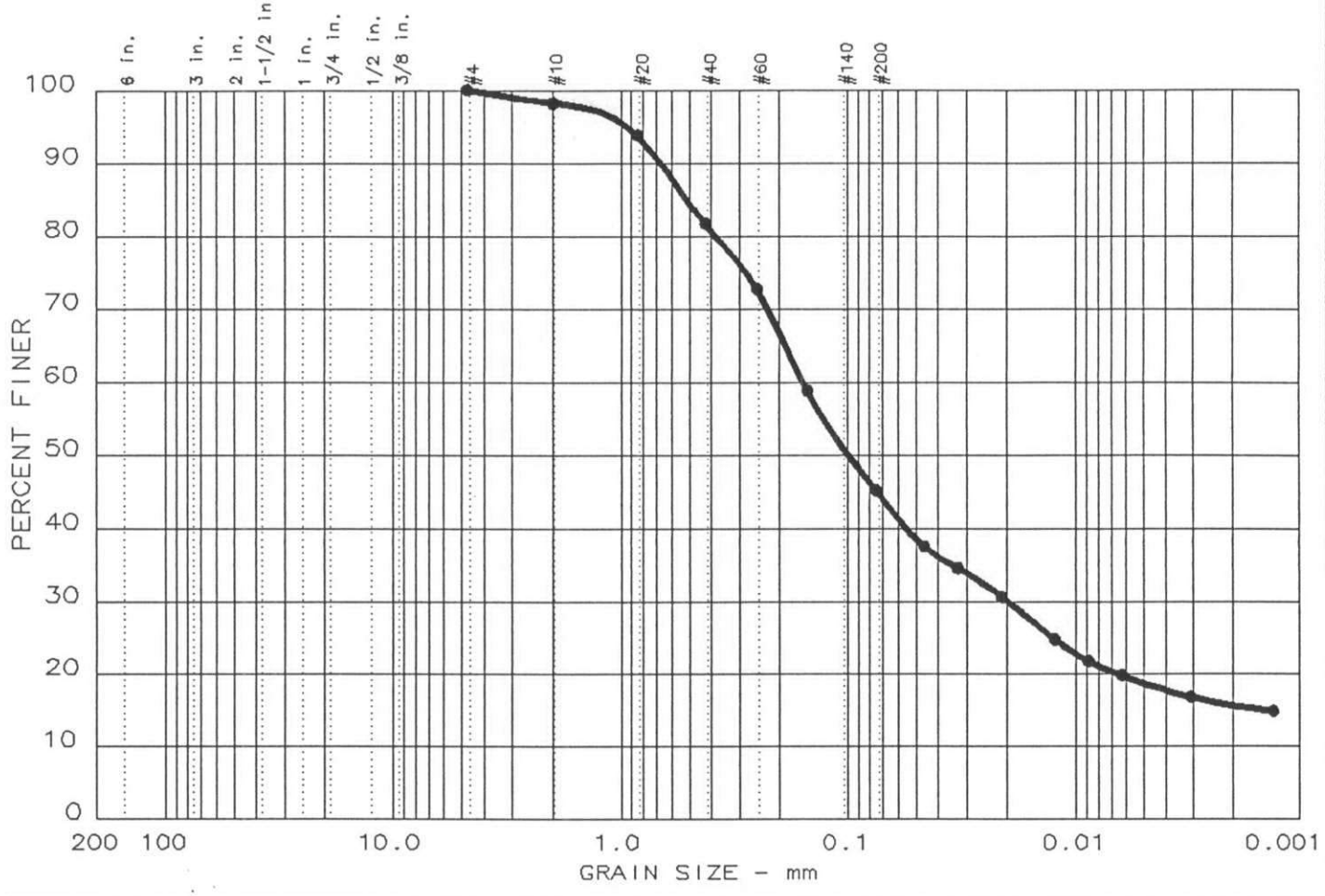
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	21.5	25.0	19.0	0.0133	26.0	12.0	0.0462	37.6
2.0	21.5	23.5	17.5	0.0133	24.5	12.3	0.0330	34.6
5.0	21.5	21.5	15.5	0.0133	22.5	12.6	0.0211	30.7
15.0	21.5	18.5	12.5	0.0133	19.5	13.1	0.0124	24.7
30.0	21.5	17.0	11.0	0.0133	18.0	13.3	0.0089	21.8
60.0	21.5	16.0	10.0	0.0133	17.0	13.5	0.0063	19.8
250.0	22.0	14.5	8.5	0.0132	15.5	13.8	0.0031	16.8
1440.0	21.5	13.5	7.5	0.0133	14.5	13.9	0.0013	14.8

Fractional Components

Gravel/Sand based on #4 sieve
Sand/Fines based on #200 sieve
% + 3 in. = 0.0 % GRAVEL = 0.0 % SAND = 54.8
% SILT = 26.6 % CLAY = 18.6

D85= 0.51 D60= 0.156 D50= 0.099
D30= 0.0197 D15= 0.0

GRAIN SIZE DISTRIBUTION



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	54.8	26.6	18.6

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.51	0.16	0.10	0.020	0.0014			

MATERIAL DESCRIPTION	USCS	AASHTO
● ORANGE BROWN SILTY SAND	SM	

Project No.: 1356-97-394
Project: BARRETT GRADING C&D LANDFILL
● Location: OW-5, S-4 8.5-10.0'

Date: 12/3/97

GRAIN SIZE DISTRIBUTION

S&ME

Remarks:

Figure No. OW5

GRAIN SIZE DISTRIBUTION TEST DATA Test No.: 11

Date: 12/4/97
Project No.: 1356-97-394
Project: BARRETT GRADING C&D LANDFILL

Sample Data

Location of Sample: OW-1, S-6 18.5-20'
Sample Description: WHITE TAN SILTY SAND
USCS Class: SM Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.: OW1

Mechanical Analysis Data

Initial
Dry sample and tare= 97.07
Tare = 0.00
Dry sample weight = 97.07
Sample split on number 10 sieve
Split sample data:
Sample and tare = 65 Tare = 0 Sample weight = 65
Cumulative weight retained tare= 0
Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
# 4	0.00	100.0
# 10	1.37	98.6
# 20	4.87	91.2
# 40	13.81	77.6
# 60	19.74	68.6
# 100	28.77	55.0
# 200	35.09	45.4

Hydrometer Analysis Data

Separation sieve is number 10
Percent -# 10 based on complete sample= 98.6
Weight of hydrometer sample: 65
Hygroscopic moisture correction:
Moist weight & tare = 30.43
Dry weight & tare = 30.30
Tare = 17.01
Hygroscopic moisture= 1.0 %
Calculated biased weight= 65.29

Table of composite correction values:
Temp, deg C: 21.5 22.0
Comp. corr: - 7.0 - 6.0
Meniscus correction only= 1
Specific gravity of solids= 2.76
Specific gravity correction factor= 0.976
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

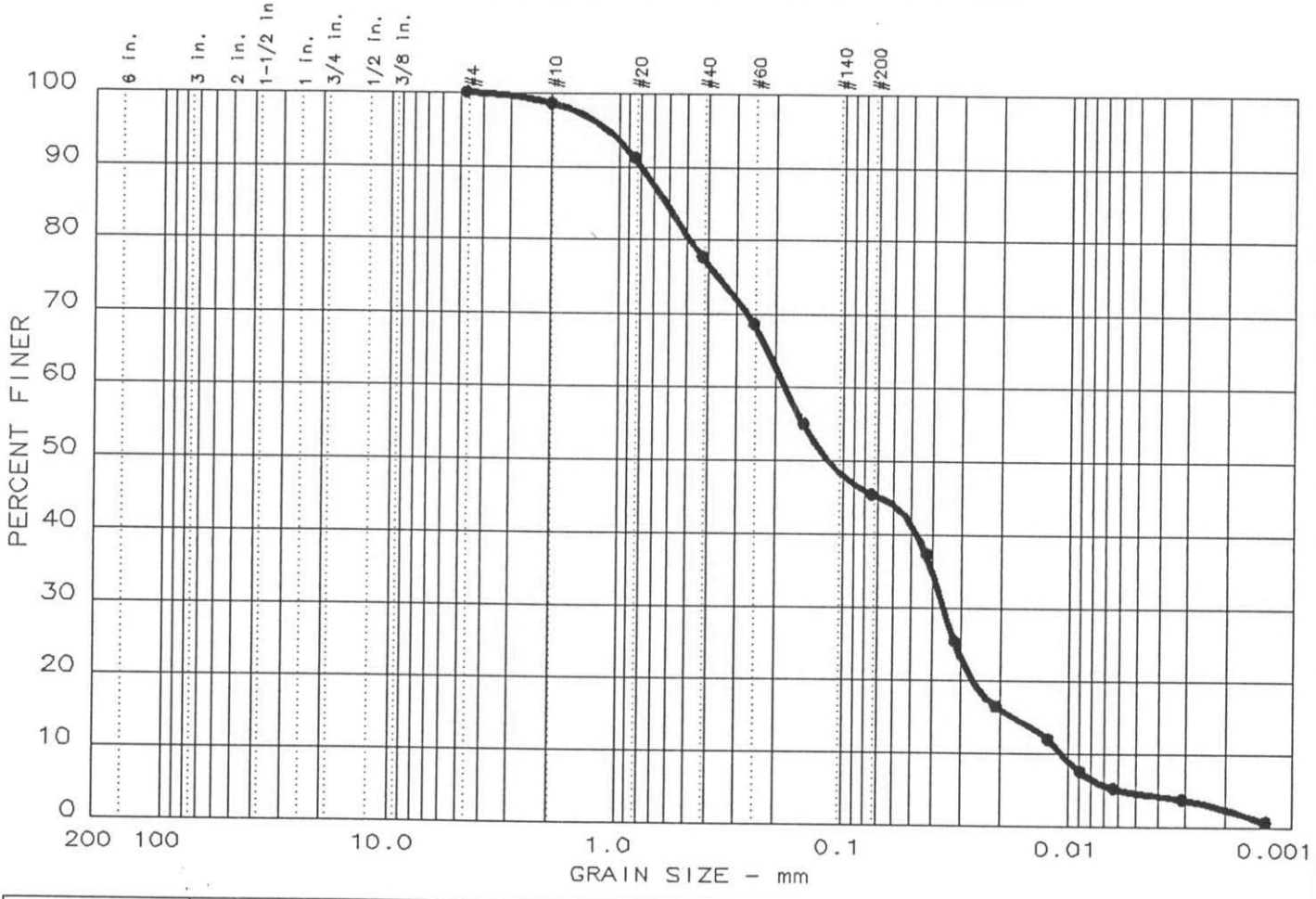
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	21.5	32.0	25.0	0.0130	33.0	10.9	0.0428	37.4
2.0	21.5	24.0	17.0	0.0130	25.0	12.2	0.0320	25.4
5.0	21.5	18.0	11.0	0.0130	19.0	13.2	0.0211	16.5
15.0	21.5	15.0	8.0	0.0130	16.0	13.7	0.0124	12.0
30.0	21.5	12.0	5.0	0.0130	13.0	14.2	0.0089	7.5
60.0	21.5	10.5	3.5	0.0130	11.5	14.4	0.0064	5.2
250.0	22.0	8.5	2.5	0.0129	9.5	14.7	0.0031	3.7
1440.0	21.5	7.5	0.5	0.0130	8.5	14.9	0.0013	0.7

Fractional Components

Gravel/Sand based on #4 sieve
Sand/Fines based on #200 sieve
% + 3 in. = 0.0 % GRAVEL = 0.0 % SAND = 54.6
% SILT = 40.8 % CLAY = 4.6

D85= 0.62 D60= 0.181 D50= 0.116
D30= 0.0357 D15= 0.01770 D10= 0.01067
Cc = 0.6607 Cu = 16.9

GRAIN SIZE DISTRIBUTION



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	54.6	40.8	4.6

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.62	0.18	0.12	0.036	0.0177	0.0107	0.66	17.0

MATERIAL DESCRIPTION	USCS	AASHTO
● WHITE TAN SILTY SAND	SM	

Project No.: 1356-97-394
Project: BARRETT GRADING C&D LANDFILL
● Location: OW-1, S-6 18.5-20'

Date: 12/4/97

GRAIN SIZE DISTRIBUTION

S&ME

Remarks:

Figure No. OW1

GRAIN SIZE DISTRIBUTION TEST DATA Test No.: 12

Date: 12/3/97
Project No.: 1356-97-394
Project: BARRETT GRADING C&D LANDFILL

Sample Data

Location of Sample: OW-8, S-7 23.5-25'
Sample Description: OLIVE GREEN SILTY SAND
USCS Class: SM Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.: OW8

Mechanical Analysis Data

Initial
Dry sample and tare= 82.35
Tare = 0.00
Dry sample weight = 82.35
Sample split on number 10 sieve
Split sample data:
Sample and tare = 65 Tare = 0 Sample weight = 65
Cumulative weight retained tare= 0
Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
# 4	0.00	100.0
# 10	0.67	99.2
# 20	1.16	97.4
# 40	4.75	91.9
# 60	11.45	81.7
# 100	28.96	55.0
# 200	40.62	37.2

Hydrometer Analysis Data

Separation sieve is number 10
Percent -# 10 based on complete sample= 99.2
Weight of hydrometer sample: 65
Hygroscopic moisture correction:
Moist weight & tare = 28.50
Dry weight & tare = 28.41
Tare = 16.88
Hygroscopic moisture= 0.8 %
Calculated biased weight= 65.03

Table of composite correction values:
Temp, deg C: 21.5 22.0
Comp. corr: - 6.0 - 6.0
Meniscus correction only= 1
Specific gravity of solids= 2.69
Specific gravity correction factor= 0.991
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

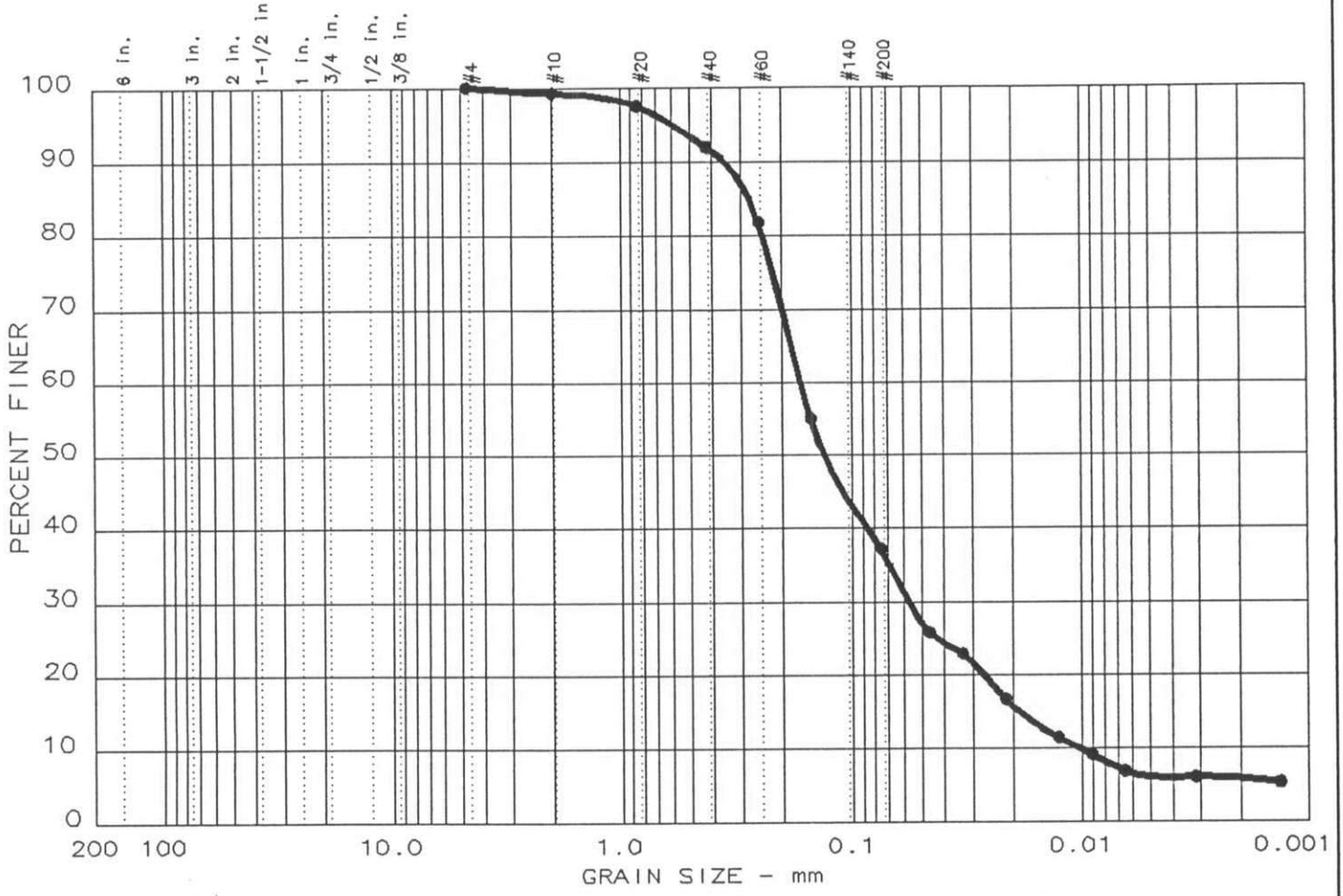
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	21.5	23.0	17.0	0.0132	24.0	12.4	0.0465	25.9
2.0	21.5	21.0	15.0	0.0132	22.0	12.7	0.0333	22.9
5.0	21.5	17.0	11.0	0.0132	18.0	13.3	0.0216	16.8
15.0	21.5	13.5	7.5	0.0132	14.5	13.9	0.0127	11.4
30.0	21.5	12.0	6.0	0.0132	13.0	14.2	0.0091	9.1
60.0	21.5	10.5	4.5	0.0132	11.5	14.4	0.0065	6.9
250.0	22.0	10.0	4.0	0.0132	11.0	14.5	0.0032	6.1
1440.0	21.5	9.5	3.5	0.0132	10.5	14.6	0.0013	5.3

Fractional Components

Gravel/Sand based on #4 sieve
Sand/Fines based on #200 sieve
% + 3 in. = 0.0 % GRAVEL = 0.0 % SAND = 62.8
% SILT = 31.1 % CLAY = 6.1

D85= 0.27 D60= 0.166 D50= 0.132
D30= 0.0562 D15= 0.01884 D10= 0.01012
Cc = 1.8836 Cu = 16

GRAIN SIZE DISTRIBUTION



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	62.8	31.1	6.1

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.27	0.17	0.13	0.056	0.0188	0.0101	1.88	16.4

MATERIAL DESCRIPTION	USCS	AASHTO
● OLIVE GREEN SILTY SAND	SM	

Project No.: 1356-97-394
Project: BARRETT GRADING C&D LANDFILL
● Location: OW-8, S-7 23.5-25'

Date: 12/3/97

GRAIN SIZE DISTRIBUTION

S&ME

Remarks:

Figure No. OW8

GRAIN SIZE DISTRIBUTION TEST DATA Test No.: 13

Date: 12/3/97
Project No.: 1356-97-394
Project: BARRETT GRADING C&D LANDFILL

Sample Data

Location of Sample: OW-9, S-6 18.5-20'
Sample Description: WHITE GRAY SILTY SAND
USCS Class: SM Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.: OW9

Mechanical Analysis Data

	Initial
Dry sample and tare=	116.17
Tare =	0.00
Dry sample weight =	116.17

Sample split on number 10 sieve
Split sample data:
Sample and tare = 65 Tare = 0 Sample weight = 65
Cumulative weight retained tare= 0
Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
# 4	0.00	100.0
# 10	1.73	98.5
# 20	2.61	94.6
# 40	10.79	82.2
# 60	21.47	66.0
# 100	31.28	51.1
# 200	41.36	35.8

Hydrometer Analysis Data

Separation sieve is number 10
Percent -# 10 based on complete sample= 98.5
Weight of hydrometer sample: 65
Hygroscopic moisture correction:
Moist weight & tare = 33.76
Dry weight & tare = 33.59
Tare = 16.64
Hygroscopic moisture= 1.0 %
Calculated biased weight= 65.33

Table of composite correction values:

Temp, deg C:	21.5	22.0
Comp. corr:	- 6.0	- 6.0

Meniscus correction only= 1
Specific gravity of solids= 2.78
Specific gravity correction factor= 0.972
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

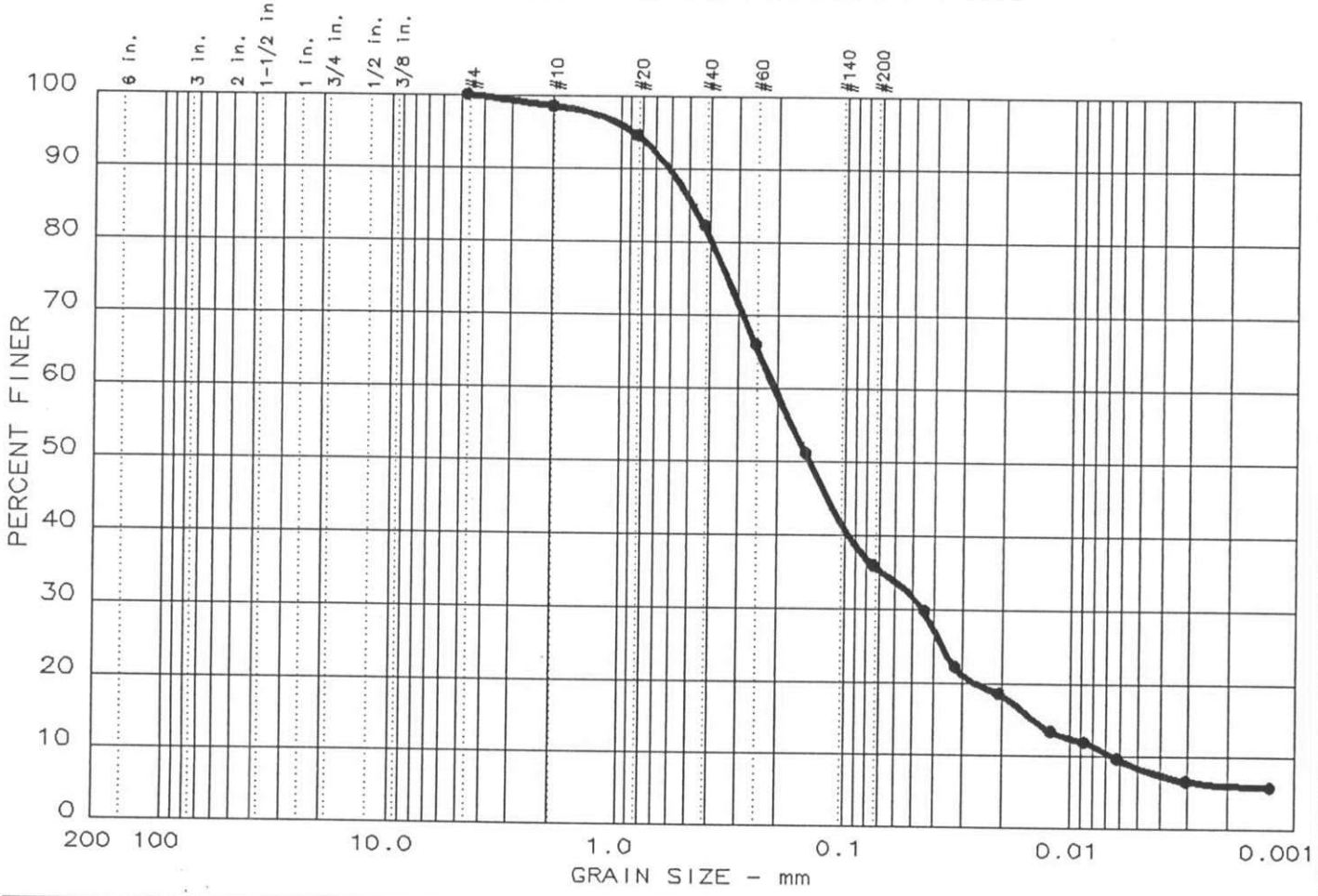
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	21.5	26.0	20.0	0.0129	27.0	11.9	0.0444	29.8
2.0	21.5	21.0	15.0	0.0129	22.0	12.7	0.0325	22.3
5.0	21.5	18.5	12.5	0.0129	19.5	13.1	0.0209	18.6
15.0	21.5	15.0	9.0	0.0129	16.0	13.7	0.0123	13.4
30.0	21.5	14.0	8.0	0.0129	15.0	13.8	0.0088	11.9
60.0	21.5	12.5	6.5	0.0129	13.5	14.1	0.0062	9.7
250.0	22.0	10.5	4.5	0.0128	11.5	14.4	0.0031	6.7
1440.0	21.5	10.0	4.0	0.0129	11.0	14.5	0.0013	6.0

Fractional Components

Gravel/Sand based on #4 sieve
Sand/Fines based on #200 sieve
% + 3 in. = 0.0 % GRAVEL = 0.0 % SAND = 64.2
% SILT = 27.5 % CLAY = 8.3

D85= 0.47 D60= 0.204 D50= 0.144
D30= 0.0445 D15= 0.01457 D10= 0.00651
Cc = 1.4911 Cu = 31.

GRAIN SIZE DISTRIBUTION



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	64.2	27.5	8.3

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.47	0.20	0.14	0.045	0.0146	0.0065	1.49	31.4

	MATERIAL DESCRIPTION	USCS	AASHTO
●	WHITE GRAY SILTY SAND	SM	

Project No.: 1356-97-394
Project: BARRETT GRADING C&D LANDFILL
● Location: OW-9, S-6 18.5-20'

Date: 12/3/97

GRAIN SIZE DISTRIBUTION

S&ME

Remarks:

Figure No. OW9

GRAIN SIZE DISTRIBUTION TEST DATA — Test No.: 19

Date: 12/1/97
Project No.: 1356-97-394
Project: BARRETT GRADING C&D LANDFILL

Sample Data

Location of Sample: OW-7, S-4 8.5-10'
Sample Description: ORANGE BROWN SILTY SAND
USCS Class: SM
AASHTO Class:
Liquid limit:
Plasticity index:

Notes

Remarks:

Fig. No.: OW7

Mechanical Analysis Data

	Initial	After wash
Dry sample and tare=	162.00	100.99
Tare =	0.00	0.00
Dry sample weight =	162.00	100.99

Minus #200 from wash= 37.7 %
T[illegible] for cumulative weight retained= 0

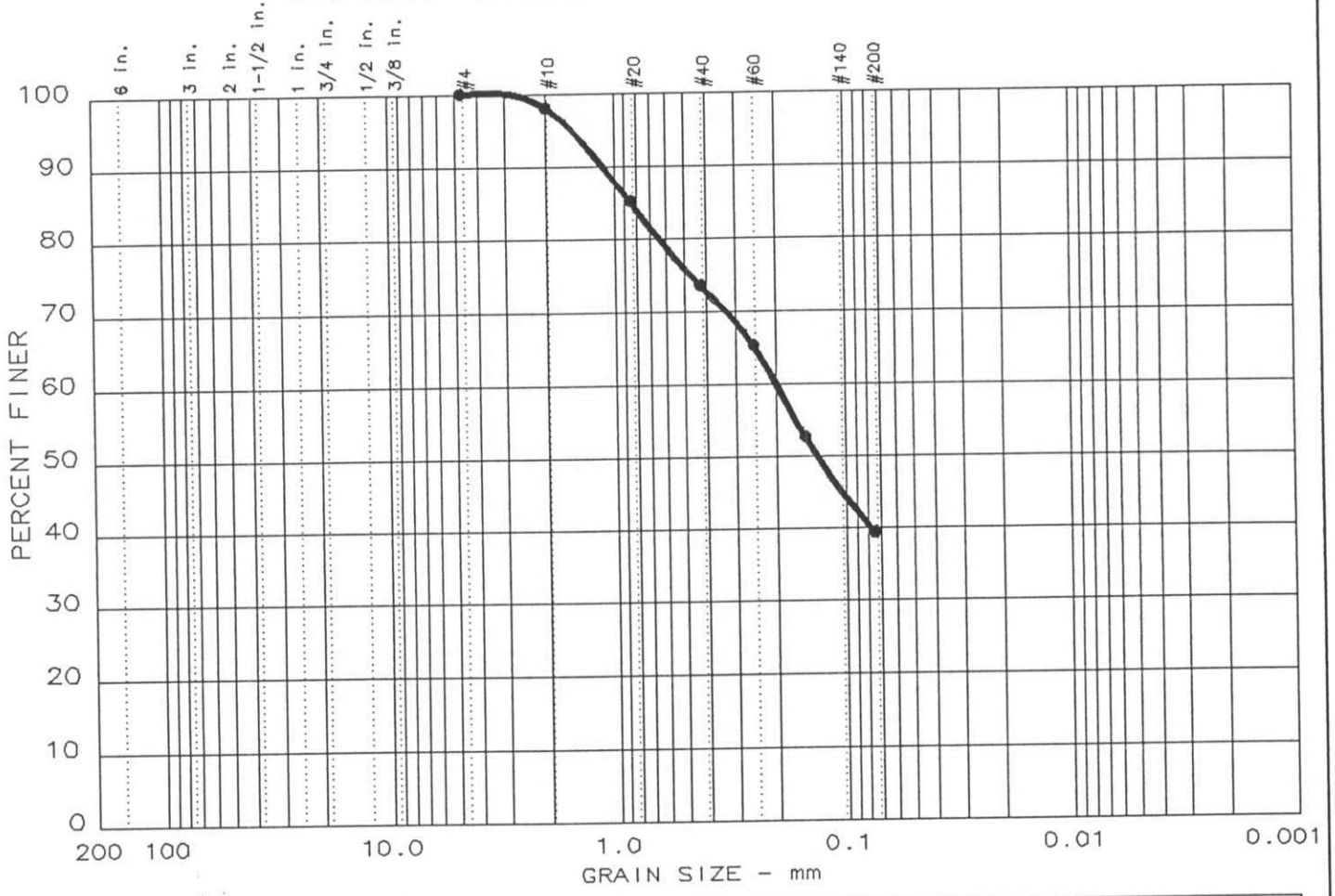
Sieve	Cumul. Wt. retained	Percent finer
# 4	0.00	100.0
# 10	3.21	98.0
# 20	24.14	85.1
# 40	42.96	73.5
# 60	56.05	65.4
# 100	76.61	52.7
# 200	98.18	39.4

Fractional Components

Gravel/Sand based on #4 sieve
Sand/Fines based on #200 sieve
% + 3 in. = 0.0 % GRAVEL = 0.0 % SAND = 60.6
% FINES = 39.4

D85= 0.84 D60= 0.199 D50= 0.133

GRAIN SIZE DISTRIBUTION



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	60.6	39.4	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.84	0.20	0.13					

MATERIAL DESCRIPTION	USCS	AASHTO
● ORANGE BROWN SILTY SAND	SM	

Project No.: 1356-97-394
Project: BARRETT GRADING C&D LANDFILL
● Location: OW-7, S-4 8.5-10'

Date: 12/1/97

GRAIN SIZE DISTRIBUTION

S&ME

Remarks:

Figure No. OW7

GRAIN SIZE DISTRIBUTION TEST DATA — Test No.: 20

Date: 12/1/97
Project No.: 1356-97-394
Project: BARRETT GRADING C&D LANDFILL

Sample Data

Location of Sample: OW-9, S-3 6-7.5'
Sample Description: ORANGE BROWN SILTY SAND
USCS Class: SM — Liquid limit:
AASHTO Class: — Plasticity index:

Notes

Remarks:

Fig. No.: OW9

Mechanical Analysis Data

	Initial	After wash
Dry sample and tare=	129.37	81.68
Tare =	0.00	0.00
Dry sample weight =	129.37	81.68

Minus #200 from wash= 36.9 %
Tare for cumulative weight retained= 0

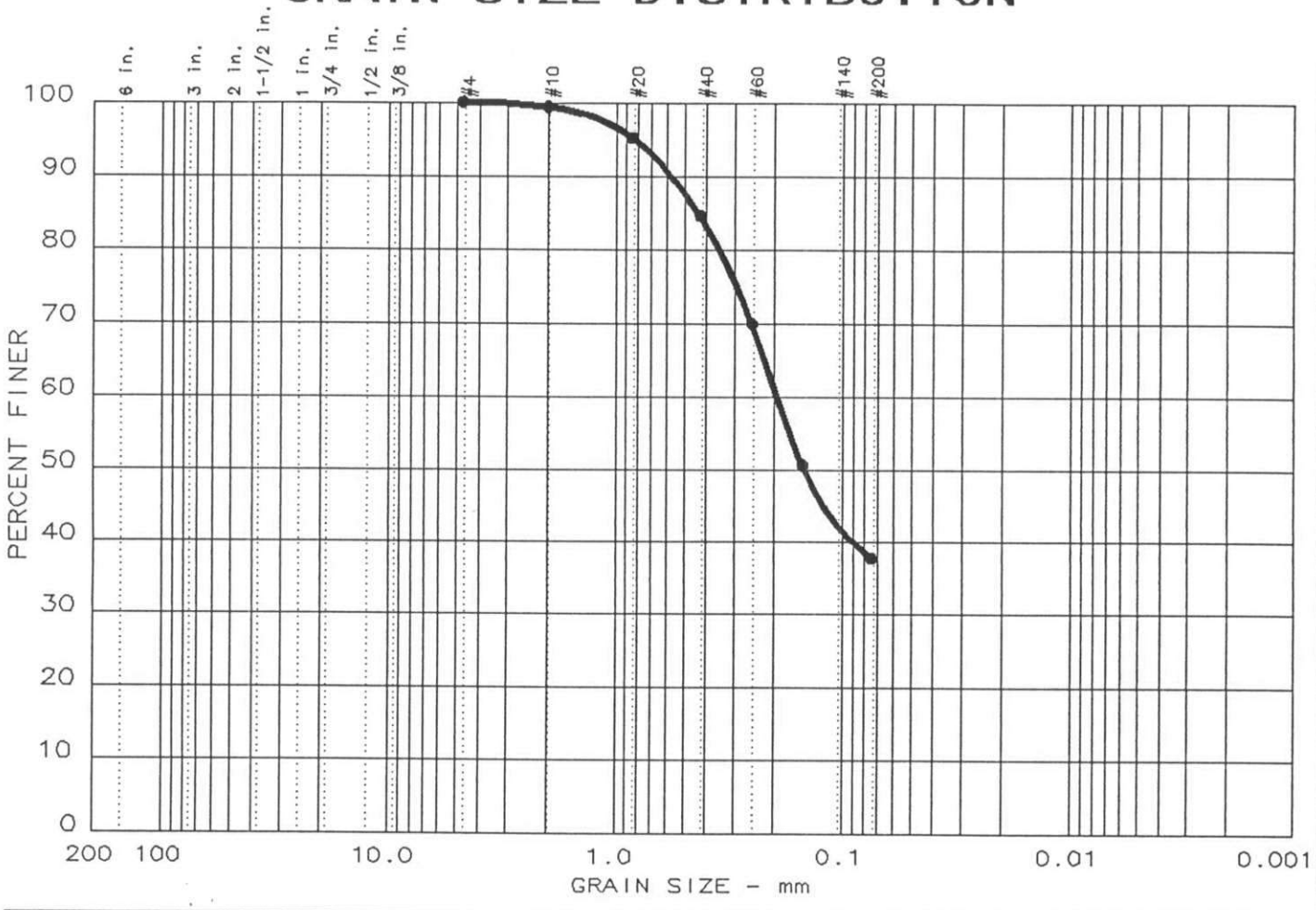
Sieve	Cumul. Wt. retained	Percent finer
# 4	0.00	100.0
# 10	0.77	99.4
# 20	6.19	95.2
# 40	19.99	84.5
# 60	38.93	69.9
# 100	63.91	50.6
# 200	80.54	37.7

Fractional Components

Gravel/Sand based on #4 sieve
Sand/Fines based on #200 sieve
% + 3 in. = 0.0 % GRAVEL = 0.0 % SAND = 62.3
% FINES = 37.7

D85= 0.43 D60= 0.194 D50= 0.147

GRAIN SIZE DISTRIBUTION



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	62.3	37.7	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.43	0.19	0.15					

MATERIAL DESCRIPTION	USCS	AASHTO
● ORANGE BROWN SILTY SAND	SM	

Project No.: 1356-97-394
Project: BARRETT GRADING C&D LANDFILL
● Location: OW-9, S-3 6-7.5'

Date: 12/1/97

GRAIN SIZE DISTRIBUTION

S&ME

Remarks:

Figure No. OW9

APPENDIX III
ENDANGERED OR THREATENED SPECIES

S&ME

February 20, 1998

Barrett Grading
Post Office Box 866
Pineville, North Carolina 28134

Attention: Mr. Chris Barrett

Reference: **FUTURE C & D LANDFILL**
WETLANDS IMPACTS
Lake Norman Landfill, Inc. C & D Landfill
Lincoln County, North Carolina
S&ME Project No. 1356-97-394

Dear Chris:

As discussed in our letter to you, dated January 14, 1998, S&ME personnel met with Mr. Steve Chapin of the United States Army Corps of Engineers (USACOE) on January 7, 1998 at the above referenced site. The purpose of the meeting with Mr. Chapin was to determine to what extent the USACOE has jurisdiction over the drainage feature located in the southern corner of the subject site. Accordingly, Mr. Chapin determined that the entire drainage feature is classified as "Waters of the United States", and is therefore under USACOE jurisdiction.

As described in that letter to you, up to approximately 650 linear feet of the drainage feature, located at the southern corner of the subject site, could be impacted by obtaining a Nationwide Permit Number 26 (NWP 26) from the USACOE. Some form of mitigation, depending on the severity of impacts, would be required. In addition, the State of North Carolina has denied a blanket waiver of water quality certification for NWP 26 and requires that an individual 401 Certification be obtained from the State Division of Water Quality.

S&ME, Inc. 9751 Southern Pine Boulevard, Charlotte, North Carolina 28273, (704) 523-4726, Fax (704) 525-3953
Mailing address: P.O. Box 7668, Charlotte, North Carolina 28241-7668

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As currently designed, impacts to the above mentioned drainage feature would not be included in the Phase 1 Lake Norman C & D Landfill construction. Permitting and mitigation considerations would be addressed in future Phase 2 C & D landfill construction.

The remaining two drainage features to the north of this feature (as shown on Sheet 2 of 12 in the permit package) have a minimum 50-foot buffer from the centerline of the features to the waste disposal.

Should you have any questions or concerns, please feel free to contact us.

Sincerely,

S&ME, Inc.

Adam H. Karagosian
Staff Environmental Professional

Jack J. Amar
Branch Manager/Sr. Vice President

S&ME

January 14, 1998

Barrett Grading
Post Office Box 866
Pineville, North Carolina 28134

Attention: Mr. Chris Barrett

Reference: **U.S. Army Corps of Engineers Verification**
Barrett Grading C & D Landfill
Lincoln County, North Carolina
S&ME Project No. 1356-97-394

Dear Mr. Barrett:

As discussed in our meeting on Wednesday, January 7, 1998, S&ME personnel met with Mr. Steve Chapin of the United States Army Corps of Engineers (USACOE) on January 7, 1998 at the above referenced site. The purpose of the meeting with Mr. Chapin was to determine to what extent the USACOE has jurisdiction over the drainage feature located in the southern corner of the subject site (see enclosed map).

According to Mr. Chapin, the entire drainage feature is classified as "Waters of the United States", and is therefore under USACOE jurisdiction. However, for purposes of impact (filling) of the drainage feature, a determination of "significant function" was also made by Mr. Chapin. Accordingly, it was determined that the upgradient-most 150 linear feet (approximate length) of the drainage feature, starting at an approximate 12" culvert, does not serve a "significant function". This 150 linear foot length of stream could be impacted without obtaining a Nationwide 26 Permit or an Individual Permit, and without mitigation. Pre-notification to the USACOE for impact to this area is, however, required.

The remainder of this drainage feature (beyond the initial 150 feet) was determined to be a "significant function" Waters of the U.S. According to a follow-up conversation with Mr.

S&ME, Inc. 9751 Southern Pine Boulevard, Charlotte, North Carolina 28273, (704) 523-4726, Fax (704) 525-3953
Mailing address: P.O. Box 7668, Charlotte, North Carolina 28241-7668

Recycled Paper

Chapin on January 9, 1997, contrary to S&ME's initial understanding, impact to the next 500 linear feet of these "significant function" waters requires a Nationwide 26 Permit and pre-notification. Some form of mitigation will be required as well, the extent of which is dependent on the severity of the impact. Impacts to greater than 500 linear feet of "significant function" waters will require an Individual Permit and mitigation.

Specifically, up to approximately 650 linear feet of the drainage feature located at the southern corner of the subject site could be impacted by obtaining a Nationwide 26 Permit from the USACOE (the 150 linear feet [approximate length] of "non-significant function" Waters of the U.S. and up to 500 linear feet of "significant function" Waters of the U.S.). Some form of mitigation, depending on the severity of impacts would be required. Impacts beyond 650 linear feet of this drainage feature would require an Individual Permit and mitigation.

According to Mr. Steve Lund of the USACOE, there is not an agreement between the USACOE and the State of North Carolina regarding mitigation. Therefore, The State Wetlands Restoration Program does not meet USACOE qualifications, and mitigation would be required by the USACOE for the above mentioned scenarios. In addition, mitigation plans approved by USACOE may not necessarily be approved by the State, and contribution to the Restoration Fund may also be required. However, according to Mr. Chapin, if mitigation is not feasible at the subject site, the USACOE may allow contribution to the Restoration Fund in lieu of mitigation.

Some forms of mitigation suggested by the USACOE representatives include, but are not limited to: rechanneling the stream and vegetating the new stream channel; and enhancement of a degraded stream channel located on-site, if any exist. Also, according to Mr. Lund, the USACOE prefers relocation of streams (rechannelization) rather than piping.

Mr. Chapin recommended applying for no more than 650 feet of impacts to the above mentioned drainage feature, so to avoid the Individual Permitting process. In the event that an Individual Permit is sought, the USACOE circulates a public notice to elicit comments from anyone with an interest in the project. According to Mr. Lund, at a minimum, the following government entities become involved in the process: USACOE; U.S. Fish and Wildlife Service; North Carolina Division of Wildlife Resources; U.S. Environmental Protection Agency; North Carolina Division of Water Quality; and the North Carolina Historic Preservation Office. Other government agencies may become involved depending on the impacts of the project to their specific areas of jurisdiction (i.e., local Planning/Zoning Department, State Highway Department, etc.). The Individual Permitting process takes a minimum of 90 days.

S&ME is in the process of gathering information regarding cost and the time frame to obtain both a Nationwide 26 Permit and an Individual Permit, and associated mitigation plans for both. It is our opinion that a Nationwide 26 Permit for the 650 feet would enhance your property's development, and suggest you consider this approach. Please note that this length of the drainage feature now brings you within approximately100 feet of the limits defined by the North Carolina Department of Environment and Natural Resources – Division of Waste Management.

Should you have any further questions, please feel free to call.

Very Truly Yours,

S&ME, Inc.

Adam H. Karagosian
Staff Environmental Scientist

Jack J. Amar
Branch Manager/ Sr. V.P.

AHK/JJA/ak
Enclosure

Environmental
Permitting
Consultants

December 12, 1997

S&ME, Inc.
9751 Southern Pine Blvd.
Charlotte, North Carolina 28273

Attention: Dan Brewer

Reference: Protected Species Habitat Assessment
Barrett Grading Property
Lincoln County, North Carolina
EPC Project No. 97ECO84

Dear Mr. Brewer:

Enclosed please find two (2) copies of the Protected species Habitat Assessment for the Barrett Grading property located in Lincoln County, North Carolina. The results of the assessment are summarized in Section 5.0 of the report.

EPC, Inc. appreciates the opportunity to provide this Protected Species Habitat Assessment to S&ME, Inc. and Barrett Grading. If you have any questions or need additional information please call us at (864) 271-3040. If required, additional copies of the report can be forwarded to your office. At your request, I will submit a copy of the report to NCDNR Heritage Trust for concurrence.

Sincerely,
Environmental Permitting Consultants, Inc.

Richard Bates, MSPH

84 Villa Road, Suite 206 B-2 • Greenville, SC 29615 • (864) 271-3040 • Fax (864) 235-9299

PROTECTED SPECIES HABITAT ASSESSMENT
BARRETT GRADING PROPERTY
LINCOLN COUNTY, NORTH CAROLINA
EPC PROJECT NO. 97ECO84

Prepared For:

Barrett Grading Company
Waxhaw, North Carolina

Prepared By:
Environmental Permitting Consultants, Inc.
84 Villa Road, B-2, Suite 206
Greenville, South Carolina

December 1997

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1.0 INTRODUCTION

Barrett Grading Company, of Waxhaw, North Carolina (c/o S&ME, Inc.), retained Environmental Permitting Consultants (EPC) to provide a protected species habitat assessment for the Barrett Grading Property located in Lincoln County, North Carolina. The habitat assessment was performed to ensure that habitat for federally protected species would not be impacted from proposed development (construction and demolition debris landfill) of the property. Endangered and threatened species are protected under the Endangered Species Act (ESA) of 1973 (16 USC 1531-1543) and the North Carolina Plant Protection and Conservation Act of 1979. *Endangered Wildlife of North Carolina* (dated March 16, 1992) is a published list of animals that are state protected.

Endangered species are defined as those plants and animals whose prospects of survival are in immediate danger. Threatened species are those species that may become endangered if conditions related to their existence continue to deteriorate (e.g., loss of suitable habitat). Another category of concern is candidate species that may be listed as endangered or threatened in the future. Candidate species are not legally protected under the federal or state ESA.

EPC's assessment of potential protected species habitat on the Barrett Grading Property was conducted in three (3) phases. The first phase involved the qualitative and quantitative assessment of general habitat types on the property. The second phase consisted of a review of existing records obtained from federal (US Fish and Wildlife Service) and state (North Carolina Department of Natural Resources – Natural Heritage Program) agencies. Both agencies provided listings of potential protected species and habitat types for Lincoln County. The third phase of the assessment consisted of comparing the habitats identified in phase 1 with those protected species requirements identified in phase 2. Thus, a determination of critical habitats and the potential for the existence of protected species was conducted.

2.0 SITE DESCRIPTION

The Barrett Grading Property consists of one parcel comprising a total of approximately 114 acres. The property is located west of the intersection of NC Highway 16 and Seaboard Coast Railroad in Lincoln County, North Carolina. A site location map is provided as Figure 1 in Appendix 7.1.

The property is located near an industrially (mining operation) developed area. However, most of the surrounding area appeared to be undeveloped and forested. Residential and commercial developments were also observed in the general area.

Forney Creek forms the northwestern property boundary. The creek flows to the southwest to Killian Creek which flows to Dutchmans Creek approximately 4.5 miles south of the property. Two (2) small unnamed tributaries bisect the property in a

southeast to northeast direction and flow to Forney Creek. The majority of the property had been clear-cut prior to the protected species habitat assessment. Intact forest areas appeared to be less than 20 years of age. Silvicultural activity appeared to be prevalent in the area.

3.0 METHODS

3.1 Habitat Assessment

An assessment of the habitat types of the Barrett Grading Property was determined by performing an on-site survey during December 1997. Habitat characteristics were based on vegetation type, location in the landscape, past anthropological disturbances; and, hydrologic features.

3.2 Agency Review

Lists of protected species and their habitat requirements were obtained by contacting agencies responsible for the protection of threatened and endangered species. Requests for information regarding the occurrence of protected species on or near the project site were directed to the USFWS and North Carolina Department of Natural Resources (SCDNR) Heritage Trust Section. Agency responses are included in Appendix 7.3.

3.3 Selection of Protected Species

Protected species habitat requirements, as determined from literature review and agency databases, were compared to those habitat types identified on the property. If protected species habitat requirements corresponded to any of those habitats identified on the property, a qualitative assessment of the potential presence of that species was provided.

4.0 RESULTS

4.1 Habitat Characterization

Habitat types on the Barrett Grading Property were distinguished by vegetation type, location in the landscape, past disturbances and hydrologic characteristics. Specific habitat types and approximate acreage on the property are provided in the Habitat Assessment Summary in Table 1.

TABLE 1 HABITAT ASSESSMENT SUMMARY BARRETT GRADING PROPERTY LINCOLN COUNTY, NORTH CAROLINA	
Habitat Type	Approximate Acreage
1. Bottomland Hardwood Association	~30
2. Oak/Gum/Pine Wooded Slope Association (clear-cut)	~40
3. Pine/Hardwood Upland (clear-cut)	~21
4. Upland Hardwood Association	~23
Total	~114

Four (4) major habitat types were identified on the property. Habitat characteristics were compared to documented requirements for protected species to determine the potential presence of those species on the property. Specific requirements for protected fauna and flora are discussed in Sections 4.2 and 4.3, respectively.

4.2 Protected Fauna

A list of protected animal species for Lincoln County was provided by the North Carolina Department of Natural Resources, Heritage Trust Section. Listed species, status, and on-site potential are summarized in Table 2.

TABLE 2 PROTECTED FAUNA SUMMARY BARRETT GRADING PROPERTY LINCOLN COUNTY, NORTH CAROLINA			
Common Name	Scientific Name	Status (1)	On-Site Potential/Observed
Loggerhead Shrike	*Lanius l. ludovicianus*	SC	No/No
Santee Chub	*Cyprinella zanema*	SR	Yes/No
Dwarf Threetooth	*Tridopsis fulcidens*	SC	No/No
(1) SC - Species of concern (State), SR – Significantly Rare (State)			

A habitat assessment was performed for each protected animal species listed in Table 2. Species requirements were compared to those habitats observed and on-site potential for each species was assessed. The assessment for each species is provided below:

Loggerhead Shrike

The Loggerhead Shrike prefers open country habitats with scattered trees for nesting and telephone wires of fences for perching (Robbins et. al., 1966). Open areas that would provide suitable habitat for this species were not observed on the property.

Santee Chub

The Santee Chub inhabits rocky riffles and runs of small creeks and streams primarily in the Catawba, Broad, Cape Fear and Lumber drainages (Page and Burr, 1991). The two small streams on the property may provide suitable habitat for this species.

Dwarf Threetooth

The Dwarf Threetooth is a terrestrial gastropod endemic to the southwestern piedmont of North Carolina (NC Natural Heritage Program, 1993). The property is located in the outer range for this species (i.e., northeast corner of the southwest Piedmont). Therefore, it is doubtful that this species would inhabit the property.

4.3 Protected Flora

A list of protected plant species for Lincoln County was provided by the North Carolina Department of Natural Resources, Heritage Trust Section. Listed species, status and on-site potential are summarized in Table 3.

TABLE 3
PROTECTED FLORA SUMMARY
BARRETT GRADING PROPERTY
LINCOLN COUNTY, NORTH CAROLINA

Common Name	Scientific Name	Status (1)	On-Site Potential/Observed
Dissected Sneezeweed	*Helenium pinnatifidum*	SR	No/No
Dwarf-flowered Heartleaf	*Hexastylis naniflora*	E/PT – FT	Yes/?
Biltmore Carrion-flower	*Smilax biltmoreana*	C	Yes/No
Creeping Draba	*Draba reptans*	C	No/No
Michaux's Sumac	*Rhus michauxii*	E/SC – FE	No/No
Natural Communities			
Basic Mesic Forest	Piedmont Subtype	S2	No
Mesic Mixed Hardwood Forest	Piedmont Subtype	S4	Yes

(1) SR – Significantly Rare (State); E/PT – Endangered but proposed Threatened (State); C Candidate (State); E/SC – Endangered Species of concern (State)
FT – Federally Threatened; FE - Federally Endangered
S2 – Imperiled in NC because of rarity; S4 – Apparently secure in NC

Habitats were identified on the Barrett Grading Property that would potentially support several species of concern that usually inhabit rich deciduous woodland and moist slopes. Habitat descriptions for plant species were obtained from USFWS documentation; Batson, 1984; Radford *et. al.*, 1983; and, Peterson *et. al.*, 1968. The basis for the on-site potential listings for each species is provided below:

Dissected Sneezeweed

Dissected Sneezeweed is a perennial herb typically found in pocosins, bays, bogs and wet savannahs. These specific habitats were not observed on the property.

Dwarf-flowered Heartleaf

Dwarf-flowered Heartleaf normally occurs in acid sandy soils (especially Pacolet sandy loam) on bluffs and ravines in deciduous forests. The species is often associated with Mountain Laurel (*Kalmia latifolia*). Suitable habitat was observed along the steep slopes adjacent to the small streams on the property. *Hexastylis* specimens (probably *H. arifolia*) were noted in those areas.

Biltmore Carrion-flower

Carrion-flower is an unarmed (thorn-less) climbing vine found in deciduous woods in the lower mountains and Piedmont. Suitable habitat was observed on the property, however, no Carrion-flower specimens were noted.

Creeping Draba

Creeping Draba is a winter annual that inhabits sandy soil areas primarily in Lincoln County. Soils on the property were primarily sandy loam therefore suitable habitat for this species was not present.

Michaux's Sumac

Michaux's Sumac is a small shrub that inhabits sandy or rocky open woods associated with basic soils in the lower Piedmont area. Suitable habitat was not observed on the property and no *Sumac sp.* specimens were noted.

5.0 CONCLUSIONS

Potential suitable habitats for two plant species and one animal species were determined for the Barrett Grading Property. Habitat suitability determinations were based on both existing (disturbed) conditions and pre-disturbed conditions. Pre-disturbed conditions were assessed by comparisons with adjacent properties and upstream and downstream areas of Forney Creek. The animal species identified as having potential suitable habitat was the Santee Chub. That species is considered significantly rare on the State level. Plant species identified with potential suitable habitat were the Dwarf-flowered Heartleaf and the Biltmore Carrion-flower. The Dwarf-flowered Heartleaf is considered endangered (proposed threatened) at the State level and threatened at the Federal level. The Biltmore Carrion-flower is considered a State candidate species. None of the species described above were actually observed on the property during the field assessment. However, specimens of *Hexastylis sp.* were observed along the slopes adjacent to the two small tributaries on the property.

6.0 REFERENCES

Batson, W.T. 1984. A Guide to the Genera of the Plants of Eastern North America. University of South Carolina Press. Columbia, SC. 203pp.

Batson, W.T. 1987. Wild Flowers in the Carolinas. University of South Carolina Press. Columbia, SC. 153pp.+

Page, L.M. and B.M. Burr. 1991. Freshwater Fishes of North America. Houghton Mifflin Company, Boston, MA. 432pp.

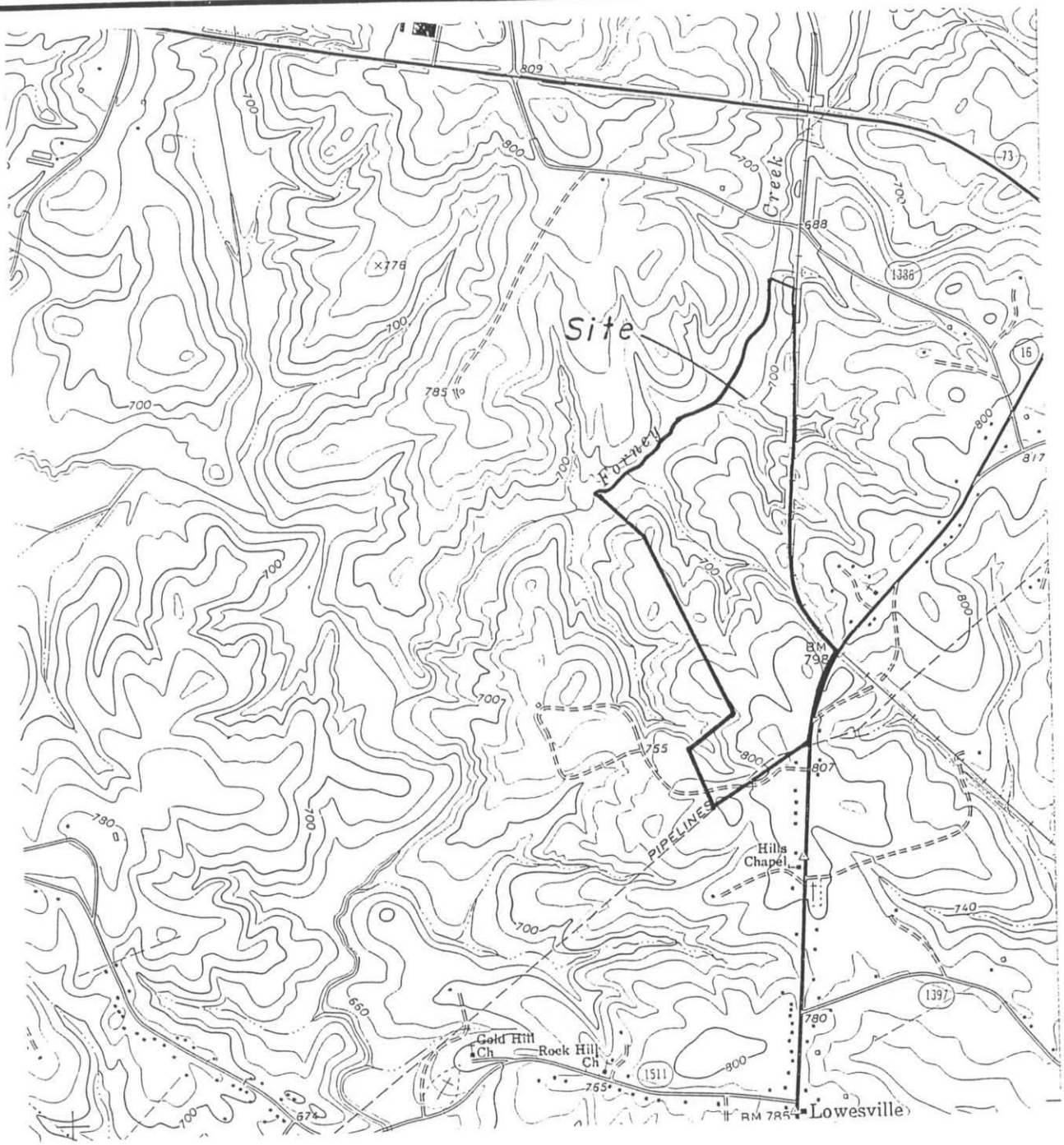
Peterson, R.T. and M. McKenny. 1968. Wildflowers: Northeast and North-central, North America. Houghton Mifflin Company, Boston, MA. 420pp.

Radford, A.E., H.E. Ahles and C.R. Bell. 1983. Manual of the Vascular Flora of the Carolinas. The University of North Carolina Press. 1183pp.

Robbins, C.S., B. Brunn, and H.S. Zim. 1966. A Guide to Field Identification: Birds of North America. Golden Press. New York, NY. 340pp.

US Soil Conservation Service. 197_. Soil Survey of Lincoln County, North Carolina. US Department of Agriculture.

Appendix 7.1
Figures



Source: USGS Topographic Map
Lowesville, North Carolina

N

Scale: 1" = 2000' Date: 12/12/97 Drawn By: RDB Reviewed By: RDB File No.: 97ECO84 Revision No.: 1	**EPC, INC.** 84 Villa Road - B2 Suite 206 Greenville, SC 29615 (864) 271-3040	Site Location and Topographic Map Barrett Grading Property Lincoln County North Carolina EPC Project No. 97ECO84	Figure **1**

Appendix 7.2
Photographs

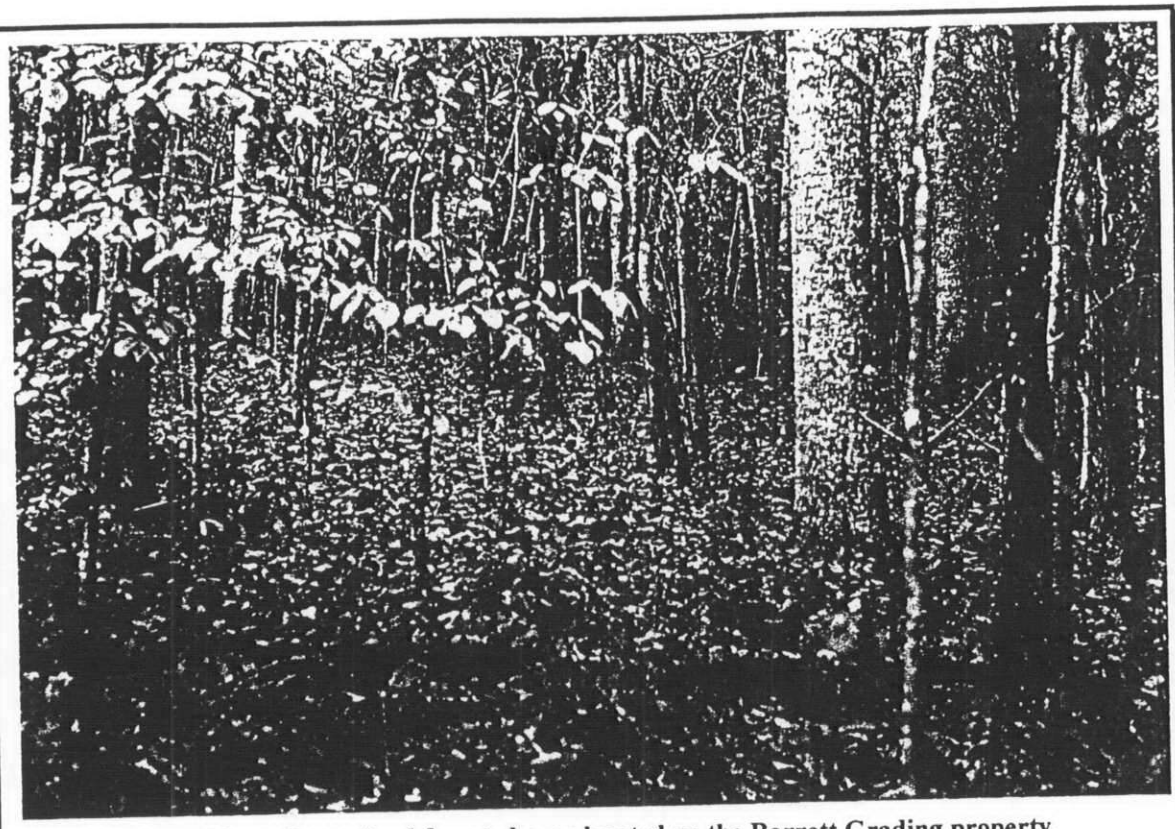


Photo No. 1 View of an upland forested area located on the Barrett Grading property.

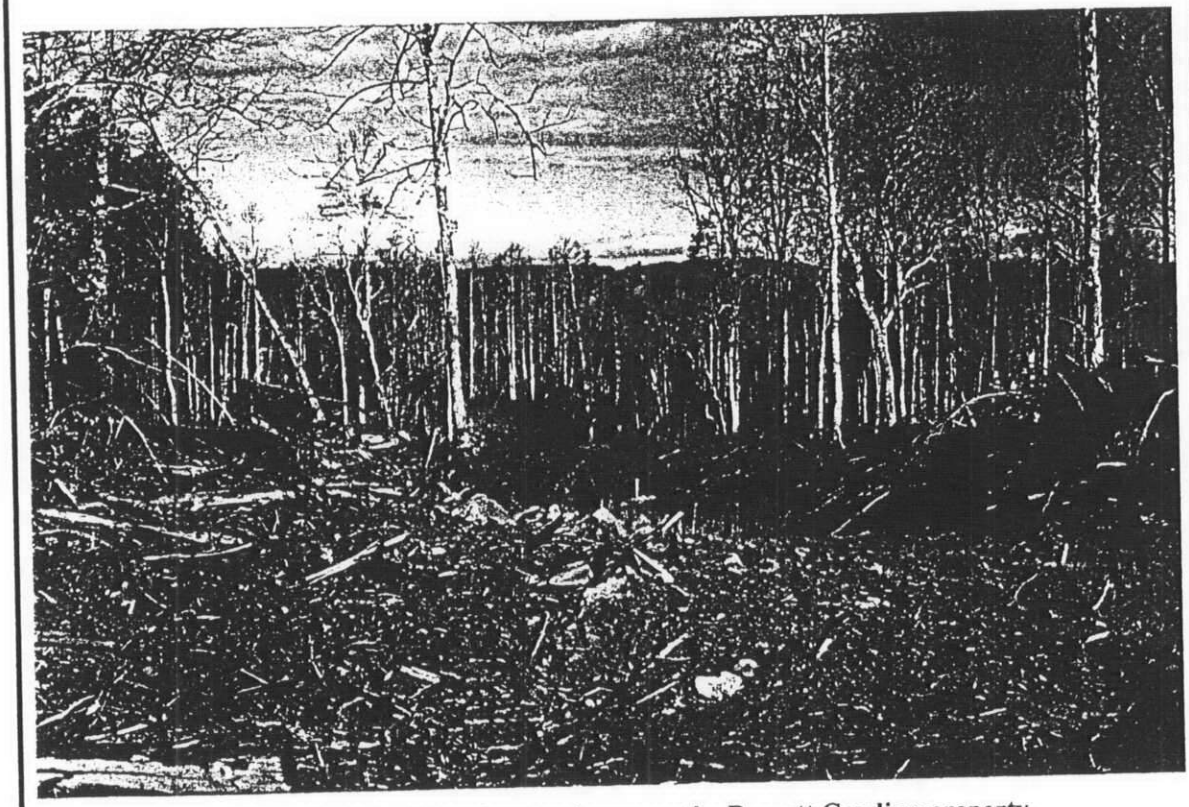


Photo No. 2 View of a disturbed (clear-cut) area on the Barrett Grading property.

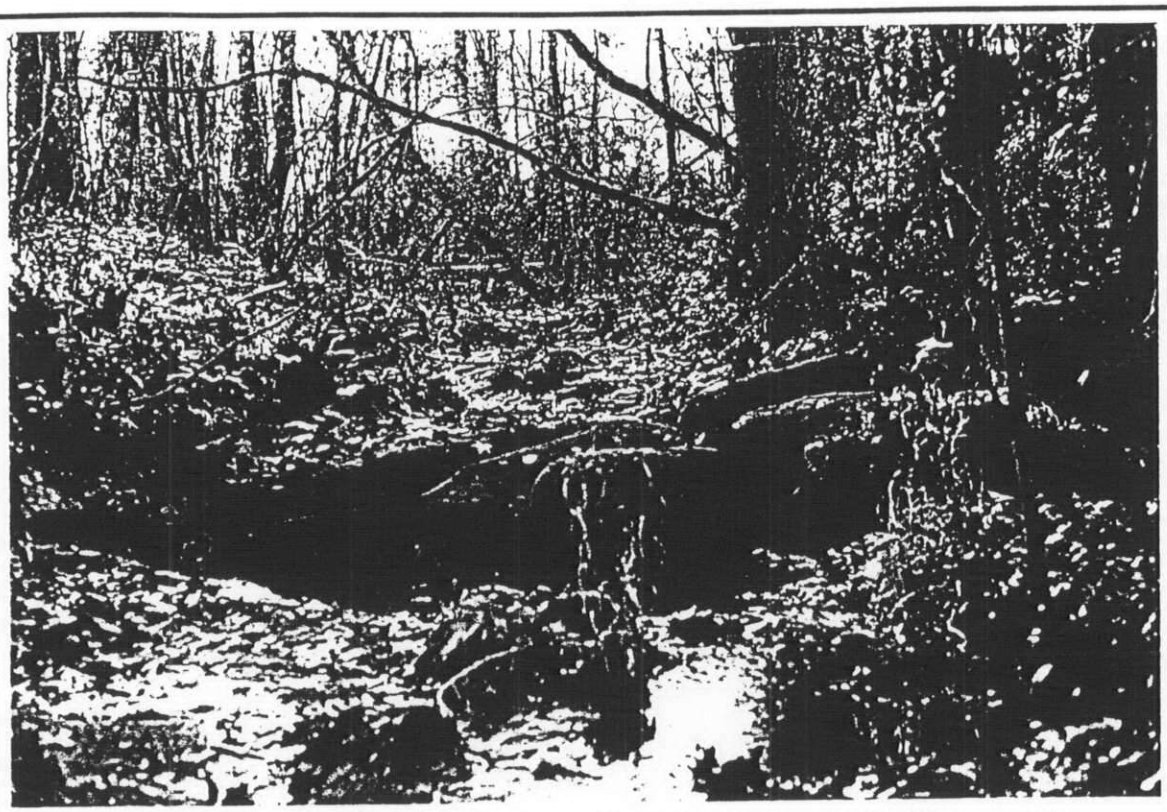


Photo No. 3 **View of a small headwater stream located on the Barrett Grading property.**

Photo No. 4 **Close-up view of *Hexastylis sp.* located on the slope adjacent to the stream.**

Appendix 7.3
Agency Responses

NOV 17 1997

State of North Carolina
Department of Environment
and Natural Resources
Division of Parks and Recreation
Natural Heritage Program

November 14, 1997

James B. Hunt, Jr., Governor
Wayne McDevitt, Secretary
Dr. Philip K. McKnelly, Director

Mr. Michael D. Plummer
S & ME, Inc.
9751 Southern Pine Boulevard
Charlotte, NC 28273

SUBJECT: Rare Species, High Quality Natural Communities, and Significant Natural Heritage Areas at the Proposed C & D Landfill Site , Lincoln County, North Carolina.

Dear Mr. Plummer:

The Natural Heritage Program does not have records of known rare species, high quality natural communities, or Significant Natural Heritage Areas occurring at or within a 1-mile radius of the proposed C & D landfill site in Lincoln County, North Carolina. However, because Lincoln County has not been systematically inventoried, I cannot say definitively that no rare species exist within this area.

Enclosed is a list of rare species that are known to occur in Lincoln County. If suitable habitat for any of these species occurs in the project areas, then those species may be present at the project site. To make sure that no rare species exist at the site, a survey would need to be done.

Contact me at the address below or call me at (919) 715-8703 if you have any questions or need further information.

Sincerely,

Susan Reece Giles
Information Specialist
Natural Heritage Program

Enclosure
/SMRG

SCIENTIFIC NAME	COMMON NAME	STATE STATUS	FED. STATUS	STATE RANK	GLOBAL RANK
Lincoln					
Vertebrates					
Lanius ludovicianus ludovicianus	Loggerhead Shrike	SC	-	S3B,S3N	G5T5
Vascular plants					
Helenium pinnatifidum	Dissected Sneezeweed	SR	-	S2	G4
Hexastylis naniflora	Dwarf-flowered Heartleaf	E/PT	T	S2	G2
Smilax biltmoreana	Biltmore Carrion-flower	C	-	S3	G3
Natural communities					
Basic Mesic Forest (Piedmont Subtype)		-	-	S2	G5T3
Mesic Mixed Hardwood Forest (Piedmont Subtype)		-	-	S4	G5T5
Lincoln*					
Vertebrates					
Cyprinella zanema pop 1	Santee Chub - Piedmont Population	SR	-	S3	G3T3Q
Invertebrates					
Triodopsis fulcidens	Dwarf Threetooth	SC	-	S2	G?
Lincoln**					
Vascular plants					
Draba reptans	Creeping Draba	C	-	SH	G5
Rhus michauxii	Michaux's Sumac	E-SC	E	S2	G2

NC NATURAL HERITAGE PROGRAM COUNTY SPECIES LIST COVER SHEET

The county species list from the NC Natural Heritage Program is a listing of the elements (rare species, natural communities, and special animal habitats) known to occur in a county. The information on this printout is compiled from a variety of sources, including field surveys, museums and herbaria, literature, and personal communications. The Heritage Program's Biological and Conservation Database (BCD) is dynamic, with new records being added and old records being revised as new information is received. The BCD was developed and is maintained using methodology developed by The Nature Conservancy. The enclosed list cannot be considered a definitive record of natural heritage elements, and it should not be considered a substitute for field surveys. When this information is used in any document, we request that the printout date be given and that the NC Natural Heritage Program be credited.

This cover sheet explains the four columns of status codes that are given on the right-hand side of the county list printout.

STATE STATUS

CODE	STATUS	CODE	STATUS
E	Endangered	P_	Proposed (E, T, or C)
T	Threatened	SR	Significantly Rare
SC	Special Concern	EX	Extirpated
C	Candidate	WL	Watch List

Plant statuses are determined by the Plant Conservation Program (NC Department of Agriculture) and the Natural Heritage Program (NC Department of Environment and Natural Resources). E, T, and SC species are protected by state law (Plant Protection and Conservation Act, 1979). C and SR designations indicate rarity and the need for population monitoring and conservation action. WL indicates a species not warranting active monitoring, but believed to of conservation concern.

Animal statuses that indicate state protection (E, T, and SC) are published in *Endangered Wildlife of North Carolina*, March 16, 1992, Nongame and Endangered Wildlife Program (NC Department of Environment and Natural Resources). SR and EX statuses are Natural Heritage Program designations. SR indicates rarity and the need for population monitoring and conservation action. WL indicates a species not warranting active monitoring, but believed to of conservation concern.

FEDERAL STATUS

This status is designated by the US Fish and Wildlife Service. Federally listed Endangered and Threatened species are protected under the provisions of the Endangered Species Act of 1973, as amended through the 100th Congress. Unless otherwise noted, definitions are taken from the *Federal Register*, Vol. 56, No. 225, November 21, 1991 (50 CFR Part 17).

CODE	STATUS	DEFINITION
E	Endangered	A taxon "in danger of extinction throughout all of a significant portion of its range."
T	Threatened	A taxon "likely to become an endangered species within the foreseeable future throughout all of a significant portion of its range."
P_	Proposed	A taxon proposed for official listing as endangered or threatened.
C	Candidate	A taxon under consideration for which there is sufficient information to support listing. This category was formerly designated as a Candidate 1 (C1) species.
FSC		Federal Species of Concern. Formerly defined as a taxon under consideration for which there is insufficient information to support listing; formerly designated as a Candidate 2 (C2) species. Currently, the US Fish and Wildlife Service does not recognize this designation.
T(S/A)		Threatened due to Similarity of Appearence. "The American Alligator is threatened due to similarity of appearance with other rare crocodilians and is listed for trade purposes. The species is no longer biologically endangered or threatened and is not subject to Section 7 consultation." (U.S. FWS)

Please note that the US Fish and Wildlife Service no longer recognizes the following categories:

3A	Candidate 3A	A taxon formerly under consideration for listing, but for which there is "persuasive evidence of extinction."
	Candidate 3B	A taxon formerly under consideration for listing, but which current taxonomic understanding does not support as a distinct entity meeting the Endangered Species Act's definition of "species."
3C	Candidate 3C	A taxon formerly under consideration for listing, but which has been "proven to more abundant or widespread than previously believed and/or [which is] not subject to any identifiable threat."

GLOBAL AND STATE RANKS

These ranks are determined by The Nature Conservancy's system of measuring rarity and threat status. "Global" refers to worldwide ranks and "State" to statewide ranks.

STATE RANK DEFINITIONS

S1	Critically imperiled in North Carolina because of extreme rarity or otherwise very vulnerable to extirpation in the state.
S2	Imperiled in North Carolina because of rarity or otherwise vulnerable to extirpation in the state.
S3	Rare or uncommon in North Carolina.
S4	Apparently secure in North Carolina, with many occurrences.
S5	Demonstrably secure in North Carolina and essentially ineradicable under present conditions.
SA	Accidental or casual; one to several records for North Carolina, but the state is outside the normal range of the species.
SH	Of historical occurrence in North Carolina, perhaps not having been verified in the past 25 years, and suspected to be still extant in the state.
SR	Reported from North Carolina, but without persuasive documentation for either accepting or rejecting the report.
SX	Believed to be extirpated from North Carolina.
SU	Possibly in peril in North Carolina, but status uncertain; more information is needed.
S?	Unranked, or rank uncertain.
_B	Rank of breeding population in the state. Used for migratory species only.
_N	Rank of non-breeding population in the state. Used for migratory species only.
_Z_	Population is not of significant conservation concern; applies to transitory, migratory species.

GLOBAL RANK DEFINITIONS

G1	Critically imperiled globally because of extreme rarity or otherwise very vulnerable to extinction throughout its range.
G2	Imperiled globally because of rarity or otherwise vulnerable to extinction throughout its range.
G3	Either very rare and local throughout its range, or found locally in a restricted area.
G4	Apparently secure globally, although it may be quite rare in parts of its range (especially at the periphery).
G5	Demonstrably secure globally, although it may be quite rare in parts of its range (especially at the periphery).
GH	Of historical occurrence throughout its range.
GX	Believed to be extinct throughout its range.
GU	Possibly in peril, but status uncertain; more information is needed.
G?	Unranked, or rank uncertain.
G_Q	Of questionable taxonomic status.
T_	Status of subspecies or variety; the G rank refers to the species as a whole.

ADDITIONAL DEFINITIONS

Elements following county names marked with 1 or 2 asterisks indicate obscure or historic records.

*	Obscure record: the date the element was last observed in the county is uncertain.
**	Historic record: the element was last observed in the county over 50 years ago.

Scientific and common names listed in parentheses are synonyms listed in US Fish and Wildlife Service, 1992, Endangered and Threatened Species of the Southeastern United States (The Red Book).

S&ME

DATE 11-5-97
TYPED BY
MAILED BY
HAND DELIVERED BY
AUTHOR/SENIOR AUTHOR MDP / DEB (INITIALS)

FILE COPY
THIS DOCUMENT DOES NOT LEAVE FILE

November 5, 1997

NCDEHNR
Division of Parks and Recreation
P.O. Box 27687
Raleigh, North Carolina 27611-7687

ATTENTION: Ms. Susan Jiles

Reference: **Threatened and Endangered Species Inquiry**
Barrett Grading C&D Landfill
Lincoln County, North Carolina
S&ME Job No. 1356-97-394

Dear Ms. Jiles:

On behalf of Barrett Grading, S&ME, Inc. submits this request to the Natural Heritage Program for information on any threatened or endangered species located on the proposed C&D Landfill site as required by Rule .0503(1)(b)(i and ii) of the North Carolina Solid Waste Management Rules. This letter is in reference to a recent conversation with Mr. Harry Legrand with the Natural Heritage Program. Mr. Legrand stated that you might be able to help us determine the possibility of endangered species located in this area.

S&ME, Inc. 9751 Southern Pine Boulevard, Charlotte, North Carolina 28273, (704) 523-4726, Fax (704) 525-3953
Mailing address: P.O. Box 7668, Charlotte, North Carolina 28241-7668

Recycled Paper

The site encompasses approximately 130 acres and is located approximately 1 mile southwest of the U.S. Highway 73 and U.S. Highway 16 intersection in Lincoln County, North Carolina. The site is sparsely to moderately wooded and contains light to moderate underbrush. The site borders Forney Creek on the north side and the Seaboard Coast Line Railroad on the east. There are two drainage features dissecting the site. These features can be seen on the site map from the Lowesville USGS quadrangle map included for your review.

We would appreciate any pertinent information regarding this site. If you have any questions, please feel free to contact me at (704) 523-4726.

Sincerely,

S&ME, Inc.

Michael D. Plummer, E.I.T.
Staff Professional

Dan E. Brewer, P.E.
Landfill Services Manager

cc: Mr. Chris Barrett

SEABOARD
PIPELINE
East Lincoln High Sch
HWY 73
Creek
SITE
HWY 16
PIPELINES
Hills Chapel
Cold Hill Ch
Rock Hill Ch
Lowesville
Creek
27'30"
25'
3924
3922
3920
3919
LAKE NORMAN SOUTH)
4854 IV NW

NOV 17 1997

State of North Carolina
Department of Environment
and Natural Resources
Division of Parks and Recreation
Natural Heritage Program

November 14, 1997

James B. Hunt, Jr., Governor
Wayne McDevitt, Secretary
Dr. Philip K. McKnelly, Director

Mr. Michael D. Plummer
S & ME, Inc.
9751 Southern Pine Boulevard
Charlotte, NC 28273

SUBJECT: Rare Species, High Quality Natural Communities, and Significant Natural Heritage Areas at the Proposed C & D Landfill Site , Lincoln County, North Carolina.

Dear Mr. Plummer:

The Natural Heritage Program does not have records of known rare species, high quality natural communities, or Significant Natural Heritage Areas occurring at or within a 1-mile radius of the proposed C & D landfill site in Lincoln County, North Carolina. However, because Lincoln County has not been systematically inventoried, I cannot say definitively that no rare species exist within this area.

Enclosed is a list of rare species that are known to occur in Lincoln County. If suitable habitat for any of these species occurs in the project areas, then those species may be present at the project site. To make sure that no rare species exist at the site, a survey would need to be done.

Contact me at the address below or call me at (919) 715-8703 if you have any questions or need further information.

Sincerely,

Susan Reece Giles
Information Specialist
Natural Heritage Program

Enclosure
/SMRG

SCIENTIFIC NAME	COMMON NAME	STATE STATUS	FED. STATUS	STATE RANK	GLOBAL RANK
Lincoln					
Vertebrates					
Lanius ludovicianus ludovicianus	Loggerhead Shrike	SC	-	S3B,S3N	G5T5
Vascular plants					
Helenium pinnatifidum	Dissected Sneezeweed	SR	-	S2	G4
Hexastylis naniflora	Dwarf-flowered Heartleaf	E/PT	T	S2	G2
Smilax biltmoreana	Biltmore Carrion-flower	C	-	S3	G3
Natural communities					
Basic Mesic Forest (Piedmont Subtype)		-	-	S2	G5T3
Mesic Mixed Hardwood Forest (Piedmont Subtype)		-	-	S4	G5T5
Lincoln*					
Vertebrates					
Cyprinella zanema pop 1	Santee Chub - Piedmont Population	SR	-	S3	G3T3Q
Invertebrates					
Triodopsis fulcidens	Dwarf Threetooth	SC	-	S2	G?
Lincoln**					
Vascular plants					
Draba reptans	Creeping Draba	C	-	SH	G5
Rhus michauxii	Michaux's Sumac	E-SC	E	S2	G2

NC NATURAL HERITAGE PROGRAM COUNTY SPECIES LIST COVER SHEET

The county species list from the NC Natural Heritage Program is a listing of the elements (rare species, natural communities, and special animal habitats) known to occur in a county. The information on this printout is compiled from a variety of sources, including field surveys, museums and herbaria, literature, and personal communications. The Heritage Program's Biological and Conservation Database (BCD) is dynamic, with new records being added and old records being revised as new information is received. The BCD was developed and is maintained using methodology developed by The Nature Conservancy. The enclosed list cannot be considered a definitive record of natural heritage elements, and it should not be considered a substitute for field surveys. When this information is used in any document, we request that the printout date be given and that the NC Natural Heritage Program be credited.

This cover sheet explains the four columns of status codes that are given on the right-hand side of the county list printout.

STATE STATUS

CODE	STATUS	CODE	STATUS
E	Endangered	P_	Proposed (E, T, or C)
T	Threatened	SR	Significantly Rare
SC	Special Concern	EX	Extirpated
C	Candidate	WL	Watch List

Plant statuses are determined by the Plant Conservation Program (NC Department of Agriculture) and the Natural Heritage Program (NC Department of Environment and Natural Resources). E, T, and SC species are protected by state law (Plant Protection and Conservation Act, 1979). C and SR designations indicate rarity and the need for population monitoring and conservation action. WL indicates a species not warranting active monitoring, but believed to of conservation concern.

Animal statuses that indicate state protection (E, T, and SC) are published in *Endangered Wildlife of North Carolina*, March 16, 1992, Nongame and Endangered Wildlife Program (NC Department of Environment and Natural Resources). SR and EX statuses are Natural Heritage Program designations. SR indicates rarity and the need for population monitoring and conservation action. WL indicates a species not warranting active monitoring, but believed to of conservation concern.

FEDERAL STATUS

This status is designated by the US Fish and Wildlife Service. Federally listed Endangered and Threatened species are protected under the provisions of the Endangered Species Act of 1973, as amended through the 100th Congress. Unless otherwise noted, definitions are taken from the *Federal Register*, Vol. 56, No. 225, November 21, 1991 (50 CFR Part 17).

CODE	STATUS	DEFINITION
E	Endangered	A taxon "in danger of extinction throughout all of a significant portion of its range."
T	Threatened	A taxon "likely to become an endangered species within the foreseeable future throughout all of a significant portion of its range."
P_	Proposed	A taxon proposed for official listing as endangered or threatened.
C	Candidate	A taxon under consideration for which there is sufficient information to support listing. This category was formerly designated as a Candidate 1 (C1) species.
FSC		Federal Species of Concern. Formerly defined as a taxon under consideration for which there is insufficient information to support listing; formerly designated as a Candidate 2 (C2) species. Currently, the US Fish and Wildlife Service does not recognize this designation.
T(S/A)		Threatened due to Similarity of Appearence. "The American Alligator is threatened due to similarity of appearance with other rare crocodilians and is listed for trade purposes. The species is no longer biologically endangered or threatened and is not subject to Section 7 consultation." (U.S. FWS)

Please note that the US Fish and Wildlife Service no longer recognizes the following categories:

3A	Candidate 3A	A taxon formerly under consideration for listing, but for which there is "persuasive evidence of extinction."
3B	Candidate 3B	A taxon formerly under consideration for listing, but which current taxonomic understanding does not support as a distinct entity meeting the Endangered Species Act's definition of "species."
3C	Candidate 3C	A taxon formerly under consideration for listing, but which has been "proven to more abundant or widespread than previously believed and/or [which is] not subject to any identifiable threat."

GLOBAL AND STATE RANKS

These ranks are determined by The Nature Conservancy's system of measuring rarity and threat status. "Global" refers to worldwide ranks and "State" to statewide ranks.

STATE RANK DEFINITIONS

S1 Critically imperiled in North Carolina because of extreme rarity or otherwise very vulnerable to extirpation in the state.
S2 Imperiled in North Carolina because of rarity or otherwise vulnerable to extirpation in the state.
S3 Rare or uncommon in North Carolina.
S4 Apparently secure in North Carolina, with many occurrences.
S5 Demonstrably secure in North Carolina and essentially ineradicable under present conditions.
SA Accidental or casual; one to several records for North Carolina, but the state is outside the normal range of the species.
SH Of historical occurrence in North Carolina, perhaps not having been verified in the past 25 years, and suspected to be still extant in the state.
SR Reported from North Carolina, but without persuasive documentation for either accepting or rejecting the report.
SX Believed to be extirpated from North Carolina.
SU Possibly in peril in North Carolina, but status uncertain; more information is needed.
S? Unranked, or rank uncertain.
_B Rank of breeding population in the state. Used for migratory species only.
_N Rank of non-breeding population in the state. Used for migratory species only.
_Z_ Population is not of significant conservation concern; applies to transitory, migratory species.

GLOBAL RANK DEFINITIONS

G1 Critically imperiled globally because of extreme rarity or otherwise very vulnerable to extinction throughout its range.
G2 Imperiled globally because of rarity or otherwise vulnerable to extinction throughout its range.
G3 Either very rare and local throughout its range, or found locally in a restricted area.
G4 Apparently secure globally, although it may be quite rare in parts of its range (especially at the periphery).
G5 Demonstrably secure globally, although it may be quite rare in parts of its range (especially at the periphery).
GH Of historical occurrence throughout its range.
GX Believed to be extinct throughout its range.
GU Possibly in peril, but status uncertain; more information is needed.
G? Unranked, or rank uncertain.
G_Q Of questionable taxonomic status.
T_ Status of subspecies or variety; the G rank refers to the species as a whole.

ADDITIONAL DEFINITIONS

Elements following county names marked with 1 or 2 asterisks indicate obscure or historic records.

* Obscure record: the date the element was last observed in the county is uncertain.
** Historic record: the element was last observed in the county over 50 years ago.

Scientific and common names listed in parentheses are synonyms listed in US Fish and Wildlife Service, 1992, Endangered and Threatened Species of the Southeastern United States (The Red Book).

NORTH CAROLINA DEPARTMENT OF
ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF PARKS AND RECREATION

NCDENR

JAMES B. HUNT JR.
GOVERNOR

WAYNE McDEVITT
SECRETARY

DR. PHILIP McKINNEY
DIRECTOR

January 07, 1998

Mr. Richard Bates
Environmental Permitting Consultants
84 Villa Road, Suite 206 B-2
Greenville, SC 29615

SUBJECT: Rare Species, High Quality Natural Communities, and Significant Natural Heritage Areas in the Proposed C & D Landfill Project Site in Lincoln County, North Carolina.

Dear Mr. Bates:

Thank you for sending a copy of the protected species habitat assessment prepared for the Barrett Grading Property located in Lincoln County, North Carolina. The assessment was reviewed by myself and our staff ecologists and botanist with the following comments offered:

> "Identity of *Hexastylis* needs to be determined during the flowering period. If *H. naniflora* is found, contact US Fish and Wildlife Service in Asheville. December is an inoptimal month for determining that no *Rhus michauxii* is present. However, given that no suitable habitat was present, then the conclusion in the report is adequate." Ecology staff, Natural Heritage Program
>
> "The *Hexastylis* in photo #4 is *H. arifolia*." Jame Amaroso, Natural Heritage Program staff botanist

Thank you for sharing this information with us. We are always saddened to see such beautiful habitat suffer such a fate as this. We appreciate that you did a thorough and comprehensive inventory of the area and accept your conclusions on the absence of habitat and/or rare species in this project site.

Sincerely,

Susan Reece Giles, Information Specialist
Natural Heritage Program

P.O. BOX 27687, RALEIGH NC 27611-7687 PHONE 919-733-4181 FAX 919-715-3085
AN EQUAL OPPORTUNITY / AFFIRMATIVE ACTION EMPLOYER - 50% RECYCLED/10% POST-CONSUMER PAPER

APPENDIX IV
ARCHEOLOGICAL OR HISTORIC SITE

REC'D DEC 0 8 1997

North Carolina Department of Cultural Resources

James B. Hunt Jr., Governor
Betty Ray McCain, Secretary

Division of Archives and History
Jeffrey J. Crow, Director

December 5, 1997

Michael D. Plummer, EIT
S&ME, Inc.
P.O. Box 7668
Charlotte NC 28241-7668

Re: Barrett Grading C&D Landfill, Lincoln County,
S&ME Job. No. 1356-97-394, ER 98-7967

Dear Mr. Plummer:

Thank you for your letter of November 5, 1997, concerning the above project.

We have conducted a review of the project and are aware of no properties of architectural, historic, or archaeological significance which would be affected by the project. Therefore, we have no comment on the project as currently proposed.

The above comments are made pursuant to Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's Regulations for Compliance with Section 106 codified at 36 CFR Part 800.

Thank you for your cooperation and consideration. If you have questions concerning the above comment, please contact Renee Gledhill-Earley, environmental review coordinator, at 919/733-4763.

Sincerely,

David Brook/w

David Brook
Deputy State Historic Preservation Officer

DB:slw

APPENDIX V
LOCAL GOVERNMENT APPROVAL

NORTH CAROLINA
LINCOLN COUNTY

CONSTRUCTION AND DEMOLITION/LAND CLEARING AND INERT DEBRIS LANDFILL PERMIT

DATE ISSUED: **February 2, 1998**
PERMIT NO.

Barrett Grading, Inc. and/or its successor in interest, Lake Norman Landfill, Inc. are hereby issued a Construction and Demolition/ Land Clearing and Inert Debris Landfill Permit (Permit) to operate a Construction and Demolition/ Land Clearing and Inert Debris Landfill (Facility) on the property located at NC Hwy. 16 and Quarry Lane, Lincoln County, North Carolina. This Permit is issued in accordance with the Ordinance for the Regulation of Construction and Demolition/Land Clearing and Inert Debris Landfills in Lincoln County, North Carolina (hereinafter "The Ordinance"). The Facility is located on the property described as follows:

PROPERTY DESCRIPTION:

A portion of Tax Parcel Number 56204 located off NC Hwy. 16 and Quarry Lane in the Catawba Springs Township and consisting of approximately 112 acres.

CONDITIONS OF PERMIT:

1. The Facility must be operated and closed in accordance with the rules cited as 15A NCAC 13B "North Carolina Solid Waste Management Rules", the provisions contained in the Ordinance and the conditions imposed by the Lincoln County Board of Commissioners at its August 4, 1997 regular board meeting.

2. The Facility shall be operated for the disposal of inert, non-decomposable waste and debris such as concrete, brick, steel, clean fill dirt, and other similar materials associated with construction, remodeling or demolition of pavement or structures as well as the disposal of organic, decomposable landclearing debris such as stumps, trees, brush, grass and other vegetative matters.

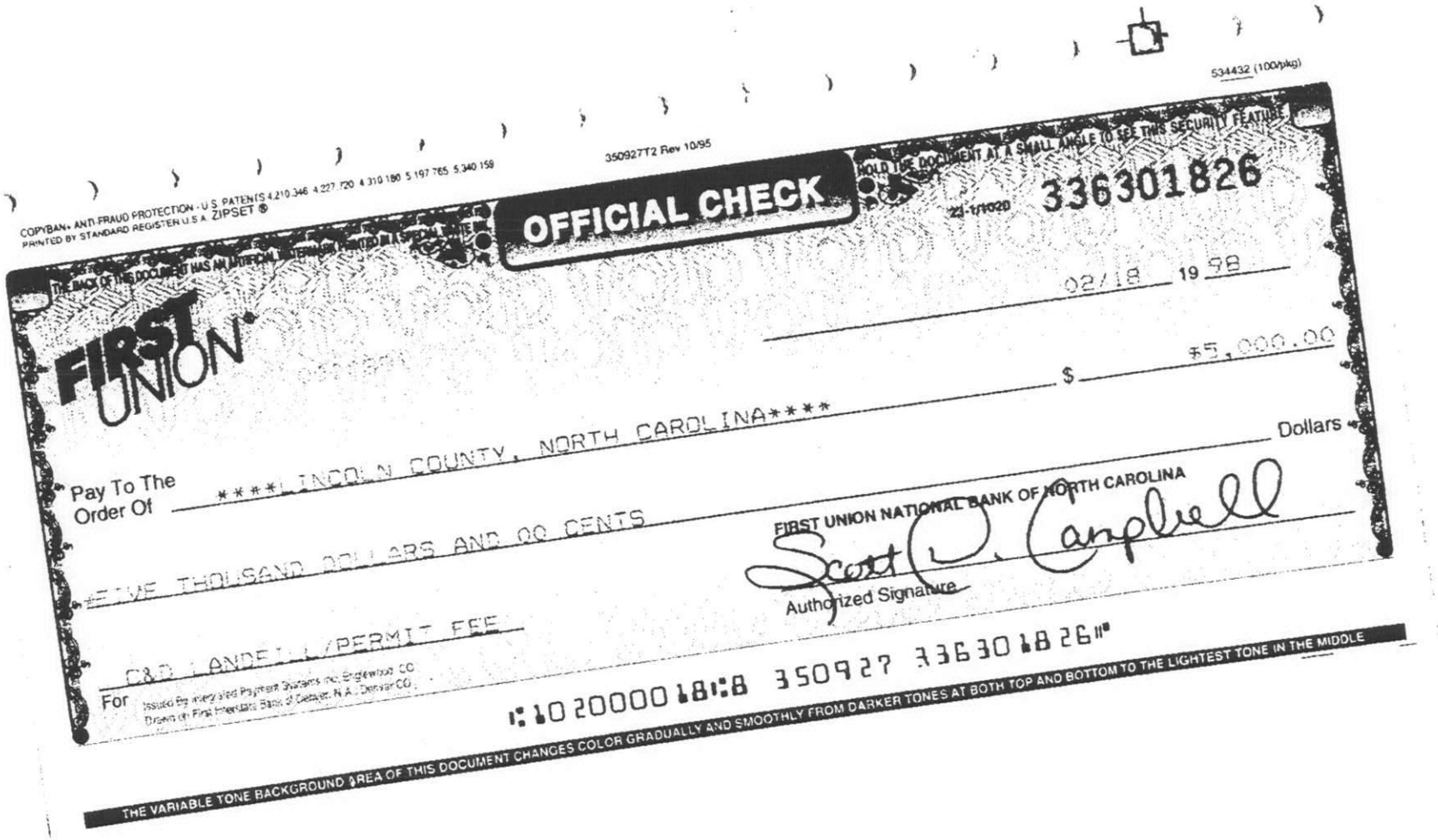
3. This Permit is issued subject only to the conditions contained in The Ordinance, which are hereby incorporated herein by reference and include the payment of the permit fee.

4. The issuance of this Permit was approved by vote of the Board of Commissioners of Lincoln County on August 4, 1997.

This 2nd day of February, 1998.

LINCOLN COUNTY

By: Louis E. McConnell
Louis E. McConnell, Chairman
Board of Commissioners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COPYBAN+ ANTI-FRAUD PROTECTION - U.S. PATENTS 4,210,346 4,227,720 4,310,180 5,197,765 5,340,158
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HOLD DOCUMENT AT A SMALL ANGLE TO SEE THIS SECURITY FEATURE
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$ *5,000.00
Pay To The Order Of ****LINCOLN COUNTY, NORTH CAROLINA****
Dollars
FIVE THOUSAND DOLLARS AND 00 CENTS
FIRST UNION NATIONAL BANK OF NORTH CAROLINA
Scott D. Campbell
Authorized Signature
For C&D LANDFILL/PERMIT FEE
Issued By Integrated Payment Systems, Inc., Englewood, CO
Drawn on First Interstate Bank of Denver, N.A., Denver, CO
⑆102000181⑆ 350927 336301826⑈
THE VARIABLE TONE BACKGROUND AREA OF THIS DOCUMENT CHANGES COLOR GRADUALLY AND SMOOTHLY FROM DARKER TONES AT BOTH TOP AND BOTTOM TO THE LIGHTEST TONE IN THE MIDDLE

APPENDIX VI
CALCULATIONS

S&ME

JOB NO. 1356-97-394
SHEET NO. 1
DATE 2/17/98

JOB NAME Lake Norman Landfill
SUBJECT Air Space / Site Life Calculation

COMPUTED BY SRN
CHECKED BY MJP

OBJECTIVE: Determine the net air space for waste and the site life given total airspace volume and proposed waste generation volume.

REFERENCE: 1.) Softdesk computer application

GIVEN: Proposed Generation => 1,000 tons / day C+D waste
=> 5 ½ days / week

Approximate Weight of C+D Waste: 1 CY = 1200 lbs.

∴ Total Airspace = 2,748,892 CY [Ref. #1]

CALCULATION:

1.) Calculate Net Airspace for waste:

Total Airspace:	2,748,892 CY
- 5% Cover Material:	-137,445 CY
- 2-ft Final Cover (31.3 acres):	-100,995 CY
	2,510,452 CY

S&ME

JOB NO. 1356-97-394
SHEET NO. 2/2
DATE 2/17/98

JOB NAME Lake Norman Landfill
SUBJECT Airspace / Site Life Calculation

COMPUTED BY SRN
CHECKED BY MDP

2) Calculate Site Life

(1,000 tons/day) (5.5 ~~days~~/week) (52 ~~weeks~~/year) = 286,000 tons/year

(286,000 tons/yr) (2,000 lbs/ton) (1 CY / 1200 lbs) = 476,667 CY/year

(2,510,452 CY) / (476,667 CY/yr) = 5.27 years

RESULTS

Total Airspace for Waste: 2,510,452 CY

Site Life @ 1,000 tons/day: 5.27 years

[Ref. #1]

Site Volume Table: Unadjusted

Cut yards	Fill yards	Net yards	Method
Site: 97394			
Stratum: asvol sub fg			
0.00	2744771.10	2744771.10 (F)	Grid
6.11	2753019.73	2753013.62 (F)	End area
		avg. 2748892.36	

S&ME

JOB NO. 1356-97-394
SHEET NO. 1/7
DATE 2/16/98

JOB NAME Lake Norman Landfill
SUBJECT Cap Design
COMPUTED BY SRN
CHECKED BY MDP

OBJECTIVE: Design Cap to handle runoff from 25 yr. storm.

REFERENCE: 1) "Erosion and Sediment Control Planning and Design Manual," NCDEHNR, 1988.

2) "Flowmaster" computer program, version 5.15

3) "Sediment Basin Design Worksheet," S&ME calc., 2/98

4) "Flexlin" computer program, Computer Aided Hydrology + Hydraulics, ver. 1.23.

5) Tri-Lock Flexible Concrete Revetment Product Guide.

Given: Benches: slope = 2%
shape = triangular w/ sides @ 20:1 and 3:1

Downchute: Slope = 33%
shape = trapezoidal w/ 2:1 side slopes

CALCULATION:

For conservative calculation, use storm intensity from the entire site

$i = 6.0$ in/hr
$C = 0.35$
} Ref. #3

Largest Area draining to a bench, $A = 5.61$ acres

Rational Equation: $Q = ciA = 0.35(6)(5.61) = 11.8$ cfs

Use Flowmaster to check depth + velocity $\Rightarrow$ $d = 0.75$, $V = 1.81$ fps

$V = 1.81$ fps $< V_{max}$ for channels lined w/ straw with net, $V_{max} = 3.80$ fps [ref. 4]

S&ME

JOB NO. 1356-97-394
SHEET NO. 2 17
DATE 2/16/98

JOB NAME Lake Norman Landfill
SUBJECT Cap Design

COMPUTED BY SRN
CHECKED BY MDP

Check Shear Stress

$T = \gamma d s$

T = shear stress, lb/ft²
γ = unit wt of water, 62.4 lb/ft³
d = flow depth, ft
s = channel gradient, ft/ft
} ref #1

$T = (62.4\ lb/ft^3)(0.75ft)(0.02)$

$= 0.94\ lb/ft^2 < T_{permissible}$, straw w/ net = 1.45 - 1.80 okay

Down Chute

Drainage Area = 17.3 acres

$Q = (0.35)(6\ in/hr)(17.3\ acres) = 36.3\ cfs$

Use Flowmaster to check depth + velocity, $d = 0.32$ ft, $v = 10.8$ fps

Channel Width: 10 ft w/ 2:1 side slopes

$V = 10.8\ fps < V_{max} = 17\ fps$ okay

Check shear stress

$T = \gamma d s$

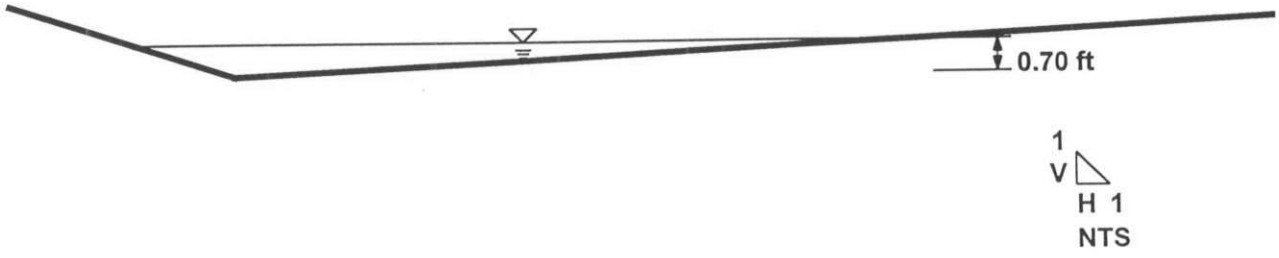
$= (62.4\ lb/ft^3)(0.32\ ft)(0.33)$

$= 6.58\ lb/ft^2 < T_{max}$, $8.5\ lb/ft^2$ okay

Cross Section
Cross Section for Triangular Channel

Project Description	
Project File	g:\apps\haestad\fmw\barrett.fm2
Worksheet	Benches
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

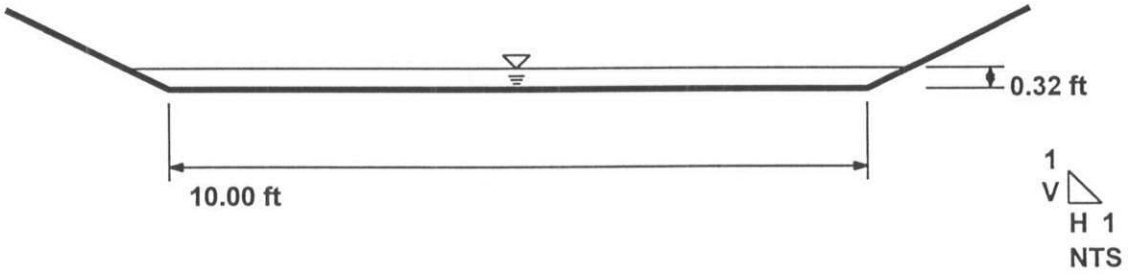
Section Data		
Mannings Coefficient	0.050	
Channel Slope	0.020000	ft/ft
Depth	0.70	ft
Left Side Slope	3.000000	H : V
Right Side Slope	20.000000	H : V
Discharge	11.78	cfs



Cross Section
Cross Section for Trapezoidal Channel

Project Description	
Project File	g:\apps\haestad\fmw\barrett.fm2
Worksheet	Down Chutes
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.035	
Channel Slope	0.333333	ft/ft
Depth	0.32	ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	10.00	ft
Discharge	36.30	cfs



Notes:

Material: Tri-Lock 4010 (4") Revetment Blocks
Velocity = 10.83 fps

Table 8.05g
Permissible Shear Stresses for Riprap and Temporary Liners

Lining Category	Lining Type	Permissible Unit Shear Stress, T_d (lb/ft^2)
Temporary	Woven Paper Net	0.15
	Jute Net	0.45
	Fiberglass Roving:	
	Single	0.60
	Double	0.85
	→ Straw with Net	1.45
	Curled Wood mat	1.55
	Synthetic Mat	2.00
	d_{50} Stone Size (inches)	
Gravel Riprap	1	0.33
	2	0.67
Rock Riprap	6	2.00
	9	3.00
	12	4.00
	15	5.00
	18	6.00
	21	7.80
	24	8.00

Adapted From: FHWA, HEC-15, April 1983, pgs. 17 & 37.

Design Procedure-Temporary Liners

The following is a step-by-step procedure for designing a temporary liner for a channel. Because temporary liners have a short period of service, the design Q may be reduced. For liners that are needed for six months or less, the 2-yr frequency storm is recommended.

Step 1. Select a liner material suitable for site conditions and application. Determine roughness coefficient from manufacturer's specifications or Table 8.05e, pg. 8.05.10.

Step 2. Calculate the normal flow depth using Manning's equation (Figure 8.05d). Check to see that depth is consistent with that assumed for selection of Manning's *n* in Figure 8.05d, pg. 8.05.11. For smaller runoffs Figure 8.05d is not as clearly defined. Recommended solutions can be determined by using the Manning equation.

Step 3. Calculate shear stress at normal depth.

Step 4. Compare computed shear stress with the permissible shear stress for the liner.

Step 5. If computed shear is greater than permissible shear, adjust channel dimensions to reduce shear or select a more resistant lining and repeat steps 1 through 4.

Design of a channel with temporary lining is illustrated in Sample Problem 8.05b, pg. 8.05.14.

LKel #4J 6/7

********** FLEXLIN **********
********** Version 2.14 **********
********** COMPUTER-AIDED HYDROLOGY & HYDRAULICS **********

JECT: BARRETT GRADING
User: SRN
Date: 02/16/1998 Monday
Time: 13:16:54
Output: LNLF.OUT

Q cfs	SIDE SLOPE LEFT h/v	SIDE SLOPE RIGHT h/v	BOTTOM WIDTH ft	BOTTOM SLOPE ft/ft	n dim	CRITICAL NORMAL FLOW DEPTH ft	CRITICAL NORMAL HYD. RADIUS ft	CRITICAL NORMAL FLOW VELOCITY fps	CRITICAL NORMAL SHEAR STRESS psf	PERMISSIBLE VELOCITY fps	PERMISSIBLE SHEAR STRESS psf
Straw with Net:											
11.8	20.00	3.00	.0	.0200	.0502	.58	.29	3.05	N/A	3.80	1.45
BENCH DESIGN						.70	.35	2.07	.88		
Synthetic Mat:											
36.3	2.00	2.00	10.0	.3300	.0350	.71	.61	4.50	N/A	17.0	8.00
DOWN CHUTE W/ TRI-LOCK REVETMENT MATERIAL						.32	.29	10.80	6.51		

FROM :

[Ref #5]

7/7

American Excelsior Company
AN EMPLOYEE OWNED COMPANY
2328 CHAFFEE DRIVE, P.O. 28337, ST. LOUIS, MO 63146, (314) 993-5540 FAX (314) 993-3549

BIOENGINEERED PRODUCTS GUIDE

EROSION CONTROL TECHNICAL SUPPORT GUIDLINES

BIODEGRADEABLE	MAX SLOPE	MAX * FLOW VELOCITY	MAX CHANNEL ** SHEAR STRESS	DARCY "F"	MANNING "N"
REGULAR CURLEX I	1:5 TO 1	5 f.p.s.	1.55 p.s.f.	0.126	0.034
CURLEX QUICK GRASS	1:5 TO 1	5 f.p.s.	1.55 p.s.f.	0.126	0.034
CURLEX II (DOUBLE NET)	1:5 TO 1	7 f.p.s.	1.55 p.s.f.	0.111	0.031
CURLEX III (HIGH VELOCITY)	1 TO 1	10 f.p.s.	1.70 p.s.f.	0.070	0.026
PERMANENT "SOFT ARMOR"					
TENSAR TB 1000 (ECRM)	1 TO 1	8 f.p.s.	3 p.s.f. *	NA	.036
TENSAR TM 3000 (TRM)	1 TO 1	14 f.p.s.	5 p.s.f. *	NA	.036
ENKAMAT 7010 (TRM)	1 TO 1	14 f.p.s.	6 p.s.f. **	NA	.036
ENKAMAT 7020 (TRM)	1 TO 1	18 f.p.s.	8 p.s.f. **	NA	.036
PERMANENT "HARD ARMOR"					
→ TRI-LOCK 4010 (4")	2 TO 1	17 f.p.s. ***	8.5 p.s.f. ****	NA	.035
TRI-LOCK 4015 (6")	2 TO 1	21 f.p.s. ***	10.8 p.s.f. ****	NA	.035
TRI-LOCK 4020 (8")	2 TO 1	24 f.p.s. ***	13 p.s.f. ****	NA	.035

NOTES:

BIODEGRADEABLE

* TESTED ON SANDY LOAM SOIL / CONCRETE FLUME

** F.H.W.A. "DESIGN ROADSIDE CHANNELS". HERC-#15.

PERMANENT

* VEGETATED, 8 fps - 24 HRS / 3 psf - 50 HRS / 14 fps - 48 HRS. / 5 psf - 50 HRS.

** VEGETATED, CIRCA A TESTING. 1986

*** FHWA - RD - 88 - 181; FHWA - RD - 89 - 199 TEST RESULTS, MINIMAL BED SLOPE / UNVEGETATED.

**** FHWA - RD - 88 - 181 ; FHWA - RD - 89 - 199 TEST RESULTS, MINIMAL BED SLOPE / UNVEGETATED.

MANNING "N" WILL VARY DEPENDING ON THE DEPTH OF FLOW

DISCLAIMER:

The above values are based upon known industry testing in a controlled test environment. Actual field conditions can effect the design hydraulic conditions, therefore please consult your manufacturers representative to evaluate the actual job site. American Excelsior Co. disclaim any liability arising out of or related to the products misuse.

S&ME

JOB NO. 1356-97-394
SHEET NO. 1
DATE 2/5/98

JOB NAME Barrett Grading
SUBJECT Landfill Slope Stability

COMPUTED BY SRN : CB
CHECKED BY MJP

OBJECTIVE: Evaluate stability of landfill using Stabl/G Program.

PARAMETERS: ① Soil Subgrade

② Final Cover

③ C+D Waste

④ Compacted Fill

- Final Cover Slope 3H:1V w/ benches every 50-ft vertical, 20-ft wide
- See attached figures for assumed strength parameters
- Use Bishop's method of slices for global stability.
- Account for seismic conditions.

REFERENCES: 1) "STABL/G" Computer program by Geosoft, 1992.

2) "Final Cover Grading Plan" by S&ME, 1998.

3.) Algermission Map, Strength Parameter Tables (attached)

RESULTS: F.S. = 1.502 for seismic conditions > 1.2 ∴ OK

Maximum Elevation = 842 ft

Slope 3H:1V w/ benches

See attached figures for failure circle.

Summary of Results

Section	Factor of Safety: Seismic Analysis	Non-seismic Analysis
A-A	1.502	2.595
B-B	1.512	3.332

SOIL PARAMETERS

Barrett Grading

C&D Landfill Slope Stability Analysis

Soil Description	Soil No.	Estimated Parameters			
		Moist Unit Wt.(lb/ft^3)	Sat. Unit Wt. (lb/ft^3)	Cohesion (lb/ft^3)	Friction Angle (°)
Existing subgrade, silty clays, sandy silts, silty sands[1,2]	1	110	135	300	28
Soil cover material, silty clays, sandy silts[1,2]	2	110	135	300	28
C&D waste[3,4]	3	45	65	0	30

References

[1] NAVAC Foundations and Earth Structures Design Manual 7.2, Table 1 "Typical Properties of Compacted Soils, p. 7.2-39.

[2] Prentice-Hall Highway Materials, Soils, and Concretes, Table 1-3 "Typical Void Ratio, Density, and Water Content", p. 15.

[3] ASTM STP 1070, Figure 4 "Summary Plot for All Tests with Recommended Parameters Shaded", p.245.

[4] McGraw-Hill Integrated Solid Waste Management, Table 4-1 "Typical specific weight and moisture content data for residential, commercial, industrial, and agricultural wastes", p. 71.

STP 1070

Geotechnics of Waste Fills—Theory and Practice

Arvid Landva and G. David Knowles, editors

ASTM
1916 Race Street
Philadelphia, PA 19103

of 15 was used by Dames & Moore (20) after rejecting values larger than 50 that may represent the encounter of obstructions. Earth Tech Corporation (9) reported the results of a vane shear test and a standard penetration test. These results are shown in Figure 3.

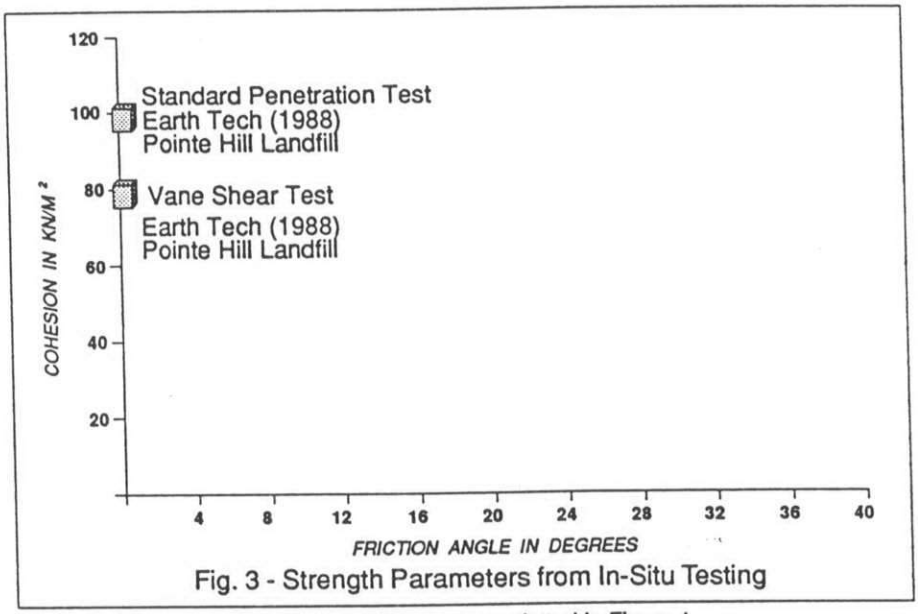


Fig. 3 - Strength Parameters from In-Situ Testing

Finally, the results of all the foregoing tests are plotted in Figure 4. Because of the scatter and scarcity of the data, it is difficult to draw any definitive conclusions on the shear strength characteristics of sanitary fill material.

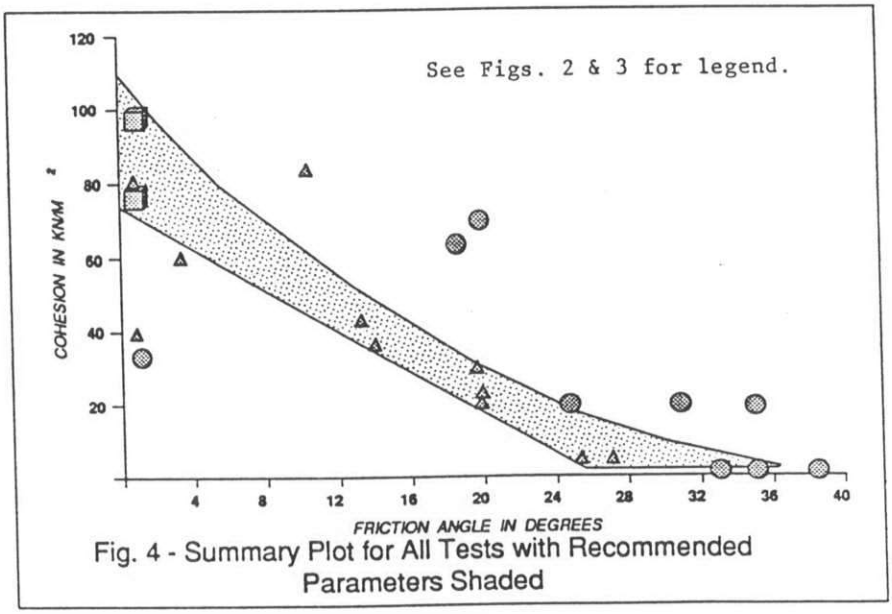


Fig. 4 - Summary Plot for All Tests with Recommended Parameters Shaded

Highway Materials, Soils, and Concretes

Second Edition

Harold N. Atkins
Seneca College of Applied Arts
and Technology
Ontario, Canada

A RESTON BOOK
PRENTICE-HALL, INC., Englewood Cliffs, New Jersey 07632

Table 1–3

TYPICAL VOID RATIO, DENSITY, AND WATER CONTENT VALUES OF SOILS

Soil	*Void Ratio*	*Density (kg/m^3)*		*Unit Weight (lb/ft^3)*		*Water Content (%)*
		Dry	*Saturated*	*Dry*	*Saturated*	*Saturated*
Gravel–sand mixture	0.5	1800	2100	110	135	20
Uniform sand	0.7	1600	2000	100	125	25
Hard glacial till	0.4	1900	2200	120	140	15
Hard glacial clay	0.6	1700	2100	105	130	20
Soft clay	2.0	1400	1600	80	100	75
Soft montmorillonite-type clay	5.0	500	1300	30	80	180

INTEGRATED SOLID WASTE MANAGEMENT

Engineering Principles and Management Issues

George Tchobanoglous

Professor of Civil and Environmental Engineering
University of California, Davis

Hilary Theisen

Vice President
Brown & Caldwell, Consulting Engineers

Samuel Vigil

Professor of Civil and Environmental Engineering
California Polytechnic State University
San Luis Obispo, California

McGraw-Hill, Inc.

New York St. Louis San Francisco Auckland Bogotá
Caracas Lisbon London Madrid Mexico Milan Montreal
New Delhi Paris San Juan Singapore Sydney Tokyo Toronto

Because the specific weights of solid wastes vary markedly with geographic location, season of the year, and length of time in storage, great care should be used in selecting typical values. Municipal solid wastes as delivered in compaction vehicles have been found to vary from 300 to 700 lb/yd^3; a typical value is about 500 lb/yd^3.

Moisture Content

The moisture content of solid wastes usually is expressed in one of two ways. In the wet-weight method of measurement, the moisture in a sample is expressed

TABLE 4-1 (*continued*)

Type of waste	Specific weight, lb/yd^3		Moisture content, % by weight	
	Range	Typical	Range	Typical
Commercial (*cont.*)				
Wooden crates	185–270	185	10–30	20
Tree trimmings	170–305	250	20–80	5
Rubbish (combustible)	85–305	200	10–30	15
Rubbish (noncombustible)	305–610	505	5–15	10
Rubbish (mixed)	235–305	270	10–25	15
Construction and demolition				
Mixed demolition (noncombustible)	1685–2695	2395	2–10	4
Mixed demolition (combustible)	505–675	605	4–15	8
Mixed construction (combustible)	305–605	440	4–15	8
Broken concrete	2020–3035	2595	0–5	—
Industrial				
Chemical sludges (wet)	1350–1855	1685	75–99	80
Fly ash	1180–1515	1350	2–10	4
Leather scraps	170–420	270	6–15	10
Metal scrap (heavy)	2530–3370	3000	0–5	—
Metal scrap (light)	840–1515	1245	0–5	—
Metal scrap (mixed)	1180–2530	1515	0–5	—
Oils, tars, asphalts	1350–1685	1600	0–5	2
Sawdust	170–590	490	10–40	20
Textile wastes	170–370	305	6–15	10
Wood (mixed)	675–1140	840	30–60	25
Agricultural				
Agricultural (mixed)	675–1265	945	40–80	50
Dead animals	340–840	605	—	—
Fruit wastes (mixed)	420–1265	605	60–90	75
Manure (wet)	1515–1770	1685	75–96	94
Vegetable wastes (mixed)	340–1180	605	60–90	75

Adapted in part from Refs. 6 and 8.

Note: lb/yd^3 × 0.5933 = kg/m^3

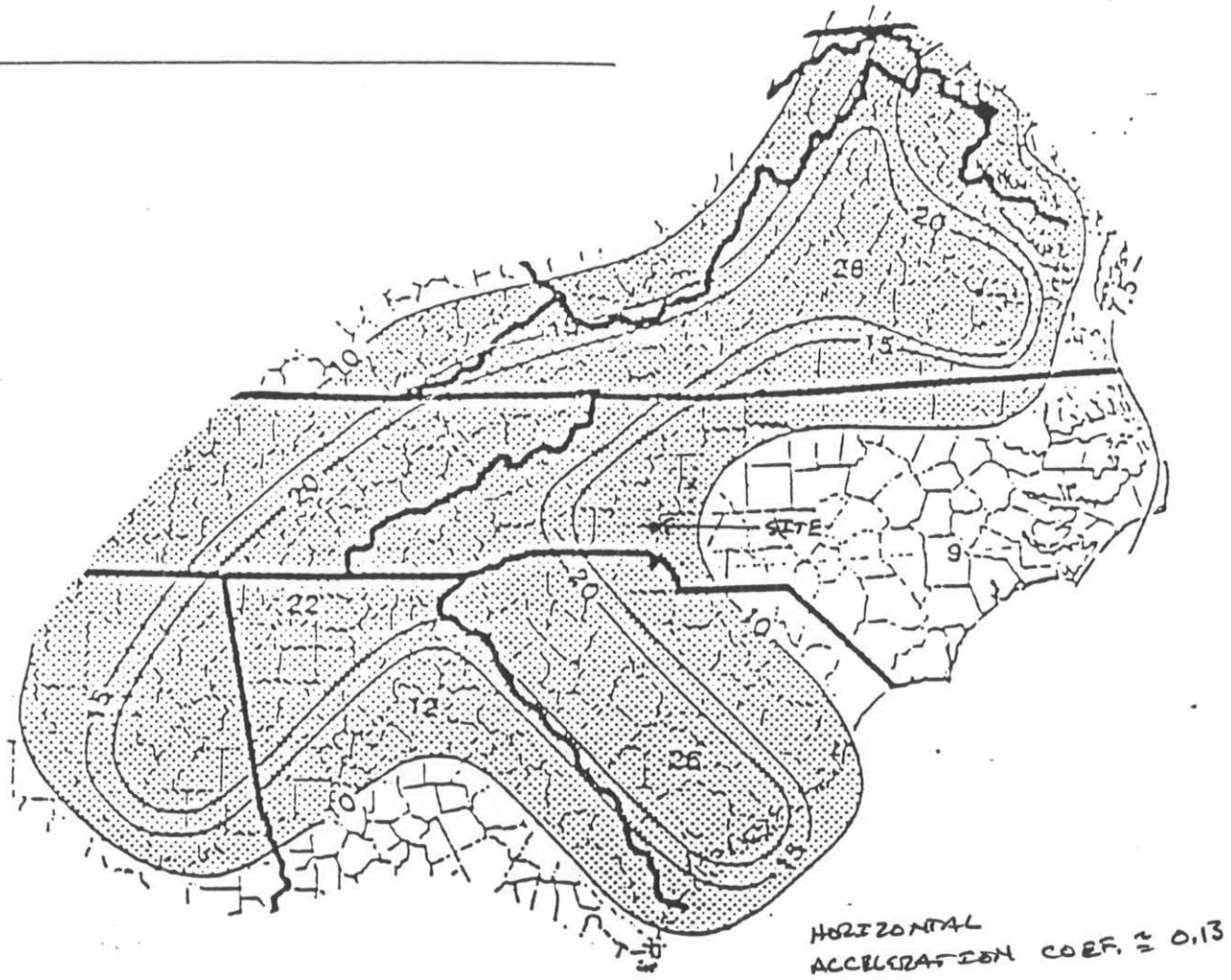
TABLE 1
Typical Properties of Compacted Soils

Group Symbol	Soil Type	Range of Maximum Dry Unit Weight, pcf	Range of Optimum Moisture, Percent	Typical Value of Compression		Typical Strength Characteristics				Typical Coefficient of Permeability ft./min.	Range of CBR Values	Range of Subgrade Modulus k lbs/cu in.
				At 1.4 tsf (20 psi)	At 3.6 tsf (50 psi)	Cohesion (as compacted) psf	Cohesion (saturated) psf	ϕ (Effective Stress Envelope Degrees)	Tan ϕ			
				Percent of Original Height								
GW	Well graded clean gravels, gravel-sand mixtures.	125 - 135	11 - 8	0.3	0.6	0	0	>38	>0.79	5×10^{-2}	40 - 80	300 - 500
GP	Poorly graded clean gravels, gravel-sand mix	115 - 125	14 - 11	0.4	0.9	0	0	>37	>0.74	10^{-1}	30 - 60	250 - 400
GM	Silty gravels, poorly graded gravel-sand-silt.	120 - 135	12 - 8	0.5	1.1	.....	.....	>34	>0.67	$>10^{-6}$	20 - 60	100 - 400
GC	Clayey gravels, poorly graded gravel-sand-clay.	115 - 130	14 - 9	0.7	1.6	.....	.....	>31	>0.60	$>10^{-7}$	20 - 40	100 - 300
SW	Well graded clean sands, gravelly sands.	110 - 130	16 - 9	0.6	1.2	0	0	38	0.79	$>10^{-3}$	20 - 40	200 - 300
SP	Poorly graded clean sands, sand-gravel mix.	100 - 120	21 - 12	0.8	1.4	0	0	37	0.74	$>10^{-3}$	10 - 40	200 - 300
SM	Silty sands, poorly graded sand-silt mix.	110 - 125	16 - 11	0.8	1.6	1050	420	34	0.67	$5 \times >10^{-5}$	10 - 40	100 - 300
SM-SC	Sand-silt clay mix with slightly plastic fines.	110 - 130	15 - 11	0.8	1.4	1050	300	33	0.66	$2 \times >10^{-6}$	5 - 30	100 - 300
SC	Clayey sands, poorly graded sand-clay-mix.	105 - 125	19 - 11	1.1	2.2	1550	230	31	0.60	$5 \times >10^{-7}$	5 - 20	100 - 300
ML	Inorganic silts and clayey silts.	95 - 120	24 - 12	0.9	1.7	1400	190	32	0.62	$>10^{-5}$	15 or less	100 - 200
ML-CL	Mixture of inorganic silt and clay.	100 - 120	22 - 12	1.0	2.2	1350	460	32	0.62	$5 \times >10^{-7}$	.....	
CL	Inorganic clays of low to medium plasticity.	95 - 120	24 - 12	1.3	2.5	1800	270	28	0.54	$>10^{-7}$	15 or less	50 - 200
OL	Organic silts and silt-clays, low plasticity.	80 - 100	33 - 21	.....	.....	.....	.....	.....	.....	.....	5 or less	50 - 100
MH	Inorganic clayey silts, elastic silts.	70 - 95	40 - 24	2.0	3.8	1500	420	25	0.47	$5 \times >10^{-7}$	10 or less	50 - 100
CH	Inorganic clays of high plasticity	75 - 105	36 - 19	2.6	3.9	2150	230	19	0.35	$>10^{-7}$	15 or less	50 - 150
OH	Organic clays and silty clays	65 - 100	45 - 21	.....	.....	.....	.....	.....	.....	.....	5 or less	25 - 10

Notes:

1. All properties are for condition of "Standard Proctor" maximum density, except values of k and CBR which are for "modified Proctor" maximum density.
2. Typical stength characteristics are for effective strength envelopes and are obtained from USBR data.
3. Compression values are for vertical loading with complete lateral confinement.
4. (>) indicates that typical property is greater than the value shown.
   (..) indicates insufficient data available for an estimate.

REF. NAVAC DESIGN MAN. 7.2



EXPLANATION

—5— Contour--Horizontal acceleration expressed as percent of gravity. Some areas show acceleration values without contours. Hachures indicate closed area of lower acceleration. No data available for Hawaii and Puerto Rico

Albers Equal Area Projection

SCALE 1:7,500,000

HORIZONTAL ACCELERATION
(90 PERCENT PROBABILITY OF NOT BEING EXCEEDED IN 250 YEARS)

(From Algermissen et al., 1990)

HORIZONTAL ACCELERATION MAP

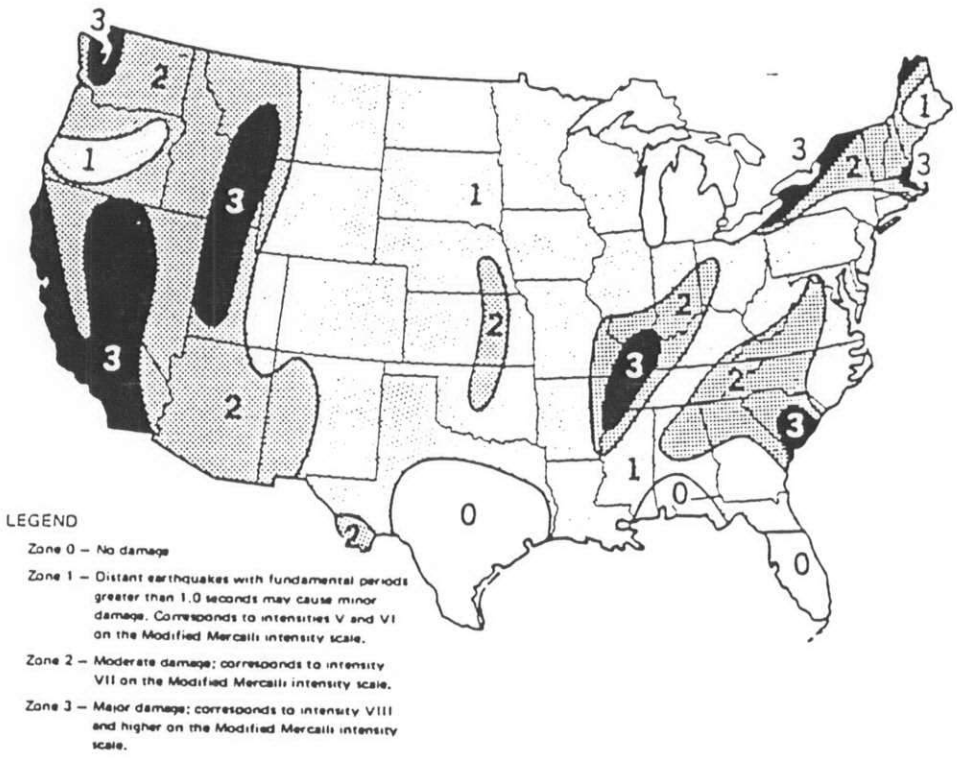


FIGURE 2.9. Seismic zone map of continental United States (After Algermissen, 1969)

analysis, if the pore pressure is known or measured. Effective stress analyses can then be made on steady-state seepage, rapid drawdown, and earthquake, respectively.

Figure 2.11 shows guidelines for analyzing cut slopes. Because the long-term stability is usually more critical, an effective stress analysis for long-term stability should be made first. If the required factor of safety for steady-state seepage is the same as that for rapid drawdown, only the case of rapid drawdown need be considered because it is more critical than the steady-state seepage. After the long-term stability is satisfied, the short-term stability at the end of construction should be checked.

It should be noted that the case of rapid drawdown cannot occur in

Table 2.2 Seismic Coefficients Corresponding to Each Zone.

ZONE	INTENSITY OF MODIFIED MERCALLI SCALE	AVERAGE SEISMIC COEFFICIENT	REMARK
0	—	0	No damage
1	V and VI	0.03 to 0.07	Minor damage
2	VII	0.13	Moderate damage
3	VII and higher	0.27	Major damage

REF. HUANG, YANG STABILITY ANALYSIS OF EARTH SLOPES, VAN NOSTRAND REINHOLD 1983.

REF 5

REF SHARMA AND LEWIS, WASTE CONTAINMENT, WAST STABILIZATION, AND LANDFILLS

10.4 SEISMIC STABILITY ANALYSES

Under static conditions, the primary driving force on a slope is gravity. When an earthquake occurs, seismic accelerations are imposed on the mass that generate inertial forces. While seismic accelerations occur both horizontally and vertically, only horizontal inertial forces are typically used in seismic slope stability analyses for waste containment applications. This is because horizontal inertial forces are usually more critical than vertical inertial forces, and in most cases, gravity forces tend to overcome vertical inertial forces.

One of the initial methods for analyzing seismic slope stability was to apply a horizontal inertial force (based on the seismic accelerations at the site) at the center of gravity of the mass and determine its effect on the factor of safety (see Figure 10.5). Table 10.1 presents acceptable factors of safety for various conditions. If the factor of safety decreased to less than 1, the slope was considered unstable under seismic conditions. However, the ability of this method, commonly referred to as the pseudostatic approach, to predict the behavior of embankments during earthquakes has been poor.

Newmark (1965) developed a method to predict permanent seismic displacements by using a yield acceleration method and assuming that the mass was a rigid body. The method assumes that failure occurs on a well-defined slip surface and that the material behaves elastically at stress levels below failure, but develops plastic behavior above yield strength. For a given potential sliding mass, when the induced acceleration exceeds the calculated "yield acceleration (k_y)," movements are assumed to occur along the direction of the failure plane. The yield acceleration (k_y) is the horizontal acceleration that reduces the factor of safety to unity in a limit

TABLE 10.1 Recommended Minimum Values of Factor of Safety for Slope Stability Analyses

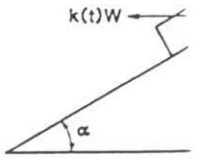
Consequences of Slope Failure	Uncertainty of Strength Measurements[a]	
	Small[b]	Large[c]
No imminent danger to human life or major environmental impact if slope fails	1.25 (1.2)	1.5 (1.3)
Imminent danger to human life or major environmental impact if slope fails	1.5 (1.3)	2.0 or greater (1.7 or greater)

Source: USEPA (1992).

[a] Numbers without parentheses apply for static conditions and those within parentheses apply to seismic conditions.

[b] The uncertainty of the strength measurements is smallest when the soil conditions are uniform and high-quality strength test data provide a consistent, complete, and logical picture of the strength characteristics.

[c] The uncertainty of the strength measurements is greatest when the soil conditions are complex and when available strength data do not provide a consistent, complete, or logical picture of the strength characteristics.



FORCES ON SLIDING BLOCK

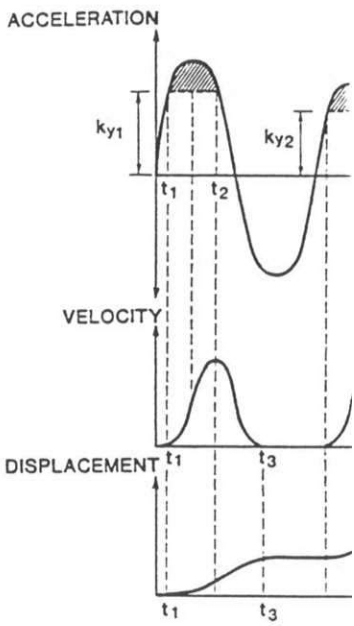


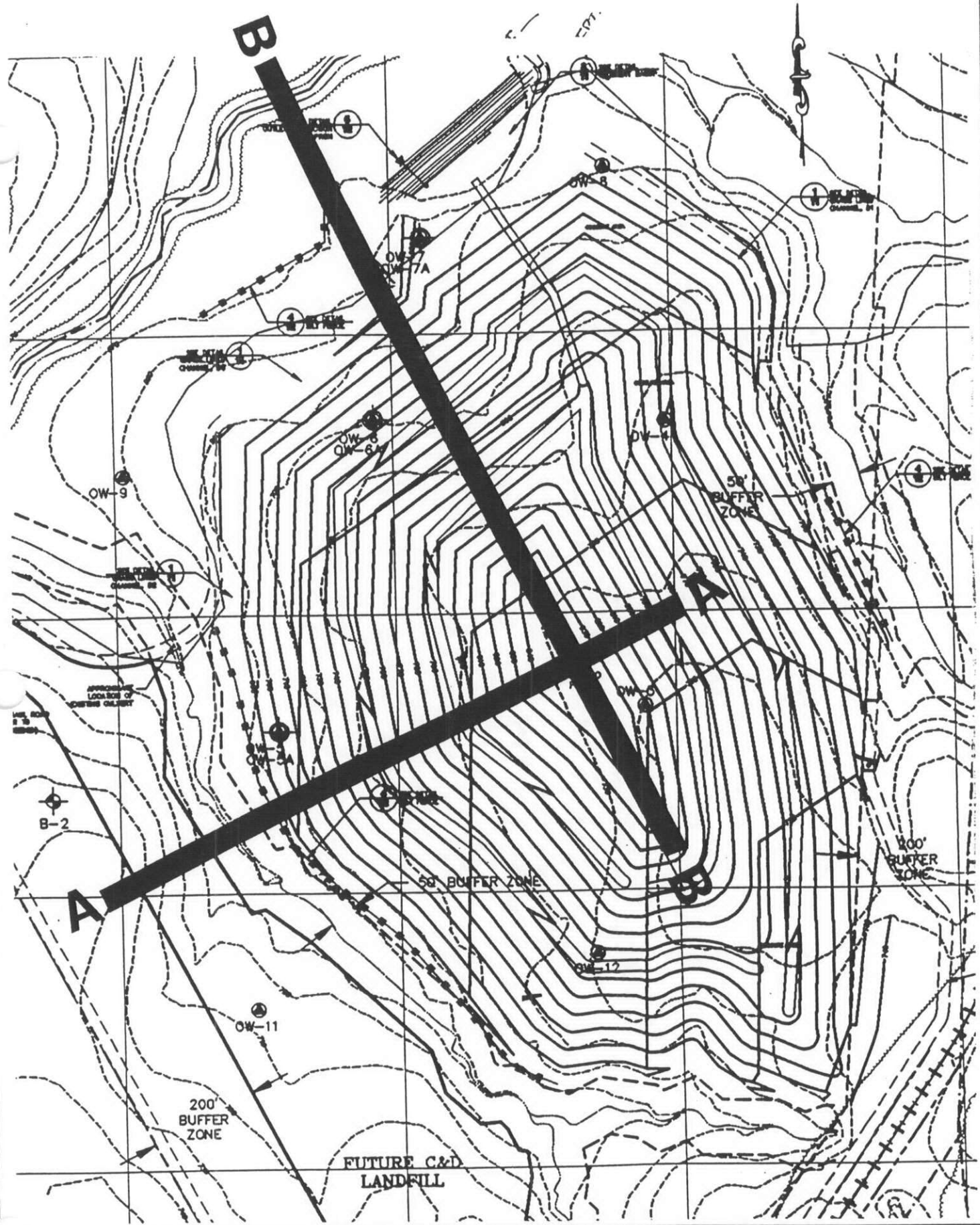
Figure 10.16 Schematic illustration of the N lative seismic displacement. (From Seed and of ASCE.)

equilibrium stability analysis. The meth 10.16.

Makdisi and Seed (1977) modified Ne dynamic response of an embankment. T Seed, involves the following steps:

"(1) A yield acceleration, i.e. an accele would develop a factor of safety of unity', are a function of the embankment geomet and the location of the potential sliding ma

(2) Earthquake induced accelerations in namic response analyses. Finite element p



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CHECKED BY:	
DRAWN BY:	CB
DATE:	2-18-98

S&ME
ENVIRONMENTAL SERVICES
ENGINEERING · TESTING

SLOPE STABILITY ANALYSIS CROSS-SECTIONS A-A, B-B

LAKE NORMAN LANDFILL
LOWESVILLE, NORTH CAROLINA

JOB NO: 1356-97-394

FIGURE NO. 1

S&ME

JOB NO. 1356-97-394

SHEET NO. 1/1

DATE 2/17/98

JOB NAME BARRETT GRADING

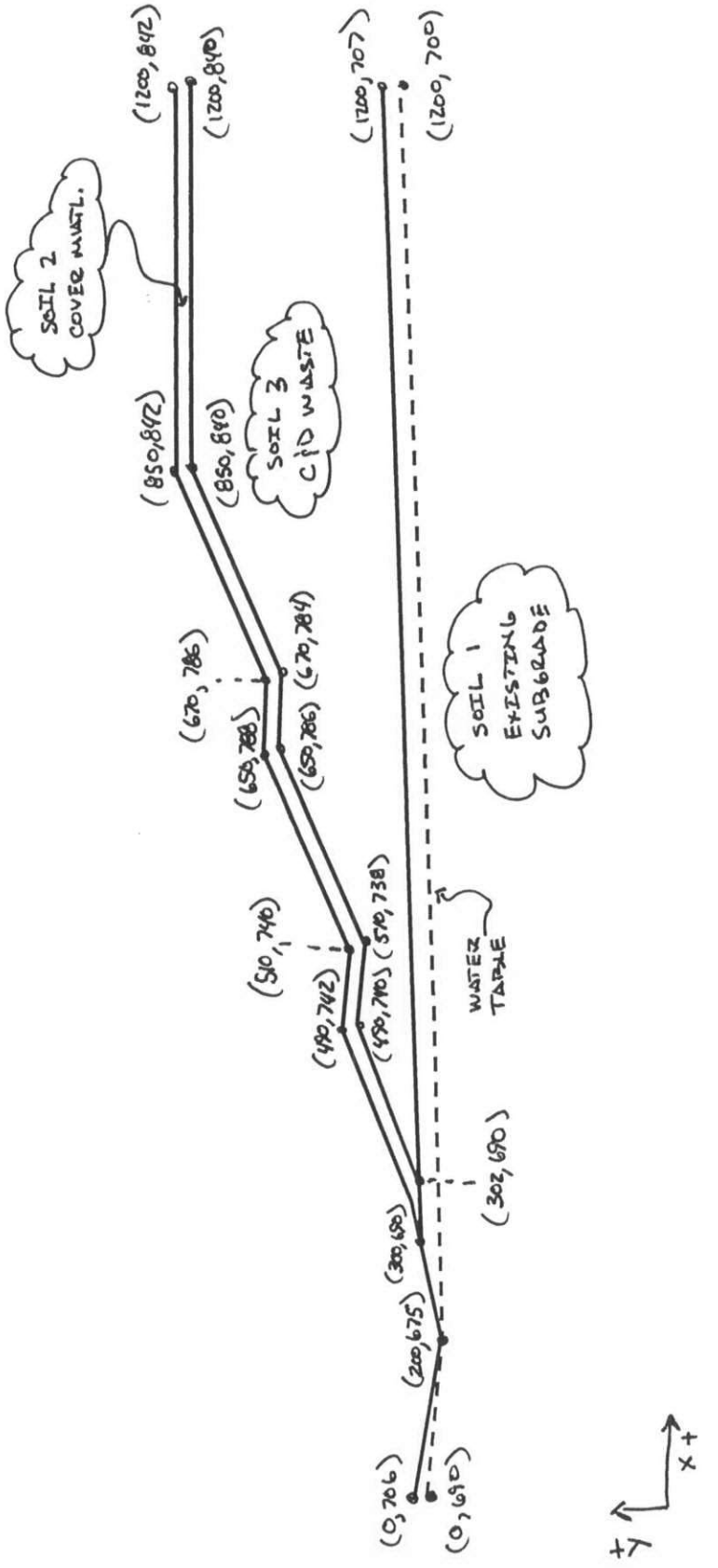
COMPUTED BY CB

SUBJECT LANDFILL SLOPE STABILITY

CHECKED BY

CROSS-SECTION A-A

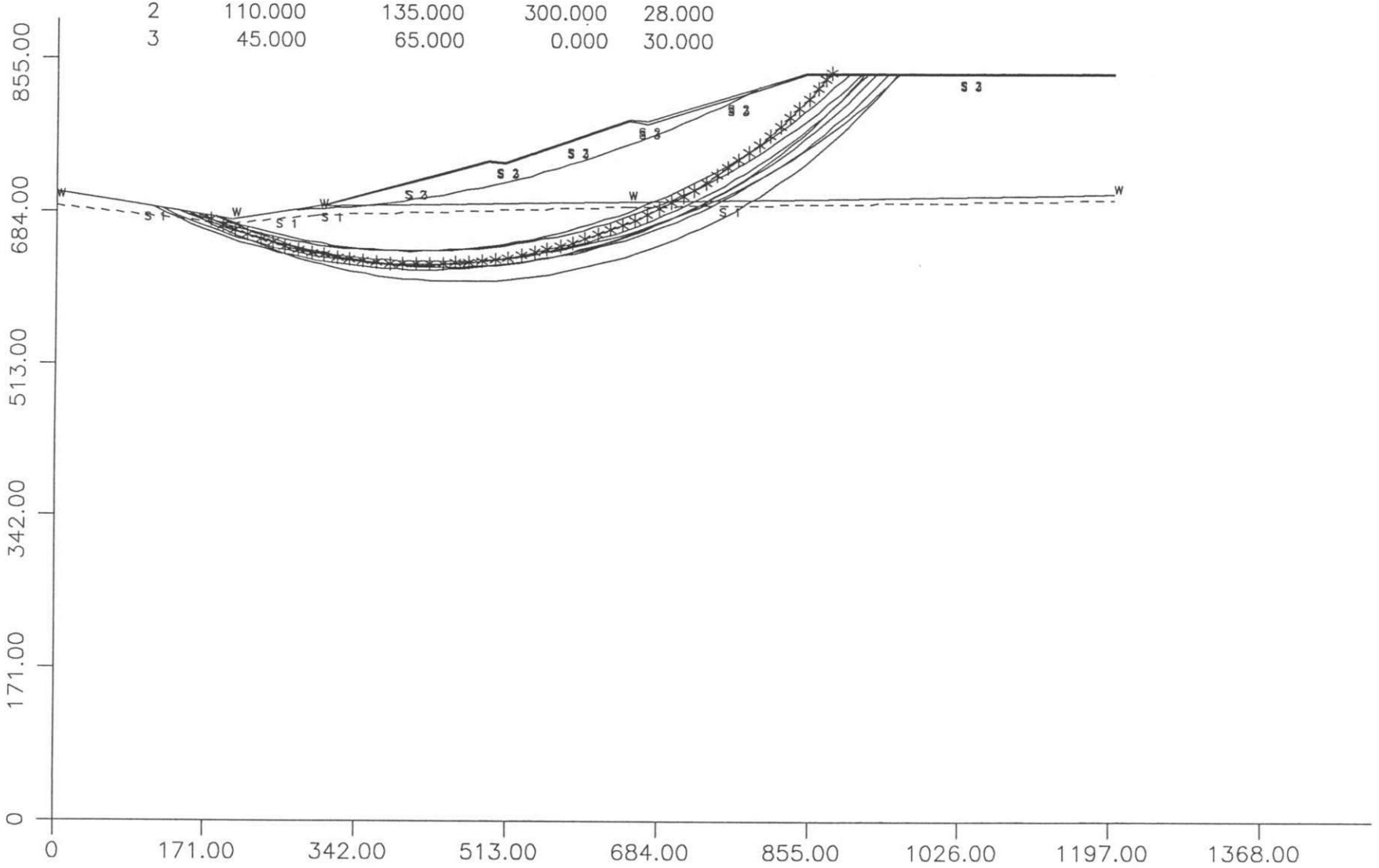
COORDINATES



Barrett Grading C&D Lan. .ll Section A–A w/siesmic cond.

Soil	Moist Unit Weight	Saturated Unit Weight	Cohesion	Friction Angle
1	110.000	135.000	300.000	28.000
2	110.000	135.000	300.000	28.000
3	45.000	65.000	0.000	30.000

Minimum Factor of Safety 1.502

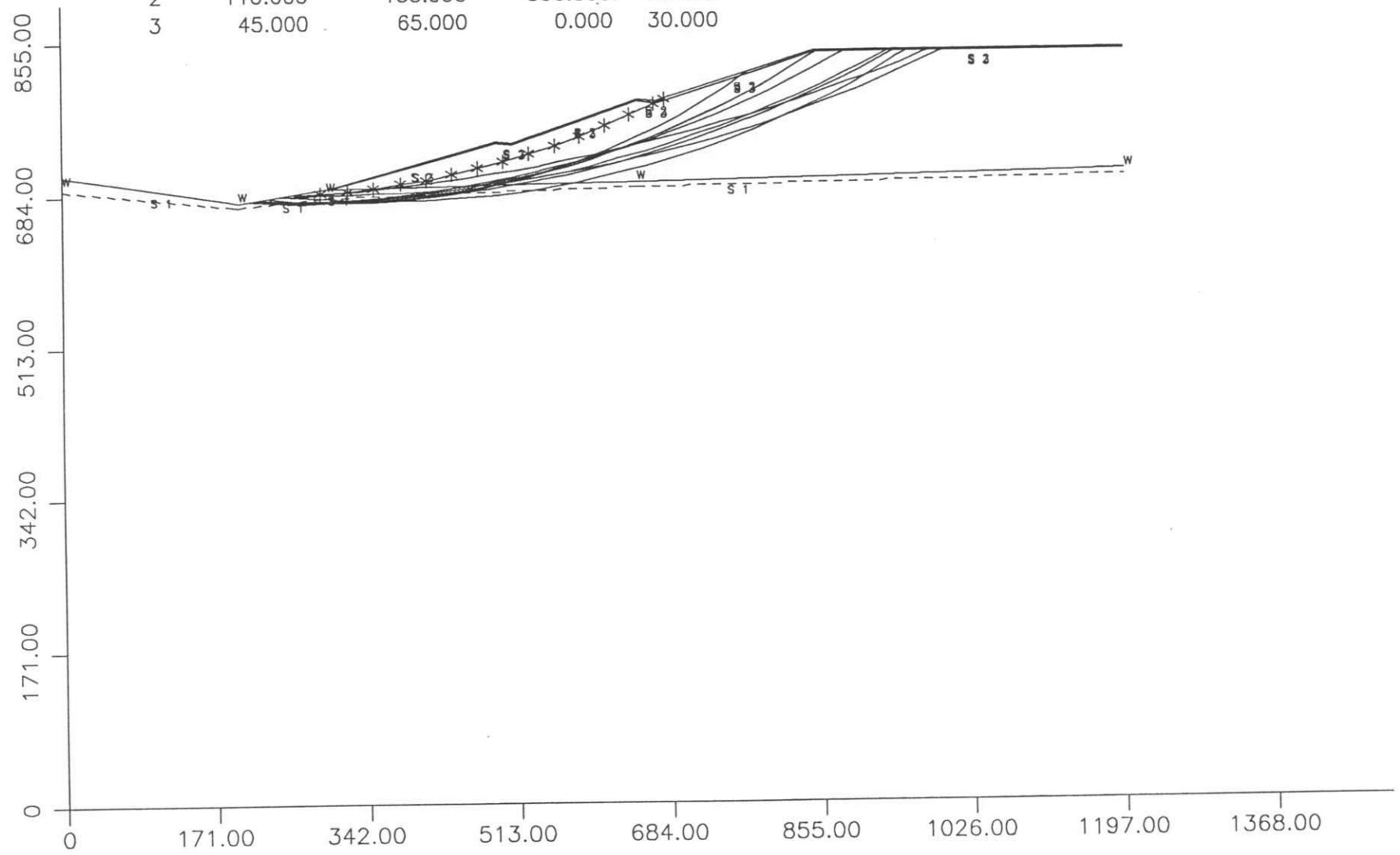


Barrett Grading &D Landfill Section A–A

Soil	Moist Unit Weight	Saturated Unit Weight	Cohesion	Friction Angle
1	110.000	135.000	300.000	28.000
2	110.000	135.000	300.000	28.000
3	45.000	65.000	0.000	30.000

Minimum Factor of Safety 2.595

W/OUT SIESMIC ANALYSIS



** STABL/G **

Slope Stability Program
Portions of this program (c) 1992
by
GEOSOFT
1442 Lincoln Avenue, Suite 146
Orange, CA 92665
U.S.A.

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 02-18-1998
Input Data Filename: 97394_1a.stb
Output Filename: 97394_1a.out
Plotted Output Filename: 97394_1a.pl1

PROBLEM DESCRIPTION Barrett Grading C&D Landfill Section A-A
w/siesmic cond.

BOUNDARY COORDINATES

8 Top Boundaries
16 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	706.00	200.00	675.00	1
2	200.00	675.00	300.00	690.00	1
3	300.00	690.00	490.00	742.00	2
4	490.00	742.00	510.00	740.00	2
5	510.00	740.00	650.00	788.00	2
6	650.00	788.00	670.00	786.00	2
7	670.00	786.00	850.00	842.00	2
8	850.00	842.00	1200.00	842.00	2
9	300.00	690.00	302.00	690.00	1
10	302.00	690.00	490.00	740.00	3
11	490.00	740.00	510.00	738.00	3
12	510.00	738.00	650.00	786.00	3
13	650.00	786.00	670.00	784.00	3
14	670.00	784.00	850.00	840.00	3
15	850.00	840.00	1200.00	840.00	3
16	302.00	690.00	1200.00	707.00	1

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	110.0	135.0	300.0	28.0	.00	.0	1
2	110.0	135.0	300.0	28.0	.00	.0	0
3	45.0	65.0	.0	30.0	.00	.0	0

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	690.00
2	200.00	670.00
3	300.00	680.00
4	650.00	690.00
5	1200.00	700.00

A Horizontal Earthquake Loading Coefficient
Of .130 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of .130 Has Been Assigned

Cavitation Pressure = .0 psf

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

4000 Trial Surfaces Have Been Generated.

50 Surfaces Initiate From Each Of 80 Points Equally Spaced
Along The Ground Surface Between X = .00 ft.
and X = 800.00 ft.

Each Surface Terminates Between X = 300.00 ft.
and X =1000.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y =600.00 ft.

15.00 ft. Line Segments Define Each Trial Failure Surface.

**** ERROR - RC11 ****

Factor Of Safety Calculation Has Gone Through Ten Iterations

The Trial Failure Surface In Question Is Defined By The Following 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	293.67	689.05
2	308.65	688.31
3	310.88	677.95
4	324.37	684.51
5	332.72	696.97
6	332.85	698.99

Factor Of Safety For The Preceding Specified Surface = 1.575

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 54 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	162.03	680.89
2	175.73	674.78
3	189.58	669.02

4	203.57	663.61
5	217.69	658.54
6	231.92	653.83
7	246.28	649.47
8	260.73	645.46
9	275.28	641.82
10	289.92	638.54
11	304.63	635.62
12	319.41	633.06
13	334.25	630.88
14	349.14	629.06
15	364.07	627.61
16	379.03	626.54
17	394.02	625.83
18	409.01	625.49
19	424.01	625.53
20	439.01	625.94
21	453.99	626.72
22	468.94	627.87
23	483.87	629.40
24	498.75	631.29
25	513.58	633.55
26	528.34	636.17
27	543.04	639.17
28	557.66	642.52
29	572.20	646.24
30	586.63	650.31
31	600.96	654.75
32	615.18	659.53
33	629.27	664.67
34	643.23	670.15
35	657.05	675.98
36	670.72	682.15
37	684.24	688.66
38	697.59	695.50
39	710.77	702.67
40	723.76	710.16
41	736.56	717.97
42	749.17	726.10
43	761.57	734.54
44	773.76	743.28
45	785.73	752.32
46	797.47	761.66
47	808.98	771.28
48	820.24	781.19
49	831.25	791.37
50	842.01	801.83
51	852.51	812.54
52	862.74	823.51
53	872.69	834.74
54	878.81	842.00

Circle Center At X = 415.0 ; Y = 1230.5 and Radius, 605.0

*** 1.502 ***

Individual data on the 65 slices

Slice No.	Width Ft(m)	Weight Lbs(kg)	Water Force Top Lbs(kg)	Water Force Bot Lbs(kg)	Tie Force Norm Lbs(kg)	Tie Force Tan Lbs(kg)	Earthquake Force Hor Lbs(kg)	Earthquake Force Ver Lbs(kg)	Surcharge Load Lbs(kg)
1	13.7	2998.0	.0	.0	.0	.0	389.7	389.7	.0
2	7.5	4063.7	.0	.0	.0	.0	528.3	528.3	.0
3	6.4	4909.3	.0	433.5	.0	.0	638.2	638.2	.0
4	10.4	10999.9	.0	2438.4	.0	.0	1430.0	1430.0	.0
5	3.6	4825.3	.0	1396.3	.0	.0	627.3	627.3	.0
6	14.1	27608.1	.0	9301.7	.0	.0	3589.1	3589.1	.0
7	14.2	41072.4	.0	15177.6	.0	.0	5339.4	5339.4	.0
8	14.4	54077.4	.0	20735.7	.0	.0	7030.1	7030.1	.0
9	14.5	66576.0	.0	25972.5	.0	.0	8654.9	8654.9	.0
10	14.6	78524.5	.0	30884.9	.0	.0	10208.2	10208.2	.0
11	14.6	89880.3	.0	35469.6	.0	.0	11684.4	11684.4	.0
12	10.1	67856.8	.0	26774.1	.0	.0	8821.4	8821.4	.0
13	2.0	14049.6	.0	5556.6	.0	.0	1826.4	1826.4	.0
14	2.6	18793.2	.0	7403.8	.0	.0	2443.1	2443.1	.0
15	14.8	110462.5	.0	43041.5	.0	.0	14360.1	14360.1	.0
16	14.8	118892.6	.0	45654.3	.0	.0	15456.0	15456.0	.0
17	14.9	126580.7	.0	47924.5	.0	.0	16455.5	16455.5	.0
18	14.9	133501.1	.0	49850.5	.0	.0	17355.1	17355.1	.0
19	15.0	139631.9	.0	51431.3	.0	.0	18152.2	18152.2	.0
20	15.0	144953.4	.0	52665.7	.0	.0	18843.9	18843.9	.0
21	15.0	149449.9	.0	53553.2	.0	.0	19428.5	19428.5	.0
22	15.0	153108.4	.0	54093.1	.0	.0	19904.1	19904.1	.0
23	15.0	155920.0	.0	54285.2	.0	.0	20269.6	20269.6	.0
24	15.0	157877.8	.0	54129.2	.0	.0	20524.1	20524.1	.0
25	15.0	158979.5	.0	53625.4	.0	.0	20667.3	20667.3	.0
26	14.9	159225.2	.0	52773.9	.0	.0	20699.3	20699.3	.0
27	6.1	65441.3	.0	21423.7	.0	.0	8507.4	8507.4	.0
28	8.7	92514.7	.0	30151.6	.0	.0	12026.9	12026.9	.0
29	11.3	116582.3	.0	38122.8	.0	.0	15155.7	15155.7	.0
30	3.6	36561.7	.0	11907.5	.0	.0	4753.0	4753.0	.0
31	14.8	150188.3	.0	48140.1	.0	.0	19524.5	19524.5	.0
32	14.7	147668.4	.0	45905.6	.0	.0	19196.9	19196.9	.0
33	14.6	144338.2	.0	43328.3	.0	.0	18764.0	18764.0	.0
34	14.5	140216.5	.0	40409.7	.0	.0	18228.1	18228.1	.0
35	14.4	135324.3	.0	37151.4	.0	.0	17592.2	17592.2	.0
36	14.3	129687.5	.0	33555.8	.0	.0	16859.4	16859.4	.0
37	14.2	123333.6	.0	29625.0	.0	.0	16033.4	16033.4	.0
38	14.1	116293.2	.0	25361.3	.0	.0	15118.1	15118.1	.0
39	14.0	108600.0	.0	20767.3	.0	.0	14118.0	14118.0	.0
40	6.8	50061.8	.0	8395.9	.0	.0	6508.0	6508.0	.0
41	7.1	49727.1	.0	7434.3	.0	.0	6464.5	6464.5	.0
42	12.9	83229.9	.0	10052.0	.0	.0	10819.9	10819.9	.0
43	.7	4345.9	.0	415.6	.0	.0	565.0	565.0	.0
44	13.5	76353.8	.0	4767.1	.0	.0	9926.0	9926.0	.0
45	4.0	20699.5	.0	273.4	.0	.0	2690.9	2690.9	.0
46	9.4	46048.7	.0	.0	.0	.0	5986.3	5986.3	.0
47	3.8	17557.0	.0	.0	.0	.0	2282.4	2282.4	.0
48	9.4	42240.4	.0	.0	.0	.0	5491.2	5491.2	.0
49	13.0	56824.8	.0	.0	.0	.0	7387.2	7387.2	.0
50	12.8	53897.8	.0	.0	.0	.0	7006.7	7006.7	.0
51	12.6	50787.0	.0	.0	.0	.0	6602.3	6602.3	.0
52	12.4	47508.4	.0	.0	.0	.0	6176.1	6176.1	.0
53	12.2	44079.0	.0	.0	.0	.0	5730.3	5730.3	.0

54	12.0	40516.4	.0	.0	.0	.0	5267.1	5267.1	.0
55	11.7	36838.8	.0	.0	.0	.0	4789.0	4789.0	.0
56	11.5	33065.3	.0	.0	.0	.0	4298.5	4298.5	.0
57	11.3	29215.3	.0	.0	.0	.0	3798.0	3798.0	.0
58	11.0	25308.5	.0	.0	.0	.0	3290.1	3290.1	.0
59	10.8	21365.4	.0	.0	.0	.0	2777.5	2777.5	.0
60	8.0	13566.0	.0	.0	.0	.0	1763.6	1763.6	.0
61	2.5	3796.7	.0	.0	.0	.0	493.6	493.6	.0
62	10.2	12362.3	.0	.0	.0	.0	1607.1	1607.1	.0
63	10.0	7059.6	.0	.0	.0	.0	917.7	917.7	.0
64	4.4	1502.2	.0	.0	.0	.0	195.3	195.3	.0
65	1.7	185.6	.0	.0	.0	.0	24.1	24.1	.0

Failure Surface Specified By 55 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	182.28	677.75
2	196.03	671.77
3	209.93	666.11
4	223.96	660.80
5	238.10	655.81
6	252.37	651.17
7	266.74	646.87
8	281.21	642.91
9	295.76	639.30
10	310.40	636.04
11	325.12	633.12
12	339.90	630.56
13	354.74	628.35
14	369.62	626.50
15	384.55	625.00
16	399.50	623.86
17	414.48	623.08
18	429.48	622.65
19	444.48	622.58
20	459.47	622.87
21	474.46	623.52
22	489.43	624.53
23	504.36	625.89
24	519.26	627.60
25	534.12	629.68
26	548.92	632.10
27	563.66	634.88
28	578.33	638.01
29	592.92	641.49
30	607.43	645.31
31	621.84	649.48
32	636.14	654.00
33	650.34	658.85
34	664.41	664.04
35	678.36	669.56
36	692.16	675.42
37	705.83	681.60
38	719.35	688.11
39	732.70	694.94
40	745.89	702.08
41	758.91	709.54

42	771.74	717.31
43	784.38	725.38
44	796.83	733.74
45	809.08	742.41
46	821.11	751.36
47	832.93	760.60
48	844.52	770.12
49	855.89	779.91
50	867.01	789.97
51	877.90	800.29
52	888.53	810.87
53	898.91	821.70
54	909.03	832.77
55	917.07	842.00

Circle Center At X = 439.8 ; Y = 1251.3 and Radius, 628.7

*** 1.502 ***

Failure Surface Specified By 58 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	162.03	680.89
2	175.82	674.99
3	189.73	669.39
4	203.77	664.10
5	217.92	659.11
6	232.17	654.43
7	246.52	650.07
8	260.96	646.02
9	275.49	642.28
10	290.09	638.86
11	304.77	635.76
12	319.51	632.98
13	334.31	630.53
14	349.16	628.39
15	364.05	626.58
16	378.97	625.09
17	393.93	623.93
18	408.90	623.10
19	423.89	622.59
20	438.89	622.40
21	453.89	622.55
22	468.89	623.02
23	483.86	623.82
24	498.82	624.94
25	513.75	626.39
26	528.65	628.16
27	543.50	630.26
28	558.30	632.68
29	573.05	635.42
30	587.73	638.49

31	602.35	641.87
32	616.88	645.57
33	631.34	649.58
34	645.70	653.91
35	659.96	658.55
36	674.12	663.50
37	688.17	668.76
38	702.10	674.32
39	715.91	680.18
40	729.58	686.35
41	743.12	692.81
42	756.52	699.56
43	769.76	706.60
44	782.85	713.93
45	795.77	721.54
46	808.53	729.44
47	821.11	737.61
48	833.51	746.05
49	845.72	754.75
50	857.74	763.73
51	869.56	772.96
52	881.18	782.45
53	892.59	792.18
54	903.79	802.17
55	914.76	812.39
56	925.51	822.86
57	936.03	833.55
58	943.99	842.00

Circle Center At X = 439.8 ; Y = 1311.1 and Radius, 688.7

*** 1.503 ***

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	273.42	686.01
2	288.40	686.68
3	303.38	687.52
4	318.34	688.55
5	333.30	689.76
6	348.23	691.16
7	363.15	692.73
8	378.04	694.49
9	392.92	696.43
10	407.77	698.55
11	422.59	700.85
12	437.38	703.34
13	452.14	706.00
14	466.87	708.84
15	481.56	711.86
16	496.22	715.07
17	510.83	718.45

18	525.41	722.00
19	539.93	725.74
20	554.41	729.65
21	568.85	733.74
22	583.23	738.01
23	597.55	742.45
24	611.83	747.06
25	626.04	751.85
26	640.20	756.81
27	654.29	761.95
28	668.32	767.25
29	682.29	772.73
30	696.18	778.38
31	710.01	784.19
32	723.76	790.18
33	737.44	796.33
34	751.05	802.65
35	764.57	809.13
36	778.02	815.78
37	791.38	822.59
38	796.86	825.47

Circle Center At X = 226.6 ; Y = 1913.8 and Radius, 1228.6

*** 1.505 ***

Failure Surface Specified By 54 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	182.28	677.75
2	196.56	673.15
3	210.93	668.85
4	225.39	664.85
5	239.92	661.15
6	254.53	657.75
7	269.21	654.65
8	283.95	651.86
9	298.74	649.37
10	313.58	647.19
11	328.46	645.31
12	343.38	643.74
13	358.32	642.48
14	373.29	641.52
15	388.28	640.88
16	403.28	640.54
17	418.28	640.52
18	433.27	640.80
19	448.26	641.40
20	463.23	642.30
21	478.19	643.51
22	493.11	645.03
23	508.00	646.86

24	522.84	649.00
25	537.64	651.44
26	552.39	654.18
27	567.08	657.23
28	581.70	660.59
29	596.25	664.24
30	610.72	668.19
31	625.10	672.44
32	639.40	676.99
33	653.59	681.83
34	667.69	686.96
35	681.67	692.38
36	695.54	698.09
37	709.29	704.09
38	722.92	710.37
39	736.41	716.92
40	749.76	723.76
41	762.97	730.86
42	776.03	738.24
43	788.93	745.89
44	801.68	753.80
45	814.25	761.98
46	826.66	770.41
47	838.89	779.09
48	850.94	788.03
49	862.80	797.21
50	874.47	806.64
51	885.94	816.30
52	897.21	826.20
53	908.27	836.33
54	914.22	842.00

Circle Center At X = 412.0 ; Y = 1367.1 and Radius, 726.6

*** 1.508 ***

Failure Surface Specified By 59 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	121.52	687.16
2	135.26	681.14
3	149.12	675.42
4	163.10	669.98
5	177.20	664.85
6	191.40	660.02
7	205.70	655.49
8	220.09	651.26
9	234.57	647.35
10	249.13	643.74
11	263.76	640.44
12	278.46	637.45
13	293.22	634.78
14	308.03	632.42

15	322.89	630.37
16	337.79	628.64
17	352.73	627.23
18	367.69	626.13
19	382.67	625.36
20	397.66	624.90
21	412.66	624.76
22	427.66	624.94
23	442.65	625.44
24	457.63	626.26
25	472.59	627.39
26	487.51	628.84
27	502.41	630.61
28	517.26	632.70
29	532.07	635.10
30	546.82	637.81
31	561.51	640.84
32	576.14	644.18
33	590.69	647.83
34	605.16	651.79
35	619.54	656.05
36	633.82	660.62
37	648.01	665.49
38	662.09	670.66
39	676.06	676.13
40	689.91	681.90
41	703.63	687.95
42	717.22	694.30
43	730.67	700.94
44	743.98	707.86
45	757.14	715.06
46	770.14	722.54
47	782.98	730.29
48	795.66	738.32
49	808.16	746.61
50	820.48	755.16
51	832.61	763.98
52	844.56	773.05
53	856.31	782.37
54	867.86	791.94
55	879.20	801.76
56	890.34	811.81
57	901.25	822.10
58	911.95	832.62
59	921.09	842.00

Circle Center At X = 411.7 ; Y = 1330.7 and Radius, 705.9

*** 1.511 ***

Failure Surface Specified By 60 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	141.77	684.03
2	155.74	678.55
3	169.81	673.36
4	183.98	668.44
5	198.25	663.80
6	212.60	659.44
7	227.03	655.36
8	241.55	651.57
9	256.13	648.06
10	270.78	644.84
11	285.49	641.90
12	300.25	639.26
13	315.07	636.90
14	329.93	634.84
15	344.82	633.06
16	359.75	631.58
17	374.70	630.39
18	389.67	629.50
19	404.66	628.90
20	419.66	628.59
21	434.66	628.58
22	449.65	628.86
23	464.64	629.43
24	479.62	630.30
25	494.57	631.46
26	509.50	632.92
27	524.40	634.66
28	539.26	636.70
29	554.08	639.03
30	568.85	641.65
31	583.56	644.56
32	598.22	647.76
33	612.81	651.24
34	627.33	655.01
35	641.77	659.06
36	656.13	663.40
37	670.40	668.01
38	684.58	672.90
39	698.66	678.08
40	712.64	683.52
41	726.51	689.24
42	740.26	695.23
43	753.89	701.49
44	767.40	708.01
45	780.77	714.80
46	794.02	721.85
47	807.12	729.16
48	820.07	736.72
49	832.87	744.53
50	845.52	752.60
51	858.01	760.91
52	870.33	769.46
53	882.48	778.25
54	894.46	787.28
55	906.26	796.55
56	917.87	806.04
57	929.30	815.76
58	940.53	825.70
59	951.57	835.85

60 957.99 842.00

Circle Center At X = 427.8 ; Y = 1393.7 and Radius, 765.1

*** 1.513 ***

Failure Surface Specified By 61 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	151.90	682.46
2	165.21	675.54
3	178.68	668.94
4	192.30	662.66
5	206.06	656.69
6	219.96	651.04
7	233.98	645.72
8	248.13	640.73
9	262.38	636.06
10	276.75	631.73
11	291.20	627.73
12	305.75	624.07
13	320.38	620.75
14	335.08	617.77
15	349.84	615.13
16	364.67	612.84
17	379.54	610.89
18	394.45	609.28
19	409.40	608.03
20	424.37	607.12
21	439.36	606.56
22	454.36	606.34
23	469.36	606.48
24	484.35	606.96
25	499.33	607.80
26	514.28	608.98
27	529.21	610.50
28	544.09	612.38
29	558.92	614.59
30	573.70	617.16
31	588.42	620.06
32	603.06	623.31
33	617.63	626.89
34	632.11	630.82
35	646.49	635.07
36	660.77	639.67
37	674.94	644.59
38	688.99	649.84
39	702.92	655.41
40	716.71	661.31
41	730.36	667.52
42	743.86	674.05
43	757.21	680.90
44	770.40	688.05

45	783.41	695.50
46	796.25	703.26
47	808.91	711.31
48	821.37	719.65
49	833.64	728.29
50	845.71	737.20
51	857.56	746.39
52	869.20	755.85
53	880.61	765.59
54	891.80	775.58
55	902.75	785.83
56	913.46	796.34
57	923.92	807.09
58	934.13	818.08
59	944.08	829.30
60	953.77	840.75
61	954.77	842.00

Circle Center At X = 456.0 ; Y = 1252.0 and Radius, 645.7

*** 1.513 ***

Failure Surface Specified By 55 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	151.90	682.46
2	166.08	677.58
3	180.37	672.99
4	194.74	668.71
5	209.20	664.71
6	223.74	661.02
7	238.35	657.62
8	253.02	654.53
9	267.76	651.74
10	282.55	649.25
11	297.39	647.06
12	312.28	645.18
13	327.19	643.61
14	342.14	642.35
15	357.11	641.39
16	372.10	640.74
17	387.09	640.40
18	402.09	640.36
19	417.09	640.64
20	432.08	641.22
21	447.05	642.11
22	462.00	643.31
23	476.93	644.82
24	491.82	646.63
25	506.67	648.75
26	521.47	651.17
27	536.22	653.90

28	550.91	656.93
29	565.54	660.26
30	580.09	663.89
31	594.57	667.82
32	608.96	672.04
33	623.26	676.56
34	637.47	681.38
35	651.57	686.48
36	665.57	691.88
37	679.45	697.56
38	693.22	703.52
39	706.85	709.77
40	720.36	716.29
41	733.73	723.09
42	746.96	730.17
43	760.04	737.51
44	772.96	745.12
45	785.73	753.00
46	798.33	761.14
47	810.76	769.53
48	823.02	778.18
49	835.09	787.08
50	846.98	796.22
51	858.68	805.61
52	870.19	815.24
53	881.49	825.10
54	892.59	835.19
55	899.78	842.00

Circle Center At X = 396.2 ; Y = 1370.0 and Radius, 729.7

*** 1.514 ***

Failure Surface Specified By 61 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	111.39	688.73
2	124.99	682.39
3	138.71	676.34
4	152.56	670.58
5	166.53	665.12
6	180.61	659.95
7	194.80	655.09
8	209.09	650.53
9	223.48	646.27
10	237.95	642.32
11	252.50	638.68
12	267.13	635.35
13	281.82	632.34
14	296.57	629.63
15	311.38	627.24
16	326.24	625.17
17	341.13	623.41

18	356.06	621.97
19	371.02	620.85
20	386.00	620.04
21	400.99	619.56
22	415.99	619.39
23	430.99	619.55
24	445.98	620.02
25	460.96	620.81
26	475.92	621.92
27	490.85	623.35
28	505.75	625.09
29	520.61	627.15
30	535.42	629.53
31	550.18	632.22
32	564.87	635.23
33	579.50	638.54
34	594.06	642.17
35	608.53	646.11
36	622.92	650.35
37	637.21	654.90
38	651.41	659.75
39	665.49	664.90
40	679.47	670.35
41	693.32	676.10
42	707.05	682.14
43	720.65	688.47
44	734.11	695.09
45	747.43	701.99
46	760.60	709.18
47	773.61	716.64
48	786.46	724.38
49	799.14	732.39
50	811.65	740.67
51	823.98	749.21
52	836.12	758.02
53	848.08	767.08
54	859.84	776.39
55	871.39	785.95
56	882.75	795.75
57	893.89	805.80
58	904.81	816.07
59	915.52	826.58
60	926.00	837.32
61	930.38	842.00

Circle Center At X = 416.3 ; Y = 1324.4 and Radius, 705.0

*** 1.514 ***

S&ME

JOB NO. 1356-97-394

SHEET NO. 1/1

DATE 2/17/98

JOB NAME BARRETT GRADING

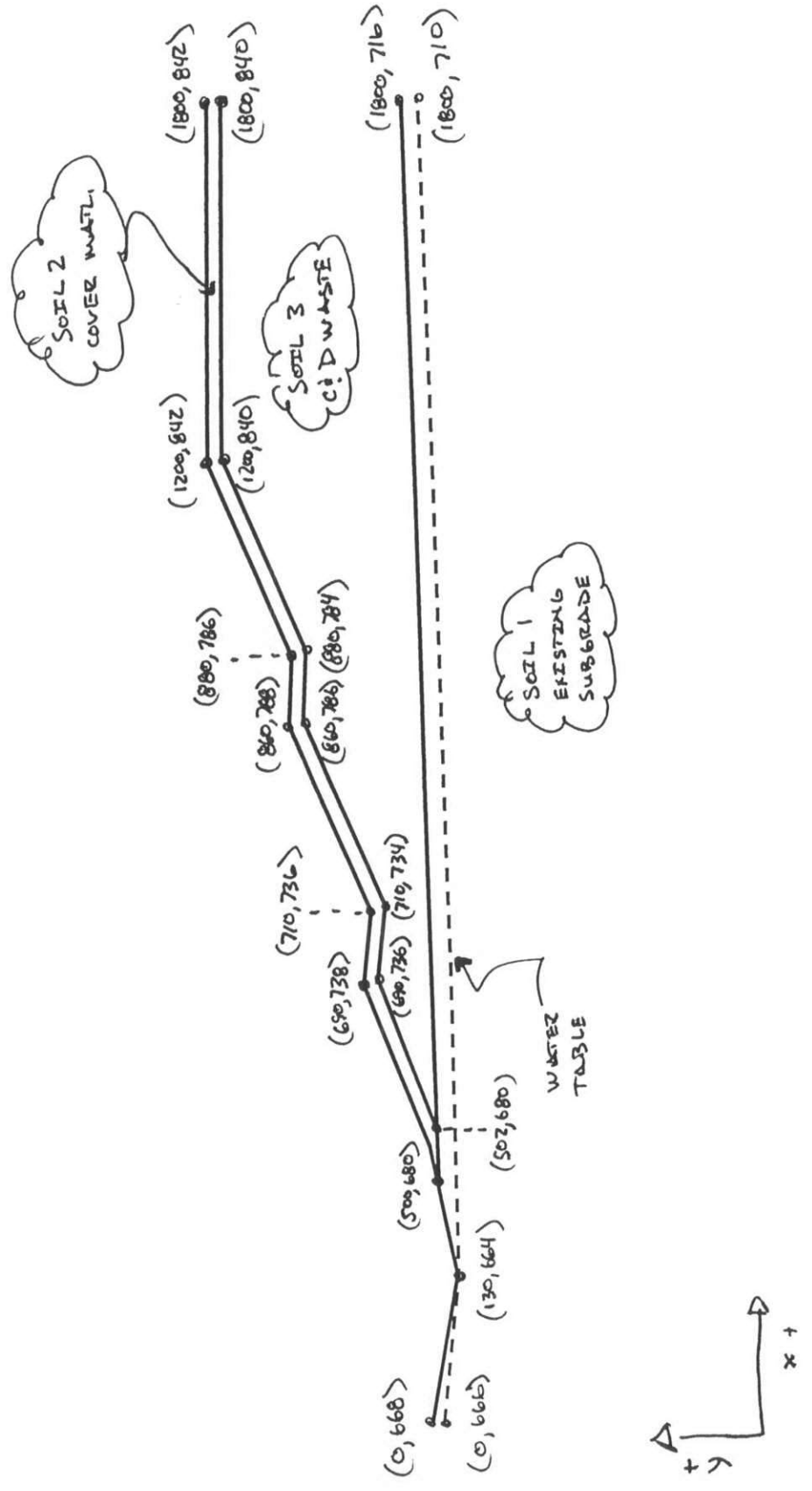
COMPUTED BY CB

SUBJECT LANDFILL SLOPE STABILITY

CHECKED BY

CROSS-SECTION B-B'

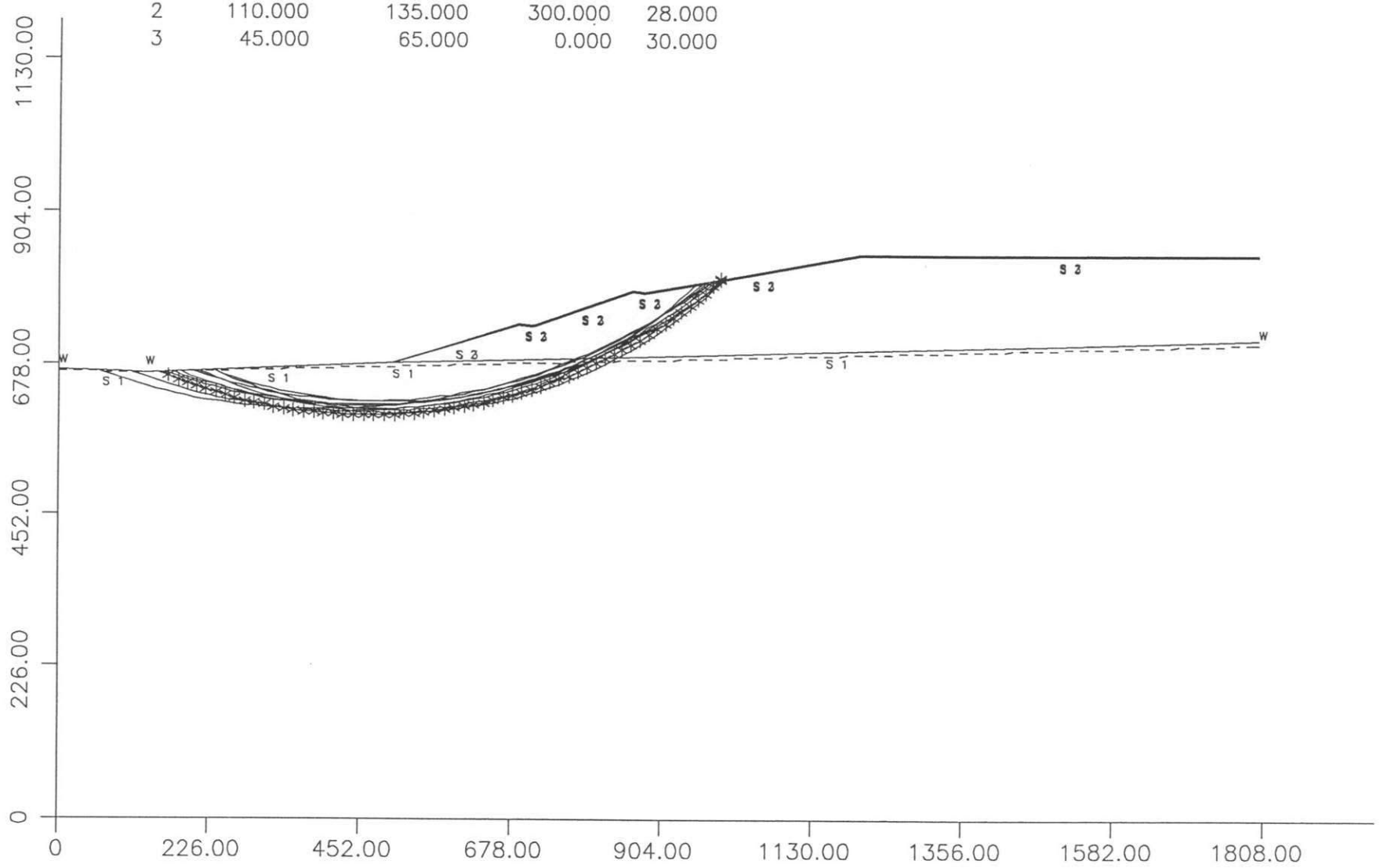
COORDINATES



Barrett Grading C&D Lana. . Section B–B w/ siesmic cond.

Soil	Moist Unit Weight	Saturated Unit Weight	Cohesion	Friction Angle
1	110.000	135.000	300.000	28.000
2	110.000	135.000	300.000	28.000
3	45.000	65.000	0.000	30.000

Minimum Factor of Safety 1.512

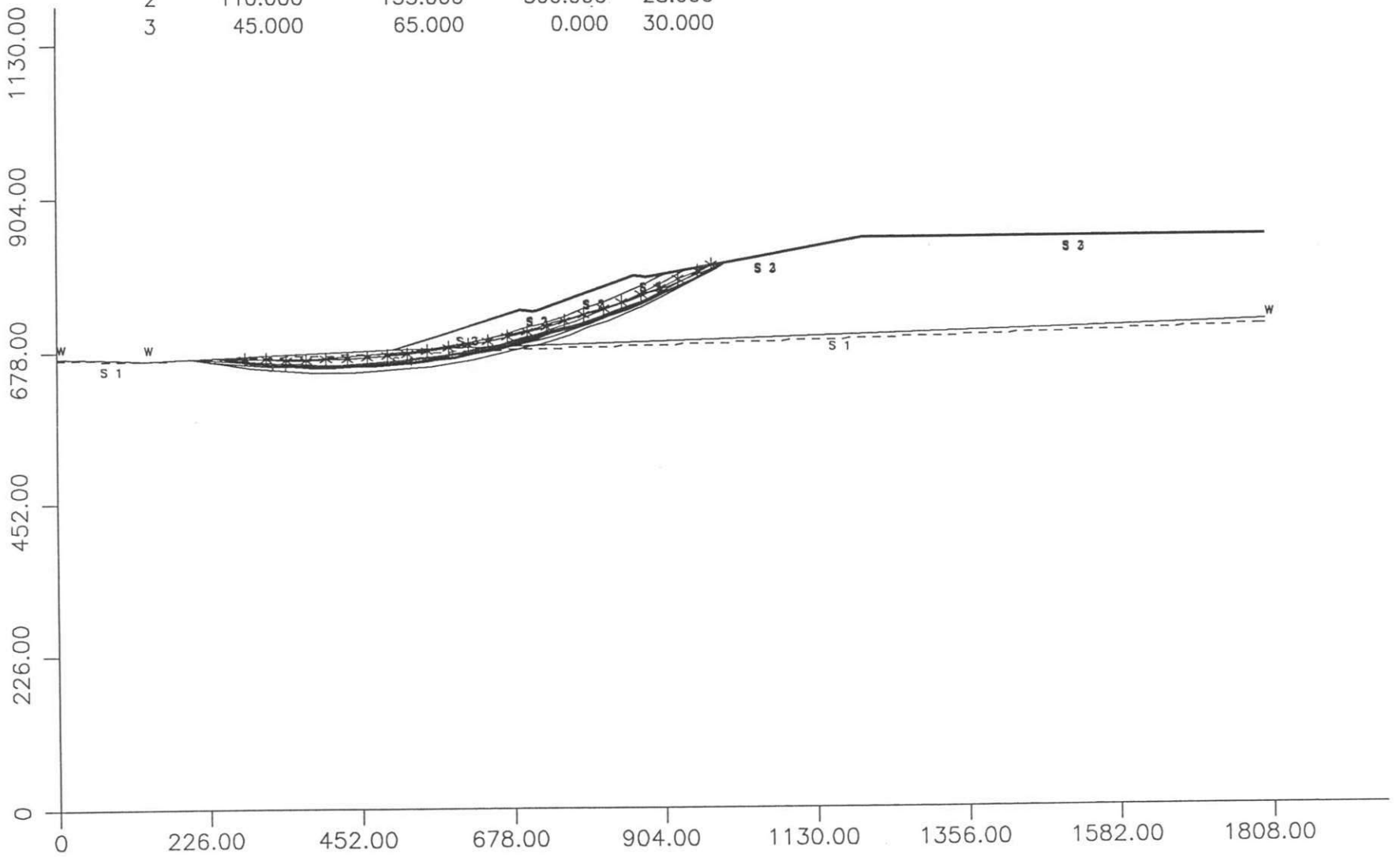


Barrett Grading &D Landfill Section B–B

Soil	Moist Unit Weight	Saturated Unit Weight	Cohesion	Friction Angle
1	110.000	135.000	300.000	28.000
2	110.000	135.000	300.000	28.000
3	45.000	65.000	0.000	30.000

Minimum Factor of Safety 3.332

W/OUT SEISMIC ANALYSIS



** STABL/G **

Slope Stability Program
Portions of this program (c) 1992
by
GEOSOFT
1442 Lincoln Avenue, Suite 146
Orange, CA 92665
U.S.A.

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 02-18-1998
Input Data Filename: 97394_1b.stb
Output Filename: 97394_1b.out
Plotted Output Filename: 97394_1b.pl1

PROBLEM DESCRIPTION Barrett Grading C&D Landfill Section B-B
w/ siesmic cond.

BOUNDARY COORDINATES

8 Top Boundaries
16 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	668.00	130.00	664.00	1
2	130.00	664.00	500.00	680.00	1
3	500.00	680.00	690.00	738.00	2
4	690.00	738.00	710.00	736.00	2
5	710.00	736.00	860.00	788.00	2
6	860.00	788.00	880.00	786.00	2
7	880.00	786.00	1200.00	842.00	2
8	1200.00	842.00	1800.00	842.00	2
9	500.00	680.00	502.00	680.00	1
10	502.00	680.00	690.00	736.00	3
11	690.00	736.00	710.00	734.00	3
12	710.00	734.00	860.00	786.00	3
13	860.00	786.00	880.00	784.00	3
14	880.00	784.00	1200.00	840.00	3
15	1200.00	840.00	1800.00	840.00	3
16	502.00	680.00	1800.00	716.00	1

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	110.0	135.0	300.0	28.0	.00	.0	1
2	110.0	135.0	300.0	28.0	.00	.0	0
3	45.0	65.0	.0	30.0	.00	.0	0

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 3 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	666.00
2	130.00	664.00
3	1800.00	710.00

A Horizontal Earthquake Loading Coefficient
Of .130 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of .130 Has Been Assigned

Cavitation Pressure = .0 psf

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

4000 Trial Surfaces Have Been Generated.

50 Surfaces Initiate From Each Of 80 Points Equally Spaced
Along The Ground Surface Between X = .00 ft.
and X = 800.00 ft.

Each Surface Terminates Between X = 300.00 ft.
and X =1000.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y =600.00 ft.

15.00 ft. Line Segments Define Each Trial Failure Surface.

**** ERROR - RC11 ****

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 62 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	151.90	664.95
2	165.73	659.14
3	179.67	653.60
4	193.71	648.33
5	207.85	643.33
6	222.09	638.60
7	236.41	634.14
8	250.81	629.95
9	265.29	626.04
10	279.85	622.40
11	294.47	619.04
12	309.15	615.97
13	323.88	613.17
14	338.67	610.65
15	353.50	608.42
16	368.38	606.47
17	383.28	604.80
18	398.22	603.42
19	413.18	602.32
20	428.16	601.51
21	443.15	600.98
22	458.15	600.74
23	473.15	600.78
24	488.14	601.11
25	503.13	601.73
26	518.10	602.63
27	533.06	603.82
28	547.98	605.29
29	562.88	607.05
30	577.74	609.09
31	592.56	611.41

32	607.33	614.01
33	622.05	616.90
34	636.71	620.07
35	651.31	623.51
36	665.84	627.23
37	680.30	631.23
38	694.68	635.50
39	708.98	640.05
40	723.18	644.87
41	737.29	649.96
42	751.30	655.31
43	765.21	660.93
44	779.01	666.82
45	792.69	672.97
46	806.25	679.38
47	819.69	686.04
48	833.00	692.96
49	846.17	700.13
50	859.21	707.55
51	872.10	715.22
52	884.84	723.14
53	897.43	731.29
54	909.86	739.68
55	922.13	748.31
56	934.24	757.17
57	946.17	766.26
58	957.92	775.58
59	969.50	785.12
60	980.89	794.87
61	992.10	804.85
62	993.13	805.80

Circle Center At X = 463.3 ; Y = 1387.7 and Radius, 787.0

*** 1.512 ***

Individual data on the 71 slices

Slice No.	Width Ft(m)	Weight Lbs(kg)	Water Force Top Lbs(kg)	Water Force Bot Lbs(kg)	Tie Force Norm Lbs(kg)	Tie Force Tan Lbs(kg)	Earthquake Force Hor Lbs(kg)	Earthquake Force Ver Lbs(kg)	Surcharge Load Lbs(kg)
1	.8	15.0	.0	.0	.0	.0	2.0	2.0	.0
2	13.1	5808.3	.0	2580.5	.0	.0	755.1	755.1	.0
3	13.9	17591.2	.0	8235.6	.0	.0	2286.9	2286.9	.0
4	14.0	29037.8	.0	13653.7	.0	.0	3774.9	3774.9	.0
5	14.1	40133.0	.0	18824.1	.0	.0	5217.3	5217.3	.0
6	14.2	50849.9	.0	23744.7	.0	.0	6610.5	6610.5	.0
7	14.3	61163.5	.0	28413.9	.0	.0	7951.3	7951.3	.0
8	14.4	71049.5	.0	32829.8	.0	.0	9236.4	9236.4	.0
9	14.5	80485.0	.0	36990.9	.0	.0	10463.0	10463.0	.0
10	14.6	89448.1	.0	40895.7	.0	.0	11628.3	11628.3	.0
11	14.6	97918.6	.0	44542.9	.0	.0	12729.4	12729.4	.0
12	14.7	105877.1	.0	47931.0	.0	.0	13764.0	13764.0	.0
13	14.7	113305.3	.0	51058.7	.0	.0	14729.7	14729.7	.0

14	14.8	120187.1	.0	53925.2	.0	.0	15624.3	15624.3	.0
15	14.8	126506.7	.0	56529.2	.0	.0	16445.9	16445.9	.0
16	14.9	132250.7	.0	58869.7	.0	.0	17192.6	17192.6	.0
17	14.9	137406.1	.0	60946.1	.0	.0	17862.8	17862.8	.0
18	14.9	141962.0	.0	62757.3	.0	.0	18455.1	18455.1	.0
19	15.0	145909.0	.0	64303.1	.0	.0	18968.2	18968.2	.0
20	15.0	149238.3	.0	65582.4	.0	.0	19401.0	19401.0	.0
21	15.0	151944.0	.0	66595.3	.0	.0	19752.7	19752.7	.0
22	15.0	154020.2	.0	67341.0	.0	.0	20022.6	20022.6	.0
23	15.0	155463.1	.0	67819.4	.0	.0	20210.2	20210.2	.0
24	15.0	156270.7	.0	68030.2	.0	.0	20315.2	20315.2	.0
25	11.9	123765.0	.0	53790.4	.0	.0	16089.5	16089.5	.0
26	2.0	20933.0	.0	9061.7	.0	.0	2721.3	2721.3	.0
27	1.1	11873.9	.0	5121.4	.0	.0	1543.6	1543.6	.0
28	15.0	158293.9	.0	67649.2	.0	.0	20578.2	20578.2	.0
29	15.0	159713.5	.0	67057.5	.0	.0	20762.8	20762.8	.0
30	14.9	160490.2	.0	66198.7	.0	.0	20863.7	20863.7	.0
31	14.9	160625.5	.0	65072.8	.0	.0	20881.3	20881.3	.0
32	14.9	160122.2	.0	63680.4	.0	.0	20815.9	20815.9	.0
33	14.8	158985.5	.0	62022.1	.0	.0	20668.1	20668.1	.0
34	14.8	157221.2	.0	60098.4	.0	.0	20438.8	20438.8	.0
35	14.7	154836.6	.0	57910.2	.0	.0	20128.8	20128.8	.0
36	14.7	151840.4	.0	55457.8	.0	.0	19739.3	19739.3	.0
37	14.6	148243.5	.0	52742.6	.0	.0	19271.7	19271.7	.0
38	14.5	144057.3	.0	49765.2	.0	.0	18727.4	18727.4	.0
39	14.5	139295.2	.0	46526.8	.0	.0	18108.4	18108.4	.0
40	9.7	90891.3	.0	29419.8	.0	.0	11815.9	11815.9	.0
41	4.7	42876.0	.0	13609.1	.0	.0	5573.9	5573.9	.0
42	14.3	124939.5	.0	39272.3	.0	.0	16242.1	16242.1	.0
43	1.0	8603.8	.0	2682.5	.0	.0	1118.5	1118.5	.0
44	13.2	107916.1	.0	32576.0	.0	.0	14029.1	14029.1	.0
45	14.1	109915.0	.0	30989.3	.0	.0	14288.9	14288.9	.0
46	14.0	102827.3	.0	26465.8	.0	.0	13367.5	13367.5	.0
47	13.9	95267.2	.0	21689.9	.0	.0	12384.7	12384.7	.0
48	13.8	87256.8	.0	16663.2	.0	.0	11343.4	11343.4	.0
49	13.7	78819.4	.0	11387.7	.0	.0	10246.5	10246.5	.0
50	13.6	69979.4	.0	5865.1	.0	.0	9097.3	9097.3	.0
51	6.9	32488.8	.0	785.8	.0	.0	4223.5	4223.5	.0
52	6.5	28520.3	.0	.0	.0	.0	3707.6	3707.6	.0
53	5.6	23401.5	.0	.0	.0	.0	3042.2	3042.2	.0
54	7.7	30838.0	.0	.0	.0	.0	4008.9	4008.9	.0
55	13.2	51734.4	.0	.0	.0	.0	6725.5	6725.5	.0
56	13.0	49573.0	.0	.0	.0	.0	6444.5	6444.5	.0
57	.8	2961.3	.0	.0	.0	.0	385.0	385.0	.0
58	12.1	42823.5	.0	.0	.0	.0	5567.1	5567.1	.0
59	7.9	25462.4	.0	.0	.0	.0	3310.1	3310.1	.0
60	4.8	14743.6	.0	.0	.0	.0	1916.7	1916.7	.0
61	12.6	36045.6	.0	.0	.0	.0	4685.9	4685.9	.0
62	12.4	32190.2	.0	.0	.0	.0	4184.7	4184.7	.0
63	12.3	28264.3	.0	.0	.0	.0	3674.4	3674.4	.0
64	12.1	24279.2	.0	.0	.0	.0	3156.3	3156.3	.0
65	11.9	20246.0	.0	.0	.0	.0	2632.0	2632.0	.0
66	11.8	16176.3	.0	.0	.0	.0	2102.9	2102.9	.0
67	11.6	12081.7	.0	.0	.0	.0	1570.6	1570.6	.0
68	11.4	7974.1	.0	.0	.0	.0	1036.6	1036.6	.0
69	9.5	3535.2	.0	.0	.0	.0	459.6	459.6	.0
70	1.7	261.9	.0	.0	.0	.0	34.0	34.0	.0
71	1.0	43.7	.0	.0	.0	.0	5.7	5.7	.0

Failure Surface Specified By 58 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	212.66	667.57
2	226.36	661.48
3	240.20	655.68
4	254.15	650.18
5	268.22	644.97
6	282.40	640.07
7	296.67	635.47
8	311.05	631.18
9	325.51	627.20
10	340.05	623.52
11	354.67	620.16
12	369.36	617.11
13	384.11	614.38
14	398.91	611.96
15	413.76	609.86
16	428.66	608.08
17	443.58	606.61
18	458.54	605.47
19	473.52	604.64
20	488.51	604.14
21	503.51	603.96
22	518.51	604.09
23	533.50	604.55
24	548.48	605.33
25	563.44	606.43
26	578.37	607.85
27	593.27	609.58
28	608.13	611.64
29	622.94	614.01
30	637.70	616.70
31	652.40	619.70
32	667.02	623.02
33	681.58	626.64
34	696.05	630.58
35	710.44	634.83
36	724.73	639.38
37	738.92	644.24
38	753.01	649.40
39	766.98	654.86
40	780.83	660.62
41	794.55	666.67
42	808.14	673.02
43	821.60	679.65
44	834.91	686.57
45	848.06	693.77
46	861.07	701.26
47	873.90	709.01
48	886.57	717.05
49	899.07	725.35
50	911.38	733.91
51	923.51	742.74
52	935.44	751.82
53	947.18	761.16
54	958.72	770.74
55	970.05	780.58

56	981.17	790.65
57	992.07	800.95
58	997.81	806.62

Circle Center At X = 504.6 ; Y = 1305.5 and Radius, 701.5

*** 1.514 ***

Failure Surface Specified By 64 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	111.39	664.57
2	125.48	659.41
3	139.64	654.49
4	153.89	649.79
5	168.22	645.34
6	182.61	641.12
7	197.07	637.14
8	211.60	633.41
9	226.19	629.91
10	240.83	626.65
11	255.52	623.64
12	270.27	620.87
13	285.05	618.35
14	299.88	616.07
15	314.74	614.04
16	329.63	612.25
17	344.55	610.72
18	359.50	609.42
19	374.46	608.38
20	389.44	607.58
21	404.43	607.04
22	419.43	606.74
23	434.43	606.68
24	449.43	606.88
25	464.42	607.33
26	479.40	608.02
27	494.37	608.96
28	509.33	610.15
29	524.26	611.59
30	539.16	613.28
31	554.04	615.21
32	568.88	617.38
33	583.68	619.81
34	598.44	622.47
35	613.16	625.38
36	627.82	628.54
37	642.43	631.94
38	656.99	635.58
39	671.48	639.45
40	685.90	643.57
41	700.25	647.93

42	714.53	652.52
43	728.73	657.35
44	742.85	662.42
45	756.88	667.72
46	770.83	673.25
47	784.68	679.01
48	798.43	684.99
49	812.08	691.21
50	825.63	697.65
51	839.07	704.31
52	852.39	711.20
53	865.61	718.30
54	878.70	725.63
55	891.66	733.17
56	904.51	740.92
57	917.22	748.88
58	929.79	757.06
59	942.23	765.44
60	954.53	774.02
61	966.69	782.81
62	978.70	791.80
63	990.56	800.99
64	997.52	806.57

Circle Center At X = 430.0 ; Y = 1512.2 and Radius, 905.5

*** 1.521 ***

Failure Surface Specified By 58 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	182.28	666.26
2	196.23	660.76
3	210.29	655.53
4	224.45	650.58
5	238.71	645.91
6	253.05	641.52
7	267.47	637.40
8	281.98	633.57
9	296.55	630.03
10	311.19	626.77
11	325.90	623.80
12	340.65	621.12
13	355.46	618.72
14	370.31	616.62
15	385.20	614.80
16	400.13	613.28
17	415.08	612.05
18	430.05	611.11
19	445.03	610.47
20	460.03	610.12
21	475.03	610.06
22	490.03	610.30

23	505.02	610.82
24	519.99	611.65
25	534.95	612.76
26	549.89	614.17
27	564.79	615.87
28	579.66	617.86
29	594.48	620.14
30	609.26	622.71
31	623.99	625.57
32	638.65	628.71
33	653.26	632.15
34	667.79	635.86
35	682.24	639.86
36	696.62	644.15
37	710.91	648.71
38	725.11	653.55
39	739.21	658.67
40	753.20	664.06
41	767.09	669.73
42	780.87	675.67
43	794.52	681.87
44	808.05	688.34
45	821.46	695.08
46	834.73	702.07
47	847.86	709.33
48	860.84	716.83
49	873.68	724.60
50	886.36	732.61
51	898.88	740.86
52	911.24	749.36
53	923.43	758.11
54	935.45	767.08
55	947.29	776.29
56	958.94	785.73
57	970.41	795.40
58	979.56	803.42

Circle Center At X = 470.5 ; Y = 1376.9 and Radius, 766.8

*** 1.522 ***

Failure Surface Specified By 60 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	172.15	665.82
2	186.32	660.90
3	200.57	656.23
4	214.91	651.80
5	229.32	647.63
6	243.80	643.71
7	258.34	640.05
8	272.95	636.64

9	287.61	633.49
10	302.33	630.60
11	317.10	627.96
12	331.91	625.59
13	346.76	623.47
14	361.65	621.62
15	376.56	620.03
16	391.50	618.69
17	406.46	617.62
18	421.44	616.82
19	436.43	616.27
20	451.43	615.99
21	466.43	615.97
22	481.43	616.22
23	496.42	616.73
24	511.40	617.50
25	526.36	618.53
26	541.31	619.83
27	556.23	621.38
28	571.12	623.20
29	585.97	625.28
30	600.79	627.62
31	615.56	630.22
32	630.28	633.08
33	644.96	636.20
34	659.57	639.57
35	674.13	643.20
36	688.62	647.08
37	703.04	651.22
38	717.38	655.61
39	731.64	660.24
40	745.82	665.13
41	759.92	670.27
42	773.92	675.65
43	787.82	681.28
44	801.63	687.15
45	815.32	693.26
46	828.91	699.62
47	842.39	706.20
48	855.75	713.03
49	868.98	720.09
50	882.09	727.37
51	895.07	734.89
52	907.92	742.63
53	920.63	750.60
54	933.20	758.79
55	945.62	767.20
56	957.89	775.82
57	970.01	784.66
58	981.97	793.71
59	993.77	802.97
60	998.38	806.72

Circle Center At X = 459.9 ; Y = 1471.2 and Radius, 855.2

*** 1.528 ***

Failure Surface Specified By 54 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	232.91	668.45
2	246.56	662.22
3	260.34	656.31
4	274.27	650.73
5	288.32	645.49
6	302.49	640.58
7	316.78	636.01
8	331.17	631.77
9	345.66	627.89
10	360.24	624.35
11	374.89	621.15
12	389.62	618.31
13	404.41	615.81
14	419.26	613.67
15	434.15	611.88
16	449.08	610.45
17	464.04	609.37
18	479.02	608.65
19	494.02	608.28
20	509.02	608.28
21	524.02	608.62
22	539.00	609.33
23	553.96	610.39
24	568.90	611.80
25	583.79	613.57
26	598.64	615.69
27	613.43	618.17
28	628.17	621.00
29	642.82	624.17
30	657.41	627.70
31	671.90	631.57
32	686.29	635.78
33	700.59	640.33
34	714.77	645.23
35	728.82	650.45
36	742.76	656.01
37	756.55	661.91
38	770.20	668.12
39	783.70	674.66
40	797.04	681.52
41	810.22	688.69
42	823.21	696.18
43	836.03	703.97
44	848.66	712.06
45	861.09	720.46
46	873.32	729.14
47	885.34	738.12
48	897.15	747.37
49	908.73	756.91
50	920.07	766.71
51	931.19	776.79
52	942.06	787.13
53	952.68	797.72

54 953.83 798.92

Circle Center At X = 501.9 ; Y = 1239.1 and Radius, 630.9

*** 1.529 ***

Failure Surface Specified By 60 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	162.03	665.38
2	176.18	660.41
3	190.41	655.69
4	204.73	651.21
5	219.13	647.00
6	233.59	643.03
7	248.13	639.33
8	262.73	635.88
9	277.38	632.68
10	292.09	629.75
11	306.85	627.08
12	321.66	624.67
13	336.50	622.52
14	351.38	620.64
15	366.30	619.02
16	381.24	617.66
17	396.20	616.56
18	411.17	615.73
19	426.16	615.17
20	441.16	614.87
21	456.16	614.83
22	471.16	615.06
23	486.15	615.55
24	501.13	616.31
25	516.09	617.34
26	531.04	618.63
27	545.96	620.18
28	560.85	621.99
29	575.70	624.07
30	590.52	626.41
31	605.29	629.01
32	620.02	631.87
33	634.69	635.00
34	649.30	638.38
35	663.85	642.01
36	678.34	645.91
37	692.75	650.06
38	707.09	654.46
39	721.35	659.12
40	735.53	664.03
41	749.61	669.19
42	763.60	674.59
43	777.50	680.24

44	791.29	686.14
45	804.98	692.28
46	818.55	698.66
47	832.01	705.28
48	845.36	712.13
49	858.57	719.22
50	871.66	726.55
51	884.62	734.10
52	897.45	741.88
53	910.13	749.89
54	922.67	758.12
55	935.07	766.57
56	947.31	775.23
57	959.40	784.11
58	971.33	793.21
59	983.09	802.51
60	985.47	804.46

Circle Center At X = 450.7 ; Y = 1463.7 and Radius, 848.9

*** 1.530 ***

Failure Surface Specified By 54 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	232.91	668.45
2	246.97	663.21
3	261.13	658.26
4	275.39	653.61
5	289.74	649.26
6	304.19	645.21
7	318.71	641.46
8	333.31	638.02
9	347.98	634.88
10	362.71	632.05
11	377.49	629.53
12	392.33	627.32
13	407.21	625.41
14	422.13	623.82
15	437.07	622.54
16	452.04	621.58
17	467.02	620.92
18	482.02	620.58
19	497.02	620.56
20	512.02	620.84
21	527.01	621.44
22	541.98	622.35
23	556.93	623.58
24	571.85	625.12
25	586.74	626.96
26	601.58	629.12
27	616.37	631.59
28	631.12	634.37

29	645.79	637.45
30	660.41	640.84
31	674.94	644.54
32	689.40	648.54
33	703.77	652.84
34	718.05	657.43
35	732.23	662.33
36	746.30	667.52
37	760.26	673.00
38	774.11	678.78
39	787.83	684.84
40	801.42	691.19
41	814.87	697.82
42	828.19	704.73
43	841.35	711.91
44	854.37	719.37
45	867.22	727.10
46	879.91	735.10
47	892.43	743.36
48	904.78	751.88
49	916.95	760.66
50	928.92	769.68
51	940.71	778.96
52	952.30	788.48
53	963.69	798.24
54	967.04	801.23

Circle Center At X = 490.8 ; Y = 1338.4 and Radius, 717.9

*** 1.536 ***

Failure Surface Specified By 56 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	202.53	667.14
2	216.74	662.33
3	231.04	657.78
4	245.41	653.51
5	259.87	649.50
6	274.40	645.77
7	288.99	642.31
8	303.65	639.13
9	318.37	636.21
10	333.13	633.58
11	347.95	631.22
12	362.80	629.14
13	377.69	627.34
14	392.62	625.82
15	407.56	624.58
16	422.53	623.62
17	437.52	622.94
18	452.51	622.54

19	467.51	622.42
20	482.51	622.58
21	497.50	623.03
22	512.49	623.75
23	527.45	624.76
24	542.40	626.04
25	557.32	627.61
26	572.20	629.45
27	587.05	631.58
28	601.86	633.98
29	616.62	636.66
30	631.32	639.61
31	645.97	642.84
32	660.56	646.34
33	675.07	650.12
34	689.52	654.16
35	703.88	658.48
36	718.16	663.07
37	732.36	667.92
38	746.46	673.04
39	760.46	678.42
40	774.36	684.06
41	788.15	689.96
42	801.83	696.12
43	815.38	702.54
44	828.82	709.20
45	842.13	716.12
46	855.31	723.29
47	868.35	730.70
48	881.25	738.35
49	894.00	746.25
50	906.61	754.38
51	919.06	762.75
52	931.35	771.35
53	943.47	780.18
54	955.43	789.23
55	967.22	798.51
56	971.51	802.01

Circle Center At X = 466.3 ; Y = 1422.8 and Radius, 800.3

*** 1.544 ***

Failure Surface Specified By 66 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	60.76	666.13
2	74.94	661.23
3	89.19	656.54
4	103.50	652.07
5	117.89	647.82
6	132.34	643.79
7	146.84	639.97

8	161.41	636.38
9	176.02	633.01
10	190.69	629.86
11	205.40	626.93
12	220.15	624.23
13	234.95	621.75
14	249.78	619.49
15	264.64	617.46
16	279.53	615.66
17	294.45	614.08
18	309.39	612.72
19	324.34	611.60
20	339.32	610.70
21	354.30	610.03
22	369.29	609.58
23	384.29	609.37
24	399.29	609.38
25	414.29	609.62
26	429.28	610.08
27	444.27	610.77
28	459.24	611.69
29	474.20	612.84
30	489.13	614.22
31	504.05	615.81
32	518.94	617.64
33	533.79	619.69
34	548.62	621.97
35	563.41	624.47
36	578.16	627.19
37	592.87	630.14
38	607.53	633.31
39	622.14	636.71
40	636.70	640.32
41	651.20	644.16
42	665.64	648.21
43	680.02	652.48
44	694.33	656.97
45	708.58	661.68
46	722.75	666.60
47	736.84	671.74
48	750.85	677.09
49	764.78	682.65
50	778.63	688.42
51	792.38	694.40
52	806.05	700.59
53	819.62	706.98
54	833.09	713.58
55	846.45	720.39
56	859.72	727.39
57	872.87	734.60
58	885.92	742.00
59	898.85	749.61
60	911.66	757.40
61	924.36	765.39
62	936.93	773.58
63	949.38	781.95
64	961.70	790.51
65	973.88	799.25
66	979.50	803.41

Circle Center At X = 391.1 ; Y = 1598.4 and Radius, 989.1

*** 1.549 ***

S&ME

JOB NO. 1356-97-394
SHEET NO. 1/1
DATE 2/17/98

JOB NAME Lake Norman Landfill
COMPUTED BY SRN
SUBJECT Soil Balance
CHECKED BY MDP

OBJECTIVE: Determine if there is sufficient amount of borrow material to be used for cover material.

REFERENCE: 1.) Softdesk computer application.
2.) Air Space / Site Life Calculation, S&ME, 2/98.

CALCULATION:

Net Amount of Cut:	980,025 CY	[Ref #1]
- Weekly Cover Material Necessary:	137,445 CY	[Ref #2]
- Final Cover Material Necessary:	100,995 CY	[Ref #2]
	741,585 CY	Extra Cut

CONCLUSION:

There will be an adequate amount of material to provide the necessary cover for landfill operations.

[Ref #1]

Site Volume Table: Unadjusted

Cut yards	Fill yards	Net yards	Method
Site: cfvol			
Stratum: cfvol r-eg cgsb			
984548.52	5039.61	979508.91	(C) Grid
989828.66	9286.75	980541.91	(C) End area
	Average 7163.18	980,025.41	

APPENDIX VII
DRAWINGS

APPENDIX VIII
EROSION AND SEDIMENTATION CONTROL PLAN

EROSION & SEDIMENTATION CONTROL PLAN
CONSTRUCTION AND DEMOLITION LANDFILL
LAKE NORMAN LANDFILL, INC.
LINCOLN COUNTY, NORTH CAROLINA
S&ME PROJECT NO. 1356-97-394

Prepared For:

North Carolina Department of Environment,
and Natural Resources
Land Quality Section

Prepared By:

S&ME, Inc.
Charlotte, North Carolina

February 20, 1998

S&ME

February 20, 1998

North Carolina Department of Environment, and Natural Resources
Land Quality Section
919 N. Main Street
Mooresville, North Carolina 28115

Attention: Mr. Steve Allred

Reference: **Erosion and Sedimentation Control Plan**
Construction and Demolition Landfill
Lake Norman Landfill, Inc.
Lincoln County, North Carolina
S&ME Project No. 1356-97-394

Dear Mr. Allred:

On behalf of Lake Norman Landfill, Inc., S&ME, Inc. presents this Erosion and Sedimentation Control Plan for construction and operation of Lake Norman Landfill's proposed Construction and Demolition (C&D) Landfill. This plan consists of engineering drawings, calculations, and a narrative that describes the construction, operation and maintenance of stormwater control measures for this project. Also included in this submittal is the financial responsibility/ownership form. Approximately 35 acres will be disturbed during this phase of the project. Attached is the required application fee of $710.00.

S&ME, Inc. 9751 Southern Pine Boulevard, Charlotte, North Carolina 28273, (704) 523-4726, Fax (704) 525-3953
Mailing address: P.O. Box 7668, Charlotte, North Carolina 28241-7668

Recycled Paper

If you have any questions or require additional information, please contact us.

Respectfully submitted,

S&ME, INC.

Scott R. Nordgren, E.I.T.
Staff Professional

Christopher J.L. Stahl, P.E.
Project Manager
N.C. Registration No. 023224

NORTH CAROLINA PROFESSIONAL SEAL 023224 ENGINEER CHRISTOPHER J. L. STAHL

Jack J. Amar, P.E.
Branch Manager/Senior Vice President
N.C. Registration No. 10861

cc: Mr. Chris Barrett, Lake Norman Landfill, Inc. (1)

EROSION & SEDIMENTATION CONTROL PLAN

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1.0 PROJECT INFORMATION

1.1 Site and Project Description

Lake Norman Landfill, Inc. is currently permitting a new Construction and Demolition (C&D) Landfill to be located in the southeastern portion of Lincoln County. The C&D Landfill is located off NC Highway 16 and Quarry Lane in Catawba Springs Township.

The proposed C&D landfill, Phase 1 site encompasses on the order of 31 acres. Approximately 35 acres will be disturbed during the construction of this phase. The site is bordered by Lake Norman Quarry property to the west and southwest, by Forney Creek to the north and by a railroad to the east and southeast. The proposed landfill area consists of clear-cut, wooded lands. Ground surface elevations range from 670 feet along the northern side of the proposed landfill to 750 feet near the railroad. Two small drainage features provide drainage towards Forney Creek. Surface water flow generally follows the topography, draining to the tributaries that eventually drain to Forney Creek.

Lake Norman Landfill, Inc. currently plans to develop the entire proposed C&D landfill, Phase 1 area shown on the Erosion and Sedimentation Control Plan. Earthwork for the proposed C&D landfill will consist of clearing, soil borrow, and placement of structural fill for the proposed new landfill area. Phase 1 will be the initial landfill area and will be graded to the contours shown using borrow soil from excavation as needed.

This erosion and sedimentation control plan is designed to allow construction and operation of the landfill until final closure of the landfill.

1.2 Soils Information

Based on soil samples S&ME obtained during drilling observation wells on-site, the soil is generally classified as silty sand, (SM), with a clay layer, (CL to CH), in the first five feet near the surface. The physical characteristics of these samples can be found in Table 1.

Based on the Soil Survey provided by Lincoln County, the predominant soil type in the area is Cecil Sandy Clay Loam. The other soil type on the site is a Pacolet Sandy Clay Loam along the southern and eastern edges of the property.

2.0 EROSION AND SEDIMENTATION CONTROL MEASURES

Temporary erosion and sedimentation control measures will be required during the construction, operation, and closure of the proposed C&D landfill. These measures are illustrated on the drawings in Appendix I. The various erosion and sedimentation control measures have been designed in accordance with the North Carolina Erosion and Sediment Control Planning and Design Manual, 1988.

2.1 Perimeter Diversion Ditch

A perimeter diversion ditch will be constructed along the outer perimeter of Phase 1 operation to divert run-on and run-off around the active C&D landfill area. Straw with net will be used as a temporary ditch lining to prevent erosion until a grass lining is established.

2.2 Diversion Ditches

Diversion ditches will be constructed along the downgradient perimeters of Phase 1 operation to divert sediment laden runoff to the sedimentation basin. The diversion ditches will be lined with a straw with net temporary liner to prevent erosion until a grass lining is established.

2.3 Permanent Seeding

Completed embankments, ditches and graded areas will be stabilized with an erosion resistant grass cover. Landfill operational areas will not be grassed unless the area will not be used for 12 months or more. Seeding will be established in general accordance with the seeding specifications illustrated on the drawings.

3.0 CONSTRUCTION SEQUENCE

1. Obtain plan approval and permits prior to beginning work.

2. Flag the work limits to prevent unnecessary clearing.

3. Hold preconstruction meeting at least one week prior to starting construction.

4. Install silt fencing and construct sedimentation basin as first construction activity. Excavate permanent diversions to ensure runoff from disturbed areas is diverted to the sedimentation basin .

5. Clear Phase 1 and prepare subgrade for structural fill placement by removing vegetation and grubbing roots. If cleared brush and grass are to be burned, Contractor shall be responsible for obtaining required burn permits.

6. Following completion of structural fill placement, stabilize disturbed areas that will not be used for landfilling in accordance with the seeding specifications.

7. All erosion and sediment control structures will be inspected weekly and after each rainfall event during construction. Maintain all erosion control measures according to the attached maintenance plan.

4.0 MAINTENANCE PLAN

The following maintenance plan shall be followed until the site is completely stabilized after construction. During construction the Contractor shall be responsible for inspection and maintenance of all erosion control features.

1. All erosion control measures will be checked for stability and operation following any runoff producing rainfall and at least once every week. Any needed repairs will be made immediately so that all erosion control measures are maintained as designed.

2. The sedimentation basin will be cleaned out when the level of sediment reaches approximately one half of the basin volume.

3. All seeded areas will be fertilized, reseeded as necessary, and mulched according to the seeding specifications in order to maintain a dense vegetative cover.

4. All seeded areas will be refertilized in the second year unless growth is fully adequate. Grassed areas will be mowed at least once per year.

FINANCIAL RESPONSIBILITY/OWNERSHIP FORM
SEDIMENTATION POLLUTION CONTROL ACT

No person may initiate a land-disturbing activity on one or more acres as covered by the Act before this form and an acceptable erosion and sedimentation control plan have been completed and approved by the Land Quality Section, North Carolina Department of Environment and Natural Resources. (Please type or print and, if question is not applicable, place N/A in the blank).

Part A.

1. Project Name Lake Norman Landfill, Inc. C&D Landfill

2. Location of land-disturbing activity: County Lincoln
   City or Township Catawba, and Highway/Street HW 16

3. Approximate date land-disturbing activity will be commenced: July 1, 1998

4. Purpose of development (residential, commercial, industrial, etc.): Industrial

5. Total acreage disturbed or uncovered (including off-site borrow and waste areas): 35 acres

6. Amount of fee enclosed $ 710.00

7. Has an erosion and sedimentation control plan been filed? Yes X No _____ Enclosed _____

8. Person to contact should sediment control issues arise during land-disturbing activity.
   Name Chris Barrett Telephone (704) 588-5891

9. Landowner(s) of Record (Use blank page to list additional owners):

Lake Norman Landfill, Inc.	
Name(s)	
P.O. Box 866	
Current Mailing Address	Current Street Address
Pineville NC 28134	
City State Zip	City State Zip

10. Recorded in Deed Book No. _____ Page No. _____

Part B.

1. Person(s) or firm(s) who are financially responsible for this land-disturbing activity (Use a blank page to list additional persons or firms):

Lake Norman Landfill, Inc.	
Name of Person(s) or Firm(s)	
P.O. Box 866	
Mailing Address	Street Address
Pineville NC 28134	
City State Zip	City State Zip
(704) 588-5891	
Telephone	Telephone

2. (a) If the Financially Responsible Party is not a resident of North Carolina give name and address of a North Carolina Agent:

N / A
Name

Mailing Address

City State Zip

Telephone

Street Address

City State Zip

Telephone

(b) If the Financially Responsible Party is a Partnership or other person engaging in business under an assumed name, attach a copy of the certificate of assumed name. If the Financially Responsible Party is a Corporation give name and street address of the Registered Agent.

N / A
Name of Registered Agent

Mailing Address

City State Zip

Telephone

Street Address

City State Zip

Telephone

The above information is true and correct to the best of my knowledge and belief and was provided by me under oath. (This form must be signed by the financially responsible person if an individual or his attorney-in-fact or if not an individual by an officer, director, partner, or registered agent with authority to execute instruments for the financially responsible person). I agree to provide corrected information should there be any changes in the information provided herein.

CHRIS BARRETT
Type or print name

Signature

PRESIDENT
Title or Authority

Date 2-19-1998

****

I, Mary M. Beare, a Notary Public of the County of Mecklenburg State of North Carolina, hereby certify that Chris Barrett appeared personally before me this day and being duly sworn acknowledged that the above form was executed by him.

Witness my hand and notarial seal, this 19 day of Feb., 1998

Seal

Mary M. Beare
Notary

My commission expires April 4, 2001

SUMMARY OF LABORATORY TEST DATA

Hydrogeological Survey

Lake Norman Landfill
Lincoln County, North Carolina
S&ME Project No. 1356-97-394

Boring No.	Sample Depth (Ft)	Sample Type*	USCS Classification	Natural Moisture Content (%)	% Finer No. 200	Atterberg Limits		Proctor Data		Remolded Conditions				Hydraulic Conductivity k (cm/sec)
						LL	PI	Max. Dry Density (pcf)	Opt. Moisture Content (%)	Specific Gravity	Porosity	Dry Density (pcf)	Moisture Content (%)	
OW-1	18.5 - 20	SS	SM	40.7	45.4					2.76				
OW-2	3.5 - 5	SS	CH	34.3	74.3	77	47			2.62				
OW-3	33.5 - 35	SS	SM	19.7	46.7					2.72				
OW-3	3.5 - 5	SS												
OW-4	28.5 - 30	SS	SM	24.7	33.7	NP	NP			2.73				
OW-5	8.5 - 10	SS	SM	30.4	45.2					2.67				
OW-6	3.5 - 5	SS	CL			39	22							
OW-6	13.5 - 15	SS												
OW-7	25.5 - 28	SS	SM	35.1	39.2					2.74				
OW-7	8.5 - 10	SS	SM	22.8	37.7									
OW-8	23.5 - 25	SS	SM	23.2	37.2					2.69				
OW-9	18.5 - 20	SS	SM	36.3	35.8					2.78				
OW-9	6 - 7.5	SS	SM	27.1	36.9									

K:\Shared...\97394\Sumlab2.xls

** Modified Proctor

* SS = Split Spoon Sample (ASTM D-1586)
UD = Undisturbed Sample (ASTM D-1587)
BAG = Bulk Sample

Job Name: Lake Norman Landfill
Location: Lincoln County, North Carolina
Job Number: 1356-97-394 Page 1 of 1

APPENDIX A
EROSION AND SEDIMENTATION CONTROL
DRAWINGS

APPENDIX B

EROSION AND SEDIMENTATION CONTROL CALCULATIONS

S&ME

JOB NO. 1356-97-394
SHEET NO. 1/4
DATE 2/11/98

JOB NAME Barrett Grading
SUBJECT Diversion Ditch Design

COMPUTED BY SRN
CHECKED BY MDP

OBJECTIVE: Design diversion ditches to drain run-off to the sediment basin.

REFERENCES: 1.) "Erosion and Sediment Control Planning and Design Manual," NCDEHNR, 1988.

2.) "FLEXLIN" computer program, Computer Aided Hydraulics and Hydrology, 1994.

3.) North American Green product manual.

4.) Sediment Basin Design Worksheet, S&ME, 2/98.

GIVEN:

Runoff Coefficient: $c = 0.35$, rough bare packed earth [ref #4]

Rainfall intensity: $i = 6.0$ in/hr [ref #4]

CALCULATIONS

Diversion Ditch - 1

drainage area = 5.74 acres

$$Q = ciA = 0.35(6.0)(5.74) = 12.1 \text{ cfs}$$

Diversion Ditch - 2

drainage area = 14.5 acres

$$Q = ciA = 0.35(6.0)(14.5) = 30.5 \text{ cfs}$$

S&ME

JOB NO. 1356-97-394
SHEET NO. 2/4
DATE 2/11/98

JOB NAME Barrett Grading
SUBJECT Ditch Design

COMPUTED BY SRN
CHECKED BY MJP

Diversion Ditch -3

drainage area = 30.26 acres

$Q = ciA = 0.35(6.0)(30.26) = 61.5$ cfs

Use the above Q values with the "FLEXLIN" computer program. sheet 3 shows the results from "FLEXLIN"

RESULTS

Diversion Ditch Schedule

Ditch	Side Slopes (h:v)	Slope (ft/ft)	Flow Depth (ft)	Design Depth (ft)
1	2:1	0.027	1.02	2.5
2	2:1	0.015	1.61	3
3	3:1	0.013	1.82	3

Note: Diversion Ditches to be lined w/ North American Green SC150 Erosion Control Matting or equivalent

********** FLEXLIN **********
********** Version 2.14 **********
********** COMPUTER-AIDED HYDROLOGY & HYDRAULICS **********

PROJECT: Barrett Grading
User: SRN
Date: 02/11/1998 Wednesday
Time: 14:08:55
Output: BARRETT2.OUT

Q cfs	SIDE SLOPE LEFT h/v	SIDE SLOPE RIGHT h/v	BOTTOM WIDTH ft	BOTTOM SLOPE ft/ft	n dim	CRITICAL NORMAL FLOW DEPTH ft	CRITICAL NORMAL HYD. RADIUS ft	CRITICAL NORMAL FLOW VELOCITY fps	CRITICAL NORMAL SHEAR STRESS psf	PERMISSIBLE VELOCITY fps	PERMISSIBLE SHEAR STRESS psf
Diversion Ditch "A"											
Straw with Net (North American Green SC150 or equivalent):											
12.1	2.00	2.00	.0	.0270	.0250	1.18 1.02	.53 .46	4.36 5.79	N/A 1.72	7.99	1.80
Diversion Ditch "B"											
30.5	2.00	2.00	.0	.0150	.0250	1.71 1.61	.76 .72	5.24 5.86	N/A 1.51	8.62	1.80
Diversion Ditch "C"											
61.5	3.00	3.00	.0	.0130	.0250	1.92 1.82	.91 .87	5.56 6.16	N/A 1.48	8.89	1.80

NORTH AMERICAN GREEN DESIGN DATA FOR SLOPES AND CHANNELS

TABLE 7 Tractive Force Limits and Roughness Coefficients for All North American Green Blankets

Blanket Type	Manning's "n" for Flow Depth			Max. Permissible Shear-lbs./sf (Pascals)	
Unvegetated	0 - .5 ft (0 - .15 m)	.5 - 2 ft. (.15 - .6m)	> 2 ft. (> .6m)	*Short Duration	*Long Duration
S75/S75BN	.055	.028	.021	1.55 (74.4)	1.55 (74.4)
S150/S150BN	.055	.028	.021	1.65 (79.2)	1.65 (79.2)
SC150/SC150BN	.050	.025	.018	1.80 (86.4)	1.80 (86.4)
C125/C125BN	.022	.014	.014	2.25 (108)	2.25 (108)
C350	.040	.025	.020	3.20 (153.6)	2.25 (108)
P300	.034	.024	.020	3.00 (144)	2.00 (96)
Vegetated					
C350 Phase 2**	.044	.044	.044	6.00 (288)	4.50 (216)
P300 Phase 2**	.044	.044	.044	5.50 (264)	4.00 (192)
C350 Phase 3	.049	.049	.049	8.00 (384)	8.00 (384)
P300 Phase 3	.049	.049	.049	8.00 (384)	8.00 (384)

** Short Duration <= 2 hr Peak Flow* ** Long Duration > 2 hr Peak Flow*

*** Phase 2 @ 6 months Veg. Growth*

TABLE 8 "VM" (Fraction of Unprotected Soil Loss) Factors for North American Green Blankets in Slope Applications Based on Slope Length and Gradient (Derived from Field Testing and Lab Research)

Slope Length / Gradient	Material Type S75	S150	SC150	C125	S75BN	S150BN	SC150BN	C125BN	C350	P300
L<= 20' (6 m)										
<= 3:1	.029	.004	.00	.00	.029	.00014	.00009	.00009	.0005	.001
3:1 - 2:1	.11	.06	.048	.029	.11	.039	.029	.018	.015	.029
> 2:1	.23	.13	.10	.082	.23	.086	.063	.05	.043	.082
L> 20' (6 m) < 50' (15.2 m)										
<= 3:1	.11	.062	.051	.036	.11	.010	.005	.003	.018	.036
3:1 - 2:1	.21	.116	.079	.060	.21	.07	.055	.04	.031	.06
> 2:1	.45	.17	.145	.096	.45	.118	.092	.06	.050	.096
L >= 50' (15.2 m)										
<= 3:1	.19	.12	.10	.07	.19	.02	.01	.007	.035	.07
3:1 - 2:1	.30	.18	.11	.09	.30	.10	.08	.07	.047	.09
> 2:1	.66	.22	.19	.11	.66	.15	.12	.07	.057	.11

SEDIMENT BASIN DESIGN WORKSHEET

SB -1

PROJECT: Barrett Grading C&D Landfill
JOB NUMBER: 1356-97-394
COMPLETED BY: SRN CHECKED BY: MJP

DETERMINE BASIN STORAGE REQUIRED

DISTURBED ACREAGE = 35 AC

REQUIRED STORAGE = DISTURBED ACREAGE * 1,800 CF / AC = 63000 CF
(STORAGE IS MEASURED BELOW CREST OF PRINCIPAL SPILLWAY)

DETERMINE BASIN STORAGE PROVIDED

ELEV.	AREA (SF)	AVG. AREA	HEIGHT	VOLUME (CF)	CUM. VOL (CF)
669	0				0
		6412.5	1	6,413	
670	12825				6,413
		14787.5	2	29,575	
672	16750				35,988
		18775	2	37,550	
674	20800				73,538
		10400	0	0	
0	0				
		STORAGE AVAILABLE (CF)		**73,538**	

DETERMINE PEAK DISCHARGE FOR 10-YR STORM USING RATIONAL METHOD; Q=CiA

1. CHOOSE RUNOFF COEFFICIENT FROM TABLE 8.03a OF THE NC EROSION AND SEDIMENTATION CONTROL PLANING AND DESIGN MANUAL

CONDITION: ROUGH BARE PACKED EARTH
C: 0.35

2. DETERMINE TIME OF CONCENTRATION FROM FIGURE 8.03a OF THE NC EROSION AND SEDIMENTATION CONTROL PLANNING AND DESIGN MANUAL

HEIGHT ABOVE OUTLET, H = 175 FT
MAXIMUM LENGTH OF TRAVEL, L = 2000 FT
TIME OF CONCENTRATION, Tc = 6 MIN

3. DETERMINE RAINFALL INTENSITY FROM FIGURES 8.03b THROUGH 8.03g OF THE NC EROSION AND SEDIMENTATION CONTROL PLANNING AND DESIGN MANUAL

CITY: CHARLOTTE
10-YR STORM: 6.0 in/hr

4. DETERMINE PEAK DISCHARGE, Q=CiA

10-YR STORM: 73.5 cfs

SEDIMENT BASIN DESIGN WORKSHEET

PROJECT:	Barrett Grading C&D Landfill		SB -1
JOB NUMBER:	1356-97-394		
COMPLETED BY:	SRN	CHECKED BY:	MJP

DESIGN PRINCIPAL SPILLWAY

1. MINIMUM PRINCIPAL SPILLWAY CAPACITY WILL BE 0.2 CFS/AC OR HALF OF THE PEAK DISCHARGE FOR THE 10-YR STORM (CHOOSE THE LARGER OF THE TWO)

0.2 CFS/AC = 7.0 CFS
1/2 OF 10-YR STORM = 36.8 CFS
Qp min= 36.8 CFS

2. SET HEIGHT OF RISER CREST A MINIMUM OF 1 FT BELOW CREST OF EMERGENCY SPILLWAY

CREST OF EMER. SPILLWAY = 674.7
RISER CREST ELEVATION = 673.4
BOTTOM OF BASIN ELEVATION = 669.0
BARRELL OUTLET ELEVATION = 668.0

3. BARREL LENGTH = 55 FT

4. USING TABLE 8.07a FROM NC EROSION AND SEDIMENTATION CONTROL PLANNING AND DESIGN MANUAL, CHOOSE APPROPRIATE PIPE DIAMETER BASED ON HEAD (FT)

HEAD ABOVE MIDDLE OF BARREL (H) = 5.5 FT
BARREL PIPE DIAMETER = 30 IN
HEAD ABOVE RISER (h) = 1.3 FT
Qp max = 46.9 CFS
Qp (h=1.3)= 42.0 CFS

5. USING FIGURE 8.07b FROM THE NC EROSION AND SEDIMENTATION CONTROL PLANNING AND DESIGN MANUAL, SELECT THE APPROPRIATE RISER PIPE DIAMETER

RISER PIPE DIAMETER = 36 IN

DESIGN EMERGENCY SPILLWAY

1. DETERMINE DISCHARGE THROUGH EMERGENCY SPILLWAY, Qe

Qe = Q10 - Qp (h=1.3) = 31.5 CFS

2. USING TABLE 8.07d FROM NC EROSION AND SEDIMENTATION CONTROL PLANNING AND DESIGN MANUAL, SELECT THE APPROPRIATE EMERGENCY SPILLWAY SECTION

SIDE SLOPES = 3H : 1V
BOTTOM WIDTH = 16 FT
SLOPE OF SPILLWAY = 8 %
Qe = 31.5 CFS
STAGE (SEE SHEET ___)= 0.3 FT
MIN. SPILLWAY DEPTH (1-FT FREEBOARD) = 1.3 FT
TOTAL SPILLWAY DEPTH = 1.3 FT

SEDIMENT BASIN DESIGN WORKSHEET

SB -1

PROJECT: Barrett Grading C&D Landfill
JOB NUMBER: 1356-97-394
COMPLETED BY: SRN CHECKED BY: MDP

DESIGN ANTI-SEEP COLLAR

ANTI-SEEP COLLAR MUST EXTEND A MINIMUM OF 1.5 FT BEYOND BARREL

MINIMUM COLLAR = 45 IN X 45 IN

ANTI-SEEP COLLAR = 4' X 4'

DESIGN ANTI-FLOTATION BLOCK

ANTI-FLOTATION BLOCK MUST EQUAL 1.1 TIMES THE WEIGHT OF WATER DISPLACED BY THE EMPTY RISER

WEIGHT OF WATER = 62.4 PCF
WEIGHT OF CONCRETE = 150.0 PCF
VOLUME OF EMPTY RISER = 40.3 CF
WEIGHT OF DISPLACED WATER = 2512.9 LBS
VOLUME OF CONCRETE REQUIRED = 18.4 CF
ANTI-FLOTATION BLOCK DIMENSIONS = 5 ft x 5 ft x 1 ft

CHECK VOLUME AVAILABLE COMPARED TO VOLUME REQUIRED:

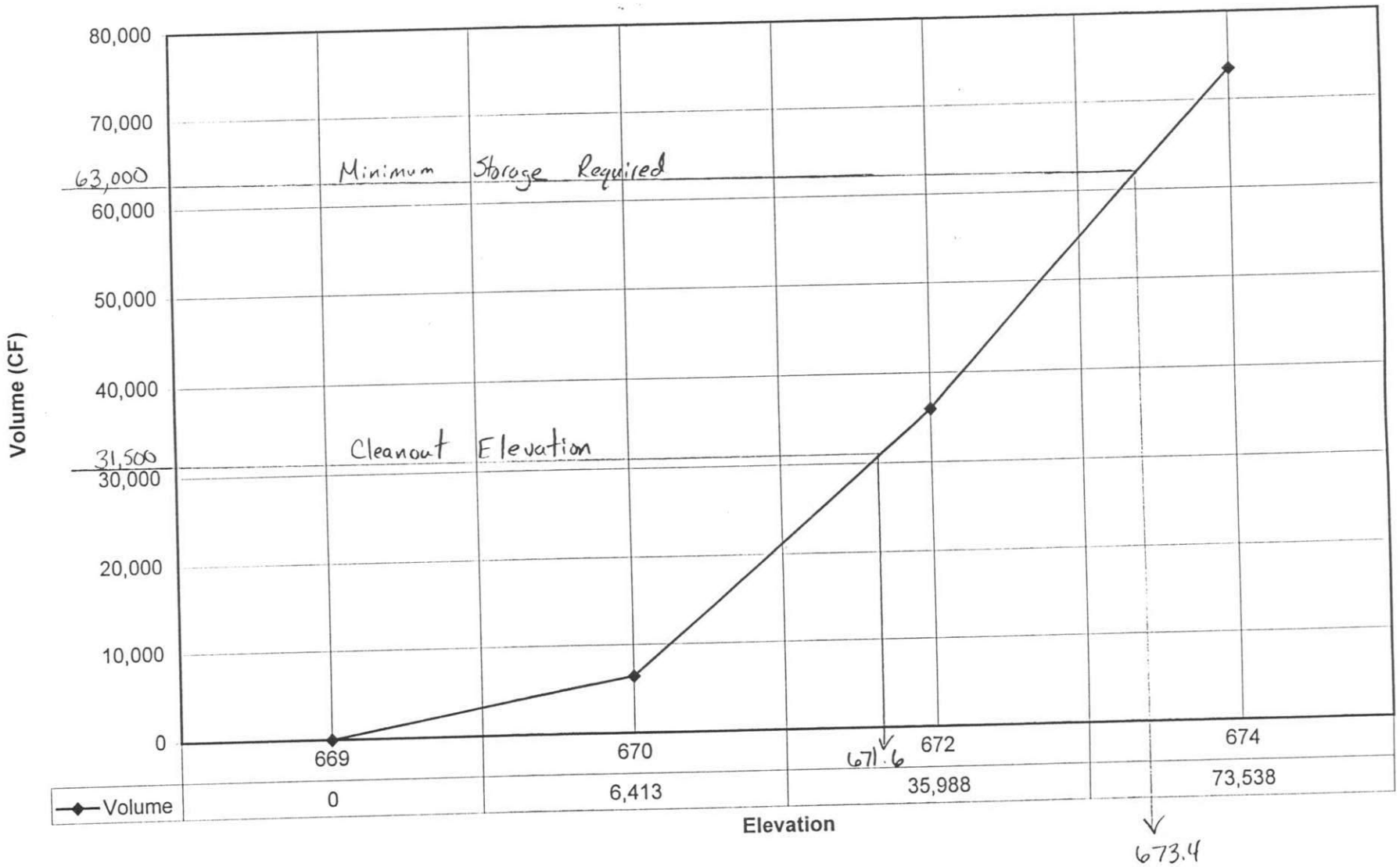
DETERMINE CLEANOUT ELEVATION

SET CLEANOUT ELEVATION CORRESPONDING TO 1/2 OF DESIGN VOLUME

CLEAN OUT VOLUME = 31500 CF
APPROX. CORRESPONDING ELEVATION = 671.6
DEPTH BELOW RISER CREST = 1.8 FT

CHECK BASIN SHAPE AND TRAPPING EFFICIENCY BELOW:

Pond Volume


80,000
70,000
63,000
Minimum Storage Required
60,000
50,000
40,000
31,500
Cleanout Elevation
30,000
20,000
10,000
0
Volume (CF)
669
670
671.6
672
673.4
674
Volume
0
6,413
35,988
73,538
Elevation

Cross Section
Cross Section for Trapezoidal Channel

Project Description	
Project File	g:\apps\haestad\fmw\bar-sed.fm2
Worksheet	Emergency Spillway
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.030	
Channel Slope	0.080000	ft/ft
Depth	0.30	ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	16.00	ft
Discharge	31.50	cfs

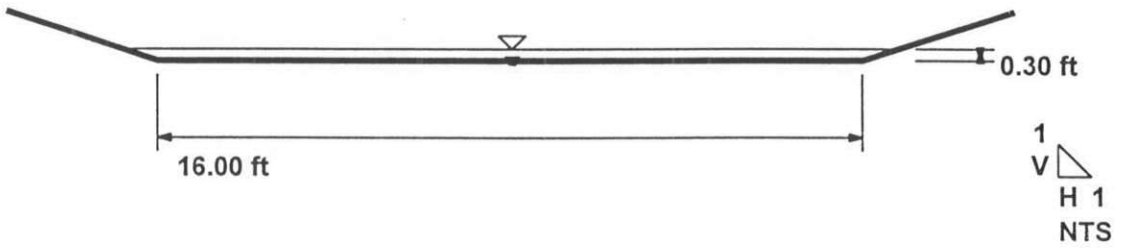


Table 8.03a
Value of Runoff Coefficient (C) for Rational Formula

Land Use	C	Land Use	C
Business:		Lawns:	
Downtown areas	0.70-0.95	Sandy soil, flat, 2%	0.05-0.10
Neighborhood areas	0.50-0.70	Sandy soil, ave., 2-7%	0.10-0.15
		Sandy soil, steep, 7%	0.15-0.20
Residential:		Heavy soil, flat, 2%	0.13-0.17
Single-family areas	0.30-0.50	Heavy soil, ave., 2-7%	0.18-0.22
Multi units, detached	0.40-0.60	Heavy soil, steep, 7%	0.25-0.35
Multi units, attached	0.60-0.75		
Suburban	0.25-0.40	Agricultural land:	
		Bare packed soil	
Industrial:		Smooth	0.30-0.60
Light areas	0.50-0.80	Rough	0.20-0.50
Heavy areas	0.60-0.90	Cultivated rows	
		Heavy soil no crop	0.30-0.60
Parks, cemeteries	0.10-0.25	Heavy soil with crop	0.20-0.50
		Sandy soil no crop	0.20-0.40
Playgrounds	0.20-0.35	Sandy soil with crop	0.10-0.25
		Pasture	
Railroad yard areas	0.20-0.40	Heavy soil	0.15-0.45
		Sandy soil	0.05-0.25
Unimproved areas	0.10-0.30	Woodlands	0.05-0.25
Streets:			
Asphalt	0.70-0.95		
Concrete	0.80-0.95		
Brick	0.70-0.85		
Drives and walks	0.75-0.85		
Roofs	0.75-0.85		

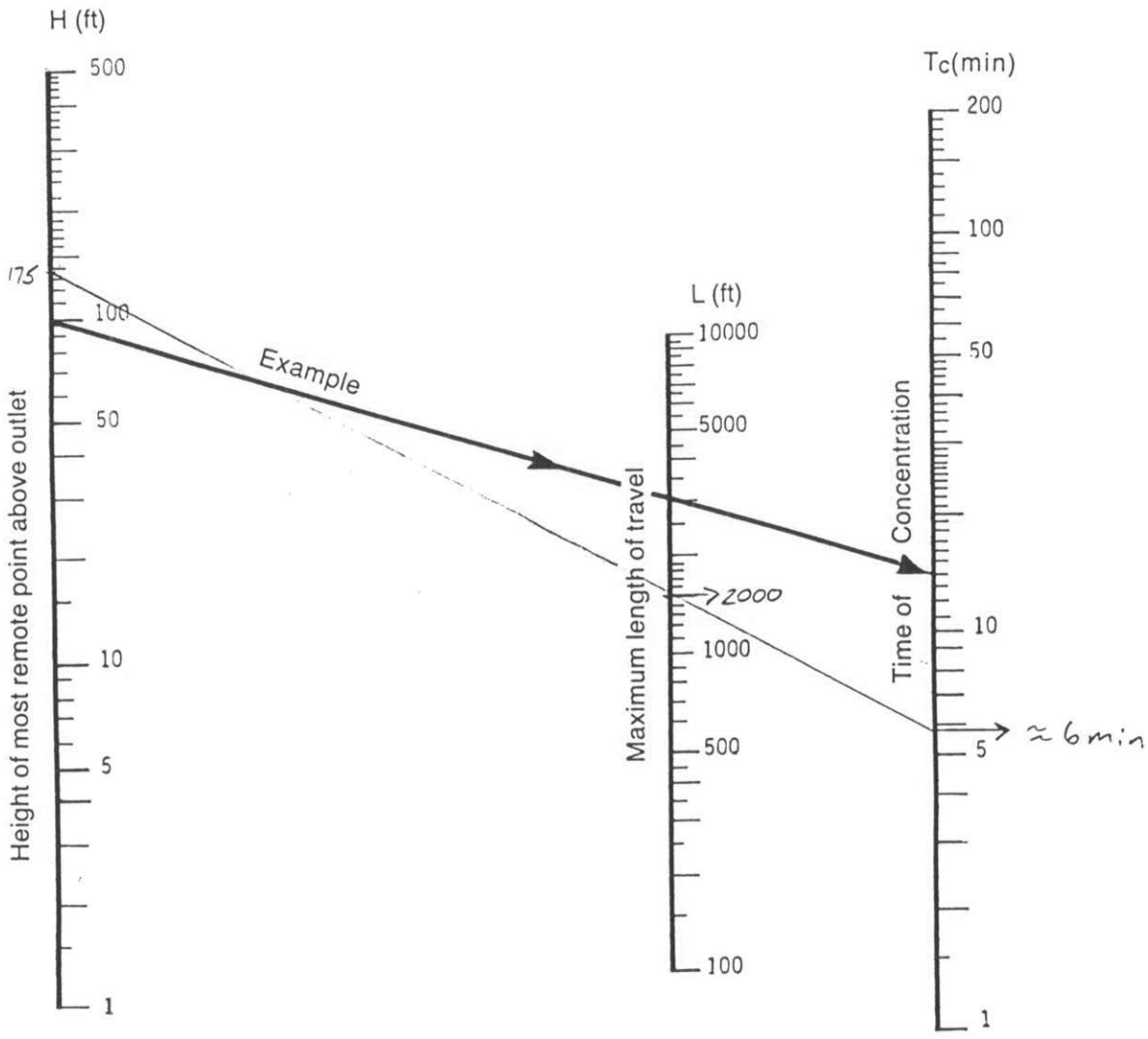
NOTE: The designer must use judgment to select the appropriate C value within the range for the appropriate land use. Generally, larger areas with permeable soils, flat slopes, and dense vegetation should have lowest C values. Smaller areas with slowly permeable soils, steep slopes, and sparse vegetation should be assigned highest C values.

Source: American Society of Civil Engineers

The overland flow portion of flow time may be determined from Figure 8.03a. The flow time (in minutes) in the channel can be estimated by calculating the average velocity in feet per minute and dividing the length (in feet) by the average velocity.

Step 4. Determine the rainfall intensity, frequency, and duration (Figures 8.03b through 8.03g—source: North Carolina State Highway Commission; Jan. 1973). Select the chart for the locality closest to your location. Enter the "duration" axis of the chart with the calculated time of concentration, T_C. Move vertically until you intersect the curve of the appropriate design storm, then move horizontally to read the rainfall intensity factor, i, in inches per hour.

Step 5. Determine peak discharge, Q (ft^3/sec), by multiplying the previously determined factors using the rational formula (Sample Problem 8.03a).



Note:
Use nomograph Tc for natural basins with well-defined channels, for overland flow on bare earth, and for mowed-grass roadside channels.

For overland flow, grassed surfaces, multiply Tc by 2.

For overland flow, concrete or asphalt surfaces, multiply Tc by 0.4.

For concrete channels, multiply Tc by 0.2.

Figure 8.03a Time of concentration of small drainage basins.

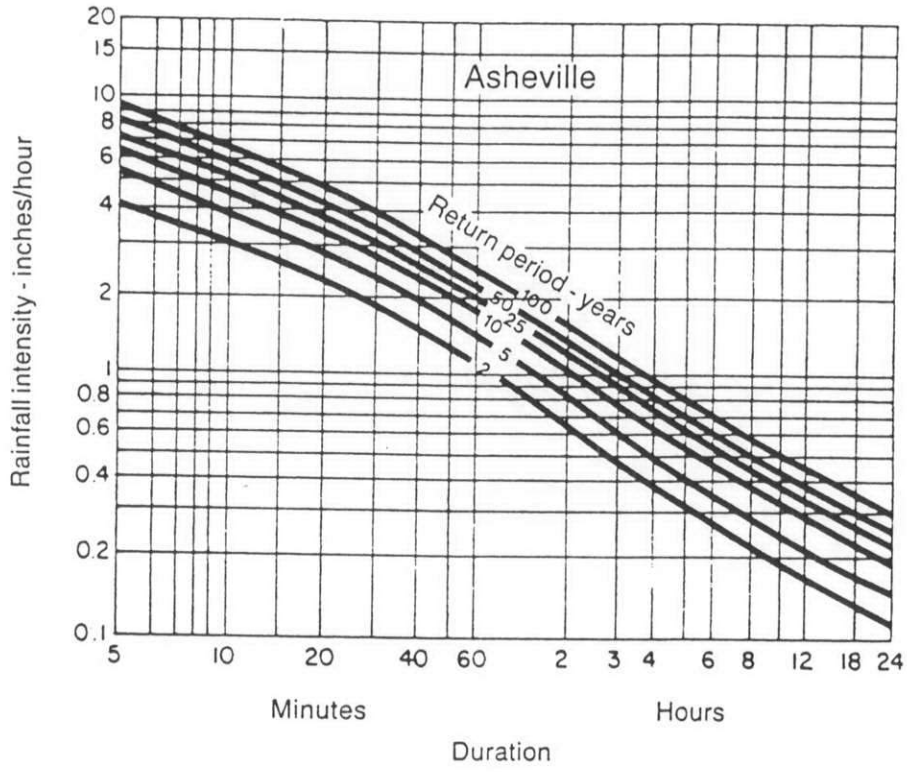


Figure 8.03f Rainfall intensity duration curves—Asheville.

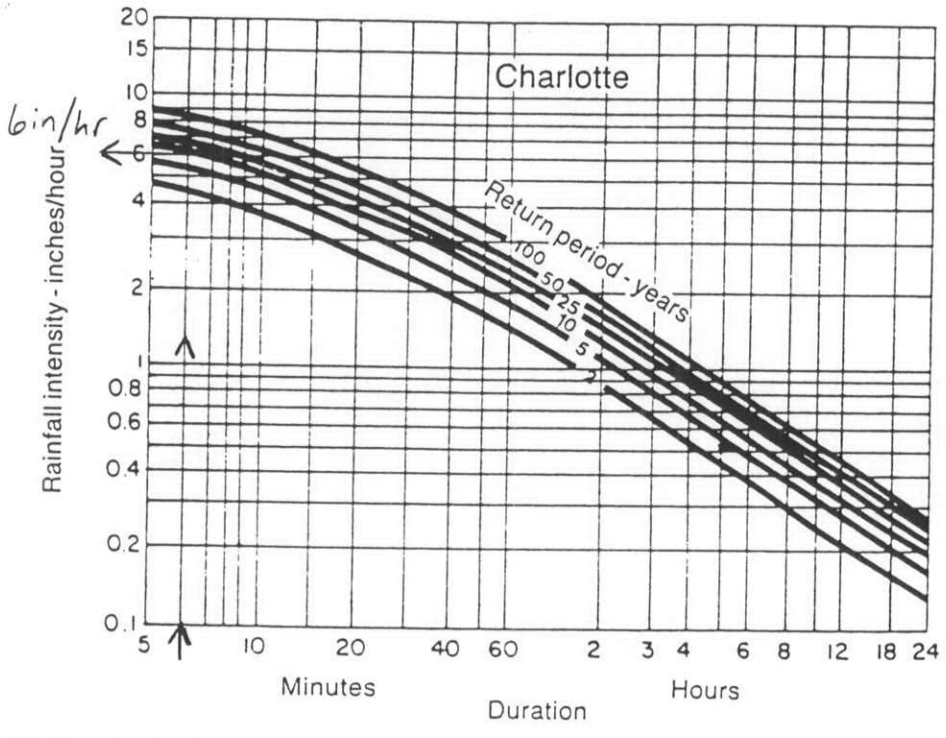


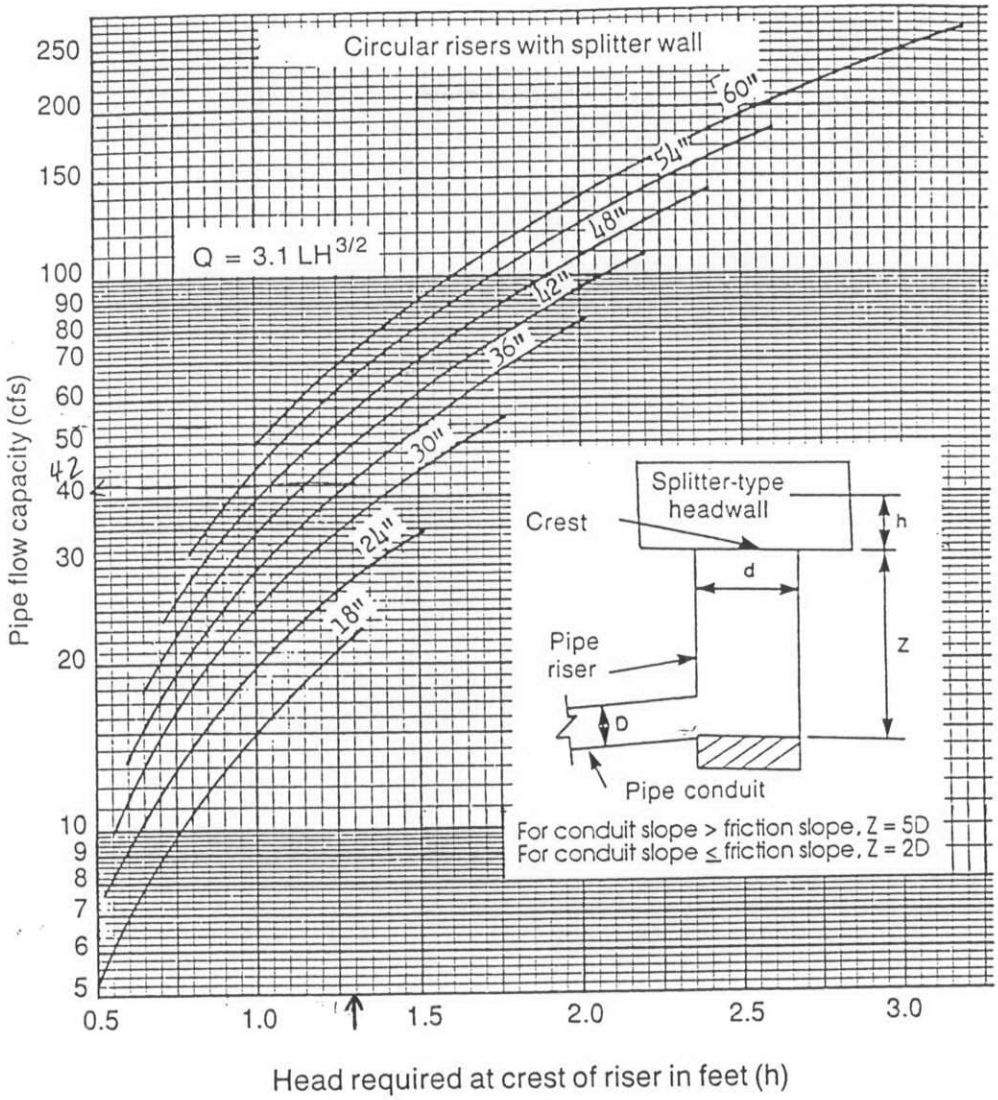
Figure 8.03g Rainfall intensity duration curves—Charlotte.

Table 8.07a
Pipe Flow Chart for Design of Corrugated Metal Outlet Conduit
(Q in cubic ft/sec)

For Corrugated Metal Pipe Inlet $K_e + K_b = 1.0$ and 70 feet of Corrugated Metal Pipe Conduit n = 0.025. Note correction factors for other pipe lengths.

Dia. / H	12"	15"	18"	21"	24"	30"	36"	42"
2	2.84	4.92	7.73	11.30	15.60	26.60	40.77	58.12
3	3.48	6.03	9.47	13.84	19.10	32.58	49.93	71.19
4	4.02	6.96	10.94	15.98	22.06	37.62	57.66	82.20
5	4.49	7.78	12.23	17.87	24.66	42.06	64.46	91.90
6	4.92	8.52	13.40	19.57	27.01	46.07	70.60	100.65
7	5.32	9.21	14.47	21.14	29.19	49.77	76.28	108.75
8	5.68	9.84	15.47	22.60	31.19	53.19	81.53	116.23
9	6.03	10.44	16.41	23.97	33.09	56.43	86.49	123.30
10	6.36	11.00	17.30	25.26	34.88	59.48	91.16	129.96
11	6.67	11.54	18.14	26.50	36.59	62.39	95.63	136.33
12	6.96	12.05	18.95	27.68	38.21	65.16	99.87	142.37
13	7.25	12.55	19.72	28.81	39.77	67.83	103.96	148.21
14	7.52	13.02	20.47	29.90	41.27	70.39	107.88	153.80
15	7.78	13.48	21.19	30.95	42.72	72.85	111.66	159.18
16	8.04	13.92	21.88	31.96	44.12	75.24	115.32	164.40
17	8.29	14.35	22.55	32.94	45.48	77.55	118.87	169.46
18	8.53	14.77	23.21	33.90	46.80	79.81	122.33	174.39
19	8.76	15.17	23.84	34.83	48.08	81.99	125.67	179.15
20	8.99	15.56	24.46	35.73	49.33	84.12	128.93	183.80
21	9.21	15.95	25.07	36.62	50.55	86.21	132.13	188.36
22	9.43	16.32	25.65	37.47	51.73	88.22	135.21	192.76
23	9.64	16.69	26.23	38.32	52.90	90.21	138.27	197.12
24	9.85	17.05	26.80	39.14	54.04	92.15	141.24	201.35
25	10.05	17.40	27.35	39.95	55.15	94.05	144.15	205.50
L	Correction Factors For Other Pipe Lengths							
40	1.23	1.22	1.20	1.19	1.16	1.14	1.13	1.11
50	1.14	1.13	1.12	1.11	1.10	1.09	1.08	1.07
60	1.07	1.06	1.06	1.05	1.05	1.04	1.04	1.03
70	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
80	0.95	0.95	0.95	0.96	0.96	0.96	0.97	0.97
90	0.90	0.91	0.91	0.92	0.92	0.93	0.94	0.94
100	0.86	0.87	0.88	0.89	0.89	0.90	0.91	0.92

H=5.5 L=55 Q=46.9



Inlet Proportions	
Pipe Conduit (D) - in	Pipe Riser (d) - in
8-12	18
15	21
18	24
21	30
24	30
30	36
36	48
42	54
48	60

Pipe drop inlet spillway design:

For a given Q and H, refer to Table 8.07a or 8.07b for conduit size. Then determine the riser diameter (d) from the Inlet Proportions Table on this figure. Next, refer to the above curves, using the conduit capacity and riser diameter, and find the head (h) required above the crest of the riser. The height of the riser should not be less than 5D - h, except as noted in the above sketch.

Example - Given: CMP; Q = 20 cfs; H = 14 ft, h max. 1.0 ft; L = 70 ft. From Table 8.07a find conduit size (D) = 18 inches. From Inlet Proportions Table, riser size = 24 inches. Head (h) required for Q = 20 and d = 24 is 1.0 ft.

Figure 8.07b Design chart for riser outlet.

Table 8.07c
Design Table for Vegetated Spillways Excavated in Erosion Resistant Soils
(side slopes–3 horizontal:1 vertical)

Discharge Q CFS	Slope Range Minimum Percent	Slope Range Maximum Percent	Bottom Width Feet	Stage Feet
15	3.3	12.2	8	.83
	3.5	18.2	12	.69
20	3.1	8.9	8	.97
	3.2	13.0	12	.81
	3.3	17.3	16	.70
25	2.9	7.1	8	1.09
	3.2	9.9	12	.91
	3.3	13.2	16	.79
	3.3	17.2	20	.70
30	2.9	6.0	8	1.20
	3.0	8.2	12	1.01
	3.0	10.7	16	.88
	3.3	13.8	20	.78
35	2.8	5.1	8	1.30
	2.9	6.9	12	1.10
	3.1	9.0	16	.94
	3.1	11.3	20	.85
	3.2	14.1	24	.77
40	2.7	4.5	8	1.40
	2.9	6.0	12	1.18
	2.9	7.6	16	1.03
	3.1	9.7	20	.91
	3.1	11.9	24	.83
45	2.8	4.1	8	1.49
	2.8	5.3	12	1.25
	2.9	6.7	16	1.09
	3.0	8.4	20	.98
	3.0	10.4	24	.89
50	2.7	3.7	8	1.57
	2.8	4.7	12	1.33
	2.8	6.0	16	1.16
	2.9	7.3	20	1.03
	3.1	9.0	24	.94
60	2.8	3.1	8	1.73
	2.7	3.9	12	1.47
	2.7	4.8	16	1.28
	2.9	5.9	20	1.15
	2.9	7.3	24	1.05
	3.0	8.8	28	.97
70	2.5	2.8	8	1.88
	2.8	3.3	12	1.60
	2.8	4.1	16	1.40
	2.7	5.0	20	1.28
	2.8	6.1	24	1.15
	2.9	7.0	28	1.05
80	2.5	2.9	12	1.72
	2.8	3.8	16	1.51
	2.7	4.3	20	1.35

Discharge Q CFS	Slope Range Minimum Percent	Slope Range Maximum Percent	Bottom Width Feet	Stage Feet
80	2.8	5.2	24	1.24
	2.8	5.9	28	1.14
	2.9	7.0	32	1.06
90	2.5	2.8	12	1.84
	2.5	3.1	16	1.61
	2.8	3.8	20	1.45
	2.7	4.5	24	1.32
	2.8	5.3	28	1.22
	2.8	6.1	32	1.14
100	2.5	2.8	16	1.71
	2.8	3.3	20	1.54
	2.8	4.0	24	1.41
	2.7	4.8	28	1.30
	2.7	5.3	32	1.21
	2.8	6.1	36	1.13
120	2.5	2.8	20	1.71
	2.8	3.2	24	1.58
	2.7	3.8	28	1.44
	2.7	4.2	32	1.34
	2.7	4.8	36	1.26
140	2.5	2.7	24	1.71
	2.5	3.2	28	1.58
	2.8	3.8	32	1.47
	2.8	4.0	36	1.38
	2.7	4.5	40	1.30
160	2.5	2.7	28	1.70
	2.5	3.1	32	1.58
	2.8	3.4	36	1.49
	2.8	3.8	40	1.40
	2.7	4.3	44	1.33
180	2.4	2.7	32	1.72
	2.4	3.0	36	1.60
	2.5	3.4	40	1.51
	2.8	3.7	44	1.43
200	2.5	2.7	36	1.70
	2.5	2.9	40	1.60
	2.5	3.3	44	1.52
	2.8	3.8	48	1.45
220	2.4	2.8	40	1.70
	2.5	2.9	44	1.61
	2.5	3.2	48	1.53
240	2.5	2.8	44	1.70
	2.5	2.9	48	1.62
	2.8	3.2	52	1.54
260	2.4	2.8	48	1.70
	2.5	2.9	52	1.62
280	2.4	2.8	52	1.70
300	2.5	2.8	56	1.69

Example of Use

Given: Discharge, Q = 87 c.f.s. Spillway slope, Exit section (from profile) = 4%.

Find: Bottom width and Stage in Spillway.

Procedure: Enter table from left at 90 c.f.s. Note that Spillway slope (4%) falls within slope ranges corresponding to bottom widths of 24, 28, and 32 ft. Use bottom width, 32 ft., to minimize velocity. Stage in Spillway will be 1.14 ft.

Note: Computations based on: Roughness coefficient, n = .040. Maximum velocity = 5.50 ft. per sec.

S&ME

JOB NO. 1356-97-394
SHEET NO. 1/3
DATE 2/12/98

JOB NAME Barrett Grading
SUBJECT Riprap Outlet Protection

COMPUTED BY SRN
CHECKED BY MJP

OBJECTIVE Determine outlet apron size for the sediment pond barrell outlet.

REFFRENCE: 1.) "Erosion and Sediment Control Planning and Design Manual," NCDEHNR, 1988.

GIVEN: Barrel size: 30 in

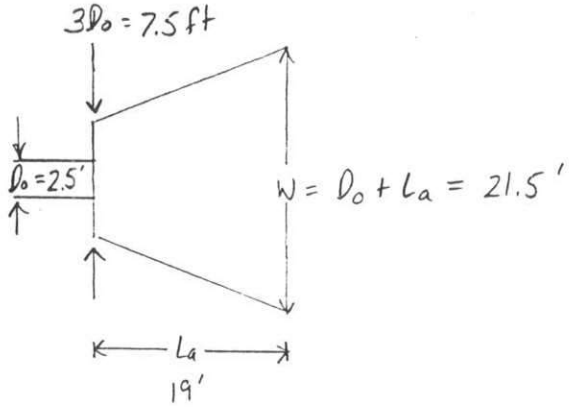
Outflow: 42.0 cfs

RESULTS: ① Use Figure 8.06a from Ref #1 to find the Riprap size and Minimum length of apron.

d_{50} riprap size = 0.70 ft => 9 inches

Min length of apron, L_a = 18 ft

2.) Determine apron shape D_o = 30" = 2.5 ft



S&ME

JOB NO. 1356-97-394
SHEET NO. 2/3
DATE 2/12/98

JOB NAME Barrett Grading
SUBJECT Riprap Outlet Protection Apron

COMPUTED BY SEN
CHECKED BY

3) Determine maximum stone diameter

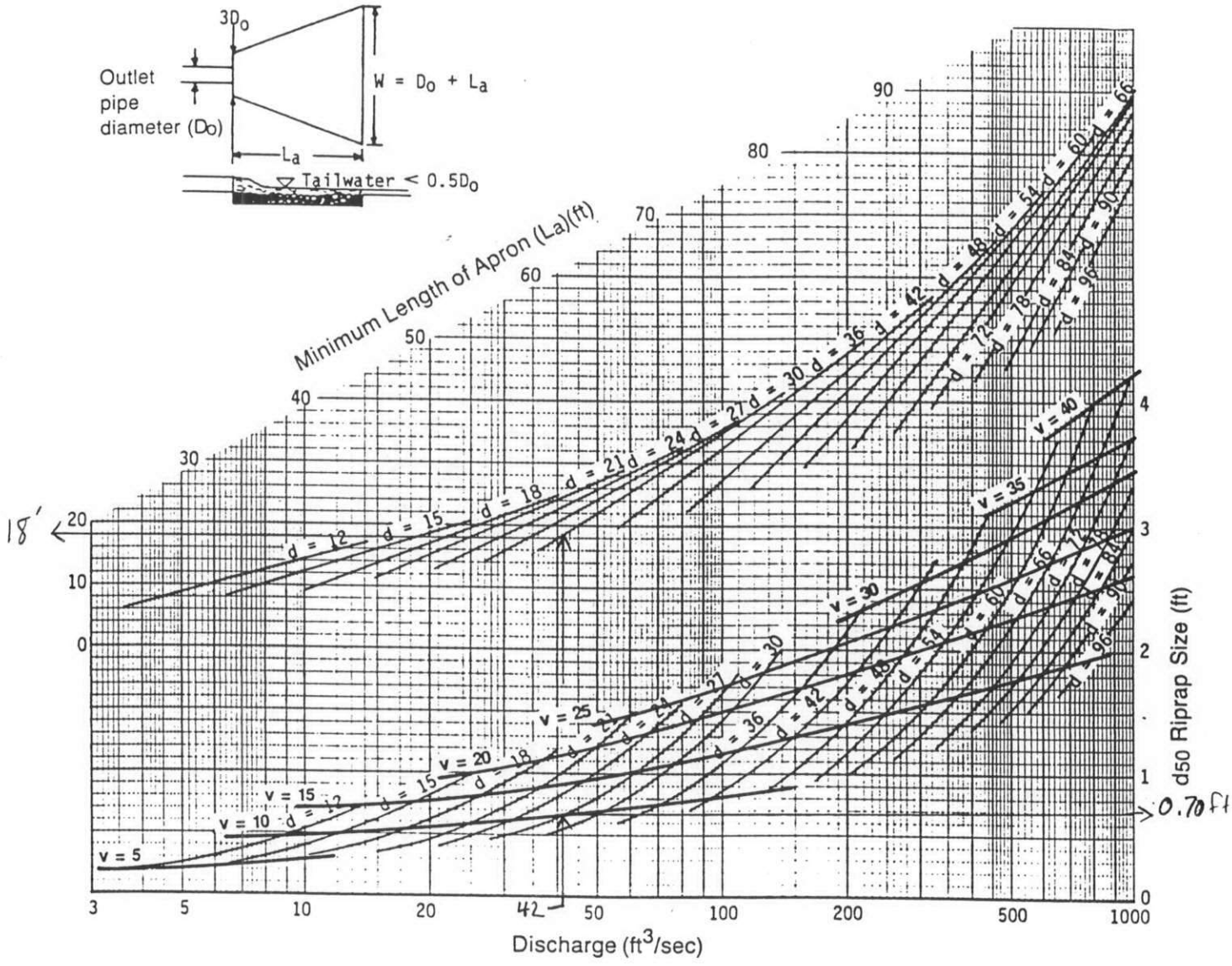
$d_{max} = 1.5 * d_{50}$

$= 1.5 * 0.75\ ft = \underline{1.13\text{-}ft}$

4.) Determine apron thickness

Apron thickness $= 1.5 * d_{max}$

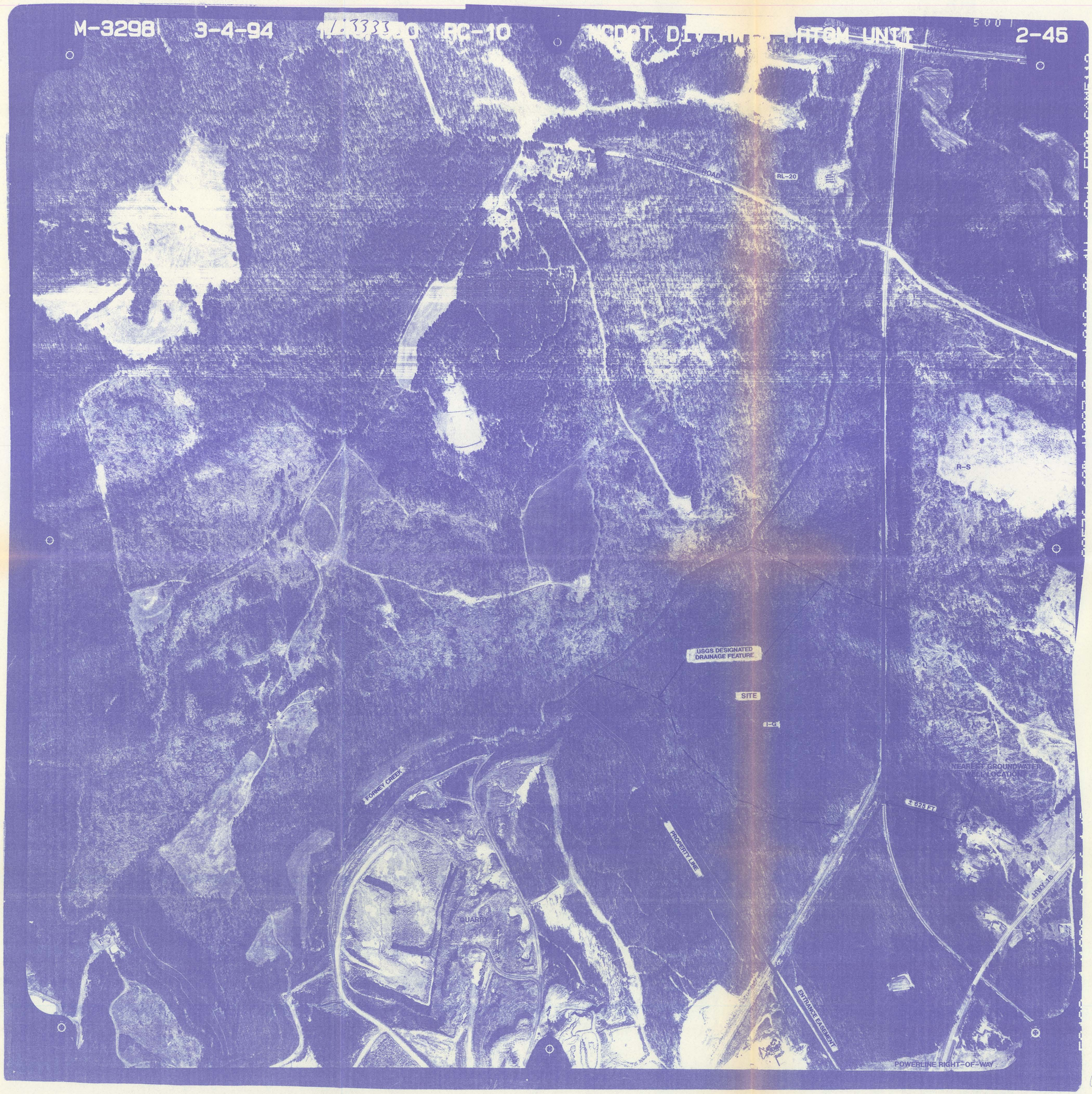
$= \underline{1.69\ ft}$



Curves may not be extrapolated.

Figure 8.06a Design of outlet protection protection from a round pipe flowing full, minimum tailwater condition (T_w < 0.5 diameter).

APPENDIX IX
PROPERTY SURVEY



NOTE:
THE SITE IS BORDERED ON THE NORTHWEST BY FORNEY CREEK AND ON THE EAST BY THE C.S.X RAILROAD

REFERENCE:
AERIAL PHOTOGRAPH WAS PROVIDED BY SUTTLES SURVEYING, P.A., DATED: MARCH 4, 1994.

ZONING INFORMATION PROVIDED BY THE LINCOLN COUNTY OFFICE OF THE TAX ADMINISTRATOR.

GRAPHIC SCALE

278 0 139 278 556 1112

(IN FEET)
1 inch = 278 ft.

NO.	DATE:	DESCRIPTION	BY

S&ME
ENVIRONMENTAL SERVICES
ENGINEERING · TESTING

AERIAL PHOTOGRAPH
LAKE NORMAN LANDFILL, INC.
LINCOLN COUNTY, NORTH CAROLINA

SCALE: AS SHOWN	DRAWN BY: MDP	CHECKED BY: CJCS
JOB NO. 1356-97-394	DATE: 2-18-98	SHEET 1 OF 12

LEGEND

- RESIDENTIAL SUBURBAN
- SINGLE FAMILY DISTRICT
- INDUSTRIAL GENERAL
- GROUNDWATER WELL LOCATION
- 100 YEAR FLOOD PLAIN
- PROPERTY BOUNDARY
- 1/4 MILE RADIUS

NOTE:
THE SITE IS BORDERED ON THE NORTHWEST BY FORNEY CREEK AND ON THE EAST BY THE C.S.X RAILROAD.

REFERENCE:
THIS TOPOGRAPHIC MAP IS TAKEN FROM THE LOWESVILLE, N.C. AND LAKE NORMAN SOUTH, N.C. USGS QUADRANGLE MAPS

NORTH CAROLINA PROFESSIONAL SEAL 023024 ENGINEER CHRISTOPHER J. STIH

GRAPHIC SCALE

400 0 200 400 800 1600

(IN FEET)
1 inch = 400 ft.

NO.	DATE:	DESCRIPTION	BY

S&ME
ENVIRONMENTAL SERVICES
ENGINEERING · TESTING

1/4 MILE RADIUS PLAN
LAKE NORMAN LANDFILL, INC.
LINCOLN COUNTY, NORTH CAROLINA

SCALE:	DRAWN BY:	CHECKED BY:
AS SHOWN	MDP	CJS
JOB NO. 1356-97-394	DATE: 2-18-98	SHEET 2 OF 12

LEGEND

- 2-MILE RADIUS
- PROPERTY LINE
- GROUNDWATER WELL LOCATION

REFERENCE:
THIS MAP WAS PROVIDED BY THE LINCOLN COUNTY OFFICE OF THE TAX ADMINISTRATOR.

GRAPHIC SCALE

1000 0 500 1000 2000 4000

(IN FEET)
1 inch = 1000 ft.

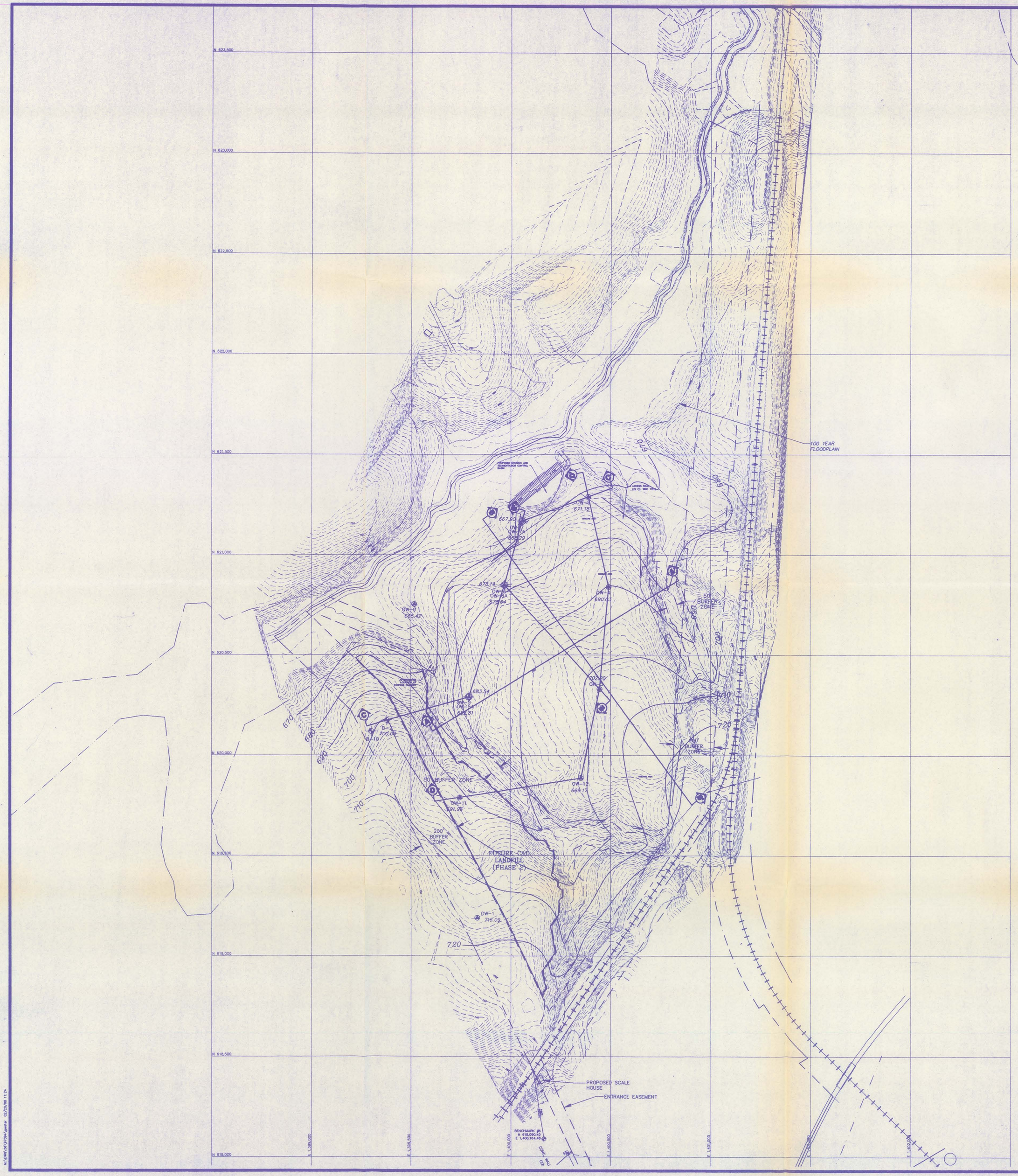
NORTH CAROLINA PROFESSIONAL SEAL 023224 ENGINEER CHRISTOPHER J. STAH

NO.	DATE:	DESCRIPTION	BY

S&ME
ENVIRONMENTAL SERVICES
ENGINEERING • TESTING

2 MILE RADIUS PLAN
LAKE NORMAN LANDFILL, INC.
LINCOLN COUNTY, NORTH CAROLINA

SCALE:	DRAWN BY:	CHECKED BY:
AS SHOWN	MDP	CJS
JOB NO. 1356-97-394	DATE: 2-18-98	SHEET 3 OF 12



LEGEND

B-2	BORING LOCATION
OW-1	OBSERVATION WELL
715.67	GROUNDWATER SURFACE ELEVATION (JANUARY 30,1998)
700	GROUNDWATER SURFACE EQUIPOTENTIAL
	BUFFER ZONE
	100 YEAR FLOODPLAIN

NOTES:

1. REFER TO SHEETS 7 AND 8 FOR CROSS-SECTIONS A AND B.
2. REFER TO THE CONSTRUCTION PLAN APPLICATION FOR FIGURES ILLUSTRATING CROSS-SECTIONS C, D, AND E.

REFERENCE:

1. TOPOGRAPHIC SURVEY FOR LAKE NORMAN LANDFILL, INC. BY SUTTLES SURVEYING, P.A., DATED SEPTEMBER 4, 1997
2. TOPOGRAPHIC SURVEY BASED ON BENCHMARK #6 NORTHING 618,090.43 EASTING 1,400,164.48 COORDINATES AT ELEVATION 784.94 MSL PROVIDED BY SUTTLES SURVEYING, P.A.

NORTH CAROLINA LICENSED SEAL 1138 GEOLOGIST AL QUARLES

2/20/98

GRAPHIC SCALE

200 0 100 300 400 600

(IN FEET)
1 inch = 200 ft.

NO.	DATE:	DESCRIPTION	BY

S&ME
ENVIRONMENTAL SERVICES ENGINEERING • TESTING

POTENTIOMETRIC SURFACE MAP
LAKE NORMAN LANDFILL, INC.
LINCOLN COUNTY, NORTH CAROLINA

SCALE: AS SHOWN	DRAWN BY: CLD	CHECKED BY: WAR	
JOB NO. 1356-97-394	DATE: 2-18-98	SHEET 4 OF 12	

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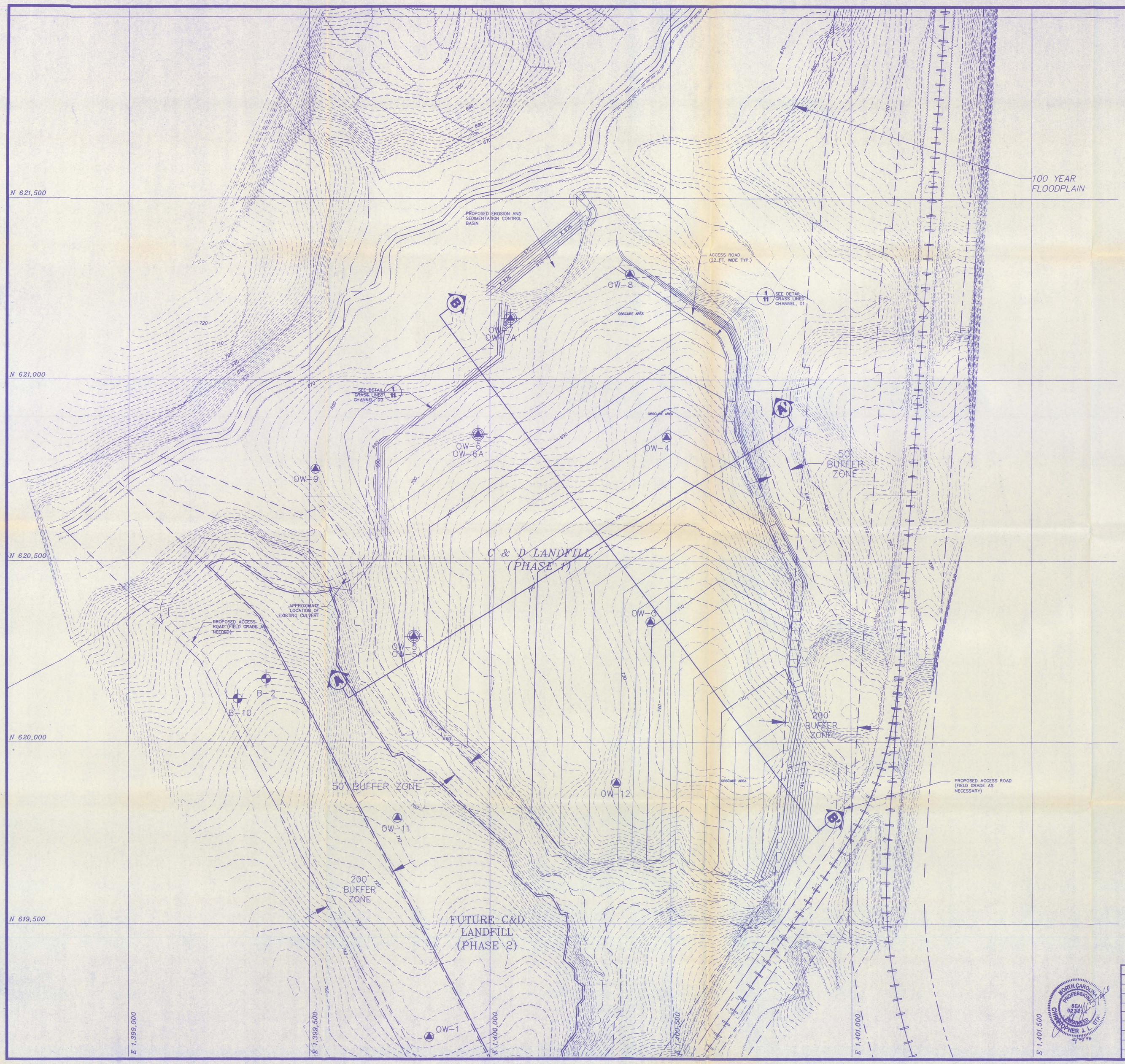


LEGEND

- EXISTING GRADE CONTOUR
- PROPOSED CONSTRUCTION GRADE CONTOUR
- PROPERTY LINE
- BUFFER LINE
- 100 YEAR FLOODPLAIN
- B-2 EXISTING BORING LOCATION
- OW-1 EXISTING OBSERVATION WELL

REFERENCE:

1. TOPOGRAPHIC SURVEY FOR LAKE NORMAN LANDFILL, INC. BY SUTTLES SURVEYING, P.A., DATED SEPTEMBER 4, 1997.
2. TOPOGRAPHIC SURVEY BASED ON BENCHMARK #6 NORTHING 618,090.43, EASTING 1,400,164.48 COORDINATES AT ELEVATION 784.94 MSL ,PROVIDED BY SUTTLES SURVEYING,P.A.

GRAPHIC SCALE

100 0 50 100 200 400

(IN FEET)
1 inch = 100 ft.

NO.	DATE:	DESCRIPTION	BY

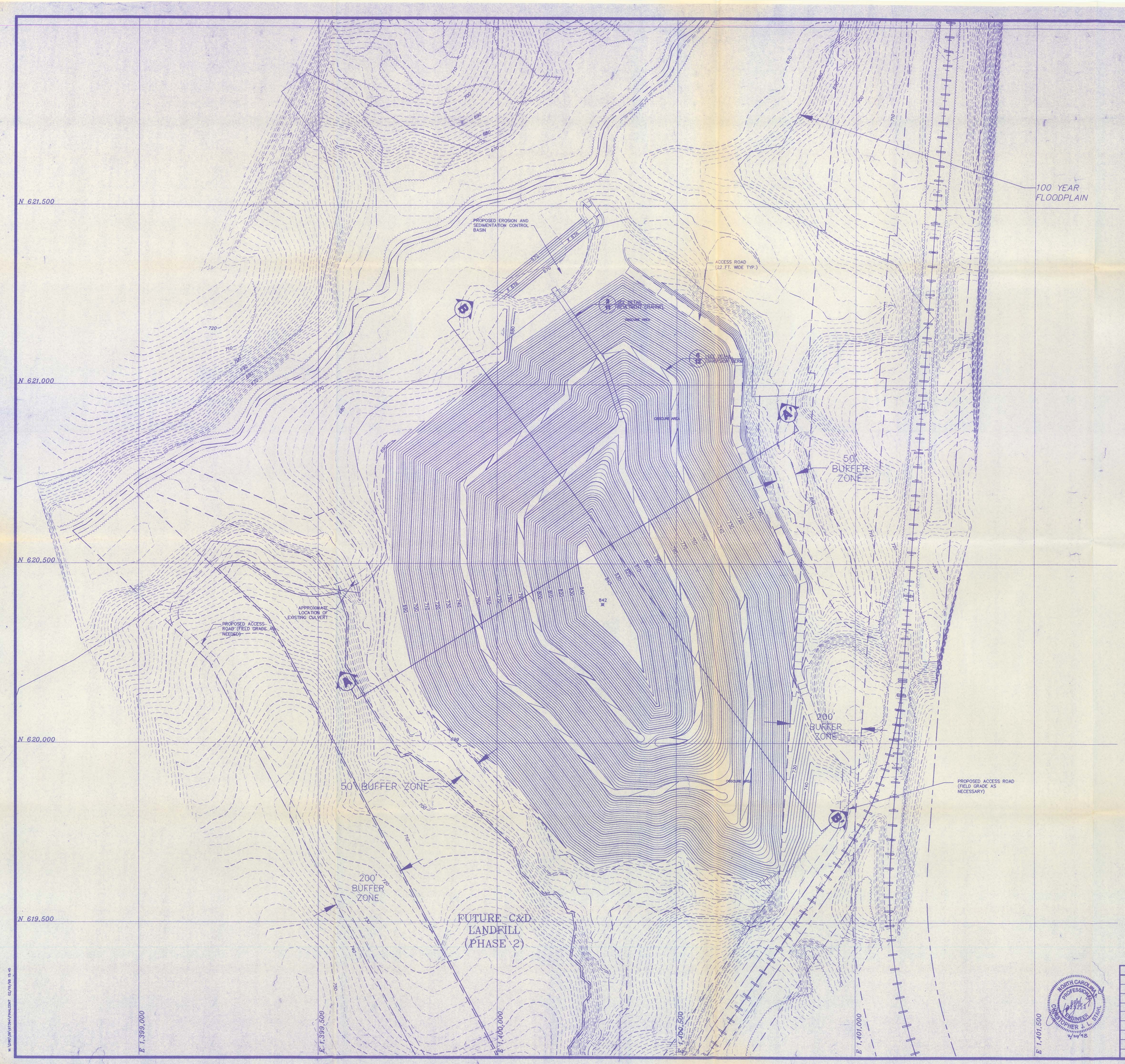
NORTH CAROLINA PROFESSIONAL SEAL 023424 ENGINEER CHRISTOPHER J. L. STR. 4/29/98

S&ME
ENVIRONMENTAL SERVICES
ENGINEERING • TESTING

PROPOSED GRADING PLAN
LAKE NORMAN LANDFILL, INC.
LINCOLN COUNTY, NORTH CAROLINA

SCALE:	DRAWN BY:	CHECKED BY:
AS SHOWN	MFP	CJS
JOB NO. 1356-97-394	DATE: 2-18-98	SHEET 5 OF 12

M:\DWG\LF\PLAN\GRADEPLAN 02/25/98 11:09



LEGEND

- EXISTING GRADE CONTOUR
- PROPOSED FINAL CONTOUR
- PROPERTY LINE
- BUFFER LINE
- 100 YEAR FLOODPLAIN

REFERENCE:

1. TOPOGRAPHIC SURVEY FOR LAKE NORMAN LANDFILL, INC. BY SUTTLES SURVEYING, P.A., DATED SEPTEMBER 4, 1997.
2. TOPOGRAPHIC SURVEY BASED ON BENCHMARK #6 NORTHING 618,090.43 EASTING 1,400,164.48 COORDINATES AT ELEVATION 784.94 MSL PROVIDED BY SUTTLES SURVEYING, P.A.

GRAPHIC SCALE

100 0 50 100 200 400

(IN FEET)
1 inch = 100 ft.

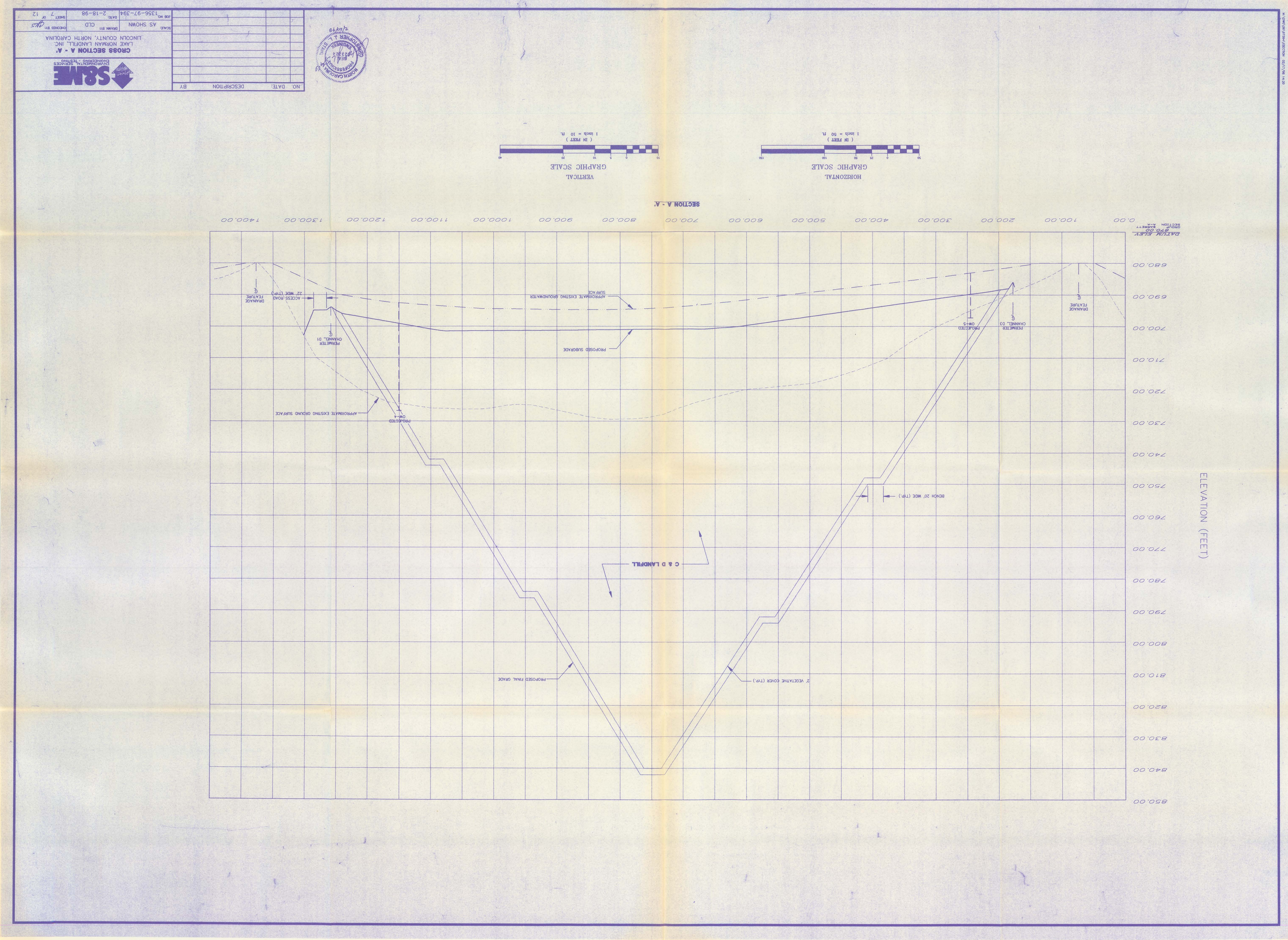
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 023224 CHRISTOPHER J. L. STAHL 2/20/98

NO.	DATE:	DESCRIPTION	BY

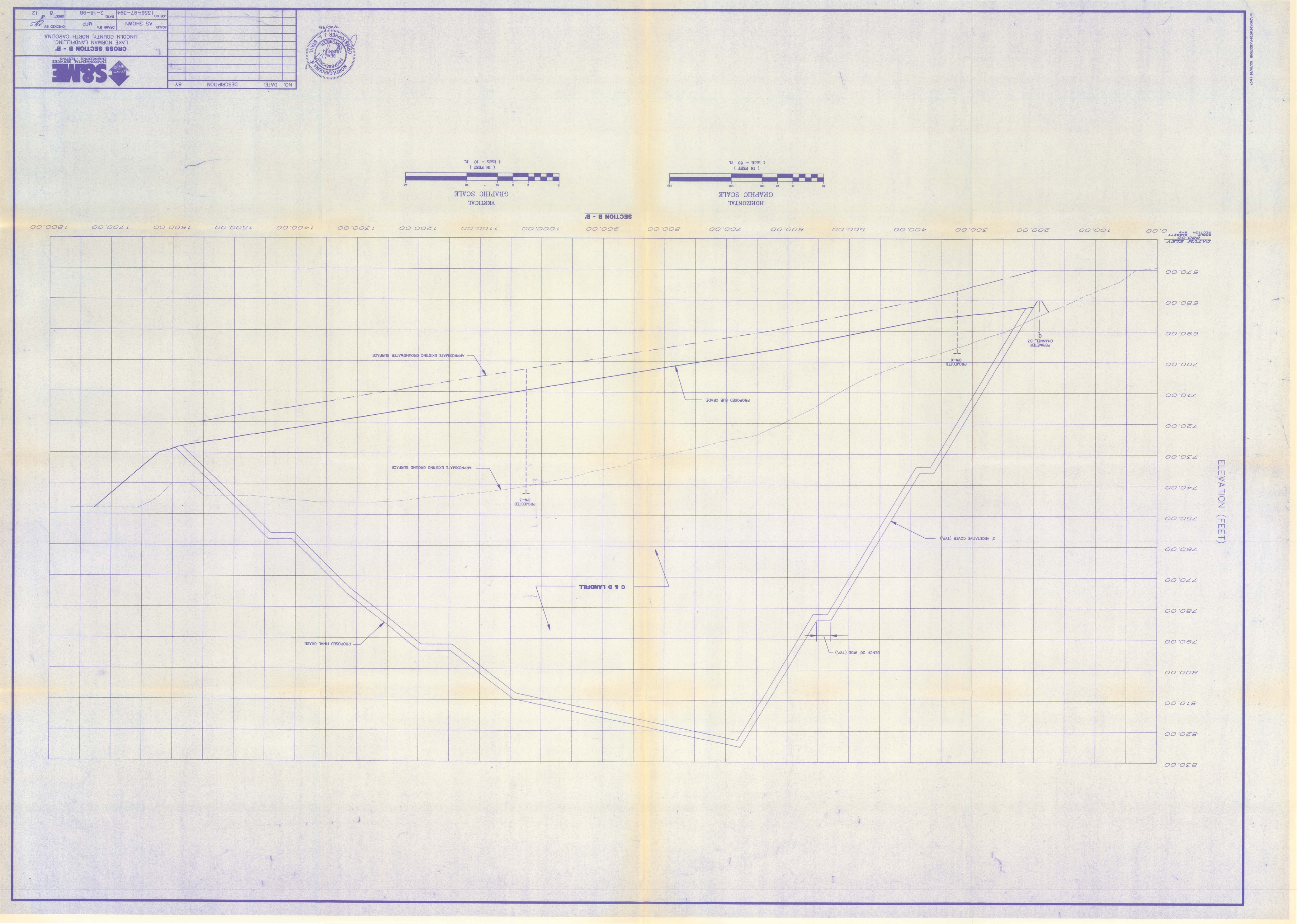
S&ME ENVIRONMENTAL SERVICES ENGINEERING · TESTING

PROPOSED FINAL CONTOURS
LAKE NORMAN LANDFILL, INC.
LINCOLN COUNTY, NORTH CAROLINA

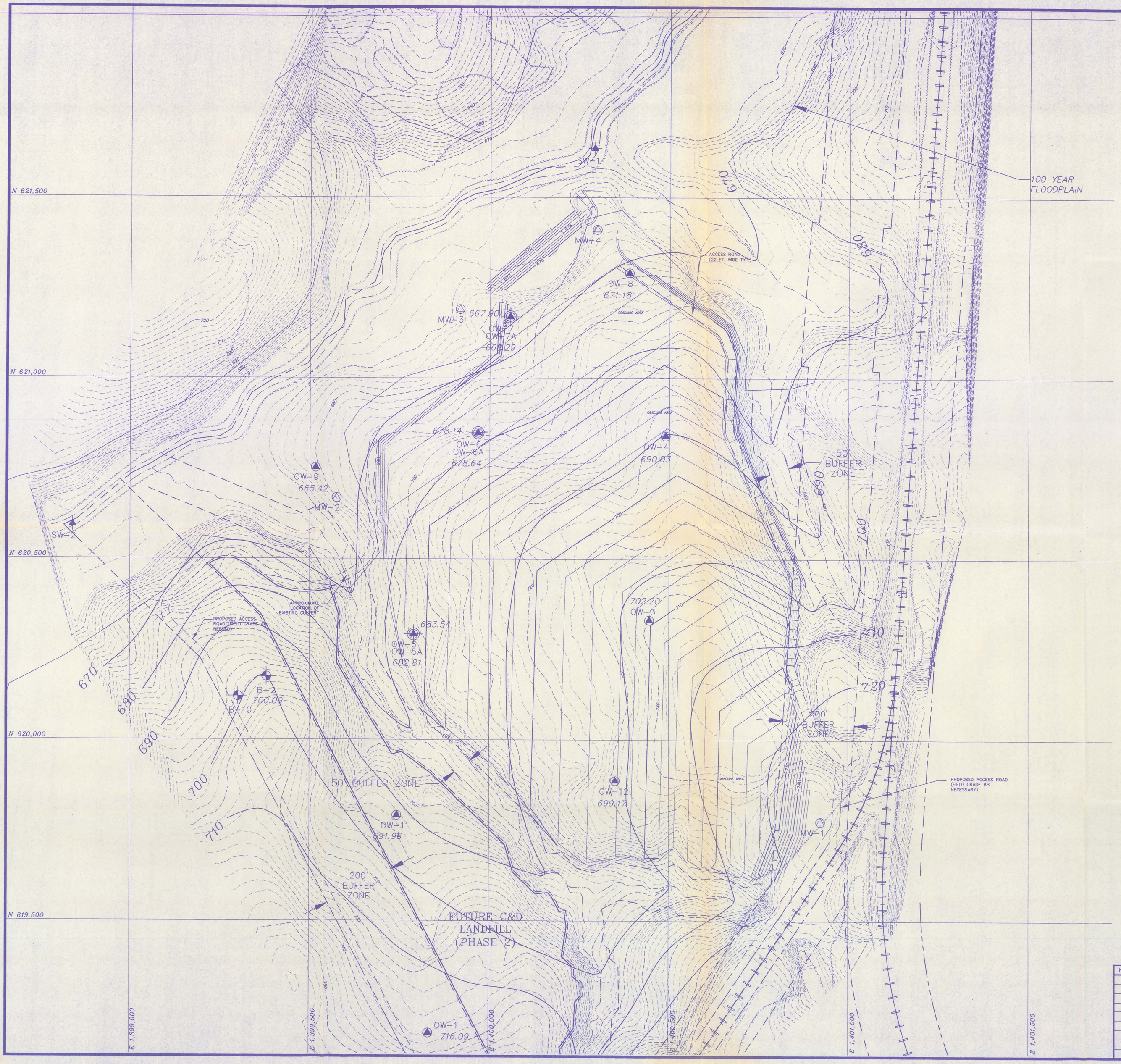
SCALE: AS SHOWN	DRAWN BY: CLD	CHECKED BY: CJLS
JOB NO. 1356-97-394	DATE: 2-18-98	SHEET 6 OF 12



S&ME
ENVIRONMENTAL SERVICES
ENGINEERING · TESTING
CROSS SECTION A - A'
LAKE NORMAN LANDFILL, INC.
LINCOLN COUNTY, NORTH CAROLINA
SCALE: AS SHOWN
DRAWN BY: CLD
CHECKED BY: GJS
JOB NO. 1356-97-394
DATE: 2-18-98
SHEET 7 OF 12
NO. DATE: DESCRIPTION BY
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 023324 CHRISTOPHER J. L. STAHL
2/27/98
VERTICAL GRAPHIC SCALE
(IN FEET)
1 inch = 10 ft.
HORIZONTAL GRAPHIC SCALE
(IN FEET)
1 inch = 50 ft.
SECTION A - A'
DATUM ELEV 670.00
GROUP BARRETT SECTION A-A'
0.00
100.00
200.00
300.00
400.00
500.00
600.00
700.00
800.00
900.00
1000.00
1100.00
1200.00
1300.00
1400.00
ELEVATION (FEET)
680.00
690.00
700.00
710.00
720.00
730.00
740.00
750.00
760.00
770.00
780.00
790.00
800.00
810.00
820.00
830.00
840.00
850.00
DRAINAGE FEATURE
ACCESS ROAD 22' WIDE (TYP.)
PERIMETER CHANNEL, D1
APPROXIMATE EXISTING GROUNDWATER SURFACE
PROPOSED SUBGRADE
PROJECTED OW-4
APPROXIMATE EXISTING GROUND SURFACE
PROJECTED OW-5
PERIMETER CHANNEL, D3
DRAINAGE FEATURE
BENCH 20' WIDE (TYP.)
C & D LANDFILL
PROPOSED FINAL GRADE
2' VEGETATIVE COVER (TYP.)



S&ME
ENVIRONMENTAL SERVICES
ENGINEERING · TESTING
CROSS SECTION B - B'
LAKE NORMAN LANDFILL, INC.
LINCOLN COUNTY, NORTH CAROLINA
SCALE: AS SHOWN
DRAWN BY: MFP
CHECKED BY:
JOB NO. 1356-97-394
DATE: 2-18-98
SHEET 8 OF 12
NO. DATE: DESCRIPTION BY
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 10202 CHRISTOPHER J. L. STAHL 2/20/98
SECTION B - B'
HORIZONTAL GRAPHIC SCALE
(IN FEET)
1 inch = 50 ft.
VERTICAL GRAPHIC SCALE
(IN FEET)
1 inch = 10 ft.
DATUM ELEV 660.00
GROUP SECTION B-B'
ELEVATION (FEET)
0.00
100.00
200.00
300.00
400.00
500.00
600.00
700.00
800.00
900.00
1000.00
1100.00
1200.00
1300.00
1400.00
1500.00
1600.00
1700.00
1800.00
670.00
680.00
690.00
700.00
710.00
720.00
730.00
740.00
750.00
760.00
770.00
780.00
790.00
800.00
810.00
820.00
830.00
APPROXIMATE EXISTING GROUNDWATER SURFACE
APPROXIMATE EXISTING GROUND SURFACE
PROPOSED SUB GRADE
PROPOSED FINAL GRADE
PROJECTED OW-3
PROJECTED OW-6
PERIMETER CHANNEL D3
C & D LANDFILL
2' VEGETATIVE COVER (TYP.)
BENCH 20' WIDE (TYP.)



COORDINATES FOR OBSERVATION WELLS AND BORINGS

Boring	Northing	Easting	Ground Elevation (MSL)	Top of Casing Elevation (MSL)
OW-1	619,190.21	1,399,831.34	735.91	738.49
B-2	620,174.86	1,399,380.05	723.18	N/A
OW-3	620,330.01	1,400,447.96	739.84	742.67
OW-4	620,840.97	1,400,489.71	720.44	722.99
OW-5	620,288.25	1,399,787.48	695.04	698.13
OW-5A	620,295.39	1,399,791.93	695.25	697.42
OW-6	620,844.01	1,399,972.14	697.01	700.34
OW-6A	620,854.97	1,399,962.16	697.97	699.76
OW-7	621,175.01	1,400,061.07	684.37	687.45
OW-7A	621,163.88	1,400,051.91	683.22	685.72
OW-8	621,291.08	1,400,387.44	690.18	693.18
OW-9	620,753.40	1,399,516.15	677.34	680.59
B-10	620,120.00	1,399,305.00	723.00	N/A
OW-11	679,790.45	1,399,743.79	702.49	706.19
OW-12	619,887.08	1,400,350.87	728.11	731.48

LEGEND

- 700 — POTENTIOMETRIC SURFACE
- EXISTING GRADE CONTOUR
- PROPOSED CONSTRUCTION CONTOUR
- PROPERTY LINE
- 100 YEAR FLOODPLAIN
- PROPOSED MONITORING WELL LOCATION
- PROPOSED SURFACE WATER SAMPLING LOCATION
- EXISTING OBSERVATION WELL
- EXISTING BORING LOCATION

NORTH CAROLINA LICENSED SEAL 1133 GEOLOGIST AL QUARLES

Al Quarles
2/20/98

REFERENCE:

1. TOPOGRAPHIC SURVEY FOR LAKE NORMAN LANDFILL, INC. BY SUTTLES SURVEYING, P.A., DATED SEPTEMBER 4, 1997.
2. TOPOGRAPHIC SURVEY BASED ON BENCHMARK #6 NORTHING 618,090.43 EASTING 1,400,164.48 COORDINATES AT ELEVATION 784.94 MSL. PROVIDED BY SUTTLES SURVEYING, P.A.

GRAPHIC SCALE

100 0 50 100 200 400

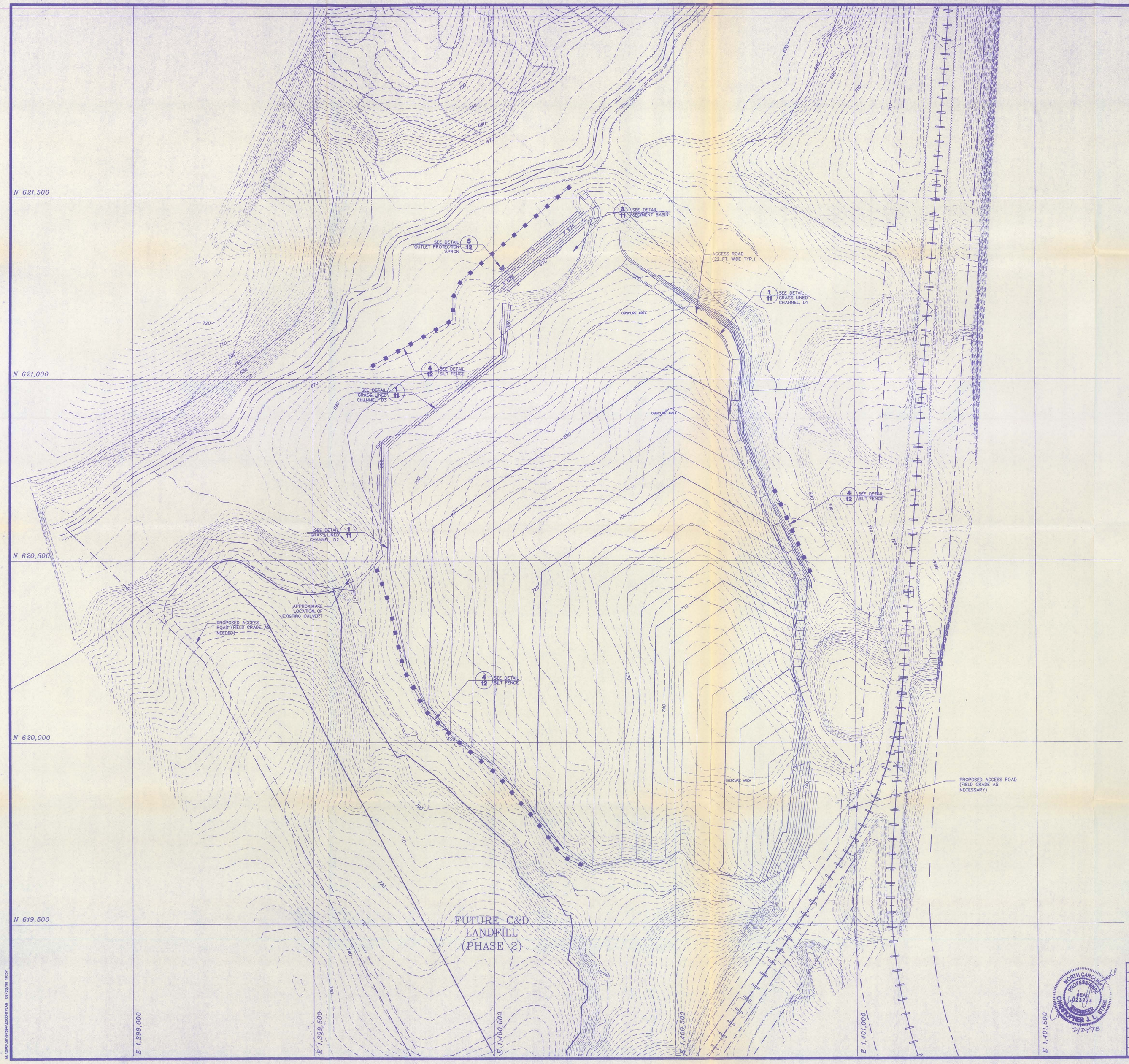
(IN FEET)
1 inch = 100 ft.

NO.	DATE:	DESCRIPTION	BY

S&ME
ENVIRONMENTAL SERVICES
ENGINEERING · TESTING

WATER QUALITY MONITORING PLAN
LAKE NORMAN LANDFILL, INC.
LINCOLN COUNTY, NORTH CAROLINA

SCALE: AS SHOWN	DRAWN BY: CLD	CHECKED BY: WAQ
JOB NO. 1356-97-394	DATE: 2-18-98	SHEET 9 OF 12



LEGEND

- SEDIMENT BASIN RISER AND BARREL OUTLET
- SILT FENCE
- PROPERTY LINE
- EXISTING CONTOUR
- PROPOSED CONTOUR

REFERENCE:

1. TOPOGRAPHIC SURVEY FOR LAKE NORMAN LANDFILL, INC. BY SUTTLES SURVEYING, P.A., DATED: SEPTEMBER 4, 1997.
2. TOPOGRAPHIC SURVEY BASED ON BENCHMARK #6 NORTHING 618,090.43, EASTING 1,400,164.48 COORDINATES AT ELEVATION 784.94, PROVIDED BY SUTTLES SURVEYING, P.A..

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 023224 CHRISTOPHER J. L. STAHL
2/20/98

NO.	DATE:	DESCRIPTION	BY

S&ME ENVIRONMENTAL SERVICES ENGINEERING • TESTING

EROSION & SEDIMENT CONTROL PLAN
LAKE NORMAN LANDFILL, INC.
LINCOLN COUNTY, NORTH CARLINA

SCALE: AS SHOWN	DRAWN BY: MFP	CHECKED BY: GJS
JOB NO. 1356-97-394	DATE: 2-18-98	SHEET 10 OF 12

SEEDING SPECIFICATIONS

DEFINITION: Controlling runoff and erosion on disturbed areas by establishing perennial vegetative cover with seed.

PURPOSE: 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 (Table 6.11a), 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 – 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. Directions, sample cartons, and information sheets are available through county Agricultural Extension offices or from NCDA. Because the NCDA soil testing lab requires 1–6 weeks for sample turn-around, sampling must be planned well in advance of final grading. Testing is also done by commercial laboratories.

When soil tests are not available, follow rates suggested on the individual specification sheet for the seeding mix chosen (Tables 6.11c through 6.11v). Application rates usually fall into the following ranges:

Ground agricultural limestone:
Light-textured, sandy soils: 1 to 1-1/2 tons/acre
Heavy-textured, clayey soils: 2–3 tons/acre

Fertilizer:
Grasses: 800–1200 lb/acre of 10-10-10 (or the equivalent)
Grass-legume mixtures: 800–1200 lb/acre of 5-10-10 (or the equivalent)

Apply lime and fertilizer evenly and incorporate into the top 4–6 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 chances of success by 30–50%. 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 weed 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 2,000 lb/acre.

Apply legume inoculants at four time the recommended rate when adding inoculant to a hydroseeder slurry.

If a machinery breakdown of 1/2 to 2 hours occurs, add 50% 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, re-evaluate choice of plant materials and quantities of lime and fertilizer. Re-establish the stand after seedbed preparation or over-seed 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.

Table 6.11o Seeding No. 5P for: Grass-lined Channels

Seeding mixture

Species[1]	Rate (lb/acre)
Tall fescue	200 (4–5 lb/1,000 ft2)

Nurse plants
Between May 1 and Aug. 15 add 15 lb/acre Sudangrass or 10 lb/acre German millet. Before May 1, or after Aug. 15, add 40 lb/acre rye (grain).

Seeding dates
Best: Aug. 25 – Oct.
Possible: Feb. – Apr. 15

Avoid seeding from Nov. to Jan. If seeding must be done at this time, add 40 lb/acre rye grain and use a channel lining that offers maximum protection.

Soil amendments
Apply lime and fertilizer according to soil tests, or apply 4,000 lb/acre ground agricultural limestone and 1,000 lb/acre 10-10-10 fertilizer. Operate tillage equipment across the waterway.

Mulch
Use jute, excelsior matting, or other effective channel lining material to cover the bottom of channels and ditches, and staple securely. The lining should extend above the highest calculated depth of flow. On channel side slopes above this height, and in drainages not requiring temporary linings, apply 4,000 lb/acre grain straw and anchor straw by stapling netting over the top.

Mulch and anchoring materials must not be allowed to wash down slopes where they can clog drainage devices.

Maintenance
Inspect and repair mulch frequently. Refertilize in late winter of the following year; use soil tests or apply 150 lb/acre 10-10-10. Mow regularly to a height of 2–4 inches.

[1]Refer to Appendix 8.02 for botanical names.

TABLE 6.11K SEEDING FOR STEEP SLOPES OR POOR SOILS: LOW MAINTENANCE

Seeding mixture

Species*	Rate (lb/acre)
Tall fescue	100
Sericea lespedeza	30
Kobe lespedeza	10

Seeding notes
1. In Eastern Piedmont add 25 lb/acre Pensacola Bahiagrass or 10 lb/acre common Bermudagrass. Use common Bermudagrass only where it is unlikely to become a pest.
2. After Aug. 15 use unscarified sericea seed.
3. Where a neat appearance is desired, omit sericea and substitute 40 lb/acre Bahiagrass or 15 lb/acre hulled Bermudagrass.
4. To extend spring seeding dates into June, add 15 lb/acre hulled Bermudagrass. However, it is preferable to seed temporary cover and seed fescue in September.

Nurse plants
Between May 1 and Aug. 15, add 10 lb/acre German millet or 15 lb/acre Sudangrass. Prior to May 1 or after Aug. 15, add 40 lb/acre rye (grain).

Seeding dates

	Best	Possible
Fall:	Aug. 25 – Sept. 15	Aug. 20 – Oct. 25
Late winter:	Feb. 15 – Mar. 21	Feb. 1 – Apr. 15

Fall is best for tall fescue and late winter for lespedezas. Overseeding of Kobe lespedeza over fall-seeded tall fescue is very effective. Use unhulled Bermudagrass seed in fall.

Soil amendments
Apply lime and fertilizer according to soil tests, or apply 4,000 lb/acre ground agricultural limestone and 1,000 lb/acre 10-10-10 fertilizer.

Mulch
Apply 4,000–5,000 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 fully adequate. May be mowed one or twice a year, but mowing is not necessary. Reseed, fertilize, and mulch damaged areas immediately.

*Refer to Appendix 8.02 for botanical names.

Construction Specifications

1. Site preparations—Clear, grub, and strip topsoil from areas under the embankment to remove trees, vegetation, roots, and other objectionable material. To facilitate sediment cleanout and restoration, clear the pool area of all brush, trees, and other objectionable materials. Stockpile all topsoil or soil containing organic matter for use on the outer shell of the embankment to facilitate vegetative establishment. Place temporary sediment control measures below the basin as needed.

2. Cut-off trench—Excavate a cut-off trench along the centerline of the earth fill embankment. Cut the trench to stable soil material, but in no case make it less than 2 ft. deep. The cut-off trench must extend into both abutments to at least the elevation of the riser crest. Make the minimum bottom width wide enough to permit operation of excavation and compaction equipment but in no case less than 2 ft. Make side slopes of the trench no steeper than 1:1. Compaction requirements are the same as those for the embankment. Keep the trench dry during backfilling and compaction operations.

3. Embankment—Take fill material from the approved areas shown on the plans. It should be clean mineral soil, free of roots, woody vegetation, rocks, and other objectionable material. Scarify areas on which fill is to be placed before placing fill. The fill material must contain sufficient moisture so it can be formed by hand into a ball without crumbling. If water can be squeezed out of the ball, it is too wet for proper compaction. Place fill material in 6 to 8-inch continuous layers over the entire length of the fill area and then compact it. Compaction may be obtained by routing the construction hauling equipment over the fill so that the entire surface of each layer is traversed by at least one wheel or tread track of the heavy equipment, or a compactor may be used. Construct the embankment to an elevation 10% higher than the design height to allow for settling.

4. Conduit spillways—Securely attach the riser to the barrel or barrel stub to make a watertight structural connection. Secure all connections between barrel sections by approved watertight assemblies. Place the barrel and riser on a firm, smooth foundation of impervious soil. Do not use pervious material such as sand, gravel, or crushed stone as backfill around the pipe or anti-seep collars. Place the fill material around the pipe spillway in 4-inch layers and compact it under and around the pipe to at least the same density as the adjacent embankment. Care must be taken not to raise the pipe from firm contact with its foundation when compacting under the pipe haunches.

Place a minimum depth of 2 ft. of hand-compacted backfill over the pipe spillway before crossing it with construction equipment. Anchor the riser in place by concrete or other satisfactory means to prevent flotation. In no case should the pipe conduit be installed by cutting a trench through the dam after the embankment is complete.

5. Emergency spillway—Install the emergency spillway in undisturbed soil. The achievement of planned elevations, grade, design width, and entrance and exit channel slopes are critical to the successful operation of the emergency spillway.

6. Inlets—Discharge water into the basin in a manner to prevent erosion. Use diversions with outlet protection to divert sediment-laden water to the upper end of the pool area to improve basin trap efficiency (References: Runoff Control Measures and Outlet Protection).

7. Erosion control—Construct the structure so that the disturbed area is minimized. Divert surface water away from bare areas. Complete the embankment before the area is cleared. Stabilize the emergency spillway embankment and all other disturbed areas above the crest of the principal spillway immediately after construction (References: Surface Stabilization).

8. Safety—Sediment basins may attract children and can be dangerous. Avoid steep side slopes, and fence and mark basins with warning signs if trespassing is likely. Follow all state and local requirements.

Maintenance

Check sediment basins after periods of significant runoff. Remove sediment and restore the basin to its original dimensions when sediment accumulates to one-half the design depth.

Check the embankment, spillways, and outlet for erosion damage, and inspect the embankment for piping and settlement. Make all necessary repairs immediately. Remove all trash and other debris from the riser and pool area.

BASIN DIMENSIONS	SB-1
BASIN STORAGE VOLUME (CF)	110'x330' 73,538
RISER DIAMETER (in)	36
BARREL DIAMETER (in)	30
BARREL INVERT @ RISER (ft.)	669
BARREL INVERT @ OUTLET (ft.)	668
BARREL LENGTH (ft)	55
RISER CREST ELEV. (ft.)	673.4
TOP OF DAM ELEV. (ft.)	676.0
EMERGENCY SPILLWAY ELEV. (ft.MSL)	674.7
EMERGENCY SPILLWAY WIDTH (ft)	16
ANTI FLOTATION BLOCK (CONCRETE)	5'x5'x1'
ANTI SEEP COLLAR (STEEL)	4'x4'

ANTI- VORTEX DEVICE DESIGN

TOP STIFFENER (IF REQUIRED) IS ANGLE WELDED TO TOP AND ORIENTED PERPENDICULAR TO CORRUGATIONS.

TOP IS 16 GAGE CORRUGATED METAL OR 1/8" STEEL PLATE. PRESSURE RELIEF HOLES MAY BE OMMITTED, IF ENDS OF CORRUGATIONS ARE LEFT FULLY OPEN WHEN THE TOP IS ATTACHED.

CYLINDER IS 16 GAGE CORRUGATED METAL PIPE OR FABRICATED FROM 1/8" STEEL PLATE.

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 TOP OF RISER.

DETAILS OF CORRUGATED METAL ANTI-SEEP COLLAR

NOTES FOR COLLARS:
1. ALL MATERIALS TO BE IN ACCORDANCE WITH CONSTRUCTION AND CONSTRUCTION MATERIAL SPECIFICATIONS.
2. WHEN SPECIFIED ON THE PLANS, COATING OF COLLARS SHALL BE IN ACCORDANCE WITH CONSTRUCTION AND CONSTRUCTION MATERIAL SPECIFICATIONS.
3. UNASSEMBLED COLLARS SHALL BE MARKED BY PAINTING OR TAGGING TO IDENTIFY MATCHING PAIRS.
4. THE LAP BETWEEN THE TWO HALF SECTIONS AND BETWEEN THE PIPE AND CONNECTING BAND SHALL BE CAULKED WITH ASPHALT MASTIC AT TIME OF INSTALLATION.
5. EACH COLLAR SHALL BE FURNISHED WITH TWO 1/2" DIAMETER RODS WITH STANDARD TANK LUGS FOR CONNECTING COLLARS TO PIPE.

(3/11) **SEDIMENT BASIN DETAIL**
NTS

Definition: A channel with vegetative lining constructed to design cross section and grade for conveyance of runoff.

Purpose: To convey and dispose of concentrated surface runoff without damage from erosion, deposition, or flooding.

Construction Specifications

1. Remove all trees, brush, stumps, and other objectionable material from the foundation area and dispose of properly.
2. Excavate the channel and shape it to dimensions shown on the plans plus a 0.2-ft overcut around the channel perimeter to allow for bulking during seedbed preparations and sod buildup.
3. Remove and properly dispose of all excess soil so that surface water may enter the channel freely.
4. The procedure used to establish grass in the channel will depend upon the severity of the conditions and selection of species. Protect the channel with mulch or a temporary liner sufficient to withstand anticipated velocities during the establishment period (see Seeding Specifications).
5. Apply lime, fertilizer and seed before laying the net (without mulch) or mat (with mulch or synthetic). If open-weave netting is used, lime may be incorporated before installing the net and the fertilizer and seed can be sprayed on afterward, otherwise apply seed and fertilizer before installation.
6. Start laying the net or mat from the top of the channel or slope and unroll it down the grade. Allow netting to lay loosely on the soil but without wrinkles—do not stretch.
7. To secure the net, bury the upslope end in a slot or trench no less than 6 inches deep, cover with soil, and tamp firmly. Staple the net every 12 inches across the top end and every 3 ft around the edges and bottom. Where 2 strips of net are laid side by side, the adjacent edges should be overlapped 3 inches and stapled together. Each strip of netting or matting should also be stapled down the center or every 3 ft if the strip is not wider than 8 feet. Do not stretch the net/mat when applying staples.
8. Staples should be the "U"-shaped type and 4" to 6" long (depending on soil conditions).
9. To join ends of two strips of netting, cut a trench to anchor the end of the down gradient net. Overlap the end of the previous roll 18 inches and staple every 12 inches just below the anchor slot.
10. To join ends of two strips of matting, overlap the upgradient strip over the downgradient one at least 4 inches. Staple the overlap at the ends and every 12 inches along the center of the overlap.

NOTE: Netting and matting products should be installed according to manufacturers guidelines. If the manufacturer does not provide guidelines, the above guidelines for netting and matting may be used.

Maintenance: During the establishment period, check grass-lined channels after every rainfall. After grass is established, periodically check the channel; check it after every heavy rainfall event. Immediately make repairs. It is particularly important to check the channel outlet and all road crossings for bank stability and evidence of piping or scour holes.

Remove all significant sediment accumulations to maintain the design carrying capacity. Keep the grass in a healthy, vigorous condition at all times, since it is the primary erosion protection for the channel (see Seeding Specifications).

Inspect all mulches periodically, and after rainstorms to check for rill erosion, dislocation, or failure. Where erosion is observed, apply additional mulch. If washout occurs, repair the slope grade, reseed, and reinstall mulch. Continue inspections until vegetation is firmly established.

GRASS – LINED DITCH TYPE	DIMENSIONS (FT) d	z
D1	2.5	2
D2	3	2
D3	3	3

NOTES:
1. DITCHES ARE TO BE LINED WITH EROSION CONTROL MAT SUCH AS NORTH AMERICAN GREEN SC150 OR EQUIVALENT.

(1/12) **GRASS - LINED CHANNELS**
NTS

DITCH TYPE	B (FT)	d (FT)	M	t (IN)	d_{50} (IN.)	d_{max}
R1	10	1.0	2	–	–	–

*NOTE:
1. DITCH R1 TO BE LINED WITH CONCRETE REVETMENT EQUIVALENT TO TRILOCK MODEL NO. 4010.

(2/11) **REVETMENT CHANNEL DETAIL**
NTS

NO.	DATE:	DESCRIPTION	BY

S&ME
ENVIRONMENTAL SERVICES • ENGINEERING • TESTING

EROSION & SEDIMENTATION CONTROL DETAILS
LAKE NORMAN LANDFILL, INC.
LINCOLN COUNTY, NORTH CAROLINA

SCALE: AS SHOWN	DRAWN BY: CLD	CHECKED BY: CJLS
JOB NO. 1356-97-394	DATE: 2-18-98	SHEET 11 OF 12

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 023???? CHRISTOPHER J. L. STAHL 2/18/98

SB

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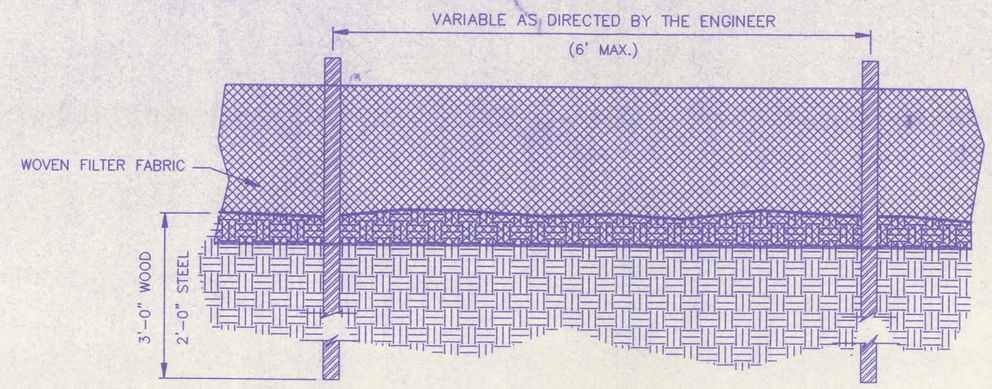
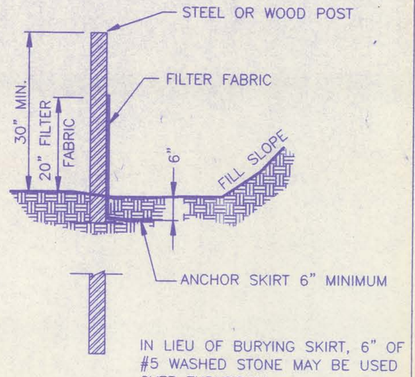
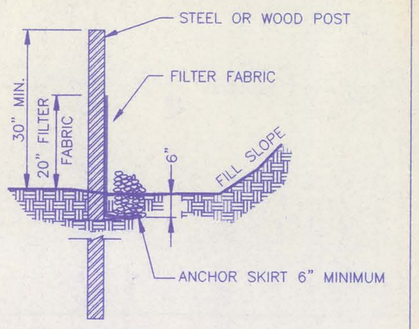




IN LIEU OF BURYING SKIRT, 6" OF #5 WASHED STONE MAY BE USED OVER TURNDOWN.

GENERAL NOTES:

1. FILTER FABRIC FENCE SHALL BE A MINIMUM OF 32" IN WIDTH AND SHALL HAVE A MINIMUM OF 6 LINE WIRES WITH 12" STAY SPACING.
2. WOVEN FILTER FABRIC BE USED WHERE SILT FENCE IS TO REMAIN FOR A PERIOD OF MORE THAN 30 DAYS.
3. STEEL POSTS SHALL BE 5'-0" IN HEIGHT AND BE OF THE SELF-FASTENER ANGLE STEEL TYPE.
4. WOOD POSTS SHALL BE 6 TO 7 FEET IN HEIGHT AND 3 TO 4 INCHES IN DIAMETER. WIRE FABRIC SHALL BE FASTENED TO WOODEN POST WITH NOT LESS THAN #9 WIRE STAPLES 1-1/2" LONG.
5. WASHED STONE SHALL BE USED TO BURY SKIRT WHEN SILT FENCE IS USED ADJACENT TO A CHANNEL, CREEK OR POND.
6. TURN SILT FENCE UP SLOPE AT ENDS.
7. WHEN FABRIC IS USED WITH WIRE MESH 8' CENTERED POSTS MAY BE USE.



MAINTENANCE NOTES:

1. FILTER BARRIERS SHALL BE INSPECTED BY THE FINANCIALLY RESPONSIBLE PARTY OR HIS AGENT IMMEDIATELY AFTER EACH RAINFALL AND AT LEAST DAILY DURING PROLONGED RAINFALL. ANY REPAIRS NEEDED SHALL BE MADE IMMEDIATELY.
2. SHOULD THE FABRIC DECOMPOSE OR BECOME INEFFECTIVE PRIOR TO THE END OF THE EXPECTED USABLE LIFE AND THE BARRIER STILL IS NECESSARY, THE FABRIC SHALL BE REPLACED PROMPTLY.
3. SEDIMENT DEPOSITS SHOULD BE REMOVED AFTER EACH STORM EVENT OR SILT FENCE SHOULD BE REPLACED. THEY MUST BE REMOVED WHEN DEPOSITS REACH APPROX. HALF THE HEIGHT OF THE BARRIER. ANY SEDIMENT DEPOSITS REMAINING IN PLACE AFTER THE SILT FENCE IS REMOVED SHALL BE DRESSED TO CONFORM TO THE EXISTING GRADE, PREPARED AND SEEDED.

REFERENCE: N.C. EROSION AND SEDIMENTATION CONTROL PLANNING AND DESIGN MANUAL, 1988.

REVISIONS

NO.	DATE	DESCRIPTION
4		

SF

4/12 SILT FENCE DETAIL
NTS

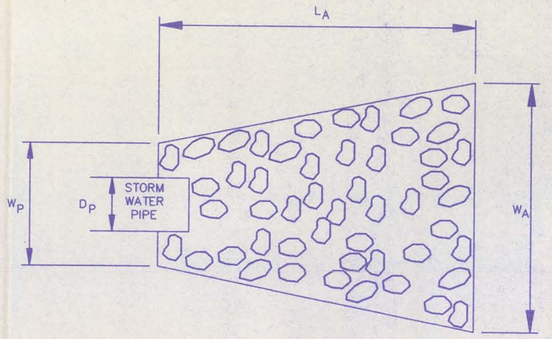
Definition — A structure designed to control erosion at the inlet or outlet of a channel or conduit.

Purpose — To prevent erosion at the outlet of a channel or conduit by reducing the velocity of flow and dissipating the energy.

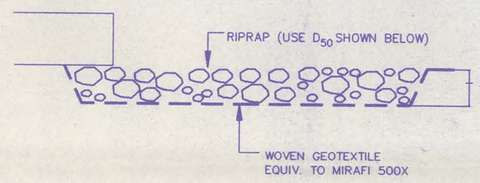
Construction Specifications

1. Ensure that the subgrade for the filter and riprap follows the required lines and grades shown in the plan. Compact any fill required in the subgrade to the density of the surrounding disturbed material. Low areas in the subgrade on undisturbed soil may also be filled by increasing the riprap thickness.
2. The riprap and gravel filter must conform to the specified grading limits shown on the plans.
3. Filter cloth, when used, must meet design requirements and be properly protected from punching or tearing during installation. Repair any damage by removing the riprap and placing another piece of filter cloth over the damaged area. All connecting joints should overlap a minimum of 1 ft. If the damage is extensive, replace the entire filter cloth.
4. Riprap may be placed by equipment, but take care to avoid damaging the filter.
5. The minimum thickness of the riprap should be 1.5 times the maximum stone diameter.
6. Riprap may be field stone or rough quarry stone. It should be hard, angular, highly weather-resistant and well graded.
7. Construct the apron on zero grade with no overfall at the end. Make the top of the riprap at the downstream end level with the receiving area or slightly below it.
8. Ensure that the apron is properly aligned with the receiving steam and preferably straight throughout its length. If a curve is needed to fit site conditions, place in the upper section of the apron.
9. Immediately after construction, stabilize all disturbed areas with vegetation.

Maintenance — Inspect riprap outlet structures after heavy rains to see if any erosion around or below the riprap has taken place or if stones have been dislodged. Immediately make all needed repairs to prevent further damage.



PLAN VIEW



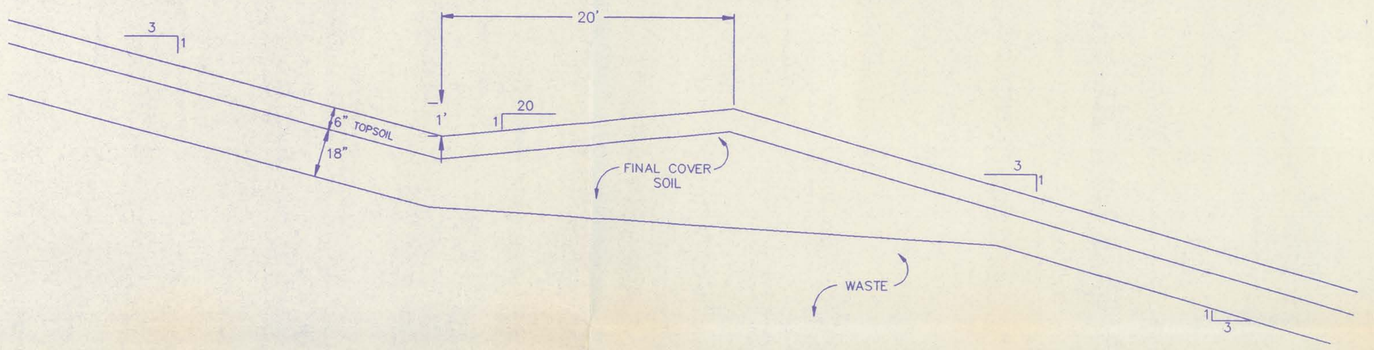
SIDE VIEW

SUMMARY OF PROTECTION APRONS

DISCHARGE PIPE LOCATION	D_P (FT)	L_A (FT)	W_P (FT)	W_A (FT)	T (IN)	D_{50} (IN)	H_{MAX} (IN)
A1	2.5	18	7.5	21.5	21	9	14

REFERENCE: N.C. EROSION AND SEDIMENTATION CONTROL PLANNING AND DESIGN MANUAL, 1988.

5/12 OUTLET PROTECTION APRON
NTS



NOTE:
APPLY EROSION CONTROL MAT ALONG ENTIRE LENGTH, 5 FEET ON 3:1, AND 10 FEET ON 20:1, OF BENCH (NORTH AMERICAN GREEN SC150 OR EQUIVALENT)

6/12 DIVERSION BERM DETAIL (3H:1V SLOPES)
NTS

NORTH CAROLINA PROFESSIONAL SEAL 023174 ENGINEER CHRISTOPHER L. STAHL 2/20/98

NO.	DATE:	DESCRIPTION	BY

S&ME
ENVIRONMENTAL SERVICES
ENGINEERING - TESTING

EROSION & SEDIMENTATION CONTROL DETAILS
LAKE NORMAN LANDFILL, INC.
LINCOLN COUNTY, NORTH CAROLINA

SCALE:	DRAWN BY:	CHECKED BY:
NTS	CLD	GLS
JOB NO. 1356-97-394	DATE: 2-18-98	SHEET 12 OF 12

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