Permit No.	Date	Document ID No.
06-03	**January 14, 2009**	**6625**

RICHARDSON SMITH GARDNER & ASSOCIATES
Engineering and Geological Services

January 9, 2009

Mr. Allen Gaither
Environmental Engineer
Division of Waste Management
Solid Waste Section
2090 US Highway 70
Swannanoa, NC 28778

Re: **Response to Comments - Transition Application**
Avery County Landfill (Solid Waste Permit No. 06-03)

Dear Mr. Gaither,

On behalf of the Avery County C&D Landfill, Richardson Smith Gardner & Associates, Inc (RSG) has prepared this response to the comments issued in correspondence dated December 16, 2008 (**copy attached**). The following responses address each comment and reference any revisions to the application previously submitted on June 26, 2008. Please find each comment in *italics* and the associated response below.

Comment No. 1

Section 1.3, Final Cover System, provides the maximum slope of the final cap will be three horizontal to one vertical, or, 33 percent. Rule 15A NCAC 13B.0543(c)(2)(A) states the post-settlement surface slopes must be a minimum of five percent and a maximum of 25 percent. Please revise these numbers or provide documentation demonstrating the proposed maximum slopes meet the criteria outlined in 15A NCAC 13B.0543(c)(3)(C).

Response No.1

A stability evaluation was performed to demonstrate that the facility is a stable and safe configuration and is included as **Attachment A** to this response. The evaluation concluded that as proposed, the configuration meets these conditions. Additionally, Section 1.3, Final Cover System, in the Closure Plan has been revised to include the following sentence:

"A stability evaluation was prepared which demonstrated a stable and safe configuration and is included as an **attachment** to this plan."

Comment No. 2

Please submit a complete Construction Quality Assurance Plan in accordance with the requirements of 15A NCAC 13B.0541.

Response No. 2

A complete CQA Plan has been prepared and is included as **Attachment B** to this response.

Comment No. 3

Rule 15A NCAC 13B.0543(c)(4) requires an owner or operator to notify the Division that a notice of the intent to close the unit has been placed in the operating record prior to beginning closure of each C&DLF unit. Please revise the plan to include this information.

Response No. 3

Section 1.6, Closure Schedule, of the Closure Plan has been revised to add the following sentence:

"Prior to initiation of any closure event, a Notice of Intent shall be submitted to the DWM and placed in the operating record."

In response to the closing comments issued in the letter, Avery County acknowledges the conditions required to return to full operations. We appreciate your attention in this matter and are prepared to promptly respond to any questions or concerns. Should you have any questions or require clarification, please contact me at (919) 828-0577, ext. 127 or by email (below).

Sincerely,

Richardson Smith Gardner & Associates, Inc.

Stacey A. Smith, P.E
Project Manager
stacey@rsgengineers.com

Attachments

Cc: Buddy Norris, Avery County Solid Waste
Bill Wagner, NCDENR
File

North Carolina Department of Environment and Natural Resources
Dexter R. Matthews, Director | Division of Waste Management | Michael F. Easley, Governor
William G. Ross Jr., Secretary

SOLID WASTE SECTION

December 16, 2008

Mr. Buddy Norris
Avery County – Solid Waste Director
PO Box 640
Newland, North Carolina 28657

Subject: Technical Review Letter
Transition Application, Avery County C&DLF
Avery County, Permit #06-03, Document ID No. 6317

Mr. Norris:

The Division of Waste Management, Solid Waste Section (Section) has completed the technical review of the document titled *Transition Application, Avery County Landfill, (Solid Waste Permit No. 06-03), Ingalls, North Carolina*. This application was submitted on your behalf by Richardson, Smith, Gardner and Associates and was received by the Section on June 27, 2008. It has been determined that additional information is required for completing the technical review. Please provide the information requested below:

Closure Plan

1. Section 1.3, Final Cover System, provides the maximum slope of the final cap will be three horizontal to one vertical, or, 33 percent. Rule 15A NCAC 13B.0543(c)(2)(A) states the post-settlement surface slopes must be a minimum of five percent and a maximum of 25 percent. Please revise these numbers or provide documentation demonstrating the proposed maximum slopes meet the criteria outlined in 15A NCAC 13B.0543(c)(3)(C).
2. Please submit a complete Construction Quality Assurance Plan in accordance with the requirements of 15A NCAC 13B.0541.
3. Rule 15A NCAC 13B.0543(c)(4) requires an owner or operator to notify the Division that a notice of the intent to close the unit has been placed in the operating record prior to beginning closure of each C&DLF unit. Please revise the plan to include this information.

The Section has determined Closure and Post-closure Cost Estimates have been prepared in accordance with 15A NCAC 13B.0546(c)(1) and (c)(3), respectively, and are acceptable. However, to fully comply with the Financial Responsibility requirement you must contact Mr. Donald Herndon in the Field Operations Branch, (919) 508-8502, for approval of the mechanism for demonstrating Financial Assurance.

As a reminder, the most recent Permit to Operate for this facility expired on October 25, 2001. In addition, the facility is at maximum capacity for existing Phases 1 and 2 and is no longer accepting waste. Prior to continuing operations at the landfill you must submit a Permit to Construct application for a new phase, prepared in accordance with 15A NCAC 13B.0547(3), for approval by the Section. Also, regardless of adequacy of the PTC application, no permit will be issued prior to complete fulfillment of the requirements of the existing Compliance Order (Document ID No. 5856).

If you should have any questions regarding this matter please contact me at (828) 296-4703, or by email at allen.gaither@ncmail.net .

Sincerely,

Allen Gaither
Environmental Engineer

Cc: Stacey Smith – RSG & Associates
Ed Mussler – SWS/CO
Bill Wagner – SWS/ARO

ATTACHMENT A

AVERY COUNTY
C&D LANDFILL

SLOPE STABILITY EVALUATION

1.0 SLOPE STABILITY

The stability of potential circular failure surfaces was evaluated based on EPA guidance and standard industry practices.

1.1 Required Factors of Safety

The minimum acceptable factors of safety for long-term slope stability were selected to be 1.5 for static conditions.

2.2 Deep-Seated Failure Surfaces

The stability of deep-seated failure surfaces was evaluated using the computer program STABL5M, a computer program developed by Purdue University, with the STEDWIN (v. 2.80) Windows interface program. Circular (rotational within waste mass and/or subgrade) failure surfaces were analyzed. The modified Bishop Method was used to analyze circular failure surfaces.

Analyses were performed for the cross sections shown in **Figure 1** (Figure 1A - Base Grades; Figure 1B - Final Cover Grades). These cross sections were chosen based on inspection as representative of worst case conditions.

2.2.1 Material Properties

A summary of material properties used in the evaluation of deep-seated failure surfaces is presented in **Table 1**. A discussion of these values is as follows:

Subgrade:

The assumed material properties for the subgrade are:

Unit Weight:	110 pcf (moist); 110 pcf (saturated)
Cohesion:	200 psf
Friction Angle (phi):	30 degrees

These properties are conservative as compared to typical soil strength properties (NAVFAC DM 7.02) considering actual subgrade conditions and the presence of relatively shallow rock in some areas.

Waste:

The assumed material properties for the C&D waste are:

Unit Weight:	70 pcf (moist); 90 pcf (saturated)
Cohesion (c):	500 psf
Friction Angle (phi):	30 degrees

The assumed unit weight is typical of landfills that do not recirculate leachate. The assumed shear strength envelope (cohesion and friction angle values) is very conservative compared to EPA guidance and summarized strength properties for MSW waste by Kavazanjian et. al. (1995) and Eid et. al. (2000). These data came from published lab and field tests on MSW wastes and from values back figured from steep landfill slopes.

2.2.2 Results

Table 2 provides a summary of the results of the stability analyses for deep-seated failure surfaces. The results demonstrate that minimum factors of safety for static conditions meet or exceed the minimum criteria (1.5 for final static conditions). These analyses are **attached**.

3.0 REFERENCES

Eid, H.T., Stark, T.D., Evans, W.D., and Sherry, P.E. (2000), "Municipal Solid Waste Slope Failure. I: Waste and Foundation Soil Properties," *Journal of Geotechnical and Geoenvironmental Engineering*, ASCE, Vol. 126, No. 5, pp. 397-407.

Kavazanjian, E., Bonaparte, R., and Schmertmann, G.R. (1995), "Evaluation of MSW Properties for Seismic Analysis," Proceedings of the *Geoenvironment 2000* Specialty Conference, ASCE, Vol. 2, pp. 1126-1141, New Orleans, LA, 24-26 February 1995.

Naval Facilities Engineering Command (1986), Foundations and Earth Structures (Design Manual 7.02), Naval Facilities Engineering Command, Alexandria, VA, p. 7.2-39.

Richardson, G.N., Kavazanjian, E., and N. Matasovic (1995), RCRA Subtitle D (258) Seismic Design Guidance for Municipal Solid Waste Landfill Facilities, EPA/600/R-95/051, U.S. Environmental Protection Agency, Washington, D.C.

U.S. Army Corps of Engineers (2003), Engineering and Design - Slope Stability, Engineer Manual, EM 1110-2-1902, Dept. of the Army, Washington, D.C.

TABLE 1: MATERIAL PROPERTIES USED IN SLOPE STABILITY ANALYSES

Material	Unit Weight (pcf)	Shear Strength Properties[1]	
		Cohesion/ Adhesion (*c*) (psf)	Friction Angle (ϕ) (degrees)
Subgrade	110 (Moist) 110 (Saturated)	200	30
Waste (C&D)	70 (Moist) 70 (Saturated)	50	28

Notes:

1. Combinations of cohesion/adhesion and friction angle that are different than these values that produce the same shear strength could also be used here (shear strength (τ) = normal load x tan (ϕ) + *c*).

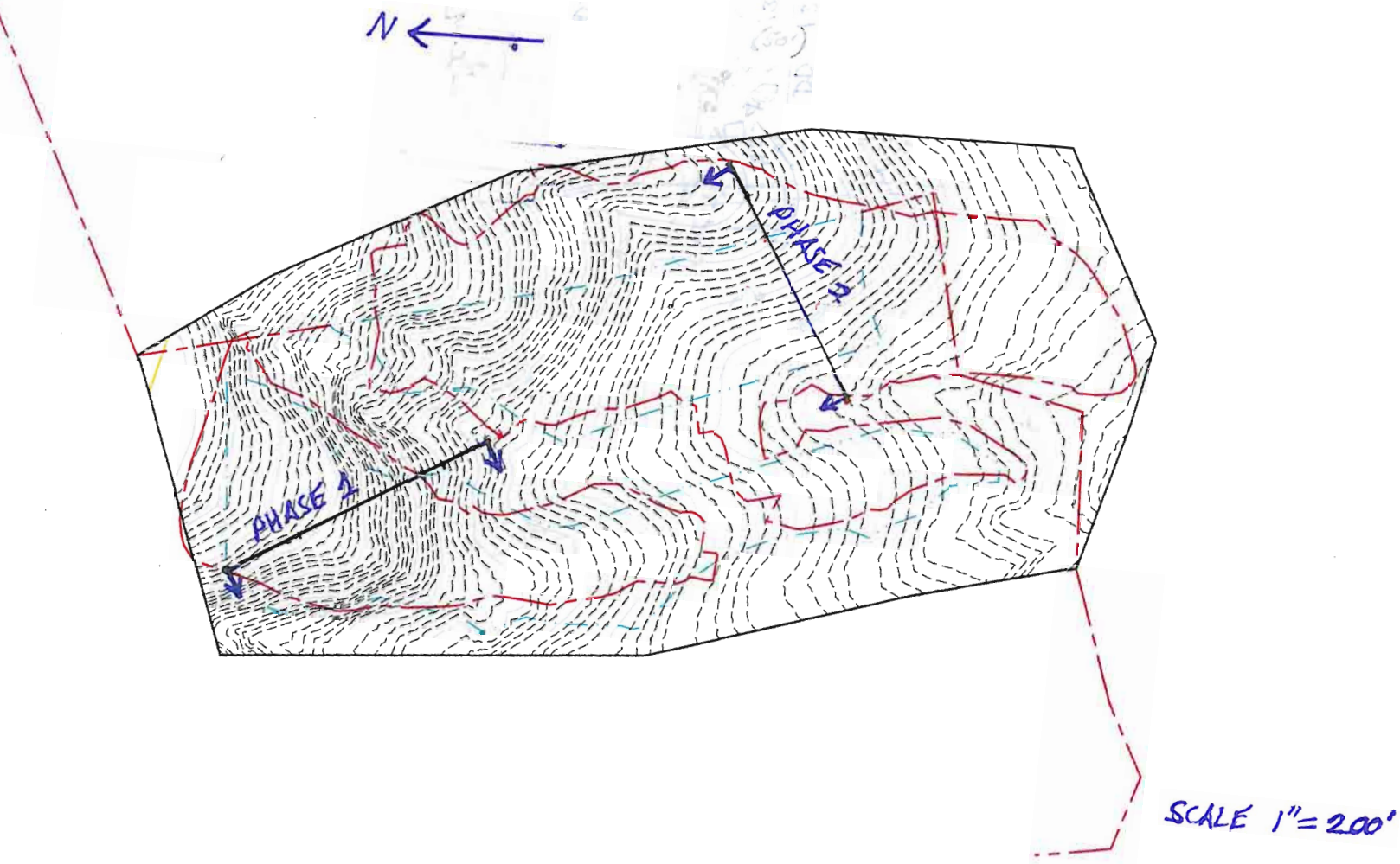
TABLE 2: RESULTS SUMMARY - DEEP-SEATED FAILURE SURFACES

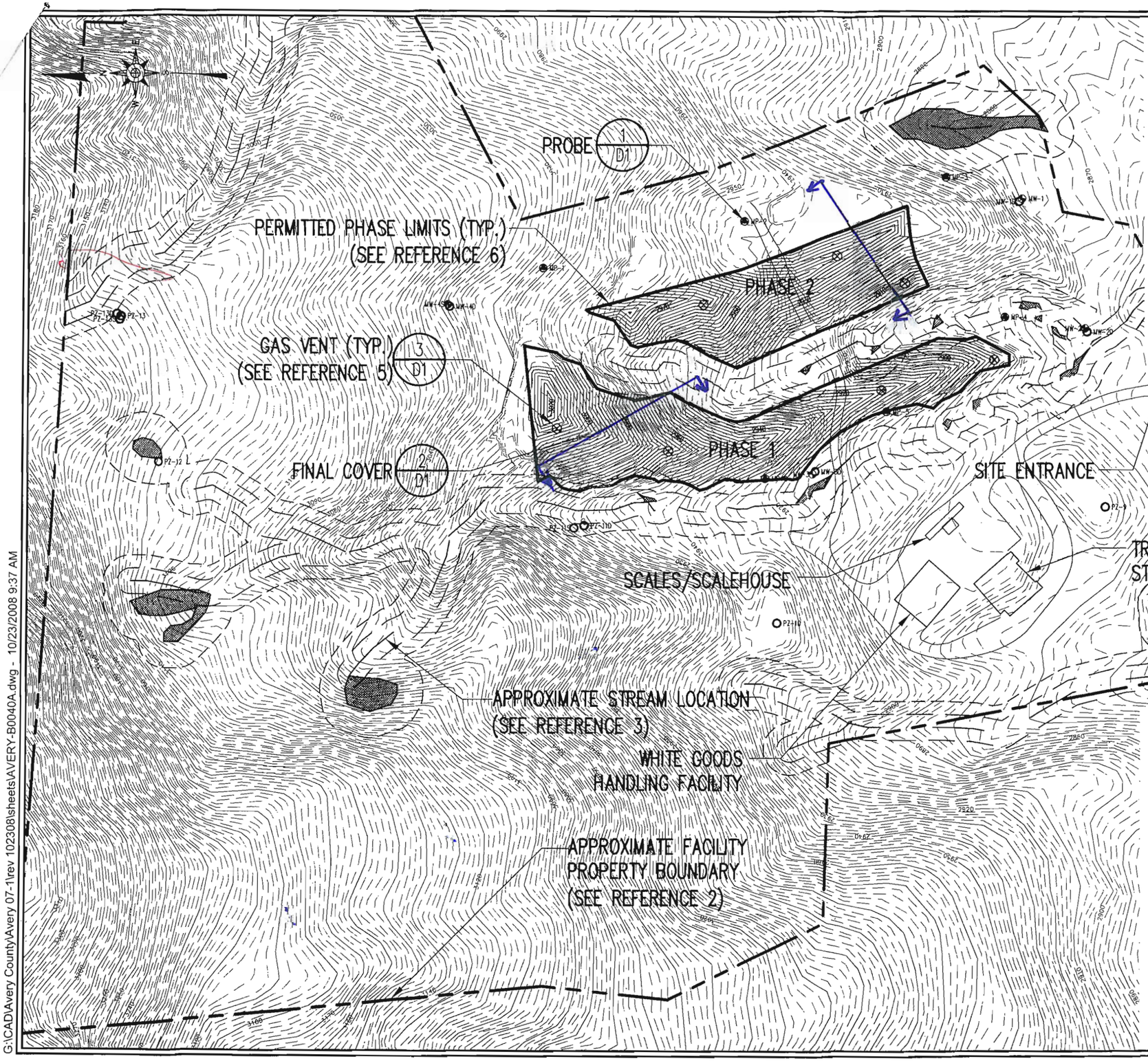
Cross Section Analyzed (Condition)	Failure Type	Method of Analysis	Factor of Safety[1]
			Static (FS $\geq$ 1.5 - Final)
Phase 1	Circular	Modified Bishop	2.38
Phase 2	Circular	Modified Bishop	1.63

Notes:

1. See **Table 1** for material properties used in each run.

FIGURE 1A
BASE GRADES
TBM 11/7/09





LEGEND

- EXISTING 10' CONTOUR (SEE REFERENCE 1)
- EXISTING 2' CONTOUR
- PROPERTY LINE (SEE REFERENCE 2)
- APPROX. STREAM LOACTION (SEE REFERENCES 3, 4)
- 50-FOOT STREAM AND WETLAND BUFFER
- 25-FOOT TROUT STREAM BUFFER
- WETLANDS (SEE REFERENCES 3, 4)
- MONITORING WELL
- PIEZOMETER
- METHANE GAS MONITORING PROBE
- GAS VENT

FIGURE 1B
FINAL COVER GRADES

REFERENCES

1. OVERALL SITE TOPOGRAPHY FROM NORTH CAROLINA DEPARTMENT OF TRANSPORTATION, DATA GENERATED FROM LIDAR DATED MARCH 2005, TOPO IN AREAS IN AND SURROUNDING PHASES 1 AND 2 FROM FIELD SURVEY DATED 9/07, BY SURVEYING SOLUTIONS, P.C.
2. SITE PROPERTY LINE AND MONITORING WELLS FROM FIELD SURVEYS DATED 9/07 AND 1/14/08, BY SURVEYING SOLUTIONS, P.C.
3. STREAM AND WETLAND LOCATIONS IN NORTHERN SECTOR OF SITE OBTAINED FROM GPS FIELD SURVEY DATED 4/07, BY CAROLINA ECOSYSTEMS, INC.
4. STREAMS AND WETLANDS NEAR PHASE 1 AND 2 FROM FIELD SURVEY DATED 2/18/08 BY SURVEYING SOLUTIONS, P.C.
5. METHANE GAS MONITORING PROBE LOCATIONS AND GAS VENT LOCATIONS FROM DRAWING "PROPOSED METHANE PLAN" BY MUNICIPAL ENGINEERING SERVICES CO., PA, DATED JULY 12, 1996.

0 200' 400' 600'

RICHARDSON SMITH GARDNER & ASSOCIATES
14 N. Boylan Ave. Raleigh, N.C. 27603
ph: 919-828-0577 fax: 919-828-3899
www.rsgengineers.com

FIGURE NO. 2
FILE NAME AVERY-B0040A
SCALE: AS SHOWN
CHECKED BY:
PROJECT NO. AVERY 07-1
DRAWN BY: J.A.L.
DATE: Oct. 2008

TITLE:
AVERY COUNTY
SOLID WASTE DEPARTMENT
AVERY COUNTY C&D LANDFILL
FINAL GRADING PLAN

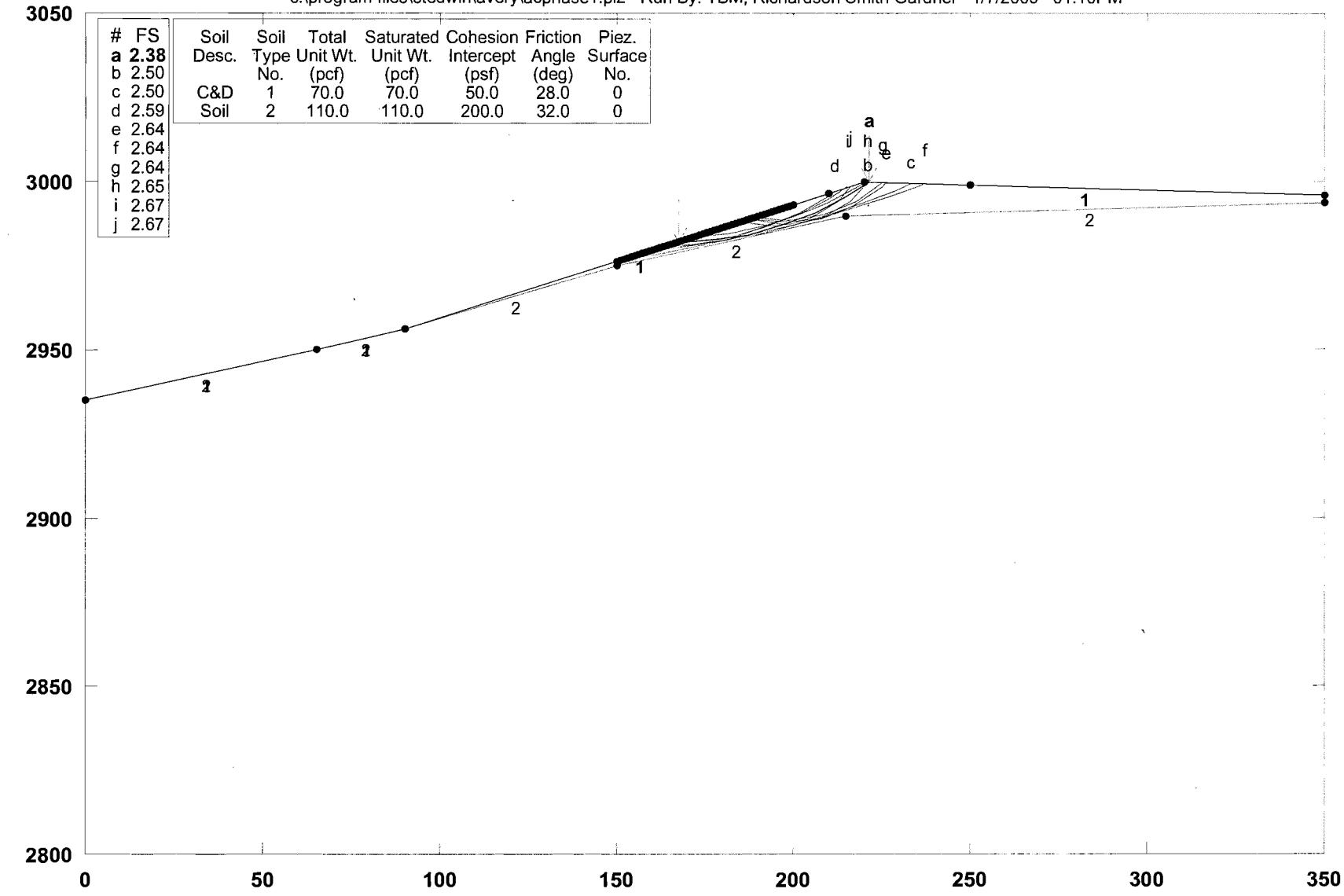
G:\CAD\Avery County\Avery 07-1\rev 102308\sheets\AVERY-B0040A.dwg - 10/23/2008 9:37 AM

Avery County C&D Landfill Phase 1 - Check for Circular Failure

c:\program files\stedwin\avery\acphase1.pl2 Run By: TBM, Richardson Smith Gardner 1/7/2009 01:10PM

#	FS
a	**2.38**
b	2.50
c	2.50
d	2.59
e	2.64
f	2.64
g	2.64
h	2.65
i	2.67
j	2.67

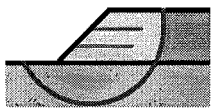
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
C&D	1	70.0	70.0	50.0	28.0	0
Soil	2	110.0	110.0	200.0	32.0	0



STABL6H FSmin=2.38

Safety Factors Are Calculated By The Modified Bishop Method

STED



**** STABL6H ****
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 1/7/2009
Time of Run: 01:10PM
Run By: TBM, Richardson Smith Gardner
Input Data Filename: C:acphase1.in
Output Filename: C:acphase1.OUT
Plotted Output Filename: C:acphase1.PLT
PROBLEM DESCRIPTION Avery County C&D Landfill
Phase 1 - Check for Circular Failure
BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 2800.00 to Y-values listed.

4 Top Boundaries
9 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	135.00	65.00	150.00	1
2	65.00	150.00	90.00	156.00	1
3	90.00	156.00	220.00	200.00	1
4	220.00	200.00	350.00	196.00	1
5	.00	135.00	65.00	150.00	2
6	65.00	150.00	90.00	156.00	2
7	90.00	156.00	150.00	175.00	2
8	150.00	175.00	215.00	190.00	2
9	215.00	190.00	350.00	194.00	2

ISOTROPIC SOIL PARAMETERS
2 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	70.0	70.0	50.0	28.0	.00	.0	0
2	110.0	110.0	200.0	32.0	.00	.0	0

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
500 Trial Surfaces Have Been Generated.
10 Surfaces Initiate From Each Of 50 Points Equally Spaced
Along The Ground Surface Between X = 150.00 ft.
and X = 200.00 ft.
Each Surface Terminates Between X = 210.00 ft.
and X = 250.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = .00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
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 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	167.35	182.18
2	177.33	182.72
3	187.20	184.36
4	196.82	187.07
5	206.10	190.81
6	214.90	195.55
7	221.31	199.96

Circle Center At X = 167.4 ; Y = 273.4 and Radius, 91.2
*** 2.384 ***
Failure Surface Specified By 9 Coordinate Points

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

1	152.04	177.00
2	161.93	178.49
3	171.72	180.52
4	181.39	183.08
5	190.90	186.16
6	200.23	189.76
7	209.36	193.85
8	218.24	198.44
9	220.86	199.97

Circle Center At X = 129.5 ; Y = 359.4 and Radius, 183.8

*** 2.495 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	161.22	180.11
2	171.17	181.20
3	181.04	182.76
4	190.83	184.79
5	200.52	187.28
6	210.07	190.23
7	219.48	193.63
8	228.71	197.48
9	233.18	199.59

Circle Center At X = 143.3 ; Y = 389.6 and Radius, 210.3

*** 2.504 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	163.27	180.80
2	173.22	181.73
3	183.02	183.75
4	192.53	186.84
5	201.64	190.96
6	210.24	196.07
7	211.75	197.21

Circle Center At X = 159.9 ; Y = 271.2 and Radius, 90.4

*** 2.586 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	187.76	189.09
2	197.69	187.93
3	207.61	189.19
4	216.94	192.80
5	225.12	198.54
6	226.23	199.81

Circle Center At X = 197.5 ; Y = 229.3 and Radius, 41.3

*** 2.637 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	159.18	179.42
2	169.09	180.82
3	178.94	182.54
4	188.73	184.56
5	198.45	186.90
6	208.10	189.54
7	217.65	192.48
8	227.11	195.73
9	236.47	199.27
10	236.97	199.48

Circle Center At X = 119.7 ; Y = 493.5 and Radius, 316.6

*** 2.643 ***

Failure Surface Specified By 5 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	188.78	189.43

2	198.75	188.72
3	208.62	190.36
4	217.83	194.25
5	225.40	199.83

Circle Center At X = 196.8 ; Y = 231.2 and Radius, 42.5
*** 2.644 ***

Failure Surface Specified By 5 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	187.76	189.09
2	197.60	187.35
3	207.45	189.09
4	216.10	194.10
5	221.00	199.97

Circle Center At X = 197.6 ; Y = 216.1 and Radius, 28.7
*** 2.648 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	171.43	183.56
2	181.39	184.48
3	191.15	186.64
4	200.57	189.99
5	209.50	194.49
6	215.39	198.44

Circle Center At X = 169.0 ; Y = 263.8 and Radius, 80.3
*** 2.666 ***

Failure Surface Specified By 5 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	184.69	188.05
2	194.60	186.69
3	204.37	188.82
4	212.81	194.18
5	216.31	198.75

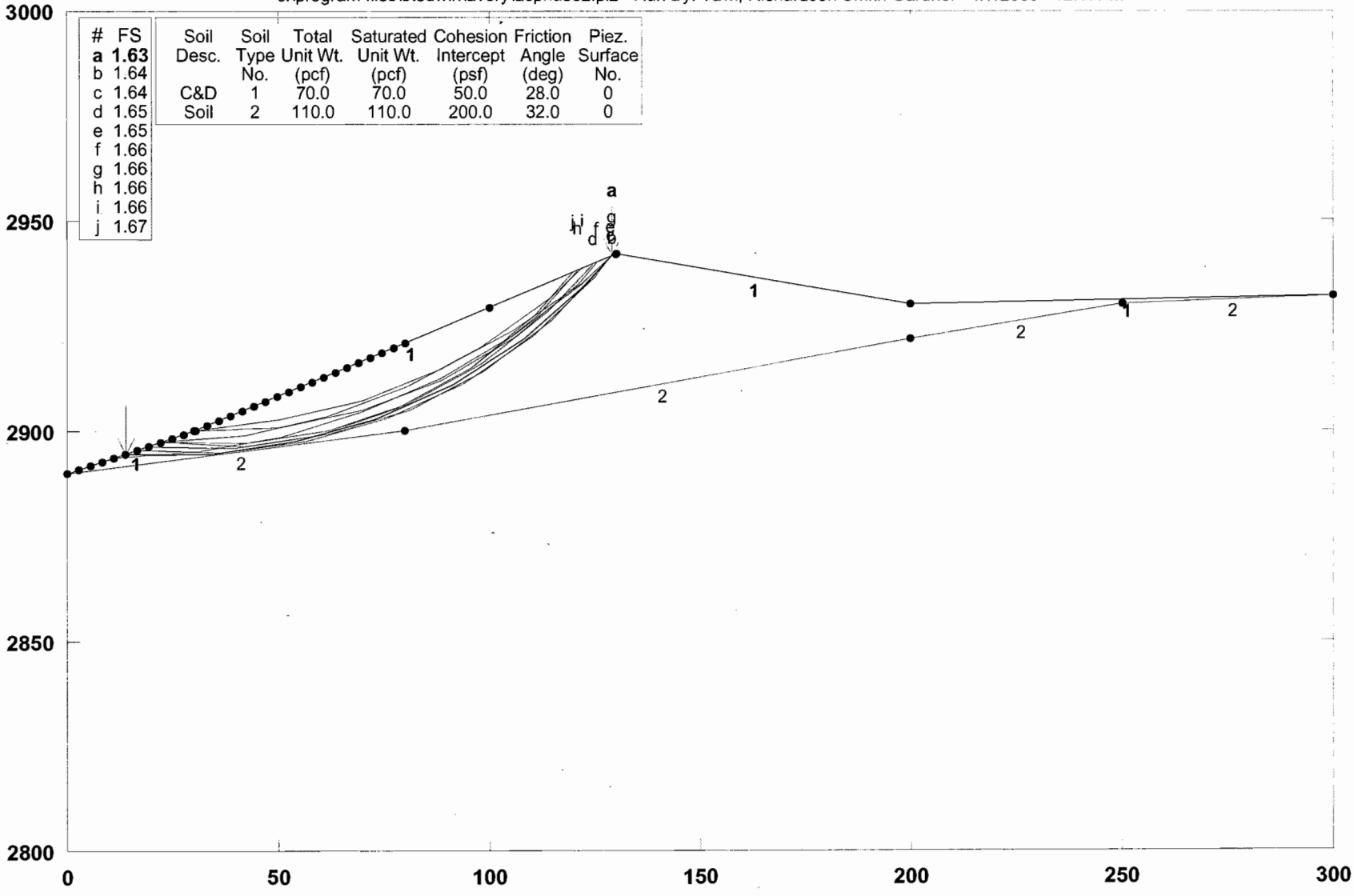
Circle Center At X = 193.5 ; Y = 215.3 and Radius, 28.6
*** 2.674 ***

Avery County C&D Landfill Phase 2 - Check for Circular Failure

c:\program files\stedwin\avery\acphase2.pl2 Run By: TBM, Richardson Smith Gardner 1/7/2009 12:17PM

#	FS
a	**1.63**
b	1.64
c	1.64
d	1.65
e	1.65
f	1.66
g	1.66
h	1.66
i	1.66
j	1.67

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
C&D	1	70.0	70.0	50.0	28.0	0
Soil	2	110.0	110.0	200.0	32.0	0



STABL6H FSmin=1.63

Safety Factors Are Calculated By The Modified Bishop Method

STED

**** STABL6H ****

by

Purdue University

--Slope Stability Analysis--

Simplified Janbu, Simplified Bishop

or Spencer`s Method of Slices

Run Date: 1/7/2009
Time of Run: 12:17PM
Run By: TBM, Richardson Smith Gardner
Input Data Filename: C:acphase2.in
Output Filename: C:acphase2.OUT
Plotted Output Filename: C:acphase2.PLT
PROBLEM DESCRIPTION Avery County C&D Landfill
Phase 2 - Check for Circular Failure

BOUNDARY COORDINATES

Note: User origin value specified.
Add 0.00 to X-values and 2800.00 to Y-values listed.

4 Top Boundaries
8 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	90.00	30.00	100.00	1
2	30.00	100.00	130.00	142.00	1
3	130.00	142.00	200.00	130.00	1
4	200.00	130.00	300.00	132.00	1
5	.00	90.00	80.00	100.00	2
6	80.00	100.00	200.00	122.00	2
7	200.00	122.00	250.00	130.00	2
8	250.00	130.00	300.00	132.00	2

ISOTROPIC SOIL PARAMETERS

2 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	70.0	70.0	50.0	28.0	.00	.0	0
2	110.0	110.0	200.0	32.0	.00	.0	0

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
300 Trial Surfaces Have Been Generated.
10 Surfaces Initiate From Each Of 30 Points Equally Spaced
Along The Ground Surface Between X = .00 ft.
and X = 80.00 ft.
Each Surface Terminates Between X = 100.00 ft.
and X = 130.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = .00 ft.
20.00 ft. Line Segments Define Each Trial Failure Surface.
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 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	13.79	94.60
2	33.79	94.56
3	53.60	97.34
4	72.81	102.90
5	91.05	111.12
6	107.94	121.83
7	123.14	134.82
8	129.15	141.64

Circle Center At X = 24.1 ; Y = 235.4 and Radius, 141.2
*** 1.632 ***
Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	11.03	93.68
2	30.99	95.09

3	50.65	98.74
4	69.77	104.61
5	88.10	112.60
6	105.41	122.62
7	121.48	134.53
8	129.03	141.59

Circle Center At X = 8.6 ; Y = 269.9 and Radius, 176.2
*** 1.635 ***
Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	16.55	95.52
2	36.54	94.88
3	56.38	97.39
4	75.59	102.99
5	93.67	111.52
6	110.20	122.79
7	124.75	136.51
8	128.50	141.37

Circle Center At X = 30.6 ; Y = 221.8 and Radius, 127.1
*** 1.642 ***
Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.07	97.36
2	42.07	97.14
3	61.82	100.28
4	80.77	106.68
5	98.38	116.16
6	114.16	128.45
7	124.39	139.64

Circle Center At X = 33.3 ; Y = 215.9 and Radius, 119.1
*** 1.654 ***
Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.07	97.36
2	42.05	96.56
3	61.88	99.19
4	80.96	105.17
5	98.74	114.33
6	114.69	126.40
7	128.34	141.02
8	128.59	141.41

Circle Center At X = 36.7 ; Y = 212.9 and Radius, 116.5
*** 1.654 ***
Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	30.35	100.15
2	50.33	100.84
3	69.93	104.83
4	88.60	112.02
5	105.81	122.19
6	121.10	135.08
7	125.30	140.03

Circle Center At X = 36.2 ; Y = 220.3 and Radius, 120.3
*** 1.655 ***
Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	30.35	100.15
2	50.20	102.59
3	69.60	107.44
4	88.27	114.62
5	105.92	124.02
6	122.29	135.50

```
    7        129.05      141.60
Circle Center At X =   20.3 ; Y =  263.5  and Radius,  163.6
      ***     1.661   ***
Failure Surface Specified By  7 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1         19.31       96.44
    2         39.31       96.05
    3         59.07       99.10
    4         78.02      105.50
    5         95.60      115.05
    6        111.27      127.47
    7        120.77      138.12
Circle Center At X =   31.5 ; Y =  212.0  and Radius,  116.2
      ***     1.663   ***
Failure Surface Specified By  7 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1         22.07       97.36
    2         41.99       99.17
    3         61.49      103.58
    4         80.25      110.53
    5         97.93      119.88
    6        114.22      131.48
    7        121.82      138.56
Circle Center At X =   18.3 ; Y =  248.9  and Radius,  151.6
      ***     1.663   ***
Failure Surface Specified By  7 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1         19.31       96.44
    2         39.30       95.95
    3         59.07       98.98
    4         78.00      105.44
    5         95.50      115.12
    6        111.03      127.72
    7        119.60      137.63
Circle Center At X =   32.1 ; Y =  209.2  and Radius,  113.4
      ***     1.668   ***
```

ATTACHMENT B

Construction Quality Assurance Manual

Avery County C&D Landfill
Ingalls, North Carolina
NC Solid Waste Permit No. 06-03

Prepared for:

Avery County
175 Linville Street
Newland, North Carolina

January 2009

PERMIT ISSUE DOCUMENTS

Prepared by:

RICHARDSON SMITH GARDNER & ASSOCIATES
ENGINEERING & GEOLOGICAL SERVICES

AVERY COUNTY
C&D LANDFILL

CONSTRUCTION QUALITY ASSURANCE MANUAL

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Table of Contents (Continued)

SECTION 1.0
GENERAL

1.1 INTRODUCTION

This Construction Quality Assurance (CQA) Manual has been prepared to provide the Owner, (Design) Engineer, and CQA Engineer the means to govern the construction quality and to satisfy landfill certification requirements under current solid waste management regulations.

More specifically, this CQA Manual addresses the construction of the landfill base grades and the final cover system.

The CQA Manual is divided into the following sections:

- Section 1.0 General
- Section 2.0 CQA Documentation
- Section 3.0 Earthwork CQA
- Section 4.0 Soil Liner CQA
- Section 5.0 Final Cover System CQA

1.2 DEFINITIONS RELATING TO CONSTRUCTION QUALITY

1.2.1 Construction Quality Assurance (CQA)

In the context of this Manual, Construction Quality Assurance is defined as a planned and systematic program employed by the Owner to assure conformity of the earthwork, liner, and final cover systems installation with the project drawings and the project specifications. CQA is provided by the CQA Engineer as a representative of the Owner and is independent from the Contractor, and all manufacturers. The CQA program is designed to provide adequate confidence that items or services meet contractual and regulatory requirements and will perform satisfactorily in service.

1.2.2 Construction Quality Control (CQC)

Construction Quality Control refers to actions taken by manufacturers, fabricators, installers, and/or the Contractor to ensure that the materials and the workmanship meet the requirements of the project drawings and the project specifications. The manufacturer's specifications and quality control (QC) requirements are included in this CQA Manual by reference only. A complete updated version of each geosynthetic component manufacturer's QC Plan shall be incorporated as part of the Contractor's CQC Plan.

1.2.3 CQA Certification Document

At the completion of construction, a certification document will be prepared by the CQA Engineer and submitted to State Solid Waste Regulators. The certification report will

include all QC testing performed by the Geosynthetics Manufacturers, all CQC testing performed by the Geosynthetic Installers, and all CQA testing performed by the CQA Engineer.

1.2.4 Discrepancies Between Documents

The Contractor is instructed to bring discrepancies to the attention of the CQA Engineer who shall then notify the Engineer for resolution. The Engineer has the sole authority to determine resolution of discrepancies existing within the Contract Documents (this may also require the approval of State Solid Waste Regulators). Unless otherwise determined by the Engineer, the more stringent requirement shall be the controlling resolution.

1.3 PARTIES TO CONSTRUCTION QUALITY ASSURANCE

1.3.1 Description of the Parties

The parties to Construction Quality Assurance and Quality Control include the Owner, Engineer, Contractor, Geosynthetics Manufacturer, Geosynthetics Installer, CQA Engineer, Geosynthetics CQA Laboratory, and Soils CQA Laboratory.

1.3.1.1 Owner

The Owner is Avery County, who owns and/or is responsible for the facility.

1.3.1.2 Engineer

The Engineer is responsible for the engineering design, drawings, and project specifications for the landfill. The Engineer is an official representative of the Owner. The Engineer serves as communications coordinator for the project, initiating the meetings outlined in **Section 1.7**. The Engineer will also be responsible for proper resolution of all quality issues that arise during construction. The Engineer is Richardson Smith Gardner & Associates, Inc.

1.3.1.3 Contractor

The Contractor is responsible for the construction of the landfill. The Contractor is responsible for the overall CQC on the project and coordination of submittals to the CQA Engineer. Additional responsibilities of the Contractor are defined by the project specifications.

1.3.1.4 CQA Engineer

The CQA Engineer is a representative of the Owner, is independent from the Contractor, and is responsible for observing, testing, and documenting activities related to the CQA of the earthworks at the site, and the installation of the soil liner,

and final cover systems. The CQA Engineer may make field observations and review submittals for the Engineer and is responsible for notifying the Owner and Engineer of all quality issues that arise during construction. The CQA Engineer is also responsible for issuing a facility certification report, sealed by a Professional Engineer registered in The State of North Carolina. Note that if the Certifying Engineer is with the same firm as the Design Engineer, they must be different individuals.

1.3.1.5 Soils CQA Laboratory

The Soils CQA Laboratory is a party, independent from the Owner, that is responsible for conducting geotechnical tests on conformance samples of soils and aggregates used in structural fills and the liner, and final cover systems. The services of the Soils CQA Laboratory are coordinated by the CQA Engineer and are paid for by the Owner.

1.3.2 Qualifications of the Parties

The following qualifications are required of all parties involved with the manufacture, fabrication, installation, transportation, and CQA of all materials for the landfill. Where applicable, these qualifications must be submitted by the Contractor to the Owner and Engineer for review and approval.

1.3.2.1 Contractor

Qualifications of the Contractor are specific to the construction contract and independent of this CQA Manual.

1.3.2.2 CQA Engineer

The CQA Engineer will act as the Owner's Quality Assurance Representative. The CQA Engineer will perform CQA testing to satisfy the requirements of this CQA Manual and will prepare the CQA certification document. The CQA Engineer will have experience in the CQA aspects of the construction and testing of structural fills and final cover systems, and be familiar with ASTM and other related industry standards. The activities of the CQA Engineer will be performed under the supervision of a Registered Professional Engineer.

1.3.2.3 Soils CQA Laboratory

The Soils CQA Laboratory will have experience in testing structural fills, soil liners, and aggregates, and be familiar with ASTM and other applicable test standards. The Soils CQA Laboratory will be capable of providing test results within 24 hours or a reasonable time after receipt of samples depending on the test(s) to be

conducted, as agreed to at the outset of the project by affected parties, and will maintain that standard throughout the installation.

1.4 SCOPE OF CONSTRUCTION QUALITY ASSURANCE MANUAL

The scope of this CQA Manual includes the CQA of the soils and geosynthetic components of the liner, and final cover systems for the subject facility. The CQA for the selection, evaluation, and placement of the soils is included in the scope.

1.5 UNITS

In this CQA Manual, all properties and dimensions are expressed in U.S. units.

1.6 REFERENCES

The CQA Manual includes references to the most recent version of the test procedures of the American Society of Testing and Materials (ASTM). **Appendix A** contains a list of these procedures.

1.7 CQA MEETINGS

To facilitate the specified degree of quality during installation, clear, open channels of communication are essential. To that end, meetings are critical.

1.7.1 Soil Liner CQA Meeting

Prior to the start of the soil liner system construction a CQA Meeting will be held. This meeting will include all parties then involved, including the Engineer, the CQA Engineer, and the Contractor.

The purpose of this meeting is to begin planning for coordination of tasks, anticipate any problems which might cause difficulties and delays in construction, and, above all, review the CQA Manual to all of the parties involved. It is very important that the rules regarding testing, repair, etc., be known and accepted by all.

This meeting should include all of the activities referenced in the project specifications.

The meeting will be documented by the Engineer and minutes will be transmitted to all parties. The Soil Liner CQA Meeting and the Geosynthetics CQA Meeting may be held as one meeting or separate meetings, depending on the direction of the Engineer.

1.7.2 CQA Progress Meetings

Progress meetings will be held between the Engineer, the CQA Engineer, the Contractor, the Geosynthetic Installation Superintendent(s), and representatives from any other

involved parties at the frequency dictated in the project specifications or, at a minimum, once per month during active construction. These meetings will discuss current progress, planned activities for the next week, and any new business or revisions to the work. The CQA Engineer will log any problems, decisions, or questions arising at this meeting in his daily or periodic reports. Any matter requiring action which is raised in this meeting will be reported to the appropriate parties. These meetings will be documented by the Engineer and minutes will be transmitted to affected parties.

1.7.3 Problem or Work Deficiency Meetings

A special meeting will be held when and if a problem or deficiency is present or likely to occur. At a minimum, the meeting will be attended by the Engineer, the CQA Engineer, the Contractor, and representatives from any other involved parties. The purpose of the meeting is to define and resolve the problem or work deficiency as follows:

- define and discuss the problem or deficiency;
- review alternative solutions; and
- implement an action plan to resolve the problem or deficiency.

The meeting will be documented by the Engineer and minutes will be transmitted to affected parties.

1.8 CONTROL VERSUS RECORD TESTING

1.8.1 Control Testing

In the context of this CQA Manual, Control Tests are those tests performed on a material prior to its actual use in construction to demonstrate that it can meet the requirements of the project plans and specifications. Control Test data may be used by the Engineer as the basis for approving alternative material sources.

1.8.2 Record Testing

Record Tests are those tests performed during the actual placement of a material to demonstrate that its in-place properties meet or exceed the requirements of the project drawings and specifications.

SECTION 2.0
CQA DOCUMENTATION

2.1 DOCUMENTATION

An effective CQA plan depends largely on recognition of construction activities that should be monitored and on assigning responsibilities for the monitoring of each activity. This is most effectively accomplished and verified by the documentation of quality assurance activities. The CQA Engineer will document that quality assurance requirements have been addressed and satisfied.

The CQA Engineer will provide the Owner and Engineer with his daily and weekly progress reports including signed descriptive remarks, data sheets, and logs to verify that required CQA activities have been carried out. These reports will also identify potential quality assurance problems. The CQA Engineer will also maintain at the job site a complete file of project drawings, reports, project specifications, a CQA Manual, checklists, test procedures, daily logs, and other pertinent documents.

2.2 DAILY CQA REPORT

The CQA Engineer's reporting procedures will include preparation of a daily report which, at a minimum, will include the following information, where applicable:

- a unique identifying sheet number for cross referencing and document control;
- date, project name, location, and other identification;
- data on weather conditions;
- a reduced-scale Site Plan showing all proposed work areas and test locations;
- descriptions and locations of ongoing construction;
- descriptions and specific locations of areas, or units, of work being tested and/or observed and documented;
- locations where tests and samples were taken;
- a summary of test results;
- calibrations or recalibrations of test equipment, and actions taken as a result of recalibration;
- off-site materials received, including quality verification documentation;

- decisions made regarding acceptance of units of work, and/or corrective actions to be taken in instances of substandard quality;

- summaries of pertinent discussions with the Contractor and/or Geosynthetic Installers; and

- the CQA Engineer's signature.

The daily report must be completed at the end of each CQA Engineer's shift, prior to leaving the site. This information will be submitted weekly to and reviewed by the Owner and Engineer.

2.3 CQA PROGRESS REPORTS

The CQA Engineer will prepare a summary progress report each week, or at time intervals established at the pre-construction meeting. As a minimum, this report will include the following information, where applicable:

- a unique identifying sheet number for cross-referencing and document control;

- the date, project name, location, and other information;

- a summary of work activities during the progress reporting period;

- a summary of construction situations, deficiencies, and/or defects occurring during the progress reporting period;

- summary of all test results, failures and retests, and

- signature of the CQA Engineer.

The CQA Engineer's progress reports must summarize the major events that occurred during that week. Critical problems that occur shall be communicated verbally to the Engineer immediately as well as being included in the weekly reports. The CQA Engineer's weekly report must be submitted to the Owner and Engineer no later than the Monday following the week reported.

2.4 CQA PHOTOGRAPHIC REPORTING

Photographs will be taken by the CQA Engineer at regular intervals during the construction process and in all areas deemed critical by the CQA Engineer.

These photographs will serve as a pictorial record of work progress, problems, and mitigation activities. These records will be presented to the Engineer upon completion of the project.

In lieu of photographic documentation, videotaping may be used to record work progress,

problems, and mitigation activities. The Engineer may require that a portion of the documentation be recorded by photographic means in conjunction with videotaping.

2.5 DEFICIENCIES

The Owner and Engineer will be made aware of any significant recurring nonconformance with the project specifications. The Engineer will then determine the cause of the non-conformance and recommend appropriate changes in procedures or specification. When this type of evaluation is made, the results will be documented, and any revision to procedures or project specifications will be approved by the Owner and Engineer.

2.6 DESIGN AND/OR PROJECT TECHNICAL SPECIFICATION CHANGES

Design and/or project specification changes may be required during construction. In such cases, the CQA Engineer will notify the Engineer. The Engineer will then notify the appropriate agency, if necessary.

Design and/or project specification changes will be made only with the written agreement of the Engineer, and will take the form of an addendum to the project specifications. All design changes will include a detail (if necessary) and state which detail it replaces in the plans.

2.7 FINAL CQA REPORT

At the completion of each major construction activity at the landfill unit, the CQA Engineer will certify all required forms, observation logs, field and laboratory testing data sheets including sample location plans, etc. The CQA Engineer will also provide a final report which will certify that the work has been performed in compliance with the plans and project technical specifications, and that the supporting documents provide the necessary information.

The CQA Engineer will also provide summaries of all the data listed above with the report. The Record Drawings will include scale drawings depicting the location of the construction and details pertaining to the extent of construction (e.g., depths, plan dimensions, elevations, soil component thicknesses, etc.). All surveying and base maps required for development of the Record Drawings will be done by the Contractor's Construction Surveyor. These documents will be certified by the Contractor and delivered to the CQA Engineer and included as part of the final CQA (Certification) report.

It may be necessary to prepare interim certifications, as allowed by the regulatory agency to expedite completion and review.

At a minimum, the items shown in **Table 2.1** will be included in the Final CQA Report. Note that some items may not be applicable to all projects.

2.8 STORAGE OF RECORDS

All handwritten data sheet originals, especially those containing signatures, will be stored by the CQA Engineer in a safe repository on site. Other reports may be stored by any standard method which will allow for easy access. All written documents will become property of the Owner.

TABLE 2.1: FINAL CQA REPORT GENERAL OUTLINE

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SECTION 3.0
EARTHWORK CQA

3.1 INTRODUCTION

This section of the CQA Manual addresses earthwork (excavation and embankment) and outlines the soils CQA program to be implemented with regard to material approval, subgrade approval, field control and record tests, and resolution of problems.

3.2 EMBANKMENT MATERIAL APPROVAL

All material to be used as compacted embankment shall be approved in advance by the CQA Engineer. Approval is based upon successful completion of CQA control testing outlined below. Such testing can be performed either during excavation and stockpiling or from existing stockpiles prior to use.

3.2.1 Control Tests

The procedure for CQA testing during excavation and stockpiling (including existing stockpiles) is outlined below.

Each load of soil will be examined either at the borrow source or the stockpile area. Any unsuitable material will be rejected or routed to separate stockpiles consistent with its end use. Appropriate entries will be made in the daily log.

During stockpiling operations, control tests, as shown on **Table 3.1**, will be performed by the CQA Engineer prior to placement of any compacted embankment.

3.3 SUBGRADE APPROVAL

The CQA Engineer will verify that the compacted embankment subgrade is constructed in accordance with the project specifications.

3.4 EARTHWORK CONSTRUCTION

3.4.1 Construction Monitoring

A. Earthwork shall be performed as described in the project specifications.

B. Only soil previously approved by the CQA Engineer (see **Section 3.2**) shall be used in construction of the compacted embankment. Unsuitable material will be removed prior to acceptance by the CQA Engineer.

C. All required field density and moisture content tests shall be completed before the overlying lift of soil is placed. The surface preparation (e.g. wetting, drying,

scarification, etc.) shall be completed before the CQA Engineer will allow placement of subsequent lifts.

D. The CQA Engineer will monitor protection of the earthwork during and after construction.

3.4.2 Control Tests

The control tests, as shown on **Table 3.2**, will be performed by the CQA Engineer prior to placement of compacted embankment.

3.4.3 Record Tests

The record tests, as shown on **Table 3.2**, will be performed by the CQA Engineer during placement of compacted embankment.

3.4.3.1 Record Test Failure

Recompaction of the failed area shall be performed and retested until the area meets or exceeds requirements outlined in the specifications.

3.4.4 Judgmental Testing

During construction, the frequency of control and/or record testing may be increased at the discretion of the CQA Engineer when visual observations of construction performance indicate a potential problem. Additional testing for suspected areas will be considered when:

- the rollers slip during rolling operation;
- the lift thickness is greater than specified;
- the fill material is at an improper moisture content;
- fewer than the specified number of roller passes are made;
- dirt-clogged rollers are used to compact the material;
- the rollers may not have used optimum ballast;
- the fill materials differ substantially from those specified; or
- the degree of compaction is doubtful.

3.5 DEFICIENCIES

The CQA Engineer will immediately determine the extent and nature of all defects and deficiencies and report them to the Owner and Engineer. All defects and deficiencies will be documented by the CQA Engineer. The Contractor shall correct defects and deficiencies to the satisfaction of the CQA Engineer. The CQA Engineer will observe all retests on repaired defects.

TABLE 3.1: CQA TESTING PROGRAM FOR EMBANKMENT MATERIAL APPROVAL

PROPERTY	TEST METHOD	MINIMUM TEST FREQUENCY
CONTROL TESTS:		
Visual Classification	ASTM D 2488	Each Soil
Moisture-Density Relationship	ASTM D 698	5,000 CY per Each Soil

TABLE 3.2: CQA TESTING PROGRAM FOR COMPACTED EMBANKMENT

PROPERTY	TEST METHOD	MINIMUM TEST FREQUENCY
CONTROL TESTS: (See **Table 3.1**)		
RECORD TESTS:		
Lift Thickness	-----	Each Lift
In-Place Density	ASTM D 6938[1]	20,000 ft^2 per lift & 1 per 500 LF/lift of Berms (< 200 ft. base width)
Moisture Content	ASTM D 6938[2]	20,000 ft^2 per lift & 1 per 500 LF/lift of Berms (< 200 ft. base width)

Notes:

1. Optionally use ASTM D 1556, ASTM D 2167, or ASTM D 2937. For every 10 nuclear density tests perform at least 1 density test by ASTM D 1556, ASTM D 2167, or ASTM D 2937 as a verification of the accuracy of the nuclear testing device.
2. Optionally use ASTM D 2216, ASTM D 4643, or ASTM D 4959. For every 10 nuclear moisture tests perform at least 1 moisture test by ASTM D 2216, ASTM D 4643, or ASTM D 4959 as a verification of the accuracy of the nuclear testing device.

SECTION 4.0
SOIL LINER CQA

4.1 INTRODUCTION

This information addresses the soil liner component of the final cover system and outlines the soils construction quality assurance (CQA) program to be implemented with regard to material approval, subgrade approval, test fill construction, field and laboratory control and record tests, and resolution of problems.

4.2 SOIL LINER MATERIAL APPROVAL

All material to be used as soil liner shall be approved in advance by the CQA Engineer. Approval is based upon successful completion of CQA control testing outlined below. Such testing can be performed either during excavation and stockpiling or from existing stockpiles prior to use.

4.2.1 Control Tests

The procedure for CQA testing during excavation and stockpiling (including existing stockpiles) is outlined below.

Each load of soil will be examined either at the borrow source or the stockpile area. Any unsuitable material will be rejected or routed to separate stockpiles consistent with its end use. Appropriate entries will be made in the daily log.

During stockpiling operations, control tests, as shown on **Table 1**, will be performed by the CQA Engineer prior to placement of any soil liner material.

4.3 SUBGRADE APPROVAL

The CQA Engineer will verify that the soil liner subgrade is constructed in accordance with the project specifications.

4.4 TEST FILL CONSTRUCTION

A test fill meeting the requirements of the project specifications will be constructed using the same construction methods, equipment, and material to be used for the soil liner component. The test fill construction will be conducted prior to or coincide with the beginning of construction of the soil liner component.

Construction equipment and methods will be reviewed by the CQA Engineer prior to test fill placement.

4.4.1 Control Tests

The control tests, as shown on **Table 2**, will be performed by the CQA Engineer prior to placement of soil liner material in the test fill.

4.4.2 Record Tests

The record tests, as shown on **Table 2**, will be performed by the CQA Engineer during placement of soil liner material in the test fill.

4.4.3 Test Fill Completion

The test fill program is completed when the Contractor has shown that the soil liner constructed using the same construction methods, equipment, and material to be used in construction of the soil liner will satisfy project specifications. No soil liner can be placed until the test fill program is completed.

4.5 SOIL LINER CONSTRUCTION

4.5.1 Construction Monitoring

A. Soil liner shall be placed as described in the applicable section(s) of the project specifications using the construction methods, equipment, and material demonstrated in the test fill construction.

B. Only soil previously approved by the CQA Engineer (see **Section 2.0**) shall be used in construction of the soil liner. Unsuitable material will be removed prior to acceptance by the CQA Engineer.

C. All required field density and moisture content tests shall be completed before the overlying lift of soil is placed. The surface preparation (e.g. wetting, drying, scarification, etc.) shall be completed before the CQA Engineer will allow placement of subsequent lifts.

D. The CQA Engineer will monitor protection of the soil liner during and after construction.

E. The liner surface shall be sprinkled with water as needed to prevent desiccation. Should desiccation occur, the last lift shall be reconstructed in accordance with the project specifications. Standing water should not be present on the soil liner.

F. Frost heave or other damage due to freezing shall require lift reconstruction in accordance with the project specifications.

G. The CQA Engineer will inspect the soil liner and certify that it is in accordance with

the project specifications and approved plans prior to the Contractor beginning installation of overlying geosynthetics.

H. The finished soil liner shall be free of all rock protrusions. All cracks and voids shall be filled and the surface made uniform. This shall be accomplished by final dressing of the soil liner with smooth-drum rollers and hand raking. No rubber tired vehicles are permitted on the final dressed surface unless authorized by the CQA Engineer.

4.5.2 Control Tests

The control tests, as shown on **Table 3**, will be performed by the CQA Engineer prior to placement of soil liner material.

4.5.3 Record Tests

The record tests, as shown on **Table 3** and as described below, will be performed by the CQA Engineer during placement of soil liner material.

A. Each lift will be checked visually for soil clods, rocks, debris, plant materials and other foreign material. Any such material which does not meet specified requirements shall be identified and removed prior to and during the compaction process.

B. The thickness of the loose lift will be measured at random locations after spreading and leveling is completed. Loose lift thickness should not exceed the depth of penetration of the compaction feet.

C. Moisture content will be monitored by the CQA Engineer prior to compaction. If the soil is drier than the specified minimum moisture content, water will be added and the lift will be disced to distribute the moisture evenly.

Results of testing will be certified within 7 days of soil liner placement.

4.5.3.1 Record Test Failure

The following procedures shall be used in the event of density or hydraulic conductivity test failure:

A. Failed Density Test: Recompaction of the failed area shall be performed and retested until the area meets or exceeds requirements outlined in the specifications.

B. Failed Hydraulic Conductivity Test: The area of failure shall be localized and reconstructed in accordance with the project specifications. This area

will be retested as outlined within the plan by the CQA Engineer. Optionally, at least five replicate samples shall be obtained and tested by the Contractor in the immediate vicinity of the failed test. If all five samples pass, then the initial failing test will be discounted. However, should the replicate samples confirm the failure of the soil liner to meet specifications, the area of failure shall be localized, reconstructed, and retested as described above.

4.5.4 Judgmental Testing

During construction, the frequency of control and/or record testing may be increased at the discretion of the CQA Engineer when visual observations of construction performance indicate a potential problem. Additional testing for suspected areas will be considered when:

- the rollers slip during rolling operation;
- the lift thickness is greater than specified;
- the fill material is at an improper moisture content;
- fewer than the specified number of roller passes are made;
- dirt-clogged rollers are used to compact the material;
- the rollers may not have used optimum ballast;
- the fill materials differ substantially from those specified; or
- the degree of compaction is doubtful.

4.5.5 Perforations In Soil Liner

All holes shall be patched with compacted soil liner or sodium bentonite compacted and hydrated in the holes.

4.6 DEFICIENCIES

The CQA Engineer will immediately determine the extent and nature of all defects and deficiencies and report them to the Owner and Engineer. All defects and deficiencies will be documented by the CQA Engineer. The Contractor shall correct defects and deficiencies to the satisfaction of the CQA Engineer. The CQA Engineer will observe all retests on repaired defects.

TABLE 4.1: CQA TESTING PROGRAM FOR SOIL LINER MATERIAL APPROVAL

PROPERTY	TEST METHOD	MINIMUM TEST FREQUENCY
CONTROL TESTS:		
Visual Classification	ASTM D 2488	Each Soil
Moisture Content	ASTM D 2216	2,000 CY per Each Soil
Grain Size Analysis	ASTM D 422	2,000 CY per Each Soil
Atterberg Limits	ASTM D 4318	2,000 CY per Each Soil
Moisture-Density Relationship	ASTM D 698	5,000 CY per Each Soil
Hydraulic Conductivity - Lab Remolded	ASTM D 5084[3]	10,000 CY per Each Soil

TABLE 4.2: CQA TESTING PROGRAM FOR SOIL LINER TEST FILL

PROPERTY	TEST METHOD	MINIMUM TEST FREQUENCY
CONTROL TESTS: (See **Table 1**)		
Moisture-Density Relationship	ASTM D 698[4]	1 per lift
Hydraulic Conductivity - Lab Remolded	ASTM D 5084[3,4]	1 per lift
RECORD TESTS:		
Lift Thickness	-----	Each Lift
Atterberg Limits	ASTM D 4318	1 per lift
Grain Size Analysis	ASTM D 422	1 per lift
In-Place Density	ASTM D 2922[1]	3 per lift
Moisture Content	ASTM D 6938[2]	3 per lift
Hydraulic Conductivity - Undisturbed (Shelby Tube)	ASTM D 6938[3]	1 per lift

TABLE 4.3: CQA TESTING PROGRAM FOR SOIL LINER

PROPERTY	TEST METHOD	MINIMUM TEST FREQUENCY
CONTROL TESTS: (See **Table 1**)		
RECORD TESTS:		
Lift Thickness	-----	Each Lift
In-Place Density	ASTM D 6938[1]	10,000 ft^2 per lift
Moisture Content	ASTM D 6938[2]	10,000 ft^2 per lift
Hydraulic Conductivity - Undisturbed (Shelby Tube)	ASTM D 5084[3]	80,000 ft^2 per lift

Notes:

1. Optionally use ASTM D 1556, ASTM D 2167, or ASTM D 2937. For every 10 nuclear density tests perform at least 1 density test by ASTM D 1556, ASTM D 2167, or ASTM D 2937 as a verification of the accuracy of the nuclear testing device.
2. Optionally use ASTM D 2216, ASTM D 4643, or ASTM D 4959. For every 10 nuclear moisture tests perform at least 1 moisture test by ASTM D 2216, ASTM D 4643, or ASTM D 4959 as a verification of the accuracy of the nuclear testing device.
3. Maximum effective confining pressure and hydraulic gradient as required by the project specifications. Backpressure as recommended by ASTM D 5084.
4. These tests performed on the test fill may count toward the minimum frequencies established in **Table 1**.

SECTION 5.0
FINAL COVER SYSTEM CQA

5.1 INTRODUCTION

This section of the CQA Manual addresses the landfill gas (LFG) system, drainage aggregate and piping, and the vegetative soil layer of the final cover system. By reference to **Section 4.0** of this CQA Manual, this section also addresses the soil liner that is included in the final cover system. This section outlines the CQA program to be implemented with regard to material approval, construction monitoring, and resolution of problems.

5.2 FINAL COVER SYSTEM MATERIAL APPROVAL

The CQA Engineer shall verify that the following are provided and installed in accordance with the project drawings, specifications, and this CQA Manual.

5.2.1 Corrugated Polyethylene (CPE) Pipe

A. Receipt of Contractor's submittals on CPE pipe.

B. Review of submittals for CPE pipe for conformity to the project specifications.

5.2.2 LFG System Components

A. Receipt of Contractor's submittals on LFG system components.

B. Review of submittals for LFG system components for conformity to the project specifications.

5.2.3 Soil Liner

The CQA program for soil liner is presented in **Section 4.0** of this CQA Manual.

5.2.4 Vegetative Soil Layer

A. Review the proposed source of vegetative soil layer for conformance with the project specifications.

B. Conduct material control tests in accordance with **Table 5.1**.

5.3 FINAL COVER SYSTEM INSTALLATION

The CQA Engineer will monitor and document the construction of all final cover system components for compliance with the project specifications. Monitoring the construction work for the components of the final cover system includes the following:

- verify location and depth of LFG wells;
- verify location of all piping;
- monitoring the placement of the final cover system components.

5.4 DEFICIENCIES

The CQA Engineer will immediately determine the extent and nature of all defects and deficiencies and report them to the Owner and Engineer. All defects and deficiencies will be documented by the CQA Engineer. The Contractor shall correct defects and deficiencies to the satisfaction of the CQA Engineer. The CQA Engineer will observe all retests on repaired defects.

TABLE 5.1: CQA TESTING PROGRAM FOR FINAL COVER SYSTEM

COMPONENT	PROPERTY	TEST METHOD	MINIMUM TEST FREQUENCY
CONTROL TESTS:			
Vegetative Soil Layer:	Visual Classification	ASTM D 2488	Each Load
	Grain Size Analysis	ASTM D 422	5,000 CY
	Atterberg Limits	ASTM D 4318	5,000 CY

Appendix A

Reference List of Test Methods

AVERY COUNTY
C&D LANDFILL

CQA MANUAL
APPENDIX A: REFERENCE LIST OF TEST METHODS

American Society American Society of Testing and Materials (ASTM):

ASTM C 136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
ASTM D 413	Standard Test Methods for Rubber Property - Adhesion to Flexible Substrate.
ASTM D 422	Standard Test Method for Particle Size Analysis of Soils.
ASTM D 698	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3).
ASTM D 792	Standard Test Method for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
ASTM D 1004	Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting.
ASTM D 1505	Standard Test Method for Density of Plastics by the Density-Gradient Technique.
ASTM D 1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
ASTM D 1603	Standard Test Method for Carbon Black in Olefin Plastics.
ASTM D 2167	Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
ASTM D 2216	Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
ASTM D 2434	Standard Test Method for Permeability of Granular Soils (Constant Head).
ASTM D 2488	Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).

ASTM D 2937	Standard Test Method for Density of Soil in Place by the Drive Cylinder Method.
ASTM D 3042	Standard Test Method for Insoluble Residue in Carbonate Aggregates.
ASTM D 4318	Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
ASTM D 4533	Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
ASTM D 4632	Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
ASTM D 4643	Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method.
ASTM D 4716	Standard Test Method for Constant Head Hydraulic Transmissivity (In-Plane Flow) of Geotextiles and Geotextile Related Products.
ASTM D 4751	Standard Test Method for Determining Apparent Opening Size of a Geotextile.
ASTM D 4833	Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
ASTM D 4959	Standard Test Method for Determination of Water (Moisture) Content of Soil by Direct Heating Method.
ASTM D 5084	Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.
ASTM D 5199	Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.
ASTM D 5596	Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics.
ASTM D 5641	Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber.
ASTM D 5820	Standard Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes.

ASTM D 5887	Standard Test Method for Measurement of Index Flux Through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter.
ASTM D 5993	Standard Test Method for Measuring Mass per Unit of Geosynthetic Clay Liners.
ASTM D 5994	Standard Test Method for Measuring Core Thickness of Textured Geomembrane.
ASTM D 6391	Standard Test Method for Field Measurement of Hydraulic Conductivity Limits of Porous Materials Using Two Stages of Infiltration from a Borehole.
ASTM D 6392	Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.
ASTM D 6496	Standard Test Method for Determining Average Bonding Peel Strength Between the Top and Bottom Layers of Needle-Punched Geosynthetic Clay Liners.
ASTM D 6693	Standard Test Method for Determining Tensile Properties of Nonreinforced Flexible Polyethylene and Nonreinforced Polypropylene Geomembranes.
ASTM D 6938	Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

Geosynthetic Research Institute (GRI):

GRI GC7	Determination of Adhesion and Bond Strength of Geocomposites.