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**CLOSURE CERTIFICATION REPORT
FOR
TOMOKA FARMS ROAD LANDFILL
SOUTH CELL**

Prepared for:

Volusia County
Solid Waste Division
3151 E. New York Avenue
DeLand, Florida

Prepared by:

SCS Engineers
500 North Grandview Avenue, Suite 400
Daytona Beach, Florida 32118
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File No. 09201053.09
October 10, 2003



Florida Department of Environmental Protection
Twin Towers Office Bldg. • 2600 Blair Stone Road • Tallahassee, FL 32399-2400

DEP Form # 62-701.900(2)
Form Title Certification of Construction Completion
Effective Date May 19, 1994
DEP Application No. _____
(Filed by DEP)

Certification of Construction Completion of a Solid Waste Management Facility

DEP Construction Permit No: SF64-0078767-011 County: Volusia
Name of Project: Tomoka Farms Road Landfill - South Cell, Class I - Closure
Name of Owner: Volusia County
Name of Engineer: SCS Engineers
Type of Project: Landfill Closure

Cost: Estimate \$ N/A Actual \$ N/A
Site Design: Quantity: N/A ton/day Site Acreage: 3,400 Acres
Deviations from Plans and Application Approved by DEP: See Attached

Address and Telephone No. of Site: 1990 Tomoka Farms Road, Daytona Beach, FL 32124
(386) 947-2952

Name(s) of Site Supervisor: Martin Bay
Date Site inspection is requested: 10 October 2003

This is to certify that, with the exception of any deviation noted above, the construction of the project has been completed in substantial accordance with the plans authorized by Construction

Permit No. SF64-0078767-011 :Dated: March 8, 2003

Date: 10 October 2003

Signature of Professional Engineer

Page 1 of 1

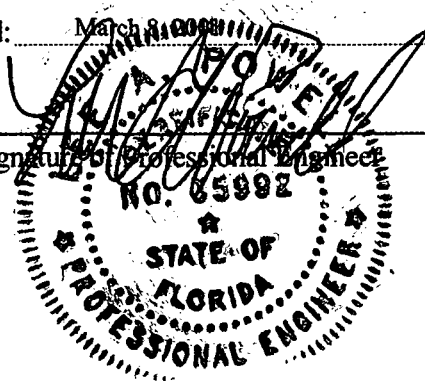


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SECTION 1

INTRODUCTION

1.1 GENERAL

This report, prepared for the Volusia County Solid Waste Division (County), summarizes the closure construction activities for the Tomoka Farms Road Landfill South Class I Cell. As part of SCS Engineers (SCS) construction services, the construction activities were documented in accordance the Florida Department of Environmental Protection (FDEP) guidelines and permit requirements.

1.2 SITE DESCRIPTION

The South Cell is part of Volusia County's Tomoka Farms Road Landfill, located at 1990 Tomoka Farms Road approximately three miles south of International Speedway Boulevard in Daytona Beach, Florida. The County property encompasses 3400 acres, and includes the active Class I cell, a Class III cell, and other solid waste management facilities. The South Cell waste disposal area occupies approximately 104 acres. With the perimeter ditch, stormwater ponds, and effluent ditch, the overall South Cell site encompasses 156 acres.

1.3 LANDFILL HISTORY

Construction of the South Cell began in 1978. The cell was operated as an excavate and fill type landfill, with the average excavation reported to be 15 feet below original grade. The landfill bottom liner system consists of a 10-mil polyvinyl chloride geomembrane, overlying a natural clay layer.

On March 17, 1994, the Florida Department of Environmental Protection (FDEP) issued permit number SO64-198377 to operate the Tomoka Farms Road Class I Landfill. Specific Condition Number 20 of that permit was as follows:

"The landfill shall operate on a "close as you go" basis, wherein, landfill disposal cells receive final cover on exterior landfill surfaces as sufficient area warrants final cover. The final cover shall consist of a low permeability final cap and shall include a minimum of 6-12 inches of daily cover, 8-inches of compacted clay, 12-inches of protective soil cover, and 6-inches of top soil to provide a root zone for vegetative growth."

Approximately 13 acres of the south slope of the landfill was closed using this final cover system.

On January 19, 1995, The FDEP modified this permit condition to allow the use of a geosynthetic clay liner (GCL) in the final cover in place of the 8 inches of compacted clay (CCL). This permit modification also added Specific Condition Number 40, which stated:

"The County shall prepare and submit to the Department a final Quality Assurance Summary Report certified by a professional engineer registered in the State of Florida, that the liner system has been installed in substantial confirmation with the plans and specifications for the liner system."

On November 8, 1995, the County submitted to the FDEP a Quality Assurance Summary Report for approximately 10 acres of the landfill that had received final cover using a GCL. The GCL was a reinforced product manufactured by Claymax.

In April and May of 1996, the County completed an additional six acres of landfill closure on the south and east slopes using Bentomat, a reinforced GCL produced by CETCO.

On September 9, 1997, the FDEP issued Permit Number SO64-291432, permitting continued operation of the landfill until the expiration date of September 8, 2002.

On March 8, 2001, the FDEP issued Closure Permit No. SF64-0078767-011. This permit expires January 30, 2006.

The FDEP issued Environmental Resource Permit (ERP) Number ERP64-020632-002-EI for the site on September 8, 1998. This permit approved the surface water management system shown on the permit application drawings. Specific Condition No. 12 of this permit requires the County to submit certification of completion within 30 days after completion of construction. This permit was renewed on June 30, 2003 with an expiration date of May 23, 2008.

On March 8, 2001, the FDEP issued Closure Permit No. SF64-0078767-011. This permit expires January 30, 2006. Specific Condition No. 21 of this permit requires the County to submit a Certificate of Completion of Construction, DEP Form 62-701.900(2), along with record drawings and a summary report describing the documented control program of installation, inspection, and quality assurance/quality control testing procedures. This report is submitted in fulfillment of these requirements.

SECTION 2

CLOSURE DESIGN

2.1 CLOSURE PHASES

Approximately 23 acres of the South Cell have been previously closed using CCL or GCL for the barrier layer. Sheet 3 of the closure permit drawings is included in this report as Exhibit 1. This drawing shows the portion of the site that has been previously closed using compacted clay liner for the low permeability barrier layer, the portion of the site that was previously closed using GCL, and the portion of the site that is included in this closure report.

2.2 EXISTING TOPOGRAPHY AND PROPOSED FINAL GRADES

The proposed final grades for the South Cell disposal area are shown on Sheet 4 of the permit drawings. This drawing is included in this report as Exhibit 2

2.3 SIDE SLOPE DESIGN

The side slopes are designed with terraces after every 20 feet of vertical rise. These terraces are constructed at elevations 50, 70, 90, and 110 feet National Geodetic Vertical Datum (NGVD). The terraces are 16 feet wide, with a one-foot reverse grade. The side slopes themselves are at a slope of 6 horizontal to 1 vertical on the south, east, and north slopes and 5 horizontal to 1 vertical on the west slope. These slopes have proven to be very stable.

The terraces are drained by a series of surface down chutes, constructed on the landfill sideslopes. Each chute is 20 feet wide, with one-foot high berms on each side of the chute. The chutes are lined with reinforced sod. The chutes are designed to handle the peak runoff from the 25-year, 24-hour design storm of 9 inches.

The upper portion of the chutes are lined with North American Green C350, a coconut fiber matrix enclosed in a permanent, three-dimensional netting structure. Rolled sod was placed over the C350 and anchored with ground staples.

The lower portions of the chutes are lined with Presto Products Company Geoweb, a high-density polyethylene cellular confinement system. The Geoweb is approximately 4 inches deep, and was placed on an 8-ounce nonwoven geotextile and filled with gravel.

At the toe of slope, the chutes drain into the perimeter ditch.

2.4 FINAL COVER

Final cover consists of the following layers, from bottom to top:

- Twelve inches of soil cover

- Bentomat, a geosynthetic clay liner (GCL)
- Eighteen inches of a sandy soil drainage layer
- Six inches of topsoil
- Sod vegetative covers

2.5 GAS COLLECTION

Landfill gas in the South Cell is collected by an active gas extraction system.

SECTION 3

CONSTRUCTION QUALITY ASSURANCE

3.1 GENERAL

Specific Condition Number 15 of the closure permit requires that the County follow the Construction Quality Assurance (CQA) Plan submitted with the closure permit application. This plan addresses the construction quality assurance and quality control procedures for construction required for closure of the South Cell. The plan supplements the project plans and permit application documents, and was prepared to meet requirements set forth in the Florida Administrative Code (F.A.C.), Chapter 62-701.

3.2 RESPONSIBILITY

Volusia County is responsible for complying with the terms and conditions of the permits issued to the County by the regulatory agencies, and with any applicable laws and regulations. The County performed the required earthwork and installed the GCL and other geosynthetics and installed the final cover.

Belcorp Inc. installed the rolled sod vegetative cover under contract with the County.

SCS Engineers prepared the closure permit application documents including the Construction Quality Assurance (CQA) Plan, and was retained by the County to provide CQA services during construction.

The Volusia County Department of Public Works provided field soil density testing for the six acres of closure completed in 1996. Universal Engineering Testing Inc, (Universal) was selected by the County to provide soil testing services for the remaining portion of the site.

Blackwell and Associates Land Surveyors, Inc. (Blackwell) was selected by the County to provide construction survey services.

The GCL installed for the South Cell closure was Bentomat ST, manufactured by the Colloid Environmental Technologies Company (CETCO). CETCO provided the manufacturer's construction quality assurance testing.

Precision Geosynthetic Laboratories (PGL) was contracted by SCS to provide laboratory CQA testing of the GCL.

3.3 CONSTRUCTION MONITORING

The CQA Plan requires the CQA engineer or his designee to be on-site at all times during construction of the liner system. SCS made periodic visits to the site during all phases of construction, including subgrade preparation, GCL installation, cover soil placement, and

installation of sod and surface drainage structures. The designee on-site during the 1996 construction including liner installation was Mr. Billy Bishop, a Supervisor II and a Volusia County employee since 1987. The designee on-site during the remaining construction was Mr. Paul Ramias, a Supervisor III and a Volusia County employee since 1982. Solid waste management training records for the on-site designees are included in Attachment 3-1. Each day GCL was installed, the on-site designee inspected the subgrade, recorded the roll numbers and the lot numbers of the GCL panels that were installed, inspected each roll of GCL for visual evidence of bentonite uniformity, geotextile quality, and degree of hydration. This information was recorded in a daily construction log. He also checked the seams between panels for proper overlap, observed the placement of cover soil and rolled sod, and oversaw the subgrade density testing and depth of soil cover measurements.

SCS made periodic visits to the site during construction to discuss the project with the on-site designee, observe the ongoing construction, observe density testing and depth of cover measurements, review the CQA procedures, and to review the daily construction logs.

ATTACHMENT 3-1
TRAINING RECORDS

Florida DEP Solid Waste Management Facility Operator Transcript

Certificate: **Class I, II, III Landfill Operator**
Track: **Standard Landfill Track**

Initial Date: **05/19/95**
Expiration Date: **05/18/04**

Status: **Current**

BISHOP, BILLY
OPERATIONS SPECIALIST
ORANGE COUNTY SOLID WASTE
5901 Young Pine Rd
Orlando, FL 32829

Phone: (407) 836-6600 x6676
Fax: (407) 836-6629
Email: billy.bishop@ocfl.net

Time Period: **Prior to Initial Date**

<u>Course #</u>	<u>Course Completed</u>	<u>Course Provided By</u>	<u>Completion Date</u>	<u>Hours</u>
21	Solid Waste Landfill Operator's Short School	University of Florida - TREEO	11/22/91	0

Time Period: **05/19/95 - 05/18/98**

<u>Course #</u>	<u>Course Completed</u>	<u>Course Provided By</u>	<u>Completion Date</u>	<u>Hours</u>
21	Solid Waste Landfill Operator's Short School	University of Florida - TREEO	05/19/95	Initial
56	Successfully Contracting for Solid Waste Services [7/14/95]	Solid Waste Association of North America (SWANA - Florida Chapter)	06/26/96	4
49	Landfill Gas and Leachate Systems	University of Florida - TREEO	01/09/97	8
72	Bird and Wildlife Management at Solid Waste Management Facilities	University of Florida - TREEO	04/30/97	7

Total hours toward Continuing Education: 19

Time Period: **05/19/98 - 05/18/01**

<u>Course #</u>	<u>Course Completed</u>	<u>Course Provided By</u>	<u>Completion Date</u>	<u>Hours</u>
39	Stormwater Management for Landfills	University of Florida - TREEO	04/19/99	8
111	Landfill Operations and Waste Screening	University of Florida - TREEO	04/20/99	8

for Class I, II, III
Sites

42	SWANA-Transfer Station Design & Operations	Solid Waste Association of North America	05/14/99	16
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Total hours toward Continuing Education: 32

Time Period: 05/19/01 - 05/18/04

<u>Course #</u>	<u>Course Completed</u>	<u>Course Provided By</u>	<u>Completion Date</u>	<u>Hours</u>
124	Landfill Compaction Training School	Caterpilla & Ringhaver Equipment	11/08/01	5
203	8-Hour Initial Training Course for Spotters at Class I, II, III Facilities, Waste Processing Facilities and C&D Facilities	Kohl Consulting, Inc.	02/07/02	8
229	Landfill Compaction Training School-8 hours	Caterpilla & Ringhaver Equipment	11/14/02	8

Total hours toward Continuing Education: 21

Hours taken prior to your initial course do not count toward your solid waste training.

Continuing Education (CE) Minimum 3 Year Requirement:
I,II,III/C&D-16 hours; TS/MRF-8 hours; Spotter-4 hours
Expired: If you have exceeded the 3 year training period without completing the minimum
number of CE, you must start over by taking an approved initial course and pass exam.

Initial hours are not counted toward continuing education.

If you have any questions, please contact djenkin@treeo.ufl.edu or jtoucht@treeo.ufl.edu
or call 352.392.9570 extensions 127, 112, or 130.

Last Updated: 6/4/2003
Date Printed: Wednesday, July 30, 2003

Florida DEP Solid Waste Management Facility Operator Transcript

Certificate: Class I, II, III Landfill Operator
Track: Standard Landfill Track

Initial Date: 11/19/93
Expiration Date: 11/18/05

Status: Current

Ramias, Paul S.
 Supervisor III
 Volusia County Solid Waste
 1990 Tomoka Farms Rd
 Daytona Beach, FL 32724

Phone: (386) 947-2952
 Fax: (386) 947-2955

Time Period: 11/19/93 - 11/18/96

<u>Course #</u>	<u>Course Completed</u>	<u>Course Provided By</u>	<u>Completion Date</u>	<u>Hours</u>
21	Solid Waste Landfill Operator's Short School	University of Florida - TREEO	11/19/93	Initial
36	Waste Screening and Identification for Landfill Operators and Spotters	University of Florida - TREEO	03/16/95	8
39	Stormwater Management for Landfills	University of Florida - TREEO	05/16/95	8
Total hours toward Continuing Education: 16				

Time Period: 11/19/96 - 11/18/99

<u>Course #</u>	<u>Course Completed</u>	<u>Course Provided By</u>	<u>Completion Date</u>	<u>Hours</u>
80	Construction and Demolition Debris Landfills: A Short Course for Operators	University of Florida - TREEO	04/01/98	20
39	Stormwater Management for Landfills	University of Florida - TREEO	04/19/99	8
111	Landfill Operations and Waste Screening for Class I, II, III Sites	University of Florida - TREEO	04/20/99	8
Total hours toward Continuing Education: 36				

Time Period: 11/19/99 - 11/18/02

<u>Course #</u>	<u>Course Completed</u>	<u>Course Provided By</u>	<u>Completion Date</u>	<u>Hours</u>
125	Management of Leachate, Gas, Stormwater and Odor at Class I, II, and III Landfills	University of Florida - TREEO	03/20/02	8
147	Training for Spotters at Construction and Demolition Sites, Landfills and Transfer Stations	University of Florida - TREEO	03/21/02	8
Total hours toward Continuing Education: 16				

Time Period: 11/19/02 - 11/18/05

Completion

Course # Course Completed

Course Provided By

Date

Hours

(No courses completed)

Continuing Education (CE) Minimum 3 Year Requirement:

I,II,III/C&D-16 hours; TS/MRF-8 hours; Spotter-4 hours

Expired: If you have exceeded the 3 year training period without completing the minimum number of CE, you must start over by taking an approved initial course and pass exam.

Initial hours are not counted toward continuing education.

If you have any questions, please contact djenkin@treeo.ufl.edu or jtought@treeo.ufl.edu or call 352.392.9570 extensions 127, 112, or 130.

Last Updated: 3/28/2002 9:28:00 PM
Date Printed: Wednesday, July 30, 2003

SECTION 4

SOIL SUBGRADE

4.1 SOIL PLACEMENT

The County placed cover soil over the compacted waste as part of the on-going landfill operation. The soil was compacted and brought up to a minimum depth of 12 inches. Additional soil was placed as needed to bring the subgrade surface up to the final grade. Grade stakes were placed by Blackwell to assist the County in constructing the subgrade.

4.2 FIELD DENSITY TESTING

The subgrade was required to be compacted to a minimum compaction of 95 percent of Standard Proctor density. Field density testing was provided at an average frequency of approximately one test per acre to verify the depth and compaction of the subgrade.

On April 15 and on May 6, 1996, Wes Kimberly from the County's Department of Public Works visited the site to perform field density testing of the soil cover using the drive sleeve method (ASTM D-2237 and AASHTO T-204). SCS selected locations for testing and witnessed the testing procedures. Eighteen sites were tested, with all sites passing. The reports of this testing is included in Attachment 4-1.

For the remainder of the site, testing was performed by Universal. Universal used either of two methods for measuring field density: the drive sleeve and the nuclear density method (ASTM D-2922). Both methods provide accurate and reliable measurements for calculating field density as a percentage of Standard Proctor Density.

Density test sites were marked with stakes and located by Blackwell.

On February 17, 2000 the density test at stake location number seven did not pass. The area around test site seven was reworked. Additional tests D22, D25, D26, and D33 were performed in this area on February 18 and 22. These tests passed and GCL was installed.

The lower portion of the northern side slope near test sites 29, 30, 39, 40, 41, and 42 was damaged by significant erosion after testing was complete. This area was repaired and re-tested at test sites A through I.

A portion of the west slope by test sites W-3 through 8, and W-12 through W-21 was also damaged by erosion and was re-tested at sites D-75, D-76, D-79, and D-87 through D-100.

The test site locations are shown on Exhibit 3, a survey drawing prepared by Blackwell. A summary of the density testing is presented in Table 4-1. The density test results are presented in Attachment 4-2.

**TABLE 4-1. SOIL DENSITY TESTING
TOMOKA FARMS ROAD LANDFILL SOUTH CELL CLOSURE**

Date	Test Sites
February 17, 2000	1-13
February 18, 2000	14-24
March 2, 2000	22A,23A
March 22, 2000	25-36
August 30, 2000	37-42
December 4, 2000	A-I
December 18, 2000	46-52
February 9, 2001	53-65
July 1, 2001	D67-D69, W1, W9-W11, W22
February 20, 2002	D70-D80
February 21, 2002	D81-D100

4.3 DEPTH OF SOIL

The depth of soil was measured at each density test site. A minimum of 12 inches of soil cover was found at all test locations.

ATTACHMENT 4-1
IN-PLACE DENSITY TEST RESULTS

1996

Volusia County Department of Public Works

IN PLACE DENSITY WORK SHEET

Report No. # _____ Lab Technician _____

Project TOMALKA LAND FILL

Course SUB-BASE

Date 2-22-96 Location EAST SIDE 110 TON

	Hole No. #	1	2	3	4	5	6	7
	Hole Location or Station #	25' N of S.E. Cor. 5' x 5' Base	30' N of #1 23' x 23' T. Base	100' N #2 50' x 50' Film Base	100' N #3 25' x 25' from Base	125' N #4 50' x 50' from Base	100' N #5 15' x 15' Top Gun	50' N #6 20' x 20' from Base
A	Volume of Hole							
B	Wgt. of Soil from Hole							
C	Wet Density	119.6	120.4	116.4	120.9	116.6	116.2	117.1
D	% Moisture	14.6	11.7	13.4	12.1	12.2	10.8	15.1
E	Dry Density	105	108.6	103.1	105.9	106.4	105.4	102.
F	Maximum Density	101.8	<hr/>					
G	% of Maximum Density	103.1	106.6	101.6	104.3	104.9	103.9	100.6
	Optimum Moisture							

(1) $C = B \div A$

(2) $E = C \div (D + 100)$

(3) $G = E \div F$

Volusia County Department of Public Works

IN PLACE DENSITY WORK SHEET

Report No. # _____ Lab Technician _____

Project TOMAPA LAND FILL

Course BASE

Date 1-22-96 Location SOUTH SLOP 3rd Tier

(Handwritten signature)

	Hole No. #	1	2	3	4	5	6	7
	Hole Location or Station #	250 W of S.E. 4th 15' S.W. 1st	100 W of #1 E of SLOP	100 W of #2 30 N of 1st	100 W of #3 E of SLOP			
A	Volume of Hole							
B	Wgt. of Soil from Hole							
C	Wet Density	116.	117.4	119.2				
D	% Moisture	10.9	12.4	10.5				
E	Dry Density	105.1	105	108.7				
F	Maximum Density	101.8	<hr/>					
G	% of Maximum Density	103.7	103.5	107.2	93.2			
	Optimum Moisture							

(1) $C = B \div A$

(2) $E = C \div (D + 100)$

(3) $G = E \div F$

Volusia County Department of Public Works

IN PLACE DENSITY WORK SHEET

Report No. # _____ Lab Technician _____

Project TOMMY VA 1 P. 100 FIELD

Course BASE

Date 2-22-96 Location # S.E. Cor of E 110 F.L.

	Hole No. #	1	2	3	4	5	6	7
	Hole Location or Station #	<u>4</u> <u>to stop</u>						
A	Volume of Hole							
B	Wgt. of Soil from Hole							
C	Wet Density	<u>109.3</u>						
D	% Moisture	<u>8.8</u>						
E	Dry Density	<u>100.4</u>						
F	Maximum Density	<u>101.4</u>						
G	% of Maximum Density	<u>98.1</u>						
	Optimum Moisture							

(1) $C = B \div A$

(2) $E = C \div (D + 100)$

(3) $G = E \div F$

Volusia County Department of Public Works

IN PLACE DENSITY WORK SHEET

Report No. # _____ Lab Technician _____

Project TAMPA LAND FILL

Course Base Brk 4 2.0' Sub Base

Date 11-15-96 Location TER #4 110

Hole No. #	1	2	3	4	5	6	7
Hole Location or Station #	25' FROM BOT. WEST END SECTION 12.5' E	125' E 15' FROM TOP	15' FROM TOP 125' E 15' #2	MID-SPAN 100' E. 15' #3	25' FROM BOT. 100' E. 15' #4	MID-SPAN 125' E 15' #5	10' FROM TOP 100' E 15' #6
A Volume of Hole							
B Wgt. of Soil from Hole							
C Wet Density	109.5	114.5	117.2	113.9	119.4	116.	117.6
D % Moisture	8.6	11.6	10.5	10.8	14.4	12.9	10.1
E Dry Density	100.9	103.4	106.6	103.1	103.	103	107.4
F Maximum Density	101.2						
G % of Maximum Density	95	97.4	100.4	99.1	99.0	97	101.2
Optimum Moisture							

(1) $C = B \div A$

(2) $E = C \div (D + 100)$

(3) $G = E \div F$

Volusia County Department of Public Works

IN PLACE DENSITY WORK SHEET

Report No. # _____ Technician _____

Project TIMOKA 50 Lee

Course Base Back Fill Rwell

Date 4-15-96 Loc: 190

	Hole No. #	1	2	3	4	5	6	7
	Hole Location or Station #	501 Flora B. 200 LAST 1/3	251/02 TOP 100' W 25' E	251/02 TOP 100' W 25' E	251/02 TOP 100' W 25' E M.H.			
A	Volume of Hole							
B	Wgt. of Soil from Hole							
C	Wet Density	119.2	112.2	109.2	112.2			
D	% Moisture	13.2	9.6	7.2	11.0			
E	Dry Density	106.	102.6	102.1	103.2			
F	Maximum Density	105.2						
G	% of Maximum Density	99.4	96.6	96.1	99.2			
	Optimum Moisture							

(1) $C = B \div A$

(2) $E = C \div (D + 100)$

(3) $G = E \div F$

Volusia County Department of Public Works

IN PLACE DENSITY WORK SHEET

Report No. # _____ Lab Technician Wesley Kennedy

Project TOMOKA LANDFILL

Course SUB-BASE

Date 5-6-96 Location 4th TER. #110 FROM S.E. COR TO 1st CB

Hole No. #	1	2	3	4	5	6	7
Hole Location or Station #	100' W 9' F.C. B ⁴ 75' UP BURN	100' W 15' #1 15' FROM TOP	100' W 15' #2 2' # BURN	100' W 16' #3 25' FROM BOTT.	100' W 18' #4 1' # BURN	100' W 15' #5 10' FROM TOP NEAR	75' W #6 ON TOP C.B. LINE #2
A Volume of Hole							
B Wgt. of Soil from Hole							
C Wet Density	116.6	117.7	115.4	118.2	119.3	118.0	116.3
D % Moisture	12.7	12.8	11.4	9.7	11.7	10.7	10.0
E Dry Density	103.4	104.4	103.7	107.7	106.8	106.6	105.8
F Maximum Density	106.2						
G % of Maximum Density	97.4	98.3	97.6	101.4	100.5	100.4 100.4	99.6
Optimum Moisture							

(1) $C = B \div A$

(2) $E = C \div (D + 100)$

(3) $G = E \div F$

ATTACHMENT 4-2
IN-PLACE DENSITY TEST RESULTS
2000-2003



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UES Project No. 41011-116-01
UES Report No. 71360
Date: 02/21/00

911 Beville Road, Suite 3 • South Daytona, Florida 32119 • (904) 756-1105 • FAX (904) 760-4067

Report of IN-PLACE DENSITY TESTS

Client: Volusia County
123 W. Indiana Avenue
DeLand, Florida 32720

Attention: Nathan Hunter

Project: Tomoka Landfill (south cell)

Course: Backfill

Type of Test: Field: AASHTO T-204
Laboratory: ASTM D-1557

Date of Test: 02/17/00

Requirements: 95% compaction of maximum density.

*Reference: 0 = Top of back fill

Location of Test	Depth of Test*	Laboratory Test Results		Field Test Results			
		Maximum Density Dry Lbs/CuFt	Optimum Moisture Percent	Density Dry Lbs/CuFt	Field Moisture Percent	Maximum Density Percent	Test Pass or Fail
1. Stake Location #1	0-1'	105.1	14.4	105.7	14.1	100.5	PASS
2. Stake Location #2	0-1'	105.1	14.4	101.9	9.9	96.9	PASS
3. Stake Location #3	0-1'	105.1	14.4	101.5	13.1	96.5	PASS
4. Stake Location #4	0-1'	105.1	14.4	104.1	14.1	99.0	PASS
5. Stake Location #5	0-1'	105.1	14.4	103.5	11.0	98.4	PASS
6. Stake Location #6	0-1'	105.1	14.4	104.6	10.8	99.5	PASS
7. Stake Location #7	0-1'	105.1	14.4	92.6	9.4	88.1	FAIL
8. Stake Location #8	0-1'	105.1	14.4	103.4	14.8	98.3	PASS
9. Stake Location #9	0-1'	105.1	14.4	103.3	11.2	98.2	PASS
10. Stake Location #10	0-1'	105.1	14.4	103.5	11.0	98.4	PASS
11. Stake Location #11	0-1'	105.1	14.4	103.1	12.4	98.1	PASS
12. Stake Location #12	0-1'	105.1	14.4	102.8	10.8	97.8	PASS
Stake Location #13	0-1'	105.1	14.4	107.6	13.0	102.3	PASS

Technician: P. May

xc: Mr. Bill Gilley; Volusia County Waste
Mr. Lee Powell, P.E., SCS Engineering

Sheila M. Smith, P.E.
P.E. No. 51512

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UES Project No. 41011-116-01

UES Report No. 71361

Date: 02/21/00

911 Beville Road, Suite 3 • South Daytona, Florida 32119 • (904) 756-1105 • FAX (904) 760-4067

Report of IN-PLACE DENSITY TESTS

Client: Volusia County
123 W. Indiana Avenue
DeLand, Florida 32720

Attention: Nathan Hunter

Project: Tomoka Landfill (south cell)

Course: Backfill

Type of Test: Field: ASTM D-2922
Laboratory: ASTM D-1557

Date of Test: 02/18/00

Requirements: 95% compaction of maximum density.

Reference: 0 = Top of back fill

Location of Test	Depth of Test*	Laboratory Test Results		Field Test Results			
		Maximum Density Dry Lbs/CuFt	Optimum Moisture Percent	Density Dry Lbs/CuFt	Field Moisture Percent	Maximum Density Percent	Test Pass or Fail
1. Stake Location #14	0-1'	105.1	14.4	102.6	16.5	97.7	PASS
2. Stake Location #15	0-1'	105.1	14.4	106.9	13.7	101.7	PASS
3. Stake Location #16	0-1'	105.1	14.4	100.1	12.9	95.3	PASS
4. Stake Location #17	0-1'	105.1	14.4	103.4	14.7	98.3	PASS
5. Stake Location #18	0-1'	105.1	14.4	99.3	9.9	95	PASS
6. Stake Location #19	0-1'	105.1	14.4	103.0	15.4	98.0	PASS
7. Stake Location #20	0-1'	105.1	14.4	106.1	13.5	101.0	PASS
8. Stake Location #21	0-1'	105.1	14.4	104.3	14.5	99.1	PASS
9. Stake Location #22	0-1'	105.1	14.4	109.5	11.5	104.2	PASS
10. Stake Location #23	0-1'	105.1	14.4	104.8	15.0	99.7	PASS
11. Stake Location #24	0-1'	105.1	14.4	102.8	14.8	97.8	PASS

Technician: N. Ellis

cc. Mr. Bill Gilley: Volusia County Waste
Mr. Lee Powell, P.E.: SCS Engineering

Sheila M. Smith, P.E. 2/25/00

P.E. No. 51512

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UES Project No. 41011-116-01

UES Report No. 71468

Date: 03/03/00

911 Beville Road, Suite 3 • South Daytona, Florida 32119 • (904) 756-1105 • FAX (904) 760-4067

Report of IN-PLACE DENSITY TESTS

Client: Volusia County
123 W. Indiana Avenue
DeLand, Florida 32720

Attention: Nathan Hunter

Project: Tomoka Landfill

Course: Subgrade Fill

Type of Test: Field: ASTM D-2922
Laboratory: ASTM D-1557

Date of Test: 03/02/00

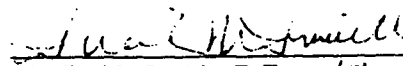
Requirements: 95% compaction of maximum density.

Reference: 0 = Top of subgrade fill

Location of Test	Depth of Test*	Laboratory Test Results		Field Test Results			
		Maximum Density Dry Lbs/CuFt	Optimum Moisture Percent	Density Dry Lbs/CuFt	Field Moisture Percent	Maximum Density Percent	Test Pass or Fail
1. Stake Location #22A	0-1'	105.1	14.4	105.5	11.6	100.4	PASS
2. Stake Location #23A	0-1'	105.1	14.4	105.6	13.5	100.5	PASS

Technician: N. Ellis

xc: Mr. Bill Gilley; Volusia County Waste
Mr. Lee Powell, P.E., SCS Engineering


Sheila M. Smith, P.E. 3/3/00
P.E. No. 51512
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UES Project No. 41011-116-01

UES Report No. 71797

Date: 04/04/00

911 Beville Road, Suite 3 • South Daytona, Florida 32119 • (904) 756-1105 • FAX (904) 760-4067

Report of IN-PLACE DENSITY TESTS

Client: Volusia County
123 W. Indiana Avenue
DeLand, Florida 32720

Attention: Nathan Hunter

Project: Tomoka Landfill

Course: Backfill

Type of Test: Field: ASTM D-2937
Laboratory: ASTM D-1557

Date of Test: 03/22/00

Requirements: 95% compaction of maximum density.

*Reference: 0 = Top of back fill

Location of Test	Depth of Test*	Laboratory Test Results		Field Test Results			
		Maximum Density Dry Lbs/CuFt	Optimum Moisture Percent	Density Dry Lbs/CuFt	Field Moisture Percent	Maximum Density Percent	Test Pass or Fail
1. Stake Location #25	0-1'	105.1	14.4	102.5	16.8	97.5	PASS
2. Stake Location #26	0-1'	105.1	14.4	103.3	14.9	98.3	PASS
3. Stake Location #27	0-1'	105.1	14.4	105.4	12.6	100.3	PASS
4. Stake Location #28	0-1'	105.1	14.4	98.5	14.7	93.7	FAIL
5. Retest of location #28 above	0-1'	105.1	14.4	98.5	10.4	97.1	PASS
6. Stake Location # 29	0-1'	105.1	14.4	102.5	16.7	97.5	PASS
7. Stake Location #30	0-1'	105.1	14.4	99.1	16.0	94.2	FAIL
8. Stake Location #31	0-1'	105.1	14.4	104.6	12.6	99.5	PASS
9. Stake Location #32	0-1'	105.1	14.4	101.4	11.4	96.4	PASS
10. Stake Location #33	0-1'	105.1	14.4	106.4	11.6	101.2	PASS
11. Stake Location #34	0-1'	105.1	14.4	106.6	11.8	101.4	PASS
12. Stake Location #35	0-1'	105.1	14.4	106.4	14.2	101.3	PASS
13. Stake Location \$36	0-1'	105.1	14.4	105.6	11.4	100.5	PASS

Technician: S. Cole

YC: Mr. Bill Gilley; Volusia County Waste
Mr. Lee Powell, P.E., SCS Engineering

Sheila M. Smith, P.E. 4/7/00

P.E. No. 51512

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911 Beville Road, Suite 3 • South Daytona, Florida 32119 • (904) 758-1105 • FAX (904) 760-4067

UES Project No. 41011-175-01
UES Report No. 73405
Date: August 30, 2000

Report of IN-PLACE DENSITY TESTS

Client: Volusia County
123 West Indiana Avenue
DeLand, Florida 32720-4262

Project: Tomoka Landfill Weigh Station

Area Tested: North East Slope (South Cell)

Course: Native

Type of Test: Field: ASTM D-2937
Laboratory: ASTM D-1557

Date of Test: 08/30/00

Requirements: 95% compaction of maximum density.

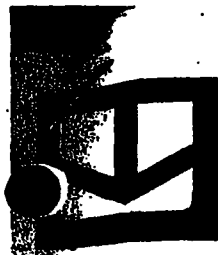
*Reference: 0=top of grade

Location of Test	Depth of Test*	Laboratory Test Results		Field Test Results			
		Maximum Density Dry Lbs/CuFt	Optimum Moisture Percent	Density Dry Lbs/CuFt	Field Moisture Percent	Maximum Density Percent	Test Pass or Fail
1. Test hole 37	0-1'	101.2	13.3	100.0	9.0	98.8	PASS
2. Test hole 38	0-1'	101.2	13.3	100.8	9.2	99.6	PASS
3. Test hole 39	0-1'	101.2	13.3	101.4	10.4	100.1	PASS
4. Test hole 40	0-1'	101.2	13.3	100.1	9.9	98.9	PASS
5. Test hole 41	0-1'	101.2	13.3	99.2	9.0	98.0	PASS
6. Test hole 42	0-1'	101.2	13.3	100.5	11.4	99.3	PASS

Technician: R. Whalen


Rick G. Kushner, P.E.
P.E. No. 38705

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UES Project No. 41011-175-01
UES Report No. 74592
Date: 12/05/00

Report of IN-PLACE DENSITY TESTS

Client: Volusia County
123 West Indiana Avenue
DeLand, Florida 32720-4262

Project: Tomoka Landfill

Area Tested: North Slope

Course: Subgrade Fill

Type of Test: Field: ASTM D-2937
Laboratory: ASTM D-1557

Date of Test: 12/04/00

Requirements: 95% compaction of maximum density for subgrade fill

*Reference: 0=top of grade

Location of Test	Depth of Test*	Laboratory Test Results		Field Test Results			
		Maximum Density Dry Lbs/CuFt	Optimum Moisture Percent	Density Dry Lbs/CuFt	Field Moisture Percent	Maximum Density Percent	Test Pass or Fail
1. Station A	0-1'	103.3	13.4	102.5	12.9	99.2	PASS
2. Station B	0-1'	103.3	13.4	102.0	9.9	98.7	PASS
3. Station C	0-1'	103.3	13.4	101.5	10.4	98.3	PASS
4. Station D	0-1'	103.3	13.4	103.2	12.1	99.9	PASS
5. Station E	0-1'	103.3	13.4	104.6	13.2	101.3	PASS
6. Station F	0-1'	103.3	13.4	100.1	11.1	96.9	PASS
7. Station G	0-1'	103.3	13.4	106.3	13.9	102.9	PASS
8. Station H	0-1'	103.3	13.4	99.7	11.5	96.5	PASS
9. Station I	0-1'	103.3	13.4	101.7	9.4	98.4	PASS

Technician: A. Roper


Rick G. Kushner, P.E.
P.E. No. 38705
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UES Project No. 41011-175-01

UES Report No. 74755

Date: 12/21/00

911 Bayville Road, Suite 3 • South Daytona, Florida 32119 • (904) 758-1105 • FAX (904) 760-4067

Report of IN-PLACE DENSITY TESTS

Client: Volusia County
123 West Indiana Avenue
DeLand, Florida 32720-4262

Project: Tomoka Landfill - South Cell

Area Tested: Top of South Cell

Course: Subgrade Fill

Type of Test: Field: ASTM D-2937
Laboratory: ASTM D-1557

Date of Test: 12/18/00

Requirements: 95% compaction of maximum density for subgrade fill

*Reference: 0=top of grade

		Laboratory Test Results		Field Test Results			
Location of Test	Depth of Test*	Maximum Density Dry Lbs/CuFt	Optimum Moisture Percent	Density Dry Lbs/CuFt	Field Moisture Percent	Maximum Density Percent	Test Pass or Fail
1. Station 46	0-1'	103.3	13.4	102.0	9.8	98.8	PASS
2. Station 47	0-1'	103.3	13.4	104.9	12.0	101.6	PASS
3. Station 48	0-1'	103.3	13.4	103.8	13.2	100.5	PASS
4. Station 49	0-1'	103.3	13.4	102.8	9.9	99.5	PASS
5. Station 50	0-1'	103.3	13.4	100.9	10.2	97.6	PASS
6. Station 51	0-1'	103.3	13.4	102.7	9.2	99.4	PASS
7. Station 52	0-1'	103.3	13.4	103.6	13.4	100.3	PASS

Technician: A. Roper


Rick G. Kushner, P.E.
P.E. No. 38705

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UES Project No. 41011-175-01

UES Report No. 75288

Date: 02/09/01

Report of IN-PLACE DENSITY TESTS

Client: Volusia County
123 West Indiana Avenue
DeLand, Florida 32720-4262

Project: Tomoka Landfill - South Cell Closure

Area Tested: North Slope West End

Course: Subgrade Fill

Type of Test: Field: ASTM D-2937
Laboratory: ASTM D-1557

Date of Test: 02/09/01

Requirements: 95% compaction of maximum density for subgrade fill

*Reference: 0=top of sub-grade

Location of Test	Depth of Test*	Laboratory Test Results		Field Test Results			
		Maximum Density Dry Lbs/CuFt	Optimum Moisture Percent	Density Dry Lbs/CuFt	Field Moisture Percent	Maximum Density Percent	Test Pass or Fail
1. Station 53	0-1'	103.3	13.4	103.9	11.4	100.5	PASS
2. Station 54	0-1'	103.3	13.4	99.1	13.4	96.0	PASS
3. Station 55	0-1'	103.3	13.4	99.1	7.1	96.0	PASS
4. Station 56	0-1'	103.3	13.4	101.3	11.8	98.1	PASS
5. Station 57	0-1'	103.3	13.4	102.7	12.9	99.4	PASS
6. Station 58	0-1'	103.3	13.4	99.2	8.8	96.0	PASS
7. Station 59	0-1'	103.3	13.4	103.0	11.8	99.7	PASS
8. Station 60	0-1'	103.3	13.4	101.3	13.6	98.0	PASS
9. Station 61	0-1'	103.3	13.4	101.8	13.0	98.6	PASS
10. Station 62	0-1'	103.3	13.4	102.2	13.4	99.0	PASS
11. Station 63	0-1'	103.3	13.4	100.9	13.1	97.7	PASS
12. Station 64	0-1'	103.3	13.4	99.5	12.9	96.3	PASS
13. Station 65	0-1'	103.3	13.4	101.0	10.4	97.8	PASS

Technician: A. Roper


Rick G. Kushner, P.E.

P.E. No. 38705

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UES Project No. 41011-175-01
UES Report No. 77258
Date: 12/21/00

Report of IN-PLACE DENSITY TESTS

Client: Volusia County
123 West Indiana Avenue
DeLand, Florida 32720-4262

Project: Tomoka Landfill - South Cell

Area Tested: South Cell/West Slope

Course: Subgrade Fill

Type of Test: Field: ASTM D-2922
Laboratory: ASTM D-1557

Date of Test: 07/26/01

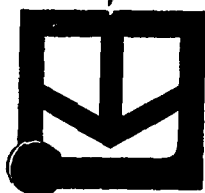
Requirements: 95% compaction of maximum density for subgrade fill

*Reference: 0=top of ground

Location of Test	Depth of Test*	Laboratory Test Results		Field Test Results			
		Maximum Density Dry Lbs/CuFt	Optimum Moisture Percent	Density Dry Lbs/CuFt	Field Moisture Percent	Maximum Density Percent	Test Pass or Fail
1. Stake W-1	0-1'	103.3	13.4	107.2	14.5	103.8	PASS
2. Stake W-2	0-1'	103.3	13.4	93.2	13.0	90.2	FAIL
3. Stake W-9	0-1'	103.3	13.4	95.0	10.3	91.9	FAIL
4. First retest of location number 3 above	0-1'	103.3	13.4	99.2	10.9	96.1	PASS
5. D-67	0-1'	103.3	13.4	98.2	14.1	95.1	PASS
6. Stake W-10	0-1'	103.3	13.4	101.6	14.8	98.4	PASS
7. Stake W-11	0-1'	103.3	13.4	98.4	15.3	95.2	PASS
8. D-68	0-1'	103.3	13.4	106.2	12.9	102.8	PASS
9. Stake W-22	0-1'	103.3	13.4	100.5	13.4	97.3	PASS
10. D-69	0-1'	103.3	13.4	102.4	13.9	99.1	PASS

Technician: N. Ellis


Rick G. Kushner, P.E.
P.E. No. 38705
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UES Project No. 41011-212-01

UES Report No. 79507

Date: 02/21/02

Report of IN-PLACE DENSITY TESTS

Client: **Volusia County**
123 West Indiana Avenue
DeLand, Florida 32720-4262

Attention: Nathan Hunter

Project: Tomoka Land Fill North Expansion

Area Tested: Slope West Side

Course: Backfill

Type of Test: Field: ASTM D-2937
Laboratory: ASTM D-1557

Date of Test: 02/20/02

Requirements: 95% compaction of maximum density

*Reference: 0 = top of grade

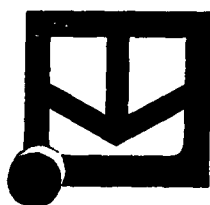
Location of Test	Depth of Test*	Laboratory Test Results		Field Test Results			
		Maximum Density Dry Lbs/CuFt	Optimum Moisture Percent	Density Dry Lbs/CuFt	Field Moisture Percent	Maximum Density Percent	Test Pass or Fail
1. Grid D-70	0-1'	105.1	12.6	107.1	9.0	101.9	PASS
2. Grid D-71	0-1'	105.1	12.6	104.7	8.8	99.6	PASS
3. Grid D-72	0-1'	105.1	12.6	103.2	11.0	98.2	PASS
4. Grid D-73	0-1'	105.1	12.6	104.1	10.6	99.1	PASS
5. Grid D-74	0-1'	105.1	12.6	103.0	12.6	98.0	PASS
6. Grid D-75	0-1'	105.1	12.6	104.1	11.0	99.0	PASS
7. Grid D-76	0-1'	105.1	12.6	102.6	13.0	97.6	PASS
8. Grid D-77	0-1'	105.1	12.6	103.8	8.6	98.9	PASS
9. Grid D-78	0-1'	105.1	12.6	102.6	13.0	97.6	PASS
10. Grid D-79	0-1'	105.1	12.6	100.3	7.6	95.5	PASS
11. Grid D-80	0-1'	105.1	12.6	101.8	8.0	96.9	PASS

Technician: P. Guarneri


Jeff Jackson, P.E.

P.E. No. 51979

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UES Project No. 41011-212-01
UES Report No. 79515
Date: 02/22/02

Report of IN-PLACE DENSITY TESTS

Client: Volusia County
123 West Indiana Avenue
DeLand, Florida 32720-4262

Attention: Nathan Hunter

Project: Tomoka Land Fill North Expansion

Area Tested: Slope (West)

Course: Backfill

Type of Test: Field: ASTM D-2937
Laboratory: ASTM D-1557

Date of Test: 02/21/02

Requirements: 95% compaction of maximum density

Reference: 0 = top of grade

		Laboratory Test Results		Field Test Results			
Location of Test	Depth of Test*	Maximum Density Dry Lbs/CuFt	Optimum Moisture Percent	Density Dry Lbs/CuFt	Field Moisture Percent	Maximum Density Percent	Test Pass or Fail
1. Grid D-81	0-1'	105.1	12.6	101.8	6.0	96.9	PASS
2. Grid D-82	0-1'	105.1	12.6	101.8	10.8	96.9	PASS
3. Grid D-83	0-1'	105.1	12.6	102.1	11.8	97.2	PASS
4. Grid D-84	0-1'	105.1	12.6	100.7	6.8	95.8	PASS
5. Grid D-85	0-1'	105.1	12.6	101.7	4.8	96.7	PASS
6. Grid D-86	0-1'	105.1	12.6	101.3	7.6	96.3	PASS
7. Grid D-87	0-1'	105.1	12.6	104.3	14.0	99.0	PASS
8. Grid D-88	0-1'	105.1	12.6	101.2	9.0	96.3	PASS
9. Grid D-89	0-1'	105.1	12.6	100.7	12.0	95.8	PASS
10. Grid D-90	0-1'	105.1	12.6	100.0	14.0	95.6	PASS
11. Grid D-91	0-1'	105.1	12.6	100.7	12.9	95.8	PASS
12. Grid D-92	0-1'	105.1	12.6	103.3	9.0	98.2	PASS



UNIVERSAL ENGINEERING SCIENCES

Consultants In: Geotechnical Engineering • Environmental Sciences •
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911 Beville Road, Suite 3 • South Daytona, Florida 32119 • (386) 756-1105 • FAX (386) 760-4067

UES Project No. 41011-212-01

UES Report No. 79515

Date: 02/22/02

Report of IN-PLACE DENSITY TESTS

Client: Volusia County
123 West Indiana Avenue
DeLand, Florida 32720-4262

Attention: Nathan Hunter

Project: Tomoka Land Fill North Expansion

Area Tested: Slope (West)

Course: Backfill

Type of Test: Field: ASTM D-2937
Laboratory: ASTM D-1557

Date of Test: 02/21/02

Requirements: 95% compaction of maximum density

*Reference: 0 = top of grade

Location of Test	Depth of Test*	Laboratory Test Results		Field Test Results			
		Maximum Density Dry Lbs/CuFt	Optimum Moisture Percent	Density Dry Lbs/CuFt	Field Moisture Percent	Maximum Density Percent	Test Pass or Fail
13. Grid D-93	0-1'	105.1	12.6	102.9	8.5	97.9	PASS
14. Grid D-94	0-1'	105.1	12.6	101.9	10.8	97.0	PASS
15. Grid D-95	0-1'	105.1	12.6	101.5	16.0	96.6	PASS
16. Grid D-96	0-1'	105.1	12.6	101.1	7.8	96.2	PASS
17. Grid D-97	0-1'	105.1	12.6	101.7	11.9	96.8	PASS
18. Grid D-98	0-1'	105.1	12.6	102.7	11.6	97.7	PASS
19. Grid D-99	0-1'	105.1	12.6	101.7	16.0	96.7	PASS
20. Grid D-100	0-1'	105.1	12.6	102.5	10.0	97.5	PASS

Technician: P. Guarneri


Jeff Jackson, P.E.
P.E. No. 51979
UNIVERSAL ENGINEERING SCIENCES

SECTION 5

GEOSYNTHETIC CLAY LINER

5.1 MANUFACTURER'S CQA

The GCL used for this project, Bentomat ST, was manufactured by CETCO. Initially, the County purchased the GCL product directly from CETCO. In 2002, the County began purchasing GCL under a contract with GSL Lining Technologies (GSL). GSL supplied Bentomat ST, manufactured by CETCO. As the manufacturer, CETCO continued to be responsible for conducting the manufacturer's CQA testing.

Mass per unit area, and moisture content for the bentonite portion of the GCL was tested a minimum of every 40,000 square feet (sf). Grab strength, peel strength, puncture strength, and thickness of the completed GCL product was tested at the CETCO plant at Fairmont, Georgia at a minimum of every 200,000 sf.

Each shipment of bentonite clay used to manufacture the GCL panels was tested at the CETCO plant in Lovell, Wyoming for free swell and fluid loss.

Based on the results of the testing, CETCO provided certification that each panel supplied to the project met the physical criteria listed In Table 5-1.

**TABLE 5-1. GCL MANUFACTURING CERTIFICATION
TOMOKA FARMS ROAD LANDFILL SOUTH CELL CLOSURE**

PROPERTY	TEST METHOD	REQUIRED VALUE
<i>Bentonite</i>		
Free Swell	ASTM D 5890	24 min.
Fluid Loss	ASTM D 5891	18 max.
<i>Finished Product</i>		
Bentonite Mass/Area	ASTM D 5993*	0.84 lb/sq.ft. min.
Grab Strength	ASTM D 4632	90 lbs. MARV
Index Flux	ASTM D 5887	$1 \times 10^{-8} \text{ m}^3/\text{m}^2/\text{sec}$ max.
Peel Strength	ASTM D 4632 (modified)	15 lbs. Min.
Permeability	ASTM D 5084	$5 \times 10^{-9} \text{ cm/sec}$ max.
Puncture	ASTM D 4833	80 min.
Thickness	ASTM D 5199	6.4 dry

* Reported at 0% moisture content

A summary of CETCO's certification and shipping is included in Attachment 5-1. A copy of CETCO's QC/QA documentation and certification is available for inspection at Volusia County.

5.2 QUALITY ASSURANCE TESTING

The County authorized Precision Geosynthetic Laboratories (PGL) to provide laboratory CQA services during construction. Samples were collected at the project site by SCS and shipped to the laboratory for testing. PGL also collected samples at the CETCO manufacturing facilities from products being shipped to Volusia County. PGL conducted tests on GCL as described in Table 5-2.

**TABLE 5-2. GCL CQA TESTING
TOMOKA FARMS ROAD LANDFILL SOUTH CELL CLOSURE**

PROPERTY	TEST METHOD	REQUIRED VALUE
Bentonite Mass/Area	ASTM D5993	0.84 lb/sq.ft. min.
Free Swell	ASTM D5890	24 min.
Hydraulic Conductivity	ASTM D5084	5×10^{-9} cm/sec max.

A summary of PGL's CQA testing is included in Attachment 5-2. A copy of PGL's CQA documentation is available for inspection at Volusia County.

5.3 GCL PANEL PLACEMENT

Prior to acceptance, the CQA engineer or his designee inspected the subgrade to determine the following:

- A qualified land surveyor has verified all lines and grades.
- The supporting soil meets the density and depth of cover requirements, and provides a firm, unyielding foundation.
- The surface to be lined is relatively smooth and free of stones, protrusions, irregularities, roots, loose soil, abrupt changes in grade, or other conditions that may puncture or abrade the geomembrane.
- There is no standing water or areas excessively softened by high moisture content, large desiccation cracks.

Copies of the on-site inspector's daily logs are available for inspection at Volusia County.

A summary of the GCL installation during the 1996 construction period is shown in Table 5-3.

**TABLE 5-3 GCL INSTALLATION, 1996
TOMOKA FARMS ROAD LANDFILL SOUTH CELL CLOSURE**

MONTH	ROLLS INSTALLED	ACRES CLOSED
April 96	89	4.4
May 96	51	2.5
Total 1996	140	6.9

During the period from 1996 to 2000, the east sideslope where the GCL had been placed settled several feet. The County placed additional soil cover over the GCL to bring the surface up to final grade.

A summary of the 2000-2002 GCL installation is shown in Table 5-4

**TABLE 5-4. GCL INSTALLATION, 2000-2002
TOMOKA FARMS ROAD LANDFILL SOUTH CELL CLOSURE**

MONTH	ROLLS INSTALLED	ACRES CLOSED
Feb-00	54	2.7
Mar-00	88	4.4
Aug-00	107	5.3
Sep-00	21	1.0
Oct-00	29	1.4
Nov-00	72	3.6
Dec-00	217	10.8
Jan-01	164	8.1
Feb-01	277	13.7
Mar-01	48	2.4
Apr-02	225	11.2
May-02	39	1.9
Sep-02	74	3.7
Oct-02	88	4.4
Nov-02	10	0.5
Total 2000-2002	1513	75.0

5.4 CONSTRUCTION PHOTOGRAPHS

Photographs of typical construction activity are included in Attachment 5-3.

ATTACHMENT 5-1

GCL CERTIFICATION AND SHIPPING SCHEDULE

CLIENT: VOLUSIA COUNTY
 PROJECT: SOUTH CELL CLOSURE
 SUBJECT: CETCO QA CERTIFICATION

SCS ENGINEERS

PROJECT NO.: 09201053.09
 BY: LAP DATE: JAN 15 2003

<u>Date of Certification</u>	<u>Date of Shipment</u>	<u># of Rolls Shipped</u>
22-Feb-00	18-Feb-00	31
25-Feb-00	24-Feb-00	32
2-Mar-00	1-Mar-00	47
7-Mar-00	3-Mar-00	16
8-Mar-00	8-Mar-00	29
21-Mar-00	20-Mar-00	15
22-Mar-00	21-Mar-00	30
30-Mar-00	27-Mar-00	62
30-Mar-00	27-Mar-00	32
25-Aug-00	24-Aug-00	40
28-Aug-00	25-Aug-00	75
29-Aug-00	28-Aug-00	87
6-Sep-00	29-Aug-00 - 5-Sep-00	89
11-Sep-00	6-Sep-00	88
15-Sep-00	11-13-Sep-00	164
29-Dec-00	28-Dec-00	37
17-Jan-01	16-Jan-01	48
22-Jan-01	17-18-Jan-01	79
20-Feb-01	19-Feb-01	48
21-Feb-01	21-Feb-01	48
2-Mar-01	28-Feb-01	48
6-Mar-01	5-Mar-01	46
7-Mar-01	6-Mar-01	48
22-Apr-02	19-Apr-02	108
6-Jun-02	5-Jun-02	68
7-Jun-02	6-Jun-02	82
31-Oct-02	30-Oct-02	30
	Total # Rolls:	1527

ATTACHMENT 5-1
GCL CERTIFICATION AND SHIPPING SCHEDULE

ATTACHMENT 5-2
CQA TESTING SUMMARY

CLIENT: VOLUSIA COUNTY
PROJECT: SOUTH CELL CLOSURE
SUBJECT: GCL QA TESTING

SCS ENGINEERS

PROJECT NO.: 09201053.09
BY: LAP DATE: JAN 15 2003

**GCL Quality Assurance Testing
By Precision Geosynthetic Laboratories**

Roll Number	Date Received	Date Certification	Hydraulic Conductivity cm./sec.	Swell Index mL/2g.	Mass Per Unit Area Clay Lb/SF
854	9-Mar-00	11-Mar-00		24.0	1.32
917	7-Mar-00	15-Mar-00	2.40E-09	28.0	1.27
244	5-Apr-00	18-Apr-00	2.20E-09	28.0	1.26
8359	30-Aug-00	1-Sep-00		29.0	1.08
8614	1-Sep-00	7-Sep-00		28.0	1.03
8640	1-Sep-00	12-Sep-00	3.80E-09	28.0	1.02
8584	11-Sep-00	18-Sep-00	3.70E-09	30.0	1.02
103	15-Sep-00	21-Sep-01		28.0	1.21
110	19-Sep-00	26-Sep-00	4.10E-09	27.0	1.26
2724	10-Jan-01	17-Jan-01	1.40E-09	28.0	0.90
2756	18-Jan-01	24-Jan-01	2.70E-09	28.0	0.93
113	19-Jan-01	31-Jan-01	2.60E-09	29.0	1.05
2629	19-Jan-01	31-Jan-01	2.80E-09	29.0	1.02
11490	19-Jan-01	31-Jan-01	3.10E-09	30.0	0.85
2803	26-Jan-01	2-Feb-01	3.30E-09	28.0	0.89
281	22-Feb-01	28-Feb-01		28.0	0.86
355	22-Feb-01	28-Feb-01		28.0	0.87
11975	27-Feb-01	2-Mar-01		27.0	0.93
397	27-Feb-01	2-Mar-01		28.0	0.84
73	6-Mar-01	8-Mar-01		26.0	1.10
646	12-Mar-01	14-Mar-01		27.0	1.07
5639	17-Dec-01	26-Dec-01			1.19
5655	17-Dec-01	26-Dec-01			1.18
5674	17-Dec-01	26-Dec-01			1.27
5691	17-Dec-01	26-Dec-01	2.8E-09	30.0	1.26
5708	17-Dec-01	26-Dec-01			1.26
5725	17-Dec-01	26-Dec-01	2.5E-09	29.0	1.31
3861	17-Dec-01	26-Dec-01			1.18
3942	17-Dec-01	26-Dec-01			1.33
3891	17-Dec-01	26-Dec-01	2.60E-09	30.0	1.21
3916	17-Dec-01	26-Dec-01	3.00E-09	31.0	1.18
4651	17-Dec-01	26-Dec-01			1.13
4531	17-Dec-01	26-Dec-01			1.01

ATTACHMENT 5-2. CQA TESTING SUMMARY

CLIENT: VOLUSIA COUNTY
PROJECT: SOUTH CELL CLOSURE
SUBJECT: GCL QA TESTING

SCS ENGINEERS

PROJECT NO.: 09201053.09
BY: LAP DATE: JAN 15 2003

**GCL Quality Assurance Testing
By Precision Geosynthetic Laboratories**

Roll Number	Date Received	Date Certification	Hydraulic Conductivity cm./sec.	Swell Index mL/2g.	Mass Per Unit Area Clay Lb/SF
4613	17-Dec-01	26-Dec-01	2.7E-09	31.0	1.04
4599	17-Dec-01	26-Dec-01			1.20
4669	17-Dec-01	26-Dec-01	2.8E-09	30.0	1.27
1106	13-Mar-02	26-Mar-02	4.10E-09	29.0	1.13
1123	13-Mar-02	26-Mar-02	3.80E-09	30.0	1.03
1141	13-Mar-02	26-Mar-02	4.50E-09	30.0	1.16
1158	13-Mar-02	26-Mar-02	3.80E-09	29.0	1.26
1176	13-Mar-02	26-Mar-02	3.80E-09	30.0	1.22
1194	13-Mar-02	26-Mar-02	3.70E-09	31.0	1.22
2370	22-Apr-02	3-May-02	3.90E-09	30.0	1.15
2431	22-Apr-02	3-May-02	3.70E-09	30.0	1.15
2501	24-Apr-02	3-May-02	4.10E-09	30.0	1.05
2530	24-Apr-02	3-May-02	4.60E-09	31.0	1.16
2417	2-May-02	9-May-02	4.60E-09	29.0	1.03
4594	7-Jun-02	12-Jun-02	4.10E-09	29.0	1.21
4641	7-Jun-02	12-Jun-02	4.50E-09	29.0	1.34
4688	7-Jun-02	12-Jun-02	4.30E-09	30.0	1.33
4736	8-Jun-02	14-Jun-02	4.70E-09	29.0	1.00
10751	3-Oct-02	11-Oct-02	3.80E-09	29.0	1.05
10795	3-Oct-02	11-Oct-02	4.40E-09	29.0	0.95
11872	31-Oct-02	8-Nov-02	4.20E-09	29.0	1.25

Note:

Hydraulic Conductivity	ASTM D5084
Swell Index	ASTM D5890
Mass Per Unit Area	ASTM D5993

ATTACHMENT 5-3
CONSTRUCTION PHOTOGRAPHS

Photograph Number 1



Site: Tomoka Farms Road Landfill, South Cell

Description: Checking subgrade soil depth

Photograph Number 2



Site: Tomoka Farms Road Landfill, South Cell

Description: Testing subgrade soil density.

Photograph Number 3



Site: Tomoka Farms Road Landfill, South Cell

Description: Unrolling Geosynthetic Clay Liner (GCL).

Photograph Number 4



Site: Tomoka Farms Road Landfill, South Cell

Description: Placing Bentonite on GCL seam.

Photograph Number 5



Site: Tomoka Farms Road Landfill, South Cell

Description: Cover soil placed over GCL.

Photograph Number 6



Site: Tomoka Farms Road Landfill, South Cell

Description: Cover soil stockpiled for placing over GCL.

Photograph Number 7



Site: Tomoka Farms Road Landfill, South Cell

Description: Excavation to expose previously placed GCL.

Photograph Number 8



Site: Tomoka Farms Road Landfill, South Cell

Description: GCL placed overlapping previously placed GCL.

Photograph Number 9



Site: Tomoka Farms Road Landfill, South Cell

Description: Placing rolled sod over completed cover.

Photograph Number 10



Site: Tomoka Farms Road Landfill, South Cell

Description: Rock in geoweb downchute.

SECTION 6

FINAL COVER

6.1 SOIL COVER

Final soil cover was placed approximately 30 inches deep over the GCL panels the on same day that each panel was installed. The soil was graded and compacted by a bulldozer before covering with sod. Three methods were used to verify that the final graded soil cover consisted of a minimum of 24 inches of soil over the GCL.

- Survey stakes were placed blunt side down over the GCL with the required final cover depth marked on the stake.
- Test holes were dug to verify that there was a minimum of 24 inches of soil cover over the GCL.
- The elevations of the final survey were compared to the elevations of the completed subgrade.

6.2 VEGETATIVE COVER

After the cover soil was graded, rolled sod was applied for the final vegetative cover.

SECTION 7

FINAL SURVEY

Southern Resource Mapping, Inc., provided aerial photography of the site dated July 28, 2002. At the time of the photomapping, Final cover including the GCL had been placed on the north, east, and south slopes. At the time of the photomapping, final cover had not been completed on the southwest corner of the landfill. Four drainage downchutes had been constructed on the north slope, and construction of four downchutes on the west slope had not been completed. The final contours as of July 28, 2002 are shown on Exhibit 4. On November 16, 2002, and June 12, 2003, Blackwell surveyed the location of the remaining downchutes. These downchutes are also shown on Exhibit 4.

The County is arranging for a final aerial survey of the closed South Cell that will show the completed closure.

SECTION 8

CONSTRUCTION MODIFICATIONS

8.1 GENERAL

As construction progressed, minor adjustments to the site were necessary to accommodate unanticipated field conditions encountered during construction. The minor revisions maintained the original design intentions of the permit. These changes are discussed in this section.

8.2 FINAL ELEVATIONS

The closure permit drawings were prepared based on aerial photomapping by 3Di, Inc. dated July 8, 1998. These drawings show a maximum elevation of 126 National Geodetic Vertical Datum (NGVD). In some locations, the final elevations were adjusted from what had been shown on the permit drawings. The actual maximum elevation of the completed site is 123 NGVD.

8.3 DRAINAGE DOWNCHUTES

The permit drawings show 17 downchutes on the east and south slopes directing water from the terrace swales to the toe of slope. The east and south slopes have been closed since 1995 with no signs of erosion. The slopes are relatively mild, at 6H to 1V and a good grass cover has been maintained on these slopes. The County therefore decided not to build the additional downchutes on these closed slopes at the present time. If erosion becomes evident in the future, the County will install the downchutes at that time.

The permit drawings show ten downchutes on the north slope. The County constructed four of these chutes in areas where surface runoff was starting to form visible erosion. If erosion becomes evident in the future, the County will install the remaining chutes at that time.

The permit drawings show seven downchutes on the west slope. The County constructed four of these chutes in areas where surface runoff was starting to form visible erosion. If erosion becomes evident in the future, the County will install the remaining chutes at that time.

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