



July 3, 2008

Ms. Donna Wilson  
Environmental Engineer  
**NC DENR - Division of Waste Management**  
401 Oberlin Road, Suite 150  
Raleigh, NC 27605

**Re: Transition Application Comments - Phase 1  
Red Rock Disposal C&D Landfill  
(Solid Waste Permit No. 92-28)  
Holly Springs, North Carolina**

Dear Ms. Wilson:

On behalf of Red Rock Disposal, LLC, Richardson Smith Gardner & Associates (RSGA) has prepared this response to comments issued in email correspondence dated June 3, 2008 (**copy attached**). The following responses address each comment and reference any revisions to the application previously submitted on May 29, 2008. Please find each comment in *italics* and the associated response below.

**Comment No. 1**

*Please provide a discussion and demonstration (reference report) for the alternate 3:1 slope, addressing stability, operation safety, and construction safety during operation and closure activities.*

**Response No. 1**

The stability for the alternate 3:1 slopes was previously evaluated in the Phase 1 Permit to Construct Application<sup>1</sup>. The evaluation concluded that the configuration is stable. In order to address construction methods and procedures during closure activities, we have added an additional specification Section 02250 (Soil Liner) (**Attachment A**) and provided an additional section on Soil Liner CQA for inclusion in the currently approved PTC Application (**Attachment B**).

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<sup>1</sup>

Revised Permit to Construct Application, Red Rock Disposal, LLC, C&D Landfill - Phase 1 dated October 2003 prepared by G.N. Richardson & Associates, Inc.

**Comment No. 2**

*Section 1.6 – Closure Schedule – The three bullets describing when final cover will be applied should be changed to be consistent with state rules. When will final cover be applied to Phase 1, or portions of Phase 1 (in terms of sequence or progress of fill)?*

**Response No. 2**

The closure language in Section 1.6 of the Closure Plan has been revised as follows:

*Closure activities must begin on the following schedule:*

- *No later than 30 days after the date on which the C&D landfill (unit) last receives waste (known final receipt of wastes);*
- *No later than 30 days after the date that a ten (10) acre or greater area of waste, is within 15 feet of final design grades; and*
- *No later than one (1) year after the most recent receipt of wastes, if the C&D landfill (unit) has remaining capacity.*

*All closure activities shall be completed within 180 days. Exemptions and extensions may be approved by the DWM.*

See **Attachment C** for updated Closure Plan.

**Comment No. 3**

*Please provide a copy of drawing E5, the final grading and drainage plan. Will there be conflicts between the locations of surface water drainage features and the gas vents?*

**Response No. 3**

A copy of **Drawing No. E5** is included as **Attachment D**. The gas vents will not be located in a surface water drainage feature. All gas vent locations are approximate and will be adjusted as necessary to avoid these features.

**Comment No. 4**

*Please provide a discussion of the installation of the cap and gas vents.*

Ms. Donna Wilson  
July 3, 2008  
Page 3 of 3

#### **Response No. 4**

As noted in **Response No. 1**, specification Section 02250 (Soil Liner) has been added as well as Section 02258 (Vegetative Soil Layer) has been updated to describe procedures necessary for final cover construction. The updated Section 02258 can be found in **Attachment E**. The gas vent details are provided on Drawing No. LFG1 and will be installed prior to soil liner installation during site preparation of the area receiving final cover.

#### **Comment No. 5**

*The post-closure cost estimates list 22 gas vents and 12 monitoring probes. The drawings show 64 gas vents and 29 gas probes. The estimates list 15 groundwater wells and 2 surface water sampling points. The permit lists 10 wells and 3 surface water points. Please clarify.*

#### **Response No. 5**

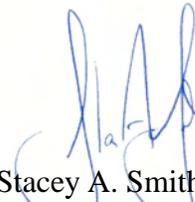
The post-closure estimate has been modified to include ten (10) groundwater wells and three (3) surface water monitoring points. A revised Post-Closure Estimate is provided as **Attachment F**.

The gas vents and monitoring probes included in the estimate address the landfill unit as presented in the Phase 1 PTC application. However, the Landfill Gas Management Plan shows a final build out for the complete facility as presented in the Site Application. The post-closure estimate assumes one (1) gas vent per two (2) acres and one (1) gas monitoring probe per 500 LF (perimeter).

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 us at (919) 828-0577 or by email.

Sincerely,  
**Richardson Smith Gardner & Associates, Inc.**

Bryan Johnson, E.I.  
Staff Engineer ext. 125  
[bryan@rsgengineers.com](mailto:bryan@rsgengineers.com)



Stacey A. Smith, P.E.  
Project Manager ext. 127  
[stacey@rsgengineers.com](mailto:stacey@rsgengineers.com)

Att.

Cc: Don Plessinger, Red Rock Disposal, LLC  
David Pepper, Waste Industries USA, Inc.  
Bradley Bailey, NCDENR (cover letter)  
File

**Subject:** Red Rock comments on C/PC/FR

**From:** Donna Wilson <Donna.Wilson@ncmail.net>

**Date:** Tue, 03 Jun 2008 10:24:26 -0400

**To:** Stacey Smith <stacey@rsgengineers.com>, David Pepper <david.pepper@wasteindustries.com>

Stacey - I've reviewed the Red Rock Landfill closure plan, post-closure plan, and cost estimates for financial responsibility in accordance with .0547, and I have a few questions/comments:

1. Please provide a discussion and demonstration (reference report) for the alternate 3:1 slope, addressing stability, operation safety, and construction safety during operation and closure activities.
2. Section 1.6 - Closure Schedule - The three bullets describing when final cover will be applied should be changed to be consistent with state rules. When will final cover be applied to Phase 1, or portions of Phase 1 (in terms of sequence or progress of fill)?
3. Please provide a copy of drawing E5, the final grading and drainage plan. Will there be conflicts between the locations of surface water drainage features and the gas vents?
4. Please provide a discussion of the installation of the cap and gas vents.
5. The post-closure cost estimates list 22 gas vents and 12 monitoring probes. The drawings show 64 gas vents and 29 gas probes. The estimates list 15 groundwater wells and 2 surface water sampling points. The permit lists 10 wells and 3 surface water points. Please clarify.

Thanks, Donna

--

Donna J. Wilson  
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NC DENR  
1646 Mail Service Center  
Raleigh NC 27699-1646  
Phone 919-508-8510  
Section webpage - <http://wastenotnc.org/swhome>

# Closure And Post-Closure Plan

**Red Rock Disposal, LLC  
C&D Landfill - Phase 1  
NC Solid Waste Permit No. 92-28**

Prepared for:



**Red Rock Disposal, LLC**  
7130 New Landfill Drive  
Holly Springs, North Carolina 27540

**April 2008**

Modified 7-3-08

**PERMIT ISSUE DOCUMENTS**

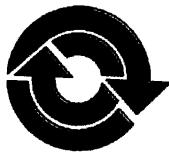
Prepared for:



# Closure and Post-Closure Plan

**Red Rock Disposal, LLC  
C&D Landfill - Phase 1  
(NC Solid Waste Permit No. 92-28)  
Holly Springs, North Carolina**

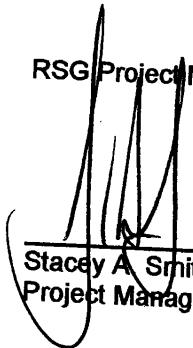
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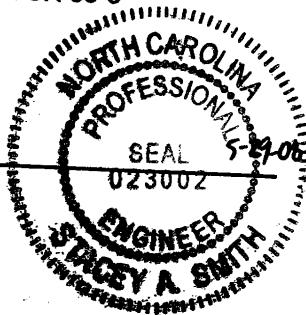


**Red Rock Disposal, LLC  
7130 New Landfill Drive  
Holly Springs, North Carolina 27540**

To the Attention of:  
**Mr. David Pepper  
Waste Industries USA, Inc.**

RSG Project No. RED ROCK-08-3

  
Stacey A. Smith, P.E.  
Project Manager



**April 2008**



## Closure and Post-Closure Plan

**Red Rock Disposal, LLC**  
**C&D Landfill - Phase 1**  
**(NC Solid Waste Permit No. 92-28)**  
**Holly Springs, North Carolina**

Prepared for:



**Red Rock Disposal, LLC**  
7130 New Landfill Drive  
Holly Springs, North Carolina 27540

To the Attention of:

**Mr. David Pepper**  
**Waste Industries USA, Inc.**

RSG Project No. RED ROCK-08-3

---

Stacey A. Smith, P.E.  
Project Manager

**April 2008**



**RED ROCK DISPOSAL, LLC  
C&D LANDFILL - PHASE 1**

**CLOSURE AND POST-CLOSURE PLAN**

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## SECTION 1.0 CLOSURE PLAN

### 1.1 OVERVIEW

This plan is intended to serve as a guide for the proposed closure of the Red Rock Disposal C&D Landfill. A formalized Closure Plan for Phase 1 (or incremental portion thereof) will be submitted to the Solid Waste Section of the North Carolina Department of Environment and Natural Resources Division of Waste Management (DWM) for approval prior to beginning closure construction.

### 1.2 MAXIMUM CLOSURE AREA AND WASTE CAPACITY

A Final Cover Grading Plan (**Drawing No. E5**) is provided as **Appendix A** of this Plan as modified from the permit<sup>1</sup> drawings in accordance with 15A NCAC 13B .0543. for Phase 1 of the Red Rock Disposal C&D Landfill. Based on this drawing, the following are the estimated areas and capacity for each landfill unit to be closed under this plan.

Phase	Area (Ac.)	Operating Capacity (CY)		Life Expectancy <sup>3</sup>
		Gross <sup>1</sup>	Net <sup>2</sup>	
1 (Active)	30.8	2,546,488	2,279,064	3.3 Years
1C-2 (Future)	13.4	1,212,326	1,085,011	1.2 Years
Total:	44.2	3,758,814	3,364,076	4.5 Years

Notes:

1. Gross capacity is based on final cover grades provided on **Drawing No. E5** and assumes subgrades as shown on **Drawing No. E4** as presented in current permit drawings<sup>1</sup>.
2. The net capacity is determined by pro-rated deductions for final cover soils from the gross capacity.
3. The existing life expectancy assumes two hundred sixty (286) operating days a year accepting 2,000 tons per day with a unit weight of 0.625 tons per cubic yard.

### 1.3 FINAL COVER SYSTEM

The final cover system will consist of the following components (top-down):

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<sup>1</sup> Red Rock Disposal, LLC Construction & Demolition Debris (C&D) Landfill Phase 1 Engineering Drawings dated May 2001 with revisions through April 2004 prepared by G.N. Richardson & Associates, Inc.

- a 18-inch thick vegetative soil layer (including 6 inches of topsoil)
- a 18-inch thick layer of low permeability material ( $1 \times 10^{-5}$  cm/sec); and
- a 12-inch thick intermediate cover layer.

The final cover system will be placed on prepared intermediate cover at a maximum slope of 3H:1V as previously demonstrated in the Permit to Construct Application for Phase 1<sup>2</sup>. This evaluation revealed a stable and safe configuration. A landfill gas (LFG) control (venting) system (as shown in **Detail 2** on **Drawing No. LFG1**) and surface water control devices will also be incorporated into the final cover. The final cover surface will be vegetated upon completion of the final cover installation according to the project seeding specifications.

Technical specifications and construction quality assurance requirements for final cover system components can be found in **Appendices B and C**, respectively. Final cover system details are shown on **Drawings No. G1 and No. EC2** (Details) as modified from the original permit drawings.

Placement of the low permeability soil layer shall be closely monitored for moisture and density to achieve the minimum requirements set forth in the specifications. The vegetative soil layer should receive no compaction other than that provided by the dozer tracks. Pans or other heavy equipment should not operate on the vegetative soil layer.

#### 1.4 LANDFILL GAS SYSTEM

A landfill gas control (venting) system is provided in the final cover system. This system includes a system of collection wells or trenches placed within the waste immediately below the cover to capture the gas passively. The collection wells should be placed before any low permeability soils are placed. The location of gas system components are shown on **Drawing No. LFG1** (Landfill Gas Management Plan).

#### 1.5 SURFACE WATER SYSTEMS

Precipitation falling on the cover will infiltrate into the cover or run off the cover. Short-term the run-off runs down the surface of the intermediate cover. Long-term the run-off is collected in a series of drainage breaks built into the areas covered by final cover. These drainage breaks are in the form of “tack-on” berms provided along side slopes and near the upper edge of the side slopes (cap diversion berms). The “tack-on” berms are designed with a maximum slope length of approximately 150 feet (horizontally projected) such that side slope erosion potential is minimized. Water captured by the “tack-on” berms routed toward one of the down pipes. Flow in the down pipes is routed to the base of the landfill and to one of the site sediment basins.

The locations of berms, and down pipes are shown on **Drawing No. E5** (Phase 1 Final Grading

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<sup>2</sup> Revised Permit to Construct Application, Red Rock Disposal, LLC C&D Landfill - Phase 1 dated October 2003 with revisions through June 2004 prepared by G.N. Richardson & Associates, Inc.

and Drainage Plan).

### **1.5.1 Incremental Operation**

During much of the life of the landfill, surface run-off will be handled by the intermediate cover system. Operations must strive to provide operational grading that encourages run-off from the intermediate cover to drain to the perimeter channels along the perimeter berms or to areas covered by final cover. Corrugated polyethylene (CPE) piping and temporary soil berms must be installed if required to accomplish this run-off routing.

### **1.5.2 Required Maintenance**

The surface water systems must be inspected annually and immediately after every major storm. Sediment build-up in the drainage features/devices must be cleaned out on a regular basis to promote run-off. Sediments removed can be used as daily or intermediate cover.

## **1.6 CLOSURE SCHEDULE**

Closure activities must begin on the following schedule:

- No later than 30 days after the date on which the C&D landfill (unit) last receives waste (known final receipt of wastes);
- No later than 30 days after the date that a ten (10) acre or greater area of waste, is within 15 feet of final design grades; and
- No later than one (1) year after the most recent receipt of wastes, if the C&D landfill (unit) has remaining capacity.

All closure activities shall be completed within 180 days. Exemptions and extensions may be approved by the DWM.

## **1.7 CLOSURE VERIFICATION**

The following procedures will be implemented following closure:

- A Construction Quality Assurance (CQA) report will be submitted to the DWM. This report will describe the observations and tests used before, during, and upon completion of construction to ensure that the construction materials meet the final cover design specifications and the construction and certification requirements. The CQA report will contain as-built drawings.
- A signed certification from a registered Professional Engineer verifying that closure has been completed in accordance with the closure plan will be submitted

to the DWM.

- Following final receipt of waste and full facility closure, at least one sign notifying all persons of the closing of the landfill (or incremental portions thereof) and that wastes are no longer accepted will be posted. Suitable barriers will be installed as necessary at former access points to prevent new waste from being deposited.
- Within 90 days, a survey plat, prepared by a registered Professional Land Surveyor, indicating the location and dimensions of landfill disposal areas, will be prepared.
- A notation will be recorded on the deed notifying any potential purchaser of the property that the land has been used as a landfill facility and that future use is restricted under the approved closure plan. A copy of the deed notation as recorded will be filed with the operating record.

## **SECTION 2.0 POST-CLOSURE PLAN**

### **2.1 OVERVIEW**

This Post-Closure Plan has been developed to outline steps to be taken to ensure the integrity of the landfill during its post-closure care period. The post-closure care period will last at least 30 years after final closure and, at a minimum, will consist of the following:

- Maintaining the integrity and effectiveness of final cover system;
- Performing groundwater and surface water monitoring;
- Maintaining and operating a gas monitoring system; and
- Maintaining run-on/run-off controls.

No wastes will remain exposed after closure of the landfill. Access to the closed site by the public will not pose a health hazard.

### **2.2 POST-CLOSURE CONTACT**

All correspondence and questions concerning the post-closure care of the unit should be directed to:

Mr. Don Plessinger  
Red Rock Disposal, LLC  
7130 New Landfill Drive  
Holly Springs, NC 27540  
Phone: (919) 557-9583  
Fax: (919) 557-9523.

### **2.3 POST-CLOSURE USE**

After filling operations cease at the landfill and the it is officially closed in accordance with the Closure Plan, the landfill will be maintained as a grassy hill. Red Rock Disposal will maintain control of the property and prevent public access to it during the post-closure period.

There may be (an) access road(s) on the final cover to allow proper maintenance during post-closure. Precise location of the access road(s) will be determined as a part of operations. Low ground pressure and rubber tire vehicles will be used for maintenance.

## 2.4 MAINTENANCE

### 2.4.1 Repair of Security Control Devices

All security control devices will be inspected and maintained as necessary to ensure access to the site is controlled. Locks, vehicular gates, and fencing will be replaced if functioning improperly. Warning signs will be kept legible at all times and will be replaced if damaged by inclement weather or vandalism.

### 2.4.2 Erosion Damage Repair

If erosion of the final cover occurs during post-closure, the affected area will be repaired and re-seeded as necessary. If necessary, rolled erosion control products (RECPs) will be used to expedite rapid revegetation of slopes and to secure topsoil in place.

### 2.4.3 Correction of Settlement, Subsidence, and Displacement

Minimum slopes of 5 percent will be maintained after settlement in order to prevent ponding and allow for proper drainage without infiltration. If vertical or horizontal displacement occurs due to differential settlement, cracks will be filled with appropriate material and final cover will be reestablished. Excessive vertical displacement is not anticipated.

### 2.4.4 Repair of Run-On/Run-Off Control Structures

All drainage swales, ditches, and perimeter channels will be repaired, cleaned, or realigned in order to maintain their original condition. Any culverts that are damaged will be repaired or replaced.

### 2.4.5 Landfill Gas Control System

The landfill gas control (venting) system will be maintained by Red Rock Disposal. Proper operation of the system is verified through periodic testing of the subsurface monitoring wells around the perimeter of the landfill.

If landfill gas wells/vents do not function as a result of irregular settlement, accumulation of liquids (condensate, leachate, water), binding or corrosion, additional and/or replacement wells/vents can be installed if necessary as shown on the Landfill Gas Management Plan (**Drawing No. LFG1**).

Monitoring shall be performed to identify (if any) subsurface migration of landfill gas at explosive levels are present in on-site structures and/or at the property boundary in accordance with **Table 2.1**. Methane or other explosive gas concentrations shall not exceed 25 percent of the lower explosive limit (LEL) (1.25% of CH<sub>4</sub>) in on-site structures, such as scale houses, or 100% of the LEL (5% of CH<sub>4</sub>) at the facility property

boundary. Subsurface methane monitoring wells are installed between the landfill perimeter and the property line, and are spaced approximately 500 feet apart. Additional wells will be installed as necessary and consistent with landfill expansion.

If landfill gas levels exceed these limits, the following must be performed:

- Immediately take all steps necessary for the protection of personnel, staff, or neighboring properties and notify the DWM;
- Within seven (7) days, place in the operating record a description of events taken following the detection event; and
- Within 60 days, implement a remediation plan for the explosive gas releases, place a copy in the operating record, and notify the DWM that the plan has been implemented.

#### **2.4.6 Groundwater Monitoring Wells**

Procedures outlined in the current Water Quality Monitoring (WQM) Plan or subsequent revision will take precedence; however, a brief description follows. All groundwater monitoring wells have been installed with concrete pads and protective casings to prevent accidental damage by vehicles and equipment. The wells are also equipped with a locking cap to discourage vandalism. Groundwater wells will be inspected regularly (at the time of sampling) to ensure integrity. Persons inspecting a well should look at the overall condition of the well, for signs of well tampering, and cracking or degradation of the concrete pad. Should a well require replacement, the defective well should be abandoned in accordance with specifications provided in the WQM Plan and a new well installed at a location that is approved by the DWM.

### **2.5 MONITORING PLAN**

The closed unit will be monitored for a minimum of 30 years. A series of inspections will be scheduled to ensure the integrity and effectiveness of the final cover system, surface water systems, groundwater monitoring system, landfill gas system, and to protect human health and the environment.

#### **2.5.1 Inspection Frequencies**

Inspections to be conducted during the post-closure care period will occur regularly as shown in **Table 2.1**.

#### **2.5.2 Quarterly Inspections**

Quarterly inspections of the closed site will be conducted by Red Rock Disposal. These inspections will include examination of the security control devices for signs of

deterioration or vandalism to ensure access to the site is limited to authorized persons. Each disposal area will be checked to ensure the integrity of the final cover system is maintained, erosion damage is repaired, vegetative cover persists, and that cover settlement, subsidence, and displacement are minimal. Drainage swales and channels will be cleared of litter and debris and benchmark integrity will be noted and maintained.

### **2.5.3 Semi-Annual Inspections**

Semi-annual inspections of the site during the post-closure period will be conducted by Red Rock Disposal with attention paid to integrity and drainage of the final cover system and condition of the groundwater and gas monitoring systems.

A report of findings will be made to the responsible party, including recommendations for actions deemed necessary to ensure the site continues to meet the closure performance standard.

## **2.6 ENGINEERING CERTIFICATION**

Based on Red Rock Disposal's monitoring reports, annual certifications by a registered engineer will be placed in the operating record. They will certify that the closure plan has been followed, noting discrepancies along with the corrective actions undertaken. At the end of the post closure period, the individual certifications will be compiled into a final document and forwarded to the DWM.

**TABLE 2.1: POST-CLOSURE INSPECTION FREQUENCIES**

<b>INSPECTION ACTIVITY</b>	<b>YEAR 1</b>	<b>YEARS 2-30</b>
Security Control Devices	Quarterly	Quarterly
Vegetative Cover Condition	Quarterly <sup>1</sup>	Quarterly
Surface Water Systems	Quarterly <sup>1</sup>	Quarterly
Erosion Damage	Quarterly <sup>1</sup>	Quarterly
Cover Drainage System	Quarterly <sup>1</sup>	Semi-Annually
Cover Settlement, Subsidence, and Displacement	Quarterly <sup>1</sup>	Semi-Annually
Landfill Gas Control System	Quarterly <sup>3</sup>	Semi-Annually <sup>3</sup>
Groundwater Monitoring System	Semi-Annually	Semi-Annually <sup>2</sup>
Benchmark Integrity	Annually	Annually

Notes:

1. These items will be inspected after each large storm event (i.e.  $\geq 1$  inch in any 24 hours).
2. Or in accordance with groundwater monitoring schedule described in the current Water Quality Monitoring Plan.
3. Or in accordance with the current Landfill Gas Management Plan.

## **SECTION 3.0 CLOSURE/POST-CLOSURE COST ANALYSIS**

### **3.1 OVERVIEW**

The purpose of this section is to provide a written estimate in current dollars of all activities and costs associated with all activities specified in the written closure and post-closure plans which have been developed for Phase 1 of the Red Rock Disposal C&D Landfill.

### **3.2 ESTIMATED CLOSURE COSTS**

**Table 3.1** summarizes the estimated costs for complete closure of Phase 1 (the current maximum area to be closed). This cost estimate is based on a third party providing the necessary services and includes labor in the unit prices given. The estimated closure costs will be reviewed and updated as required to reflect adjustments for inflation, rising costs of anticipated closure care, increased costs in construction or materials, or any other adjustments to the Closure Plan.

### **3.3 ESTIMATED POST-CLOSURE COSTS**

**Table 3.2** summarizes the estimated costs for the post-closure care maintenance activities. This cost estimate is based on a third party providing the necessary services and includes labor in the unit prices given. The estimated post-closure costs will be reviewed and updated as required to reflect adjustments for inflation, rising costs of anticipated post-closure care, or any other adjustments to the Post-Closure Plan.

**TABLE 3.1**  
**Red Rock Disposal C&D Landfill (NC SW Permit No. 92-28)**  
**Engineer's Closure Construction Cost Estimate**

Item No.	Item Description	Unit	Contractor			Comments
			Quantity	Unit Price	Total Price	
<b>Closure Area (Horizontal Plan) ----&gt;</b>		<b>AC</b>	<b>44.2</b>			
<b>1.0</b>	<b>Pre-Construction</b>			<b>Subtotal</b>	<b>\$37,100.00</b>	
1.1	Construction Documents & Bidding	AC	44	\$15k + \$500/AC	\$37,100.00	RSG Estimate
<b>2.0</b>	<b>Construction</b>				<b>\$2,225,470.00</b>	References 1 and 2.
2.1	Surveys and Layout	AC	44	\$1,000.00	\$44,200.00	RSG Historical Estimate
2.2	Mobilization	AC	44	\$5,000.00	\$221,000.00	~4% of Construction Cost
2.3	Site Preparation (repairs to intermediate cover layer)	AC	44	\$500.00	\$22,100.00	Assumed estimate for repair of erosion rills.
2.4	18" On-site Low Permeability Soil	CY	106,964	\$8.00	\$855,712.00	RSG Estimate
2.5	18" Vegetative Support Layer	CY	106,964	\$4.50	\$481,338.00	Site Historical Estimate for On-Site Materials.
2.6	Landfill Gas Venting System	AC	44	\$3,500.00	\$154,700.00	RSG Estimate
2.7	Cap Drainage Structures (berms, piping, etc.)	AC	44	\$7,500.00	\$331,500.00	RSG Historical Estimate
2.8	Erosion & Sediment Control (grading, silt fence, maintenance, etc.)	AC	44	\$800.00	\$35,360.00	RSG Historical Estimate
2.9	Revegetation	AC	44	\$1,800.00	\$79,560.00	Site Historical Estimate
<b>3.0</b>	<b>Quality Assurance, Certification, &amp; Deed Notation</b>				<b>\$263,570.00</b>	
3.1	Field Monitoring	AC	44	\$3,000.00	\$132,600.00	RSG Estimate
3.2	Laboratory Testing	AC	44	\$2,500.00	\$110,500.00	RSG Estimate
3.3	Engineering Certification	AC	44	\$5k + \$250/AC	\$16,050.00	RSG Estimate
3.4	Surveying and Deed Notation	AC	44	\$100.00	\$4,420.00	RSG Historical Estimate
<b>4.0</b>	<b>Miscellaneous Costs to Close</b>				<b>\$55,250.00</b>	
4.1	Erosion and Stormwater Control (outside landfill footprint)	AC	44	\$1,000.00	\$44,200.00	RSG Historical Estimate
4.2	Engineering and Reporting	AC	44	\$250.00	\$11,050.00	RSG Historical Estimate
<b>5.0</b>	<b>Total Closure Costs</b>					
<b>Construction Estimate ----&gt;</b>					<b>\$2,581,390</b>	
<b>Cost per Acre ----&gt;</b>					<b>\$58,402</b>	
<b>Total Estimate ----&gt;</b>					<b>\$2,581,390 (2008\$) (See Note 1)</b>	

Notes:

- All costs are presented in current dollars and should be increased at an inflation rate of 1.5% if additional review is not performed annually.
- This ESTIMATE has been prepared for financial assurance purposes only and shall not be considered a replacement for an actual bid from a licensed contractor and is considered acceptable within a +/- 10% of the Total Estimate value.

References:

- Red Rock Disposal, LLC - C&D Landfill - Phase 1 - Permit to Construct Application by G.N. Richardson & Associates, Inc. dated June 2001 with revisions through April 2004.
- Red Rock Disposal, LLC - C&D Landfill - Phase 1 - Revised Permit to Construct Application by G.N. Richardson & Associates, Inc. dated October 2003.

Denotes values calculated in spreadsheet.



DATE: 20-Jun-08  
BY: SAS

**TABLE 3.2**  
**Red Rock Disposal C&D Landfill (NC SW Permit No. 92-28)**  
**Engineer's Post Closure Estimate**

Item	Quantity	Unit	Comments
<b>Groundwater Monitoring</b>			
Monitoring wells	10	wells	Reference 1
Surface water point	3	points	Reference 1
Sampling frequency	2	events	Reference 1
Field sampling, collection, and shipping	\$1,000	per event	Goldier Proposal
Laboratory Analysis	\$200	per well	Goldier Proposal
Data review, statistics, and reporting	\$1,500	per event	RSG estimate
Maintenance and repair	\$100	per well	RSG historical estimate
<b>Subtotal Cost</b>	<b>\$11,200</b>	<b>per year</b>	
<b>Landfill Gas Management</b>			
Control System Vents	22	vents	Assume one (1) well per two (2) acres.
Sub-Surface Monitoring Probes	12	probes	Assume one (1) per 500 LF along perimeter
Control system monitoring, maintenance and repair	\$50	per vent per year	RSG estimate
Semi-Annual Perimeter Monitoring	\$50	per probe per year	RSG estimate
<b>Subtotal Cost</b>	<b>\$1,700</b>	<b>per year</b>	Averaged over post-closure period
<b>Final Cover Management</b>			
Area of maintenance	44.2	acres	Extends to area immediately around landfill for Phase 1.
Mowing	\$100	per acre	Site historical estimate
Erosion and sediment control maintenance	\$200	per acre	Site historical estimate
Topdressing (seed & fertilizer)	\$150	per acre	Site historical estimate
Vector and rodent control	\$10	per acre	Site historical estimate
Maintenance mobilization	\$1,000	per year	Site historical estimate
<b>Subtotal Cost</b>	<b>\$21,332</b>	<b>per year</b>	
<b>Administration, Inspections, and Reporting</b>			
Administration and record keeping	\$1,000	per year	Site historical estimate
Inspection	\$1,000	per year	Site historical estimate
Miscellaneous engineering	\$1,500	per year	Site historical estimate
<b>Subtotal Cost</b>	<b>\$3,500</b>	<b>per year</b>	
<b>Total Post-Closure Costs</b>			
Estimated Average Annual Costs	\$37,732	per year (2008\$)	
Number of Years for Post-Closure	30	years (see Note 1)	
<b>Total Post Closure Costs</b>	<b>\$1,131,960</b>	(2008\$) (See Note 2)	

Notes:

1. All costs are presented in current dollars and should be increased at an inflation rate of 1.5% if additional review is not performed annually.
2. This ESTIMATE has been prepared for financial assurance purposes only and shall not be considered a replacement for an actual bid from a licensed contractor and is considered acceptable within a +/- 10% of the Total Estimate value.

References:

1. Red Rock Disposal, LLC - Phase 1 Permit to Construct Application by G.N. Richardson & Associates, Inc. dated October 2003.

Denotes values calculated in spreadsheet.

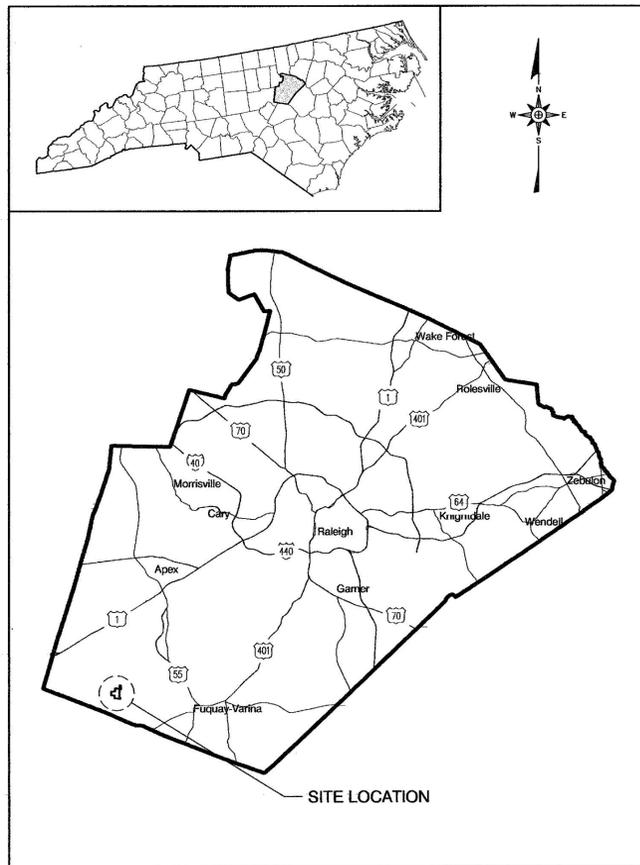
ATTACHMENT B

Revised Permit Drawings

RED ROCK DISPOSAL, LLC  
WAKE COUNTY, NORTH CAROLINA

**CONSTRUCTION & DEMOLITION LANDFILL  
PHASE 1  
ENGINEERING DRAWINGS**

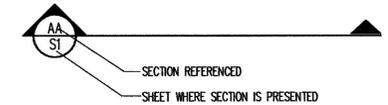
MAY 2001  
REVISED MAY 2008



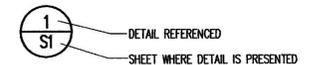
SITE LOCATION MAP  
NOT TO SCALE

SHEET NO.	DRAWING NO.	TITLE	REVISION
1	1	TITLE/COVER SHEET	△ △ △ △
2	E1	EXISTING SITE CONDITIONS (NOT INCLUDED IN REVISED DRAWING SET)	△ △
3	E2	FACILITY PLAN - BASE GRADES	△ △ △
4	E3	FACILITY PLAN - FINAL COVER GRADES	△ △
5	E4	PHASE 1 - SUBGRADE (NOT INCLUDED IN REVISED DRAWING SET. REFER TO DRAWING EC8 FOR PHASE 1C SUBGRADE)	△ △
6	E5	PHASE 1 - FINAL GRADING AND DRAINAGE PLAN	△ △
7	G1	PHASE 1 - DETAILS (NO REVISIONS)	△ △ △ △
8	X1	PHASE 1 - ENGINEERING CROSS SECTIONS (SHEET 1 OF 2)	△ △ △ △
9	X2	PHASE 1 - ENGINEERING CROSS SECTIONS (SHEET 2 OF 2)	△ △ △ △
10	EC1	PHASE 1 - EROSION AND SEDIMENTATION CONTROL DETAILS (SHEET 1 OF 5)	△ △ △ △
11	EC2	PHASE 1 - EROSION AND SEDIMENTATION CONTROL DETAILS (SHEET 2 OF 5)	△ △ △ △
12	EC3	PHASE 1 - EROSION AND SEDIMENTATION CONTROL DETAILS (SHEET 3 OF 5)	△ △ △ △
13	EC4	PHASE 1 - EROSION AND SEDIMENTATION CONTROL DETAILS (SHEET 4 OF 5)	△ △ △ △
14	EC5	PHASE 1 - EROSION AND SEDIMENTATION CONTROL DETAILS (SHEET 5 OF 5)	△ △ △ △
15	EC6	PHASE 1C - INITIAL GRADING AND DRAINAGE PLAN	△ △ △ △
16	EC7	PHASE 1C-1 SUBGRADE AND DRAINAGE PLAN	△ △ △ △
17	EC8	PHASE 1C-2 SUBGRADE AND DRAINAGE PLAN	△ △ △ △
18	P1	PHASE 1 - FILLING SEQUENCE (NOT INCLUDED IN REVISED DRAWING SET.)	△ △ △ △
	LFG1	GAS MANAGEMENT PLAN	△ △ △ △

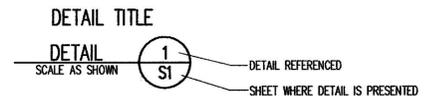
STANDARD SECTION LOCATION CALLOUT (SHEET AND DETAIL)



STANDARD DETAIL CALLOUT



STANDARD DETAIL LABEL AND CALLOUT



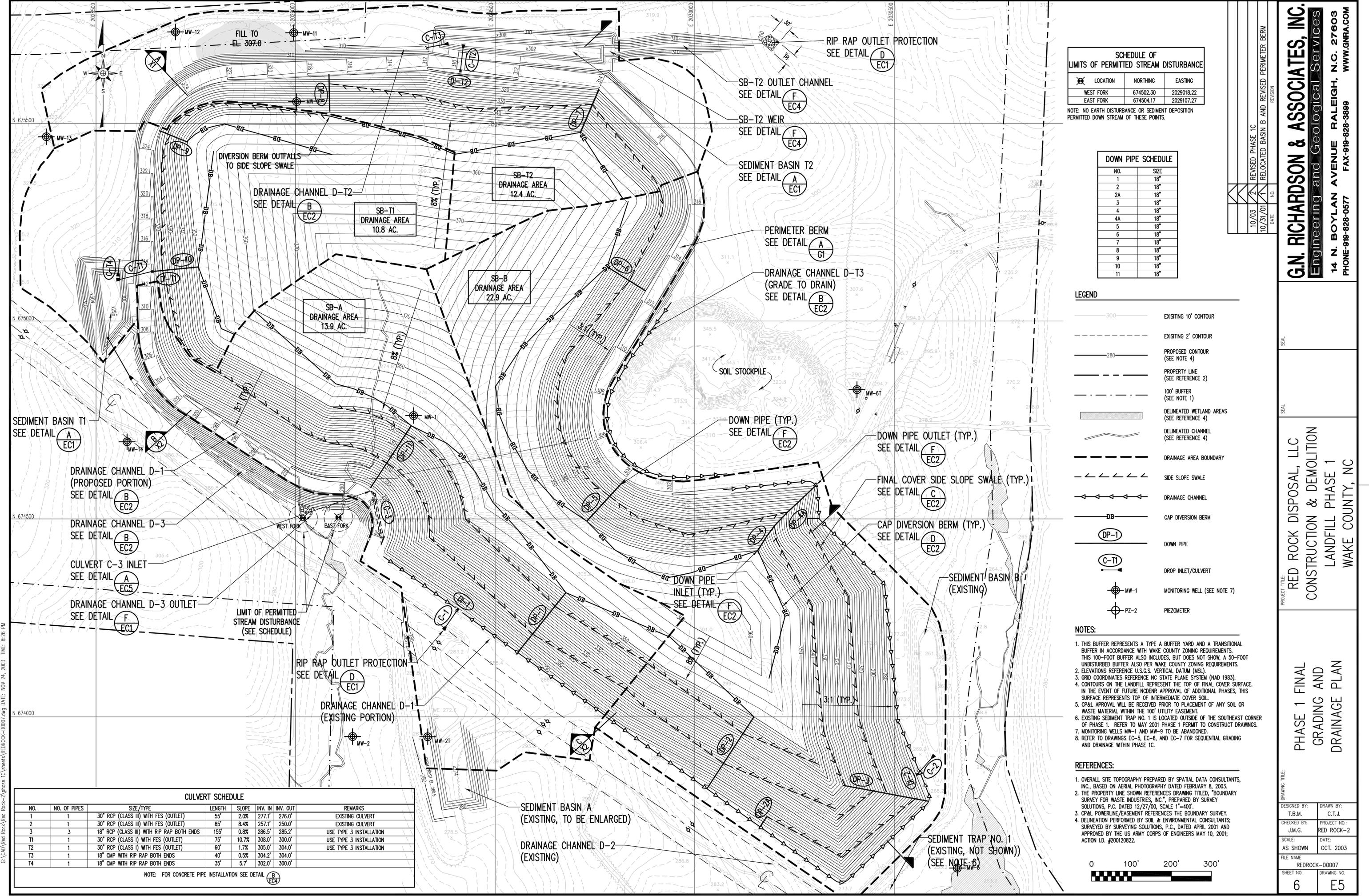
STANDARD REVISION CALLOUT (SHEET AND DETAIL)



DATE	NO.	REVISION DESCRIPTION	REVISION

**SAFETY NOTE:**  
THE CONTRACTOR IS SOLELY RESPONSIBLE FOR SITE SAFETY ASSOCIATED WITH THE WORK UNDER THIS CONTRACT AND FOR COMPLIANCE WITH ALL FEDERAL, STATE AND LOCAL HEALTH AND SAFETY LAWS, CODES, REGULATIONS, AND ORDINANCES INCLUDING BUT NOT LIMITED TO THOSE CURRENTLY MANDATED BY THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA).

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



**SCHEDULE OF LIMITS OF PERMITTED STREAM DISTURBANCE**

LOCATION	NORTHING	EASTING
WEST FORK	674502.30	2029018.22
EAST FORK	674504.17	2029107.27

NOTE: NO EARTH DISTURBANCE OR SEDIMENT DEPOSITION PERMITTED DOWN STREAM OF THESE POINTS.

**DOWN PIPE SCHEDULE**

NO.	SIZE
1	18"
2	18"
2A	18"
3	18"
4	18"
4A	18"
5	18"
6	18"
7	18"
8	18"
9	18"
10	18"
11	18"

**LEGEND**

- 300 --- EXISTING 10' CONTOUR
- 280 --- EXISTING 2' CONTOUR
- 280 --- PROPOSED CONTOUR (SEE NOTE 4)
- --- PROPERTY LINE (SEE REFERENCE 2)
- --- 100' BUFFER (SEE NOTE 1)
- --- DELINEATED WETLAND AREAS (SEE REFERENCE 4)
- --- DELINEATED CHANNEL (SEE REFERENCE 4)
- --- DRAINAGE AREA BOUNDARY
- --- SIDE SLOPE SWALE
- --- DRAINAGE CHANNEL
- DB --- CAP DIVERSION BERM
- DP-1 --- DOWN PIPE
- C-T1 --- DROP INLET/CULVERT
- MW-1 --- MONITORING WELL (SEE NOTE 7)
- PZ-2 --- PIEZOMETER

- NOTES:**
- THIS BUFFER REPRESENTS A TYPE A BUFFER YARD AND A TRANSITIONAL BUFFER IN ACCORDANCE WITH WAKE COUNTY ZONING REQUIREMENTS. THIS 100-FOOT BUFFER ALSO INCLUDES, BUT DOES NOT SHOW, A 50-FOOT UNDISTURBED BUFFER ALSO PER WAKE COUNTY ZONING REQUIREMENTS.
  - ELEVATIONS REFERENCE U.S.G.S. VERTICAL DATUM (MSL).
  - GRID COORDINATES REFERENCE NC STATE PLANE SYSTEM (NAD 1983).
  - CONTOURS ON THE LANDFILL REPRESENT THE TOP OF FINAL COVER SURFACE. IN THE EVENT OF FUTURE MODERN APPROVAL OF ADDITIONAL PHASES, THIS SURFACE REPRESENTS TOP OF INTERMEDIATE COVER SOIL.
  - CP&L APPROVAL WILL BE RECEIVED PRIOR TO PLACEMENT OF ANY SOIL OR WASTE MATERIAL WITHIN THE 100' UTILITY EASEMENT.
  - EXISTING SEDIMENT TRAP NO. 1 IS LOCATED OUTSIDE OF THE SOUTHEAST CORNER OF PHASE 1. REFER TO MAY 2001 PHASE 1 PERMIT TO CONSTRUCT DRAWINGS.
  - MONITORING WELLS MW-1 AND MW-9 TO BE ABANDONED.
  - REFER TO DRAWINGS EC-5, EC-6, AND EC-7 FOR SEQUENTIAL GRADING AND DRAINAGE WITHIN PHASE 1C.

- REFERENCES:**
- OVERALL SITE TOPOGRAPHY PREPARED BY SPATIAL DATA CONSULTANTS, INC., BASED ON AERIAL PHOTOGRAPHY DATED FEBRUARY 8, 2003.
  - THE PROPERTY LINE SHOWN REFERENCES DRAWING TITLED, "BOUNDARY SURVEY FOR WASTE INDUSTRIES, INC.", PREPARED BY SURVEY SOLUTIONS, P.C. DATED 12/27/00, SCALE 1"=400'.
  - CP&L POWERLINE/EASEMENT REFERENCES THE BOUNDARY SURVEY.
  - DELINEATION PERFORMED BY SOIL & ENVIRONMENTAL CONSULTANTS; SURVEYED BY SURVEYING SOLUTIONS, P.C., DATED APRIL 2001 AND APPROVED BY THE US ARMY CORPS OF ENGINEERS MAY 10, 2001; ACTION I.D. #200120822.

**CULVERT SCHEDULE**

NO.	NO. OF PIPES	SIZE/TYPE	LENGTH	SLOPE	INV. IN	INV. OUT	REMARKS
1	1	30" RCP (CLASS III) WITH FES (OUTLET)	55'	2.0%	277.1'	276.0'	EXISTING CULVERT
2	1	30" RCP (CLASS III) WITH FES (OUTLET)	85'	8.4%	257.1'	250.0'	EXISTING CULVERT
3	3	18" RCP (CLASS III) WITH RIP RAP BOTH ENDS	155'	0.8%	286.5'	285.2'	USE TYPE 3 INSTALLATION
T1	1	30" RCP (CLASS I) WITH FES (OUTLET)	75'	10.7%	308.0'	300.0'	USE TYPE 3 INSTALLATION
T2	1	30" RCP (CLASS I) WITH FES (OUTLET)	60'	1.7%	305.0'	304.0'	USE TYPE 3 INSTALLATION
T3	1	18" CMP WITH RIP RAP BOTH ENDS	40'	0.5%	304.2'	304.0'	
T4	1	18" CMP WITH RIP RAP BOTH ENDS	35'	5.7%	302.0'	300.0'	

NOTE: FOR CONCRETE PIPE INSTALLATION SEE DETAIL (B) EC4

**G.N. RICHARDSON & ASSOCIATES, INC.**  
 Engineering and Geological Services  
 14 N. BOYLAN AVENUE RALEIGH, N.C. 27603  
 PHONE-919-828-3898 FAX-919-828-0577  
 WWW.GNRA.COM

PROJECT TITLE: RED ROCK DISPOSAL, LLC CONSTRUCTION & DEMOLITION LANDFILL PHASE 1 WAKE COUNTY, NC

DRAWING TITLE: PHASE 1 FINAL GRADING AND DRAINAGE PLAN

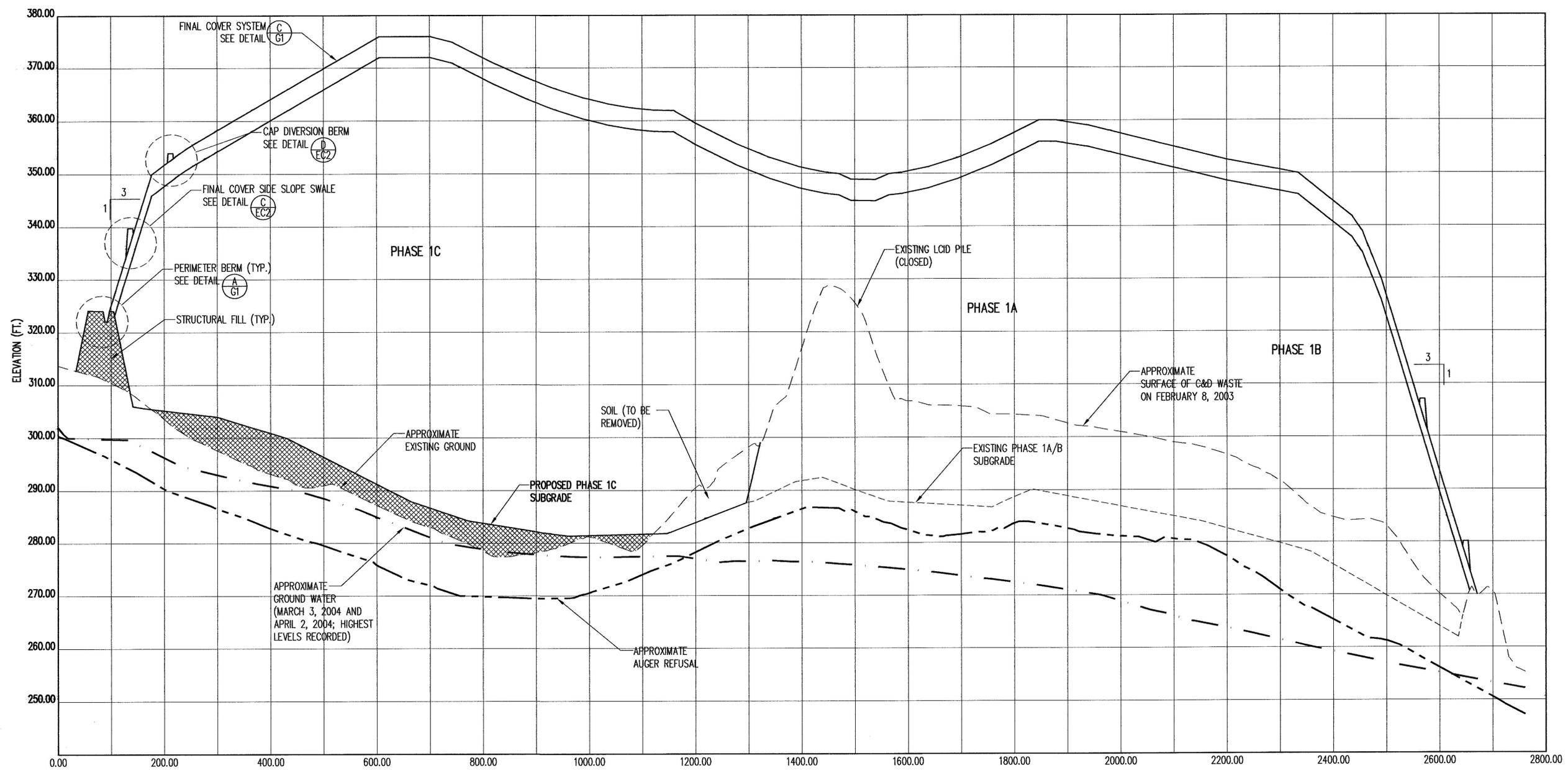
DESIGNED BY: T.B.M. DRAWN BY: C.T.J.  
 CHECKED BY: J.M.G. PROJECT NO.: RED ROCK-2  
 SCALE: AS SHOWN DATE: OCT. 2003  
 FILE NAME: REDROCK-D0007  
 SHEET NO. 6 DRAWING NO. E5

REVISIONS:  
 10/03/03 REVISED PHASE 1C  
 10/31/01 RELOCATED BASIN B AND REVISED PERIMETER BERM

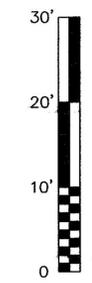
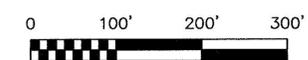




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SECTION A-A A  
X1



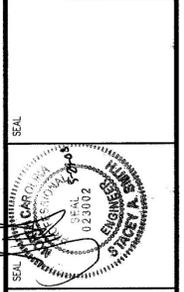
**LEGEND**

	EXISTING GROUND (SEE REFERENCE 1)
	PROPOSED GRADE
	APPROXIMATE BEDROCK SURFACE
	APPROXIMATE GROUND WATER SURFACE

**REFERENCES:**  
 1. OVERALL SITE TOPOGRAPHY PREPARED BY SPATIAL DATA CONSULTANTS, INC., BASED ON AERIAL PHOTOGRAPHY DATED FEBRUARY 8, 2003.

NO.	DATE	REVISION
4	5/06	REVISED FINAL COVER GRADING
3	4/04	GRADING REVISIONS; REVISED GROUND WATER LEVELS
2	10/03	PHASE 1C REVISIONS

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 14 N. Boylan Ave.  
 Raleigh, N.C. 27603  
 ph: 919-428-0577  
 fax: 919-428-3899  
 www.rsgengineers.com

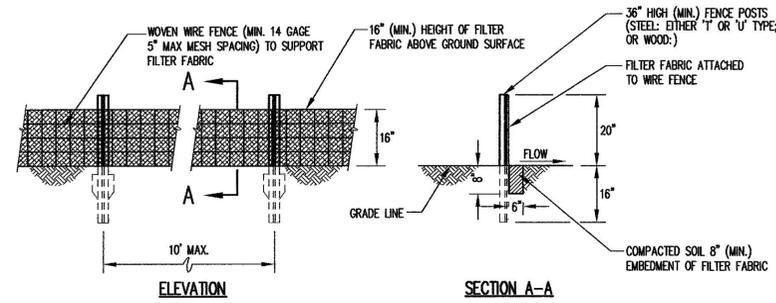


PROJECT TITLE:  
**RED ROCK DISPOSAL, LLC  
 CONSTRUCTION/DEMOLITION  
 LANDFILL PHASE 1  
 WAKE COUNTY, NC**

DRAWING TITLE:  
**PHASE 1  
 ENGINEERING CROSS SECTIONS  
 (SHEET 1 OF 2)**

DESIGNED BY: T.B.M.	DRAWN BY: C.T.J.
CHECKED BY: JH	PROJECT NO.: RED ROCK-2
SCALE: AS SHOWN	DATE: OCT. 2003
FILE NAME: REDROCK-00190	
SHEET NO. <b>8</b>	DRAWING NO. <b>X1</b>

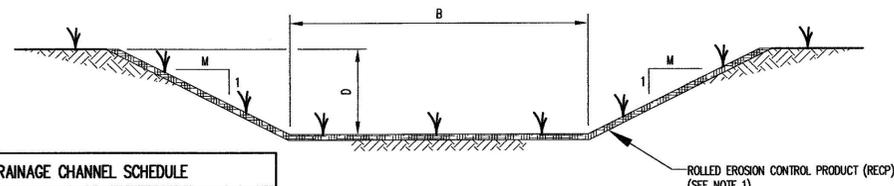




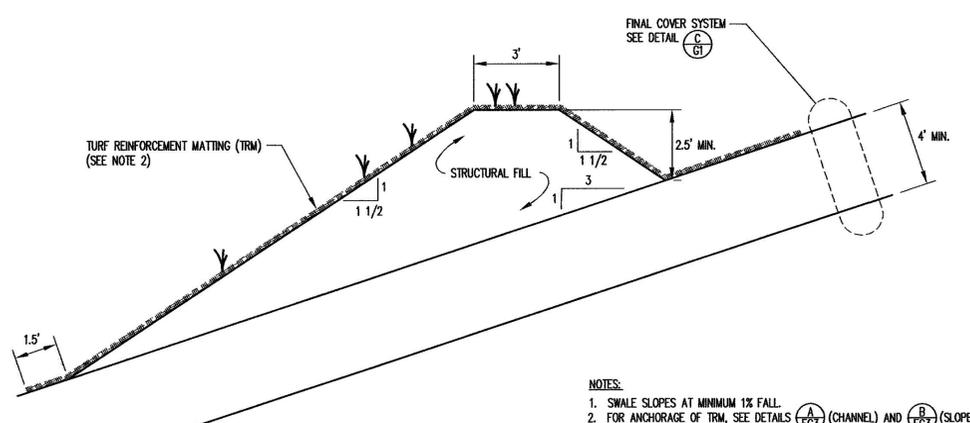
**DRAINAGE CHANNEL SCHEDULE**

DRAINAGE CHANNEL NO.	LINING	B	D	M
D-1	TRM*	4.0'	2.0'	2
D-2	TRM	0'	1.5'	2
D-3	TRM	4.0'	2.0'	2
D-T1	TRM	4.0'	2.0' MIN	2
D-T2	GRASS	3.0'	1.0' - 2.0'	2
D-T3	GRASS	0'	1.5'	2
SED. BASIN T1 OUTLET	TRM	4.0'	2.0'	2
SED. BASIN T2 OUTLET	TRM	4.0'	2.0'	2

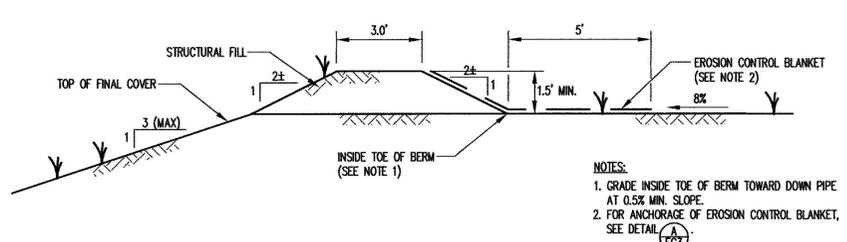
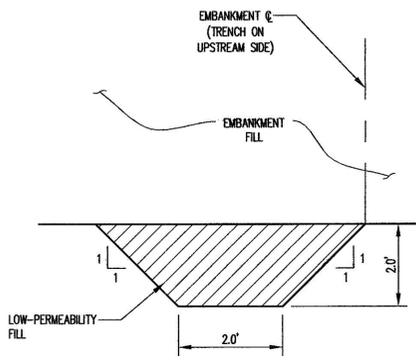
\*TRM = TURF REINFORCEMENT MATTING



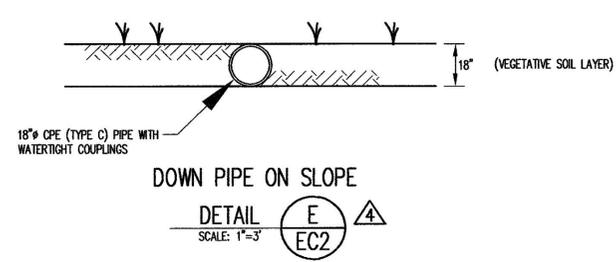
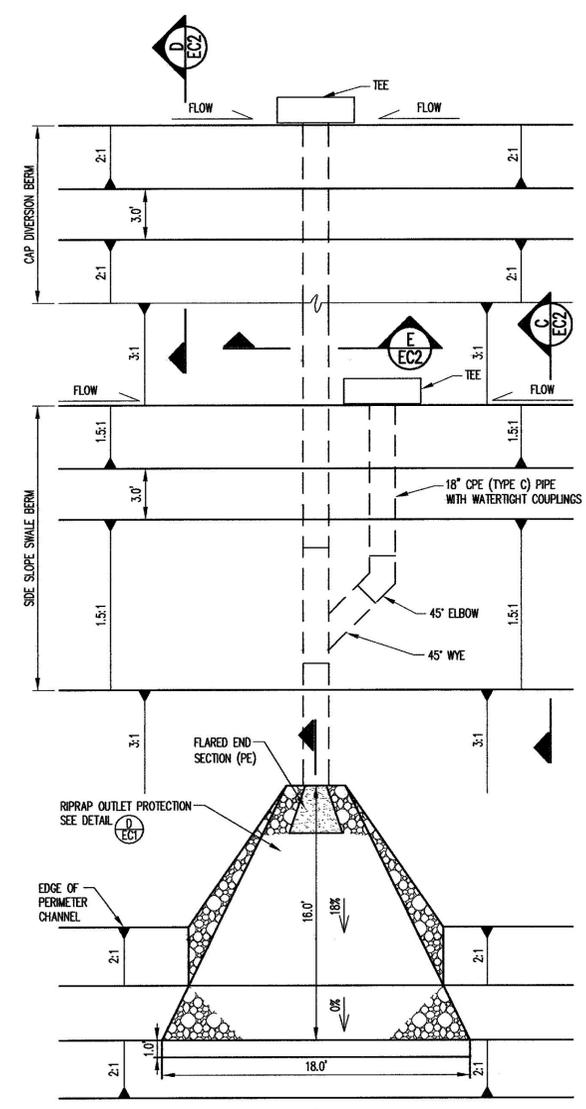
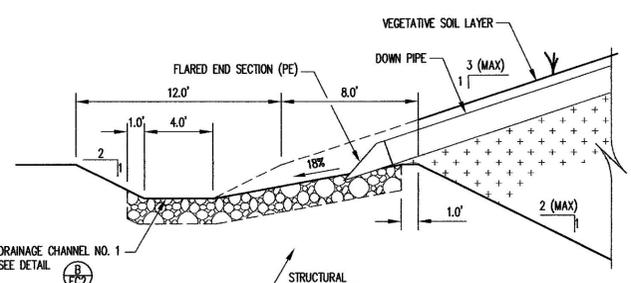
**NOTES:**  
 1. FOR ANCHORAGE OF RECP, SEE DETAIL A.  
 2. WHERE DEPTH OF CUT TO CHANNEL BOTTOM EXCEEDS 'D', INSTALL TRM TO HEIGHT 'D' ABOVE CHANNEL BOTTOM.



**NOTES:**  
 1. SWALE SLOPES AT MINIMUM 1% FALL.  
 2. FOR ANCHORAGE OF TRM, SEE DETAILS A (CHANNEL) AND B (SLOPE).

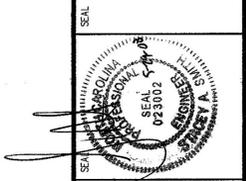


**NOTES:**  
 1. GRADE INSIDE TOE OF BERM TOWARD DOWN PIPE AT 0.5% MIN. SLOPE.  
 2. FOR ANCHORAGE OF EROSION CONTROL BLANKET, SEE DETAIL A.



**RICHARDSON SMITH GARDNER & ASSOCIATES**  
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 ph: 919-282-9577  
 fax: 919-282-5889

NO.	DATE	REVISION
1	5/08	REVISED FINAL COVER GRADING
2	10/03	PHASE 1C REVISIONS

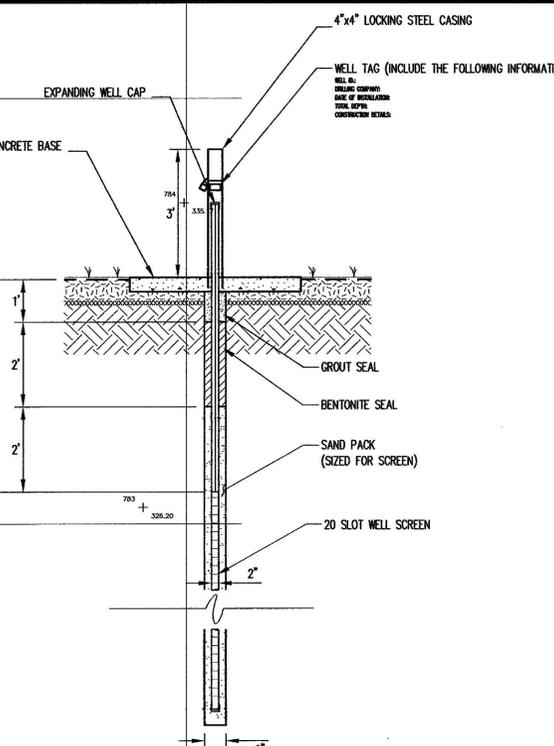
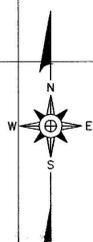
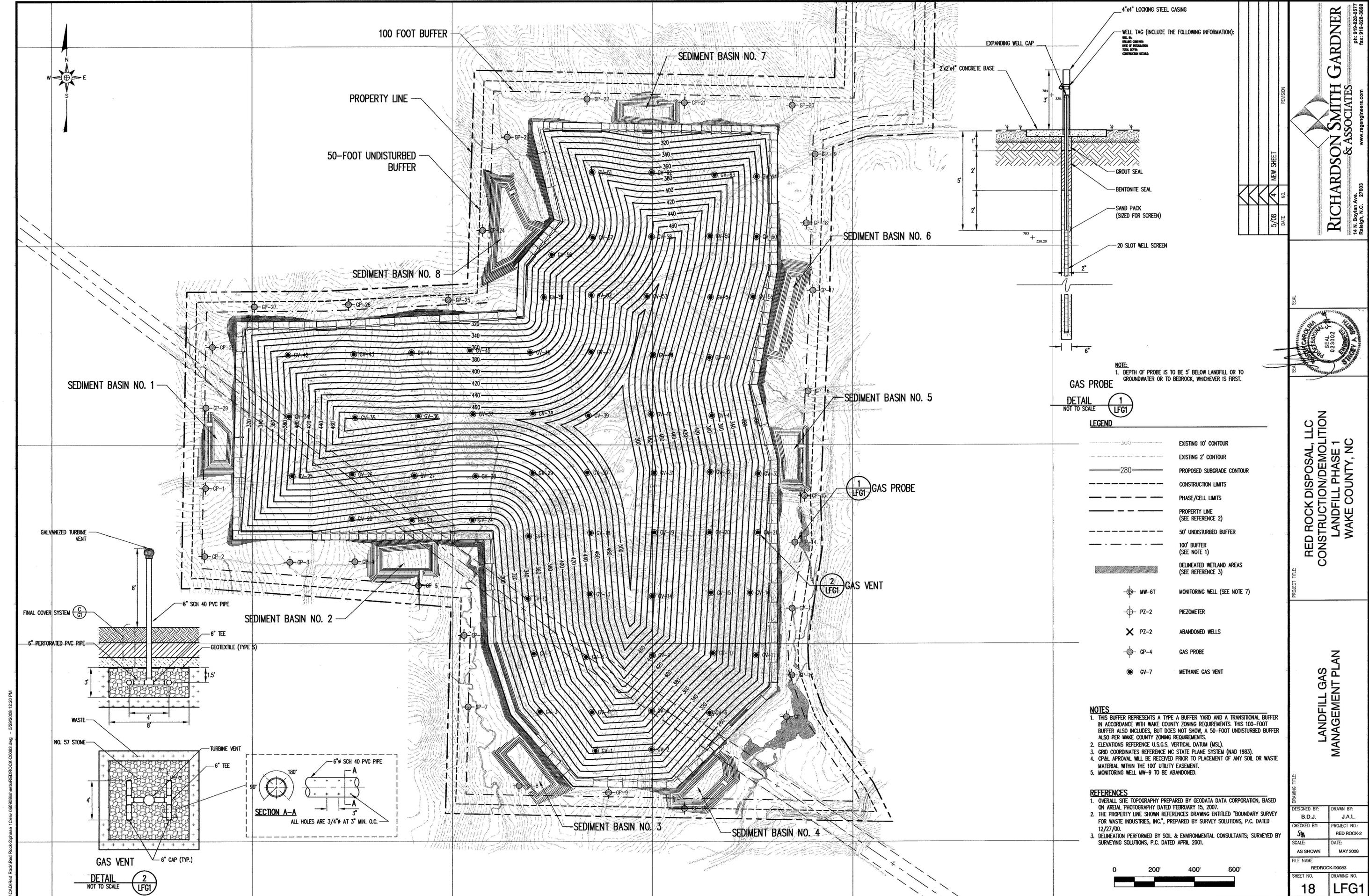


**RED ROCK DISPOSAL, LLC**  
**CONSTRUCTION/DEMOLITION**  
**LANDFILL PHASE 1**  
**WAKE COUNTY, NC**

**PHASE 1 - EROSION & SEDIMENTATION CONTROL DETAILS (SHEET 2 OF 5)**

DESIGNED BY: T.B.M.	DRAWN BY: C.T.J.
CHECKED BY: SM	PROJECT NO.: RED ROCK-2
SCALE: AS SHOWN	DATE: OCT. 2003
FILE NAME: REDROCK-D0011D	SHEET NO.: 11
SHEET NO.:	DRAWING NO.: EC2

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NOTE:  
1. DEPTH OF PROBE IS TO BE 5' BELOW LANDFILL OR TO GROUNDWATER OR TO BEDROCK, WHICHEVER IS FIRST.

**GAS PROBE**  
DETAIL 1  
NOT TO SCALE (LFG1)

**LEGEND**

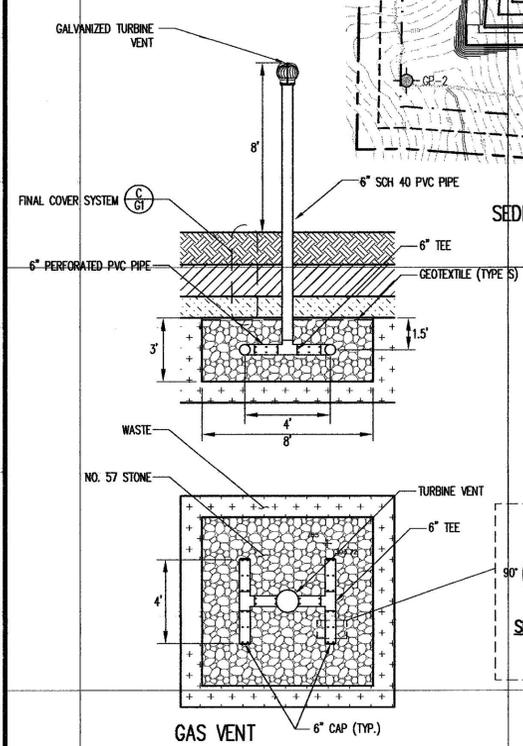
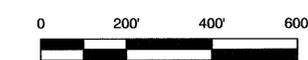
- 500 --- EXISTING 10' CONTOUR
- 400 --- EXISTING 2' CONTOUR
- 280 --- PROPOSED SUBGRADE CONTOUR
- - - - - CONSTRUCTION LIMITS
- - - - - PHASE/CELL LIMITS
- - - - - PROPERTY LINE (SEE REFERENCE 2)
- - - - - 50' UNDISTURBED BUFFER (SEE NOTE 1)
- - - - - 100' BUFFER (SEE NOTE 1)
- ▨ DELINEATED WETLAND AREAS (SEE REFERENCE 3)
- ⊕ MW-6T MONITORING WELL (SEE NOTE 7)
- ⊕ PZ-2 PIEZOMETER
- ⊗ PZ-2 ABANDONED WELLS
- ⊕ GP-4 GAS PROBE
- ⊙ GV-7 METHANE GAS VENT

**NOTES**

1. THIS BUFFER REPRESENTS A TYPE A BUFFER YARD AND A TRANSITIONAL BUFFER IN ACCORDANCE WITH WAKE COUNTY ZONING REQUIREMENTS. THIS 100-FOOT BUFFER ALSO INCLUDES, BUT DOES NOT SHOW, A 50-FOOT UNDISTURBED BUFFER ALSO PER WAKE COUNTY ZONING REQUIREMENTS.
2. ELEVATIONS REFERENCE U.S.G.S. VERTICAL DATUM (MSL).
3. GRID COORDINATES REFERENCE NC STATE PLANE SYSTEM (NAD 1983).
4. CP&L APPROVAL WILL BE RECEIVED PRIOR TO PLACEMENT OF ANY SOIL OR WASTE MATERIAL WITHIN THE 100' UTILITY EASEMENT.
5. MONITORING WELL MW-9 TO BE ABANDONED.

**REFERENCES**

1. OVERALL SITE TOPOGRAPHY PREPARED BY GEODATA DATA CORPORATION, BASED ON AERIAL PHOTOGRAPHY DATED FEBRUARY 15, 2007.
2. THE PROPERTY LINE SHOWN REFERENCES DRAWING ENTITLED "BOUNDARY SURVEY FOR WASTE INDUSTRIES, INC.", PREPARED BY SURVEY SOLUTIONS, P.C. DATED 12/27/00.
3. DELINEATION PERFORMED BY SOIL & ENVIRONMENTAL CONSULTANTS; SURVEYED BY SURVEYING SOLUTIONS, P.C. DATED APRIL 2001.



**GAS VENT**  
DETAIL 2  
NOT TO SCALE (LFG1)

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

REVISION NO. DATE  
4 NEW SHEET  
5/08

PROJECT TITLE:  
**RED ROCK DISPOSAL, LLC  
CONSTRUCTION/DEMOLITION  
LANDFILL PHASE 1  
WAKE COUNTY, NC**

DRAWING TITLE:  
**LANDFILL GAS  
MANAGEMENT PLAN**

DESIGNED BY: B.D.J. DRAWN BY: J.A.L.  
CHECKED BY: S.H. PROJECT NO.: RED ROCK-2  
SCALE: AS SHOWN DATE: MAY 2008  
FILE NAME: REDROCK-DO083  
SHEET NO. 18 DRAWING NO. LFG1

© CAD Plant Red Rock-2.dwg - I:\new\050808\in\redrock\REDROCK-DO083.dwg - 5/28/2008 12:20 PM

Attachment A

Section 02250  
Soil Liner (Final Cover)

**SECTION 02250**

**SOIL LINER (FINAL COVER)**

<p><u>Soil Liner:</u> The Soil Liner serves as a hydraulic containment barrier in the final cover system.</p>
---

A. DESCRIPTION

1. General:

- a. The Contractor shall furnish all labor, material, and equipment to complete installation of the Soil Liner including borrowing, hauling, screening, mixing, stockpiling, discing, compacting, drying or wetting, removal of surface water, removal of all previously placed material affected by adverse weather conditions or construction disturbance, final grading and sealing, and all necessary and incidental items as detailed or required to complete the Soil Liner, all in accordance with the Contract Drawings and these Specifications.
  
- b. The Contractor shall provide suitable soil from an on-site or off-site borrow site that meets all requirements outlined in these Specifications for Soil Liner.

Off-site borrow sources shall be approved in advance by the Engineer. The Contractor shall be responsible for all submittals required for Engineer approval of off-site borrow sources.

2. Related Work:

Related Contract Work is described in the following sections of the Specifications:

<u>Work</u>	<u>Section</u>
Vegetative Soil Layer	02258

3. Reference Standards:

The latest revision of the following standards of the American Society of Testing and Materials (ASTM) are hereby made a part of these Specifications.

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 <sup>3</sup> ).
ASTM D 1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
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 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 4318	Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
ASTM D 4643	Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method.
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 6938	Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

4. Quality Assurance:

Quality Assurance during placement of Soil Liner will be provided by the Owner.

B. MATERIALS

All material for Soil Liner shall conform to the requirements shown in Table 1 of this section.

C. SUBMITTALS

The Contractor shall submit the following to the CQA Engineer:

1. Before approval is given to proceed with test fill construction, the Contractor shall submit descriptive information on compaction equipment to be used for construction of the Soil Liner.

2. Off-Site Borrow Sources (If Applicable):

a. For each off-site borrow source for Soil Liner soils, the Contractor shall provide the following information at least four weeks prior to placement of the Soil Liner:

(1) The name, location, and owner of proposed borrow site, including a topographic map and location map of the site.

(2) A certification submitted by an independent Registered Professional Engineer that the proposed borrow site contains a minimum of double the in-place volume of Soil Liner required to complete the work.

(3) A certification submitted by an independent Registered Professional Engineer that the proposed borrow soils meet the requirements for Soil Liner outlined in these Specifications. Certification shall include the following minimum testing and test frequency:

<u>Test</u>	<u>Min. Number of Tests</u>
Atterberg Limits (ASTM D 4318)	10
Grain Size (with Hydrometer) (ASTM D 422)	10
Standard Proctor (ASTM D 698)	5
Natural Moisture Content (ASTM D 2216)	10
Hydraulic Conductivity (Lab Remolded) (ASTM D 5084)	5

Testing samples for certification shall be obtained from well distributed locations within the proposed borrow area. All test data shall be submitted with the soil certification.

b. The Contractor shall be responsible for maintaining quality of the Soil Liner borrow source throughout construction and shall ensure that the borrow soil meets the project criteria outlined in these Specifications. The

Contractor shall cooperate with the CQA Engineer so that the CQA Engineer has unlimited access to the borrow area during construction for the purposes of sampling and testing borrow soil.

- c. If the borrow source does not meet the requirements outlined in these Specifications, the Contractor shall be responsible for providing an alternative borrow source at no cost to the Owner.

## D. CONSTRUCTION

### 1. General:

- a. All placement and compaction of Soil Liner shall be performed only when the CQA Engineer is informed by the Contractor of intent to perform such work.
- b. The Contractor shall place and compact the Soil Liner to the lines and grades shown on the Contract Drawings with the exception that a 0.15 foot overbuild at the Contractor's expense is allowed. Thickness requirements are minimum values. The Contractor will perform all surveys necessary to establish and verify lines and grades for all Soil Liner.

### 2. Borrow Soils:

- a. The Contractor may haul borrow soil to an on-site stockpile area. Unless otherwise allowed by the Engineer, borrow soil cannot be hauled directly to the containment area for placement and compaction unless each load is monitored and approved by the CQA Engineer prior to loading at the borrow site.
- b. Any borrow soil not meeting the requirements for Soil Liner shall be rejected and removed from the project site by the Contractor at no cost to the Owner.

### 3. Test Fill Construction:

The Contractor shall construct a test fill prior to construction of Soil Liner. The test fill shall be at least 20 feet wide by 50 feet long and shall be compacted in lifts to the full design thickness. The Contractor shall use materials and equipment for test fill construction that the Contractor intends to use during construction.

No Soil Liner construction may be performed until the test fill construction is confirmed to be adequate in accordance with the Project CQA Manual.

The Contractor shall amend construction techniques or equipment in order to meet all criteria outlined for Soil Liner in these Specifications at no cost to the Owner.

4. Subgrade Preparation:

- a. The CQA Engineer shall inspect the exposed subgrade prior to placement of Soil Liner to assure that all rocks, topsoil, vegetation, roots, debris, or other deleterious materials have been removed.
- b. Prior to placement of Soil Liner, the exposed subgrade shall be proofrolled using a static smooth-drum roller, loaded tandem axle dump truck, or other suitable equipment in the presence of the CQA Engineer. Any soft or unsuitable subgrade materials revealed before or during the in-place compaction shall be removed as directed by the CQA Engineer and replaced with Soil Liner.

5. Placement and Compaction:

- a. All Soil Liner shall be placed in loose lifts no greater than the height of the feet on compaction equipment to be used. The loose Soil Liner shall be free from clods or rocks which exceed the sizes in Table 1. Where excessive sized clods do occur, the Contractor shall break up the clods using methods approved by the CQA Engineer.
- b. Lift compaction shall be performed with an appropriately heavy, properly ballasted, penetrating-foot compactor. Compaction equipment shall be the same as used in the test fill, unless otherwise approved by the Engineer.

Each lift shall be compacted prior to placement of succeeding lifts. The maximum lift thickness shall be as shown in Table 2. In confined areas, mechanical equipment, suitable for small areas and capable of achieving the density requirements, shall be required.

- c. The exposed surface of Soil Liner shall be protected from adverse weather conditions or desiccation of the soil. This is commonly done by rolling the surface of the Soil Liner with a smooth-drum roller at the end of each work day. Alternative means of protecting the Soil Liner may be employed by the Contractor.
- d. The in-place Soil Liner shall conform to the requirements shown in Table 2 of this section. If Soil Liner does not meet the specified requirements, the Contractor shall rework the material, as may be necessary and continue compaction to achieve these requirements, or remove and replace the material to achieve the specified requirements, at Contractor's expense.

- e. Any Soil Liner surface which is smooth, has a moisture content outside of the specified moisture content range, as defined by ASTM D 698, or exhibits evidence of desiccation cracking ½ inch deep or greater, shall be scarified to a depth of 1 to 3 inches and brought to a proper moisture content prior to placement of a subsequent lift. This includes any Soil Liner surface that was previously seal rolled for protection.
  - f. No Soil Liner shall be placed or compacted when soil temperatures are so low as to produce ice lenses in the Soil Liner borrow soil.
  - g. Soil Liner placed on side slopes shall be placed and compacted in lifts which are parallel to the slope. Lift criteria shall be as described herein.
  - h. Locations of control stakes, in-place density tests, thickness checks, or other samples in the Soil Liner shall be patched with compacted Soil Liner or sodium bentonite compacted and hydrated in the holes.
6. Surveying:

After completion of a segment of Soil Liner, but before installation of subsequent layers, the Soil Liner shall be surveyed (by test pit or hand auger) on a 100 foot grid to ensure the minimum specified thickness of Soil Liner has been achieved.

**TABLE 1: SOIL LINER MATERIAL REQUIREMENTS**

<b>PROPERTY</b>	<b>TEST METHOD</b>	<b>VALUE</b>
Visual Classification	ASTM D 2488	Clean natural fine-grained soil free from organics, debris, or other detrimental material. Soil type as required to achieve the hydraulic conductivity criteria.
Clod Size	-----	Maximum = ¾ inch (or less if required to achieve hydraulic conductivity criteria)
Gradation	ASTM D 422	Max. = 1½ inches
Atterberg Limits	ASTM D 4318	As required based on soil type.
Hydraulic Conductivity (Lab Remolded)  (Compacted Soil Barrier)	ASTM D 5084 <sup>3</sup>	≤ 1 x 10 <sup>-5</sup> cm/s at a density of ≥ 95% maximum standard dry density and a moisture content ≥ optimum moisture content <sup>4</sup>

**TABLE 2: IN-PLACE SOIL LINER REQUIREMENTS**

<b>PROPERTY</b>	<b>TEST METHOD</b>	<b>VALUE</b>
Density	ASTM D 6938 <sup>1</sup>	≥ 95% maximum standard dry density <sup>4</sup>
Moisture Content	ASTM D 6938 <sup>2</sup>	≥ optimum moisture content <sup>4</sup>
Maximum Lift Thickness (Compacted):  (Compacted Soil Barrier)	-----	9 inches
Hydraulic Conductivity (Shelby Tube):  (Compacted Soil Barrier)	ASTM D 5084 <sup>3</sup>	≤ 1 x 10 <sup>-5</sup> cm/s
Completed Thickness:  (Compacted Soil Barrier)	Survey	18 inches minimum

Notes:

1. Optionally use ASTM D 1556, ASTM D 2167, or ASTM D 2937.
2. Optionally use ASTM D 2216, ASTM D 4643, or ASTM D 4959.
3. Maximum effective confining pressure and maximum hydraulic gradient as follows.  
Backpressure as recommended by ASTM D 5084. Modifications of the maximum hydraulic gradient may be allowed by the Engineer depending on actual hydraulic conductivity values.

<b>Material</b>	<b>Maximum Effective Confining Pressure (psi)</b>	<b>Maximum Hydraulic Gradient</b>
Compacted Soil Barrier (k ≤ 1 x 10 <sup>-5</sup> cm/s)	5	15

4. Or as otherwise determined by remolded samples to achieve hydraulic conductivity criteria.

END OF SECTION

Attachment B

Soil Liner CQA

# SOIL LINER CQA

## 1.0 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.

## 2.0 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.

### 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.

## 3.0 SUBGRADE APPROVAL

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

## 4.0 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.

#### **4.1 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.

#### **4.2 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.

#### **4.3 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.

### **5.0 SOIL LINER CONSTRUCTION**

#### **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.

## **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.

## **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.

### **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: Recomposition 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.

#### **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.

#### **5.5 Perforations In Soil Liner**

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

### **6.0 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 1: CQA TESTING PROGRAM FOR SOIL LINER MATERIAL APPROVAL**

<b>PROPERTY</b>	<b>TEST METHOD</b>	<b>MINIMUM TEST FREQUENCY</b>
<b>CONTROL TESTS:</b>		
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 <sup>3</sup>	10,000 CY per Each Soil

**TABLE 2: CQA TESTING PROGRAM FOR SOIL LINER TEST FILL**

PROPERTY	TEST METHOD	MINIMUM TEST FREQUENCY
<b>CONTROL TESTS:</b> (See Table 1)		
Moisture-Density Relationship	ASTM D 698 <sup>4</sup>	1 per lift
Hydraulic Conductivity - Lab Remolded	ASTM D 5084 <sup>3,4</sup>	1 per lift
<b>RECORD TESTS:</b>		
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 <sup>1</sup>	3 per lift
Moisture Content	ASTM D 6938 <sup>2</sup>	3 per lift
Hydraulic Conductivity - Undisturbed (Shelby Tube)	ASTM D 6938 <sup>3</sup>	1 per lift

**TABLE 3: CQA TESTING PROGRAM FOR SOIL LINER**

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

Attachment E

Section 02258  
Vegetative Soil Layer

## SECTION 02258

### VEGETATIVE SOIL LAYER

Vegetative Soil Layer (VSL): The Vegetative Soil Layer (VSL) is placed in the final cover system in order to support permanent vegetative cover.

#### A. DESCRIPTION

##### 1. General:

The Contractor shall furnish all labor, material, and equipment to complete installation of the VSL for the landfill cover, including borrowing, hauling, spreading, and final grading and all necessary and incidental items as detailed or required to complete the VSL, all in accordance with the Contract Drawings and these Specifications.

##### 2. Related Work:

Related Contract Work is described in the following sections of the Specifications:

<u>Work</u>	<u>Section</u>
Soil Liner	02250
Revegetation	02930

##### 3. Quality Assurance:

Quality Assurance during placement of Vegetative Soil Layer will be provided by the Owner.

#### B. MATERIALS

Soil that meets all of the following requirements shall be classified as select soil fill for use in construction of the VSL.

1. Soil materials used in the VSL shall be reasonably free of gypsum, ferrous, and/or calcareous concretions and nodules, refuse, roots, or other deleterious substances.
2. The VSL shall be uniform, smooth, and free of debris, rock, plant materials, and other foreign material larger than 3 inches in diameter. The material should contain no sharp edges. This material must be capable of supporting growth of vegetative cover.

C. SUBMITTALS

The Contractor shall submit the following to the CQA Engineer:

1. Before approval is given to proceed, the Contractor shall submit descriptive information on placement equipment to be used in construction of the VSL.

D. CONSTRUCTION

1. All placement and compaction of VSL shall be performed only when the CQA Engineer is informed by the Contractor of intent to perform such work.
2. VSL shall be placed as specified below:
  - a. The VSL, including topsoil, shall be placed and spread using tracked equipment. The CQA Engineer shall approve the equipment used to place the VSL.
  - b. VSL shall be placed and compacted to the lines and grades shown on the Contract Drawings with the exception that a 0.15 foot overbuild at Contractor's expense is allowed. The Contractor will perform all surveys necessary to establish and verify lines and grades for all VSL.
  - c. VSL shall be compacted by tracking the final lift with tracked equipment.
3. After the specified thickness has been achieved and verified, the Contractor shall proceed immediately with seeding.
4. Surveying:

After completion of a segment of VSL, the VSL shall be surveyed (by test pit or hand auger) on a 100 foot grid to ensure the minimum specified thickness of VSL has been achieved.

END OF SECTION