



November 20, 2009

Permit No.	Date	Document ID No.
98-09	November 24, 2009	8946

Mr. Ming-Tai Chao, P.E.
 Environmental Engineer II
 NC DENR - Division of Waste Management
 401 Oberlin Road, Suite 150
 Raleigh, NC 27605

RECEIVED
November 20, 2009 via a mail
 Solid Waste Section
 Raleigh Central Office

**Re: Wilson County - Westside C&D Landfill (Permit No. 98-09)
 Permit Application for Continued Operations
 Response to Comments**

Dear Mr. Chao:

On behalf of Wilson County, Richardson Smith Gardner & Associates, Inc. (RSG) would like to the comments in your letter dated October 2, 2009 (see **attached**), as follows. The comments stated in your letter are repeated below in *italics* and our response follows in **bold**.

Attachment A - Specifications & CQA Requirements

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

Please find attached technical specifications and a complete CQA Manual covering all components of the proposed final cover system. Please replace the original information in Attachment A in its entirety.

- (Soil Liner CQA, Paragraph 5.0 on page 2) The Paragraph 5.G is inconsistent with the proposed final soil cover system. Please clarify.*

The referenced statement has been removed from the attached CQA Manual.

- (Soil Liner CQA, Table 3, & Table 3.1 in Attachment B) The proposed CQA testing frequency for hydraulic conductivity (ASTM D 5084) of soil liner is 80,000 square feet per lift. This proposed testing frequency is less than the waste industry standard of 1 test per lift per acre. Please clarify, and the costs for conducting CQA in Table 3.1 may need to be revised.*

The attached CQA Manual has been revised to require hydraulic conductivity testing every 40,000 ft² per lift. The CQA cost per acre listed in Table 3.1 of the Closure and Post-Closure Plan has been increased to \$6,500 per acre to account for the change.

Attachment B – Closure Plan

- (Section 1.3 and Figure 2) The Paragraph D.4 of Section 02250 in Attachment A specifies that a subgrade will be properly constructed prior to placement of the soil liner. Please describe this subgrade (or intermediate cover) in Section 1.3 and show the subgrade in Detail 1 of Figure 2.*

Intermediate cover is placed as part of landfill operations and is, thus, not specified. The

Soil Liner specification (Section 02250) requires inspection and proofrolling prior to placement of the Compacted Soil Barrier portion of the final cover.

Detail 1/Fig. 2 has been revised to show a 12 inch layer of intermediate cover placed on top of the waste as part of operations. Please see the attached revised Figure 2.

5. *(Section 1.4, Figure 1, & Table 3.1) On Figure 1 there are five (5) landfill gas wells/vents to be installed over the 10.5-acre closed area. Comparing to the waste industry standard of one (1) gas vent per acre of the final cover, the number of the proposed gas vents is not sufficient. Please clarify and add the final number of the proposed gas well/vents to Section 1.4 and Figure 1. The costs of installing the gas system in Table 3.1 may need to be revised as well.*

The total number of proposed gas wells/vents has been increased to 10 on the attached revised Figure 1, which is equal to approximately one per acre. However, because C&D landfills typically produce much less gas than MSW landfills, from which the “industry standard” rule of thumb is determined, the County will evaluate gas pressure following final cover application and may reduce the number of wells to the minimum amount necessary to adequately relieve any significant gas pressure (see Note 1 on Figure 1). The landfill gas system unit cost of \$3,000/acre in Table 3.1 was very conservative for 5 wells or vents and should be adequate for 10 fairly shallow wells or vents.

6. *(Section 1.6) Please add the closure notification requirements in accordance with Rule 15 A NCAC 13B .0543(c)(4) to the proposed Closure Plan.*

Section 1.6 has been revised accordingly. Please find attached a revised Closure and Post-Closure Plan.

7. *(Section 1.7) Please describe (i) where to record a notation on the deed and (ii) the requirement of informing the DWM upon completion of placing notation on of deed of landfill facility property.*

Section 1.7 has been revised to indicate that deed notations will be recorded with the County Register of Deeds and that the DWM will be notified.

8. *(Table 3.1) Is there a “shrinkage factor” used to calculate the quantity of soil cap system components? What is the assumption of the soil sources - from the on-site or off-site borrow sources? Please clarify.*

The quantities shown are in-place quantities. It is expected that all soil will come from current or future borrow areas located on site.

Attachment B – Post-Closure Plan

9. *(Section 2.3) Please add maintenance requirements for the access road to all monitoring points. The costs for road maintenance need to include in the cost estimate Table 3.2.*

Section 2.3 has been revised accordingly. Table 3.2 has been also revised to add cost for the maintenance of access roads.

10. (Section 2.4.2) Please describe the requirements for mowing, re-vegetation, and fertilization (See cost items in Table 3.2) to encourage the growth and establish healthy vegetation on the final cover during the post-closure period.

Specification Section 02930 (Revegetation) has been added to cover the establishment of vegetation at the time of closure. Section 2.4.2 has been revised to reflect vegetative requirements also.

11. (Section 2.4.4) Please describe the maintenance requirements for the on-site sedimentation pond/basin.

Section 2.4.4 has been revised to reflect that all basins must be cleaned out when sediment reaches design cleanout levels.

Note also that Section 2.4.7 has been added to cover potential leachate seeps and Sections 2.5 (Monitoring Plan) and 2.6 (Engineering Certification) have been reworded.

Please contact me at your earliest convenience with any questions or comments which you may have on this submittal or any further questions or comments you may have on this application. Additionally and per our recent discussion, Wilson County intends to follow up soon with a complete permit renewal application for the landfill, which will include the revised information herein.

Sincerely,
Richardson Smith Gardner & Associates, Inc.



Pieter K. Scheer, P.E.
Principal, Project Manager
pieter@rsgengineers.com



Attachments: NC DWM Letter - October 2, 2009
Revised Technical Specifications
Revised CQA Manual
Revised Closure and Post-Closure Plan
Revised Figures 1 and 2

cc: Andy Davis, Wilson County
Gary Ahlberg, P.E., Blackrock Engineers

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North Carolina Department of Environment and Natural Resources

Division of Waste Management

Beverly Eaves Perdue
Governor

Dexter R. Matthews
Director

Dee Freeman
Secretary

Solid Waste Section

October 2, 2009

Mr. Steve Clayton, Director
Wilson County Solid Waste Department
P.O. Box 1728
Wilson, North Carolina 27894-1728

Re: Comments on Permit Application of Wilson County Westside Construction and Demolition Debris Landfill (C&DLF), Cells 1 through 3 Continued Operations (the Permit Application)
Wilson County, North Carolina
Permit No. 98-09, Document ID No. 8713

Dear Mr. Clayton:

This letter constitutes a review of the Permit Application for the above- referenced facility. The Permit Application is titled:

Wilson County Westside C&D Landfill (Permit 98-09) Continued Operations. Prepared by: BlackRock Engineers, Inc., Wilmington, NC and Richardson Smith Gardner & Associates (RSG), Raleigh, NC.
Prepared for: Wilson County. July, 2008. DIN 5152.

The Solid Waste Section of the Division of Waste Management (DWM) conducted a review of compliance with the Solid Waste Management Rule (Rules), 15A NCAC 13B .0547(2) and requests you to provide the following additional information:

Attachment A

1. Please submit a complete Construction Quality Assurance Plan (CQA) in accordance with the requirements of 15 A NCAC 13B .0541.
2. (Soil Liner CQA, Paragraph 5.0 on page 2) The Paragraph 5.G is inconsistent with the proposed final soil cover system. Please clarify.
3. (Soil Liner CQA, Table 3, & Table 3.1 in Attachment B) The proposed CQA testing frequency for hydraulic conductivity (ASTM D 5084) of soil liner is 80,000 square feet per lift. This proposed testing frequency is less than the waste industry standard of 1 test per lift per acre. Please clarify, and the costs for conducting CQA in Table 3.1 may need to be revised.

Attachment B – Closure Plan

4. (Section 1.3 and Figure 2) The Paragraph D.4 of Section 02250 in Attachment A specifies that a subgrade will be properly constructed prior to placement of the soil liner. Please describe this subgrade (or intermediate cover) in Section 1.3 and show the subgrade in Detail 1 of Figure 2.

5. (Section 1.4, Figure 1, & Table 3.1) On Figure 1 there are five (5) landfill gas wells/vents to be installed over the 10.5-acre closed area. Comparing to the waste industry standard of one (1) gas vent per acre of the final cover, the number of the proposed gas vents is not sufficient. Please clarify and add the final number of the proposing gas well/vent to Section 1.4 and Figure 1. The costs of installing the gas system in Table 3.1 may need to be revised as well.
6. (Section 1.6) Please add the closure notification requirements in accordance with Rule 15 A NCAC 13B .0543(c)(4) to the proposed Closure Plan.
7. (Section 1.7) Please describe (i) where to record a notation on the deed and (ii) the requirement of informing the DWM upon completion of placing notation on of deed of landfill facility property.
8. (Table 3.1) Is there a "shrinkage factor" used to calculate the quantity of soil cap system components? What is the assumption of the soil sources - from the on-site or off-site borrow sources? Please clarify.

Attachment B – Post-Closure Plan

9. (Section 2.3) Please add maintenance requirements for the access road to all monitoring points. The costs for road maintenance need to include in the cost estimate Table 3.2.
10. (Section 2.4.2) Please describe the requirements for mowing, re-vegetation, and fertilization (See cost items in Table 3.2) to encourage the growth and establish healthy vegetation on the final cover during the post-closure period.
11. (Section 2.4.4) Please describe the maintenance requirements for the on-site sedimentation pond/basin.

Please incorporate the requested information and associated documents, revisions, and responses to a new hard copy and an electronic copy of the revised permit application. The Solid Waste Section appreciates your efforts and cooperation in this matter. If you have any questions, please contact me at (919) 508-8507.

Sincerely,



Ming-Tai Chao, P.E.
Environmental Engineer II
Permitting Branch, Solid Waste Section

cc:

Pieter K. Scheer, P.E., RSG
Ed Mussler, Permitting Branch Supervisor
Dennis Shackelford, DWM
Central Files

Gary Ahlberg, P.E. Blackrock Engineers
Donna Wilson, DWM
Ben Barnes, DWM

Technical Specifications

Wilson County Westside C&D Landfill Wilson County, North Carolina

Prepared for:

Wilson County Solid Waste Management Dept.
Wilson, North Carolina

November 2009



14 N. BOYLAN AVENUE
RALEIGH, NORTH CAROLINA 27603
NC LIC. NO. C-0828 (ENGINEERING)

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WILSON COUNTY WESTSIDE C&D LANDFILL

TECHNICAL SPECIFICATIONS

TABLE OF CONTENTS

<u>Section No.</u>	<u>Specification</u>
02222	Excavation
02223	Embankment
02250	Soil Liner
02258	Vegetative Soil Layer
02930	Revegetation

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SECTION 02222

EXCAVATION

Excavation: Excavation includes excavating, sealing, hauling, scraping, undercutting, removal of accumulated surface water or ground water, stockpiling, and all necessary and incidental items as required for bringing the landfill and related structures to the specified lines and grades.

A. DESCRIPTION

1. General:

The Contractor shall furnish all labor, material, and equipment required to complete Excavation of the project area 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>
Embankment	02223
CQA Manual	Attached

3. Quality Assurance:

Quality Assurance during Excavation will be provided by the Owner as described in the accompanying Project CQA Manual.

4. Definitions:

- a. Excavation: shall consist of the removal and satisfactory disposal and/or stockpiling of materials located within the limits of construction including widening cuts and shaping of slopes necessary for the preparation of roadbeds, landfill slope areas, cutting of any ditches, channels, waterways, entrances, and other work incidental thereto.
- b. Borrow: shall consist of approved on-site material required for the construction of embankments/fills or for other portions of the work.

- c. Select Borrow: shall consist of approved off-site material required for the construction of embankments/fills, roadway subgrade, backfilling, or for other portions of the work as shown on Contract Drawings or in these Specifications. The Contractor shall make his own arrangements for obtaining select borrow and pay all costs involved.
- d. Unsuitable Material: is any in-place or excavated material which contains undesirable materials, or is in a state which is not appropriate; in the opinion of the CQA Engineer, for the intended use or support of planned structures, embankment, or excavation. This may include but not be limited to organic material, waste/refuse, soft, or wet material not meeting required specifications, etc.
- e. Unsuitable Materials Excavation (Overexcavation): shall consist of the removal and satisfactory disposal of all unsuitable material located within the limits of construction. Where excavation to the finished grade section shown results in a subgrade or slopes of unsuitable material, the Contractor shall overexcavate such material to below the grade shown on the Contract Drawings or as directed by the Engineer and CQA Engineer.

B. MATERIALS

Excavation shall include the removal of all soil, weathered rock, boulders, conduits, pipe, and all other obstacles encountered and shown on the Contract Drawings or specified herein.

C. SUBMITTALS

The Contractor shall submit the following to the CQA Engineer before approval is given to proceed:

- 1. Descriptive information on Excavation equipment to be used.

D. CONSTRUCTION

- 1. The Contractor shall conduct Excavation activities in such a manner that erosion of disturbed areas and off site sedimentation is absolutely minimized.
- 2. The Contractor shall excavate to the lines and grades shown on the Contract Drawings and stockpile all suitable excavated materials. As the excavation is made, the materials will be examined and identified to the CQA Engineer.

The Contractor will perform all surveys necessary to establish and verify lines and grades for all Excavation, including pipe excavations, soil overexcavation, and anchor trenches.

3. Stockpiling:

The Contractor shall stockpile the materials in appropriate stockpiles as approved by the CQA Engineer.

Stockpiles shall be properly sloped and the surfaces sealed by the Contractor at the end of each working day, or during the day in the event of heavy rain, to the satisfaction of the Engineer.

4. The Contractor shall protect all existing facilities and structures including, but not limited to, existing utilities, monitoring wells, signs, grade stakes, etc. during the grading and stockpiling operations.
5. All excavations shall be made in the dry and in such a manner and to such widths as will give ample room for properly constructing and inspecting the structures and/or piping they are to contain and for such sheeting, timbering, pumping, and drainage as may be required.
6. The Contractor shall be responsible for the control of surface and subsurface water when necessary.
7. Excavation slopes shall be flat enough to avoid sloughs and slides that will cause disturbance of the subgrade or damage of adjacent areas. Slides and overbreaks which occur due to negligence, carelessness, or improper construction techniques on the part of the Contractor shall be removed and disposed of by the Contractor as directed by the Engineer at no additional cost to the Owner.
8. The intersection of slopes with natural ground surfaces, including the beginning and ending of cut slopes, shall be uniformly rounded. All protruding roots and other vegetation shall be removed from slopes.
9. The bottom of all excavations for structures and pipes shall be examined by the CQA Engineer for bearing value and the presence of unsuitable material. If, in the opinion of the CQA Engineer, additional Excavation is required due to the low bearing value of the subgrade material, or if the in-place materials are soft, yielding, pumping and wet, the Contractor shall remove such material to the required width and depth and replace it with thoroughly compacted structural fill, or material directed by the CQA Engineer. No payment will be made for subgrade disturbance caused by inadequate Dewatering or improper construction methods.
10. Any areas excavated below design subgrade elevations by the Contractor, unless directed by the CQA Engineer, shall be brought back to design elevations at no cost to the Owner. The Contractor shall place and compact such material in accordance with Section 02223, Embankment, of these Specifications.

11. The Contractor shall dispose of excess or unsuitable excavation materials on-site at location(s) approved by the Owner.
12. The Contractor shall properly level-off bottoms of all excavations. Proof-rolling shall be conducted with appropriate equipment.
13. Upon reaching subgrade elevations shown in excavation areas, the Contractor shall scarify subgrade soils to a minimum depth of 6" and obtain the CQA Engineer's approval of quality. If unsuitable materials are encountered at the subgrade elevation, perform additional excavations as approved by the CQA Engineer to remove unsuitable materials.

14. Overexcavation and Backfill:

Where subgrade materials are determined to be unsuitable, such materials shall be removed by the Contractor to the lengths, widths and depths approved by the CQA Engineer and backfilled with suitable material in accordance with Section 02223, Embankment, of these Specifications unless further excavation or earthwork is required. No additional payment will be made for such excavation and backfill 1 foot or less than the finished subgrade. Unsuitable material excavation greater than 1 foot beneath the finished subgrade shall be made on a unit price basis for excavation and backfill, only as approved by the Engineer and CQA Engineer prior to the work. Unit price for overexcavation and backfill greater than 1 foot in depth shall include disposal of unsuitable materials.

15. All cuts shall be brought to the grade and cross section shown on the Contract Drawings, or established by the Engineer, prior to final inspection.

16. The Contractor shall protect finished lines and grades of completed excavation against excessive erosion, damage from trafficking, or other causes and shall repair any damage at no additional cost to the Owner.

17. Trench Excavation:

- a. All pipe Excavation and trenching shall be done in strict accordance with these Specifications, all applicable parts of the OSHA Regulations, 29 CFR 1926, Subpart P, and other applicable regulations. In the event of any conflicts in this information, safe working conditions as established by the appropriate OSHA guidelines shall govern.
- b. The minimum trench widths shall be as indicated on the Contract Drawings. Enlargements of the trench shall be made as needed to give ample space for operations at pipe joints. The width of the trench shall be limited to the maximum dimensions shown on the Contract Drawings,

except where a wider trench is needed for the installation of and work within sheeting and bracing.

- c. Except where otherwise specified, excavation slopes shall be flat enough to avoid slides which will cause disturbance of the subgrade, damage to adjacent areas, or endanger the lives or safety of persons in the vicinity.
- d. Hand excavation shall be employed wherever, in the opinion of the Engineer, it is necessary for the protection of existing utilities, poles, trees, pavements, obstructions, or structures.
- e. No greater length of trench in any location shall be left open, in advance of pipe laying, than shall be authorized or directed by the Engineer and, in general, such length shall be limited to approximately one hundred (100) feet.
- f. Pipe Bedding: All pipe bedding shall be as shown on the Contract Drawings, unless otherwise specified herein.

18. Sheeting and Bracing:

- a. The Contractor shall furnish, place, and maintain such sheeting and bracing which may be required to support sides of Excavation or to protect pipes and structures from possible damage and to provide safe working conditions in accordance with current OSHA requirements. If the Engineer is of the opinion that at any point sufficient or proper supports have not been provided, he may order additional supports put in at the sole expense of the Contractor. The Contractor shall be responsible for the adequacy of all sheeting and bracing used and for all damage resulting from sheeting and bracing failure or from placing, maintaining, and removing it.
- b. The Contractor shall exercise caution in the installation and removal of sheeting to insure that excessive or unusual loadings are not transmitted to any new or existing structure. The Contractor shall promptly repair at his expense any and all damage that can be reasonably attributed to sheeting installation or removal.
- c. All sheeting and bracing shall be removed upon completion of the work.

19. If grading operations are suspended for any reason whatsoever, partially completed cut and fill slopes shall be brought to the required slope and the work of seeding and mulching or other required erosion and sedimentation control operations shall be performed at the Contractor's sole expense.

END OF SECTION

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SECTION 02223

EMBANKMENT

Embankment: Embankment is the on-site compacted fill that provides the foundation and the berms for the containment area, the subgrade for some access roadways and structures, and backfill around structures and piping.

A. DESCRIPTION

1. General:

The Contractor shall furnish all labor, material, and equipment to complete Embankment including borrowing, hauling, screening, discing, drying, compaction, control of surface and subsurface water, final grading, sealing, and all necessary and incidental items as detailed or required to complete the Embankment, 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>
Excavation	02222
CQA Manual	Attached

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 698	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft ³).
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 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 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 Embankment will be provided by the Owner as described in the accompanying Project CQA Manual.

5. Definitions:

- a. Embankment: Shall include construction of all site earthwork including roadways, subgrade, perimeter berm embankments, including preparation of the areas upon which materials are to be placed. Embankment may also be referred to as structural and/or controlled fill. All Embankment materials may be either (off-site) Select Borrow or (on-site) Borrow unless otherwise noted on Contract Drawings or specified by the Engineer.
- b. Prepared Subgrade: The ground surface after clearing, grubbing, stripping, excavation, scarification, and/or compaction, and/or proof rolling to the satisfaction of the CQA Engineer.
- c. Well-Graded: A mixture of particle sizes that has no specific concentration or lack thereof of one or more sizes. Well-graded does not define any numerical value that must be placed on the coefficient of uniformity, coefficient of curvature, or other specific grain size distribution parameters. Well-graded is used to define a material type that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids.

- d. Unclassified Fill: The nature of materials to be used is not identified or described herein but must be approved by the Engineer prior to use.

B. MATERIALS

1. Embankment materials shall consist of clean well-graded natural soil classified as SW, SM, SM-SC, SC, ML, CL-ML, or CL (ASTM D 2488) containing no topsoil or other deleterious material. Other material classifications may be approved by the Engineer.
2. Stones or rock fragments shall not exceed one half the maximum lift thickness as compacted in any dimension. Isolated rocks shall be a maximum of 24-inches in any dimension.

C. SUBMITTALS

The Contractor shall submit the following to the CQA Engineer before approval is given to proceed:

1. Descriptive information on compaction equipment to be used for construction of Embankment.
2. Descriptive information on the location and source of any off-site borrow material to be used for Embankment, where applicable. Information shall include Standard Proctor curves (ASTM D698) for each borrow material.

D. CONSTRUCTION

1. The Contractor shall conduct Embankment activities in such a manner that erosion of disturbed areas and off-site sedimentation is absolutely minimized.
2. All placement and compaction of Embankment shall be performed only when the CQA Engineer is informed by the Contractor of intent to perform such work.
3. Embankment shall be placed and compacted to the lines and grades shown on the Contract Drawings. Placement of Embankment outside the construction limits shall occur only as directed and approved by the Engineer.

The Contractor will perform all surveys necessary to establish and verify lines and grades for all Embankment.

4. The Contractor shall protect all existing facilities including, but not limited to, utilities and monitoring wells.

5. Subgrade Preparation:
 - a. The CQA Engineer shall inspect the exposed subgrade prior to placement of Embankment to assure that all rocks, topsoil, vegetation, roots, debris, or other deleterious materials have been removed.
 - b. Prior to placement of Embankment, 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 materials revealed before or during the in-place compaction shall be removed as directed by the CQA Engineer and replaced with suitable Embankment.
6. Surfaces on which Embankment is to be placed, shall be scarified or stepped in a manner which will permit bonding of the Embankment with the existing surface.
7. The Contractor shall be responsible for preparing the materials for the Embankment, including but not limited to, in-place drying or wetting of the soil necessary to achieve the compaction criteria of these Specifications.
8. The Contractor shall be responsible for the control of surface and subsurface water, when necessary.
9. Embankment materials shall be placed in a manner permitting drainage and in continuous, approximately horizontal layers.
10. Compaction Requirements:
 - a. The Contractor shall compact Embankment in accordance with the requirements shown in Table 1 of this section. If Embankment 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.
 - b. Each lift shall be compacted prior to placement of succeeding lifts. In confined areas, mechanical equipment, suitable for small areas and capable of achieving the density requirements, shall be required.
 - c. Lift compaction shall be performed with an appropriately heavy, properly ballasted, penetrating-foot or smooth-drum vibratory compactor depending on soil type. Compaction equipment shall be subject to approval by the CQA Engineer.

11. Embankment that becomes excessively eroded, soft, or otherwise unsuitable shall be removed or repaired by the Contractor as directed by the CQA Engineer, at no cost to the Owner.
12. The exposed surface of Embankment shall be rolled with a smooth-drum roller at the end of each work day to protect from adverse weather conditions.
13. Where Embankment is to be placed and compacted on slopes that are steeper than 3:1, the subgrade shall be benched to a minimum depth of 6 inches and the Embankment shall be placed in horizontal lifts.
14. Backfilling for Structures and Piping:
 - a. All structures, including manholes and pipes shall be backfilled with Embankment as shown in the Contract Drawings and as described in these Specifications.
 - b. Where sheeting is used, the Contractor shall take all reasonable measures to prevent loss of support beneath and adjacent to pipes and existing structures when sheeting is removed. If significant volumes of soil cannot be prevented from clinging to the extracted sheets, the voids shall be continuously backfilled as rapidly as possible. The Contractor shall thereafter limit the depth below subgrade that sheeting will be driven in similar soil conditions or employ other appropriate means to prevent loss of support.
 - c. When backfilling around structures, do not backfill until concrete has sufficiently cured (as determined by the CQA Engineer) and is properly supported. Place backfill in a manner to avoid displacement or damage of structures.

TABLE 1: REQUIRED EMBANKMENT PROPERTIES

ITEM	Required % Standard Proctor (ASTM D698)²	Required Moisture Content³	Maximum Lift Thickness (Compacted) (inches)
Embankment	95	As Required for Compaction	8
Embankment Beneath Structures and Roads ¹	98		8
Backfill Around Structures	95		8
Backfill in Pipe Trenches	95		6
Unclassified Fill	N/A	N/A	N/A

Notes:

1. Embankment beneath structures shall be considered to include a zone 10 feet out from the foundation of the structure extending down to the natural ground on a 45° slope. Embankment beneath roads shall be considered to include all embankment placed within 2 vertical feet of the final wearing surface and shall also include shoulders.
2. Determine field density using ASTM D 6938, ASTM D 1556, ASTM D 2167, or ASTM D 2937.
3. Determine field moisture content using ASTM D 6938, ASTM D 2216, ASTM D 4643, or ASTM D 4959.
4. The Engineer may allow exceptions to the above criteria for areas outside of the containment area which are not subject to significant long-term loads.

END OF SECTION

SECTION 02250

SOIL LINER

Soil Liner: The Soil Liner serves as a hydraulic containment barrier in the final cover system.

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 ³).
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

PROPERTY	TEST METHOD	VALUE
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 ³	≤ 1 x 10 ⁻⁵ cm/s at a density of ≥ 95% maximum standard dry density and a moisture content ≥ optimum moisture content ⁴

TABLE 2: IN-PLACE SOIL LINER REQUIREMENTS

PROPERTY	TEST METHOD	VALUE
Density	ASTM D 6938 ¹	≥ 95% maximum standard dry density ⁴
Moisture Content	ASTM D 6938 ²	≥ optimum moisture content ⁴
Maximum Lift Thickness (Compacted): (Compacted Soil Barrier)	-----	9 inches
Hydraulic Conductivity (Shelby Tube): (Compacted Soil Barrier)	ASTM D 5084 ³	≤ 1 x 10 ⁻⁵ 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.

Material	Maximum Effective Confining Pressure (psi)	Maximum Hydraulic Gradient
Compacted Soil Barrier (k ≤ 1 x 10 ⁻⁵ cm/s)	5	15

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

END OF SECTION

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

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

SECTION 02930

REVEGETATION

Revegetation: Revegetation includes permanent Revegetation of all site areas disturbed by the Contractor whether inside the Contract Limits or not.

A. DESCRIPTION

1. General:

The Contractor shall furnish all labor, material, and equipment to complete Revegetation 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>
Vegetative Soil Layer	02258

3. Warranty:

The Contractor shall be responsible for the satisfactory establishment and growth of a permanent stand of vegetation for a period of one year following the final seeding as judged by the Engineer. During this period, the Contractor shall be responsible for the maintenance items described in Paragraph D.4 (Maintenance) of this Specification.

B. MATERIALS

1. Limestone: Unless otherwise defined by specific soil tests, supply agricultural grade ground limestone conforming to the current “Rules, Regulations, and Standards of the Fertilizer Board of Control.”

2. Fertilizer: Unless otherwise defined by specific soil tests, supply commercial fertilizer of 10-10-10 analysis, meeting applicable requirements of State and Federal law. Do not use cyanamic compounds of hydrated lime. Deliver fertilizer in original containers labeled with content analysis.

3. Grass Seed: Supply fresh, clean, new-crop seed as specified in Table 1 of this section. Do not use seed which is wet, moldy, or otherwise damaged. Deliver

seed in standard sealed containers labeled with producer's name and seed analysis, and in accord with US Department of Agriculture Rules and Regulations under Federal Seed Act.

4. Mulch: Supply clean, seed-free, threshed straw of oats, wheat, barley, rye, beans, or other locally available mulch material.
 - a. Do not use mulch containing a quantity of matured, noxious weed seeds or other species that will be detrimental to seeding, or provide a menace to surrounding land.
 - b. Do not use mulch material which is fresh or excessively brittle, or which is decomposed and will smother or retard growth of grass.
5. Binder: Supply emulsified asphalt or synthetic binder.
6. Water: Supply potable, free of substances harmful to growth.

C. SUBMITTALS

The Contractor shall submit the following to the Engineer:

1. Results of soil tests performed and proposed modifications, if any, to the specified requirements.
2. Certificates for each grass seed mixture, stating botanical and common name, percentage by weight, and percentages of purity, germination, and weed seed. Certify that each container of seed delivered is fully labeled in accordance with Federal Seed Act and equals or exceeds specification requirements.
3. Copies of invoices for fertilizer, showing grade furnished and total quantity applied.

D. CONSTRUCTION

1. The Contractor shall establish a smooth, healthy, uniform, close stand of grass from the specified seed. Prior to Revegetation, the Contractor shall adequately test the soils to be revegetated to ensure the adequacy of the specified requirements. Any modifications to these requirements deemed necessary after the review of soil test results, shall be at the Contractor's sole expense. The Engineer will perform the observations to determine when successful Revegetation is achieved.

2. Soil Preparation:

- a. Limit preparation to areas which will be planted soon after preparation.
- b. Loosen surface to minimum depth of four (4) inches.
- c. Remove stones, sticks, roots, rubbish and other extraneous matter over three (3) inches in any dimension.
- d. Spread lime uniformly over designated areas at the rate specified in Table 1 of this section.
- e. After application of lime, prior to applying fertilizer, loosen areas to be seeded with double disc or other suitable device if soil has become hard or compacted. Correct any surface irregularities in order to prevent pocket or low areas which will allow water to stand.
- f. Distribute fertilizer uniformly over areas to be seeded at the rate specified in Table 1 of this section.
 - (1) Use suitable distributor.
 - (2) Incorporate fertilizer into soil to depth of a least two (2) inches.
 - (3) Remove stones or other substances which will interfere with turf development or subsequent mowing.
- g. Grade seeded areas to smooth, even surface with loose, uniformly fine texture.
 - (1) Roll and rake, remove ridges and fill depressions, as required to meet finish grades.
 - (2) Fine grade just prior to planting.

3. Seeding:

- a. Use approved mechanical power driven drills or seeders, mechanical hand seeders, or other approved equipment.
- b. Distribute seed evenly over entire area at the rate specified in Table 1 of this section.

- c. Stop work when work extends beyond most favorable planting season for species designated, or when satisfactory results cannot be obtained because of drought, high winds, excessive moisture, or other factors.
- d. Resume work only when favorable condition develops, or as directed by the Engineer.
- e. Lightly rake seed into soil followed by light rolling or cultipacking.
- f. Immediately protect seeded areas against erosion by mulching or placing Rolled Erosion Control Products in accordance with Section 02275 of these Specifications, where applicable.
 - (1) Spread mulch in a continuous blanket at the rate specified in Table 1 of this section.
 - (2) Immediately following spreading mulch, secure with evenly distributed binder at the rate specified in Table 1 of this section.

4. Maintenance:

The Contractor shall be responsible for maintaining all seeded areas through the end of his warranty period. The Contractor shall provide, at his expense, protection of all seeded areas against damage at all times until acceptance of the work. Maintenance shall include, but not be limited to, the following items:

- a. Regrade and revegetate all eroded areas until adequately stabilized by grass.
- b. Remulch with new mulch in areas where mulch has been disturbed by wind or maintenance operations sufficiently to nullify its purpose. Anchor as required to prevent displacement.
- c. Replant bare areas using same materials specified.

TABLE 1: SEEDING SCHEDULE

MATERIAL	SEED TYPE	APPLICATION RATE ¹
Lime	-----	4,000 lbs/acre
Fertilizer	-----	1,000 lbs/acre
Seed Permanent:	Tall Fescue Pensacola Bahiagrass Sericea Lespedeza ² Kobe Lespedeza Seasonal Nurse Crop	80 lbs/acre 50 lbs/acre 30 lbs/acre 10 lbs/acre See Note 3
Temporary:	See Note 4	See Note 4
Mulch	-----	4,000 - 5,000 lbs/acre
Binder	-----	150 gallons/acre

Notes:

1. Application rates and/or chemical analysis shall be confirmed or established by a soil test(s).
2. From Sept. 1 - March 1, use unscarified Sericea seed.
3. Use seasonal nurse crop in accordance with seeding dates as stated below:

April 15 - August 15	10 lbs/acre German Millet or 15 lbs/acre Sudangrass
August 16 - April 14	25 lbs/acre Rye (grain).
4. For temporary seeding, follow the guidelines of the NC Erosion and Sediment Control Planning and Design Manual.

END OF SECTION

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Construction Quality Assurance Manual

**Wilson County Westside C&D Landfill
Wilson County, North Carolina**

Prepared for:

Wilson County Solid Waste Management Dept.
Wilson, North Carolina

November 2009



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RALEIGH, NORTH CAROLINA 27603
NC LIC. NO. C-0828 (ENGINEERING)

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WILSON COUNTY WESTSIDE C&D LANDFILL
CONSTRUCTION QUALITY ASSURANCE MANUAL

TABLE OF CONTENTS

		<u>Page</u>
1.0	GENERAL	
1.1	Introduction	1.0-1
1.2	Definitions Relating to Construction Quality	1.0-1
1.2.1	Construction Quality Assurance (CQA)	1.0-1
1.2.2	Construction Quality Control (CQC)	1.0-2
1.2.3	CQA Certification Document	1.0-2
1.2.4	Discrepancies Between Documents	1.0-2
1.3	Parties to Construction Quality Assurance	1.0-2
1.3.1	Description of the Parties	1.0-2
	1.3.1.1 Owner	1.0-2
	1.3.1.2 Engineer	1.0-2
	1.3.1.3 Contractor	1.0-3
	1.3.1.4 CQA Engineer	1.0-3
	1.3.1.5 Soils CQA Laboratory	1.0-4
1.3.2	Qualifications of the Parties	1.0-4
	1.3.2.1 Contractor	1.0-4
	1.3.2.2 CQA Engineer	1.0-4
	1.3.2.3 Soils CQA Laboratory	1.0-5
1.4	Scope of Construction Quality Assurance Manual	1.0-5
1.5	Units	1.0-5
1.6	References	1.0-5
1.7	CQA Meetings	1.0-5
	1.7.1 Soil Liner CQA Meeting	1.0-6
	1.7.2 CQA Progress Meetings	1.0-6
	1.7.3 Problem or Work Deficiency Meetings	1.0-7
1.8	Control Versus Record Testing	1.0-7
	1.8.1 Control Testing	1.0-7
	1.8.2 Record Testing	1.0-7
2.0	CQA DOCUMENTATION	
2.1	Documentation	2.0-1
2.2	Daily CQA Report	2.0-1
2.3	CQA Progress Reports	2.0-2
2.4	CQA Photographic Reporting	2.0-2
2.5	Deficiencies	2.0-3
2.6	Design And/Or Project Technical Specification Changes	2.0-3

Table of Contents (Continued)

	<u>Page</u>
2.7	Final CQA Report 2.0-3
2.8	Storage of Records 2.0-4
3.0	EARTHWORK CQA
3.1	Introduction 3.0-1
3.2	Embankment Material Approval 3.0-1
3.2.1	Control Tests 3.0-1
3.3	Subgrade Approval 3.0-1
3.4	Earthwork Construction 3.0-1
3.4.1	Construction Monitoring 3.0-1
3.4.2	Control Tests 3.0-2
3.4.3	Record Tests 3.0-2
3.4.3.1	Record Test Failure 3.0-2
3.4.4	Judgmental Testing 3.0-2
3.5	Deficiencies 3.0-2
4.0	SOIL LINER CQA
4.1	Introduction 4.0-1
4.2	Soil Liner Material Approval 4.0-1
4.2.1	Control Tests 4.0-1
4.3	Subgrade Approval 4.0-1
4.4	Test Fill Construction 4.0-1
4.4.1	Control Tests 4.0-2
4.4.2	Record Tests 4.0-2
4.4.3	Test Fill Completion 4.0-2
4.5	Soil Liner Construction 4.0-2
4.5.1	Construction Monitoring 4.0-2
4.5.2	Control Tests 4.0-3
4.5.3	Record Tests 4.0-3
4.5.3.1	Record Test Failure 4.0-3
4.5.4	Judgmental Testing 4.0-4
4.5.5	Perforations in Soil Liner 4.0-4
4.6	Deficiencies 4.0-4
5.0	FINAL COVER SYSTEM CQA
5.1	Introduction 5.0-1
5.2	Final Cover System Material Approval 5.0-1
5.2.1	Corrugated Polyethylene (CPE) Pipe 5.0-1
5.2.2	Landfill Gas (LFG) System Components 5.0-1
5.2.3	Vegetative Soil Layer 5.0-2

Table of Contents (Continued)

	<u>Page</u>
5.3 Final Cover System Installation	5.0-2
5.4 Deficiencies	5.0-3

APPENDICES

Appendix A	Reference List of Test Methods
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SECTION 1.0 GENERAL

1.1 INTRODUCTION

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

More specifically, this CQA Manual addresses the soils components of the final cover system. The final cover system consists of a landfill gas (LFG) system, compacted soil barrier, and overlying vegetative soil layer.

The CQA Manual is divided into the following sections:

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

1.2 DEFINITIONS RELATING TO CONSTRUCTION QUALITY

1.2.1 Construction Quality Assurance (CQA)

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

1.2.2 Construction Quality Control (CQC)

Construction Quality Control refers to actions taken by manufacturers, fabricators, installers, and/or the Contractor to ensure that the materials and the workmanship meet the requirements of the project drawings and the project specifications.

1.2.3 CQA Certification Document

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

1.2.4 Discrepancies Between Documents

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

1.3 PARTIES TO CONSTRUCTION QUALITY ASSURANCE

1.3.1 Description of the Parties

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

1.3.1.1 Owner

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

1.3.1.2 Engineer

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

1.3.1.3 Contractor

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

1.3.1.4 CQA Engineer

The CQA Engineer is a representative of the Owner, is independent from the Contractor, and is responsible for observing, testing, and documenting activities related to the CQA of the earthworks at the site and the installation of the soil component of the final cover system. The CQA Engineer may make field observations and review submittals for the Engineer and is responsible for notifying the Owner and Engineer of all quality issues that arise during construction. The

CQA Engineer is also responsible for issuing a facility certification report, sealed by a Professional Engineer registered in The State of North Carolina.

1.3.1.5 Soils CQA Laboratory

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

1.3.2 Qualifications of the Parties

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

1.3.2.1 Contractor

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

1.3.2.2 CQA Engineer

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

1.3.2.3 Soils CQA Laboratory

The Soils CQA Laboratory will have experience in testing structural fills, soil liners, and aggregates, and be familiar with ASTM and other applicable test standards. The Soils CQA Laboratory will be capable of providing test results within 24 hours or a reasonable time after receipt of samples depending on the test(s) to be conducted, as agreed to at the outset of the project by affected parties, and will maintain that standard throughout the installation.

1.4 SCOPE OF CONSTRUCTION QUALITY ASSURANCE MANUAL

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

1.5 UNITS

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

1.6 REFERENCES

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

1.7 CQA MEETINGS

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

1.7.1 Soil Liner CQA Meeting

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

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

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

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

1.7.2 CQA Progress Meetings

Progress meetings will be held between the Engineer, the CQA Engineer, the Contractor, and representatives from any other involved parties at the frequency dictated in the project specifications or, at a minimum, once per month during active construction. These meetings will discuss current progress, planned activities for the next week, and any new business or revisions to the work. The CQA Engineer will log any problems, decisions, or questions arising at this meeting in his daily or periodic reports. Any matter requiring

action which is raised in this meeting will be reported to the appropriate parties. These meetings will be documented by the Engineer and minutes will be transmitted to affected parties.

1.7.3 Problem or Work Deficiency Meetings

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

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

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

1.8 CONTROL VERSUS RECORD TESTING

1.8.1 Control Testing

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

1.8.2 Record Testing

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

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SECTION 2.0 CQA DOCUMENTATION

2.1 DOCUMENTATION

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

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

2.2 DAILY CQA REPORT

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

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

- decisions made regarding acceptance of units of work, and/or corrective actions to be taken in instances of substandard quality;
- summaries of pertinent discussions with the Contractor; and
- the CQA Engineer's signature.

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

2.3 CQA PROGRESS REPORTS

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

- a unique identifying sheet number for cross-referencing and document control;
- the date, project name, location, and other information;
- a summary of work activities during the progress reporting period;
- a summary of construction situations, deficiencies, and/or defects occurring during the progress reporting period;
- summary of all test results, failures and retests, and
- signature of the CQA Engineer.

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

2.4 CQA PHOTOGRAPHIC REPORTING

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

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

In lieu of photographic documentation, videotaping may be used to record work progress, problems, and mitigation activities. The Engineer may require that a portion of the

documentation be recorded by photographic means in conjunction with videotaping.

2.5 DEFICIENCIES

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

2.6 DESIGN AND/OR PROJECT TECHNICAL SPECIFICATION CHANGES

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

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

2.7 FINAL CQA REPORT

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

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

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

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

2.8 STORAGE OF RECORDS

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

TABLE 2.1: FINAL CQA REPORT GENERAL OUTLINE (FINAL COVER SYSTEM)

- 1.0 Introduction
- 2.0 Project Description
- 3.0 CQA Program
 - 3.1 Scope of Services
 - 3.2 Personnel
- 4.0 Earthwork CQA
- 5.0 Final Cover System CQA
- 6.0 Soil Liner CQA
- 7.0 Summary and Conclusions
- 8.0 Project Certification

Appendices

- Appendix A Design Clarifications/Modifications
- Appendix B Photographic Documentation
- Appendix C CQA Reporting
 - C1. CQA Reports
 - C2. CQA Meeting Minutes
- Appendix D Earthwork CQA Data
 - D1. CQA Test Results - Control Tests
 - D2. CQA Test Results - Record Tests
- Appendix E Final Cover System CQA Data
 - E1. CQA Test Results - Vegetative Soil Layer
- Appendix F Soil Liner CQA Data
 - F1. CQA Test Results - Control Tests
 - F2. CQA Test Results - Record Tests
- Appendix G Record Drawings
 - G1. Compacted Soil Liner As-Built
 - G2. Vegetative Soil Layer As-Built

SECTION 3.0 EARTHWORK CQA

3.1 INTRODUCTION

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

3.2 EMBANKMENT MATERIAL APPROVAL

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

3.2.1 Control Tests

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

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

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

3.3 SUBGRADE APPROVAL

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

3.4 EARTHWORK CONSTRUCTION

3.4.1 Construction Monitoring

- A. Earthwork shall be performed as described in the project specifications.
- B. Only soil previously approved by the CQA Engineer (see **Section 3.2**) shall be used in construction of the compacted embankment. Unsuitable material will be removed prior to acceptance by the CQA Engineer.
- C. All required field density and moisture content tests shall be completed before the overlying lift of soil is placed. The surface preparation (e.g. wetting, drying,

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

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

3.4.2 Control Tests

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

3.4.3 Record Tests

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

3.4.3.1 Record Test Failure

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

3.4.4 Judgmental Testing

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

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

3.5 DEFICIENCIES

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

TABLE 3.1: CQA TESTING PROGRAM FOR EMBANKMENT MATERIAL APPROVAL

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

TABLE 3.2: CQA TESTING PROGRAM FOR COMPACTED EMBANKMENT

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

Notes:

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

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SECTION 4.0 SOIL LINER CQA

4.1 INTRODUCTION

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

4.2 SOIL LINER MATERIAL APPROVAL

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

4.2.1 Control Tests

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

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

During stockpiling operations, control tests, as shown on **Table 4.1**, will be performed by the CQA Engineer prior to placement of any soil liner material.

4.3 SUBGRADE APPROVAL

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

4.4 TEST FILL CONSTRUCTION

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

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

4.4.1 Control Tests

The control tests, as shown on **Table 4.2**, will be performed by the CQA Engineer prior to placement of soil liner material in the test fill.

4.4.2 Record Tests

The record tests, as shown on **Table 4.2**, will be performed by the CQA Engineer during placement of soil liner material in the test fill.

4.4.3 Test Fill Completion

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

4.5 SOIL LINER CONSTRUCTION

4.5.1 Construction Monitoring

- A. Soil liner shall be placed as described in the applicable section(s) of the project specifications using the construction methods, equipment, and material demonstrated in the test fill construction.
- B. Only soil previously approved by the CQA Engineer (see **Section 4.2**) 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. All cracks and voids shall be filled and the surface made uniform. This shall be

accomplished by final dressing of the soil liner with smooth-drum rollers and hand raking. No rubber tired vehicles are permitted on the final dressed surface unless authorized by the CQA Engineer.

4.5.2 Control Tests

The control tests, as shown on **Table 4.3**, will be performed by the CQA Engineer prior to placement of soil liner material.

4.5.3 Record Tests

The record tests, as shown on **Table 4.3** and as described below, will be performed by the CQA Engineer during placement of soil liner material.

- A. Each lift will be checked visually for soil clods, rocks, debris, plant materials and other foreign material. Any such material which does not meet specified requirements shall be identified and removed prior to and during the compaction process.
- B. The thickness of the loose lift will be measured at random locations after spreading and leveling is completed. Loose lift thickness should not exceed the depth of penetration of the compaction feet.
- C. Moisture content will be monitored by the CQA Engineer prior to compaction. If the soil is drier than the specified minimum moisture content, water will be added and the lift will be disced to distribute the moisture evenly.

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

4.5.3.1 Record Test Failure

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

- A. Failed Density Test: 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.

4.5.4 Judgmental Testing

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

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

4.5.5 Perforations In Soil Liner

All holes shall be patched with compacted soil liner (if allowed by the project specifications) or sodium bentonite compacted and hydrated in the holes.

4.6 DEFICIENCIES

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

TABLE 4.1: CQA TESTING PROGRAM FOR SOIL LINER MATERIAL APPROVAL

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

TABLE 4.2: CQA TESTING PROGRAM FOR SOIL LINER TEST FILL

PROPERTY	TEST METHOD	MINIMUM TEST FREQUENCY
CONTROL TESTS: (See Table 4.1)		
Moisture-Density Relationship	ASTM D 698 ⁴	1 per lift
Hydraulic Conductivity - Lab Remolded	ASTM D 5084 ^{3,4}	1 per lift
RECORD TESTS:		
Lift Thickness	-----	Each Lift
Atterberg Limits	ASTM D 4318	1 per lift
Grain Size Analysis	ASTM D 422	1 per lift
In-Place Density	ASTM D 2922 ¹	3 per lift
Moisture Content	ASTM D 6938 ²	3 per lift
Hydraulic Conductivity - Undisturbed (Shelby Tube)	ASTM D 6938 ³	1 per lift

TABLE 4.3: CQA TESTING PROGRAM FOR SOIL LINER

PROPERTY	TEST METHOD	MINIMUM TEST FREQUENCY
CONTROL TESTS: (See Table 4.1)		
RECORD TESTS:		
Lift Thickness	-----	Each Lift
In-Place Density	ASTM D 6938 ¹	10,000 ft ² per lift
Moisture Content	ASTM D 6938 ²	10,000 ft ² per lift
Hydraulic Conductivity - Undisturbed (Shelby Tube)	ASTM D 5084 ³	40,000 ft ² per lift

Notes:

1. Optionally use ASTM D 1556, ASTM D 2167, or ASTM D 2937. For every 10 nuclear density tests perform at least 1 density test by ASTM D 1556, ASTM D 2167, or ASTM D 2937 as a verification of the accuracy of the nuclear testing device.
2. Optionally use ASTM D 2216, ASTM D 4643, or ASTM D 4959. For every 10 nuclear moisture tests perform at least 1 moisture test by ASTM D 2216, ASTM D 4643, or ASTM D 4959 as a verification of the accuracy of the nuclear testing device.
3. Maximum effective confining pressure and hydraulic gradient as required by the project specifications. Backpressure as recommended by ASTM D 5084.
4. These tests performed on the test fill may count toward the minimum frequencies established in **Table 4.1**.

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SECTION 5.0 FINAL COVER SYSTEM CQA

5.1 INTRODUCTION

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

5.2 FINAL COVER SYSTEM MATERIAL APPROVAL

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

5.2.1 LFG System Components

- A. Receipt of Contractor's submittals on LFG system components.
- B. Review of submittals for LFG system components for conformity to the project specifications.

5.2.2 Compacted Soil Barrier

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

5.2.3 Vegetative Soil Layer

- A. Review the proposed source of vegetative soil layer for conformance with the project specifications.
- B. Conduct material control tests in accordance with **Table 5.1**.

5.3 FINAL COVER SYSTEM INSTALLATION

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

- verify location and depth of LFG wells; and
- verify location of all piping.

5.4 DEFICIENCIES

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

TABLE 5.1: CQA TESTING PROGRAM FOR FINAL COVER SYSTEM

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

Appendix A

Reference List of Test Methods

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CQA MANUAL
APPENDIX A: REFERENCE LIST OF TEST METHODS

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

ASTM D 422	Standard Test Method for Particle Size Analysis of Soils.
ASTM D 698	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft ³).
ASTM D 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).

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Closure and Post-Closure Plan

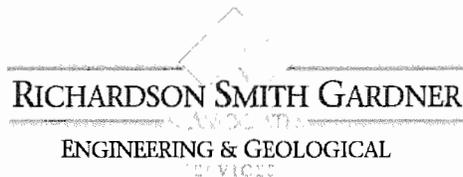
**Wilson County Westside C&D Landfill
Wilson County, North Carolina**

Prepared for:

Wilson County Solid Waste Management Dept.
Wilson, North Carolina

July 2008

Revised: November 2009



14 N. BOYLAN AVENUE
RALEIGH, NORTH CAROLINA 27603
NC LIC. NO. C-0828 (ENGINEERING)

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WILSON COUNTY WESTSIDE C&D LANDFILL

CLOSURE AND POST-CLOSURE PLAN

TABLE OF CONTENTS

	<u>Page</u>
1.0 CLOSURE PLAN	
1.1 Overview	1.0-1
1.2 Maximum Closure Area and Waste Capacity	1.0-1
1.3 Final Cover System	1.0-1
1.4 Landfill Gas System	1.0-2
1.5 Surface Water Systems	1.0-2
1.5.1 Incremental Operation	1.0-2
1.5.2 Required Maintenance	1.0-2
1.6 Closure Schedule	1.0-2
1.7 Closure Verification	1.0-3
2.0 POST-CLOSURE PLAN	
2.1 Overview	2.0-1
2.2 Post-Closure Contact	2.0-1
2.3 Post-Closure Use	2.0-1
2.4 Maintenance	2.0-2
2.4.1 Repair of Security Control Devices	2.0-2
2.4.2 Erosion Damage Repair and Vegetation	2.0-2
2.4.3 Correction of Settlement, Subsidence, and Displacement	2.0-2
2.4.4 Repair of Run-On/Run-Off Control Structures	2.0-2
2.4.5 Landfill Gas System	2.0-2
2.4.6 Groundwater Monitoring Wells	2.0-3
2.4.7 Leachate Seeps	2.0-3
2.5 Monitoring Plan	2.0-3
2.5.1 Inspection Frequencies	2.0-4
2.5.2 Inspection Activities	2.0-4
2.5.3 Record Keeping	2.0-4
2.6 Engineering Certification	2.0-4
3.0 CLOSURE/POST-CLOSURE COST ANALYSIS	
3.1 Overview	3.0-1
3.2 Estimated Closure Costs	3.0-1
3.3 Estimated Post-Closure Costs	3.0-1
3.4 Financial Assurance Mechanism	3.0-1

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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. A formalized Closure Plan for each landfill unit (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

The following are the estimated areas and capacity for each landfill unit to be closed under this plan.

Landfill Unit	Closure Area (Acres) ¹	Gross Capacity (CY) ¹	Net (Waste) Capacity (CY/Tons) ¹
C&D Landfill Unit			
Cells 1-3	10.5	433,560	319,060 CY 215,000 Tons

Notes:

1. Values from approved Construction Plan Application prepared by Gary W. Ahlberg, P.E., dated December 2003. Note that the gross capacity reported is from bottom of waste (top of subgrade) to top of final cover.

1.3 FINAL COVER SYSTEM

The final cover systems for the C&D landfill unit will consist of the following components (top-down):

C&D Landfill Units:

- an 18-inch thick vegetative soil layer; and
- an 18-inch thick soil liner with a hydraulic conductivity of no more than 1×10^{-5} cm/sec ("compacted soil barrier").

The final cover system will be placed on prepared intermediate cover at a maximum slope of 4H:1V. Surface water control devices and landfill gas (LFG) components will also be incorporated into the final cover of each landfill unit. The final cover surface will be vegetated upon completion of the final cover installation according to the project seeding specifications.

Refer to the appropriate permit application for a detailed discussion and details related to the design of the final cover system for each landfill unit.

1.4 LANDFILL GAS SYSTEM

For the C&D landfill unit, a landfill gas system is provided in the final cover design. This system includes a system of collection wells or vents placed within the waste to capture and passively vent the gas.

Refer to the appropriate permit application for a detailed discussion and details related to the design of the landfill gas system for each landfill unit.

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 provided along side slopes (rain gutters and/or diversion berms). Water captured by rain gutters or diversion berms is 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.

Refer to the appropriate permit application for a detailed discussion and details related to the design of surface water systems for each landfill unit.

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 diversion 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:

C&D Landfill Units (15A NCAC 13B.0543(c)(5)):

- No later than 30 days after the date on which the C&DLF unit receives the known final receipt of wastes;

- No later than 30 days after the date that a 10 acre or greater area of waste, is within in 15 feet of final design grades; or
- No later than one year after the most recent receipt of wastes, if the C&DLF unit has remaining capacity.

Prior to beginning closure of any landfill unit, the County will notify the DWM that a notice of the intent to close the unit has been placed in the operating record.

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.
- 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 (through the County Register of Deed's Office) 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 and notification will be provided to the DWM.

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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 landfill should be directed to:

Wilson County Solid Waste Management Department
Attn: Andy Davis, Director
P.O. Box 1728
Wilson, NC 27894
Phone: (252) 399-2823.

2.3 POST-CLOSURE USE

After filling operations cease at the landfill and the landfill is officially closed in accordance with the Closure Plan, each landfill unit will be maintained as a grassy hill. Wilson County 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. Additionally, the County will maintain access to all site monitoring locations through the post-closure period.

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 and Vegetation

If erosion of the final cover occurs during post-closure, the affected area will be repaired and revegetated as necessary. If necessary, rolled erosion control products (RECPs) will be used to expedite rapid revegetation of slopes and to secure topsoil in place. Revegetation (including fertilization and seeding) will be performed in accordance with the most recently approved erosion and sedimentation control plan and the North Carolina Erosion and Sediment Control Planning and Design Manual.

Mowing of the final cover surfaces will occur approximately once per year in order to help maintain a healthy stand of grasses and to cut down saplings and woody-stemmed plants.

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. Sediment basins/ponds will be cleaned out when sediment has reached design cleanout levels.

2.4.5 Landfill Gas System

While gas production from the waste is expected to be very low, a passive venting system is proposed for final closure. Surrounding groundwater levels and buffer areas minimize the potential for gas migration.

The landfill gas system will be maintained by the County and operated in accordance with any site air quality permits. Proper operation of the system is verified through testing at

the landfill gas monitoring wells.

If 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.

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.

2.4.7 Leachate Seeps

If evidence of leachate seeps is observed, the County will take the following actions. Depending on the circumstances, various combinations of actions may be appropriate.

1. If leachate is observed outside of the limits of waste disposal areas, notify the DWM.
2. Contain the flow of leachate using soil berms and/or excavation.
3. Excavate the area of seepage to attempt to allow flow into the underlying waste (i.e. break-up soil layers that may be causing the seep.).
4. For contained leachate that will not flow into underlying waste, a pump may be required to route the leachate to a tanker truck for proper disposal off-site.
5. The use of soil (particularly clay) to plug the seepage may be successful in the case where flows are minor.
6. Remove and dispose of impacted cover soils accordingly.
7. Repair landfill cover as necessary.

2.5 MONITORING PLAN

The closed unit will be monitored for a minimum of 30 years. Inspections of the closed landfill 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 Inspection Activities

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. Additionally, the condition of the groundwater and gas monitoring systems and permanent benchmarks will be checked.

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.

2.5.3 Record Keeping

Records of inspections and repairs will be kept on file by the County throughout the post-closure period.

2.6 ENGINEERING CERTIFICATION

Following completion of the post-closure care period for each landfill unit, the County will notify the DWM that a certification, signed by a registered professional engineer, verifying that post-closure care has been completed in accordance with the post-closure plan, has been placed in the operating record.

TABLE 2.1: POST-CLOSURE INSPECTION FREQUENCIES

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

Notes:

1. These items will be inspected after each large storm event (i.e. ≥ 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 and/or air quality permit(s), if applicable.

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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 costs associated with all activities specified in the written closure and post-closure plans which have been developed for the C&D landfill unit of the Wilson County Landfill.

3.2 ESTIMATED CLOSURE COSTS

Table 3.1 summarizes the estimated costs for complete closure of the C&D landfill unit. The 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, 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 for the C&D landfill unit. The 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.

3.4 FINANCIAL ASSURANCE MECHANISM

Wilson County intends to continue to use the Local Government Financial Test to demonstrate financial assurance for this facility.

TABLE 3.1: C&D UNIT - CLOSURE COST ESTIMATE¹

ITEM	QUANTITY	UNITS	UNIT COST	ITEM COST (2009 \$)
Surface Preparation	10.5	Acre	\$2,000	\$21,000
Landfill Gas Wells/Vents	10.5	Acre	\$3,000	\$31,500
Compacted Soil Barrier (18")	25,500	CY	\$7.00	\$178,500
Vegetative Soil Layer (18")	25,500	CY	\$4.00	\$102,000
Erosion Control (Diversion Berms, Down Pipes, Drainage Channels, Etc.)	10.5	Acre	\$5,000	\$52,500
Revegetation	10.5	Acre	\$1,500	\$15,750
Surveying	10.5	Acre	\$2,000	\$21,000
Subtotal:				\$422,250
Bonds, Mobilization, & Insurance	(4% of Subtotal):			\$16,890
Subtotal:				\$439,140
Contingency (10%):				\$43,914
Construction Subtotal:				\$483,054
Engineering	10.5	Acre	\$2,000	\$21,000
CQA	10.5	Acre	\$6,500	\$68,250
TOTAL:				\$572,304

Notes:

1. Assumes closure of 10.5 acres (Cells 1-3).

TABLE 3.2: C&D UNIT - POST-CLOSURE COST ESTIMATE¹

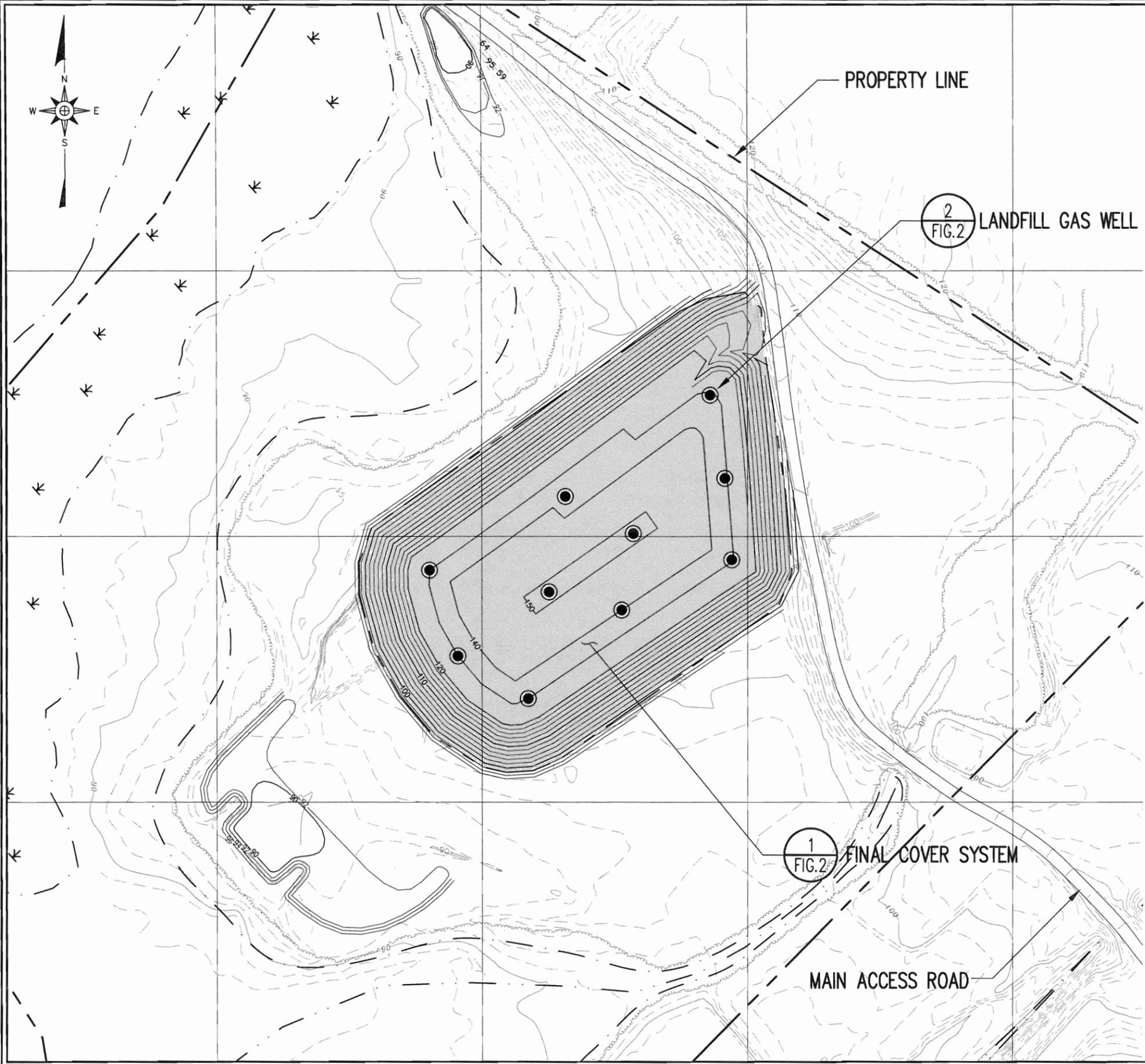
ITEM	QUANTITY	UNIT	UNIT COST	TOTAL (2009 \$)
Site Inspection And Record Keeping	20	HR	\$75	\$1,500
Revegetation (5% Total Area)	0.5	Acre	\$1,500	\$750
Mowing (once per year)	11	Acre	\$100	\$1,100
Erosion Control	1	LS	\$2,000	\$2,000
Gates/Fences/Access	1	LS	\$1,500	\$1,500
Groundwater/Surface Water Monitoring & Reporting (4 Long-Term Wells - Semi-Annual)	4	Each	\$1,200	\$9,600
Methane Monitoring & Reporting (Semi-Annual After Year 1)	2	Each	\$1,500	\$3,000
Subtotal:				\$19,450
Contingency (10%):				\$1,945
ANNUAL TOTAL:				\$21,395
30-YEAR TOTAL:				\$641,850

Notes:

1. Assumes post-closure of Cell 1-3 (10.5 Ac.).

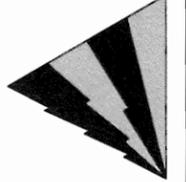
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BLACKROCK ENGINEERS, INC.

POST OFFICE BOX 58
 WILMINGTON, NORTH CAROLINA 28401
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 CASTLE HAYNE, NORTH CAROLINA 28429
 PHONE: 910.232.6696



RICHARDSON SMITH GARDNER & ASSOCIATES
 www.rsgengineers.com
 14 N. Boylan Ave. Raleigh, N.C. 27603
 ph: 919-828-0577
 fax: 919-828-3699

LEGEND

	EXISTING 10' CONTOUR (SEE REFERENCE 1)
	EXISTING 2' CONTOUR
	PROPOSED GRADING 10' CONTOUR (SEE REFERENCE 2)
	PROPOSED GRADING 2' CONTOUR
	PROPERTY LINE (SEE REFERENCE 2)
	WETLAND AREA (SEE REFERENCE 2)
	STREAM (SEE REFERENCE 2)
	AREA TO CLOSE (±10.5 AC.)
	PROPOSED LANDFILL GAS WELL OR VENT

NOTES

1. THE COUNTY WILL EVALUATE GAS PRESSURES UPON INSTALLATION OF THE FINAL COVER SYSTEM AND WILL INSTALL A NUMBER OF WELLS/VENTS AS NECESSARY TO ADEQUATELY RELIEVE GAS PRESSURE.

REFERENCES

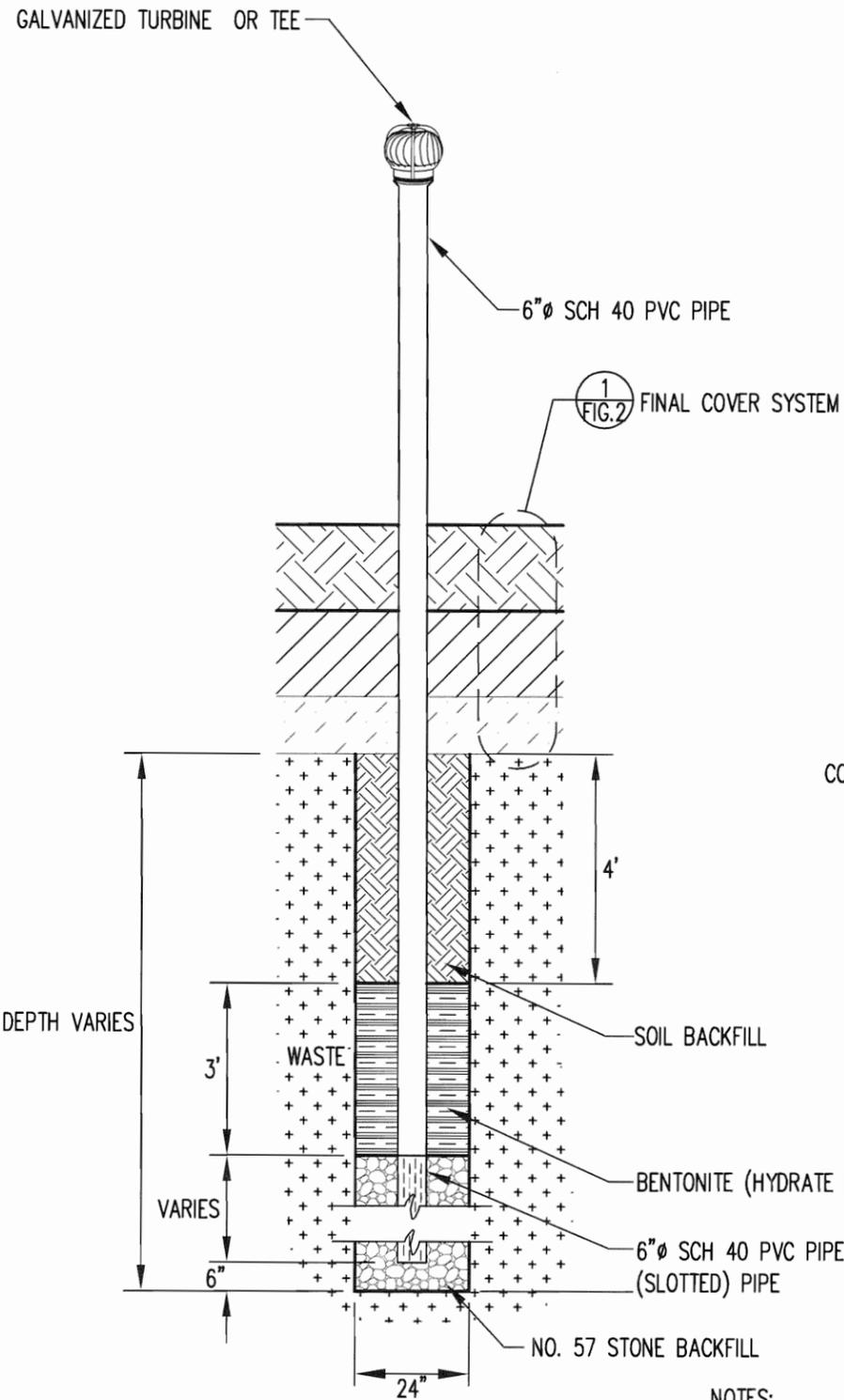
1. TOPOGRAPHY FROM DRAWING "FINAL COVER PLAN", DATED 9/1/04, PREPARED BY GARY W. AHLBERG, P.E.
2. SITE PROPERTY LINE, WELLS, FINAL COVER GRADES, WETLAND AREAS, STREAMS AND FEATURES FROM DRAWING "FINAL COVER PLAN", DATED 9/1/04, PREPARED BY GARY W. AHLBERG, P.E.



DRAWN BY: J.A.L.	CHECKED BY:	SCALE: AS SHOWN	FIGURE NO. 1
DATE: Nov. 2009	PROJECT NO. WESTSIDE 08-1	FILE NAME WESTSIDE-B0001	

TITLE:
**WILSON COUNTY
 WESTSIDE C&D LANDFILL
 CLOSURE AREA**

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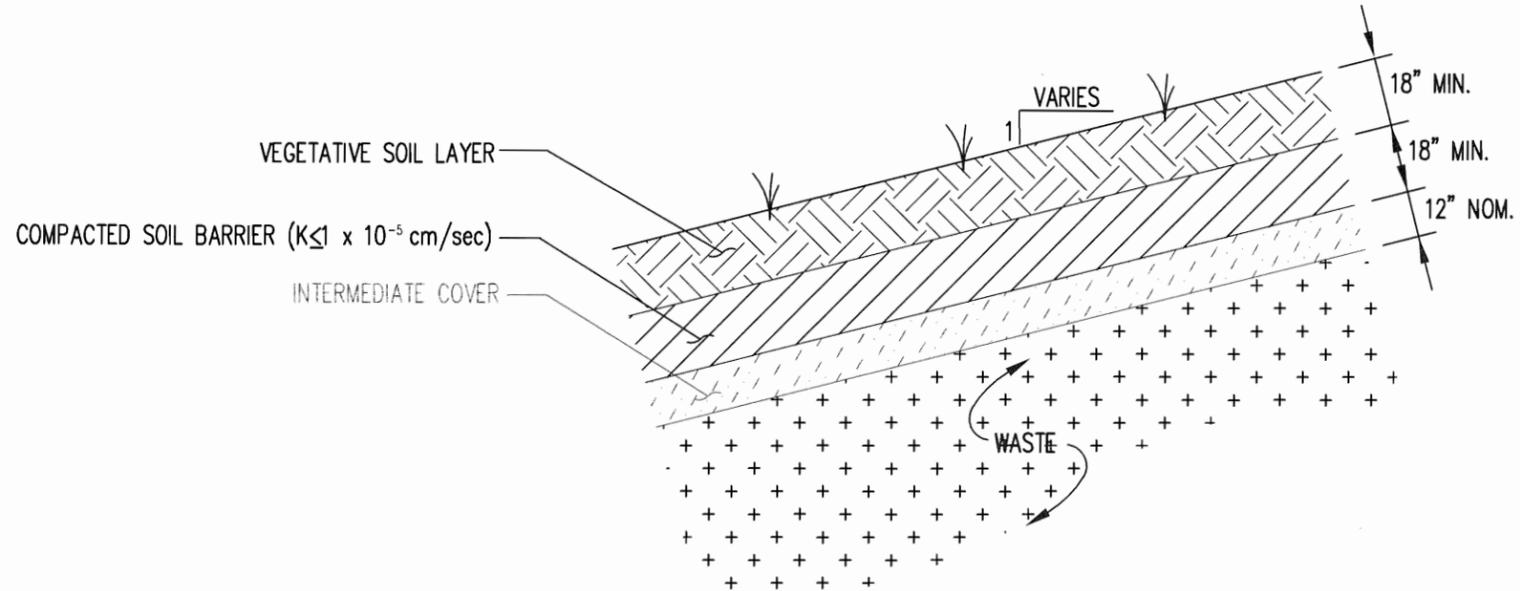
TYPICAL LANDFILL GAS WELL

DETAILS
NOT TO SCALE

2
FIG.2

NOTES:

1. AS AN ALTERNATIVE TO WELLS, GAS COLLECTION TRENCHES MAY BE INSTALLED JUST BELOW THE FINAL COVER. TRENCHES SHALL CONSIST OF PERFORATED PIPE BEDDED IN NO. 57 STONE AND WRAPPED IN A NONWOVEN GEOTEXTILE. TRENCHES SHALL HAVE NOMINAL SIZE OF 6' WIDE x 20' LONG x 2' DEEP.



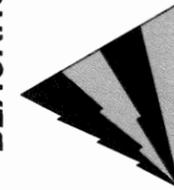
FINAL COVER SYSTEM

DETAILS
NOT TO SCALE

1
FIG.2

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FIGURE NO.

2

SCALE:

AS SHOWN

CHECKED BY:

PROJECT NO.

DRAWN BY:

J.A.L.

DATE:

Nov. 2009

WESTSIDE 08-1

FILE NAME

WESTSIDE-B0002

WILSON COUNTY
WESTSIDE C&D LANDFILL
DETAILS

TITLE: