

5101Permit1998 - Batch No. ___

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51011998

NORTH CAROLINA DEPARTMENT OF
ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF WASTE MANAGEMENT

December 22, 1998



JAMES B. HUNT JR.
GOVERNOR

Mr. Haywood Phthisic, Director
Johnston County Public Utilities
P.O. Box 2263
Smithfield, North Carolina 27577

WAYNE MCDEVITT
SECRETARY

Subject: Johnston County MSWLF Facility Transition Plan Modification for Permit
#51-01: Modification #1.

WILLIAM L. MEYER
DIRECTOR

Dear Mr. Phthisic:

The Solid Waste Section hereby approves the modification of the referenced MSWLF Facility permit to allow the construction and operation of a CONSTRUCTION & DEMOLITION LANDFILL UNIT, Phase 4A at the Johnston County landfill. The operation of Phase 4A is effective 22 December 1998 and the operational permit for the facility will be reviewed every five years, on or before 22 December 2003 (see Condition Number 2, Page 1).

Please note operational conditions outlined on pages 1 thru five for the facility. The Waste Management Specialist for this facility is Mr. Mark Fry and he can be reached in our Fayetteville Regional Office at (910) 486-1191 Ext. 227.

If you have any questions about this approval letter, please contact me at (910) 486-1191 or James C. Coffey at (919) 733-0692 Ext. 255.

Sincerely,


Jim Barber
Eastern Area Engineer
Solid Waste Section

cc: Terry Dover

Mark Fry

Raleigh Central Office: Johnston County MSW Facility Transition Plan Permit #
51-01.

FAYETTEVILLE REGIONAL OFFICE
225 GREEN STREET, SUITE 601, FAYETTEVILLE, NC 28301-5043
PHONE 910-486-1191 FAX 910-486-1791

AN EQUAL OPPORTUNITY / AFFIRMATIVE ACTION EMPLOYER - 50% RECYCLED/10% POST-CONSUMER PAPER

PERMIT NO. 51-01
Modification dated: 12-22-98

STATE OF NORTH CAROLINA

DEPARTMENT OF ENVIRONMENT, HEALTH, AND NATURAL RESOURCES

DIVISION OF SOLID WASTE MANAGEMENT

P.O. BOX 27687 RALEIGH, NC 27611

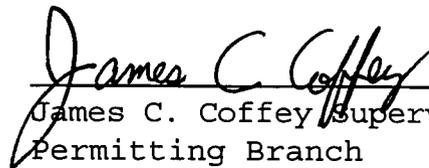
SOLID WASTE PERMIT

COUNTY OF JOHNSTON

is hereby issued a permit to operate PHASE 4A of a

Construction and Demolition Landfill Unit

located at the Johnston County Landfill at the end of S.R. 1503, Smithfield, Johnston County in accordance with Article 9, Chapter 130A, of the General Statutes of North Carolina and all rules promulgated thereunder and subject to the conditions set forth in this permit.



James C. Coffey Supervisor
Permitting Branch
Solid Waste Section

SOLID WASTE PERMIT
Permit to Operate
Johnston County Landfill
Construction and Demolition Debris Landfill Unit 4A

CONDITIONS OF PERMIT:

GENERAL

1. When this property is sold, leased, conveyed or transferred, the deed or other instrument of transfer shall contain in the description section in no smaller type than that used in the body of the deed or instrument, a statement that the property has been used as a sanitary landfill.
2. This permit will be subject to review every five years, on or before 22 December 2003, as per 15A NCAC 13B .0201(c) or sooner, according to the issuance date of this permit. Modifications to the facility may be required in accordance with rules in effect at the time of review.
3. The approved plan is described by Attachment 1, "List of Documents for Approved Plan". Where discrepancies may exist, the most recent submittal and the Conditions of Permit shall govern. Some components of the approved plan are reiterated in the Conditions of Permit.
4. This permit is not transferable.
5. The Financial Assurance Instrument (FAI) for this facility shall be amended when Closure Certification has been complete and the Closure/Post-Closure Care portion of the instrument is amended. The FAI shall be reviewed and updated annually for this facility once closure of the MSW unit is complete.
6. If during the operational life of the C&D unit it becomes apparent that the operations at the facility are impacting ground water adversely; the Solid Waste Section will require landfilling activities to cease and closure of the operating unit.

CONSTRUCTION AND OPERATION

1. This permit is for development of the Johnston County Landfill Construction and Demolition Unit, Phase 4A, in accordance with sheet S-2, P-1 and P-2 of the approved plan dated 10 December 1998.
2. This solid waste management facility is permitted to receive the following waste types:
 - a. Land-clearing debris as defined in G.S. 130A-290, specifically, solid waste which is generated solely from land-clearing activities, such as stumps, trees, etc.;
 - b. Inert debris defined as solid waste which consists solely of material that is virtually inert, such as brick, concrete, rock and clean soil; and
 - c. Asphalt in accordance with G.S. 130-294(m).
 - d. Construction and demolition debris defined as solid waste resulting solely from construction, remodeling, repair or demolition operations on pavement, buildings, or other structures.
 - e. C&D like waste that are similar to wastes typically found in the land clearing-inert debris and C&D waste streams consisting of wastes at this time: roofing shingle waste from the manufacturer, waste building materials from mobile home/modular home manufacturer and wooden pallets. Other wastes **MAY** be approved by the Division upon receipt of a written request with the specific waste type, how its generated, how much is generated; along with any additional information the Division may request to render a final decision on the disposal options for the waste. Yard trash as defined in G.S. 130A-290, shall not be disposed in the landfill area. However, yard trash, along with land-clearing debris, may be accepted for processing in the Yard Waste Composting Area.
3. All sedimentation/erosion control activities will be conducted in accordance with the Sedimentation Control Act codified at 15 NCAC 4. Native vegetation shall be established on the completed landfill.
4. The following requirements shall be met prior to operation of Phase 4A at this facility:

- a. Site preparation and or closure of that area of the MSW unit shall be in accordance with the transition and/or approved construction plans.
 - b. Signs shall be posted at the facility in accordance with the Access and Safety Requirements under Operation Condition No. 5 listed below.
 - c. The existing groundwater monitoring system will be utilized for ground water monitoring for the C&D unit(s) in accordance with .1630 thru .1633. Assessment monitoring shall continue in accordance with Solid Waste Management Rules and any additional requirements set forth by Solid Waste Section Hydrogeologist.
 - d. Closure certification and documentation shall be submitted to the Solid Waste Section and approved by the Section prior to receiving C&D waste in the proposed unit(s). This information is provided by letter dated 21 December 1998 in the revised application prepared by G.N. Richardson & Assoc.. Partial closure of units will be accepted with certification and documentation of partial unit closure submitted for approval. Seeding and stabilization of cover soils shall be performed prior to receiving C&D waste.
 - e. The **SOUTH** and **EAST** limits of Phase 4A shall be staked/flagged in the field for visual operating reference and shall be maintained.
5. Operation of the C&D landfill units shall conform to the operating procedures described in the approved plan, in accordance with Section .1626 of the Solid Waste Management Rules, and in accordance with the following requirements:

Waste Acceptance and Disposal

- a. The facility shall accept only those solid wastes which it is permitted to receive.
- b. No municipal solid waste, hazardous waste, industrial waste, liquid waste or waste not characterized as LCID or C&D shall be accepted for disposal.
- c. The permittee shall implement a program at the facility for detecting and preventing the disposal wastes listed in item "b" of this section. The program shall include, at a minimum:
 - (i) Random inspections of incoming loads or other comparable procedures:

- (ii) Records of any inspections;
- (iii) Training of personnel to recognize hazardous and liquid wastes;
- (iv) Development of a contingency plan to properly manage any identified wastes listed in item "b" of this section; the plan must address identification, removal, storage, and final disposition of waste.

Cover Material Requirements

- a. Operational soil cover of at least six inches shall be placed at least once per week or when the active area reaches 1/2 acre in size or more often as necessitated by the nature of the waste so as to prevent the site from becoming a visual nuisance and to prevent fire, windblown materials, vectors or water infiltration.
- b. Areas which will not have additional waste placed on them for 12 months or more, but where final termination of operations has not occurred, shall be covered with a minimum of one foot of soil cover.
- c. After final termination of disposal operations at the site or major part thereof, or upon revocation of a permit, the fill areas shall be covered with a cap in accordance with .1627(c) or in accordance with the rules at the time of closure.

Access and Safety

- a. The facility shall be adequately secured by means of gates, chains, berms, fences, or other security measures approved by the DSWM to prevent unauthorized entry.
- b. An attendant shall be on duty at the site at all times while it is open for public use to ensure compliance with operational requirements.
- c. The access road to the site shall be of all-weather construction and maintained in good condition.
- d. Dust control measures shall be implemented when necessary.
- e. Signs providing information on dumping procedures, the hours of operation, the permit number, and other pertinent information shall be posted at the site entrance.
- f. Signs shall be posted stating that no MSW, hazardous waste or liquid waste can be received.

- g. Traffic signs or markers shall be provided as necessary to promote an orderly traffic pattern to and from the discharge area and to maintain efficient operating conditions.
- h. The removal of solid waste from the facility is prohibited unless the owner/operator approves and the removal is not performed on the working face.
- i. Barrels and drums shall not be disposed of unless they are empty and perforated sufficiently to ensure that no liquid or hazardous waste is contained therein, except fiber drums containing asbestos.
- j. Open burning of solid waste is prohibited.
- k. The concentration of explosive gases generated at the facility shall not exceed:
 - i. twenty-five percent of the limit for gases in site structures (excluding gas control or recovery system components; and
 - ii. the lower explosive limit for gases at the facility boundary.

Erosion and Sedimentation Control

- a. Adequate sedimentation and erosion control measures shall be practiced to prevent silt from leaving the site.
- b. Adequate sedimentation and erosion control measures shall be practiced to prevent excessive on-site erosion.
- c. Provisions for a vegetative ground cover sufficient to restrain erosion must be accomplished within 30 working days or 120 calendar days upon completion of any phase of C&D landfill development.

Drainage Control and Water Protection Requirements

- a. Surface water shall be diverted from the operational area.
- b. Surface water shall not be impounded over or in waste.
- c. A separation distance of at least four feet shall be maintained between waste and the ground-water table.
- d. Solid waste shall not be disposed of in water.
- e. Leachate shall be contained on site or properly treated prior to discharge. An NPDES permit may be required prior to discharge of leachate to surface waters.

All pertinent landfill operating personnel will receive training and supervision necessary to properly operate this landfill.

6. Ground water quality at this facility is subject to the classification and remedial action provisions referenced in Rule .1634 thru .1637 of 15A NCAC 13B.
7. A closure and post-closure plan must be submitted for approval at least 90 days prior to closure or partial closure of any landfill unit. The plan must include all steps and measures necessary to close and maintain the facility in accordance with all rules in effect at that time. At a minimum, the plan shall address the following:
 - a. Design of a final cover system; using the cap requirements outlined in Rule .1627
 - b. Construction and maintenance/operation of the final cover system and erosion control structures;
 - c. Surface water, ground water, and explosive gas monitoring.

MONITORING AND REPORTING REQUIREMENTS

1. Ground-water monitoring wells and monitoring requirements for the C&D landfill units shall be in accordance with the monitoring system approved in the TRANSITION PLAN for the facility and these additional conditions:
 - a. Monitoring well design and construction shall conform to the specifications outlined in Attachment 2, "North Carolina Water Quality Monitoring Guidance Document for Solid Waste Facilities".
 - b. A geologist shall be in the field to supervise well installation, if necessary. The exact locations, screened intervals, and nesting of the wells shall be established after consultation with the SWS Hydrogeologist at the time of well installation for new monitoring wells.
 - c. For each new monitoring well constructed, a well completion record shall be submitted to DSWM within 30 days upon completion.

- d. Sampling equipment, procedures, and parameters shall conform to specifications outlined in the above-referenced guidance document, (Attachment 2), or the current guidelines established by DSWM at the time of sampling and in accordance with the approved TRANSITION PLAN OR ASSESSMENT AND REMEDIATION PLAN.
 - e. In order to determine ground-water flow directions and rates, each monitoring well shall be surveyed, and hydraulic conductivity values and effective porosity values shall be established for the screened intervals for each new monitoring well.
 - f. The permittee shall sample the monitoring wells semi-annually or as directed by the SWS Hydrogeologist.
 - g. A readily accessible unobstructed path shall be initially cleared and maintained so that four-wheel drive vehicles may access the monitoring wells at all times.
2. The permittee shall maintain a record of all monitoring events and analytical data. Reports of the analytical data for each water quality monitoring sampling event shall be submitted to DSWM in a timely manner.
 3. The permittee shall maintain a record of the amount of solid waste received at the facility, compiled on a monthly basis. Scales shall be used to weigh the amount of waste received.
 4. On or before 01 August 98 (or an earlier date as requested by the Solid Waste Section), and each year thereafter, the permittee shall report the amount of waste received (in tons) at this facility and disposed of in the landfill to the Solid Waste Section and to all counties from which waste was accepted, on forms prescribed by the Section. This report shall include the following information:
 - a. The reporting period shall be for the previous year, beginning 01 July and ending on 30 June;
 - b. The amount of waste received and landfilled in tons, compiled on a monthly basis, according to Condition 6 described above; and
 - c. Documentation that a copy of the report has been forwarded to all counties from which waste was accepted.

5. All records shall be maintained on-site and made available to the SWS upon request.
6. The Post-Closure plan approved in the TRANSITION PLAN shall be implemented and followed upon capping and closing the operating unit(s).

ATTACHMENT 1

List of Additional Documents for the Approved Transition Plan

1. Site and Construction Transition Plan modification application for the Johnston County Landfill, Permit # 51-01. Document titled Johnston County C&D Landfill Vertical Expansion, Transition Plan Amendment for Construction and Demolition Landfill Operations, dated December 1998.

2. Cap Closure Certification Letter for the Johnston County Landfill dated 21 December 1998 by G.N. Richardson & Associates and received 22 December 1998 and incorporated into the approved application.

NORTH CAROLINA DEPARTMENT OF
ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF WASTE MANAGEMENT



JAMES B. HUNT JR.
GOVERNOR

WAYNE McDEVITT
SECRETARY

WILLIAM L. MEYER
DIRECTOR

December 3, 1998

Mr. Haywood Phthisic
Johnston County Director of Public Utilities
P.O. Box 2263
Smithfield, N.C. 27577

Re: Approval of the Proposed Phase I Groundwater Assessment at the
Johnston County Landfill (Permit #51-01).

Dear Mr. Phthisic,

The phase I water quality assessment plan submitted on behalf of Johnston County by G.N. Richardson & Associates, Inc. is approved for implementation. This approval is for the phase I water quality assessment only and does not consider future assessment phases or corrective action/site restoration proposals. The site assessment and subsequent corrective action/site restoration is subject to the requirements of the 15A NCAC 13B .1600 regulations.

The proposed field work and subsequent report shall be due April 30, 1999. Thank you for your prompt attention to these matters. If you have any questions, please contact Mark Poindexter at (919) 733-0692, extension 261.

Sincerely,

Philip Prete, Head
Field Operations Branch
Solid Waste Section

c: Mark Poindexter
Terry Dover
Mark Fry
central file

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**NORTH CAROLINA DEPARTMENT OF
ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF WASTE MANAGEMENT**



August 4, 1998

**JAMES B. HUNT JR.
GOVERNOR**

Pieter K. Scheer, P.E.
G.N. Richardson & Associates
425 N. Boylan Avenue
Raleigh, North Carolina 27603

**WAYNE McDEVITT
SECRETARY**

Re: Permit Modification - Proposed Alternative Cap Design;
Johnston County Landfill, Permit # 51-01

**WILLIAM L. MEYER
DIRECTOR**

Mr. Scheer:

The Solid Waste Section(Section) has received the proposed alternative cap design for the Johnston County Landfill(Phases I/II, III, & IV) dated 29 July 1998. In accordance with North Carolina General Statutes 130A-294 and North Carolina Solid Waste Management Rules, 15A NCAC 13B .1603(a)(3A), a modification to the permit is hereby approved for the proposed installation of the alternative cap system at the above referenced facility in accordance with your report dated 29 July 1998. Please provide a revised Landfill Cap Closure Specification, prior to installation, for the testing/sampling of the light geomembranes and GCL to be installed.

This approval is for the installation of a light geomembrane on the flat(5% or less) portions of the facility (Phases I/II and IV) and a GCL on the top portion of Phase III(consisting of a slope of 3%). A soil component will be used on the facility side slopes of 25% and the soil having a permeability ranging from 1 to 5×10^{-4} cm/sec. Following installation of the cap system, submit a construction quality assurance certification report in accordance with Rule .1624(b)(15). Please note that the use of the proposed alternate cap system today will not relieve Johnston County of the responsibility of installing additional cap system(s) based on results of on-going and future groundwater investigations and assessments.

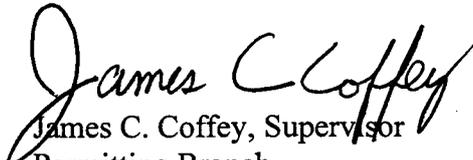
**FAYETTEVILLE REGIONAL OFFICE
225 GREEN STREET, SUITE 601, FAYETTEVILLE, NC 28301-5043
PHONE 910-486-1191 FAX 910-486-1791**

AN EQUAL OPPORTUNITY / AFFIRMATIVE ACTION EMPLOYER - 50% RECYCLED/10% POST-CONSUMER PAPER

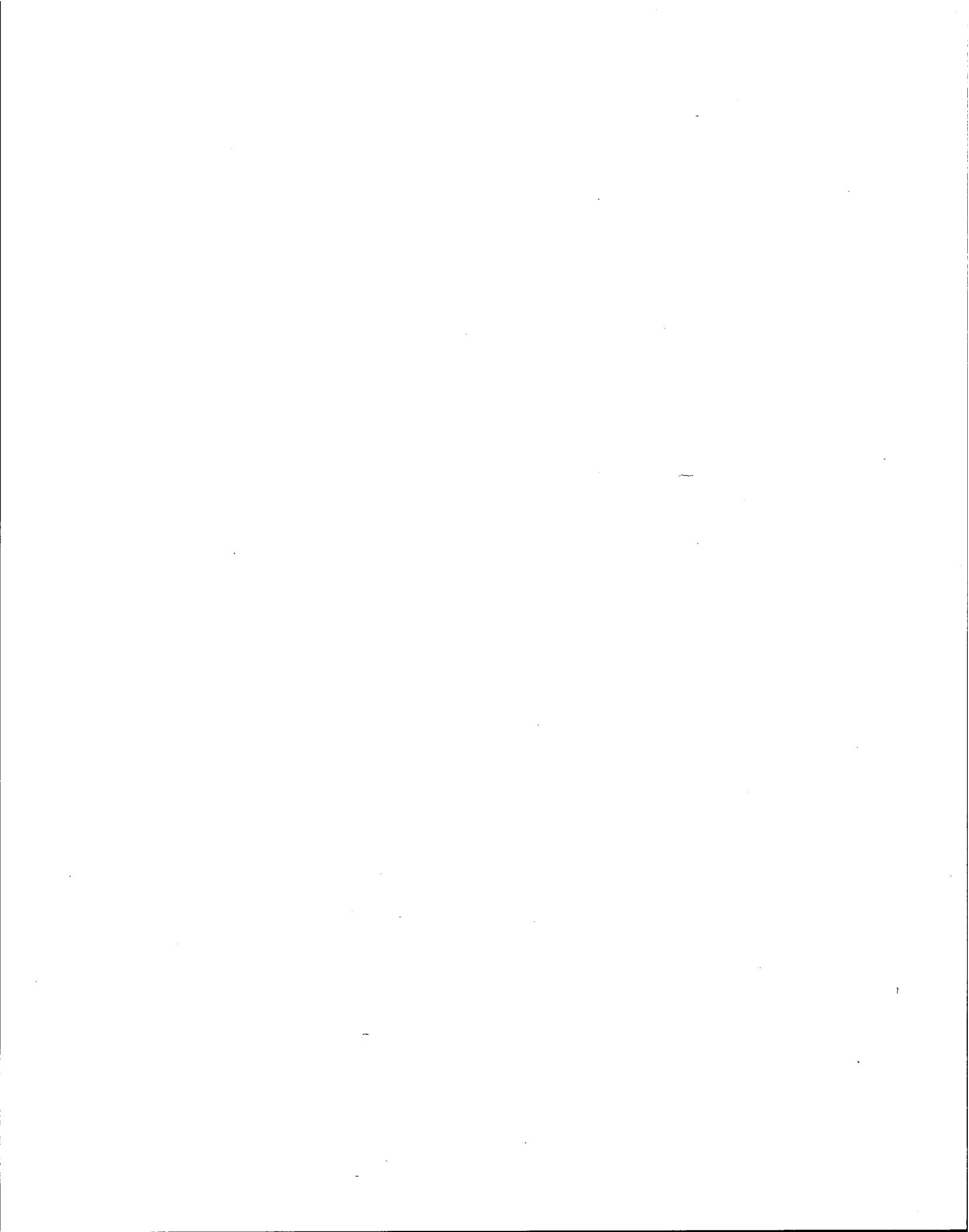
Mr. Scheer
Page 2
August 4, 1998

If you have any questions or comments, please contact Jim Barber at (910) 486-1191, ext. 225.

Sincerely,


James C. Coffey, Supervisor
Permitting Branch
Solid Waste Section

cc: Terry Dover
Jim Barber
Ben Barnes
✓ Raleigh Central Files: Johnston County Transition Plan; Permit #51-01



-Booklet-

51-01

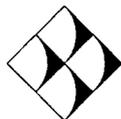
Technical Specifications

**Johnston County
MSW Landfill Closure**

Prepared for:
Johnston County Public Utilities
Smithfield, NC

August 1998

BID ISSUE DOCUMENTS



G.N. Richardson & Associates, Inc.
Engineering and Geological Services
425 N. Boylan Avenue
Raleigh, North Carolina 27603

**JOHNSTON COUNTY
MSW LANDFILL CLOSURE
TECHNICAL SPECIFICATIONS**

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02270	Erosion and Sedimentation Control
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02781	Cover Geomembrane
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 borrow operations, subgrade preparation, and the construction of erosion control features.

A. DESCRIPTION

1. General:

The Contractor shall furnish all labor, material, and equipment required to complete Excavation 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
Compacted Soil Barrier	02252
Erosion and Sedimentation Control	02270
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 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. 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.
- d. 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 as outlined in Section 02270, Erosion and Sedimentation Control, of these Specifications.
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 overexcavation.

3. Stockpiling:

The Contractor shall stockpile the materials in appropriate stockpiles as approved by the CQA Engineer. The Contractor shall use equipment and methods as necessary to maintain the moisture content of soils stockpiled (excluding topsoil) at or near their optimum moisture content.

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 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. 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 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. 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.

E. MEASUREMENT AND PAYMENT

All work required for Excavation shall be considered incidental to the other pay items in this contract and no separate measurement or payment will be made.

All work required for Additional Excavation provided outside the scope of this Contract and at the direction of the Engineer, shall be included for payment in the Contractor's Unit Price Bid for Miscellaneous Item 1, per cubic yard excavated.

END OF SECTION

SECTION 02223

EMBANKMENT

Embankment: Embankment is the on-site compacted fill that provides the berms for some erosion control features. Areas defined as Embankment are indicated on the Contract Drawings.

A. DESCRIPTION

1. General:

The Contractor shall furnish all labor, material, and equipment to complete Embankment including 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
Erosion and Sedimentation Control	02270
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.
ASTM D 1556	Test for Density of Soil in Place by the Sand-Cone Method.
ASTM D 2167	Test for Density of Soil in Place by the Rubber-Balloon Method.
ASTM D 2216	Standard Test Method for Laboratory Determination of Water Content of Soil and Rock.

ASTM D 2488	Standard Practice for Description and Identification of Soils.
ASTM D 2922	Test for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
ASTM D 2937	Standard Test Method for Density of Soil in Place by the Drive Cylinder Method.

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 subgrade and berms. Work for Embankment shall also include 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 shall be (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 SM, SP, SC, ML, MH, CL-ML, CL or CH (ASTM D 2488) containing no topsoil or other deleterious material.
- 2. Stones or rock fragments shall not exceed one half the maximum lift thickness as compacted 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 and appurtenant structures.

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 as outlined in Section 02270, Erosion and Sedimentation Control, of these Specifications.
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 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.

E. MEASUREMENT AND PAYMENT

All work required for Embankment shall be considered incidental to the other pay items in this contract and no separate measurement or payment will be made.

All work required for Additional Embankment provided outside the scope of this Contract and at the direction of the Engineer, shall be included for payment in the Contractor's Unit Price Bid for Miscellaneous Item 2, per cubic yard in-place.

TABLE 1: REQUIRED EMBANKMENT PROPERTIES

ITEM	Required % Standard Proctor (ASTM D698)	Maximum Lift Thickness (Loose) (inches)
Embankment	95	8
Unclassified Fill	N/A	N/A

END OF SECTION

SECTION 02240

GEOTEXTILES

Geotextiles: For the proposed construction, a Type GT-S (Separator/Filter) Geotextile is specified. The Type GT-S Geotextile will be placed in some erosion control and drainage applications and as a separator material in Landfill Gas Vents.

A. DESCRIPTION

1. General:

The Contractor shall furnish all labor, material, and equipment to complete installation of Geotextiles including all necessary and incidental items as detailed or required for the Contractor to complete the installation in accordance with the Contract Drawings and these Specifications, except as noted below:

- a. Geotextiles used as a Silt Fence is covered under Section 02270, Erosion and Sedimentation Control, of these Specifications.

2. Related Work:

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

<u>Work</u>	<u>Section</u>
Erosion and Sedimentation Control	02270
Geonet Drainage Media	02712
Landfill Gas Vents	13250

3. Reference Standards:

The latest revision of the following standards of the American Society of Testing and Materials (ASTM) and the American Association of State Highway and Transportation Officials (AASHTO) are hereby made a part of these specifications.

ASTM D 3786 Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics: Diaphragm Bursting Strength Tester Method.

ASTM D 4355 Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus).

ASTM D 4491	Test Methods for Water Permeability of Geotextiles by Permittivity.
ASTM D 4533	Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
ASTM D 4632	Test Method for Grab Breaking Load and Elongation of Geotextile.
ASTM D 4751	Test Method for Determining Apparent Opening Size of a Geotextile.
ASTM D 4833	Test Methods for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
ASTM D 5261	Standard Test Method for Measuring Mass per Unit Area of Geotextiles.
AASHTO M 288	Standard Specification for Geotextiles.

4. Quality Assurance:

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

B. MATERIALS

1. General:

The materials supplied under these Specifications shall consist of new, first-quality products designed and manufactured specifically for the purpose of this work, which shall have been satisfactorily demonstrated, by prior use, to be suitable and durable for such purposes.

Labels on each roll of Geotextile shall identify the length, width, lot and roll numbers, and name of Manufacturer.

2. The Type GT-S Geotextile shall be a woven, nonwoven spunbonded, or nonwoven needlepunched synthetic fabric consisting of polyester or polypropylene manufactured in a manner approved by the Engineer and the Owner.

3. All Geotextiles shall conform to the properties listed in Table 1 of this section.

C. SUBMITTALS

The Contractor shall submit the following to the CQA Engineer:

1. Mill Certificate and Sample: Prior to shipping to the site, the Contractor shall submit one copy of a mill certificate or affidavit signed by a legally authorized official of the Manufacturer for each type of Geotextile attesting that the Geotextiles meet the physical and manufacturing requirements stated in these Specifications. The Contractor shall also submit a sample (4" x 6") of each Geotextile to be used. The samples shall be labeled with the product name and be accompanied by the Manufacturer's specifications.
2. Furnish copies of the delivery tickets or other approved receipts as evidence for materials received that will be incorporated into the construction.

D. CONSTRUCTION

1. Shipping, Handling, and Storage:

All Geotextiles shall be shipped, handled, and stored in strict accordance with the Manufacturer's recommendations.

2. Installation of Geotextiles:

- a. The surface receiving the Geotextiles shall be prepared to a relatively smooth condition, free of obstructions, excessive depressions, debris, and very soft or loose pockets of soil. This surface shall be approved by the CQA Engineer prior to Geotextile placement.
- b. Geotextiles shall be placed to the lines and grades shown on the Contract Drawings. At the time of installation, Geotextiles shall be rejected by the CQA Engineer if they have defects, rips, holes, flaws, evidence of deterioration, or other damage.
- c. The Geotextiles shall be placed smooth and free of excessive wrinkles.
- d. On slopes, Geotextiles shall be anchored at the top and unrolled down the slope. In the presence of wind, all Geotextiles shall be weighted with sandbags or other material as approved by the CQA Engineer. Geotextiles uplifted by wind may be reused upon approval by the CQA Engineer.

3. Seams:

- a. All Geotextile seams shall be overlapped at least 18 inches.
- b. Alternately, the Contractor may sew or heat bond adjacent panels with methods approved by the Engineer.

4. Repair Procedures:

Any Geotextile that is torn or punctured shall be repaired or replaced, as directed by the CQA Engineer, by the Contractor at no additional cost to the Owner. The repair shall consist of a patch of the same type of Geotextile placed over the failed areas and shall overlap the existing Geotextile a minimum of 18 inches from any point of the rupture. Patches shall be spot sewn or tacked so as not to shift during cover placement.

5. Cover Placement:

Placement of cover over Geotextiles shall be performed in a manner as to ensure that the Geotextiles are not damaged. Cover material shall be placed such that excess tensile stress is not mobilized in the Geotextile.

E. MEASUREMENT AND PAYMENT

All work required for Geotextiles shall be considered incidental to the other pay items in this contract and no separate measurement or payment will be made.

All work required for Additional Type GT-S Geotextile provided outside the scope of this Contract and at the direction of the Engineer, shall be included for payment in the Contractor's Unit Price Bid for Miscellaneous Item 3, per square yard installed.

TABLE 1: REQUIRED GEOTEXTILE PROPERTIES

PROPERTY	TEST METHOD	UNITS	VALUE ¹
			TYPE GT-S
Geotextile Construction (NW = Nonwoven) (W = Woven)	-----	-----	NW ² or W ³
Mass per Unit Area (Unit Weight)	ASTM D 5261	oz/yd ²	N/A
Ultraviolet Resistance (500 hrs)	ASTM D 4355	%	70
Grab Tensile Strength	ASTM D 4632	lbs	160 (NW) 250 (W)
Grab Tensile Elongation	ASTM D 4632	%	≥ 50 (NW) < 50 (W)
Trapezoidal Tear Strength	ASTM D 4533	lbs	55 (NW) 90 (W)
Puncture Resistance	ASTM D 4833	lbs	55 (NW) 90 (W)
Burst Strength	ASTM D 3786	psi	200 (NW) 400 (W)
Apparent Opening Size (AOS)	ASTM D 4751	U.S. Sieve	70+
Permittivity	ASTM D 4491	sec ⁻¹	1.0

Notes:

1. Minimum Average Roll Value (MARV).
2. Nonwoven geotextiles that have been heat calendered are not acceptable.
3. Woven geotextiles formed exclusively with slit film fibers are not acceptable.

END OF SECTION

SECTION 02252

COMPACTED SOIL BARRIER

Compacted Soil Barrier (CSB): The Compacted Soil Barrier is used as an infiltration barrier in the final cover system on the Phase 3 side slopes. Compacted on-site soils will be used for CSB such that the compacted permeability of the layer is $\leq 5 \times 10^{-4}$ cm/sec.

A. DESCRIPTION

1. General:

The Contractor shall furnish all labor, material, and equipment to complete installation of the CSB for the landfill cover, including hauling, screening, discing, compacting, drying, removal of rainfall and removal of all previously placed material unsuitable due to weather conditions, final grading and sealing and all necessary and incidental items as detailed or required to complete the CSB, 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>
Vegetative Soil Layer	02258
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 422	Standard Test Method for Particle Size Analysis of Soils.
ASTM D 698	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort.
ASTM D 2216	Standard Test Method for Laboratory Determination of Water Content of Soil and Rock.
ASTM D 2488	Standard Practice for Description and Identification of Soils.

ASTM D 2922	Test for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
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 5084	Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Material Using a Flexible Wall Permeameter.

4. Quality Assurance:

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

B. MATERIALS

All material for CSB 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 CSB.

D. CONSTRUCTION

1. General:

- a. All placement and compaction of CSB 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 CSB to a minimum thickness of 18 inches and to the lines and grades shown on the Contract Drawings with the exception that a 2 inch overbuild at the Contractor's expense is allowed. The Contractor will perform all surveys necessary to establish and verify lines and grades for all CSB.

2. Test Fill Construction:

The Contractor shall construct a test fill prior to construction of CSB. The test fill shall be at least 20 feet wide by 50 feet long and consist of at least three compacted lifts. The Contractor shall use materials and equipment for test fill construction that the Contractor intends to use during construction.

No CSB 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 CSB in these Specifications at no cost to the Owner.

3. Subgrade Preparation:

- a. The Contractor shall remove all vegetation, debris, large rocks (> 6"), and other deleterious materials from the existing intermediate cover surface and grade the surface evenly, removing existing ruts and erosion rills, prior to placement of CSB. The Contractor shall dispose of removed materials on-site where directed by the Engineer.
- b. Surfaces on which CSB is to be placed, shall be scarified or stepped in a manner which will permit bonding of the CSB with the existing surface.
- c. The CQA Engineer shall inspect the exposed subgrade prior to placement of CSB to assure that the surface has been adequately prepared.

4. Placement and Compaction:

- a. Prior to compaction, each lift of select soil fill material shall be thoroughly disced. Equipment or truck trafficking of the surface shall not be permitted during the period between scarifying and placement of the following lift.
- b. After scarifying, representative samples will be taken by the CQA Engineer and tested for moisture content prior to any compactive efforts. If the moisture content is within the range specified below, compaction may begin. If the moisture content is outside of this range, the select soil fill will be wetted or dried and reworked accordingly.
- c. Each lift will be thoroughly compacted and must satisfy moisture and density controls through field testing before a subsequent lift is placed.
- d. Compaction of lifts shall be as follows:
 - (1) All CSB shall be placed in loose lifts no greater than the height of

the feet on the compaction equipment to be used.

- (2) Compaction of lifts shall be performed with an appropriately heavy, properly ballasted penetrating-foot compactor (such as a CAT 815 or equivalent). Compaction equipment shall be the same as used in the test fill.
 - (3) The daily work area shall extend a distance no greater than necessary to maintain moist soil conditions (facilitate bonding) and continuous operations. Desiccation and crusting of the lift surface shall be avoided as much as possible.
 - (4) If desiccation and crusting of the lift surface occurs before placement of the next lift, this area shall be sprinkled with water and then scarified and tested for water content to ensure uniform moisture before placement of a subsequent lift.
 - (5) Transition from full depth cover to beginning of adjacent new section shall be accomplished by sloping (cutting back) the end of a full depth section at 5H:1V (horizontal to vertical) or flatter for tying in a new lift.
 - (6) Dozer or scraper equipment shall not be used for primary compaction efforts.
- e. The in-place CSB shall conform to the requirements shown in Table 2 of this section. If CSB does not meet the above specified requirements, the Contractor shall rework the material, as may be necessary and continue compaction to achieve these requirements at his own expense, or remove and replace the material to achieve the specified requirements, at Contractor's expense.
 - f. No CSB shall be placed or compacted when the soil temperatures are so low as to produce ice lenses in the CSB borrow soil.
 - g. During construction, finished lifts or sections of CSB must be sprinkled with water as needed to prevent drying and desiccation.
 - h. The exposed surface of CSB shall be protected from adverse weather conditions or desiccation of the clay. This is commonly done by rolling the surface of the CSB with a smooth-drum roller at the end of each work day. Alternative means of protecting the CSB may be employed by the Contractor.
5. After the specified thickness has been achieved and verified by the CQA Engineer and passing CQA tests have been achieved, the Contractor shall proceed

immediately with the placement of the Vegetative Soil Layer.

E. MEASUREMENT AND PAYMENT

All work required for Compacted Soil Barrier - Phase 3 shall be included for payment in the Contractor's Lump Sum Price for Item 3.0, wherein no measurement will be made.

All work required for Additional Compacted Soil Barrier provided outside the scope of this Contract and at the direction of the Engineer, shall be included for payment in the Contractor's Unit Price Bid for Miscellaneous Item 4, per cubic yard in-place.

TABLE 1: COMPACTED SOIL BARRIER MATERIAL REQUIREMENTS

PROPERTY	TEST METHOD	VALUE ³
Visual Classification	ASTM D 2488	Clean natural fine-grained soil free from organics, debris, or other detrimental material. USCS Classification CL, CH, MH, ML, CH-MH, or CL-ML
Clod Size	-----	Maximum = 3/4 inch
Gradation	ASTM D 422	≥ 30% Passing No. 200 U.S. Standard Sieve Max. = 1-1/2 inches
Coefficient of Permeability - Lab Remolded	ASTM D 5084 ²	≤ 5 x 10 ⁻⁴ cm/s at a density of ≥ 95% Maximum Standard dry density and a moisture content 0 to 4 percent wet of optimum

TABLE 2: IN-PLACE COMPACTED SOIL BARRIER REQUIREMENTS

PROPERTY	TEST METHOD	VALUE ³
Moisture Content	ASTM D 2216	0 to 4 percent wet of optimum
Density	ASTM D 2922 ¹	≥ 95% Maximum Standard dry density
In-Place Coefficient of Permeability (Shelby Tube)	ASTM D 5084 ²	≤ 5 x 10 ⁻⁴ cm/s
Thickness	Hand Auger	18 inches minimum (2 inch overbuild allowed)

Notes:

1. Optionally use ASTM D 1556, ASTM D 2167, or ASTM D 2937.
2. Maximum Effective Confining Pressure of 5 psi.
3. The Engineer may allow variances to these values such that the required permeability and thickness values are met.

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. This section includes the topsoil to be placed as the upper 6 inches of the VSL.

A. DESCRIPTION

1. General:

The Contractor shall furnish all labor, material, and equipment to complete installation of the VSL (including topsoil) for the landfill cover, including 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>
Compacted Soil Barrier	02252
Geonet Drainage Media	02712
Geosynthetic Clay Liner	02776
Cover Geomembrane	02781
Revegetation	02930

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 2488	Standard Practice for Description and Identification of Soils.
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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 shall be classified according to the Unified Soil Classification System

(USCS) as SM, SC, ML, MH, CL-ML, or CL (ASTM D 2488).

2. Select soil fill materials shall be reasonably free of gypsum, ferrous, and/or calcareous concretions and nodules, refuse, roots, or other deleterious substances.
3. Continuous and repeated visual inspection of the materials being used will be performed by the Contractor to ensure proper soils are being used. In addition, the CQA Engineer shall make frequent inspections of the placement operations and materials, and will consult with the Engineer.
4. The VSL shall be uniform, smooth, and free of debris, rock, plant materials, and other foreign material larger than 3 inches in diameter for Phase 3 areas and 0.5 inches for Phases 1 & 2 and 4. The material should contain no sharp edges. This material must be capable of supporting growth of vegetative cover.
5. Placement of Vegetative Soil Layer over Geosynthetics:
 - a. VSL shall be placed over geosynthetics only after areas have been released by the Geosynthetics Installer and the CQA Engineer. VSL shall be placed as specified below:
 - (1) VSL shall be placed and spread with low ground pressure equipment (6 psi ground pressure or less) as approved by the CQA Engineer to reduce potential damage to the underlying geosynthetics. The surface of geosynthetics shall be off-limits to construction traffic. The Contractor shall place plastic traffic cones or other marker approved by the CQA Engineer on 100 foot centers to monitor thickness during placement.
 - (2) Low ground pressure equipment used to spread VSL shall operate on at least 1 foot of material overlying geosynthetics and/or piping. Sharp turning of tracked equipment on the VSL will not be permitted.
 - b. The VSL shall be spread in a manner that minimizes development of folds in the Cover Geomembrane (Phases 1 & 2 and 4). Any portions of the Geomembrane that develop crimp shall be repaired by the Geomembrane Installer at no expense to the Owner.
 - c. If during spreading, excessive wrinkles develop, the Contractor shall adjust placement and spreading methods, or cease until the Geomembrane cools and wrinkles decrease in size.
 - d. Stockpiling of VSL within the limits of the geosynthetics shall be subject to advance approval by the Engineer. Any hauling equipment (dump trucks, etc.) operating within the containment area shall have a minimum

of 3 feet of separation between the vehicle wheels and the Geomembrane.

- e. The Contractor shall minimize equipment operations directly over coarse aggregate and piping.
 - f. The CQA Engineer may require removal of VSL and/or other underlying layers to allow examination of the underlying geosynthetics and/or piping. Any damage to the underlying layers during placement of VSL shall be repaired in accordance with the applicable section of these Specifications at the Contractor's sole expense.
6. Topsoil: The upper 6 inches of VSL shall contain a minimum of 2% by weight of organics evenly blended into the material in order to support the growth of vegetative cover.

For Phases 1 & 2 and 4, the Contractor shall strip, stockpile, and replace the existing upper 6 inches of topsoil and vegetation as the upper 6 inches of VSL on these areas.

7. Sludge Application: The Contractor shall apply and disc-in Owner supplied wastewater treatment plant sludge at agronomic rates over all areas covered by VSL as directed by the Engineer.

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 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 low ground pressure (less than 6 psi) tracked equipment. The CQA Engineer shall approve the equipment used to place the VSL.
 - b. VSL shall be placed to the lines and grades shown on the Contract Drawings with the exception that a 2 inch overbuild at Contractor's expense is allowed. The Contractor will perform all work necessary to establish and verify lines and grades for all VSL.

3. After the specified thickness has been achieved and verified, the Contractor shall proceed immediately with seeding.

E. MEASUREMENT AND PAYMENT

All work required for Vegetative Soil Layer - Phases 1 & 2 and 4 shall be included for payment in the Contractor's Lump Sum Price for Item 4.0, wherein no measurement will be made.

All work required for Vegetative Soil Layer - Phase 3 shall be included for payment in the Contractor's Lump Sum Price for Item 4.1, wherein no measurement will be made.

All work required for Sludge Application shall be included for payment in the Contractor's Unit Price Bid for Item 4.2, per acre (horizontal plan area) applied.

All work required for Additional Vegetative Soil Layer provided outside the scope of this Contract and at the direction of the Engineer, shall be included for payment in the Contractor's Unit Price Bid for Miscellaneous Item 5, per cubic yard in-place.

END OF SECTION

SECTION 02270

EROSION AND SEDIMENTATION CONTROL

Erosion and Sedimentation Control: Erosion and Sedimentation Control is a system of construction practices and engineered structures which act to minimize surface water induced erosion of disturbed areas and resulting sedimentation off-site.

A. DESCRIPTION

1. General:

The Contractor shall furnish all labor, material, and equipment to complete installation of and maintain Erosion and Sedimentation Control facilities and other construction 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>
Geotextiles	02240
Rip Rap	02271
Revegetation	02930

B. MATERIALS

1. Permanent Sediment Basins:

Permanent sediment basins shall be constructed as shown on the Contract Drawings.

2. Permanent Ditches, Swales, and Drainage Channels:

Permanent ditches, swales, and drainage channels shall be constructed as shown on the Contract Drawings.

3. Silt Fence:

Silt fences shall be constructed as shown on the Contract Drawings and as needed, based on the Contractor's discretion and Engineer's approval. The silt fence is a permeable barrier erected within and downgradient of small disturbed areas to

capture sediment from sheet flow. It is made of filter fabric buried at the bottom, stretched, and supported by posts and wire mesh backing. Silt fence shall conform to the following properties:

Posts: Posts shall be 3 feet long "U" or "T"-type steel or wood posts.

Filter Fabric: Filter fabric shall be a woven geotextile made specifically for sediment control. Filter fabric shall have the following minimum properties:

PROPERTY	TEST METHOD	UNITS	MINIMUM VALUE
Grab Tensile Strength	ASTM D 4632	lbs	100
Grab Elongation	ASTM D 4632	%	15
Trapezoidal Tear Strength	ASTM D 4533	lbs	50
Mullen Burst Strength	ASTM D 3786	lbs	265
Puncture Strength	ASTM D 4833	lbs	55
UV Resistance	ASTM D 4355	%	80

4. Geotextiles:

Geotextiles shall conform to the requirements outlined in Section 02240, Geotextiles, of these Specifications.

5. Filter Berms:

Filter Berms shall be constructed as shown on the Contract Drawings.

6. Rip Rap Aprons:

Rip Rap Aprons shall be constructed as shown on the Contract Drawings.

7. Rip Rap:

Rip Rap shall conform to the requirements outlined in Section 02271, Rip Rap, of these Specifications.

8. Turf Reinforcement Matting:

The matting shall consist of entangled nylon, polypropylene, or polyester monofilaments melt bonded at their intersections forming a three dimensional structure. The mat shall be crush-resistant, pliable, water-permeable, and highly resistant to chemical and environmental degradation. The matting shall also meet the following criteria:

Maximum Permissible Velocity ≥ 10 ft/sec
Maximum Permissible Shear Stress ≥ 5 lbs/ft².

Turf reinforcement matting shall be LANDLOK TRM 435, as manufactured by Synthetic Industries, or approved equal.

9. Straw With Net Temporary Erosion Control Matting:

The matting shall consist of clean wheat straw from agricultural crops made into a knitted straw mat that is machine assembled. The straw shall be evenly distributed throughout the mat. The mat shall be covered with a photodegradable synthetic mesh attached to the straw with degradable thread.

10. Other Work:

In addition to the erosion control measures shown on the Contract Drawings, the Contractor shall provide adequate means to prevent any sediment from entering any ditches, streams, or bodies of water downstream of any area disturbed by construction. Excavation materials shall be placed upstream of any trench or other excavation to prevent sedimentation of off-site areas. In areas where a natural buffer area exists between the work area and the closest stream or water course, this area shall not be disturbed. All paved areas shall be scraped and swept as necessary to prevent the accumulation of dirt and debris. Work associated with this provision shall be considered incidental to the project and no separate payment will be made.

11. Temporary Ground Cover:

The Contractor shall provide temporary or permanent ground cover adequate to restrain erosion on erodible slopes or other areas that will be left unworked for periods exceeding 30 calendar days.

C. SUBMITTALS

The Contractor shall submit the following to the Engineer:

1. Submit a certification and summary of all required test results, prior to installation, that all Erosion and Sedimentation Control materials manufactured for the project have been produced in accordance with these Specifications.
2. Furnish copies of the delivery tickets or other approved receipts as evidence for materials received that will be incorporated into construction.

D. CONSTRUCTION

1. Establishment of Erosion Control Devices:

- a. All erosion control structures will be constructed according to the Contract Drawings and these Specifications.
- b. Due to the nature of the work required by this Contract, it is anticipated that the location and nature of the erosion control devices may need to be adjusted on several occasions to reflect the current phase of construction.
- c. Erosion control devices shall be established prior to the work in a given area. Where such practice is not feasible, the erosion control device(s) shall be established immediately following completion of the clearing operation.
- d. The construction schedule adopted by the Contractor will impact the placement and need for specific devices required for the control of erosion. The Contractor shall develop and implement such additional techniques as may be required to minimize erosion and off-site sedimentation.
- e. The location and extent of erosion control devices shall be revised at each phase of construction that results in a change in either the quantity or direction of surface runoff from construction areas. All deviations from the control provisions shown on the Contract Drawings shall have the prior approval of the Engineer.

2. Maintenance of Erosion Control Devices:

- a. The Contractor shall furnish the labor, material, and equipment required for maintenance of all erosion control devices. Maintenance shall be scheduled as required for a particular device to maintain the removal efficiency and intent of the device.
- b. All erosion control devices shall be inspected immediately after each significant rainfall event, and appropriate maintenance conducted.
- c. Maintenance shall include, but not be limited to:

- (1) The removal and satisfactory disposal of trapped sediments from basins or silt barriers;
- (2) Replacement of filter fabrics used for silt fences upon loss of specified efficiency; and
- (3) Replacement of any other components which are damaged or cannot serve the intended use.

d. Sediments removed from erosion control devices shall be disposed of in locations that will not result in off-site sedimentation as approved by the Engineer.

e. All erosion control structures shall be maintained to the satisfaction of the Engineer until the site has been stabilized.

3. Finish Grading:

All disturbed areas outside of the disposal area shall be uniformly graded to the lines, grades, and elevations shown on the Contract Drawings. Finished surfaces shall be reasonably smooth, compacted, and free from irregular surface changes. Unless otherwise specified, the degree of finish shall be that ordinarily obtainable from either blade or scraper operations. Areas shall be finished to a smoothness suitable for application of topsoil.

4. Seeding:

Seeding shall conform to the requirements of Section 02930, Revegetation, of these Specifications.

5. Cleanup:

a. The Contractor shall remove from the site all subsoil excavated from his work and all other debris including, but not limited to, branches, paper, and rubbish in all landscape areas, and remove temporary barricades as the work proceeds.

b. All areas shall be kept in a neat, orderly condition at all times. Prior to final acceptance, the Contractor shall clean up the entire landscaped area to the satisfaction of the Engineer.

E. MEASUREMENT AND PAYMENT

All work required for Erosion and Sedimentation Control, which is not otherwise covered under related sections of these Specifications, shall be included for payment in the

Contractor's Lump Sum Price for Item 5.0, wherein no measurement will be made, except for the following items:

1. Silt Fence placed in the locations indicated on the Contract Drawings shall be paid on the basis of the Unit Price Bid for Item 5.1, per linear foot in-place.
2. Drainage Channel 1, which includes channel lining and related earthwork, shall be paid on the basis of the Unit Price Bid for Item 5.2, per linear foot in-place.
3. Drainage Channel 2, which includes channel lining and related earthwork, shall be paid on the basis of the Unit Price Bid for Item 5.3, per linear foot in-place.
4. Drainage Channel 3, which includes channel lining and related earthwork, shall be paid on the basis of the Unit Price Bid for Item 5.4, per linear foot in-place.
5. Drainage Channel 4, which includes channel lining and related earthwork, shall be paid on the basis of the Unit Price Bid for Item 5.5, per linear foot in-place.
6. Drainage Channel 5, which includes channel lining and related earthwork, shall be paid on the basis of the Unit Price Bid for Item 5.6, per linear foot in-place.
7. Drainage Channel 6A, which includes channel lining and related earthwork, shall be paid on the basis of the Unit Price Bid for Item 5.7, per linear foot in-place.
8. Drainage Channel 6B, which includes channel lining and related earthwork, shall be paid on the basis of the Unit Price Bid for Item 5.8, per linear foot in-place.
9. Rip Rap Aprons, which includes related earthwork and materials, shall be paid on the basis of the Unit Price Bid for Item 5.9, per each apron installed.
10. Filter Berms, which includes related earthwork and materials, shall be paid on the basis of the Unit Price Bid for Item 5.10, per each berm installed.
11. Down Pipes, which includes related earthwork and materials, shall be paid on the basis of the Unit Price Bid for Item 5.11, per linear foot installed.
12. Borrow Area B Erosion Control, which includes related earthwork and materials, shall be paid on the basis of the Lump Sum Bid for Item 5.12, wherein no measurement will be made.
13. All work required for Additional Turf Reinforcement Matting provided outside the scope of this Contract and at the direction of the Engineer, shall be included for payment in the Contractor's Unit Price Bid for Miscellaneous Item 6, per square yard in-place.

END OF SECTION

SECTION 02271

RIP RAP

Rip Rap: This section includes all rip rap aprons and channel protection.

A. DESCRIPTION

1. General:

The Contractor shall furnish all labor, material, and equipment to complete installation of Rip Rap for protection of earthen slopes against erosion as indicated, including all necessary and incidental items, 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>
Geotextiles	02240
Erosion and Sedimentation Control	02270

3. Reference Standards:

The latest revision of the following standards of the North Carolina Department of Transportation (NCDOT) are hereby made a part of these Specifications.

NCDOT Standard Specifications for Roads and Structures.

B. MATERIALS

1. Rip Rap: Rip Rap shall be of the size indicated on the Contract Drawings and shall conform to NCDOT Section 1042, Rip Rap Materials.
2. Geotextiles: Geotextiles shall conform to the requirements outlined in Section 02240, Geotextiles, of these Specifications.

C. SUBMITTALS

The Contractor shall submit the following to the Engineer:

1. Submit a certification and summary of all required test results prior to installation, that all Rip Rap has been produced in accordance with these Specifications.
2. Furnish copies of the delivery tickets or other approved receipts as evidence for materials received that will be incorporated into construction.

D. CONSTRUCTION

1. Surface Preparation:

- a. Trim and dress all areas to conform to the Contract Drawings as indicated with tolerance of 2 inches from theoretical slope lines and grades.
- b. Bring areas that are below allowable minimum tolerance limit to grade by filling with compacted Embankment material similar to adjacent material.
- c. Geotextiles shall be placed as shown on the Contract Drawings and in accordance with Section 02240, Geotextiles, of these Specifications.
- d. Do not place any stone material on the prepared surface prior to inspection and approval to proceed from the Engineer.

2. Placing Rip Rap:

Rip Rap shall be placed in accordance with NCDOT Section 868, Rip Rap.

E. MEASUREMENT AND PAYMENT

All work required for Rip Rap shall be considered incidental to the other pay items in this contract and no separate measurement or payment will be made.

All work required for Additional Rip Rap provided outside the scope of this Contract and at the direction of the Engineer, shall be included for payment in the Contractor's Unit Price Bid for Miscellaneous Item 7, per ton in-place.

END OF SECTION

SECTION 02712

GEONET DRAINAGE MEDIA

Geonet Drainage Media (GDM): The Geonet Drainage Media consists of a layer of Geonet with a Type GT-S Geotextile bonded to the upper surface. The purpose of the GDM is to rapidly transmit side slope flow to leachate collection pipes. Thus, it is important that this layer remain hydraulically connected and clog-free.

A. DESCRIPTION

1. General:

The Contractor shall furnish all labor, material, and equipment to complete installation of GDM, including all necessary and incidental items, 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>
Geotextiles	02240
Geosynthetic Clay Liner	02776
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 413	Standard Test Methods for Rubber Property - Adhesion to Flexible Substrate.
ASTM D 1505	Standard Test Method for Density of Plastics by the Density-Gradient Technique.
ASTM D 4716	Standard Test Method for Constant Head Hydraulic Transmissivity (In-Plane Flow) of Geotextiles and Geotextiles Related Products.
ASTM D 5199	Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.

4. Quality Assurance:

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

B. MATERIALS

1. General:

The materials supplied under these Specifications shall consist of new, first-quality products designed and manufactured specifically for the purpose of this work, which shall have been satisfactorily demonstrated, by prior use, to be suitable and durable for such purposes.

Labels on each roll of GDM shall identify the length, width, lot and roll numbers, and name of Manufacturer.

2. The Geonet shall be manufactured by extruding polyethylene strands to form a three dimensional structure to provide planer water flow.
3. A Type GT-S Geotextile shall be heat bonded to the upper side of the Geonet. Heat bonding shall be performed by the Manufacturer prior to shipping to the site. The Type GT-S Geotextile shall be a nonwoven needlepunched synthetic fabric meeting the property requirements of Section 02240, Geotextiles, of these Specifications.
4. The Geonet shall contain UV inhibitors to prevent ultraviolet light degradation.
5. Physical properties of the GDM shall be as shown in Table 1 of this section.
6. Drainage piping used to collect flow at the perimeter of the GDM shall be embedded in stone/geotextile and be of the size and type as shown on the Contract Drawings.

C. SUBMITTALS

The Contractor shall submit the following to the CQA Engineer:

1. Mill Certificate and Sample: Prior to shipping to the site, the Contractor shall submit one copy of a mill certificate or affidavit signed by a legally authorized official of the Manufacturer for the GDM attesting that the GDM meets the physical and manufacturing requirements stated in these Specifications. The Contractor shall also submit a sample (4" x 6") of the GDM to be used. The sample shall be labeled with the product name and be accompanied by the Manufacturer's specifications.

2. Shipping, Handling, and Storage Instructions: The Manufacturer's plan for shipping, handling, and storage shall be submitted for review.
3. Quality Control Certificates: For GDM delivered to the site, quality control certificates, signed by the Manufacturer's quality assurance manager shall be provided for every roll of GDM. Each certification shall have the roll identification number(s), test methods, frequency, and test results. At a minimum, the test results and frequency of testing shall be as shown in Table 2 of this section.
4. Furnish copies of delivery tickets or other approved receipts as evidence for materials received that will be incorporated into the construction.

D. CONSTRUCTION

1. Shipping, Handling, and Storage:

All GDM shall be shipped, handled, and stored in strict accordance with the Manufacturer's recommendations.

2. Installation:

- a. GDM shall be placed to the lines and grades shown on the Contract Drawings. At the time of installation, the GDM shall be rejected, if it has defects, rips, holes, flaws, evidence of deterioration, or other damage.
- b. The GDM shall be placed only on Geomembrane that has been approved by the Geomembrane Installer and accepted by the CQA Engineer.
- c. The Contractor shall provide temporary anchorage of the GDM at the top of perimeter and interior berms during installation to prevent movement during construction. Such anchorage may include sandbags and the like, as approved by the CQA Engineer. Permanent bonding to the Geomembrane shall be prohibited.
- d. Adjacent rolls of GDM shall be overlapped a distance of at least 3 inches and secured using polyethylene ties. For GDM placed on slopes, the ties shall be placed every 5 feet. For GDM placed on the facility floor, tie spacing shall be every 10 feet.

The overlying Type GT-S Geotextile shall extend at least 6 inches past the geonet joint and shall be permanently bonded to the Type GT-S Geotextile of the adjacent rolls by heat bonding or sewing as approved by the Engineer.

No end (transverse) GDM joints shall be constructed on landfill side slopes or within 10 feet of the toe of the side slope, except where approved in advance by the Engineer.

- e. Any GDM that is torn, crushed, or punctured shall be repaired or replaced by the Contractor at no additional cost to the Owner. The repair shall consist of a patch of the same type of material, placed over the failed area and shall overlap the existing material a minimum of 12 inches from any point of the rupture. The patch shall be connected to the Geonet using polyethylene ties at a 5 foot spacing.
- f. Where applicable, the Contractor shall remove debris, including sediment to the degree possible, from the sump areas prior to placement of the GDM. The sump areas shall be approved by the CQA Engineer prior to GDM placement.

3. Placement of Overlying Vegetative Soil Layer:

The Vegetative Soil Layer shall be placed over GDM as described in Section 02258, Vegetative Soil Layer, of these Specifications.

E. MEASUREMENT AND PAYMENT

- 1. Measurement of GDM: Measurement of GDM shall be measured by the square foot (SF) in place. Measurement shall be based on the horizontal projected area installed and shall be limited to the neat lines of the cross sections as shown on the Contract Drawings. No adjustments will be made in the area for slope, uneven contours, overlap at seams, repairs, or wasted material.

2. Payment:

All work required for Geonet Drainage Media shall be included in the Contractor's Unit Price Bid for Item 6.0, per square foot in-place.

All work required for Drainage Piping, including related stone and geotextile materials, shall be included for payment in the Contractor's Unit Price Bid for Item 6.1, per linear foot installed.

TABLE 1: REQUIRED GEONET DRAINAGE MEDIA PROPERTIES

PROPERTY	TEST METHOD	UNITS	VALUE
Thickness (geonet only)	ASTM D 5199	inches	0.20
Resin Density (geonet only)	ASTM D 1505	g/cm ³	0.92
Ply Adhesion	ASTM D 413	lb/inch	2.0
Transmissivity	ASTM D 4716	gpm/ft (m ³ /m/sec)	2.0 ¹ (4.1 x 10 ⁻⁴)

Notes:

1. Conduct test for transmissivity at a normal compressive load of 1000 psf and at a hydraulic gradient of 0.25 after a seating period of at least 24 hours. Boundary conditions are soil interface on the upper Type GT-S Geotextile and GCL against the geonet. The Engineer may accept alternate test conditions at his discretion.

TABLE 2: REQUIRED MANUFACTURER'S QUALITY CONTROL TEST DATA

PROPERTY	TEST METHOD	MINIMUM TEST FREQUENCY
Thickness (geonet only)	ASTM D 5199	Every Roll
Resin Density (geonet only)	ASTM D 1505	50,000 ft ²
Ply Adhesion	ASTM D 413	50,000 ft ²
Transmissivity	ASTM D 4716	100,000 ft ²

END OF SECTION

SECTION 02720

STORM WATER SYSTEMS

Storm Water Systems: Storm Water Systems shall include all piping, pipe fittings, headwalls, flared end sections, and other appurtenances designated to convey stormwater.

A. DESCRIPTION

1. General:

The contractor shall furnish all labor, material, and equipment to complete installation of Storm Water Systems 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>
Erosion and Sedimentation Control	02270
Rip Rap	02271

3. Reference Standards:

The latest revision of the following standards of the American Society of Testing and Materials (ASTM) and the American Association of State Highway and Transportation Officials (AASHTO) are hereby made a part of these specifications.

ASTM C 76	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
ASTM C 150	Specification for Portland Cement.
ASTM D 1248	Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.
ASTM D 2321	Standard Specification for Underground Installation of Flexible Thermoplastic Sewer Pipe.
ASTM D 3350	Standard Specification for Polyethylene Plastics Pipe and Fitting Materials.

AASHTO M 36	Specification for Corrugated Steel Pipe.
AASHTO M 252	Specification for Corrugated Polyethylene Drainage Tubing, 3 to 10 Inch Diameter.
AASHTO M 294	Specification for Corrugated Polyethylene Pipe, 12 to 36 Inch Diameter.

B. MATERIALS

1. Corrugated Metal Pipe (CMP):

- a. Corrugated metal pipe and fittings shall be of the sizes shown or specified and shall conform to every aspect of AASHTO M 36.
- b. Corrugated metal pipe shall be fabricated from galvanized steel sheets. Corrugation profile shall be 2-2/3 inch crest to crest and 1/2 inch crest to valley, and sheet thickness shall be 16 gage/.064 inch minimum.
- c. Pipe sections shall be helically corrugated with each pipe end rerolled to obtain no less than two (2) annular corrugations.
- d. Coupling Bands: CMP shall be firmly joined by coupling bands in accordance with the manufacturer's recommendations. These bands shall be not more than two nominal sheet thicknesses lighter than the thickness of the pipe to be connected and in no case lighter than 0.052 inches.
- e. All CMP utilized for permanent installation shall have gasketed joints.
- f. Asphaltic or bituminous coatings shall be applied in conformance with the manufacturer's requirements, as applicable.

2. Corrugated Polyethylene (CPE) Pipe:

CPE Pipe and fittings shall be of the sizes and type shown on the Contract Drawings and shall conform to every aspect of AASHTO M 252 (3 to 10 inch diameters) or AASHTO M 294 (12 to 36 inch diameters).

3. Headwalls and Flared End Sections:

Headwalls and flared end sections shall be as described in the Contract Drawings.

C. SUBMITTALS

The Contractor shall submit the following to the CQA Engineer:

1. Submit a certification and summary of all required test results, prior to installation, that all Storm Water Systems have been produced in accordance with these Specifications.
2. Furnish copies of the delivery tickets or other approved receipts as evidence for materials received that will be incorporated into construction.

D. CONSTRUCTION

1. All piping shall be installed by skilled workmen and in accordance with the best standards for piping installation. Proper tools and appliances for the safe and convenient handling and installation of the pipe and fittings shall be used.
2. All pieces shall be carefully examined for defects, and no piece shall be installed which is known to be defective. If any defective pieces should be discovered after having been installed, it shall be removed and replaced at the Contractor's expense.
3. Excavation and backfilling of pipe trenches shall be as described in Section 02222, Excavation and Section 02223, Embankment, respectively, of these Specifications.
4. Following proper preparation of the trench subgrade, pipe and fittings shall be carefully lowered into the trench so as to prevent dirt and other foreign substances from gaining entrance into the pipe and fittings. Proper facilities shall be provided for lowering sections of pipe into trenches. No materials shall be dropped or dumped into the trench.
5. Water shall be kept out of the trench until jointing and backfilling are completed. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no water, earth, or other substance will enter the pipes, fittings, or valves. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored as required.
6. All piping shall be erected to accurate lines and grades with no abrupt changes in line or grade.
7. The full length of each section of pipe shall rest solidly upon the bed of the trench, with recesses excavated to accommodate bells, couplings, joints, and fittings. Before joints are made, each pipe shall be well bedded on a solid foundation. No pipe shall be brought into position until the preceding length has been thoroughly bedded and secured in place. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid by the Contractor at his own expense.

E. MEASUREMENT AND PAYMENT

All work required for Storm Water Systems shall be considered incidental to the other pay items in this contract and no separate measurement or payment will be made.

END OF SECTION

SECTION 02776

GEOSYNTHETIC CLAY LINER (GCL)

Geosynthetic Clay Liner (GCL): The GCL is used as a hydraulic barrier within the final cover.

A. DESCRIPTION

1. General:

The Contractor shall furnish all labor, material, and equipment to complete installation of GCL 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
Geonet Drainage Media	02712
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 1777	Method for Measuring Thickness of Textile Materials.
ASTM D 4632	Test Method for Grab Breaking Load and Elongation of Geotextile.
ASTM D 5084	Test Method for Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.
ASTM D 5321	Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method.

ASTM D 5993 Standard Test Method for Measuring Mass per Unit of Geosynthetic Clay Liners.

4. Quality Assurance:

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

5. Manufacturer Qualifications:

The GCL shall be furnished by a Manufacturer that has previously produced a minimum of 10,000,000 square feet of the material for use in similar projects.

6. Warranties:

- a. General: Should a defect occur, which is covered under warranty, the Warrantor shall bear all costs for repair and/or relocation and replacement of the GCL.
- b. Manufacturer's Warranty: The Contractor shall furnish the Owner a warranty from the GCL Manufacturer for the materials used. The material warranty shall be for defects or failures related to manufacture on a non-prorata basis for five (5) years after date of shipment.

B. MATERIALS

1. General:

The GCL shall consist of bentonite encased, front and back, with geotextile. At least one side of the GCL shall consist of a non-woven geotextile. The materials supplied under these Specifications shall be first quality products designed and manufactured specifically for the purposes of this work.

The GCL shall be supplied in rolls which have a minimum width of 12 feet. The roll length shall be maximized to provide the largest manageable sheet for the fewest overlaps. Labels on the roll shall identify the length, width, lot and roll numbers, name of Manufacturer, proper direction of unrolling, and minimum recommended overlap.

2. Physical Properties:

Physical properties of GCL shall be as shown in Table 1 of this section.

C. SUBMITTALS

The Contractor shall submit the following to the CQA Engineer:

1. Pre-Installation Requirements:

Prior to GCL installation the Contractor shall submit the following:

- a. Mill Certificate and Sample: Prior to shipping to the site, the Contractor shall submit one copy of a mill certificate or affidavit signed by a legally authorized official of the Manufacturer for the GCL attesting that the GCL meets the physical and manufacturing requirements stated in these Specifications. The Contractor shall also submit a sample (4" x 6") of the GCL to be used. The sample shall be labeled with the product name and be accompanied by the Manufacturer's specifications.
- b. Qualifications:
 - (1) Submit list of equipment and personnel proposed for the Project. Include equipment type and quantities. Include personnel experience on similar projects.
 - (2) Submit resume and references of Installation Supervisor to be assigned to the Project, including data and duration of employment and pertinent experience information.
- c. Shipping, Handling, and Storage Instructions: The Manufacturer's recommendations for shipping, handling, and storage shall be submitted for review.
- d. Delivery Date: Submit notification of the scheduled delivery date for the materials.
- e. Quality Control Certificates: For GCL delivered to the site, quality control certificates, signed by the Manufacturer's quality assurance manager shall be provided for every roll of GCL. Each certificate shall have the roll identification number(s), test methods, frequency, and test results. At a minimum, the test results and frequency of testing shall be as shown in Table 2 of this section.
- f. Furnish copies of the delivery tickets or other approved receipts as evidence for materials received that will be incorporated into the construction.

2. Post-Installation Requirements:

Upon completion of GCL installation the Contractor shall submit the following:

- a. A certificate stating that the GCL has been installed in accordance with the Drawings, Specifications, and the Manufacturer's recommendations.
- b. Completed Manufacturer's and Workmanship Warranties.
- c. Record Information: Record information shall include but not be limited to: drawings showing the location of all areas covered by GCL.

Finalization of payment for GCL installation shall not be made until the above submittals have been reviewed by the CQA Engineer.

D. CONSTRUCTION

1. Shipping , Handling, and Storage:

The GCL shall be shipped, handled, and stored in strict accordance with the Manufacturer's recommendations.

2. Failing CQA Material Control Tests:

GCL that is rejected upon testing shall be removed from the project site and replaced at Contractor's cost. Sampling and CQA testing of GCL supplied as replacement for rejected material shall be performed by the CQA Engineer at Contractor's cost.

3. Installation of GCL:

- a. GCL shall be placed to the lines and grades shown on the Contract Drawings. At the time of installation, GCL shall be rejected by the CQA Engineer if it has defects, rips, holes, flaws, evidence of deterioration, or other damage.
- b. The surface receiving the GCL shall be prepared to a relatively smooth condition, free of obstructions, excessive depressions, debris, and very soft or loose pockets of soil. This surface shall be approved by the CQA Engineer prior to GCL placement.
- c. The GCL shall be placed smooth and free of excessive wrinkles with the non-woven side up.
- d. When GCL is placed with upslope and downslope portions, the upslope portion shall be lapped such that it is the upper or exposed surface.

- e. The GCL shall not be placed in standing water or while raining. Any material that becomes hydrated shall be removed and replaced at Contractor expense.
- f. The GCL shall be laid with a 6 inch minimum overlap seam along roll edges and a 12 inch minimum overlap seam along roll ends. Powdered sodium bentonite shall be added between all overlapped seams at a rate of approximately 0.25 pounds per linear foot.
- g. GCL shall be temporarily secured in a manner approved by the CQA Engineer prior to placement of overlying materials.
- h. Any GCL that is torn or punctured shall be repaired or replaced as directed by the CQA Engineer, by the Contractor at no additional cost to the Owner. The repair shall consist of a patch of GCL placed over the failed areas and shall overlap the existing GCL a minimum of 12 inches from any point of the rupture.
- i. If in-place GCL is not otherwise protected from hydration due to rainfall, the GCL shall be covered with a minimum of 6 inches of the overlying design material within 24 hours of GCL placement.

E. MEASUREMENT AND PAYMENT

1. Measurement: Measurement of GCL shall be measured by the square foot (SF) in place. Measurement shall be based on the horizontal projected area installed and shall be limited to the neat lines of the cross sections as shown on the Contract Drawings. No adjustments will be made in the area for slope, uneven contours, overlap at seams, repairs, or wasted material.
2. Payment:

All work required for Geosynthetic Clay Liner shall be included in the Contractor's Unit Price Bid for Item 7.0, per square foot in-place.

TABLE 1: REQUIRED GCL PROPERTIES

PROPERTY	TEST METHOD	UNITS	VALUE ¹
Hydraulic Conductivity	ASTM D 5084 ²	cm/s	5×10^{-9}
Bentonite Content	ASTM D 5993	psf	0.75 (@ 0% moisture)
Thickness	ASTM D 1777	inches	0.20
Grab Tensile Strength	ASTM D 4632	lbs	88
Minimum Shear Strength	ASTM D 5321 ³	psf	500

TABLE 2: REQUIRED MANUFACTURER'S QUALITY CONTROL TEST DATA

PROPERTY	TEST METHOD	MINIMUM TEST FREQUENCY
Hydraulic Conductivity	ASTM D 5084 ²	Weekly
Bentonite Content	ASTM D 5993	50,000 ft ²
Thickness	ASTM D 1777	Periodic
Grab Tensile Strength	ASTM D 4632	200,000 ft ²
Minimum Shear Strength	ASTM D 5321 ³	Periodic

Notes:

1. Minimum Average Roll Values (MARV)
2. Conduct test at 30 psi effective stress or less.
3. Conduct test at 3 psi effective stress and hydrate the GCL.

END OF SECTION

SECTION 02781

COVER GEOMEMBRANE

Cover Geomembrane (COVER-GM): The Cover Geomembrane serves as the primary hydraulic barrier in the landfill final cover system on Phases 1 & 2 and 4. It is of great importance that the COVER-GM be free from defects and installed free from damage.

A. DESCRIPTION

1. General:

The Contractor shall furnish all labor, material, and equipment to install COVER-GM including all necessary and incidental items as detailed or required to complete the installation 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
CQA Manual	Attached

3. Quality Assurance:

Quality Assurance during installation of COVER-GM will be provided by the Owner as described in the accompanying Project CQA Manual.

5. Manufacturers Qualifications:

The Manufacturer shall have previously demonstrated his ability to produce the required COVER-GM by having successfully manufactured a minimum of 5,000,000 ft² of COVER-GM (or similar material) for hydraulic containment purposes.

B. MATERIALS

1. General:

The materials supplied under these Specifications shall consist of first-quality products designed and manufactured specifically for the purpose of this work,

which shall have been satisfactorily demonstrated, by prior use, to be suitable and durable for such purposes. The COVER-GM and COVER-GM Manufacturer shall be approved by the Engineer prior to the Contract award.

The COVER-GM shall be supplied in panels which shall be of maximum size to provide the largest manageable sheet for the fewest seams. Labels on the panels shall identify the thickness, length, width, lot and panel numbers, and name of Manufacturer.

2. COVER-GM Materials:

a. COVER-GM shall be manufactured to meet the following requirements:

- (1) COVER-GM shall be either a polyethylene, polypropylene, or polyvinyl chloride (PVC) based material. COVER-GM shall be at least 20 mil thick for unreinforced material and at least 12 mil thick for reinforced geomembrane.
- (2) Provide finished product free from holes, pin holes, bubbles, blisters, excessive gels, undispersed resins and/or carbon black, contamination by foreign matter, and nicks or cuts on edges.

b. Approved COVER-GM:

- (1) Griffolyn TX-1200 as manufactured by Reef Industries, Inc. of Houston, Texas.
- (2) Integra 12 BW as manufactured by Integra Plastics, Inc. of Madison, South Dakota.
- (3) Cormier WP-1440 as manufactured by Cormier Textile Products, Inc. of Sanford, Maine.
- (4) Any 20 mil unreinforced polyethylene, polypropylene, or PVC geomembrane approved by the Engineer.
- (5) Approved equal material.

3. Seaming Materials:

Seams for reinforced COVER-GM shall consist of double-sided asphaltic tape of a width as recommended by the Manufacturer. Seams for unreinforced COVER-GM shall consist of hot-wedge or solvent-welded (PVC) seams or other method as approved by the Engineer.

C. SUBMITTALS

The Contractor shall submit the following to the CQA Engineer:

1. Pre-Installation Requirements:

Prior to COVER-GM installation the Contractor shall submit the following:

- a. Mill Certificate and Sample: Prior to shipping to the site, the Contractor shall submit one copy of a mill certificate or affidavit signed by a legally authorized official of the Manufacturer for the COVER-GM attesting that the COVER-GM meets the physical and manufacturing requirements stated in these Specifications. The Contractor shall also submit a sample (6" x 8") of the COVER-GM to be used. The sample shall be labeled with the product name and be accompanied by the Manufacturer's specifications.
- b. Shipping, Handling, and Storage Instructions: The Manufacturer's plan for shipping, handling, and storage shall be submitted for review.
- c. Delivery Date: Submit notification of the scheduled delivery dates for the materials.
- d. Installation Procedures and Schedules:

Submit installation procedures and a schedule for carrying out the work. Installation procedures to be addressed shall include but not be limited to material unloading, storage, installation, repair, and protection to be provided in the event of rain or strong winds.
- e. Quality Control Certificates: For COVER-GM delivered to the site, quality control certificates, signed by the Manufacturer's quality assurance manager shall be provided for every shipment of COVER-GM. Each certificate shall have the panel identification number(s), test methods, frequency, and test results.
- f. Furnish copies of the delivery tickets or other approved receipts as evidence for materials received that will be incorporated into the construction.

2. Post-Installation Requirements:

Upon completion of the COVER-GM installation, the Contractor shall submit the following:

- a. Certificate stating that the COVER-GM has been installed in accordance with the Drawings, Specifications, and the Manufacturer's recommendations.
- b. Record Information: Record information shall include but not be limited to: drawings showing the location of all areas covered by COVER-GM.

Finalization of payment for COVER-GM installation shall not be made until the above submittals have been reviewed by the CQA Engineer.

D. CONSTRUCTION

1. Shipping, Handling, and Storage:

The COVER-GM shall be shipped, handled, and stored in strict accordance with the Manufacturer's recommendations.

2. Subgrade Preparation:

- a. For all areas to be covered by COVER-GM, the Contractor shall remove the upper 6 inches of soil and vegetation and grade the surfaces such that drainage is maintained toward existing down pipes. The upper 6 inches removed shall be stockpiled and placed as the topsoil layer of the Vegetative Soil Layer placed over COVER-GM. Refer to Section 02258, Vegetative Soil Layer, of these Specifications.
- b. The surface of the subgrade shall be smooth, uniform, free from sudden changes in grade (such as vehicular ruts), rocks or stones greater than 1/2 inch in maximum size, debris, and deleterious materials. During actual placing and seaming of the COVER-GM, the subgrade shall be kept free of all standing water. If the subgrade below the COVER-GM becomes excessively wet and unstable, as determined by the CQA Engineer it shall be dried and recompact, and replaced if needed.
- c. Before an individual panel of COVER-GM is installed; the Contractor and Installer shall verify in writing and submit to the CQA Engineer:
 - (1) Lines and grades are in conformance with the Drawings and Specifications.
 - (2) The surface area to be lined has been rolled and compacted, free of irregularities and abrupt changes in grade.

3. COVER-GM Placement:

a. Weather Conditions:

COVER-GM placement shall not proceed at an ambient temperature below 40° F or above 100° F unless otherwise authorized, in writing, by the Engineer. COVER-GM placement shall not be performed during precipitation, excessive moisture, in an area of ponded water, or in excessive winds. Any portion of COVER-GM or subgrade damaged due to weather conditions shall be repaired at the Contractor's cost.

b. Method of Placement:

- (1) Each panel of the COVER-GM shall be installed in accordance with the Manufacturer's recommendations.
- (2) The CQA Engineer shall inspect each panel, after placement and prior to seaming, for damage and/or defects. Defective or damaged panels shall be replaced or repaired, as approved by the CQA Engineer and as described in this section.
- (3) The Installer shall avoid dragging the COVER-GM on rough soil subgrades.
- (4) Personnel working on the COVER-GM shall not smoke, wear damaging shoes, or involve themselves in any activity that may damage the COVER-GM, in the opinion of the CQA Engineer.
- (5) The COVER-GM shall be properly weighted to avoid uplift due to wind.
- (6) Vehicular traffic across the COVER-GM shall not be allowed.
- (7) The COVER-GM shall be kept free of debris, unnecessary tools, and materials. In general, the COVER-GM area shall remain neat in appearance.

c. Pipe Penetrations:

All pipe penetrations through the COVER-GM shall be as shown in the Contract Drawings. Alternate penetration details may be approved by the Engineer.

4. Field Seams:

- a. Field seams shall be made according to the Manufacturer's recommendations.
- b. Individual panels of COVER-GM shall be laid out and overlapped by a minimum of 4 inches prior to seaming. The area to be seamed shall be cleaned and prepared in accordance with the Manufacturer's recommendations.
- c. All seams constructed on sloped surfaces shall be vertical seams. Where horizontal seams are required and no other option is available on sloped surfaces, the panels shall be placed such that the "upstream" panel forms the upper panel and overlaps the "downstream" panel in order to minimize infiltration potential.
- d. No overlying material shall be placed over the COVER-GM until approved by the CQA Engineer.

5. Repair Procedures:

- a. Any portion of the COVER-GM exhibiting signs of defect shall be repaired. Several procedures exist for the repair of these areas. The final decision as to the appropriate repair procedure shall be made by the CQA Engineer.

6. Placement of Overlying Vegetative Soil Layer:

The Vegetative Soil Layer shall be placed over COVER-GM as described in Section 02258, Vegetative Soil Layer, of these Specifications.

E. MEASUREMENT AND PAYMENT

1. Measurement: Measurement of COVER-GM shall be measured by the square foot (SF) in place. Measurement shall be based on the horizontal projected area installed and shall be limited to the neat lines of the cross sections as shown on the Contract Drawings. No adjustments will be made in the area for slope, uneven contours, overlap at seams, repairs, or wasted material.

2. Payment:

All work required for COVER Geomembrane shall be included in the Contractor's Unit Price Bid for Item 8.0, per square foot in-place.

END OF SECTION

SECTION 02930

REVEGETATION

Revegetation: Revegetation includes permanent Revegetation of disturbed site areas as indicated on the Contract Drawings. Note that the seeding schedule provided in this section is based on Table 6.11p of the North Carolina Erosion and Sediment Control Planning and Design Manual.

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>
Embankment	02223
Vegetative Soil Layer	02258
Erosion and Sedimentation Control	02270

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. 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.
2. 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. 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.

5. 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 erosion control matting or netting, 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.

SECTION 13250

LANDFILL GAS VENTS

Landfill Gas Vents: Landfill Gas Vents are installed under the landfill cover in order to vent landfill gases, particularly methane, which builds up due to the decomposition of waste.

A. DESCRIPTION

1. General:

The Contractor shall furnish all labor, material, and equipment to complete installation of Landfill Gas Vents 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>
Geotextiles	02240

3. Reference Standards:

The latest revision of the following standards of the American Society of Testing and Materials (ASTM) and the North Carolina Department of Transportation (NCDOT) are hereby made a part of these specifications.

ASTM D 1785 Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120.

NCDOT Standard Specifications for Roads and Structures.

B. MATERIALS

1. All pipe used for construction of Landfill Gas Vents shall be either solid (riser pipe) or perforated (collector pipe) 6 inch diameter schedule 80 polyvinyl chloride (PVC) pipe as shown on the Contract Drawings.
2. Backfill for Landfill Gas Vents shall be NCDOT #57 stone.
3. Geotextiles used for Landfill Gas Vents shall conform to the requirements outlined in Section 02240, Geotextiles, of these Specifications.

4. Turbines: Turbines shall be galvanized steel with aluminum external bracing. Turbines shall have an oil impregnated top bearing and a thrust-type bottom pivot bearing with hardened steel ball riding in a hardened steel seat. Turbines shall be installed complete with all required fittings for a complete installation. Turbines shall be Empire brand, or equal.

C. SUBMITTALS

The Contractor shall furnish copies of the delivery tickets or other approved receipts to the Engineer as evidence for materials received that will be incorporated into construction.

D. CONSTRUCTION

1. All Landfill Gas Vents shall be constructed at the locations and according to the details shown on the Contract Drawings. Care shall be taken to ensure that these locations are not in areas which are prone to pond water.
2. The depth of Landfill Gas Vents shall be adjusted such that the perforated PVC piping and stone backfill lies below the existing intermediate cover.
3. The Contractor shall exercise caution as excavations will extend into existing municipal solid waste. The Contractor shall construct Landfill Gas Vents such that Contractor personnel are not required to enter the excavation.
4. All waste materials removed during construction of Landfill Gas Vents shall be disposed of on site in the active lined landfill (Phase 5) as directed by the Owner and Engineer.

E. MEASUREMENT AND PAYMENT

All work required for Landfill Gas Vents shall be included for payment in the Contractor's Unit Price Bid for Item 10.0, per each vent installed.

END OF SECTION



Construction Quality Assurance Manual

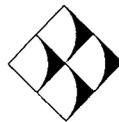
**Johnston County
MSW Landfill Closure**

Prepared for:

Johnston County Public Utilities
Smithfield, NC

August 1998

BID ISSUE DOCUMENTS



G.N. Richardson & Associates, Inc.

Engineering and Geological Services

425 N. Boylan Avenue

Raleigh, North Carolina 27603

**JOHNSTON COUNTY
MSW LANDFILL CLOSURE**

CONSTRUCTION QUALITY ASSURANCE MANUAL

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SECTION 1.0 GENERAL

1.1 INTRODUCTION

This Construction Quality Assurance (CQA) Manual has been prepared to provide the Owner, 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 and geosynthetics components of the final cover system.

The CQA Manual is divided into the following sections:

- Section 1.0 General
- Section 2.0 CQA Documentation
- Section 3.0 Earthwork CQA
- Section 4.0 Compacted Soil Barrier CQA
- Section 5.0 Geosynthetic Clay Liner CQA
- Section 6.0 Geonet Drainage Media CQA
- Section 7.0 Cover Geomembrane 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 QC testing performed by the Geosynthetics Manufacturers and all CQA testing performed by the CQA Engineer.

1.2.4 Discrepancies Between Documents

The CQA Manual is intended to be a supporting document to improve the overall documentation of the work. The CQA Manual is less specific than the project specifications, and conflicts may exist between the documents. The Contractor is instructed to bring discrepancies to the attention of the CQA Engineer for resolution who shall then notify the Engineer. The Engineer has the sole authority to determine resolution of discrepancies existing within the Contract Documents. Unless otherwise determined by the Engineer, the more stringent requirement shall be the controlling resolution.

1.3 PARTIES TO CONSTRUCTION QUALITY ASSURANCE

1.3.1 Description of the Parties

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

1.3.1.1 Owner

The Owner is Johnston 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 shall also be responsible for proper resolution of all quality issues that arise during construction. The Engineer is G.N. Richardson & Associates, Inc.

1.3.1.3 Contractor

The Contractor is responsible for the construction of general earthwork and soil and geosynthetic barriers. 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 Geosynthetics Manufacturer

The Geosynthetics Manufacturer(s) is (are) responsible for the production of the geosynthetic components used in final cover construction. The Manufacturer(s) is

(are) responsible for Quality Control (QC) during manufacture of the geosynthetic components, certification of the properties of the geosynthetic components, and field installation criteria.

1.3.1.5 Geosynthetics Installer

The Geosynthetics Installer(s) is (are) routinely a subcontractor of the Contractor and is (are) responsible for field handling, storing, placing, seaming, protection of (against wind, etc.), and other aspects of the geosynthetics installations. The Installer may also be responsible for transportation of these materials to the site, and for the preparation and completion of anchor trenches. The Contractor may act as his own Geosynthetic Installer on this project.

1.3.1.6 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 barrier layers 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. The CQA Engineer is G.N. Richardson & Associates, Inc.

1.3.1.7 Geosynthetics CQA Laboratory

The Geosynthetics CQA Laboratory is a party, independent from the Owner, that is responsible for conducting tests on conformance samples of geosynthetics used in the final cover system. The Geosynthetics CQA Laboratory service cannot be provided by any party involved with the manufacture, fabrication, or installation of any of the geosynthetic components.

1.3.1.8 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 used in structural fills and the final cover system. Engineering Tectonics, P.A. will provide for on-site and laboratory soils testing.

1.3.2 **Qualifications of the Parties**

The following qualifications are required of all parties involved with the manufacture, fabrication, installation, transportation, and CQA of all materials for the 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 Geosynthetics Manufacturers

Each Geosynthetics Manufacturer must satisfy the qualifications presented in the project specifications.

The physical properties of each geosynthetic product must be certified by the geosynthetics manufacturer. The properties certified must include, at a minimum, those identified in the project specifications. Manufacturer's certification(s) must be approved by the CQA Engineer before the product is used.

1.3.2.3 Geosynthetic Installer(s)

The Geosynthetic Installer(s) will be trained and qualified to install the geosynthetics components of the final cover system.

1.3.2.4 CQA Engineer

The CQA Engineer will act as the Owner's and Engineer's CQA Representative. The CQA Engineer will perform CQA testing to satisfy the requirements of this CQA Plan and will prepare the CQA certification document. The CQA Engineer will have experience in the CQA aspects of landfill final cover system construction and soils testing, 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.

1.3.2.5 Geosynthetics CQA Laboratory

The Geosynthetics CQA Laboratory will have experience in testing geosynthetics and be familiar with ASTM and other applicable test standards. The Geosynthetics 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 run, as agreed to at the outset of the project by the Owner, Engineer, CQA Engineer, and Contractor and will maintain that standard throughout the installation.

1.3.2.6 Soils CQA Laboratory

The Soils CQA Laboratory will have experience in testing structural fills and soil liners, 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, as agreed to at the outset of the project, receipt of samples, and will maintain that standard throughout the installation.

1.4 SCOPE OF CONSTRUCTION QUALITY ASSURANCE MANUAL

The scope of this CQA Manual includes the CQA of the soils and geosynthetic components of the 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) and the Geosynthetic Research Institute (GRI).

1.7 SITE AND PROJECT CONTROL

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 Final Cover System CQA Meeting

Prior to the start of the final cover 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 Monthly CQA Progress Meetings

A monthly progress meeting will be held between the Engineer, the CQA Engineer, the Contractor, and representatives from any other involved parties. This meeting 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 report. Any matter

requiring action which is raised in this meeting will be reported to the appropriate 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 VERSES RECORD TESTING

1.8.1 Control Testing

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

1.8.2 Record Testing

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

SECTION 2.0 CQA DOCUMENTATION

2.1 DOCUMENTATION

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

The CQA Engineer will provide the Owner and Engineer with his daily and progress reports including signed descriptive remarks, data sheets, and logs to verify that required CQA activities have been carried out. These reports shall 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:

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

be taken in instances of substandard quality;

- summaries of pertinent discussions with the Contractor and/or Geosynthetic Installers; and
- the CQA Engineer's signature.

The daily report must be completed at the end of each CQA Engineer's shift, prior to leaving the site. This information will be submitted weekly to and reviewed by the 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 Engineer no later than the Monday following the week reported.

2.4 CQA PHOTOGRAPHIC REPORTING DATA SHEETS

Photographic reporting data sheets, where used, will be cross-referenced with CQA observation logs and testing data sheets and/or CQA construction problem and solution data sheets. Photographs shall be taken 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. The basic file will contain color prints; negatives will also be stored in a separate file in chronological order. 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 non-conformance 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 shall 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, construction problem and solution data sheets. 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 CQA documentation (Certification) report.

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

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.

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 shall be made in the daily log.

During stockpiling operations, control tests, as shown on Table 1, will be performed prior to placement of any compacted embankment.

3.3 SUBGRADE APPROVAL

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

3.4.2 Control Tests

The control tests, as shown on Table 2, will be performed prior to compaction of embankment.

3.4.3 Record Tests

The record tests, as shown on Table 2, will be performed 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 shall be properly documented by the CQA Engineer. The Contractor will correct defects and deficiencies to the satisfaction of the CQA Engineer. The CQA Engineer shall observe all retests on repaired defects.

TABLE 1: CQA TESTING PROGRAM FOR 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 2: CQA TESTING PROGRAM FOR COMPACTED EMBANKMENT

PROPERTY	TEST METHOD	MINIMUM TEST FREQUENCY
CONTROL TESTS: (See Table 1)		
RECORD TESTS:		
Loose Lift Thickness	-----	Each Lift
Moisture Content	ASTM D 2216	80,000 ft ² per lift
In-Place Density	ASTM D 2922 ¹	80,000 ft ² per lift

Notes:

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

SECTION 4.0 COMPACTED SOIL BARRIER CQA

4.1 INTRODUCTION

This section of the CQA Manual addresses the compacted soil barrier 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 COMPACTED SOIL BARRIER MATERIAL APPROVAL

All material to be used as compacted soil barrier 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 shall be made in the daily log.

During stockpiling operations, control tests, as shown on Table 1, will be performed prior to placement of any compacted soil barrier material.

4.3 SUBGRADE APPROVAL

The CQA Engineer shall verify that the soil barrier 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 compacted soil barrier component. The test fill construction will be conducted prior to or coincide with the beginning of construction of the soil barrier component.

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

4.4.1 Control Tests

The control tests, as shown on Table 2, will be performed prior to compaction of compacted soil barrier material in the test fill.

4.4.2 Record Tests

The record tests, as shown on Table 2, will be performed during placement of compacted soil barrier 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 barrier constructed using the same construction methods, equipment, and material to be used in construction of the compacted soil barrier will satisfy project specifications. No compacted soil barrier can be placed until the test fill program is completed.

4.5 COMPACTED SOIL BARRIER CONSTRUCTION

4.5.1 Construction Monitoring

- A. Compacted soil barrier shall be placed as described in 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 compacted soil barrier. 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 shall monitor protection of the soil barrier during and after construction.
- E. The soil barrier 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 compacted soil barrier.
- F. Frost heave or other damage due to freezing shall require lift reconstruction in accordance with the project specifications.

- G. The CQA Engineer shall inspect the compacted soil barrier and certify that it is in accordance with the project specifications and approved plans prior to the Contractor beginning installation of overlying layers.

4.5.2 Control Tests

The control tests, as shown on Table 3, will be performed prior to compaction of compacted soil barrier material.

4.5.3 Record Tests

The record tests, as shown on Table 3 and as described below, will be performed during placement of compacted soil barrier material.

- A. Each lift shall be checked visually for soil clods, rocks, debris, plant materials and other foreign material.
- B. The thickness of the loose lift shall be measured at random locations after spreading and leveling is completed. Loose lift thickness should not exceed 10 inches for a final 6-inch compacted lift thickness.
- C. Moisture content will be monitored by the CQA Engineer or his representative 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 shall be certified within 7 days of compacted soil barrier placement.

4.5.3.1 Record Test Failure

The following procedures shall be used in the event of density or permeability 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 Permeability Test: The area of failure shall be localized and reconstructed in accordance with the project specifications. This area shall be retested as outlined within the plan. Optionally, at least three replicate samples shall be obtained in the immediate vicinity of the failed test. If all three samples pass, then the initial failing test will be discounted. However, should the replicate samples confirm the failure of the compacted soil barrier 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 Compacted Soil Barrier

All holes shall be patched with hand tamped compacted soil barrier material 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 shall be properly documented by the CQA Engineer. The Contractor will correct defects and deficiencies to the satisfaction of the CQA Engineer. The CQA Engineer shall observe all retests on repaired defects.

TABLE 1: CQA TESTING PROGRAM FOR MATERIAL APPROVAL

PROPERTY	TEST METHOD	MINIMUM TEST FREQUENCY/ SOIL
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
Permeability - Lab Remolded	ASTM D 5084 ²	10,000 CY per Each Soil

TABLE 2: CQA TESTING PROGRAM FOR TEST FILL

PROPERTY	TEST METHOD	MINIMUM TEST FREQUENCY/SOIL
CONTROL TESTS: (See Table 1)		
RECORD TESTS:		
Loose Lift Thickness	-----	Each Lift
Atterberg Limits	ASTM D 4318	1 per lift
Grain Size Analysis	ASTM D 422	1 per lift
Moisture Content	ASTM D 2216	3 per lift
In-Place Density	ASTM D 2922 ¹	3 per lift
Permeability - In-Place (Shelby Tube)	ASTM D 5084 ²	1 per lift

TABLE 3: CQA TESTING PROGRAM FOR COMPACTED SOIL BARRIER

PROPERTY	TEST METHOD	MINIMUM TEST FREQUENCY
CONTROL TESTS: (See Table 1)		
RECORD TESTS:		
Loose Lift Thickness	-----	Each Lift
Moisture Content	ASTM D 2216	40,000 ft ² per lift
In-Place Density	ASTM D 2922 ¹	40,000 ft ² per lift
Permeability - In-Place (Shelby Tube)	ASTM D 5084 ²	160,000 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. Maximum Effective Confining Pressure of 5 psi.

**SECTION 5.0
GEOSYNTHETIC CLAY LINER (GCL) CQA**

5.1 INTRODUCTION

This section of the CQA Manual addresses geosynthetic clay liner (GCL) and outlines the CQA program to be implemented with regard to material approval, material control tests, repairs, and resolution of problems.

5.2 GCL MANUFACTURER APPROVAL

The Contractor shall submit the qualifications of the GCL Manufacturer, as described in the specifications, to the CQA Engineer for approval.

5.3 GCL MATERIAL APPROVAL

5.3.1 GCL Product Data

The CQA Engineer will review the Contractor's submittals for conformance with the project specifications.

5.3.2 Shipment And Storage

During shipment and storage, GCL will be protected as required by the project specifications. The CQA Engineer will observe rolls upon delivery at the site.

5.3.3 Quality Control Certificates

Upon delivery, the CQA Engineer will:

- verify that the Manufacturer's quality control certificates have been provided at the specified frequency and that each certificate identified the rolls related to it; and
- review the Manufacturer's quality control certificates and verify that the certified properties meet the project technical specifications.

5.3.4 GCL Material Control Tests

Samples for material control tests, as shown on Table 1, will be obtained at the indicated frequencies upon delivery of the GCL.

Samples will be taken across the entire width of the roll and will not include the first lineal 3 feet. Unless otherwise specified, samples will be 3 feet long by the roll width. The CQA Engineer will mark the machine direction on the samples with an arrow.

All material control tests will be performed by the Geosynthetics CQA Laboratory.

All test results must be available at the site prior to the deployment of all GCL. The CQA Engineer will examine all results from laboratory testing.

5.3.4.1 Material Control Test Failure

The following procedure will apply whenever a sample fails a material control test:

- A. The Geosynthetic Installer will replace the roll of GCL that is in nonconformance with the project specifications with a roll that meets project specifications.
- B. The Geosynthetic Installer will remove samples for testing by the Geosynthetics CQA Laboratory from the closest numerical roll on both sides of the failed roll. These two samples must both conform to project specifications. If either of these samples fail, then the next numerical roll will be tested until a passing roll is found. This additional testing will be at the expense of the Geosynthetic Installer. If either of the two closest rolls fail, the Engineer will dictate the frequency of additional testing.

The CQA Engineer will document actions taken in conjunction with material control test failures.

5.4 GCL INSTALLATION

5.4.1 Handling And Placement

The Geosynthetic Installer will handle and place all GCL in such a manner as required by the project specifications.

5.4.2 Seams And Overlaps

All GCL will be seamed or overlapped in accordance with project specifications or as approved by the CQA Engineer and Engineer.

5.4.3 Repairs

Any holes or tears in the GCL will be repaired in accordance with the project specifications. The CQA Engineer will observe any repair.

5.4.4 Placement Of Overlying Materials

All soil materials located on top of the GCL shall be placed in accordance with

the project specifications.

5.5 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 shall be properly documented by the CQA Engineer. The Contractor will correct defects and deficiencies to the satisfaction of the CQA Engineer. The CQA Engineer shall observe all retests on repaired defects.

TABLE 1: CQA TESTING PROGRAM FOR MATERIAL APPROVAL

PROPERTY	TEST METHOD	TEST FREQUENCY
CONTROL TESTS:		
Hydraulic Conductivity	ASTM D 5084 (@ ≤ 30 psi effective stress)	200,000 ft ² or 1 per Lot ¹
Bentonite Content	ASTM D 5993 (@ 0% moisture)	200,000 ft ² or 1 per Lot ¹
Grab Tensile Strength	ASTM D 4632	200,000 ft ² or 1 per Lot ¹

Notes:

1. Whichever provides the larger number of tests.

SECTION 6.0 GEONET DRAINAGE MEDIA CQA

6.1 INTRODUCTION

This section of the CQA Manual addresses geonet drainage media (GDM) and outlines the CQA program to be implemented with regard to material approval, material control tests, repairs, and resolution of problems.

6.2 GDM MATERIAL APPROVAL

6.2.1 GDM Product Data

The CQA Engineer will review the Contractor's submittals for conformance with the project specifications.

6.2.2 Shipment And Storage

During shipment and storage, all GDM will be protected as required by the project specifications. The CQA Engineer will observe rolls upon delivery at the site.

6.2.3 Quality Control Certificates

Upon delivery, the CQA Engineer will:

- verify that the Manufacturer's quality control certificates have been provided at the specified frequency and that each certificate identified the rolls related to it; and
- review the Manufacturer's quality control certificates and verify that the certified properties meet the project technical specifications.

6.3 GDM INSTALLATION

6.3.1 Handling And Placement

The Geosynthetic Installer will handle and place all GDM in such a manner as required by the project specifications.

6.3.2 Stacking And Joining

When several layers of GDM are stacked, care should be taken to ensure that stacked GDM are placed in the same direction. Stacked GDM will never be laid in perpendicular directions to the underlying GDM (unless otherwise specified by the Engineer). The CQA Engineer will observe the stacking of GDM.

Adjacent rolls of GDM will be joined according to construction drawings and project specifications.

6.3.3 Repairs

Any holes or tears in the GDM will be repaired in accordance with the project specifications. The CQA Engineer will observe any repair.

6.3.4 Placement Of Overlying Materials

All soil materials located on top of GDM shall be placed in accordance with the project specifications.

6.4 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 shall be properly documented by the CQA Engineer. The Contractor will correct defects and deficiencies to the satisfaction of the CQA Engineer.

SECTION 7.0 COVER GEOMEMBRANE CQA

7.1 INTRODUCTION

This section of the CQA Manual addresses the cover geomembrane (COVER-GM) and outlines the CQA program to be implemented with regard to material approval, material control tests, repairs, and resolution of problems.

7.2 GDM MATERIAL APPROVAL

7.2.1 COVER-GM Product Data

The CQA Engineer will review the Contractor's submittals for conformance with the project specifications.

7.2.2 Shipment And Storage

During shipment and storage, all COVER-GM will be protected as required by the project specifications. The CQA Engineer will observe panels upon delivery at the site.

7.2.3 Quality Control Certificates

Upon delivery, the CQA Engineer will:

- verify that the Manufacturer's quality control certificates have been provided at the specified frequency and that each certificate identified the panels related to it; and
- review the Manufacturer's quality control certificates and verify that the certified properties meet the project technical specifications.

7.3 COVER-GM INSTALLATION

7.3.1 Handling And Placement

The Geosynthetic Installer will handle and place all COVER-GM in such a manner as required by the project specifications.

7.3.2 Repairs

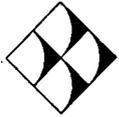
Any holes or tears in the COVER-GM will be repaired in accordance with the project specifications. The CQA Engineer will observe any repair.

7.3.3 Placement Of Overlying Materials

All soil materials located on top of COVER-GM shall be placed in accordance with the project specifications.

7.4 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 shall be properly documented by the CQA Engineer. The Contractor will correct defects and deficiencies to the satisfaction of the CQA Engineer.



G.N. RICHARDSON & ASSOCIATES, INC.

Engineering and Geological Services

TRANSMITTAL FORM

If enclosures are not as noted or if you require additional information, please notify us immediately

September 8, 1998

Mr. Jim Barber
Regional Engineer
NC DENR - Solid Waste Section
Wachovia Building
225 Green Street, Suite 601
Fayetteville, NC 28301

SUBJECT: Johnston County MSW Landfill Closure

GNRA PROJECT NO: JOHNSTON-3

We are sending you the following items:

COPIES	ITEM	DESCRIPTION
1	Book	Technical Specifications & CQA Manual
1	Plans	Closure Drawings

These are transmitted as checked below:

- For Information
- As Requested
- For Review and Comments
- For Revision
- For Approval
- Approved

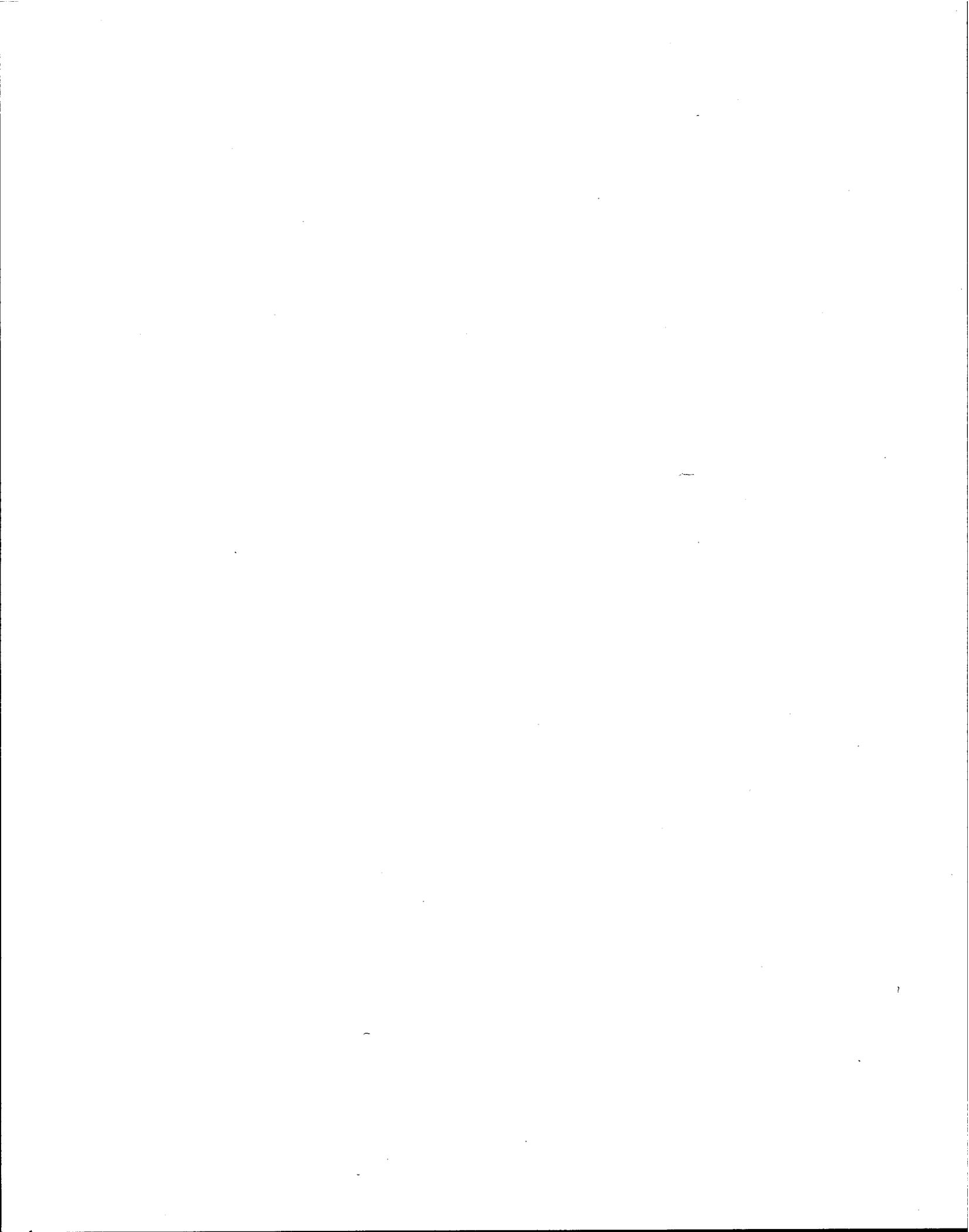
- Approved as Noted
- Approved as Noted-Revise and Resubmit
- Not Approved-Revise and Resubmit
- For Record and File
- Submittal
- For Recording

REMARKS:

cc: **Jim Coffey, NC DENR - Raleigh**



Pieter K. Scheer, P.E.



NORTH CAROLINA DEPARTMENT OF
ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF WASTE MANAGEMENT



July 29, 1998

JAMES B. HUNT JR.
GOVERNOR

Mr. Pieter K. Scheer, P.E.
G.N. Richardson & Associates
425 N. Boylan Avenue
Raleigh, North Carolina 27603

WAYNE McDEVITT
SECRETARY

RE: Revised Closure Schedule for Johnston County Landfill
Permit No. 51-01.

WILLIAM L. MEYER
DIRECTOR

Dear Mr. Scheer:

The Solid Waste Section has reviewed your letter dated 24 July 1998, requesting an extension of time to close the above referenced landfill located in Smithfield, North Carolina. The Solid Waste Section (the Section) approves of the proposed schedule that you have outlined in the above referenced letter and approves of the proposed schedule, with a completion date of 31 December 1998. If for reasons beyond the control of Johnston County or its closure contractor, items addressed in the 24 July 1998 letter can not be completed in the proposed time frame; the Section shall be notified with an explanation provided for the delay, along with a revised time line. In the interim, Johnston County should maintain the existing interim cover and repair any erosion or damage done to the interim cover. If necessary, temporary seeding or mulch shall be applied to landfill areas to minimize on-site erosion.

As a reminder, in accordance with Waste Management rules 15A NCAC 13B section .1627(c)(7) "following closure of each MSWLF unit, the owner or operator shall notify the Division that a certification, signed by the project engineer verifying that closure has been completed in accordance with the closure plan, has been placed in the operating record".

FAYETTEVILLE REGIONAL OFFICE
225 GREEN STREET, SUITE 601, FAYETTEVILLE, NC 28301-5043
PHONE 910-486-1191 FAX 910-486-1791

AN EQUAL OPPORTUNITY / AFFIRMATIVE ACTION EMPLOYER - 50% RECYCLED/10% POST-CONSUMER PAPER

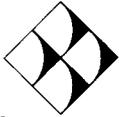
Mr. Scheer
Page 2
July 29, 1998

This notification can accompany the CQA document, that is submitted to the Section upon completion of the cell closure, with the stated date that the notice was placed in the operating record.

Should you have any questions concerning this letter, please contact this office at (919) 733-0692 Ext: 255 or Jim Barber at (910) 486-1191 Ext: 225.


James C. Coffey, Supervisor
Permitting Branch
Solid Waste Section

cc: Terry Dover
Mark Fry
Jim Barber
✓ Raleigh Central File: Permit 51-01 Johnston County Landfill



G.N. RICHARDSON & ASSOCIATES

Engineering and Geological Services

July 24, 1998

Mr. Jim Barber
Regional Engineer
NC DENR - Solid Waste Section
Wachovia Building
225 Green Street, Suite 601
Fayetteville, NC 28301

**RE: Johnston County Landfill
Phases 1-4 - Schedule of Closure Activities**

Dear Jim:

This letter is written to follow up our letter of June 19 which formally requested an extension to complete closure of the Phase 3 MSW landfill. After receiving the letter you had asked that we provide a schedule of the closure activities to take place. Also, per our recent telephone conversations, we have identified portions of Phases 1&2 and Phase 4 which will also require closure this year. The County intends to contract out the closure work. The following are the anticipated target dates for this work:

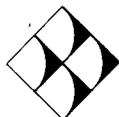
Advertise Closure Work:	Week of Aug. 3
Receive Bids:	Week of Aug. 17
Begin Construction:	Week of Sept. 7
Substantial Completion:	December 31

On behalf of Johnston County, GNRA requests an extension for closure activities through December 31, 1998. Please contact us at your convenience with any further questions or comments which you may have on this project.

Sincerely,
G.N. Richardson & Associates, Inc.

Pieter K. Scheer, P.E.
Project Engineer

cc: Jim Coffey, DENR - Raleigh
Mark Fry, DENR - Fayetteville
Haywood Phthisic, Johnston County
Warren Grimes, Johnston County



June 19, 1998

Mr Jim Barber
Regional Engineer
NC DENR - Solid Waste Section
Wachovia Building
225 Green Street, Suite 601
Fayetteville, NC 28301

RECEIVED

JUN 22 1998

DIVISION OF WASTE MANAGEMENT
FAYETTEVILLE REGIONAL OFFICE

**RE: Johnston County Landfill
Closure Activities Status and Request for Final Closure Extension
Phase 3 MSW Landfill**

Dear Mr Barber:

This letter is written to update you on the status of the closure activities and to formally request an extension to complete closure of the Phase 3 MSW landfill.

Status of Closure Activities

Over the past several months G.N. Richardson & Associates (GNRA) has been working with the County to develop long term restoration plans for Phase 3 along with previously closed Phases 1, 2, and 4. This plan, which has been submitted to your office for review, includes plans to put a lined piggyback landfill between Phases 3 and 4. This liner system would provide final cover on the western side of Phase 3 and the eastern side of Phase 4. Also part of the future site restoration plan is to place an enhanced cover system on the flatter areas on top of Phases 1-2, 3, and 4. As part of the closure of Phases 1-2, a construction and demolition debris fill is planned to enhance the grades on top of this area.

Currently, it was planned to close the remainder of Phase 3 (eastern slope and north and south ends) with 18 inches of 1×10^{-5} cm/sec soil and at least 6 inches of vegetative cover soil this year. The attached site plan shows a delineation of the proposed current and future areas to be closed. In performing a review of previous site geotechnical reports and a limited test pit investigation of potential borrow areas it became apparent that limited quantities of 1×10^{-5} to 1×10^{-6} cm/sec soils are available on site. The site does have a fair quantity of 1×10^{-7} range soils in the future Phase 6, 7, and 8 areas. However, due to the need to save this material for future cell liner construction, the County does not want to use this material for Phase 3 cover construction. Most of the on site soils consist of 1×10^{-4} cm/sec range clayey and silty sands. GNRA is currently evaluating alternative final cover materials which will equal or exceed the performance of the regulatory minimum final cover and which will be economically feasible for the County.

GNRA was able to identify a limited supply of clay soils in the borrow area to the east of Phase

3. It is anticipated that enough clay is available to place an 18 inch thick barrier layer in the \pm 0.5 acre "trough" at the south end of Phase 3. This would allow the County to place construction and demolition debris waste in this area and round out the Phase 3 contours.

Request for Closure Extension

At this time, GNRA, on behalf of Johnston County, would like to formally request an extension to the time allowed for final closure of Phase 3. Currently, the County intends to proceed on closure of the "trough" at the southern end of Phase 3 while a decision is being made on the options available for closure of the remainder of the Phase 3 slopes. It is the intent of the County to continue with closure activities until the work is completed.

Please contact us at your convenience with any further questions or comments which you may have on this project.

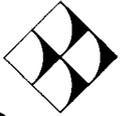
Sincerely,
G.N. Richardson & Associates, Inc.



Pieter K. Scheer, P.E.
Project Engineer

Attachment

cc: Jim Coffey, DENR - Raleigh
Mark Fry, DENR - Fayetteville
Haywood Phthisic, Johnston County
Warren Grimes, Johnston County

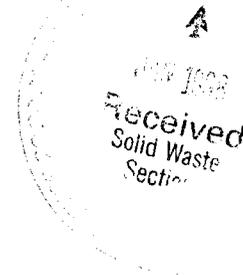


G.N. RICHARDSON & ASSOCIATES
Engineering and Geological Services

January 7, 1998

Mr. Ed Mussler, P.E.
Environmental Engineer
NC DENR - Solid Waste Section
P.O. Box 27687
Raleigh, NC 27611-7687

APPROVED
DIVISION OF SOLID WASTE MANAGEMENT
DATE 1/12/98 BY [Signature]
5102



**RE: Johnston County Landfill - Phase 5
Leachate Piping Modification**

Dear Ed:

G.N. Richardson & Associates (GNRA) has recently been contracted by Johnston County to provide consulting services on both their old unlined landfills (Phases 1-4) and the new lined facility (Phase 5) which has been in operation for several months. Due to the County's long-term desire to operate Phase 5 as a wet-cell bioreactor, we have recently evaluated the design of the leachate collection system for the ability to handle the recirculation of leachate.

In our evaluation, we discovered a potential clogging problem with the use of a filter geotextile and sand drainage layer directly over collection piping. While this may work fine for a dry landfill, a wet-cell will require the ability to handle increased loads of leachate and the ability to be periodically cleaned (flushed). The attached details document the original as-built condition and the proposed modification. The modification to the system involves the removal of the exposed geomembrane flap and the sand layer, cutting and peeling back the filter geotextile, and placing a column of No. 57 stone directly over the No. 78 stone (waste will be placed directly on the No. 57 stone). This modification will be made incrementally by County personnel working in advance of waste placement. In this fashion, current stormwater/leachate separation strategies will remain the same.

GNRA personnel worked with County personnel this past Monday to come up with the best way to implement this change in a safe and efficient manner. Using a 20 foot long section of collection piping on the southeast end of Phase 5, we discovered that a track hoe will be the most effective piece of equipment to implement the modification. Note that the teeth of the track hoe bucket will be modified or removed such that the risk of damage to piping or the base liner system is minimized.

Over the next few months, GNRA will be evaluating the use of Phase 5 as a wet-cell. Once we have finished this evaluation, we will submit a formal application to the Solid Waste Section describing the recirculation methods and operational changes which will be required.

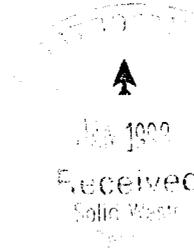
Mr. Ed Mussler, P.E.
January 7, 1998
Page 2

Please contact us at your convenience with any further questions or comments which you may have on this project.

Sincerely,
G.N. Richardson & Associates, Inc.



Pieter K. Scheer, P.E.
Project Engineer



Enclosures

cc: Warren Grimes, Johnston County
Haywood Phthisic, Johnston County
Tim Broome, P.E., Johnston County