PERMIT APPLICATION

FOR

PHASE 5 CONSTRUCTION PERMIT

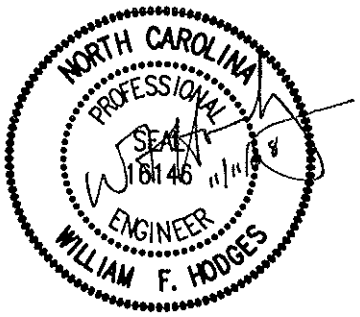
EAST CAROLINA REGIONAL LANDFILL
BERTIE COUNTY, NORTH CAROLINA

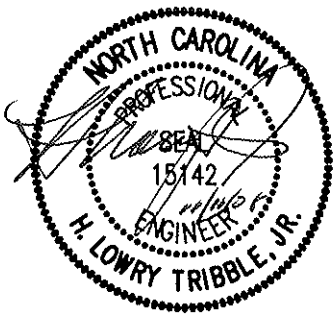
FOR

REPUBLIC SERVICES OF NORTH CAROLINA, LLC
dba
EAST CAROLINA ENVIRONMENTAL

APRIL 2008
REVISED NOVEMBER 2008

VOLUME 1 OF 2





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PERMIT APPLICATION
FOR
EAST CAROLINA REGIONAL LANDFILL
PHASE 5 CONSTRUCTION PERMIT

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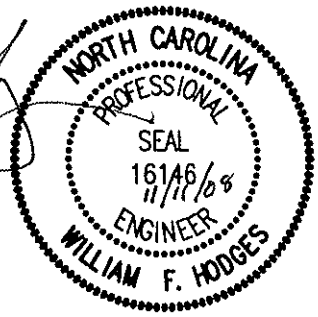
STATEMENT OF COMPLIANCE WITH ENGINEERING PLAN REQUIREMENTS

This Construction Permit Application has been prepared by a Professional Engineer licensed to practice engineering in accordance with N.C.G.S. 89C and the Administrative Rules developed thereunder. It is our opinion that the design described in this Permit Application including Engineering Plans meets the intent of the requirements of 15A NCAC 13B .1620 of the Solid Waste Management Plan.

Respectfully Submitted,
HODGES, HARBIN, NEWBERRY & TRIBBLE, INC.



William F. Hodges, P.E.
Professional Engineer

I. CHECK LIST

Facility: East Carolina Phase V

PERMIT TO CONSTRUCT REGULATORY REVIEW CHECKLIST
NORTH CAROLINA SOLID WASTE MANAGEMENT RULES
CHAPTER 13 SOLID WASTE MANAGEMENT

Rule No.	Requirement	Application Location	Acceptable (yes/no/NA)
REQUIREMENTS FOR MSWLFs - SECTION .1600			
.1620 ENGINEERING PLAN			
(b)	Prepared and sealed by a Professional Engineer	Cover, Section I	
(c)	The engineering plan shall contain a report and a set of drawings which represent the engineering design.	Volume 1 and 2 of 2	
(d)(1)(A) (B)(C)	The engineering report must contain: An analysis of the facility design that conforms to the standards for the foundation and the base liner system; Standards for the cap system, and Standards for the leachate storage facilities.	Section VII Report of Geotechnical Analysis Section II Narrative Section V Operation Plan	
(d)(2)(A) (B)(C)(D)	A summary of the facility design that includes: A discussion of the analytical methods used to evaluate the design; Definition of the critical conditions evaluated and assumptions made; a List of technical references used in the evaluation, and Completion of any applicable location restriction demonstration.	Incorporated throughout Section V Operation Plan, Section VI E&S Design Calcs, Section VIII Leachate Design Calcs, and Section VIII Report of Geotechnical Analysis. Location restriction demonstration was previously submitted and approved during site suitability	
(d)(3)	A description of the materials and construction practices that conforms to the requirements of Rule .1624.	Section IV Technical Specs	
(d)(4)	A copy of the Design Hydrogeologic Report.	Previously submitted under separate cover	
(e)(1)	Engineering drawings must clearly illustrate existing conditions (site topography, features, existing disposal areas, roads, buildings).	Section IX Engineering Plans	
(e)(2)	Grading plans (proposed limits of excavation, subgrade elevations, boring locations, intermediate grading for partial construction).	Section IX Engineering Plans	
(e)(3)	Base liner system (grades for top of composite liner, slopes, anchor configuration, liner penetration locations and details).	Section IX Engineering Plans	
(e)(4)	Leachate collection system (base elevations, piping system grade and inverts, cleanouts, valves, sumps, top of protection cover elevations, and details).	Section IX Engineering Plans	
(e)(5)	Stormwater segregation system (location and detail of features).	Section IX Engineering Plans	
(e)(6)	Cap system (base and top elevations, landfill gas collection, infiltration barrier, surface water removal, protective and vegetative cover, and details).	Section IX Engineering Plans	
(e)(7)	Temporary and permanent sedimentation and erosion control plans.	Section IX Engineering Plans	
(e)(8)	Vertical separation requirements with boring locations, cross sections, maps used in the Hydrogeologic report (ground-water contour map and bedrock contour map), and grading plans.	Section IX Engineering Plans	
(e)(9)	Additional engineering features and details.	Section IX Engineering Plans	

Rule No.	Requirement	Application Location	Acceptable (yes/no/NA)
.1621 CONSTRUCTION QUALITY ASSURANCE PLAN			
(a)	The construction quality control and quality assurance (CQA) plan must describe the observations and tests used before, during and upon completion of construction to ensure construction materials meet the design specifications and the construction and certification requirements outlined in the construction requirements for MSWLF facilities (Rule .1624). The CQA plan must describe the procedures to ensure the integrity of the landfill systems will be maintained prior to waste placement.	Section III CQA Manual	
(b)(1)	For construction of each cell, the CQA plan shall include: The plan shall establish responsibilities and authorities for the construction management organization. A pre-construction meeting shall be conducted prior to beginning construction on the base liner system for a new cell in order to determine the construction management organization, respective duties during construction, and periodic reporting requirements for test results and construction activities.	Section III CQA Manual	
(b)(2)	For inspection activities, the CQA plan shall include a description of all field observations, tests, equipment and calibration procedures for field testing equipment.	Section III CQA Manual	
(b)(3)	For sampling strategies the CQA plan must include a description of all sampling protocols, sample size, methods for determining sample locations and frequency of sampling.	Section III CQA Manual	
(b)(4)	Reporting requirements for CQA activities must be described in detail in the CQA plan and must include progress and trouble shooting meetings (daily and monthly) and the contents of the meetings must be documented.	Section III CQA Manual	

Rule No.	Requirement	Application Location	Acceptable (yes/no/NA)
.1625 OPERATIONAL PLAN FOR MSWLF FACILITIES			
(b)	An operation plan shall be prepared for each phase of landfill development and include drawings and a report clearly defining the information proposed for the Division approved plan.	Section V Operation Plan Section IX Engineering Plans	
(b)(1)	Drawings shall be prepared for each phase of landfill development and be consistent with the engineering plan and include the following:	Section IX Engineering Plans	
(b)(1)(A)	Existing Conditions (include known limits of existing disposal areas).	Section IX Engineering Plans	
(b)(1)(B)	Progression of construction cells for incremental or modular construction.	Section IX Engineering Plans	
(b)(1)(C)	Progression of operation (include initial waste placement, daily operations, transition contours, and final contours).	Section IX Engineering Plans	
(b)(1)(D)	Leachate and stormwater controls for active and inactive subcells.	Section IX Engineering Plans	
(b)(1)(E)	Special waste areas within the MSWLF unit.	Section IX Engineering Plans	
(b)(1)(F)	Buffer zones, noting restricted use.	Section IX Engineering Plans	
(b)(1)(G)	Stockpile and borrow operations.	Section IX Engineering Plans	
(b)(2)	The operation report shall provide a narrative discussion of the operation drawings and contain a description of the facility operation that conforms to the requirements of Rule .1626.	Section V Operation Plan	
3(A)(B)(C)	The operation plan shall include a program for detecting and preventing the disposal of hazardous and liquid waste that meets the requirements of Rule .1626(1)(f) and a routine methane monitoring program meeting the requirements of Rule .1626 (4); a Sedimentation and Erosion Control plan which incorporates adequate measures to control surface water run-off and run-on generated from the 24 hour, 25 year storm event, and operation drawings that illustrate annual phases of development which are consistent with the minimum and maximum slope requirements set forth in Subparagraph (c)(3) of Rule .1627.	Section V Operation Plan Section IX Engineering Plans	

Rule No.	Requirement	Application Location	Acceptable (yes/no/NA)
.1629 CLOSURE AND POST-CLOSURE PLAN			
(b)(1)	Describe steps necessary to close all MSWLF units at any point during its active life in accordance with the cap system requirements described below:	Section II Narrative and Section V Operation Plan	
(b)(1)(A)	Describe the cap system and the methods and procedures to be used to install the cap that conforms to the requirements set forth in Paragraph (c) of the Closure and Post-Closure Requirements section (Rule .1627).	Section II Narrative and Section V Operation Plan	
(b)(1)(B) (i)(ii)	Estimate the largest area of the MSWLF unit ever requiring the specified cap system at any time during the active life that is consistent with the drawings prepared for the Engineering Plans.	Section II Narrative and Section V Operation Plan	
(b)(1)(C)	Estimate the maximum inventory of waste ever on-site over the active life of the landfill facility.	Section II Narrative and Section V Operation Plan	
(b)(1)(D)	Include a schedule for completing all activities necessary to satisfy the closure criteria set forth in Paragraph (c) of the Closure and Post-Closure Requirements section (Rule .1627).	Section II Narrative and Section V Operation Plan	
(b)(2)	Existing MSWLF units not designed and constructed with a base liner system permitted by the Division shall provide the following information:	N/A	
(b)(2)(A) (i)(ii)(iii)(iv) (v)	A local characterization study which includes the landfill facility and a 2000 ft. perimeter measured from the permitted facility boundary, a topography map prepared at a scale of at least one in. equals 400 ft. which provides current topographic information for the permitted facility, identify all water supply intakes (ground and surface water), identify underground utilities lines, identify private residences, and identify any known or potential sources of contamination.	N/A	
(b)(2)(B)	The proposed final capacity of the existing MSWLF unit must be calculated from October 9, 1993, and shall be consistent with the criteria set forth in Subparagraph (c)(1) of Closure and Post-Closure Requirements section (Rule .1627). The method, data, and assumptions used to calculate the remaining capacity shall be clearly stated.	N/A	
(b)(2)(C) (i)(ii)(iii)	A compliance report that demonstrates compliance with Paragraphs (1), (2) and (6) of Rule .1622 (Location Restrictions for MSWLF Facility Siting) and containing a summary of the facility's compliance record for the past five years and contains the water quality and explosive gas monitoring data for the past five years.	N/A	
(b)(3)	The cost estimate for closure required under the Financial Assurance Rule (Rule .1628) shall be included as a component of the plan.	Section II Narrative and Section V Operation Plan	

(c)	Prepare a written post-closure plan that includes, at a minimum, the following information:	Section II Narrative and Section V Operation Plan	
(c)(1)	A description of the monitoring and maintenance activities required in Paragraph (d) of the Closure and Post-Closure Requirements section (Rule.1627) for each MSWLF unit and the frequency at which these activities shall be performed.	Section II Narrative and Section V Operation Plan	
(c)(2)	The name, address and telephone number of the person or office to contact about the facility during the post-closure period.	Section II Narrative and Section V Operation Plan	
(c)(3)	A description of the planned uses of the property during the post-closure period. Post-closure use of the property shall not disturb the integrity of the cap system, base liner system, or any other components of the containment system, or the function of the monitoring systems unless necessary to comply with the requirements in this Section. The Division may approve any other disturbance if the owner or operator demonstrates that disturbance of the cap system, base liner system, or other component of the containment system, including any removal of waste, will not increase the potential threat to human health or the environment.	Section II Narrative and Section V Operation Plan	
(c)(4)	As a component of the plan, the owner or operator shall submit the cost estimate for post-closure required under the Financial Assurance Rule (Rule .1628).	Section II Narrative and Section V Operation Plan	

Rule No.	Requirement	Application Location	Acceptable (yes/no/NA)
.1680 LEACHATE STORAGE REQUIREMENTS			
Construction of Leachate Storage Tanks and Surface Impounds/Liquid Treatment and Disposal at SWLF			
(b)	Applications for a permit to construct a landfill facility which includes leachate storage facilities shall contain the following:		
(b)(1-7) 1. 2. 3. 4. 5. 6. 7.	Description of liquid Estimated volume of liquid generated and proposed recordkeeping of actual quantities stored. Schedule for liquid removal Description of final treatment and disposal of liquid stored Description of liquid storage facility design Contingency plan for unexpected surges in liquid quantities Closure plan	Section V Operation Plan and Section VII Leachate Design Calculations	
(c)(2)(A)(B)	A secondary containment system which may consist of dikes, liners, pads, ponds, impoundments, curbs, ditches, sumps, or other systems capable of containing the liquid stored. (A) The design volume for secondary containment systems shall be 110% of the volume of either the largest tank within the containment system or the total volume of all interconnected tanks, whichever is greater. The secondary containment system shall be constructed of a material compatible with the liquid being stored and equipped with an overfill prevention system which may include: level sensors and gauges, high level alarms or automatic shutoff controls.	Section V Operation Plan and Section VII Leachate Design Calculations	
(c)(3)	A system shall be designed to contain and remove stormwater from the secondary containment area. Provisions shall be included for the removal of any accumulated precipitation and be initiated within 24 hours or when 10% of the storage capacity is reached, whichever occurs first.	Section V Operation Plan and Section VII Leachate Design Calculations	
(c)(4)	All aboveground and onground tanks shall be equipped with an overfill prevention system which may include, but not be limited to: level sensors and gauges, high level alarms or automatic shutoff controls. The overfill control equipment shall be inspected weekly.	Section V Operation Plan and Section VII Leachate Design Calculations	
(c)(6)	All uncovered tanks shall have a minimum of 2 ft of freeboard. Odor and vector control shall be practiced when necessary.	Section V Operation Plan and Section VII Leachate Design Calculations	

II. NARRATIVE

NARRATIVE

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I. INTRODUCTION

This report was prepared on behalf of Republic Services of North Carolina, LLC, in accordance with the North Carolina Solid Waste Management Rules, 15A NCAC 13B, Section .1600, et seq. The purpose of this report is to demonstrate compliance with the applicable permit application requirements so that a Permit to Construct may be issued for the proposed Phase 5 at the East Carolina Regional Landfill.

The East Carolina Regional Landfill is owned and operated by Republic Services of North Carolina, LLC (Republic), doing business as East Carolina Environmental (East Carolina). The facility is located on Republican Road S.R.1225, north of Windsor, Bertie County, N.C. The facility encompasses approximately 662 acres. The facility was originally permitted in 1993, prior to the adoption of the .1600 Rules, which became effective on October 9, 1993. The facility is currently operating under North Carolina Solid Waste Permit No. 08-03. Based on the current waste stream and a capacity analysis performed for Republic Services, the life of the existing Phase 4 area is projected to extend into 2010. In order for Republic Services of North Carolina to continue operating, a new permitted area within the facility is needed for waste disposal. At this time, the facility is seeking a permit renewal to include engineering and operation plans for Phase 5, Cells No. 13 and 14, which will cover approximately 25 acres plus related infrastructure. This permit renewal is being handled under the .1600 Rules. The estimated life of Phase 5 is approximately five years. It is expected that Phase 5 will be constructed in sequence by cell in two separate construction events. Should additional construction events be planned, i.e. partial cell construction, the Section shall be notified, and appropriate plans addressing those revisions will be provided to the Section.

The MSWLF unit is permitted to dispose of household, industrial and commercial solid waste. Hazardous or other banned waste such as yard waste and white goods are not approved for disposal. The facility service area encompasses the State of North Carolina.

Phase 5 of the facility will have a permitted capacity of approximately 3,425,000 cubic yards. The total facility capacity is approximately 24,200,000 cubic yards, over the ±34 year life. This capacity corresponds to an approximate disposal rate of 584,000 tons of waste per year, for the next 21 years or a daily average of approximately 1,600 tons per day, based on 365 days per year or 48,667 tons per month with a maximum variance of 10%.

This report contains information pertinent to the design and construction of a proposed landfill expansion immediately east of the active landfill cells, as well as information related to operations and closure of the facility. Information related to landfill siting requirements was submitted and approved previously, and is therefore not included in this report except as may be necessary to support the design. This permit application is intended to provide the information necessary to allow the Solid Waste Section to issue a Permit to Construct for 25 acres (Phase 5). The estimated operating life for the Phase 5 is five years.

This application consists of eight sections.

- Narrative
- Construction Quality Assurance
- Technical Specifications
- Operation Plan
- E&S Design Calculations
- Leachate Design Calculations
- Engineering Plans
- Correspondence

This document incorporates the appropriate .1600 Rules and the Facility Plan required for permit renewal. (.1617 (e)).

II. .1617 APPLICATION REQUIREMENTS FOR MSWLF FACILITIES

(e) Permit renewal. A complete application for a permit to construct a lateral expansion or a new MSWLF unit shall contain the following:

(1) A Facility Plan that describes comprehensive development of the MSWLF facility prepared in accordance with Rule .1619 of this section;

A Facility Plan prepared in accordance with Rule .1619 of this section has been approved by the Solid Waste Section.

(2) An Engineering Plan that is prepared for the initial phase of landfill development prepared in accordance with Rule .1620 of this section;

An Engineering Plan prepared for this phase of landfill development prepared in accordance with Rule .1620 of this section is included in this document.

(3) A Construction Quality Assurance Plan prepared in accordance with Rule .1621 of this section;

A Construction Quality Assurance (CQA) Plan prepared in accordance with Rule .1621 of this section is included in this document.

(4) An Operation Plan prepared in accordance with Rule .1625 of this section;

An Operation Plan prepared in accordance with Rule .1625 of this section is included in this document.

(5) *A Closure and Post Closure Plan prepared in accordance with Rule .1629 of this section; and*

A Closure and Post Closure Plan prepared in accordance with Rule .1629 of this section is included in this document.

(6) *A Water Quality Monitoring Plan prepared as set forth in Paragraph (b) of Rule .1623.*

A Water Quality Monitoring Plan prepared as set forth in Paragraph (b) of Rule .1623 is included in the Design Hydrogeologic Report, East Carolina Regional Landfill Phase 5, prepared by Golder Associates, dated July 2007 (last revised December 2007).

III. .1619 FACILITY PLAN

(a) Purpose. As required under Rule .1617 of this section, a permit applicant shall prepare a facility plan which meets the requirements of this Rule.

(b) Scope.

(1) The facility plan defines comprehensive development of the property proposed for permit or described in the permit of an existing facility. The plan includes a set of drawings and a report which present the long-term, general design concepts related to construction, operation, and closure of the MSWLF unit(s), including leachate management. The scope of the plan spans the active life of the MSWLF unit(s). Additional solid waste management facilities located at the MSWLF facility shall be identified in the plan and shall meet the requirements of this Subchapter. The facility plan defines the waste stream proposed for management at the MSWLF facility. If different types of landfill units or non-disposal facilities are included in the facility design, the plan must describe general waste acceptance procedures.

(2) The area limits of the MSWLF unit(s), total capacity of the MSWLF unit(s), and the proposed waste stream shall be consistent with the Section's approval set forth:

(A) In accordance with Rule .1618 (a)(1) of this section for a new facility: or,

(B) In accordance with the current permit for an existing facility applying for permit renewal.

(c) Use of Terms. The terminology used in describing areas of the landfill unit shall be defined in the facility plan and shall be used consistently throughout a permit application. The Section recommends the use of the following terms:

(1) A "phase" is an area constructed with a base liner system that provides no more than approximately five years of operating capacity.

(2) A "cell" is a subdivision of a phase which describes modular or partial construction.

(3) A "subcell" is a subdivision of a cell which describes leachate and stormwater management for active or inactive areas of the constructed MSWLF.

(d) Facility Drawings. The facility plan shall include the following drawings:

(1) Site Development. The two drawings which plot site development shall be prepared on a topographic map representative of existing site conditions; the map shall locate the physical features referenced in Rule .1622 of this section and shall incorporate a survey locating all property boundaries for the proposed landfill facility certified by an individual licensed to practice land surveying in the State of North Carolina.

(A) Landfill units and leachate facilities. This drawing shall delineate the aerial limits of all landfill units and leachate facilities and incorporate the buffer requirements set forth in Subparagraph (b)(3) of Rule .1624.

(B) *All facilities. This drawing shall locate all solid waste management facilities and facility infrastructure, including landfill units and leachate facilities.*

Facility Drawings have been previously approved. The permitted East Carolina Regional Landfill encompasses approximately 662 acres, 150 acres of which are approved for MSW disposal capacity by the Solid Waste Section of North Carolina. The approved lined MSW acreage has been subdivided into seven (7) five year phases. The facility is currently operating in Phase 4, which includes Cells No. 11 and 12. Construction of Cell No. 11 was completed in early 2006 and a permit to operate was issued by the Section on June 15, 2006. Cell No. 12 is expected to be constructed during 2008 and will provide approximately1 ½ to 2 years of capacity.

(2) *Landfill Construction. All on-site grading activities related to the construction and operation of the MSWLF unit(s) shall be illustrated in facility drawings which:*

(A) *Delineate the limits of grading, including borrow and stockpile areas;*

(B) *Define phases of development which do not exceed approximately five years of operating capacity;*

(C) *Propose base grades for the MSWLF unit(s);*

(D) Delineate the location of access roads, sedimentation basins, leachate pipeline and storage or treatment facilities and other structures related to the operation of the MSWLF unit; and

(E) Propose final contours for the MSWLF unit(s) and facility features for closure.

The approved Facility Drawings show each item required by the Rules.

(3) Landfill Operation. The following information related to the long-term operation of the MSWLF units shall be included in facility drawings;

(A) General grade and flow direction for the drainage layer component of the leachate collection system;

(B) Size, location, and general grade for the leachate piping system, including on-site pipelines to leachate management facilities;

(C) Proposed transitional contours for each phase of development, including operational grades for existing phase(s) and construction grading for the new phase; and

(D) If included in the design, stormwater segregation features and details for inactive landfill subcells.

The approved Facility Drawings show each item required by the Rules.

(e) Facility Report. The facility plan shall include the following information:

(1) Waste stream. A discussion of the characteristics of the wastes received at the facility and facility specific management plans shall incorporate:

(A) The types of waste specified for disposal;

This facility will accept municipal solid waste, non-hazardous industrial waste, and other non-hazardous waste types allowed by the Rule.

(B) Average monthly disposal rates and estimated variance;

The facility will have an average monthly disposal rate of 1,600 tons per day, 365 days per year, with a variance of 10%. Additionally, allowances may be made from time to time to exceed this volume for disposal of hurricane debris.

(C) The area served by the facility;

The area to be served by the facility includes all cities, counties, and commercial / industrial facilities in the State of North Carolina.

(D) Procedures for segregated management at different on-site facilities; and

All waste will be managed at the working face of the landfill. Future activities may include Construction / Demolition

management areas, storm debris storage, waste solidification, white goods storage, composting operations, borrow areas and other facilities for solid waste management.

(E) Equipment requirements for operation of the MSWLF unit.

The facility will utilize the following equipment:

Steel Wheel Compactors
Excavator
Dozers
Pick-up Trucks
Farm Tractor
Mowers
Articulated Trucks

In addition to this basic equipment, other equipment will be utilized or substituted on-site when necessary.

(2) Landfill Capacity. An analysis of landfill capacity and soil resources shall be performed.

(A) The data and assumptions used in the analysis shall be:

(i) Consistent with the facility drawings and disposal rates specified in the facility plan; and

(ii) Representative of operational requirements and conditions.

Calculations shown in the Narrative Appendix demonstrate that data and assumptions used in the analysis are consistent with the facility drawings and disposal rates in the facility plan; and that they are representative of operational requirements and conditions.

(B) The conclusions shall provide accurate volumetric estimates of:

(i) Total operating capacity;

The gross capacity of the facility is approximately 24,200,000 cubic yards, based on the facility drawings.

(ii) Operating capacity for each phase of development;

A preliminary estimate of the operating of each phase is:

Phase 1	**± 1,850,000 Cubic Yards**	**(completed)**
Phase 2	**± 1,850,000 Cubic Yards**	**(completed)**
Phase 3	**± 3,600,000 Cubic Yards**	
Phase 4	**± 5,200,000 Cubic Yards**	
Phase 5	**± 3,425,000 Cubic Yards**	
Phase 6	**± 4,075,000 Cubic Yards**	
Phase 7	**± 4,200,000 Cubic Yards**	

Detailed facility design could affect phase size and configuration of the phases. Also, final capacity will be

determined based on the final design for each specific phase.

(iii) In-Place ratio of waste to soil;

It is projected that daily and intermediate soil cover will be equal to about 8% of the total airspace volume, and that final cover will be equal to 5% of the total airspace volume. Therefore, the waste-to-soil ratio, will be about eight to one.

(iv) Available soil resources from on-site or specific off-site sources;

Available cover soil and soil for other purposes exceeds ±3,900,000 cubic yards. Adequate material is located on-site, or on other lands controlled by East Carolina adjacent to the site, though off-site soils may be utilized from time to time. (East Carolina owns or leases adjacent lands which can be utilized for borrow material.)

(v) Required quantities of soil for landfill construction, operation, and closure; and

Approximately 3,900,000 cubic yards of soil will be required for landfill construction, operation and closure.

(vi) The estimated operating life of all MSWLF units in years.

The landfill life will exceed 34 years, based on projected waste streams. Each phase will provide approximately five years capacity. Phase sizes may be changed during detail design to match cell capacity to a five year life. Life remaining from the time of this application will be about 21 years.

(3) Containment and environmental control systems. A general description of the systems designed for proper landfill operation, system components, and corresponding functions shall be provided.

This landfill facility is designed as a lined MSW landfill system. During landfill development, cell filling, and closure; a liner and leachate collection system will be utilized to assure that all precipitation contacting waste will be collected, and managed as leachate. Leachate collected on the liner will drain to pump stations or sideslope riser pumps where it will be pumped to one of two leachate storage tanks. These storage tanks will be equipped with independent secondary containment systems. The in-cell leachate collection system is designed to collect and remove leachate from the cell, while assuring leachate head on the liner will not exceed 12 inches.

The base liner system will be a composite system of a 24 inch thickness of $\leq 1x10^{-7}$ cm/sec clay, covered by a 60 mil HDPE flexible membrane liner. Quality Control and Quality Assurance procedures will be utilized to demonstrate liner construction quality.

The leachate collection and removal system will utilize a highly permeable soil media above the liner, with a piping network, to assure

complete removal of leachate. All components will be sized to adequately manage flows and surges.

Once leachate is removed from the liner, it will be transferred by gravity lines, pumping stations and force mains to the leachate storage tanks.

(4) Leachate Management. An analysis of the leachate management requirements and plans for the MSWLF facility shall incorporate the information required under this Subparagraph.

(A) The performance of and design concepts for the leachate collection system within active areas of the MSWLF unit and any storm water segregation included in the engineering design shall be described.

The cells are designed with stormwater rain flaps to minimize the precipitation contact with the waste. This procedure minimizes production of leachate within the landfill. The leachate collection system is designed with pipes and filter media to promote leachate drainage, and to assure sustained leachate head on the liner does not exceed 12 inches.

(B) Normal operating conditions. Normal operating conditions shall be defined and must consider:

(i) Average monthly values for leachate generation representative of the landfill's environment and operation using:

(I) empirically derived estimates; or

Leachate volumes have been estimated based on the U.S. Army Corp of Engineers HELP Model (Hydraulic Evaluation of Landfill Performance). The average leachate production based on the HELP Model will be approximately 6,500 to 12,100 gallons per day. This correlates to the actual leachate production of 365 days per year.

(II) for landfill expansions, actual leachate generation data from the existing landfill.

Since this is an existing landfill, estimates of actual volume are utilized for determining leachate volume. Volumes recorded for the past three years have been between 5,000 and 12,000 gallons per day, with an average of 7,500 gallons per day.

Also, the leachate volumes appear to be somewhat reduced by the more effective stormwater management of unfilled new cells. Due to the many phases of development the landfill has experienced, a per acre leachate calculation based entirely on the HELP Model would not be reliable. Therefore, historical figures on this facility were utilized to estimate leachate volumes.

(ii) Surge volumes generated by storm events.

Surge volumes are estimated by inserting the 24-hour, 25-hour storm event into the HELP Model manually. Utilizing this technique indicates a daily peak volume of about 41,944 gallons per day at this facility. This could be exceeded immediately after a cell or sub-cell opens if a rainfall event occurs.

(C) Leachate management system. A description of the leachate management system components and their engineered function shall be provided, including:

(i) Leachate pipeline operating capacity;

All piping has been designed to handle the greater of the peak daily flow, or the pump capacity feeding these pipes.

(ii) Capacity of the storage and if applicable, the treatment facilities;

The leachate storage capacity is 412,000 gallons, which includes both the original 250,000 gallon tank and the new 162,000 gallon tank installed in 2007. This volume is based on the average monthly leachate production rate. Storage will be accomplished in the glass lined steel leachate storage tanks. Currently, there are no on-site treatment facilities at the site. Future pretreatment or treatment facilities are anticipated and shall be considered part of this facility plan. Design of any future treatment

facilities will be completed when that treatment is required.

(iii) Final disposal plans and applicable discharge limits, including documented prior approval of the waste water treatment plant which may be designated in the plan.

Leachate will be managed through recirculation, or transported off-site to either commercial treatment facilities, or publicly owned treatment works (POTW). Each receiving treatment facility will establish pretreatment standards and applicable discharge limits. As the strength of the leachate increases with time, applicable treatment facilities will be added.

(D) A contingency plan shall be prepared for storm surges or other considerations exceeding design parameters for the storage or treatment facilities.

The facility is being designed and developed with a system for segregating cells with waste from cells which have not yet received waste. Those cells which have not yet received waste will be drained (gravity or pumped) to the storm drainage system which is capable of handling the 25-year storm event. Sub-cells containing waste are limited to about 2 acres. This limitation is sufficient for the management of the 25-year storm event in the leachate management system. Storms with greater duration, or conditions causing surges greater than projected will be stored in the lined cell for periods not-to-exceed 72 hours.

(5) Special engineering features.

This facility utilizes engineering features shown on the engineering drawings. Also, as detail design is completed, other engineering features may be added which enhance the facility operations.

IV. .1620 ENGINEERING PLAN

(a) Purpose. The engineering plan incorporates the detailed plans and specifications relative to the design and performance of the landfill's containment and environmental control systems. This plan sets forth the design parameters and construction requirements for the components of the landfill's systems and establishes the responsibilities of the design engineer. The engineered components are described in Rule .1624 of this section. As required under Rule .1617 of this section, the owner or operator shall submit an engineering plan which meets the requirements of this Rule.

(b) Responsibilities of the design engineer. The engineering plan shall be prepared by a Professional Engineer licensed to practice engineering in accordance with GS 89C and the Administrative Rules developed thereunder. The plan shall meet the requirements of this Rule; the design engineer shall incorporate a statement certifying this fact and bearing his or her seal of registration.

(c) Scope. An engineering plan shall be prepared for a phase of development not to exceed approximately five years of operating capacity, consistent with the development phases and design criteria defined in the facility plan. The original and subsequent plans must incorporate the design of leachate management and other environmental control facilities. The engineering plan shall contain a report and a set of drawings which consistently represent the engineering design.

(d) An engineering report must contain:

(1) An analysis of the facility design that conforms to:

(A) The standards for the foundation and the base liner system set forth in Rule .1624 of this section;

These items are discussed in Section VIII of this report, entitled Geotechnical Analyses Phase 5 Construction, prepared by Bunnell-Lammons Engineering, Inc., dated January 9, 2008.

(B) The standards for the cap system set forth in Paragraph (c) of Rule .1627 of this section; and

These items are discussed in this document.

(C) The standards for the leachate storage facilities set forth in Rule .1680 of this section.

These items are discussed in this document.

(2) A summary of the facility design that includes:

(A) a discussion of the analytical methods used to evaluate the design;

The calculations include discussion of the analytical methods used to evaluate the design. Additionally, this is discussed in the Operation Plan.

(B) definition of the critical conditions evaluated and assumptions made;

The critical conditions evaluated and the assumptions made are clearly shown with the calculations to which they pertain.

(C) a list of technical references used in the evaluation; and

Technical references are listed with the calculations to which they pertain. Additionally, this is discussed in the Operation Plan.

(D) completion of any applicable location restriction demonstrations in accordance with Rule .1622 of this section.

The location restriction demonstrations were completed during the site suitability phase of the application process. These are further discussed in the Design Hydrogeologic Report by Golder Associates, dated July 2007.

(3) A description of the materials and construction practices that conforms to the requirements set forth in Rule .1624 of this section, and is consistent with the analysis of the facility design prepared in accordance with this Part.

Materials and construction practices that conform to the requirements set forth in Rule .1624 are included in the technical specifications.

(4) A copy of the Design Hydrogeologic Report prepared in accordance with Paragraph (b) of Rule .1623.

The Design Hydrogeologic Report prepared in accordance with Paragraph (b) of Rule .1623 has been submitted under separate cover. This report was prepared by Golder Associates, dated July 2007 (last revised December 2007).

(e) Engineering drawings must clearly illustrate:

(1) Existing conditions; site topography, features, existing disposal areas, roads, buildings;

These items are shown in the engineering plans attached.

(2) Grading plans; proposed limits of excavation, subgrade elevations, boring locations, intermediate grading for partial construction;

These items are shown in the engineering plans attached.

(3) Base liner system; grades for top of composite liner, slopes, anchor configuration, liner penetration locations and details;

These items are shown in the engineering plans attached.

(4) Leachate collection system; base elevations, piping system grade and inverts, cleanouts, valves, sumps, top of protective cover elevations, and details;

These items are shown in the engineering plans attached.

(5) Stormwater segregation system; location and detail of features;

These items are shown in the attached engineering plans and are discussed in the Operation Plan.

(6) Cap system; base and top elevations, landfill gas collection, infiltration barrier, surface water removal, protective and vegetative cover, and details;

These items are shown in the attached engineering plans and are discussed in the Operation Plan.

(7) Temporary and permanent sedimentation and erosion control plans;

These items are shown in the engineering plans attached.

(8) Vertical separation requirements incorporating boring locations, cross sections, the maps prepared in accordance with Rules .1623(b)(2)(E) and (F) of this section, and the grading plans; and

A vertical separation demonstration incorporating cross sections, prepared in accordance with Rules .1623(b)(2)(E) and .1623(b)(2)(F) is attached. It is shown on the engineering plans.

(9) Additional engineering feature and details.

The engineering plans, the technical specifications, the Operation Plan, and this application document discuss all engineering features and details.

V. .1621 CONSTRUCTION QUALITY ASSURANCE PLAN

(a) Purpose. The construction quality control and quality assurance (CQA) plan must describe the observations and tests that will be used before, during, and upon completion of construction to ensure that the construction materials meet the design specifications and the construction and certification requirements set forth in Rule .1624 of this section. The CQA plan must also describe the procedures to ensure that the integrity of the landfill systems will be maintained prior to waste placement.

(b) For construction of each cell, the CQA plan shall include, but not be limited to:

(1) Responsibilities and authorities. The plan shall establish responsibilities and authorities for the construction management organization. A pre-construction meeting shall be conducted prior to beginning construction of the base liner system for a new cell. The meeting shall include a discussion of the construction management organization, respective duties during construction, and periodic reporting requirements for test results and construction activities.

(2) Inspection activities. A description of all field observations, tests, equipment, calibration procedures for field testing equipment that will be used to ensure that the construction and installation meets or exceeds all design criteria established in accordance with Rules .1620 and .1624 of this section must be presented in the CQA plan.

(3) Sampling strategies. A description of all sampling protocols, sample size, methods for determining sample locations and frequency of sampling must be presented in the CQA plan.

(4) *Documentation. Reporting requirements for CQA activities must be described in detail in the CQA plan. Progress and troubleshooting meetings, daily and monthly, must be addressed in the plan and the contents of the meetings must be documented.*

A construction quality assurance plan (CQA) is attached to this permit document. This CQA plan meets the requirements of Rule .1621.

VI. .1624 CONSTRUCTION REQUIREMENTS FOR MSWLF FACILITIES

(a) This Rule establishes the performance standards and minimum criteria for designing and constructing a new MSWLF unit or lateral expansion of existing MSWLF units. Additional standards for the cap system are described in Rule .1627 of this section.

The East Carolina Regional Landfill is designed to meet the performance standards and the minimum criteria established by the Rules. The design is shown in the engineering plans, the technical specifications, the CQA document, the calculations, and the permit application.

(b) New MSWLF units and lateral expansions shall comply with the following design and construction criteria:

(1) Base liner system description. The base liner system is constructed on the landfill subgrade and shall be designed to efficiently contain, collect, and remove leachate generated by the MSWLF unit. At a minimum, the components of the liner system shall consist of the following:

(A) A Base Liner. The base liner shall consist of one of the following designs. The design described in Subpart (b)(1)(A)(i) of this Rule is the standard composite liner. If a landfill owner or operator proposes to utilize one of the alternative composite liner designs described in Subparts (b)(1)(A)(ii) and (iii) of this Rule, the owner or operator shall demonstrate through a model that the proposed design will ensure that maximum concentration levels (MCLs) listed in Table 1 will not be exceeded in the uppermost aquifer at the relevant point of compliance as established in Rule .1631(a)(2) of this section. For these two designs, the Section may waive the site-specific modeling

requirement if it can be demonstrated that a previous site for which a model was approved had similar hydrogeologic characteristics, climatic factors and volume and physical and chemical leachate characteristics. If an alternative liner design other than Subparts (b)(1)(A)(ii) and (iii) of this Rule is proposed, the Section shall require site-specific, two-phase modeling as described in Subpart (b)(1)(A)(iv) of this Rule.

(i) A composite liner utilizing compacted clay liner (CCL). The composite liner is one liner that consists of two components; a geomembrane liner installed above and in direct and uniform contact with a compacted clay liner with a minimum thickness of 24 inches (0.61 m) and a permeability of no more than 1.0×10^{-7} cm/sec. The composite liner shall be designed and constructed in accordance with Subparagraphs (b)(8) and (10) of this Rule.

(ii) A composite liner utilizing a geosynthetic clay liner (GCL). The composite liner is one liner that consists of three components: a geomembrane liner installed above and in uniform contact with a GCL overlying a compacted clay liner with a minimum thickness of 18 inches (0.46 m) and a permeability of no more than 1.0×10^{-5} cm/sec. The composite liner shall be designed and constructed in accordance with Subparagraphs (b)(8), (9), and (10) of this Rule.

(iii) A composite liner utilizing two geomembrane liners. The composite liner consists of three components; two

geomembrane liners each with an overlying leachate drainage system designed to reduce the maximum predicted head acting on the lower membrane liner to less than one inch. The lower membrane liner shall overlie a compacted clay liner with a minimum thickness of 12 inches (0.31 m) and a permeability of no more than 1.0 x 10^{-5} cm/sec. The composite liner system shall be designed and constructed in accordance with Subparagraphs (b)(8) and (10) of this Rule.

(iv) An Alternative base liner. An alternative base liner system may be approved by the Section if the owner or operator demonstrates through a two-phase modeling approach that the alternative liner design meets the following criteria:

(I) The rate of leakage through the alternative liner system will be less than or equal to the composite liner system defined in Subparts (b)(1)(A)(i) of this Rule; and

(II) The design will ensure that concentration values listed in Table 1 will not be exceeded in the uppermost aquifer at the relevant point of compliance as established in Rule .1631 (a)(2) of this section.

The composite liner utilized on the East Carolina Regional Landfill design conforms to this section of the Rules. A detail of that liner system is included in the engineering plans.

(B) A leachate collection system (LCS). The LCS is constructed directly above the base liner and shall be designed to effectively collect and remove leachate from the MSWLF unit. The secondary function of the LCS is to establish a zone of protection between the base liner and the waste, The LCS shall be designed and constructed in accordance with Subparagraphs (b)(2), (11), (12) and (13) of this Rule.

The LCS utilized on the East Carolina Regional Landfill is designed to conform to the Rules. This LCS is shown in the engineering plans.

(2) Leachate collection system design and operation.

(A) The leachate collection system shall be hydraulically designed to remove leachate from the landfill and ensure that the leachate head on the composite liner does not exceed one foot. A means of quantitatively assessing the performance of the leachate collection system must be provided in the engineering plan. The performance analysis must evaluate the flow capacities of the drainage network necessary to convey leachate to the storage facility or off-site transport location. The engineering evaluation shall incorporate the following criteria:

(i) At a minimum, the geometry of the landfill shall be designed to control and contain the volume of leachate generated by the 24-hour, 25-year storm.

The geometry of the East Carolina Regional Landfill and the LCS are designed to control and contain the leachate generated by the 24-hour, 25-year storm event.

(ii) The performance analysis shall evaluate the leachate collection system for the flow capacities during conditions when the maximum impingement rate occurs on the LCS. The LCS flow capacity shall be designed to reduce the head on the liner system generated by the 24-hour, 25-year storm to less than one foot within 72 hours after the storm event.

(B) The leachate collection system shall be designed to provide a zone of protection at least 24 inches separating the composite liner from landfilling activities, or shall be subject to approval from the Section upon a demonstration of equivalent protection for the liner system.

The leachate collection system utilizes a 24" thick sand or sandy soil drainage media to separate the composite liner from landfilling activities.

(C) The leachate collection system shall be designed to resist clogging and promote leachate collection and removal from the landfill.

The LCS utilizes a 24" thick sand or sandy soil drainage layer, and stone filter system, and a network of pipes with cleanouts. This system is detailed in the engineering plans and is designed to prevent physical clogging and promote leachate collection and removal from the landfill.

(D) The leachate collection system shall be operated to remove leachate from the landfill in such a way as to ensure that the leachate head on the composite liner does not exceed one foot under normal operating conditions.

(3) Horizontal separation requirements.

(A) Property line buffer. New MSWLF units at a new facility shall establish a minimum 300-foot buffer between the MSWLF unit and all property lines.

The East Carolina Regional Landfill has minimum 300-foot buffers between the MSWLF unit and all property lines.

(B) Private residences and wells. All MSWLF units at a new facility shall establish a minimum 500-foot buffer between the MSWLF unit and existing private residences and wells.

The East Carolina Regional Landfill has minimum 500-foot buffers between the MSWLF unit and existing private residences and wells.

(C) Surface waters. All MSWLF units at new facilities shall establish a minimum 50-foot buffer between the MSWLF unit and any stream, river, or lake unless the owner or operator can demonstrate:

(i) To the Section that the alternative management of the water and any discharge will adequately protect the public health and environment; and

The East Carolina Regional Landfill maintains minimum 50' buffers between the MSWLF unit and any perennial stream, river or lake.

(ii) That the construction activities conform to the requirements of Sections 404 and 401 of the Clean Water Act.

The East Carolina Regional Landfill maintains minimum 50' buffers between the MSWLF unit and any stream, river or lake.

(D) Existing landfill units. An adequate buffer distance shall be established between a new MSWLF unit and any existing landfill units to establish a ground water monitoring system as set forth in Rule .1631 of this section.

The East Carolina Regional Landfill is approximately one mile from any existing landfill unit, and as such, its ground water monitoring system can meet the requirements of Rule .1631.

(E) Existing facility buffers. At a minimum, a lateral expansion or new MSWLF unit at an existing facility shall conform to the requirements of the effective permit.

Buffers are shown on the engineering plans.

(4) Vertical separation requirements. A MSWLF unit shall be constructed so that the post-settlement bottom elevation of the base liner system is a

minimum of four feet above the seasonal high ground-water table and bedrock datum plane contours established in the Design Hydrogeological Report prepared in accordance with Rule .1623(b) of this section.

The East Carolina Regional Landfill Units are designed to maintain a post-settlement bottom elevation of the base liner system a minimum of four feet above the seasonal high ground water table and final bedrock contours. Any materials other than in-place soil utilized for this separation will be compacted soil from on-site and off-site borrow. This compaction effort shall be in accordance with the methods detailed in the technical specifications.

(5) *Survey control. One permanent benchmark of known elevation measured from a U.S. Geological Survey benchmark shall be established and maintained for each 50 acres of developed landfill, or part thereof, at the landfill facility. This benchmark shall be the reference point for establishing vertical elevation control.*

Benchmarks are established as required by this Rule and are shown on the engineering plans.

(6) *Location coordinates. The North Carolina State Plane (NCSP) Coordinates shall be established and one of its points shall be the benchmark of known NCSP coordinates.*

One benchmark for the site has known and established North Carolina State Plane Coordinates. This benchmark is shown on the engineering plans with the State Plane Coordinates.

(7) *Landfill subgrade. The landfill subgrade is the in-situ soil layer(s), constructed embankments, and select fill providing the foundation for construction of the unit. A foundation analysis shall be performed to determine the structural integrity of the subgrade to support the loads and stresses imposed by the weight of the landfill and to support overlying facility components and maintain their integrity of the components. Minimum post-settlement slope for the subgrade shall be two percent. Safety factors shall be specified for facilities located in a Seismic Impact Zones.*

A structural analysis of the subgrade, along with the project design has taken into account the foundation strength and the integrity of the components. These items are included in the permit submittal. Post-settlement slope for the subgrade floor exceeds two percent. This site is not located in a Seismic Impact Zone. These analyses are included in the report of Geotechnical Analyses Phase 5 Construction, prepared by Bunnell-Lammons Engineering, Inc. dated January 9, 2008.

(A) *Materials required. The landfill subgrade shall be adequately free of organic material and consist of in-situ soils or a select fill approved by the Section in accordance with the performance standards contained in Subparagraph (b)(7) of this Rule.*

This requirement of the Rules is specified in the project technical specifications. A construction quality assurance program will certify compliance.

(B) Construction requirements.

(i) The landfill subgrade shall be graded in accordance with the approved plans and specifications, which are incorporated into the permit to construct in accordance with Rule .1604(b) of this section.

The East Carolina Regional Landfill will be graded and constructed in accordance with the Section approved plans and specification.

(ii) The owner or operator of the MSWLF units may be required by the permit to notify the Section's hydrogeologist and inspect the subgrade when excavation is completed or if bedrock or other unpredicted subsurface conditions are encountered during excavation.

If directed by the Section, the East Carolina Regional Landfill will notify the Section's hydrogeologist so the subgrade can be inspected. If unpredicted subsurface conditions are encountered during construction, the Section will be notified.

(C) Certification requirements. At a minimum, the subgrade surface shall be inspected in accordance with the following requirements:

(i) Before beginning construction of the base liner system, the project engineer shall visually inspect the exposed surface to evaluate the suitability of the subgrade and document that the

surface is properly prepared and that the elevations are consistent with the Section approved engineering plans incorporated into the permit to construct in accordance with Rule .1604(b) of this section;

The certification is detailed in the CQA plan. This certification meets the requirements of this Rule.

(ii) The subgrade shall be proof-rolled using specified procedures and equipment specified by the design or project engineer; and

The certification is detailed in the CQA plan. This certification meets the requirements of this Rule.

(iii) The subgrade shall be tested for density and moisture content at a minimum frequency as specified in the plans incorporated into the permit to construct in accordance with Rule .1604(b) of this section.

The certification is detailed in the CQA plan. This certification meets the requirements of this Rule.

(8) Compacted clay liners. Compacted clay liners are low permeability barriers designed to control fluid migration in a cap liner system or base liner system.

(A) Materials required. The soil materials used in constructing a compacted clay liner may consist of on-site or off-site sources, or a combination of sources; sources may possess adequate native

properties or may require bentonite conditioning to meet the permeability requirement. The soil material shall be free of particles greater than three inches in any dimension.

The compacted clay liner is designed and will be installed to meet the requirements of this section of the Rule. This is detailed in the technical specifications.

(B) Construction requirements. Construction methods for the compacted clay liner shall be based upon the type and quality of the borrow source and shall be verified in the field by constructing test pad(s). The project engineer shall ensure that the compacted clay liner installation conforms with the Section approved plans including following minimum requirements:

(i) A test pad shall be constructed prior to beginning installation of the compacted clay liner and whenever there is a significant change in soil material properties. The area and equipment, liner thickness, and subgrade slope and conditions shall be representative of full scale construction. Acceptance and rejection criteria shall be verified for the test specified in accordance with Part (C) of this Subparagraph. For each lift, a minimum of three test locations shall be established for testing moisture content, density, and a composite sample for recompacted lab permeability. At least one shelby tube sample for lab permeability testing, or another in-situ test that is approved by the Section as equivalent for permeability determination shall be obtained per lift.

The technical specifications for the test pad meet this Rule requirement. This is shown in the technical specifications.

(ii) *Soil conditioning, placement, and compaction shall be maintained within the range identified in the moisture-density-permeability relation developed in accordance with Subparagraph (C) of this Paragraph.*

The compacted clay liner soil placement is specified to be in accordance with this Rule. This is defined in the technical specifications.

(iii) *The final compacted thickness of each lift shall be a maximum of six inches.*

This condition is met as defined in the technical specifications.

(iv) *Prior to placement of successive lifts, the surface of the lift in place shall be scarified or otherwise conditioned to eliminate lift interfaces.*

This condition is met as defined in the technical specifications.

(v) *The final lift shall be protected from environmental degradation.*

This condition is met as defined in the technical specifications.

(C) Certification requirements. The project engineer shall include in the construction quality assurance report a discussion of all quality assurance and quality control testing required in this Subparagraph. The testing procedures and protocols shall be submitted in accordance with Rule .1621 of this section and approved by the Section. The results of all testing shall be included in the construction quality assurance report including documentation of any failed test results, descriptions of the procedures used to correct the improperly installed material, and statements of all retesting performed in accordance with the Section approved plans including the following requirements:

(i) At a minimum, the quality control testing for accepting materials prior to and during construction of a compacted clay liner should include: particle size distribution analysis, Atterberg limits, triaxial cell laboratory permeability, moisture content, percent bentonite admixed with soil, and the moisture-density-permeability relation. The project engineer shall certify that the materials used in construction were tested according to the Section approved plans.

This Rule will be conformed with as defined in the engineering plans, technical specifications, and construction quality assurance document. Final reporting will conform to this format.

(ii) *At a minimum, the quality assurance testing for evaluating each lift of the compacted clay liner shall include: moisture content and density, and permeability testing. For each location the moisture content and density shall be compared to the appropriate moisture-density-permeability relation. The project engineer shall certify that the liner was constructed using the methods and acceptance criteria consistent with test pad construction and tested in accordance with the plans incorporated into the permit to construct in accordance with Rule .1604 (b) of this section.*

This Rule will be conformed with as defined in the engineering plans, technical specifications, and construction quality assurance document. Final reporting will conform to this format.

(iii) *Any tests resulting in the penetration of the compacted clay liner shall be repaired using bentonite or as approved by the Section.*

This Rule will be conformed with as defined in the engineering plans, technical specifications, and construction quality assurance document. Final reporting will conform to this format.

(9) *Geosynthetic Clay liners. Geosynthetic clay liners are geosynthetic hydraulic barriers manufactured in sheets and installed by field seaming techniques.*

(A) Materials required. Geosynthetic clay liners shall consist of natural sodium bentonite clay or equivalent, encapsulated between two geotextiles or adhered to a geomembrane. The liner material and any seaming materials shall have chemical and physical resistance not adversely affected by environmental exposure, waste placement, leachate generation and subgrade moisture composition. Accessory bentonite, used for seaming, repairs and penetration seaming shall be made from the same sodium bentonite as used in the geosynthetic clay liner or as recommended by the manufacturer. The type of geosynthetic clay liner shall be approved by the Section according to the criteria set forth in this Part.

(i) Reinforced geosynthetic clay liners shall be used on all slopes greater than 10H:1V.

(ii) The geosynthetic clay liner material shall have a demonstrated hydraulic conductivity of not more than 5 x 10^{-9} cm/sec under the anticipated confining pressure.

(B) Design and Construction requirements. The design engineer shall ensure that the design of the geosynthetic clay liner installation conforms to the requirements of the manufacturer's recommendations and the Section approved plans. The Section approved plans shall provide for and include the following provisions:

(i) The surface of the supporting soil upon which the geosynthetic clay liner will be installed shall be reasonably free of stones, organic matter, protrusions, loose soil, and any abrupt changes in grade that could damage the geosynthetic clay liner;

This component is not utilized on this facility.

(ii) *Materials placed on top of the GCL shall be placed in accordance with the plans incorporated into the permit to construct in accordance with Rule .1604(b) of this section. Equipment used to install additional geosynthetics shall be specified by the design engineer and as recommended by the manufacturer. A minimum of 12 inches of separation between the application equipment and the geosynthetic clay liner shall be provided when applying soil materials;*

This component is not utilized on this facility.

(iii) *Materials that become prematurely hydrated shall be removed, repaired, or replaced, as specified by the project engineer and in accordance with the plans incorporated into the permit to construct prepared in accordance with Rule .1604(b) of this section;*

This component is not utilized on this facility.

(iv) *Field seaming preparation and methods, general orientation criteria, and restrictive weather conditions;*

This component is not utilized on this facility.

(v) *Anchor trench design;*

This component is not utilized on this facility.

(vi) Critical tensile forces and slope stability, including seismic design;

This component is not utilized on this facility.

(vii) Protection from environmental damage; and

This component is not utilized on this facility.

(viii) Physical protection from the materials installed directly above the geosynthetic clay liner.

This component is not utilized on this facility.

(C) Certification requirements.

(i) Before beginning installation of the geosynthetic clay liner, the project engineer shall visually inspect the exposed surface to evaluate the suitability of the subgrade and document that the surface is properly prepared and that the elevations are consistent with the approved engineering plans incorporated into the permit to construct in accordance with Rule .1604 (b) of this section.

This component is not utilized on this facility.

(ii) The project engineer shall ensure that the geosynthetic clay installation conforms to the requirements of the manufacturer's

recommendations and the plans incorporated into the permit to construct in accordance with Rule .1604 (b) of this section.

This component is not utilized on this facility.

(iii) The project engineer shall include in the construction quality assurance report a discussion of quality assurance and quality control testing to document that material is placed in accordance with plans incorporated into the permit to construct in accordance with Rule .1604(b) of this section.

This component is not utilized on this facility.

(iv) The project engineer shall include in the construction quality assurance report a discussion of the approved data resulting from the quality assurance and quality control testing required in this Subparagraph.

This component is not utilized on this facility.

(v) The testing procedures and protocols for field installation shall be submitted in accordance with Rule .1621 of this section and approved by the Section.

This component is not utilized on this facility.

(vi) The results of all testing shall be included in the construction quality assurance report, including documentation of any failed test results, descriptions of the procedures used to correct the improperly installed material, and performance documentation of all retesting, in accordance with the plans incorporated into the permit to construct in accordance with Rule .1604 (b) of this section, including the following:

This component is not utilized on this facility.

(I) Quality control testing of the raw materials and manufactured product;

This component is not utilized on this facility.

(II) Field and independent laboratory destructive testing of geosynthetic clay liner samples;

This component is not utilized on this facility.

(III) Documentation prepared by the project engineer in accordance with Subpart (b)(9)(C)(i) of this Rule.

This component is not utilized on this facility.

(10) Geomembrane liners. Geomembrane liners are geosynthetic hydraulic barriers manufactured in sheets and installed by field seaming techniques.

(A) Materials required. The liner material and any seaming materials shall have chemical and physical resistance not adversely affected by environmental exposure, waste placement and leachate generation. The type of geomembrane shall be approved by the Section according to the criteria set forth in this Part.

These conditions are met as described in the technical specifications.

(i) High density polyethylene geomembrane liners shall have a minimum thickness of 60 mils.

These conditions are met as described in the technical specifications.

(ii) The minimum thickness of any geomembrane approved by the Section shall be greater than 30 mils.

These conditions are met as described in the technical specifications.

(B) Construction requirements. The project engineer shall ensure that the geomembrane installation conforms to the requirements of the manufacturer's recommendations and the Section approved plans including the following:

These conditions are met as described in the technical specifications.

(i) The surface of the supporting soil upon which the geomembrane will be installed shall be reasonably free of stones, organic matter, protrusions, loose soil, and any abrupt changes in grade that could damage the geomembrane;

These conditions are met as described in the technical specifications.

(ii) Field seaming preparation and methods, general orientation criteria, and restrictive weather conditions;

These conditions are met as described in the technical specifications.

(iii) Anchor trench design;

These conditions are met as described in the technical specifications.

(iv) Critical tensile forces and slope stability;

These conditions are met as described in the technical specifications.

(iii) Protection from environmental damage; and

These conditions are met as described in the technical specifications.

(vi) Physical protection from the materials installed directly above the geomembrane.

These conditions are met as described in the technical specifications.

(C) Certification requirements. The project engineer shall include in the construction quality assurance report a discussion of the approved data resulting from the quality assurance and quality control testing required in this Subparagraph. The testing procedures and protocols for field installation shall be submitted in accordance with Rule .1621 of this section and approved by the Section. The results of all testing shall be included in the construction quality assurance report including documentation of any failed test results, descriptions of the procedures used to correct the improperly installed material, and statements of all retesting performed in accordance with the plans incorporated into the permit to construct in accordance with Rule .1604(b) of this section, including the following:

These conditions are met as described in the technical specifications.

(i) Quality control testing of the raw materials and manufactured product;

These conditions are met as described in the technical specifications.

(ii) At a minimum, test seams shall be made upon each start of work for each seaming crew, upon every four hours of continuous seaming, every time seaming equipment is changed or if significant changes in geomembrane temperature and weather conditions are observed;

These conditions are met as described in the technical specifications.

(iii) Nondestructive testing of all seams; and

These conditions are met as described in the technical specifications.

(iv) Field and independent laboratory destructive testing of seam samples.

These conditions are met as described in the technical specifications.

(11) Leachate collection pipes. A leachate collection pipe network shall be a component of the leachate collection system and shall be hydraulically designed to convey leachate from the MSWLF unit to an appropriately sized leachate storage or treatment facility or a point of off-site transport. Leachate collection piping shall comply with the following:

(A) Materials required.

(i) The leachate collection piping shall have a minimum nominal diameter of six inches.

The engineering plans and detail drawings show the leachate pipe diameter. All primary leachate pipe shall have a nominal minimum diameter of eight inches. Supplemental pipes with smaller diameters may be used for short term enhancement of the system.

(ii) The chemical properties of the pipe and any materials used in installation shall not be adversely affected by waste placement or leachate generated by the landfill.

The leachate collection piping is HDPE material which is not adversely affected by waste placement or leachate generated by a MSW landfill.

(iii) The physical properties of the pipe shall provide adequate structural strength to support the maximum static and dynamic loads and stresses imposed by the overlying materials and any equipment used in construction and operation of the landfill. Specifications for the pipe shall be submitted in the engineering report.

Calculations and specifications for the leachate pipe are included in the Leachate Design Calculations and the technical specifications.

(B) Construction requirements.

(i) Leachate collection piping shall be installed according to the plans incorporated into the permit to construct in accordance with Rule .1604(b) of this section.

The East Carolina Regional Landfill will install leachate piping in accordance with the plans approved by the Section. Additionally, supplemental smaller leachate collection lines may be utilized to further improve the performance of the collection system.

(ii) The location and grade of the piping network shall provide access for periodic cleaning.

Required leachate piping has appropriate cleanouts and access for periodic cleaning of the pipe. These cleanouts are shown and detailed in the engineering plans.

(iii) The bedding material for the leachate collection pipe shall consist of a coarse aggregate installed in direct contact with the pipe. The aggregate shall be chemically compatible with the leachate generated and shall be placed to provide adequate support to the pipe. The bedding material for main collector lines should be extended to and in direct contact with the waste layer or a graded soil or granular filter.

The pipe bedding is a stone coarse aggregate installed in direct contact with the pipe. This is shown and detailed in the engineering plans.

(C) Certification requirements. The project engineer shall include in the construction quality assurance report a discussion of the quality assurance and quality control testing to ensure that the material is placed according to

the approved plans. The testing procedures and protocols for field installation shall be submitted in accordance with Rule .1621 of this section and approved by the Section. The results of all testing shall be included in the construction quality assurance report including documentation of any failed test results, descriptions of the procedures used to correct the improperly installed material, and statements of all retesting performed in accordance with plans incorporated into the permit to construct in accordance with Rule .1604(b) of this section, including the following::

(i) All leachate piping installed from the MSWLF unit to the leachate storage or treatment facility shall be watertight.

This requirement of the Rules is met. The piping between the unit and leachate storage or treatment is shown on the engineering plans. Watertightness requirements are contained in the technical specifications.

(ii) The seal where the piping system penetrates the geomembrane shall be inspected and non-destructively tested for leakage.

The penetration assembly used on existing cells or the leachate side slope riser sump used on future cells is shown and detailed on the engineering plans. This is discussed in the technical specifications.

(12) Drainage layers. Any soil, granular, or geosynthetic drainage nets used in the leachate collection system shall conform to the following requirements:

(A) Materials required.

(i) *The chemical properties of the drainage layer materials shall not be adversely affected by waste placement or leachate generated by the landfill.*

Materials used will be geotextile, sand, and gravels that are not adversely affected by waste placement or leachate generated by the landfill.

(ii) *The physical and hydraulic properties of the drainage layer materials shall promote lateral drainage of leachate through a zone of relatively high permeability or transmissivity under the predicted loads imposed by overlying materials.*

The materials specified have adequate hydraulic conductivities after being loaded which will promote lateral drainage of the leachate.

(B) *Construction requirements.*

(i) *The drainage layer materials shall be placed in accordance with the approved plans prepared in accordance with Rule .1604(b) of this section and in a manner that prevents equipment from working directly on the geomembrane.*

The technical specifications and CQA document specify methods for drainage layer placement which prevent equipment from working directly on the geomembrane.

(ii) The drainage layer materials shall be stable on the slopes specified on the engineering drawings.

The drainage layer materials are stable on all landfill bottom areas. Drainage media shall be placed on sideslopes in an incremental manner that prevents excessive loading of the sideslopes. This is detailed in the operations documents, technical specifications, and the engineering plans.

(C) Certification requirements. The project engineer shall include in the construction quality assurance report a discussion of the quality assurance and quality control testing to ensure that the drainage layer material is placed according to the approved plans. The testing procedures and protocols for field installation shall be submitted in accordance with of Rule .1621 of this section and approved by the Section. The results of all testing shall be included in the construction quality assurance report including documentation of any failed test results, descriptions of the procedures used to correct the improperly installed material, and statements of all retesting performed in accordance with the approved plans prepared in accordance with Rule .1604(b) of this section.

The CQA for drainage layer installation and reporting is defined in the CQA document and the technical specifications.

13) Filter layer criteria. All filter collection layers used in the leachate collection system shall be designed to prevent the migration of fine soil particles into a courser grained material, and permit water or gases to freely enter a drainage medium (pipe or drainage layer) without clogging.

(A) Materials required.

(i) Graded cohesionless soil filters. The granular soil material used as a filter shall have no more than five percent by weight passing the No. 200 sieve and no soil particles larger than three inches in any dimension.

(ii) Geosynthetic filters. Geosynthetic filter materials shall demonstrate adequate permeability and soil particle retention, and chemical and physical resistance which is not adversely affected by waste placement, any overlying material or leachate generated by the landfill.

(B) Construction requirements. All filter layers shall be installed in accordance with the engineering plan and specifications incorporated into the permit to construct prepared in accordance with Rule .1604(b) of this section. Geosynthetic filter materials shall not be wrapped directly around leachate collection piping.

(C) Certification requirements. The project engineer shall include in the construction quality assurance report a discussion of the quality assurance and quality control testing to ensure that the filter layer material is placed according to the approved plans. The testing procedures and protocols for field installation shall be submitted in accordance with Rule .1621 of this section and approved by the Section. The results of all testing shall be included in the construction quality assurance report including documentation of any failed test results, descriptions of the procedures used to correct the improperly installed material, and statements of all retesting

performed in accordance with the approved plans prepared in accordance with Rule .1604(b) of this section.

The filter system used with the leachate collection piping is adequate to prevent fines from entering the pipes.

(14) Special engineering structures. Engineering structures incorporated in the design and necessary to comply with the requirements of this section shall be specified in the engineering plan. Material, construction, and certification requirements necessary to ensure that the structure is constructed according the design and acceptable engineering practices shall be included in the Section approved plan.

The engineering plans and technical specifications describe, specify, and detail special engineering structures utilized in the design/construction of this facility. The technical specifications provide the basis of material, construction, and certification requirements.

(15) Sedimentation and erosion control. Adequate structures and measures shall be designed and maintained to manage the run-off generated by the 24-hour, 25-hour *storm event, and conform to the requirements of the Sedimentation Pollution Control Law (15A NCAC 4).*

A sedimentation control plan is incorporated into the engineering plans which details the requirements to meet the Sediment Pollution Control Law (15 A NCAC 4). These plans will be submitted for approval to the Land Division. A copy of the Land Division approval will be placed in the facility operating record.

(16) Construction quality assurance (CQA) report.

(A) A CQA report shall be submitted:

(i) after completing landfill construction in order to qualify the constructed MSWLF unit for a permit to operate:

This CQA report will be filed in a timely manner to qualify the constructed MSWLF unit for a permit to operate.

(ii) after completing construction of the cap system in accordance with the requirements of Rule .1629; and

Upon completion of fill within various areas of the landfill facility, and these areas being appropriately capped in accordance with Rule .1629, a CQA report on that activity shall be filed in a timely manner.

(iii) according to the reporting schedule developed in accordance with Rule .1621 of this section.

These reports shall be filed according to the reporting schedule developed and defined in Rule .1621.

(B) The CQA report shall include, at a minimum, the information prepared in accordance with the requirements of Rule .1621 of this section containing results of all construction quality assurance and construction quality control testing required in this Rule including documentation of any failed test results, descriptions of procedures used to correct the improperly installed

material and results of all retesting performed. The CQA report shall contain as-built drawings noting any deviation from the approved engineering plans and shall also contain a comprehensive narrative including but not limited to daily reports from the project engineer and a series of color photographs of major project features.

The reports will be filed as described in this Rule section.

(C) The CQA report shall bear the seal of the project engineer and a certification that construction was completed in accordance with:

(i) the CQA plan;
(ii) the conditions of the permit to construct;
(iii) the requirements of this Rule; and
(iv) acceptable engineering practices.

A CQA report with a certification letter meeting the requirements delineated above will be filed to comply with this Rule.

(D) The Section shall review the CQA report within 30 days of a complete submittal to ensure that the report meets the requirements of this Subparagraph.

VII. .1625 OPERATION PLAN FOR MSWLF FACILITIES

(a) The operator of a MSWLF unit shall maintain and operate the facility according to the operation plan prepared in accordance with this Rule.

(1) Existing MSWLF units. The operator of an existing MSWLF unit shall meet the following requirements.

(A) The operation plan shall be prepared as the information becomes available.

An Operation Plan is included into this document.

(B) The operation plan shall be completed and submitted on or before April 9, 1994.

An Operation Plan was completed and submitted before April 9, 1994 as part of the facility's Transition Plan.

(C) The operation plan shall describe the existing phase of landfill development through the final receipt of wastes established in accordance with Subparagraph (c)(10) of the Rule .1627.

An Operation Plan meeting this requirement is included in this document.

(D) The operator of an existing MSWLF unit which will reach permitted capacity prior to October 9, 1996 as set forth in the effective permit shall:

(i) *Complete the operation plan and submit five copies to the Section at least 60 days prior to reaching permitted capacity; and*

Not Applicable.

(ii) *Receive at least partial approval from the Section as set forth in Part (d)(2)(B) of Rule .1603 in order to continue operation of the existing MSWLF unit.*

Not Applicable.

(2) *New MSWLF units and lateral expansions. The Operation Plan shall be submitted in accordance with Rules .1617 and .1604(b)(2)(P) of this section. Each phase of operation shall be defined by an area which will contain approximately five years of disposal capacity.*

The Operation Plan is submitted as part of this Construction Permit Application. The Operation Plan was developed in accordance with Rules .1617 and .1604(b)(2)(P).

(b) *Operation Plan. The owner or operator of a MSWLF unit shall prepare an Operation Plan for each phase of landfill development. The plan shall include drawings and a report clearly defining the information proposed for the Section approved plan.*

(1) *Operation drawings. Drawings shall be prepared for each phase of landfill development. The drawings shall be consistent with the engineering plan and*

prepared in a format which is useable for the landfill operator. The operation drawings shall illustrate the following:

(A) existing conditions, including the known limits of existing disposal areas;

A drawing showing existing conditions including the existing disposal areas is included in the engineering plans.

(B) progression of construction cells for incremental or modular construction;

The cell construction sequencing is shown in the engineering plans.

(C) progression of operation, including initial waste placement, daily operations, transition contours, and final contours;

The progression of operation including initial waste placement, daily operations, transition contours, and final contours are shown on the engineering plans, and further described in the Operation Plan.

(D) leachate and stormwater control for active and inactive subcells;

Leachate management/stormwater control is discussed in the Operation Plan.

(E) special waste areas within the MSWLF unit;

No special waste areas are designated within the MSWLF units.

(F) buffer zones, noting restricted use; and

Buffer areas are shown on the engineering plans with restrictions noted.

(G) stockpile and borrow operations.

The cover and construction soil materials will be borrowed from the cell areas and other soil borrow areas during construction of the cells. On-site soil borrow areas are shown on the engineering plans and include other areas on site where soil borrow may be obtained.

(2) Operations report. The report shall provide a narrative discussion of the operation drawings and contain a description of the facility operation that conforms to the requirements of Rule .1626 of this section.

The operations report is a part of the Operation Plan. This report provides a discussion of the facility operation that conforms to the requirements of Rule .1626.

(3) The Operation Plan for an existing MSWLF unit shall include:

(A) The facility's programs set forth in Parts (1)(f), (2)(b), and (4)(b) of Rule .1626;

The Operation Plan complies with these Rule sections.

(B) A Sedimentation and Erosion Control Plan which incorporates adequate measures to control surface water run-off and run-on generated from the 24-hour, 25-year storm event;

The facility design includes a Erosion and Sedimentation (E&S) Control Plan which incorporates adequate measures to control surface water run-off and run-on generated from the 24-hour, 25-year storm event.

(C) Operation drawings that illustrate annual phases of development which are consistent with the minimum and maximum slope requirements set forth in Subparagraph (c)(3) of Rule .1627;

The operation drawings comply with this Rule section.

(D) The remaining permitted capacity approved by the Section prior to October 9, 1993, and calculated from October 9, 1993 using reasonable methods, data, and assumptions, and

The estimate of remaining capacity is included in this Construction Permit Application.

(E) Documented closure of the landfill unit(s) which stopped receiving waste before October 9, 1991.

Not Applicable.

VIII. .1626 OPERATIONAL REQUIREMENTS FOR MSWLF FACILITIES

The owner or operator of any MSWLF unit must maintain and operate the facility in accordance with the requirements set forth in this Rule and the Operation Plan as described in Rule .1625 of this section.

(1) Waste Acceptance and Disposal Requirements.

(a) A MSWLF shall only accept those solid wastes which it is permitted to receive. The landfill owner or operator shall notify the Section within 24 hours of attempted disposal of any waste the landfill is not permitted to receive, including waste from outside the area the landfill is permitted to serve.

The East Carolina Regional Landfill will evaluate all incoming wastes at the scale facility. Records will be maintained of any attempt to dispose of non-permitted waste, and the Section will be notified as called for in this Rule. The methods for screening waste are discussed in the Operation Plan.

(b) The following wastes are prohibited from disposal at a MSWLF unit:

(i) Hazardous waste as defined within 15A NCAC 13A, to also include hazardous waste from conditionally exempt small quantity generators.

These wastes will not be allowed into the East Carolina Regional Landfill for disposal.

(ii) Polychlorinated biphenyls (PCB) wastes as defined in 40 CFR 761.

These wastes will not be allowed into the East Carolina Regional Landfill for disposal.

(iii) Liquid wastes unless they are managed in accordance with Rule .1626(9) of this section.

These wastes will not be allowed into the East Carolina Regional Landfill for disposal. Only liquids managed in accordance with .1626(9) will be accepted for disposal in the landfill.

(c) Spoiled foods, animal carcasses, abattoir waste, hatchery waste, and other animal waste delivered to the disposal site shall be covered immediately.

This condition will be complied with.

(d) Asbestos waste shall be managed in accordance with 40 CFR 61, which is hereby incorporated by reference including any subsequent amendments and additions. Copies of 40 CFR 61 are available for inspection at the Department of Environment, Health, and Natural Resources, Solid Waste Section, 401 Oberlin Road, Raleigh, N.C. at no cost. The waste shall be covered immediately with soil in a manner that will not cause airborne conditions and must be disposed of separate and apart from other solid wastes:

(i) At the bottom of the working face or;

This condition will be complied with.

(ii) In an area not contiguous with other disposal areas. Separate areas shall be clearly designated so that asbestos is not exposed by future land-disturbing activities.

This condition will be complied with.

(e) Wastewater treatment sludges may only be accepted for disposal in accordance with the following conditions:

(i) Utilized as a soil conditioner and incorporated into or applied onto the vegetative growth layer but, in no case greater than six inches in depth.

Sewage sludge may be utilized in this manner.

(ii) Co-disposed if the facility meets all design requirements contained within Rule .1624, and approved within the permit, or has been previously approved as a permit condition.

The East Carolina Regional Landfill proposes to co-dispose sludge and proposes this as a permit condition.

(f) Owners or operators of all MSWLF units must implement a program at the facility for detecting and preventing the disposal of hazardous and liquid wastes. This program must include, at a minimum:

(i) Random inspections of incoming loads or other comparable procedures;

Inspection procedures are discussed in the Operation Plan.

(ii) Records of any inspections;

Recordkeeping is discussed in the Operation Plan.

(iii) Training of facility personnel to recognize hazardous and liquid wastes.

The training procedures are outlined in the Operation Plan.

(iv) Development of a contingency plan to properly manage any identified hazardous and liquid wastes. The plan must address identification, removal, storage and final disposition of the waste.

The procedures for handling hazardous and liquid waste are described in the Operation Plan. The Operation Plan also discussed procedures for identifying prohibited waste types.

(g) Waste placement at existing MSWLF units shall meet the following criteria:

(i) Waste placement at existing MSWLF units not designed and constructed with a base liner system approved by the Section shall be within the areal limits of the actual waste boundary established prior to October 9, 1993 and in a manner consistent with the effective permit.

Not Applicable since the entire facility has an approved base liner system.

(ii) *Waste placement at existing MSWLF units designed and constructed with a base liner system permitted by the Section prior to October 9, 1993 and approved for operation by the Section shall be within the areal limits of the base liner system and in manner consistent with the effective permit.*

The waste placement is in a manner consistent with the effective permit.

(2) *Cover material requirements.*

(a) *Except as provided in (2) (B) of this Paragraph, the owners or operators of all MSWLF units must cover disposed solid waste with six inches of earthen material at the end of each operating day, or at more frequent intervals if necessary, to control disease vectors, fires, odors, blowing litter, and scavenging.*

Both soil and alternative daily cover are proposed for use at this facility. See section (b) below.

(b) *Alternative materials of an alternative thickness (other than at least six inches of earthen material) may be approved by the Section if the owner or operator demonstrates that the alternative material and thickness control disease vectors, fires, odors, blowing litter, and scavenging without presenting a threat to human health and the environment. A MSWLF owner*

or operator may apply for a generic approval of an alternative cover material, which would extend to all MSWLF units.

Currently approved alternate daily covers at the East Carolina Regional Landfill include petroleum contaminated soils (PCS) and fabric tarps. The site may use additional alternative daily covers such as, posi-shell, yard waste type compost/mulch, foam, shredded wood, crushed gypsum, C&D fines, foundry sand, paper pulp sludge, alum sludge and automotive shredder residue (ASR) in the future. However, these additional alternative daily covers must be approved by the Section in accordance with 15A NCAC 13B .1626(2)(b) prior to any use of such.

(c) Areas which will not have additional wastes placed on them for 12 months or more, but where final termination of disposal operations has not occurred, shall be covered with a minimum of one foot of intermediate cover.

Intermediate cover will be utilized as described by this section.

(3) Disease vector control.

(a) Owners or operators of all MSWLF units must prevent or control on-site populations of disease vectors using techniques appropriate for the protection of human health and the environment.

(b) For purposes of this Item, "disease vectors" means any rodent, flies, mosquitoes, or other animals, including insects, capable of transmitting disease to humans.

Vector control will be accomplished through appropriate use of daily cover on the facility.

(4) Explosive gases control.

(a) Owners or operators of all MSWLF units must ensure that:

(i) The concentration of methane gas generated by the facility does not exceed 25 percent of the lower explosive limit for methane in facility structures (excluding gas control or recovery system components); and

(ii) The concentration of methane gas does not exceed the lower explosive limit for methane at the facility property boundary.

(b) Owners or operators of all MSWLF units must implement a routine methane monitoring program to ensure that the standards of (4)(a) are met. A permanent monitoring system shall be constructed on or before October 9, 1994. A temporary monitoring system shall be used prior to construction of the permanent system.

(i) The type and frequency of monitoring must be determined based on the following factors:

(A) Soil conditions;
(B) The hydrogeologic conditions surrounding the facility;
(C) The hydraulic conditions surrounding the facility;
(D) The location of facility structures and property boundaries.

(ii) The minimum frequency of monitoring shall be quarterly.

(c) If methane gas levels exceeding the limits specified in (4)(a) are detected, the owner or operator must:

(i) Immediately take all necessary steps to ensure protection of human health and notify the Section;

(ii) Within seven days of detection, place in the operating record the methane gas levels detected and a description of the steps taken to protect human health; and

(iii) Within 60 days of detection, implement a remediation plan for the methane gas releases, place a copy of the plan in the operating record, and notify the Section that the plan has been implemented. The plan shall describe the nature and extent of the problem and the proposed remedy.

(iv) Based on the need for an extension demonstrated by the operator, the Section may establish alternative schedules for demonstrating compliance with (4)(c)(ii) and (iii) of this Rule..

(d) The purposes of the Item, "lower explosive limit" means the lowest percent by volume of a mixture of explosive gases in air that will propagate a flame at 25°C and atmospheric pressure.

Explosive gas control is discussed in the Operation Plan.

(5) Air Criteria

(a) Owners or operators of all MSWLF's must ensure that the units do not violate any applicable requirements developed under a State Implementation Plan (SIP) approved or promulgated by the U.S. EPA Administrator pursuant to Section 110 of the Clean Air Act, as amended.

Air regulations (North Carolina SIP - NSPS for landfills) will be complied with.

(b) Open burning of solid waste, except for the infrequent burning of land clearing debris generated on site or debris from emergency clean-up operations, is prohibited at all MSWLF units. Any such infrequent burning must be approved by the Section.

East Carolina Regional Landfill will request approval from the Section prior to any infrequent burning of land clearing debris generated on-site or debris from emergency clean-up operations.

(c) Equipment shall be provided to control accidental fires or arrangements shall be made with the local fire protection agency to immediately provide fire-fighting services when needed.

East Carolina Regional Landfill will provide fire fighting equipment on-site for small fires. In addition, arrangements will be made with the local fire departments for fire fighting services.

(d) Fires that occur at a MSWLF require verbal notice to the Section within 24 hours and written notification shall be submitted within 15 days.

(6) Access and safety requirements.

(a) The MSWLF shall be adequately secured by means of gates, chains, berms, fences and other security measures approved by the Section to prevent unauthorized entry.

Access will be controlled by natural and manmade barriers. These controls will be maintained by the facility operator.

(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.

This item will be complied with and is discussed in the Operation Plan.

(c) The access road to the site shall be of all-weather construction and maintained in good condition.

The site roads will be constructed for all weather use as shown on the engineering plans.

(d) Dust control measures shall be implemented when necessary.

Dust control will be provided as described in the Operations Plan on the roads as necessary.

(e) Signs providing information on dumping procedures, the hours during which the site is open for public use, the permit number and other pertinent information shall be posted at the site entrance,

Appropriate signs will be posted.

(f) *Signs shall be posted stating that no hazardous or liquid waste can be received.*

Appropriate signs will be posted.

(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.*

Appropriate signs will be posted.

(h) *The removal of solid waste from a MSWLF is prohibited unless the owner or operator approves and the removal is not performed on the working face.*

This is discussed in the Operation Plan.

(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.*

This is discussed in the Operation Plan.

(7) *Erosion and sedimentation control requirements.*

(a) *Adequate sediment control measures (structures or devices), shall be utilized to prevent silt from leaving the MSWLF facility.*

(b) *Adequate sediment control measures (structures or devices), shall be utilized 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 MSWLF development.*

Each of the erosion and sedimentation controls is detailed in the Erosion and Sedimentation (E&S) Control Plan to be approved for this site.

(8) *Drainage control and water protection requirements.*

(a) *Surface water shall be diverted from the operational area.*

This item will be complied with.

(b) *Surface water shall not be impounded over or in waste.*

This item will be complied with.

(c) *Solid waste shall not be disposed of in water.*

This item will be complied with.

(d) *Leachate shall be contained on site or properly treated prior to discharge. An NPDES permit may be required prior to the discharge of leachate to surface waters.*

Leachate will either be irrigated over the lined areas, re-circulated into the waste mass, or transported via truck to private treatment facilities or a POTW. This is discussed under leachate management in the Operation Plan.

(e) MSWLF units shall not:

(i) Cause a discharge of pollutants into waters of the United States, including wetlands, that violates any requirements of the Clean Water Act, including, but not limited to, the National Pollutant Discharge Elimination System (NPDES) requirements, pursuant to Section 402.

(ii) Cause the discharge of a nonpoint source of pollution to waters of the United States, including wetlands, that violated any requirement of an area-wide or State-wide water quality management plan that has been approved under Section 208 or 319 of the Clean Water Act, as amended.

These conditions will be complied with.

(9) Liquids restrictions.

(a) Bulk or non-containerized liquid waste may not be placed in MSWLF units unless:

(i) The waste is household waste other than septic waste and waste oil, or,

(ii) The waste is leachate or gas condensate derived from the MSWLF unit, whether it is a new or existing MSWLF unit or lateral expansion, is designed with a composite liner and leachate collection system as described within Rule .1624 of this section.

The East Carolina Regional Landfill is constructed with a composite liner and leachate collection system as described in Rule .1624. The facility will recirculate leachate into the landfill waste mass as discussed in the Operation Plan.

(b) Containers holding liquid wastes may not be placed in the MSWLF unit unless:

(i) The container is a small container similar in size to that normally found in household waste:

(ii) The container is designed to hold liquids for use other than storage; or

(iii) The waste is household waste.

(c) For the purpose of this Paragraph:

(i) Liquid waste means any waste material that is determined to contain "free liquids" as defined by Method 9095 (Paint Filter Liquids Test), S.W. 846.

(ii) Gas Condensate means the liquid generated as a result of gas recovery processes at the MSWLF unit.

(10) Recordkeeping requirements.

(a) The owner or operator of a MSWLF unit must record and retain at the facility, or an alternative location near the facility approved by the Section, in an operating record the following as it becomes available:

(i) Inspection records, waste determination records, and training procedures required in Item (1) of this Rule;

(ii) Amounts by weight of solid waste received at the facility to include source of generation;

(iii) Gas monitoring results and any remediation plans required by Item (4) of this Rule;

(iv) Any demonstration, certification, finding, monitoring, testing, or analytical data required by Rule .1630 thru .1637 of this section;

(v) Any monitoring, testing, or analytical data as required by Rule .1627 of this section.

(vi) Any cost estimates and financial assurance documentation required by Rule .1628 of this section.

(b) All information contained in the operating record must be furnished upon request to the Section or be made available at all reasonable times for inspection by the Section.

(c) *The owner or operator must maintain a copy of the Operation Plan required by Rule .1625 of this section at the facility.*

These conditions will be complied with, and they are discussed in the Operation Plan.

(11) *Spreading and Compacting requirements.*

(a) *MSWLF units shall restrict solid waste into the smallest area feasible.*

(b) *Solid waste shall be compacted as densely as practical into cells.*

(c) *Appropriate methods such as fencing and diking shall be provided within the area to confine solid waste subject to be blown by the wind. At the conclusion of each day of operation, all windblown material resulting from the operation shall be collected and returned to the area by the owner or operator.*

These conditions will be complied with, and they are discussed in the Operation Plan.

(12) *Leachate management plan. The owner or operator of a MSWLF unit designed with a leachate collection system must establish and maintain of leachate management plan which, at a minimum, includes the following:*

(a) *Periodic maintenance of the leachate collection system;*

(b) *Maintaining records for the amounts of leachate generated;*

(c) Semi-annual leachate quality sampling;

(d) Approval for final leachate disposal; and

(e) A contingency plan for extreme operational conditions.

This is included in the Operation Plan for this facility.

IX. .1627 CLOSURE AND POST CLOSURE REQUIREMENTS FOR MSWLF FACILITIES

(a) Purpose. This Rule establishes criteria for the closure of all MSWLF units and subsequent requirements for post-closure compliance. The owner or operator is required to develop specific plans for the MSWLF facility under Rule .1629.

(b) Scope

(1) Closure. Standards are established for the scheduling and documenting closure of all MSWLF units, and designing the cap system. Construction requirements for the cap system incorporate specific requirements from Rule .1624 of this section.

(2) Post-Closure. Standards are established for the monitoring and maintenance of the MSWLF unit(s) following closure.

(c) Closure criteria

(1) New and existing MSWLF units and lateral expansions shall install a cap system that is designed to minimize infiltration and erosion. The cap system shall be designed and constructed to:

(A) have a permeability less than or equal to the permeability of any base liner system or the in-situ subsoils underlaying the landfill, or the permeability specified for the final cover in the effective permit, or a permeability no greater than 1 x 10^{-5} cm/sec, whichever is less;

(B) minimize infiltration through the closed MSWLF by the use of low-permeability barrier that contains a minimum 18 inches of earthen material; and

(C) minimize erosion of the cap system and protect the low-permeability barrier from root penetration by use of an erosion layer that contains a minimum of six inches of earthen material that is capable of sustaining native plant growth.

The East Carolina Regional Landfill has an approved alternate cap which meets the requirements of this Rule. This cap is shown in the engineering plans.

(2) The Section may approve an alternative cap system if the owner or operator can adequately demonstrate the following:

(A) The alternative cap system will achieve an equivalent or greater reduction in infiltration as the low-permeability barrier specified in Subparagraph (1) of this Paragraph; and

(B) The erosion layer will provide equivalent or improved protection as the erosion layer specified in Subparagraph (3) of this Paragraph.

The East Carolina Regional Landfill proposes to utilize an alternative cap system. Demonstrations for each alternate cap have been provided to the Section with copies placed in the Facility Operating Record.

(3) Construction of the cap system for all MSWLF units shall conform to the requirements set forth in Subparagraphs (b)(8), (b)(9) and (b)(15) of Rule .1624 and the following requirements:

(A) post-settlement surface slopes shall be a minimum of five percent and a maximum of 25 percent;

(B) a gas venting or collection system shall be installed below the low-permeability barrier to minimize pressures exerted on the barrier.

The facility is designed with slopes to meet those specified in (A) above, except that the alternate cap uses slopes greater than 25%. The facility has an NSPS gas extraction system.

(4) Prior to beginning closure of each MSWLF unit as specified in Subparagraph (5) of this Paragraph, an owner or operator shall notify the Section that a notice of the intent to close the unit has been placed in the operating record.

This notice of intent to close a unit will be sent to the Section, and placed in the facility operating record.

(5) The owner or operator shall begin closure activities of each MSWLF unit no later than 30 days after the date on which the MSWLF unit receives the known final receipt of wastes or, if the MSWLF unit has remaining capacity and there is a reasonable likelihood that the MSWLF unit will receive additional wastes, no later than one year after the most recent receipt of wastes. Extensions beyond the one-year deadline for beginning closure may be granted by the Section if the owner or operator demonstrates that the MSWLF unit has the capacity to receive additional wastes and the owner or

operator has taken and will continue to take all steps necessary to prevent threats to human health and the environment from the unclosed MSWLF unit.

This item will be complied with at the time of MSWLF unit closure.

(6) The owner or operator of all MSWLF units shall complete closure activities of each MSWLF unit in accordance with the closure plan within 180 days following the beginning of closure as specified in Subparagraph (5) of this Paragraph. Extensions of the closure period may be granted by the Section if the owner or operator demonstrates that closure will, of necessity, take longer than 180 days and they have taken and will continue to take all steps to prevent threats to human health and the environment from the unclosed MSWLF unit.

This item will be complied with at the time a MSWLF unit is closed.

(7) Following closure of each MSWLF unit, the owner or operator shall notify the Section 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.

The engineer's certifications will be placed in the facility operating record, and the Section will be notified of this.

(8) Recordation

(A) Following closure of all MSWLF units, the owner or operator shall record a notation on the deed to the landfill facility property, or some other instrument that is normally examined during title search, and

notify the Section that the notation has been recorded and a copy has been placed in the operating record.

(B) The notation on the deed shall in perpetuity notify and potential purchaser of the property that:

(i) The land has been used as a landfill facility; and

(ii) Its use is restricted under the closure plan approved by the Section.

The notations and language in this section will be affixed to the deed to the property following closure of all MSWLF units.

(9) The owner or operator may request permission from the Section to remove the notation from the deed if all wastes are removed from the facility.

Should all waste be removed from this facility, this request will be made in a timely manner.

(10) Existing MSWLF units. The following criteria shall apply to existing MSWLF units not designed and constructed with a base liner system permitted by the Section.

(A) The existing MSWLF unit shall cease receiving solid waste on or before January 1, 1998.

(B) The Section shall schedule closure of the existing MSWLF unit based on its review of the application submitted in accordance with Paragraph (d) of Rule .1617 and reviewed in accordance with Subparagraph (d) of Rule .1603.

At this time, the facility is filing this application for construction permit renewal.

(C) Final contours for the existing MSWLF unit shall be consistent with the capacity requirements necessary to close the unit in accordance with the requirements of this Subparagraph.

These requirements will be met.

(d) Post-closure criteria

(1) Following closure of each MSWLF unit, the owner or operator shall conduct post-closure care. Post-closure care shall be conducted for 30 years, except as provided under Subparagraph (2) of this Paragraph, and consist of at least the following:

(A) Maintaining the integrity and effectiveness of any cap system, including making repairs to the cover as necessary to correct the effects of settlement, subsidence, erosion, or other events, and preventing run-on and run-off from eroding or otherwise damaging the cap system;

(B) Maintaining and operating the leachate collection system in accordance with the requirements in Rules .1624 and .1626. The

Section may allow the owner or operator to stop managing leachate if the owner or operator demonstrates that leachate no longer poses a threat to human health and the environment;

(C) Monitoring the ground water and surface water in accordance with the requirements of Rules .1631 through .1637 and maintaining the ground water monitoring system, if applicable; and monitoring the surface water in accordance with the requirements of Rule .0602; and

(D) Maintaining and operating the gas monitoring system in accordance with the requirements of Rule .1626 of this section.

During the Post Closure period, requirements (A), (B), (C) and (D) will be complied with by the landfill operator.

(2) The length of the post-closure care period may be:

(A) Decreased by the Section if the owner or operator demonstrates that the reduced period is sufficient to protect human health and the environment and this demonstration is approved by the Section; or

(B) Increased by the Section if the Section determines that the lengthened period is necessary to protect human health and the environment.

The time length of Post Closure will be determined by the Section.

(3) *Following completion of the post-closure care period for each MSWLF unit, the owner or operator shall notify the Section that a certification, signed by a registered professional engineer, verifying that post-closure care has been completed in accordance with the post-closure plan, has been placed in the operating record.*

This certification will be placed in the facility operating record and notice will be provided to the Section.

X. .1680 LEACHATE STORAGE REQUIREMENTS

(a) Applicability.

(1) Construction of leachate storage tanks and surface impoundments located at solid waste landfill facilities after October 9, 1993 shall meet the requirements set forth in this Rule.

The aboveground leachate storage tanks meet all the provisions of this Rule.

NARRATIVE APPENDIX

LANDFILL CAPACITY

ASSUMPTIONS:	1.	Waste Stream	1,600 tons/day
	2.	One Year	286 days
	3.	Waste Density	1,400 lbs/c.y.
	4.	Cover consumes	Final Cap +8%
	5.	Capacity of Phase 5	3,425,000 c.y.

Phase 5 - Five Year Requirements

286 days/year x 1,600 tpd x (2,000 lbs/ton / 1,400 lbs/c.y.)
x 5 years ÷ 0.92 (cover) = 3,552,795 c.y.

∴ Use 3,550,000 c.y. for 5 years capacity or 710,000 c.y. per year.

Phase 5 Facility Life

3,425,000 c.y. ÷ 710,000 c.y./year = 4.82 years

∴ Phase 5 life is approximately 5 years.

TOTAL SOIL REQUIREMENTS

Phase 5 - Structural Soil Requirements

Calculated Cut	±66,158 c.y.
Calculated Fill + 30% shrinkage	683,815 c.y.
Clay Liner	79,890 c.y.
Net Fill Required	829,863 c.y.

Phase 5 – Soil Cover Requirements

Total Cover Requirements	Final Cap +8%
Daily & Intermediate Cover	274,000 c.y.
Final Cover	74,000 c.y.
Net Soil Cover Required	348,000 c.y.
TOTAL SOIL REQUIREMENTS	1,177,863 c.y.

∴ Use 1,200,000 c.y.

III. CQA MANUAL

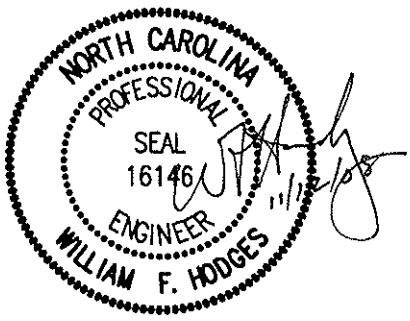
CQA MANUAL
CONSTRUCTION QUALITY ASSURANCE

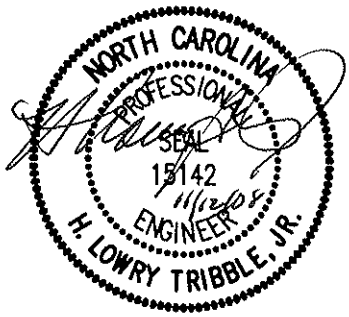
EAST CAROLINA REGIONAL LANDFILL – PHASE 5
BERTIE COUNTY, NORTH CAROLINA

FOR

REPUBLIC SERVICES OF NORTH CAROLINA, LLC
dba
EAST CAROLINA ENVIRONMENTAL

APRIL 2008
REVISED NOVEMBER 2008





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I. GENERAL

A. Republic Services of North Carolina, LLC, (the OWNER) will retain an engineering consulting firm (CQA Firm) to assure that proper construction techniques and procedures are used and to verify that the materials used meet the Contract Specifications. The CQA Firm must employ engineers licensed to practice engineering in the State of North Carolina and experienced in the field of solid waste management and sanitary landfill construction. At the completion of the work, the program requires certification reports indicating that the facility has been constructed in accordance with the Construction Specifications and approved design. It is the responsibility of the certifying Engineer(s) to prepare these reports.

B. To implement the construction project, a CONTRACTOR, familiar with earthwork and geomembrane construction, will serve as a general contractor (CONTRACTOR) providing construction services. In addition, a CQA ENGINEER will be retained to serve as an independent third party to ensure project conformance of all construction activities to established CQA standards. In most instances, the CONTRACTOR will perform all earthwork activities, and may retain a geomembrane contractor for installation of geosynthetic materials. Republic may, at their discretion, directly contract with a geomembrane contractor for installation of geosynthetic materials. The CQA Manual provides guidance information and procedures that should be undertaken by Republic, the DESIGN ENGINEER, and the CONTRACTOR so the work will be of the quality necessary to meet the project objectives and will be responsive to the requirements of Republic Services of North Carolina, LLC.

C. This CQA Manual is a supplemental document to the Construction Plans and Specifications for each project. Where a conflict arises, the Contract Documents will govern.

D. The activities addressed under this CQA Manual include the following activities:

- Grading;
- Clay liner construction;
- Installation of a HDPE geomembrane liner and leachate collection system;
- Soil cap construction;
- Installation of a geomembrane cap and drainage layer; and
- Placement of soil protective cover and vegetative support layer

E. Definitions

- Quality Control: A planned system of activities, or the use of such a system, whose purpose is to provide a level of quality that meets the needs of users.

The objective of quality control is to provide construction quality control that is safe, adequate, dependable, and economical. The overall system involves integrating the quality factors of several related steps including: the proper specification of what is wanted, production to meet the full intent of the specification, inspection to determine whether the resulting material, product, service, etc. is in accordance with the Construction Specifications, and review of usage to determine necessary revisions of the Construction Specifications.

In practice, Quality Control refers to those procedures, criteria, and tests employed and paid for by the CONTRACTOR(s) to confirm that the work satisfies the CONTRACTOR's standards and is in compliance with the Construction Plans and Specifications. This plan does not address quality control procedures, criteria, and/or tests employed by the CONTRACTOR.

- Quality Assurance: A planned system of activities whose purpose is to provide assurance that the overall quality control program is in fact being effectively implemented. The system involves a continuing evaluation of the adequacy and effectiveness of the overall quality control program with the ability to have corrective measures initiated where necessary. For a specific material, product, service, etc., this involves verifications, audits, and the evaluation of the quality factors that affect the specification, production, inspection, and use of the product, service, system, or environment.

  In practice, Quality Assurance refers to those procedures, criteria, and tests required and paid for by the OWNER to confirm that the work performed by the CONTRACTOR(s) is in compliance with the approved Construction Plans and Specifications and any additional requirements of this Plan.

- Lot: A quantity of resin (usually the capacity of one rail car) used in the manufacture of polyethylene geomembrane rolls. The finished roll will be identified by a roll number traceable to the resin lot used.

- Panel: The unit area of geomembrane that will be seamed in the field. A panel is identified as a roll or portion of a roll that is larger than 100 square feet.

- Subgrade Surface: The soil layer surface which immediately underlies the structural fill, compacted clay liner/cap, or geomembrane liner/cap.

F. Parties referenced in this CQA Manual shall consist of the following:

1. DESIGN ENGINEER: The DESIGN ENGINEER is the official representative of the OWNER. The DESIGN ENGINEER is responsible for the preparation of the construction plans and specifications of the project and for the preparation of the CQA Manual. The DESIGN ENGINEER is also responsible for the interpretation of these documents and for resolution of construction matters that arise during construction. The DESIGN ENGINEER shall review and approve shop drawings, authorize minor variations in the work from the contract documents and reject defective work (duties and responsibilities are described in the General Conditions as "ENGINEER"). The DESIGN ENGINEER shall be a registered professional engineer licensed in North Carolina.

2. CQA ENGINEER: Responsible for defining quality assurance, requirements compatible with the project objectives, verifying basic data as reasonable and complete, outlining procedures to process data, development of statistical procedures for the analysis of test data and preparing quality assurance memoranda and quality control reports. The CQA ENGINEER shall report to the DESIGN ENGINEER. The CQA ENGINEER shall be a registered professional engineer licensed in North Carolina. Reference to the CQA ENGINEER, for the purpose of this document, shall include the CQA ENGINEER or his representative.

3. Engineering Technicians: Responsible for field observations, testing and inspection. Technicians will be assigned to the project as deemed necessary by the CQA ENGINEER and will be responsible to the CQA ENGINEER. The CQA ENGINEER, Technician or the CQA ENGINEER's representative shall be on-site during all construction activities, except clearing and grubbing and initial cell excavation. A daily log of all field technicians, testing and inspection shall be maintained by the Technician.

4. OWNER: The OWNER is the individual, entity, public body, or authority with whom the CONTRACTOR has entered into the Agreement and for whom the Work is performed. For this project, the OWNER is Republic Services of North Carolina, LLC.

5. CONTRACTOR: The CONTRACTOR has the primary responsibility for ensuring that the landfill cell is constructed in accordance with the Construction Plans and Specifications developed by the ENGINEER and approved by the permitting agency. Other responsibilities include the performance of all construction activities at the site including site facilities, administration, material purchasing, procurement, supervision, construction

quality control, installation, and subcontracting. The CONTRACTOR is responsible for the protection of completed work until it is accepted by the OWNER. The CONTRACTOR is also responsible for informing the OWNER and CQA Consultants of the scheduling and occurrence of all construction activities.

6. Geomembrane Manufacturer (Manufacturer): The party responsible for manufacturing the geomembrane rolls.

7. Geosynthetic CQA Laboratory (Testing Laboratory): Party, independent from the OWNER, Manufacturer and Installer, responsible for completing laboratory tests on samples of geosynthetics obtained at the site or during manufacturing usually under the direction of the OWNER.

8. Geotechnical CQA Laboratory: Party, independent from the OWNER or CONTRACTOR, responsible for completing laboratory tests on soil samples obtained at the site or source usually under the direction of the OWNER.

9. Geomembrane Installer (Installer): The Installer is responsible for field handling, sorting, placing, seaming, loading (against wind), and other aspects of the geosynthetics installation, including geomembranes, geotextiles, geocomposites, geosynthetic clay liners, and geocomposite composites.

II. GRADING

A. GENERAL

The CQA ENGINEER shall test the grading, placement, and compaction of in-situ materials and structural fill. The CQA ENGINEER shall certify the materials and construction were in accordance with the plans, specifications, and this CQA Manual.

B. RELATED WORK

The CQA ENGINEER should reference the grading section of the technical specifications for pertinent soil materials, physical properties and construction requirements.

C. SUBGRADES

During construction, conformance and performance testing of the subgrade soil materials shall be performed by the CQA ENGINEER. The CQA ENGINEER shall monitor proofrolling of areas that are cut to achieve grade. Material placed to achieve grades indicated on the plans shall be tested by the CQA ENGINEER in accordance with the test methods and frequencies listed herein to verify that the compacted fill materials used by the CONTRACTOR complies with the technical specifications. Areas of proofrolling or compacted fill that do not conform to the technical specifications will be delineated and reported to the CONTRACTOR. These areas will be re-worked by the CONTRACTOR and re-tested until passing results are achieved.

The CQA ENGINEER shall monitor the repair and re-work of subgrade which is damaged by excess moisture (causing softening) and insufficient moisture (causing dessiccation and shrinkage) or be freezing. If such conditions are found to exist, the CQA ENGINEER shall evaluate the suitability of the subgrade by the following methods as applicable:

- moisture / density testing;
- continuous visual inspection during proof-rolling;
- other test methods identified herein.

D. CONFORMANCE TESTING

It will be necessary for the CQA ENGINEER to observe and test the structural fill soils to ensure they are uniform and conform to the requirements of the technical specifications. For soil materials obtained from on-site or off-site borrow areas, visual inspections and conformance tests shall be performed by the CQA

ENGINEER prior to the materials being used. Borrow area inspections may also be utilized by the CQA ENGINEER to ensure that only suitable soil materials are transported to the site. For both on-site and off-site borrow areas containing non-uniform materials, it shall be necessary for the CONTRACTOR and the CQA ENGINEER to coordinate excavation and monitoring of the segregation of substandard materials. All materials failing to comply with conformance standards shall be rejected for use.

Initial evaluation of various soil types by the CQA personnel during construction shall be largely visual; therefore, the CQA personnel must be experienced with visual-manual soil classification procedures. CQA personnel shall observe soils for deleterious materials (e.g., roots, stumps, rocks, and large objects). When necessary, the visual-manual procedure for the description and identification of soils shall be conducted by the CQA ENGINEER and the description shall be in accordance with test method ASTM D2488.

E. TEST METHODS AND FREQUENCY

All testing shall be conducted in accordance with the technical specifications or as directed by the DESIGN ENGINEER. The field testing methods, used to evaluate the suitability of soils during their installation, shall be performed by the CQA ENGINEER in accordance with current ASTM test procedures indicated in the table below. Documentation and reporting of the test results shall be the responsibility of the CQA ENGINEER.

The Standard Proctor Test (ASTM D698) shall be used for the determination of moisture / density relationships unless otherwise indicated. In-place surface moisture / density nuclear test method ASTM D2922 or drive cylinder test method ASTM D2937 shall be used for in-situ field testing. The sand cone test method ASTM D1556 or drive cylinder test method ASTM D2937 shall be used to establish correlations of moisture and density in cases of uncertainty, and as a check of the nuclear surface moisture / density gauge calibration. Any conflict regarding acceptance of test results shall be resolved by the DESIGN ENGINEER.

Testing shall be conducted during the course of the work. The minimum construction testing frequencies are presented in the table below. The frequency may be increased at the discretion of the CQA ENGINEER or if variability of the materials is observed by the CQA ENGINEER. Sampling locations shall be selected by the CQA ENGINEER. If necessary, the location of routine in-place density tests shall be determined using a non-biased sampling approach.

A special testing frequency shall be used at the discretion of the CQA ENGINEER when visual observations of construction performance indicate a potential problem.

MINIMUM TESTING REQUIREMENTS FOR STRUCTURAL FILL	
TEST	**FREQUENCY**
Laboratory Moisture-Density / ASTM D698	1 test for each type of soil encountered
Liquid Limit, Plastic Limit, Plasticity Index / ASTM D4318	1 test for each type of soil encountered
Sieve Analysis / ASTM D422	1 test for each type of soil encountered
Field Density and Moisture Content / Sand Cone, ASTM D1556 Drive Cylinder, ASTM D2937 Nuclear, ASTM D2922	1 test per 1,000 c.y. of structural fill

F. COMPACTION

The CQA ENGINEER shall confirm that structural fill conforms to compaction requirements as follows:

Description	**General Compaction**	**Top 12"**
Sediment Pond Embankments	95%	95%
Roadways	95%	98%
Shoulders and Embankments	95%	95%
Utilities Under Structures	95%	98%
Other Areas	95%	95%

G. PROTECTION OF SUBGRADES AND FILL SURFACES

The CQA ENGINEER shall monitor newly graded areas to verify the CONTRACTOR is protecting these areas from traffic and erosion until construction is complete.

III. COMPACTED CLAY LINER

A. GENERAL

1. The CQA ENGINEER shall certify the materials and installation are in accordance with the plans, specifications, and this CQA Manual.

B. MATERIAL

1. The clay liner material shall consist of on-site cohesive soils, synthetically improved soils, or imported cohesive soils meeting the permeability criteria of $k \leq 1.0 \times 10^{-7}$ cm/sec. Soils used in compacted clay liners shall consist of clean, select material free of debris, excessive coarse particles or other deleterious matter. Liner material shall be clayey soil, classified according to the United Soil Classification System as SC, CL, CH, SM, ML, or MH (ASTM D2487).

C. STOCKPILING AND MATERIAL APPROVAL

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

2. The procedure for testing during excavation and stockpiling is outlined below.

    a. 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.

    b. During stockpiling operations, one bulk sample of material placed will be collected. The following tests will be performed prior to placement of any compacted clay liner material:

        1. Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures, ASTM D2216.

        2. Method for Particle - Size Analysis of Soils, ASTM D422.

        3. Test Method for Liquid Limit, and Plasticity Index of Soils, ASTM D4318.

C. One (1) sample for every 10,000 cubic yards of material stockpiled will be selected for moisture – density relationship (ASTM D698) and corresponding permeability testing (ASTM D 5084-90 Measurement of Hydraulic Conductivity of Saturated Porous Materials using a Flexible Wall Parameter).

3. Reports for clay liner will be prepared by the CQA ENGINEER and shall include:

   a. Summary of laboratory test data,

   b. A summary of construction, sampling and testing method, and recommendations.

D. TEST FILL

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

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

3. Construction methods, sampling, and testing, including permeability testing, shall be specified by the CQA ENGINEER.

E. SUBGRADE

1. The CQA ENGINEER shall verify that the clay liner subgrade is constructed in accordance with the grading specifications.

2. The landfill cell shall be excavated to the lines and grades as indicated on the drawings. The subgrade shall be scarified to a depth of 6" and compacted to 95% as determined by the Standard Proctor Test, ASTM-D698.

3. The subgrade shall be reasonably free of large rocks, roots, stumps and other debris.

4. Existing and future drainage channels shall be cleaned so that all sediment, vegetation, and deleterious material is removed prior to placement of the compacted clay liner in these areas.

F. CONSTRUCTION

1. Clay Liner shall be placed to conform to the $k \leq 1.0 \times 10^{-7}$ cm/sec permeability criteria.

2. Only soil previously approved by the CQA ENGINEER shall be used in construction of the clay liner. Unsuitable material will be removed prior to acceptance by the CQA ENGINEER.

3. 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.

4. 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 mixed to distribute the moisture evenly.

   The surface of each lift shall be scarified prior to placement of subsequent lifts.

5. 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" for a final 6" compacted lift thickness.

   Each lift shall be checked visually for rocks, debris, plant materials, and other foreign material. The upper 6" of clay liner shall be reasonably free of material which will not pass through a 1" screen. The remaining 18" of compacted clay liner (below the top 6") shall be free of material which will not pass through a 3" screen. This may require mechanical pulverizing of these soils.

6. The exposed surface of the clay liner shall be rolled with a smooth drum roller or equivalent at the end of each work day or when required to protect the compacted clay from adverse weather conditions.

7. The finished clay liner shall be reasonably free of all rock or rock fragments within 6" of the surface. Rock or rock fragments are defined as the material retained by a standard 1" screen. Protrusions shall be removed and all cracks and voids shall be filled and the surface made uniform. Rock or other material protruding more than ½" shall not be allowed. This shall be

accomplished by final dressing of the soil liner with smooth drum rollers and hand raking.

8. The surface on which the geomembrane is to be placed shall be maintained in a firm, clean, dry and smooth condition before and during the liner installation.

9. The CQA ENGINEER shall inspect the clay liner and certify that it is in accordance with the specifications and approved plans and receive concurrence of the state prior to the CONTRACTOR beginning installation of geomembrane. This may require separate certifications of liner sections. If this is required, surveys of each section shall be provided by the CONTRACTOR to define the limits of these sections. Placement of geomembrane on any portion of the soil liner surface by the geomembrane installer will constitute his acceptance of the surface.

G. SAMPLING AND TESTING

1. The CQA ENGINEER or his representative will perform field density tests to assure that the soil density and moisture content are within the prescribed limits. The frequency of testing is noted below.

2. Bottom and Sidewall of Cell

   a. Field density tests shall be performed at the rate of one per 10,000 square feet of lined area for each lift of the clay liner base and the subgrade.

   b. The field density tests will be performed using a nuclear density gauge or drive tube method. The location of each test will be randomly determined by the CQA ENGINEER or his representative. All holes shall be repaired as described below.

   c. Perforations in the clay liner resulting from sampling or testing procedures, survey stakes or other activities shall be identified and backfilled by the CQA ENGINEER. The perforations shall be filled with a soil-bentonite mix consisting of 10% minimum by weight bentonite powder or granules mixed with clay liner material. The perforations shall be backfilled with the soil-bentonite mixture in 3-inch loose lifts and thoroughly compacted by hand tamping by the CQA ENGINEER.

d. Two bulk samples of the clay liner for each lift will be collected during placement or compaction. The following tests will be performed:

1. Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures, ASTM D2216.

2. Method for particle-Size Analysis of Soils, ASTM D422.

3. Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils, ASTM D4318.

4. Moisture - Density Relationship, ASTM D 698.

e. One sample per acre per each lift of clay liner component will be selected by the CQA ENGINEER for permeability testing (ASTM D5084-90).

f. A one square foot section of clay liner for every 20,000 square feet of liner shall be screened with acceptance of the liner will be based on the following criteria:

Upper 6" Clay Liner

Percentage of Material Passing (by weight)	Screen Size
95% (all tests)	1"
100% (avg. of all tests)	3"

Lower 18" Clay Liner

Percentage of Material Passing (by weight)	Screen Size
100% (avg. of all tests)	3"

Should any sample fail the 99% passing requirement of 1" for the upper 6", then four (4) additional test areas within the 20,000 square foot test area shall be selected by the CQA ENGINEER and tested in like manner. If the four (4) areas pass, then all test areas shall be repaired and the 20,000 square foot area accepted. If any one (1) of the four (4) areas fails, then the 20,000 square foot area shall be reworked and retested. Alternatively, should any sample fail the 95%

or 100% passing requirement, the entire area represented by the test (20,000 square feet) may be reworked and resampled by a single test sample. Rocks or roots remaining on or protruding through the surface shall be removed and the surface repaired. These rocks or roots will not be cause for rejection.

g. The following procedure shall be used in the event of density or permeability test failure. If density tests do not meet minimum requirements of the specifications, recompaction of the failed area (minimum 100' x 100') shall be performed and retested until the area meets or exceeds requirements outlined in the specifications. If a permeability sample fails to meet the minimum hydraulic conductivity requirements outlined in the specifications, at least five (5) replicate samples shall be obtained in the immediate vicinity of the failed test. Should the replicate samples confirm the failure of the soil to meet specifications, the area of failure shall be localized and reconstructed in accordance with the specifications. This area shall be retested as outlined within the plan. Alternatively, the entire 40,000 square foot area representing the failing permeability sample shall be reworked and retested for density, moisture and permeability.

IV. HDPE GEOMEMBRANE LINER

A. GENERAL

Stringent quality assurance and careful documentation are required in the production and installation of all geosynthetic materials. The work addressed under this section shall facilitate proper construction of all geosynthetic components of the liner for the landfill. All work shall be constructed to the lines, grades, and dimensions indicated on the project plans, in accordance with the Construction Specifications, or as required by the OWNER or DESIGN ENGINEER.

The CQA ENGINEER shall issue a written daily report of activities to the DESIGN ENGINEER. These reports shall include, at a minimum, observations and test results as well as problems encountered and solutions achieved. Construction reports summarizing significant events, as well as addressing all problems encountered and their solutions, shall be issued to the DESIGN ENGINEER. The format of these reports and frequency shall be established at the pre-construction meeting.

The CQA ENGINEER shall certify the materials and installation are in accordance with the plans, specifications, and this CQA Manual.

B. MATERIAL

1. The geomembrane will be 60 mil High Density Polyethylene (HDPE) supplied and installed by firms approved by the OWNER.

2. Seams for providing watertight joints will be extrusion or double hot wedge fusion seams using techniques approved by the CQA ENGINEER.

3. Construction Quality Assurance shall confirm the material meets the minimum physical properties and test frequencies of the Geosynthetic Research Institute GRI Test Method GM-13, as latest revised, for 60 mil High Density Polyethylene (HDPE) Geomembrane. The minimum thickness requirement shall be for the lowest individual measurement, not the average.

4. The CQA ENGINEER or his representative will sample two (2) rolls from each shipment of geomembrane at the manufacturing plant prior to shipment to the site.

5. The random samples must be representative of the material supplied and exclude the outer wrap of geomembrane if signs of scuffing or other damage is observed. Samples should be full roll width and at least 2 feet long.

6. The laboratory testing of the samples selected by the CQA representative shall be directed by the CQA ENGINEER and shall confirm conformance with the following properties:

a.	Thickness	(ASTM D5199 for smooth sheet (ASTM D5994 for textured sheet)
b.	Density	(ASTM D1505)
c.	Melt Index	(ASTM D1238)
d.	Carbon Black Content	(ASTM D1603)
e.	Tensile Properties	(ASTM D6693 or GRI GM-13)
f.	Tear Resistance	(ASTM D1004, DIE C)
g.	Asperity Height	(GRI GM-12)

7. The CQA ENGINEER or his representative will measure geomembrane thickness of each roll made for the project at the manufacturing plant prior to shipment. Material that does not fall within acceptable thickness criteria will be rejected.

C. GEOMEMBRANE MANUFACTURER AND INSTALLER

1. The Geomembrane Installer will submit the following as obtained from the Geomembrane Manufacturer to the CQA ENGINEER:

   a. Production Certification including project references

   b. Testing Program of Compound Ingredients

   c. Material Certification

   d. Test Data for Material and Resin

   e. All of the above submittals will be reviewed and retained by the CQA ENGINEER

2. The Geomembrane Installer will submit the following to the CQA ENGINEER prior to the installation:

   a. Qualifications of Geomembrane Installer Superintendent and Foreman

   b. Resumes of Geomembrane CONTRACTOR field crew

   c. Six (6) sets of geomembrane panel layout drawings

D. DELIVERY AND STORAGE

1. Upon delivery at the site, the CQA ENGINEER shall inventory all rolls and conduct a surface observation of each roll or factory panel for defects or damage. The inspection will be performed without unrolling rolls or unfolding factory panels unless defects or damages are found or suspected. The CQA ENGINEER will indicate those rolls with severe flaws that should be removed from the site and those rolls with minor flaws.

2. The CONTRACTOR will be responsible for the storage of the geomembrane on-site upon arriving at the site. The OWNER will provide storage space in a location (or several locations) such that on-site transportation and handling are minimized. Storage space should be protected from theft, vandalism, passage of vehicles, etc.

3. The CQA ENGINEER will verify that storage space selected is in a well-drained area and that cribbing techniques have been used as needed to ensure that the materials will not be sitting in ponded water in the event of rainfall.

E. GEOMEMBRANE INSTALLATION

1. An initial CQA meeting will be held prior to installation (pre-deployment meeting). The Geomembrane Installer, CQA ENGINEER or his representative, and a representative of the OWNER will be in attendance. The following issues will be discussed and agreed upon by all parties and shall be included in a report in the CQA documentation.

   a. Testing of welds

   b. Characteristics of "good" weld, and

   c. Repair procedures

2. The CQA ENGINEER or his representative will mark all areas where grinding is considered to be excessive. The location and repair method for the excessive grinding will be recorded in the daily field reports. The method or repair will be determined by the CQA ENGINEER.

3. Overheating of the geomembrane will be monitored by the CQA ENGINEER or his representative. At the discretion of the CQA ENGINEER, coupons will be cut from the end of the extrusion seams and the bottom side of the seam will be observed for visible warping or deformation. The location and

repair method of overheated areas will be recorded in the daily field reports. The method of repair will be determined in the field by the CQA ENGINEER.

4. During seaming, the CQA ENGINEER or his representative will observe the seams for the following:

   a. proper preparation
   b. grinding technique, where applicable, and
   c. overheating

5. The CQA ENGINEER or his representative will observe the geomembrane during the coolest part of the day to check for slack. Any areas where excessive "trampolining" occurs will be marked by the CQA ENGINEER for repair by the Geomembrane Installer.

6. The CQA ENGINEER or his representative will mark all areas where the geomembrane indicates a protrusion from the compacted clay liner. The method of repair will be determined in the field by the CQA ENGINEER.

F. TEST SEAMS

1. Test seams shall be made each day prior to commencing field seaming. The seams shall be made on fragment pieces of geomembrane under the same surface and environmental conditions as the production seams to verify that seaming conditions are adequate. The test seams shall be made at the beginning of each seaming period; at changes of equipment, equipment settings, operator, weather, or sheet temperature; at the CQA ENGINEER's discretion, and at least once every four to six hours during continuous operation of each welding machine; or at change in material type (i.e., smooth-to-smooth seam versus smooth-to-textured seam).

2. The test seam sample shall be at least five feet long by one foot wide with the seam centered lengthwise. For dual track fusion welds nine, one-inch wide by six-inch long test strips shall be cut from the test seam. Quantitatively test three specimens for inside peel adhesion (peel), three for outside peel, and then three specimens for bonded seam strength (shear). For extrusion welds six, one-inch wide by six-inch long test strips shall be cut from the trial seam. Quantitatively test three specimens for peel and three specimens for bonded seam strength (shear).

3. A test seam sample shall pass when the results of the tests shown below are achieved in both peel and shear test and when the break can be described as a

film tear bond. A film tear bond is defined as a failure in the ductile mode of one of the bonded sheets by tearing prior to complete separation to the bonded area.

- Peel strength (fusion) – ASTM D6392
- Peel strength (extrusion) – ASTM D6392
- Shear strength (fusion & extrusion) – ASTM D6392

4. Test seams shall be repeated, in its entirety, when any of the test seam samples fail in either peel or shear. If additional test seams fail, the seaming apparatus or seamer shall not be accepted and shall not be used for seaming until the deficiencies are corrected and two consecutive successful full test seams are achieved. No welding equipment or welder shall be allowed to begin production welds until equipment and welders have a successfully completed test seam. Seaming shall not proceed when ambient air temperature or adverse weather conditions jeopardize the integrity of the liner installation. Installer shall demonstrate that acceptable seaming can be achieved by completing passing trial seams.

5. The remainder of the successful test seam shall be assigned a number and marked accordingly by the CQA ENGINEER, who shall also log the date, hour, ambient temperature, number of seaming apparatus, name of seamer, and pass or fail description. The sample itself should be archived until project completion.

G. FIELD DESTRUCTIVE TESTING

1. The Geomembrane Installer will obtain 12" x 60" samples of field seams, suitable for testing, at an average frequency of one sample per 500 linear feet of weld. The date, time and equipment, seam number, and seaming parameters will be marked on each sample and recorded by the CQA ENGINEER.

2. Samples retained will be tested in the field by the Geomembrane Installer. A minimum of five specimens from each sample will be tested in peel and shear (ASTM D6392) for the properties in the Seam Strength Table in this section.

SEAM STRENGTH AND RELATED PROPERTIES OF THERMALLY BONDED SMOOTH AND TEXTURED HIGH DENSITY POLYETHYLENE (HDPE) GEOMEMBRANE 60 MIL SHEET		
Property	Units	Value
Hot Wedge Seams		
shear strength (1)	lb/in	120
shear elongation at break (2)	%	50
peel strength (1)	lb/in	91
peel separation	%	25
Extrusion Fillet Seams		
shear strength (1)	lb/in	120
shear elongation at break (2)	%	50
peel strength (1)	lb/in	78
peel separation	%	25
(1) Value listed for shear and peel strengths are for 4 out of 5 test specimens; the 5th specimen can be as low as 80% of the listed values. Average of all 5 must meet minimum specified value (2) Elongation measurements should be omitted for field testing (3) A maximum of one non-film tear bond failure out of a set of 5 tests is acceptable provided the non-film tear specimen meets strength requirements		

If unresolved discrepancies exist between the CQA ENGINEER's and CONTRACTOR's test results, the archived sample may be tested by the CQA ENGINEER. Samples which do not pass the shear and peel tests will be resampled from locations at least 10 feet on each side of the original location. These two re-test samples must pass both shear and peel testing. If these two samples do not pass, then additional samples will continue to be obtained until the questionable seam area is defined.

3. The CQA ENGINEER or the OWNER may require additional random samples to be taken for testing in areas which visually appear defective and not in accordance with the project requirements.

At the end of each double wedge welded field seam of 100' or more in length, a 1" wide coupon is to be cut from near the end of the seam. This coupon is to be tested in peel using a field tensiometer. The CQA ENGINEER will observe this test and FTB type failures will be the criteria for preliminary acceptance of the production seam. (Final seam acceptance is contingent on air and destructive testing).

H. NON-DESTRUCTIVE TESTING

1. The CQA ENGINEER shall confirm that the geomembrane installer has conducted non-destructible testing of the entire length of all field seams in accordance with Section 02750 of the Technical Specifications. The testing method shall be approved by the CQA ENGINEER in advance.

2. Non-destructive testing will be observed by the CQA ENGINEER or his representative on a full-time basis.

I. DESTRUCTIVE LABORATORY TESTING

1. Destructive seam samples will be laboratory tested by the CQA ENGINEER. Testing frequency shall average one sample per 500 linear feet of field seam.

   a. Test samples will be at least 12" x 36". A minimum of five peel specimens will be tested for each sample in accordance with ASTM D6392 for the properties in the Seam Strength table in this section. At least five specimens from each sample will be tested for bonded shear strength (shear) in accordance with ASTM D6392. These test samples shall be taken at the same locations as the CONTRACTOR's destructive testing samples.

   b. All laboratory specimens will be conditioned for a minimum of one hour prior to testing at the Standard Atmosphere for Testing Geosynthetics, that is, air maintained at a relative humidity of 65 $\pm$5% and a temperature of 21 $\pm$2°C (70 $\pm$4°F).

2. The load and elongation at failure will be measured for each specimen. FTB is the qualifying criterion.

   a. The CQA ENGINEER will describe the type of failure for each specimen and record the presence of any disbonding, delamination, foreign material in the bond area, etc.

   b. The criteria for determining passing welded seam shall be as stated in the "Seam Strength" table in this section.

   c. If unresolved discrepancies exist between the CQA ENGINEER's and CONTRACTOR's test results, the archived sample may be tested by the CQA ENGINEER. Samples which do not pass the shear and peel tests will be resampled from locations at least 10 feet on each side of the original location. These two re-test samples must pass both sear

and peel testing. If these two samples do not pass, then additional samples will continue to be obtained until the questionable seam area is defined.

SEAM STRENGTH AND RELATED PROPERTIES OF THERMALLY BONDED SMOOTH AND TEXTURED HIGH DENSITY POLYETHYLENE (HDPE) GEOMEMBRANE 60 MIL SHEET

Property	Units	Value
Hot Wedge Seams		
shear strength (1)	lb/in	120
shear elongation at break (2)	%	50
peel strength (1)	lb/in	91
peel separation	%	25
Extrusion Fillet Seams		
shear strength (1)	lb/in	120
shear elongation at break (2)	%	50
peel strength (1)	lb/in	78
peel separation	%	25

(1) Value listed for shear and peel strengths are for 4 out of 5 test specimens; the 5th specimen can be as low as 80% of the listed values. Average of all 5 must meet minimum specified value
(2) Elongation measurements should be omitted for field testing
(3) A maximum of one non-film tear bond failure out of a set of 5 tests is acceptable provided the non-film tear specimen meets strength requirements

J. REPAIRS

Any portion of unsatisfactory geomembrane or seam area failing a destructive or non-destructive test shall be repaired. Damaged geomembrane shall be removed and replaced with acceptable geomembrane materials if damage cannot be satisfactorily repaired. Installer shall be responsible for repair of damaged or defective areas. Agreement upon the appropriate repair method shall be decided between the CQA ENGINEER and the Installer. Procedures available include the following:

- Patching - Used to repair large holes, tears, undispersed raw materials and contamination by foreign matter;
- Spot Welding - Used to repair localized flaws (minor) or where geomembrane thickness has been reduced;
- Capping - Used to repair large lengths of failed seams; and
- Replacement - Used to remove the unacceptable seam and replace with new material.

In addition, surfaces of the geomembrane which are to be repaired by extrusion welds shall be lightly abraded with disc grinder or equivalent to assure cleanliness. All geomembrane surfaces shall be clean and dry at the time of repair. Patches or caps shall be extended at least six inches for extrusion weld and four inches for wedge

weld beyond the edge of the defect. All corners of patch material shall be rounded.

The CQA ENGINEER shall number and log each patch repair, and the Installer shall non-destructively test each repair using methods specified in this plan.

K. FINAL INSPECTION

A final inspection shall be completed by the Installer, DESIGN ENGINEER, CQA ENGINEER and OWNER prior to the Installer demobilizing from the site. All identified problem areas shall be repaired by the Installer and accepted by the CQA ENGINEER prior to the Installer demobilizing from the site.

V. GEOTEXTILE

A. MATERIAL

1. The geotextile shall be a non-woven geotextile of polypropylene fibers or polyester yarns which is intended to be and shall be suitable for separation and cushioning. The geotextile shall be a 6 ounce per square yard fabric.

2. During shipment and storage, the geotextile shall be protected from ultraviolet light exposure, precipitation, contamination or other damaging conditions. Geotextile rolls shall be shipped and stored in relatively opaque and watertight wrappings. The CQA ENGINEER shall verify that rolls of geotextile have been shipped and are stored in accordance with the specifications.

3 All handling on-site is the responsibility of the CONTRACTOR or Installer. The CONTRACTOR or Installer is responsible for the submittal of shipping manifests and all other relevant documents to the CQA ENGINEER.

4. The CQA ENGINEER shall random sample from each shipment of geotextile delivered to the site, sampling a minimum of 10% of each shipment. The 3' x 3' samples shall be retained as part of the project records. Should visual inspection by the CQA ENGINEER reveal any apparent deficiencies in the material, the CQA ENGINEER shall at the OWNER's expense, take a minimum of two samples and have them tested for the properties listed in Section 02757 of the Technical Specifications.

B. GEOTEXTILE MANUFACTURER AND INSTALLER

1. The CONTRACTOR shall submit the following as obtained from the Geotextile Manufacturer to the CQA ENGINEER to review:

   a. Production Certification
   b. Material Certification
   c. Test Data for Material

2. The CONTRACTOR shall submit the following to the CQA ENGINEER prior to installation:

   a. Qualifications of installer superintendent, foreman and field crew.
   b. Six sets of field installation drawings.

C. INSTALLATION

1. The CQA ENGINEER will allow installation of the geotextile to proceed after he has provided certification of the geomembrane liner or a section thereof.

2. The CQA ENGINEER shall monitor the installation of the geotextile to verify there is no damage to the geomembrane liner. Should the liner be damaged the CQA ENGINEER shall direct the CONTRACTOR to make the necessary repairs.

3. The CQA ENGINEER or his representative shall be present during all placement operations and shall verify that all work is in accordance with the plans and specifications.

4. At the conclusion of this activity, the CQA ENGINEER shall provide a written certification that the work has been installed according to plans and specifications.

VI. LEACHATE COLLECTION SYSTEM

A. General

The CQA ENGINEER shall certify the materials and installation are in accordance with the plans, specifications, and this CQA Manual.

B. MATERIALS

1. Leachate collection piping shall be in accordance with Section 02745 - Leachate Piping of the Technical Specifications.

2. Gravel for encasing leachate pipe and penetration assembly shall be clean washed gravel composed of a hard mineral such as quartz. Gravel size shall be No. 57 in accordance with ASTM D448-86.

3. The cushion geotextile shall be a non-woven geotextile of polypropylene fibers or polyester yarns which are intended to be and shall be suitable for separation and cushioning. Geotextile shall be 24 ounce per square yard cushioning fabric.

4. The transition media shall be gravel of a clean washed, hard, non-carbonaceous mineral such as quartz. The gravel size shall be ASTM No. 89 and in accordance with ASTM D448-86, NC DOT size No. 89, or NC DOT size No. 78M.

5. The CQA ENGINEER or his representative shall verify that all materials provided are those specified or are equal and are in accordance with the approved plans, specifications and this CQA Manual.

C. INSTALLATION

1. The CQA ENGINEER will allow installation of the leachate collection system to proceed after he has received all of the destructive test results of the FML and has reviewed and approved the FML as built survey.

2. The CQA ENGINEER shall verify there is no damage to the geomembrane during the installation of the leachate collection system. Should damage occur the CQA ENGINEER shall direct the CONTRACTOR to make the required repairs.

3. The CQA ENGINEER or his representative shall be present during all phases of the leachate collection system construction and shall verify that all work is in accordance with the approved plans, specifications and this CQA Manual.

D. QUALITY ASSURANCE

The CQA ENGINEER or his representative shall verify that the following are provided and installed in accordance with the approved plans, specifications and this CQA Manual. This shall include:

1. High Density Polyethylene Pipe

   a. Receipt of CONTRACTOR's submittals on materials

   b. Review of submittals for pipe

      1. compliance with applicable ASTM standard
      2. unit weight
      3. diameter and SDR
      4. physical dimensions
      5. method of jointing with instructions
      6. nominal pipe joint lengths
      7. re-ended bedding and installation details
      8. instructions and tables or information on strength of each pipe type versus bury
      9. conditions of depth and traffic loadings
      10. certification by manufacturer that material properties meet the values listed in the material properties sheet

   c. Secure certification that pipe supplied is represented by the quality assurance data.

   d. Reject pipe which does not meet appropriate ASTM Standards.

   e. Results of any samples taken by the CQA ENGINEER for testing.

   f. Witness and verify that jointing and installation is in accordance with manufacturer's re-endations and the specifications.

   g. Leachate conduits external to the collection system are tested and demonstrated to be leakproof.

2. Gravels

   a. Receipt of CONTRACTOR's submittals on gravel.

   b. Review of submittals for conformity to specifications including quarry's certification of gradation.

   c. Reject material which does not meet specifications.

   d. Results of any samples taken by the CQA ENGINEER for testing.

   e. Verify that gravel encasement is in accordance with the approved plans, specifications and this CQA Manual.

3. Geotextile

   a. Receipt of CONTRACTOR's submittals on geotextile and review for conformity to specifications.

   b. Reject material which does not meet specifications.

   c. Verify that geotextile is in accordance with the approved plans, specifications and this CQA Manual.

   d. Results of any samples taken by the CQA ENGINEER for testing.

VII. PROTECTIVE COVER - ON LINER - NATIVE SANDY SOILS

A. GENERAL

The CQA ENGINEER shall certify the materials and installation are in accordance with the plans, specifications, and this CQA Manual.

B. MATERIAL

1. Soil for protective cover - native soils - on liner shall be classified according to the United Soil Classification System (USCS) (ASTM D2487-93). Liquid limit, plasticity index (PI), and percent passing the No. 200 sieve will be considered for proper classification. Construction Quality Assurance shall confirm the following minimum requirements:

Test	Minimum Frequency	Criteria
Permeability (ASTM D2434)	3,000 c.y.	$k \geq 1 \times 10^{-3}$ cm/sec

2. Soil 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 CQA ENGINEER 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 site personnel on suitable materials and locations of such. All material shall be taken from select sources or stockpiles.

4. The protective cover native soils shall be uniform, smooth, and reasonably free of debris, rock, plant materials, and other foreign material larger than ¾ inch in diameter. The material should contain no sharp edges.

C. STOCKPILING AND MATERIAL APPROVAL

1. All material to be used as protective cover gravel and geotextile shall be approved in advance by the CQA ENGINEER. The CQA ENGINEER must verify the gravel meets all the material requirements.

2. Verification can be accomplished at source and during stockpiling or prior to use at existing stockpiles.

3. The CQA ENGINEER shall prepare reports of all testing, analysis, and verification.

D. CONSTRUCTION

1. The CQA ENGINEER shall provide verification of the following:

   a. Approved material was used to construct the cover.

   b. The gravel cover was constructed in accordance with the approved plans, specifications, and this CQA Manual.

   c. The required cover thickness was achieved.

VIII. PROTECTIVE COVER - ON LINER - SANDY SOILS

A. GENERAL

The CQA ENGINEER shall certify the materials and installation are in accordance with the plans, specifications, and this CQA Manual.

B. MATERIAL

Material for the sandy soil (protective cover) shall be a loose granular material resulting from the disintegration of rocks, shall be capable of 98% passage through a ½" screen and shall have no more than 5% by weight passing the No. 200 sieve. The protective cover material shall contain no aggregate rocks, debris, plant material, material with sharp edges, lignite, coal, ash, or carbonaceous material. By-products of industrial processes, with the exception of quarry grinding operations, shall not be accepted. The sandy soil (protective cover) material shall have a permeability of $k \geq 1 \times 10^{-2}$ cm/sec.

Construction Quality Assurance shall meet the minimum requirements for the Granular Drainage Blanket as follows:

Test	Minimum Frequency	Criteria
Grain size to No. 200 sieve (ASTM D 422)	1,500 yd^3	78M
Permeability (ASTM D 2434)	3,000 yd^3	$k \geq 1 \times 10^{-2}$ cm/sec

C. STOCKPILING AND MATERIAL APPROVAL

1. All material to be used as protective cover sandy soils shall be approved in advance by the CQA ENGINEER. The CQA ENGINEER must verify the sand meets all the material requirements.

2. Verification can be accomplished during excavation and stockpiling or prior to use at existing stockpiles.

3. The CQA ENGINEER shall prepare reports of all testing, analysis, and verification.

D. CONSTRUCTION

1. The CQA ENGINEER shall provide verification of the following:

   a. Approved material was used to construct the cover.

   b. The sandy soil cover was constructed in accordance with the approved plans, specifications, and this CQA Manual.

   c. The geomembrane was not damaged during the construction of the cover.

   d. The required cover thickness was achieved.

IX. COMPACTED SOIL CAP

A. GENERAL

The CQA ENGINEER shall certify the materials installation are in accordance with the plans, specifications, and this CQA Manual.

B. MATERIAL

1. The compacted soil cap material shall consist of soils meeting the permeability criterion of $k \leq 1.0 \times 10^{-5}$ cm/sec. Soils used in the compacted soil cap shall consist of clean, select material free of debris, excessive coarse particles or other deleterious matter. The cap material shall be classified under the Unified Soil Classification System as MH, ML, CL, CH or SC.

C. STOCKPILING AND MATERIAL APPROVAL

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

2. The procedures for testing during excavation and stockpiling is outlined below.

    a. Each load of soil will be examined either at the borrow source or the stockpile area. Any unsuitable material will be routed to separate stockpiles consistent with its end use.

    b. During stockpiling operations, one bulk sample of material placed will be collected. The following tests will be performed prior to placement of any compacted soil cap material.

        1. Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures, ASTM D2216.

        2. Method for Particle - Size Analysis of Soils, ASTM D422.

        3. Test Method for Liquid Limit, and Plasticity Index of Soils, ASTM D4318.

c. One (1) sample for every 10,000 cubic yards of material stockpiled will be selected for Moisture Density Relationship, ASTM D698, and permeability testing (ASTM D5084 - 90 measurement of Hydraulic Conductivity of Saturated Porous Materials using a Flexible Wall Permeameter).

3. Reports for the compacted soil cap will be prepared by the CQA ENGINEER and shall include:

a. Summary of laboratory test data.

b. A summary of construction, sampling and testing method, and recommendations.

D. CONSTRUCTION

1. Compacted soil cap shall be placed to conform to the $k \leq 1.0x10^{-5}$ cm/sec permeability criterion.

2. Only soil previously approved by the CQA ENGINEER shall be used in construction of the compacted soil cap. Unsuitable material will be removed prior to acceptance by the CQA ENGINEER.

3. 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.

4. 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. The surface of each lift shall be scarified prior to placement of subsequent lifts.

5. The thickness of the loose lift shall be measured at random locations after spreading and leveling is complete. Loose lift thickness should not exceed 10 inches for a final 6 inch compacted lift thickness. Each lift shall be checked visually for excess rocks, debris, plant materials and other foreign material. Any significant amounts of such material which will not pass through a 3" screen shall be identified and removed prior to and during the compaction process, if such material will be within 6" of the top of the compacted clay surface.

6. The exposed surface of the compacted soil cap shall be rolled with a smooth drum roller or equivalent at the end of each work day or when required to protect the compacted soil from adverse weather conditions.

7. The finished compacted soil cap shall be reasonably free of all rocks, soil clods greater than 3" on the surface. Protrusions shall be removed and all significant cracks and voids shall be filled and the surface made uniform. Rock or other material protruding more than 1 inch shall not be allowed, and should be removed. This shall be accomplished by final dressing of the soil cap with smooth drum rollers and hand raking.

8. The surface on which the geomembrane is to be placed shall be maintained in a firm, clean, dry and smooth condition before and during the cap installation.

9. The CQA ENGINEER shall inspect the compacted soil cap and certify that it is in accordance with the specifications, prior to the CONTRACTOR beginning installation of the geomembrane. Placement of geomembrane on any portion of the soil cap surface by the geomembrane installer will constitute his acceptance of the site.

E. SAMPLING AND TESTING

1. The CQA ENGINEER or his representative will perform field density tests to assure that the soil density and moisture content are within the prescribed limits. The frequency of testing is noted below.

   a. Field density tests shall be performed at the rate of one per 20,000 square feet of lined area for the compacted soil cap.

   b. The field density tests will be performed using a nuclear density gauge, or drive tube. The location of each test will be randomly determined by the CQA ENGINEER or his representative. All holes shall be repaired with bentonite as described below.

      Perforations in the compacted soil cap resulting from sampling or testing procedures, survey stakes or other activities shall be identified and backfilled by the CQA ENGINEER. The perforations shall be filled with a soil-bentonite mix consisting of 10% minimum by weight bentonite powder or granules mixed with soil cap material. The perforations shall be backfilled with the soil-bentonite mixture in 3-inch loose lifts and thoroughly compacted by hand tamping by the CQA ENGINEER.

c. Two bulk samples of the compacted soil cap for each lift will be collected during placement or compaction. The following tests will be performed:

1. Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures ASTM D2216.

2. Method for Particle - Size Analysis of Soils ASTM D422.

3. Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils, ASTM D4318.

4. Moisture-density relationship (ASTM D698).

d. One sample of the compacted soil cap for every one (1) acre of soil cap area will be selected by the CQA ENGINEER for permeability testing (ASTM D5084-90).

X. GEOMEMBRANE (FML) CAP

A. GENERAL

Stringent quality assurance and careful documentation are required in the production and installation of all geosynthetic materials. The work addressed under this section shall facilitate proper construction of all geosynthetic components of the cap for the landfill. All work shall be constructed to the lines, grades, and dimensions indicated on the project plans, in accordance with the Construction Specifications, or as required by the OWNER or DESIGN ENGINEER.

The CQA ENGINEER shall issue a written daily report of activities to the DESIGN ENGINEER. These reports shall include, at a minimum, observations and test results as well as problems encountered and solutions achieved. Construction reports summarizing significant events, as well as addressing all problems encountered and their solutions, shall be issued to the DESIGN ENGINEER. The format of these reports and frequency shall be established at the pre-construction meeting.

The CQA ENGINEER shall certify the materials and installation are in accordance with the plans, specifications, and this CQA Manual.

B. MATERIAL

1. The geomembrane will be 40 mil Linear Low Density Polyethylene (LLDPE) supplied and installed by firms approved by the OWNER.

2. Seams for providing watertight joints will be extrusion or double hot wedge fusion seams using techniques approved by the CQA ENGINEER.

3. Construction Quality Assurance shall confirm the material meets the minimum physical properties and test frequencies of the Geosynthetic Research Institute GRI Test Method GM-17, as latest revised, for 40 mil Liner Low Density Polyethylene (LLDPE) Geomembrane. The minimum thickness requirement shall be the lowest individual measurement, not the average.

4. The CQA ENGINEER or his representative will sample two (2) rolls from each shipment of geomembrane at the manufacturing plant prior to shipment to the site.

5. The random samples must be representative of the material supplied and exclude the outer wrap of geomembrane if signs of scuffing or other damage is observed. Samples should be full roll width and at least 2 feet long.

6. The laboratory testing of the samples selected by the CQA representative shall be directed by the CQA ENGINEER and shall confirm conformance with the following properties:

a.	Thickness	(ASTM D5199 for smooth sheet (ASTM D5994 for textured sheet)
b.	Density	(ASTM D1505)
c.	Melt Index	(ASTM D1238)
d.	Carbon Black Content	(ASTM D1603)
e.	Tensile Properties	(ASTM D6693 or GRI GM-13)
f.	Tear Resistance	(ASTM D1004, DIE C)
g.	Asperity Height	(GRI GM-12)

7. The CQA ENGINEER or his representative will measure geomembrane thickness of each roll made for the project at the manufacturing plant prior to shipment. Material that does not fall within acceptable thickness criteria will be rejected.

C. GEOMEMBRANE MANUFACTURER AND INSTALLER

1. The Geomembrane Installer will submit the following as obtained from the Geomembrane Manufacturer to the CQA ENGINEER:

   a. Production Certification including project references

   b. Testing Program of Compound Ingredients

   c. Material Certification

   d. Test Data for Material and Resin

   e. All of the above submittals will be reviewed and retained by the CQA ENGINEER

2. The Geomembrane Installer will submit the following to the CQA ENGINEER prior to the installation:

   a. Qualifications of Geomembrane Installer Superintendent and Foreman

   b. Resumes of Geomembrane CONTRACTOR field crew

   c. Six (6) sets of geomembrane panel layout drawings

D. DELIVERY AND STORAGE

1. Upon delivery at the site, the CQA ENGINEER shall inventory all rolls and conduct a surface observation of each roll or factory panel for defects or damage. The inspection will be performed without unrolling rolls or unfolding factory panels unless defects or damages are found or suspected. The CQA ENGINEER will indicate those rolls with severe flaws that should be removed from the site and those rolls with minor flaws.

2. The CONTRACTOR will be responsible for the storage of the geomembrane on-site upon arriving at the site. The OWNER will provide storage space in a location (or several locations) such that on-site transportation and handling are minimized. Storage space should be protected from theft, vandalism, passage of vehicles, etc.

3. The CQA ENGINEER will verify that storage space selected is in a well-drained area and that cribbing techniques have been used as needed to ensure that the materials will not be sitting in ponded water in the event of rainfall.

E. GEOMEMBRANE INSTALLATION

1. An initial CQA meeting (pre-deployment meeting) will be held prior to installation. The Geomembrane Installer, CQA ENGINEER or his representative, and a representative of the OWNER will be in attendance. The following issues will be discussed and agreed upon by all parties and shall be included in a report in the CQA documentation.

   a. Testing of welds

   b. Characteristics of "good" weld, and

   c. Repair procedures

2. The CQA ENGINEER or his representative will mark all areas where grinding is considered to be excessive. The location and repair method for the excessive grinding will be recorded in the daily field reports. The method or repair will be determined by the CQA ENGINEER.

3. Overheating of the geomembrane will be monitored by the CQA ENGINEER or his representative. At the discretion of the CQA ENGINEER, coupons will be cut from the end of the extrusion seams and the bottom side of the seam will be observed for visible warping or deformation. The location and

repair method of overheated areas will be recorded in the daily field reports. The method of repair will be determined in the field by the CQA ENGINEER.

4. During seaming, the CQA ENGINEER or his representative will observe the seams for the following:

   a. proper preparation
   b. grinding technique, where applicable, and
   c. overheating

5. The CQA ENGINEER or his representative will observe the geomembrane during the coolest part of the day to check for slack. Any areas where excessive "trampolining" occurs will be marked by the CQA ENGINEER for repair by the Geomembrane Installer.

6. The CQA ENGINEER or his representative will mark all areas where the geomembrane indicates a protrusion from the compacted soil cap. The method of repair will be determined in the field by the CQA ENGINEER.

F. TEST SEAMS

1. Test seams shall be made each day prior to commencing field seaming. The seams shall be made on fragment pieces of geomembrane under the same surface and environmental conditions as the production seams to verify that seaming conditions are adequate. The test seams shall be made at the beginning of each seaming period; at changes of equipment, equipment settings, operator, weather, or sheet temperature; at the CQA ENGINEER's discretion, and at least once every four to six hours during continuous operation of each welding machine; or at change in material type (i.e., smooth-to-smooth seam versus smooth-to-textured seam).

2. The test seam sample shall be at least five feet long by one foot wide with the seam centered lengthwise. For dual track fusion welds nine, one-inch wide by six-inch long test strips shall be cut from the test seam. Quantitatively test three specimens for inside peel adhesion (peel), three for outside peel, and then three specimens for bonded seam strength (shear). For extrusion welds six, one-inch wide by six-inch long test strips shall be cut from the trial seam. Quantitatively test three specimens for peel and three specimens for bonded seam strength (shear).

3. A test seam sample shall pass when the results of the tests shown below are achieved in both peel and shear test and when the break can be described as a

film tear bond. A film tear bond is defined as a failure in the ductile mode of one of the bonded sheets by tearing prior to complete separation to the bonded area.

- Peel strength (fusion) – ASTM D6392
- Peel strength (extrusion) – ASTM D6392
- Shear strength (fusion & extrusion) – ASTM D6392

4. Test seams shall be repeated, in its entirety, when any of the test seam samples fail in either peel or shear. If additional test seams fail, the seaming apparatus or seamer shall not be accepted and shall not be used for seaming until the deficiencies are corrected and two consecutive successful full test seams are achieved. No welding equipment or welder shall be allowed to begin production welds until equipment and welders have a successfully completed test seam. Seaming shall not proceed when ambient air temperature or adverse weather conditions jeopardize the integrity of the cap installation. Installer shall demonstrate that acceptable seaming can be achieved by completing passing trial seams.

5. The remainder of the successful test seam shall be assigned a number and marked accordingly by the CQA ENGINEER, who shall also log the date, hour, ambient temperature, number of seaming apparatus, name of seamer, and pass or fail description. The sample itself should be archived until project completion.

G. FIELD DESTRUCTIVE TESTING

1. The Geomembrane Installer will obtain 12" x 60" samples of field seams, suitable for testing, at an average frequency of one sample per 500 linear feet of weld. The date, time and equipment, seam number, and seaming parameters will be marked on each sample and recorded by the CQA ENGINEER.

2. Samples retained will be tested in the field by the Geomembrane Installer. A minimum of five specimens from each sample will be tested in peel and shear (ASTM D6392).

   Five specimens from each sample shall be tested for Bonded Seam Strength (shear) using ASTM D6392. Failures in grind areas of extrusion seams may require resampling and retesting.

At least five specimens from each sample shall be tested for Peel Adhesion using ASTM D6392.

The criteria for determining passing welded seam shall be as stated in the "Seam Strength" table in this section. If unresolved discrepancies exist between the CQA ENGINEER's and CONTRACTOR's test results, the archived sample may be tested by the CQA ENGINEER. Samples which do not pass the shear and peel tests will be resampled from locations at least 10 feet on each side of the original location. These two re-test samples must pass both sear and peel testing. If these two samples do not pass, then additional samples will continue to be obtained until the questionable seam area is defined.

3. The CQA ENGINEER or the OWNER may require additional random samples to be taken for testing in areas which visually appear defective and not in accordance with the project requirements.

At the end of each double wedge welded field seam of 100' or more in length, a 1" wide coupon is to be cut from near the end of the seam. This coupon is to be tested in peel using a field tensiometer. The CQA ENGINEER will observe this test and FTB type failures will be the criteria for preliminary acceptance of the production seam. (Final seam acceptance is contingent on air and destructive testing).

H. NON-DESTRUCTIVE TESTING

1. The CQA ENGINEER shall confirm that the geomembrane installer has conducted non-destructible testing of the entire length of all field seams in accordance with Section 02750 of the Technical Specifications. The testing method shall be approved by the CQA ENGINEER in advance.

2. Non-destructive testing will be observed by the CQA ENGINEER or his representative on a full-time basis.

I. DESTRUCTIVE LABORATORY TESTING

1. Destructive seam samples will be laboratory tested by the CQA ENGINEER. Testing frequency shall average one sample per 500 linear feet of field seam.

   a. Test samples will be at least 12" x 36". A minimum of five peel specimens will be tested for each sample in accordance with ASTM D6392 for the properties listed in the Seam Strength table in this section. At least five specimens from each sample will be tested for

bonded shear strength (shear) in accordance with ASTM D6392. These test samples shall be taken at the same locations as the CONTRACTOR's destructive testing samples.

b. All laboratory specimens will be conditioned for a minimum of one hour prior to testing at the Standard Atmosphere for Testing Geosynthetics, that is, air maintained at a relative humidity of 65 $\pm$5% and a temperature of 21 $\pm$2°C (70 $\pm$4°F).

2. The load and elongation at failure will be measured for each specimen. FTB is the qualifying criterion.

a. The CQA ENGINEER will describe the type of failure for each specimen and record the presence of any disbonding, delamination, foreign material in the bond area, etc.

b. The criteria for determining passing welded seams shall be as stated in the "Seam Strength" table in this section.

c. If a peel specimen fails in the grinding or preparation area, this should be clearly noted on the test report. Both sides of the double-wedge fusion seam must pass the testing requirements to constitute a passing test.

d. If unresolved discrepancies exist between the CQA ENGINEER's and CONTRACTOR's test results, the archived sample may be tested by the CQA ENGINEER. Samples which do not pass the shear and peel tests will be resampled from locations at least 10 feet on each side of the original location. These two re-test samples must pass both sear and peel testing. If these two samples do not pass, then additional samples will continue to be obtained until the questionable seam area is defined.

SEAM STRENGTH AND RELATED PROPERTIES OF THERMALLY BONDED SMOOTH AND TEXTURED LINER LOW DENSITY POLYETHYLENE (LLDPE) GEOMEMBRANE 40 MIL SHEET		
Property	Units	Value
Hot Wedge Seams		
shear strength (1)	lb/in	60
shear elongation at break (2)	%	50
peel strength (1)	lb/in	50
peel separation	%	25
Extrusion Fillet Seams		
shear strength (1)	lb/in	60
shear elongation at break (2)	%	50
peel strength (1)	lb/in	44
peel separation	%	25
(1) Value listed for shear and peel strengths are for 4 out of 5 test specimens; the 5th specimen can be as low as 80% of the listed values. Average of all 5 must meet minimum specified value (2) Elongation measurements should be omitted for field testing (3) A maximum of one non-film tear bond failure out of a set of 5 tests is acceptable provided the non-film tear specimen meets strength requirements		

J. REPAIRS

Any portion of unsatisfactory geomembrane or seam area failing a destructive or non-destructive test shall be repaired. Damaged geomembrane shall be removed and replaced with acceptable geomembrane materials if damage cannot be satisfactorily repaired. Installer shall be responsible for repair of damaged or defective areas. Agreement upon the appropriate repair method shall be decided between the CQA ENGINEER and the Installer. Procedures available include the following:

- Patching - Used to repair large holes, tears, undispersed raw materials and contamination by foreign matter;
- Spot Welding - Used to repair pinholes, other localized flaws (minor) or where geomembrane thickness has been reduced;
- Capping - Used to repair large lengths of failed seams; and
- Replacement - Used to remove the unacceptable seam and replace with new material.

In addition, surfaces of the geomembrane which are to be repaired by extrusion welds shall be lightly abraded with disc grinder or equivalent to assure cleanliness. All geomembrane surfaces shall be clean and dry at the time of repair. Patches or caps shall be extended at least six inches for extrusion weld and four inches for wedge

weld beyond the edge of the defect. All corners of patch material shall be rounded.

The CQA ENGINEER shall number and log each patch repair, and the Installer shall non-destructively test each repair using methods specified in this plan.

K. FINAL INSPECTION

A final inspection shall be completed by the Installer, DESIGN ENGINEER, CQA ENGINEER and OWNER prior to the Installer demobilizing from the site. All identified problem areas shall be repaired by the Installer and accepted by the CQA ENGINEER prior to the Installer demobilizing from the site.

XI. GEOCOMPOSITE DRAINAGE MEDIA (GDM)

A. GENERAL

The CQA ENGINEER shall certify the materials and installation are in accordance with the plans, specifications, and this CQA Manual.

B. MATERIAL

1. The geocomposite shall be a composite consisting of a net-like drainage sandwiched between two (2) layers of 6 ounce geotextile fabric. The composite shall be equivalent to Fabri-net by Gundle Lining Systems or Enkadrain by AKZO Industrial Systems Company, or equal and approved by the CQA ENGINEER.

2. During shipment and storage, the geocomposite shall be protected from ultraviolet light exposure, precipitation, contamination or other damaging conditions. Geocomposite rolls shall be shipped and stored in relatively opaque and watertight wrappings. The CQA ENGINEER shall verify that rolls of geocomposite have been shipped and are stored in accordance with the specifications.

3. All handling on-site is the responsibility of the Installer. The CONTRACTOR or Installer is responsible for submittal of shipping manifests and all other relevant documents to the CQA ENGINEER.

4. The CQA ENGINEER or his representative shall take random samples from each shipment of geocomposite delivered to the site, sampling a minimum of 10% of each shipment. The 3' x 3' samples shall be retained as part of the project records. The ENGINEER shall at the OWNER's expense, take a minimum of two samples and have them tested for the properties listed below; should visual inspection by the CQA ENGINEER reveal any apparent deficiencies in the material additional testing may be performed.

REQUIRED GEOCOMPOSITE DRAINAGE MEDIA PROPERTIES AND MANUFACTURER'S QUALITY CONTROL TEST DATA				
Property	Test Method	Units	Value	Test Frequency
Thickness (geonet only)	ASTM D5199	inches	0.25	Every roll
Resin Density (geonet only)	ASTM D 1505	g/cm^3	0.92	50,000 ft^2
Ply Adhesion	ASTM D 413 or GRI GC7	lb/inch	2.0 (TYP) 1.0 Min. Avg.	50,000 ft^2
Transmisssivity [1]	ASTM D4716	m^2/s	$1x10^{-3}$	100,000 ft^2
Mass Per Unit Area (unit weight) Geotextile Only	ASTM D5216	oz/yd^2	6[2]	100,000 ft^2

Notes: [1] Conduct test for transmissivity at a normal compressive load of 500 psf and at a hydraulic gradient of 0.25 after a seating period of at least 100 hours. Boundary conditions are soil interface on the upper filter Geotextile and smooth geomembrane against the lower filter Geotextile.
[2] Nominal value.

C. GEOCOMPOSITE MANUFACTURER AND INSTALLER

1. The CONTRACTOR shall submit the following as obtained from the Geocomposite Manufacturer to the CQA ENGINEER to review:

   a. Production Certification
   b. Material Certification
   c. Test Data for Material

2. The CONTRACTOR shall submit the following to the CQA ENGINEER prior to installation:

   a. Qualifications of installer superintendent, foreman and field crew.
   b. Six sets of field installation drawings.

D. INSTALLATION

1. The CQA ENGINEER will allow installation of the geocomposite to proceed after he has provided certification of the geomembrane cap or a section thereof.

2. The CQA ENGINEER shall monitor the installation of the geocomposite to verify there is no damage to the geomembrane cap. Should the cap be damaged the CQA ENGINEER shall direct the CONTRACTOR to make the necessary repairs.

3. The CQA ENGINEER or his representative shall be present during all placement operations and shall verify that all work is in accordance with the plans and specifications.

4. At the conclusion of this activity, the CQA ENGINEER shall provide a written certification that the work has been installed according to plans and specifications.

XII. PROTECTIVE SOIL COVER ON LANDFILL CAP

A. GENERAL

The CQA ENGINEER shall certify the materials and installation are in accordance with the plans, specifications and this CQA Manual.

B. MATERIAL

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

   a. Soil shall be classified according to the United Soil Classification System (USCS) as ML, MH, CH, SC, or CL (ASTM D2487-83). Liquid limit, plasticity index (PI), and percent passing the No. 200 sieve will be considered for proper classification.

   b. Select soil fill materials shall be reasonably free of gypsum, ferrous, and/or calcareous concretions and nodules, refuse, roots, or other deleterious substances.

   c. The soil cover shall be uniform, smooth, and free of debris, rock, plant materials, and other foreign material larger than 3" in diameter. The material should contain no sharp edges.

2. The top 6" of soil cover must be capable of supporting growth of vegetative cover. The top 6" may consist of the soils listed in XII.B.1.a, expanded to include SM.

C. STOCKPILING AND MATERIAL APPROVAL

1. All material to be used as soil cover shall be approved in advance by the CQA ENGINEER. The CQA ENGINEER must verify the soil meets all the material requirements.

2. Verification can be accomplished during excavation and stockpiling or prior to use at existing stockpiles.

3. The CQA ENGINEER shall prepare reports of all testing, analysis and verification.

D. CONSTRUCTION

1. The CQA ENGINEER shall provide verification of the following:

   a. Approved stockpiled material was used to construct the cover.

   b. The soil cover was constructed in accordance with the approved plans, specifications, and this CQA Manual.

   c. The geomembrane and geocomposite were not damaged during the construction of the soil cover.

   d. The soil cover thickness of 18" has been achieved. The layer thickness shall be measured by the test excavation or hard auger boring.

   e. At least one (1) sample for every 5,000 in-place cubic yards will be taken and tested in accordance with ASTM D-422 (Grain Size) by an independent testing lab.

   f. Tested samples will meet or exceed the requirements outlined in the specifications.

   g. If tests indicate that the in-place material does not meet the required specifications, the material will be removed, replaced, and retested.

   h. The final lift of the soil cover layer grades will be measured to plus or minus two-tenths of a foot measured across any 10-foot section.

XIII. CERTIFICATION

A. The CQA ENGINEER will provide certification that the construction of the liner, cap, leachate collection system, and other associated ancillary facilities for the particular landfill area are constructed according to the approved plans, specifications, and this CQA Manual. Said certification shall have the CQA ENGINEER's seal as a professional engineer registered in the State of North Carolina. The report shall be submitted as each cell or section is constructed and within 30 days of completion of a cell or section.

B. The Certification Report shall include assessments of the CONTRACTOR's compliance with the Construction Plans and Specifications and physical sampling and testing. The Certification Report shall also include statements summarizing the extent of construction, with special attention given to changes from the design plans. The report will certify the results of the various field tests and laboratory tests performed, and assess whether or not the constructed project is in compliance with the Construction Plans and Specifications the report shall include a copy of all test reports and field notes..

C. The project will not be deemed complete and acceptable until the North Carolina Department of Environmental Health and Natural Resources Solid Waste Section has accepted the construction certification and all supplement reports and data as completed.

IV. TECHNICAL SPECIFICATIONS

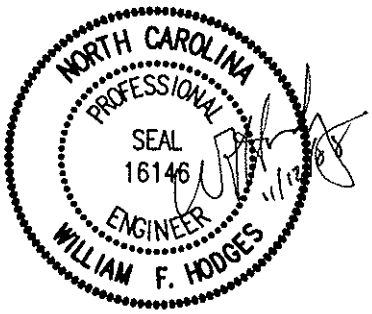
TECHNICAL SPECIFICATIONS

EAST CAROLINA REGIONAL LANDFILL – PHASE 5
BERTIE COUNTY, NORTH CAROLINA

FOR

REPUBLIC SERVICES OF NORTH CAROLINA, LLC
dba
EAST CAROLINA ENVIRONMENTAL

APRIL 2008
REVISED NOVEMBER 2008



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TECHNICAL SPECIFICATIONS

EAST CAROLINA REGIONAL MSW LANDFILL - PHASE 5

FOR

REPUBLIC SERVICES OF NORTH CAROLINA, LLC
BERTIE COUNTY, NORTH CAROLINA

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SECTION 01000

PRE-CONSTRUCTION CONFERENCE

1.01 PRE-CONSTRUCTION CONFERENCE

Prior to beginning excavation activities, a pre-construction conference will be held on-site with representatives of:

Facility Manager
Design Engineer
CQA Engineer
State Regulatory Agency

The purpose of the meeting will be to discuss issues relating to the proper prosecution of the work effort. The CONTRACTOR shall have a schedule of work effort on either a CPM or Gannt format which defines all major work events, target dates, time of completion, and the interrelationship of work effort.

Special attention shall be given to who can make field changes, approve change orders, stop the work, or otherwise make changes in either the project design or the construction sequence. Attention shall also be given to the relationship with the State Regulatory Agency.

An agenda should be prepared for the meeting which specifically lists each item in the Rules for discussion.

The pre-construction conference will be the first of several project conferences or meetings. A schedule for meetings after the pre-construction conference will be established at the pre-construction conference.

Detailed minutes of this meeting shall be kept and copies distributed to all parties in attendance.

-- END OF SECTION --

SECTION 01050

CONFIRMATION SURVEYS

PART 1 - GENERAL

1.01 GENERAL

This section covers the confirmation surveys required for the project. Landfill confirmation surveys are required for the cell subgrade, the liner and cap system components, all leachate system and underground pipelines and electrical, structures, roads and other improvements.

1.02 QUALITY ASSURANCE

The confirmation surveys shall be sealed by a registered land surveyor licensed in this State.

1.03 SHOP DRAWINGS

A. Grade Stakes Numbering System: Provide grid numbering methodology for review. Provide method to number and log individual stakes to assure no stakes remain in compacted soil liner.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.01 GRID OVERLAY

The Surveyor shall establish a grid pattern for control over the entire landfill cell area. The grid dimensions for the landfill cell shall be 50 foot by 50 foot. The grid pattern shall remain in the same location for each land survey described below. The Surveyor shall develop and utilize a numbering system for grid points. The Surveyor shall coordinate the establishment of the grid pattern with the grading CONTRACTOR and this grid pattern will be used in the construction staking.

3.02 CELL SUBGRADE SURVEY

The Surveyor shall provide a two (2) foot contour map with grid elevations shown for the landfill cell(s) subgrade. The survey shall represent as-built elevations immediately prior to placement of the compacted soil liner. The survey shall confirm the correct slopes and grades with those given on the Construction Drawings.

3.03 COMPACTED CLAY LINER SURVEY

The Surveyor shall provide a two (2) foot contour map with grid elevations shown for the landfill clay liner and subgrade. The grid elevations shall be presented to facilitate confirmation of the required thickness (see Figure 1). The survey shall represent as-built elevations immediately prior to placement of the geomembrane liner. The survey shall confirm the correct layer thickness, slopes, and grades with those given on the Construction Drawings. The survey shall include limits of the low permeability soil liner.

3.04 GEOSYNTHETICS SURVEY OF LINER

The Surveyor shall provide a map locating the anchor trench, edge-of-liner, FML panels, all destructive test sample locations, and all FML repairs, and limits of each layer of geosynthetics and locations of all unique structures. The survey shall represent as-built final elevations. The surface area(s) of the geosynthetics shall be shown on the survey.

3.05 PROTECTIVE COVER ON LINER

The Surveyor shall provide a two (2) foot contour map with grid elevations shown for the landfill protective cover layer, compacted soil liner, and subgrade. The grid elevations shall be presented to facilitate confirmation of the required thickness (see Figure 1). The survey shall represent as-built final elevations. The survey shall confirm the correct layer thickness, slopes, and grades with those given on the Construction Drawings. The protective cover survey should include the location of rain flaps and all leachate system piping.

3.06 GEOSYNTHETICS SURVEY OF CAP

The Surveyor shall provide a map locating the anchor trench, edge-of-liner, FML panels, all destructive test sample locations, all FML repairs, limits of each layer of geosynthetics, and locations of all unique structures. The surface area(s) of the geosynthetics shall be shown on the survey.

3.07 PROTECTIVE COVER ON CAP

The Surveyor shall provide a two (2) foot contour map with grid elevations shown for the landfill protective cover layer. The survey shall represent as-built final elevations, drainage berms, and storm water control piping and features.

3.08 OVERALL CONSTRUCTION SITE SURVEY

The Surveyor shall provide a two (2) foot contour map of the entire construction site outside of the cells. This survey can be shown on one of the cell confirmation surveys or as a separate survey. This survey shall locate all improvements in this project including structures, underground pipelines and electrical, and roads.

3.09 GRADE STAKES

The Surveyor shall remove all grade stakes prior to placement of subsequent layer. The Surveyor shall develop and utilize a grade stake numbering system to log and number individual stakes.

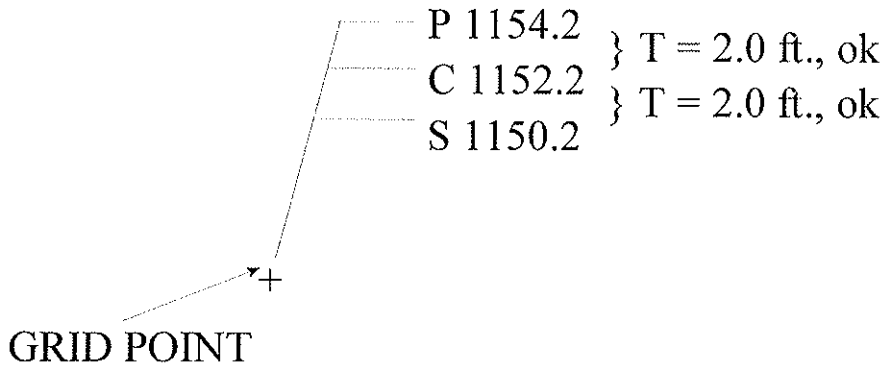
3.10 SURVEYS

The Surveyor shall provide seven (7) sealed and signed prints of each survey and an electronic data file compatible with AutoCad Release 14. The surveys shall include the data of surveys, vertical control utilized, and horizontal control utilized. The surveys shall be at a scale not less than 1" = 50'.

3.11 SCHEDULE

The Surveyor shall provide the confirmation surveys within five (5) days of completion of the particular portion of the work to which they pertain.

DATA PRESENTATION EXAMLE



* The specific minimum thickness is measured perpendicular to surface. A greater difference in elevation will be required on slopes in order to obtain the specified minimum thickness.

KEY

P	**PROTECTIVE SOIL LAYER ELEVATION**
C	**CLAY LINER ELEVATION**
S	**COMPACTED SUBGRADE**
T	**THICKNESS**

FIGURE 1

--END OF SECTION--

SECTION 01051

CONSTRUCTION SURVEYS

PART 1 - GENERAL

1.01 GENERAL

This section covers construction staking and quantity surveys provided by the CONTRACTOR. Construction staking is required for horizontal and vertical location of all site improvements including grading, compacted soil liner, and protective cover. Quantity surveys are required for the purpose of determining quantities of excavation.

1.02 QUALITY ASSURANCE

Quantity surveys shall be performed under the direction of a registered land Surveyor licensed in this State. Reports of quantity surveys shall be signed and sealed by a Registered Land Surveyor licensed in this State.

1.03 SHOP DRAWING

A. Grade Stakes Numbering System

Provide grid numbering methodology (in cells) for review. This shall be coordinated with the confirmation surveying. Provide method to number and log individual stakes to assure no stakes remain within the cell(s).

PART 2 - PRODUCTS

2.01 GENERAL

The CONTRACTOR shall furnish all such stakes, spikes, steel pins, templates, platforms, equipment, instruments, tools, and other materials as may be required for staking and quantity surveys.

PART 3 - EXECUTION

3.01 CONSTRUCTION STAKING

A. General

1. The DESIGN ENGINEER will provide benchmarks for vertical and dimensional data for horizontal location.

2. From a baseline and benchmarks, the CONTRACTOR shall complete the layout of the work and shall be responsible for all measurements that may be required for the execution of the work prescribed in the specifications or on the Construction Drawings, subject to such modifications as may be required to meet changed conditions or as a result of necessary modifications to the work.

3. It shall be the responsibility of the CONTRACTOR to maintain and preserve all benchmarks shown on the plans and any other benchmarks provided by the DESIGN ENGINEER.

4. All survey data shall be recorded in accordance with standard and approved methods. All field notes, sketches, records, and computations made by the CONTRACTOR in laying out the work shall be available at all times during the progress of the work for the ready examination by the DESIGN ENGINEER or CQA ENGINEER or his duly authorized representative.

5. The DESIGN ENGINEER or CQA ENGINEER may make checks as the work progresses to verify lines and grades established by the CONTRACTOR and to determine the conformance of the completed work as it progresses with the requirements of the Contract Documents and Construction Drawings. Such checking by the DESIGN ENGINEER or CQA ENGINEER or his representative shall not relieve the CONTRACTOR of his responsibility to perform all work in accordance with the Contract Documents and Construction Drawings and the lines and grades given therein. In the event that location marks as established by the CONTRACTOR are found to be inaccurate or inadequate, work shall be suspended until corrections have been made.

B. LANDFILL CELL(S)

The CONTRACTOR shall establish a grid pattern for control over the entire landfill cell area. The grid dimensions shall be 50 foot by 50 foot. The grid pattern shall remain in the same location for subgrade, compacted soil liner, and protective cover construction. The CONTRACTOR shall develop and utilize a numbering system for grid points. The CONTRACTOR shall coordinate the establishment of the grid pattern with the confirmation Surveyor so that the same grid pattern may be used for the confirmation surveys. The grid pattern shall be submitted to the DESIGN ENGINEER for approval prior to any grading activities in the cell area.

3.02 QUANTITY SURVEYS

The CONTRACTOR's Surveyor shall develop topographic surveys for the purpose of determining quantities of excavation. Quantities of excavation and fill shall be calculated by

the average end area method or utilizing digital terrain modeling software. The CONTRACTOR's Surveyor shall develop topographic surveys after completion of clearing, grubbing and stripping topsoil and again after completion of grading. Additional cross surveys may be required depending on sequencing of construction. The OWNER may survey portions of the work for confirmation of quantities.

3.03 GRADE STAKES

The CONTRACTOR shall remove all grade stakes prior to placement of subsequent layers during cell construction. The CONTRACTOR shall develop and utilize a grade stake numbering system to log and number individual stakes.

--END OF SECTION--

SECTION 01300

SUBMITTALS

1.01 DESCRIPTION

A. The following submittals shall be provided for this project:

1. Construction Progress Schedules
2. Shop Drawings and Product Data
   a. Construction Surveys
      1. grade stakes numbering system
      2. initial topographic survey
   b. Erosion and Sediment Control
      1. all products
   c. Access Road
      1. graded aggregate
      2. road stabilization fabric
   d. Protective Cover
      1. native sandy soil
   e. Protective Cover
      1. sandy soil
   f. Storm Sewer
      1. all storm pipe and joint materials
      2. headwalls, drop inlets, junction boxes
   g. Leachate Pipe
      1. solid and perforated HDPE pipe
   h. HDPE Fabrication
      1. all fabricated structures
   i. HDPE Geomembrane Liner and Cap
      1. geomembrane material
   j. Geonet Drainage Media
      1. drainage media material
   k. Geotextile
      1. geotextile fabric
   l. Permanent Grassing
      1. grass seed
      2. fertilizer
      3. lime
      4. mulch
      5. soil analysis and recommendation

B. Type or neatly letter the following identifying title on all submittals:

NAME OF OWNER
PROJECT NAME

1.02 CONSTRUCTION PROGRESS SCHEDULES

A. Submit construction progress schedules for the work to DESIGN ENGINEER, with subschedules of related activities which are essential to progress of the Work.

B. Prepare schedules in the form of a horizontal bar chart.

1. Provide separate horizontal bar for each sequence of construction by activity clearly referenced to the corresponding specification section number.

2. Show the chronological order, duration, and projected percentage completion of each sequence of construction.

3. Horizontal time scale: Maximum unit - one (1) month.

4. Sheet size shall be 8½" x 11".

5. Show timeframe for submittal of shop drawings, product data, samples, operation and maintenance data, and other pertinent submittals.

6. Show dates of applications for progress payments at the bottom of the bar chart, indicate payment number, amount of payment request, and cumulative payment to date.

C. Submission Requirements

1. CONTRACTOR shall submit schedules as provided in Article 2.05 of the General Conditions.

2. Submit revised Progress Schedule with each application for payment.

1.03 SHOP DRAWINGS

A. General

1. CONTRACTOR shall submit shop drawings, product data and samples required by the Contract Documents.

2. Designate in the construction progress schedule the dates for submission and the dates that reviewed shop drawings, product data and samples will be needed to cause no delay in the construction progress.

B. Shop drawings

1. Drawings shall be presented in a clear and thorough manner.

   a. Details shall be identified by reference to sheet and detail number shown on Construction Drawings and applicable specification section(s).

   b. Minimum sheet size: 8 ½" x 11"; maximum sheet size 24" x 36".

2. Product data

   a. Clearly mark each copy to identify pertinent products or models.

   b. Show performance characteristics and capacities.

   c. Show dimensions and clearance capacities.

   d. Show wiring or piping diagrams and controls.

3. Manufacturer's standard schematic drawings and diagrams

   a. Modify drawings and diagrams to delete information which is not applicable to the work.

   b. Supplement standard information to provide information specifically applicable to the work.

4. Samples

   a. Office samples shall be of sufficient size and quantity to clearly illustrate:

      1. Functional characteristics of the product, with integrally related parts and attachment devices.

      2. Full range of color, texture, and pattern.

C. CONTRACTOR Responsibilities

1. Review shop drawings, product data, and samples prior to submission.

2. Determine and verify:

   a. Field measurements,
   b. Field construction criteria,
   c. Catalog numbers and similar data, and
   d. Conformance with specifications.

3. Coordinate each submittal with requirements of the work and of the Construction Drawings.

4. Notify the DESIGN ENGINEER in writing, at time of submission, of any deviations in the submittals from requirements of the Contract Documents.

5. Begin no fabrication or work which requires submittals until return of submittals with DESIGN ENGINEER review stamp.

D. Submission requirements

1. Make submittals for all items prior to ordering or fabrication, and in such sequence as to cause no delay in the work or in the work of any other CONTRACTOR.

2. Number of submittals required

   a. Shop Drawings

      Submit a minimum of five (5) copies as required by General Conditions, plus additional copies which CONTRACTOR requires.

   b. Samples

      Submit the number stated in each specification section.

3. Submittals shall contain:

   a. The date of submission, submission number (in consecutive order), and dates of any previous submissions.

   b. Contract identification as specified in Article 1.01, paragraph B.

c. The name of:

1. CONTRACTOR
2. Supplier
3. Manufacturer

d. Identification of the product with the specification section number.

e. Field dimensions clearly identified as such.

f. Relation to adjacent or critical features of the work or materials.

g. Applicable standards, such as ASTM or Federal specification numbers.

h. Identification of deviations from Contract Documents.

i. Identification of revisions on resubmittals.

j. CONTRACTOR's review stamp.

4. All shop drawings shall be coordinated between trades prior to submission for review and approval.

a. Manufacturer's equipment submittals with statements such as "Field Wiring by Others", "Control Wiring by Others", or "Not by Manufacturer" (referring to related fittings, control or interlock wiring, etc.) will be "REJECTED" unless specifically noted as having been coordinated with all related trades.

5. CONTRACTOR's stamp initialed or signed, certifying to review of submittal, verification of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.

E. Resubmission requirements

1. CONTRACTOR shall make any corrections or changes in the submittals required by the DESIGN ENGINEER and resubmit.

2. Drawings and Product Data

a. Revise initial drawings or data, and resubmit as specified for the initial submittal.

b. Indicate any changes which have been made other than those requested by the DESIGN ENGINEER.

3. Samples

Submit new samples as required for initial submittal.

F. Distribution

CONTRACTOR shall distribute reproductions of Shop Drawings which carry the DESIGN ENGINEER's review stamp to:

a. Job site file,
b. Record documents file, and
c. Others as required.

G. DESIGN ENGINEER will return three (3) reviewed and appropriately stamped copies of submittals to CONTRACTOR for distribution, or for resubmission, unless CONTRACTOR requests and submits additional copies as provided in paragraph D of this Article 1.04.

-- END OF SECTION--

SECTION 01400

QUALITY CONTROL

1.01 DESCRIPTION

A. The OWNER shall employ and pay for the services of a third party CQA firm and a geotechnical engineering firm to confirm the installation of the geomembrane and clay liners, and perform soils, concrete and other required testing. The CONTRACTOR shall coordinate his work with the third party firms. The third party CQA firm shall use the CQA manual for this project which is included as a part of these specifications by reference.

1. Employment of the third party CQA firm and geotechnical firm shall in no way relieve CONTRACTOR's obligations to perform the work of the Contract.

2. While the OWNER will provide all materials testing, any retesting required due to failure of material installation by CONTRACTOR shall be back-charged to the CONTRACTOR.

B. Related requirements specified in other sections:

1. Certification of Products: The respective sections of Specifications.

2. Test, adjust and balance of equipment: The respective section of Specifications.

3. Laboratory tests required, and standards for testing: The respective section of the Specifications.

C. Testing laboratory inspection, sampling and testing is required for but not limited to the following:

1. Section 02210 - Grading
2. Section 02220 - Trenching, Backfilling and Compaction
3. Section 02250 - Compacted Clay Liner
4. Section 02252 - Protective Soil Cover on Landfill Cap
5. Section 02253 - Protective Cover - On-Liner Native Sandy Soils
6. Section 02255 - Protective Cover - On-Liner Sandy Soils
7. Section 02260 - Compacted Soil Cap
8. Section 02745 - Leachate Piping

9. Section 02747 - Leachate Collection System
10. Section 02750 - HDPE Geomembrane Liner
11. Section 02754 - Geonet Drainage Media (GDM)
12. Section 02755 - Geomembrane (FML) Cap
13. Section 02757 - Geotextile

1.02 QUALIFICATION OF LABORATORY

A. Meet "Recommended Requirements for Independent Laboratory Qualifications", published by American Council of Independent Laboratories.

B. Meet basic requirements of ASTM E 329, "Standards of Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction, as appropriate.

C. Authorized to operate in the State in which Project is located.

D. Must have established credentials and experience in CQA of geomembrane and compacted clay liners, as appropriate.

E. Testing Equipment

1. Calibrated at reasonable intervals by devices of accuracy traceable to either:

a. National Bureau of Standards
b. Accepted values of natural physical constants

1.03 LABORATORY DUTIES

A. Cooperate with DESIGN ENGINEER and CONTRACTOR: provide qualified personnel after due notice.

B. Perform specified inspections, sampling and testing of materials and methods of construction:

1. Comply with specified standards.

2. Ascertain compliance of materials with requirements of Contract Documents.

C. Promptly notify DESIGN ENGINEER and CONTRACTOR of observed irregularities or deficiencies of work or products.

D. Promptly submit written report of each test and inspection; two copies each to DESIGN ENGINEER, and one copy to CONTRACTOR and record documents file. Each report shall include:

1. Date issued.

2. Project title and number.

3. Testing laboratory name, address and telephone number.

4. Name and signature of laboratory inspector.

5. Date and time of sampling or inspection.

6. Record of temperature and weather conditions.

7. Date of test.

8. Identification of product and specification section.

9. Location of sample or test in the Project.

10. Type of inspection or test.

11. Results of tests and compliance with Contract Documents.

12. Interpretation of test results, when requested by DESIGN ENGINEER.

E. Perform additional tests as required by DESIGN ENGINEER or the OWNER if initial tests are not conclusive to merit acceptance.

1.04 LIMITATIONS OF AUTHORITY OF TESTING LABORATORY

A. Laboratory is not authorized to:

1. Release, revoke, alter or enlarge on requirements of Contract Documents.

2. Approve or accept any portion of the work.

3. Perform any duties of the CONTRACTOR.

1.05 CONTRACTOR'S RESPONSIBILITIES

A. Cooperate with laboratory personnel, provide access to work, to manufacturer's operations.

B. Secure and deliver to the laboratory adequate quantities of representational samples of materials proposed to be used and which require testing.

C. Provide to the laboratory the preliminary design mix proposed to be used for concrete, and other material mixes which require control by the testing laboratory.

D. Furnish copies of product test reports as required.

E. Furnish incidental labor and facilities:

1. To provide access to work to be tested.

2. To obtain and handle samples at the Project site or at the source of the product to be tested.

3. To facilitate inspections and tests.

4. For storage and curing of test samples.

--END OF SECTION--

SECTION 01560

EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 WORK INCLUDED

A. Installation of soil erosion control devices.

B. Maintenance of soil erosion devices during construction.

C. Removal of temporary soil erosion control devices after stabilization of disturbed areas.

D. Temporary grassing for soil erosion control.

1.02 QUALITY CONTROL

A. After installing the soil erosion control devices as called for on the Construction Plans, the CONTRACTOR shall assure himself that all reasonable measures possible have been taken to prevent the siltation of nearby water courses.

B. The erosion and sediment control shall conform with the rules and regulations of the Erosion Control Ordinance of the North Carolina Department of Natural Resources and Community Development.

PART 2 PRODUCTS

2.01 SILT FENCE AND INLET PROTECTION

A. Posts

Silt fence posts shall be 2" x 4" pressure treated pine, a minimum of four (4') feet long and spaced a maximum of six (6') feet apart.

B. Woven Wire Fence

Wire fence reinforcement shall be a minimum of 14-gauge 4" x 4" hogwire.

C. Filter Fabric

Use a synthetic filter fabric or a previous sheet of polypropylene, nylon, polyester, or polyethylene yarn, which is certified by the manufacturer or supplier as conforming to the requirements shown in the Table below.

Synthetic filter fabric should contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six (6) months of expected usable construction life at a temperature of 0 to 120°F.

Physical Property	Requirements
Filtering Efficiency	85% (min)
Tensile Strength at 20% (max) Elongation	Standard Strength-30 lb/lin in (min) Extra Strength-50 lb/lin in (min)
Slurry Flow Rate	0.3 gal/sq ft/min (min)

2.02 RIP-RAP FOR STORMWATER CONVEYANCE CHANNELS AND OUTLET PROTECTION

A. Stone

Stone for rip-rap shall be durable, dense, specifically selected and graded, quarried stone. The d_{50} size shall be 6, 9, or 12 inches as called for on the plans.

B. Gravel

Gravel for filter blanket shall be ASTM No. 57.

C. Filter Fabric

Filter fabric for filter blanket shall be a non-woven geotextile suitable for filtration and separation. The fabric weight shall be a minimum of 6.0 ounces per square yard.

2.03 TEMPORARY GRASSING

A. Temporary seed

Temporary seed shall be annual ryegrass and pearl millet at the planting rates specified herein.

B. Mulch

Mulch for temporary grassing shall consist of grain straw or other acceptable material, and shall have been approved by the DESIGN ENGINEER before being used. All mulch shall be reasonably free from mature seedbearing stalks, roots, or bulblets of Johnson Grass, Nutgrass, Sandbur, Wild Garlic, Wild Onion, Bermuda Grass, Crotalaria, and Witchweed, and free from an excessive amount of noxious weeds at the time of use of the mulch, and also there shall be compliance with all applicable State and Federal domestic plant quarantines. Straw mulch that is matted or lumpy shall be loosened and separated before being used.

Material for holding mulch in place shall be an approved binding material. No asphalt tacking material will be allowed.

2.04 TEMPORARY STORMWATER CONVEYANCE CHANNEL LINER

A. Excelsior Matting

Excelsior matting shall be an erosion control blanket consisting of an excelsior mat with a synthetic netting on one side similar and equal to Curlex as manufactured by American Excelsior Company.

PART 3 EXECUTION

3.01 GENERAL

Construct temporary and permanent erosion control measures as shown on the plans, as required by site conditions, regulatory agency or DESIGN ENGINEER. All permanent erosion control work shall be incorporated into the project at the earliest practicable time. Temporary erosion control measures shall be coordinated with permanent erosion control measures and all other work on the project to assure economical, effective, and continuous erosion control throughout the construction and post-construction period and to minimize siltation of rivers, streams, lakes, reservoirs, other water impoundments, ground surfaces, or other property. If active construction ceases for more than 30 days, all disturbed areas shall be seeded and mulched using the temporary seed type and planting rates specified herein.

The CONTRACTOR shall be liable for all damages to public or private property and fines as may be placed on the project by the local regulatory agencies due to soil erosion from the project site. Clear only those areas required to install the soil erosion control devices, request an inspection by the local agency having jurisdiction.

All erosion control devices shall be inspected by the CONTRACTOR after each rainfall. Any required repairs shall be made immediately. Sediment deposits shall be removed when deposits reach approximately one-half of the capacity of the erosion control.

3.02 SILT FENCE

A. Silt fence shall be installed in accordance with the details in the plans.

B. Should the filter fabric deteriorate or become ineffective prior to the end of the construction as determined by the DESIGN ENGINEER or CQA ENGINEER, the fabric shall be replaced immediately at no additional cost to the OWNER.

3.03 RIP-RAP

A. Prepare subgrade to the required lines and grades as shown or indicated on the Construction Drawings. Place any fill required in the subgrade to a density equal to that of the surrounding area. Place filter fabric on the finished subgrade.

B. Place rip-rap by mechanical methods, augmented by hand placing where necessary to prevent damage to permanent works, provided that when the rip-rap is completed it forms a properly graded, dense, neat layer of stone. The completed rip-rap shall have a thickness as shown on the plans.

3.04 TEMPORARY GRASSING

Temporary grassing procedures will be implemented only under the direction of the DESIGN ENGINEER, a cease of construction in excess of 30 days, or as required by the soil erosion inspector.

Seeding for temporary grassing shall be applied to all shoulders, side stormwater conveyance channels, cut slopes, fill slopes, and any other area disturbed by the CONTRACTOR and not designated for pavement or structures. Temporary seeding shall occur immediately following final land disturbing activities. Any unseeded area which erodes shall be repaired to the satisfaction of the DESIGN ENGINEER at no additional cost to the OWNER. Temporary seeding shall be applied at the following rates:

Temporary Seeding	LBS / Acre	Depth of Cover	Date of Planting
German Millet	40	¼" - ½"	5/1 - 8/15
Rye (Grain)	120	¼" - ½"	1/1 - 5/1

Areas not receiving permanent cover that will be exposed for more than three (3) months shall receive temporary grassing. Temporary grassing shall consist of rye grass. Other cereal grass (i.e., millet) may also be used. Other grassing methods which have proved effective by the operator may be substituted for these.

3.05 INLET PROTECTION

A sump shall be constructed around the drop inlet and silt fence installed in accordance with the details in the plans for Drop Inlet Protection.

3.06 TEMPORARY STORMWATER CONVEYANCE CHANNEL LINER

A. After installation of the utilities, the stormwater conveyance channels shall be reconstructed as near as possible to the original configuration.

B. Apply lime, fertilizer, and seed to the stormwater conveyance channel and adjoining areas in accordance with the grassing specifications.

C. Place the excelsior mat in accordance with the detail and table in the erosion control plan.

D. Start laying the mat from the top of the upstream end of the channel and unroll it downgrade. Do not stretch netting.

E. Bury the upslope end and staple the mat every 12" across the top end, every three (3) feet around the edges and across the mat so that it is held closely against the soil. However, do not stretch the mat when stapling.

F. To join ends of strips, insert the new roll of mat in a trench as with upslope end and overlap it 18" with the previously laid upper roll. Turn under 6" of the 18" overlap and staple every 12" across the end.

3.08 REMOVAL OF TEMPORARY EROSION DEVICES

The CONTRACTOR shall remove all sedimentation and erosion control devices upon the approval of permanent seeding and stabilization by the agency having jurisdiction of the area and the DESIGN ENGINEER. All sediment deposits remaining in place after the erosion control devices are removed shall be dressed to conform with the existing grade, prepared, and seeded. The cost of removal and cleanup shall be included in the cost of the installation of the device or in the cost for maintenance.

3.09 CLEAN OUT PERMANENT EROSION CONTROL DEVICES

The CONTRACTOR shall clean out permanent sediment and erosion control devices upon approval of permanent seeding and stabilization by the agency having jurisdiction of the area and the DESIGN ENGINEER. The devices shall be cleaned out to the original condition. The cost of cleanup shall be included in the cost of installation or in the cost of maintenance of the device.

--END OF SECTION--

SECTION 01666

TESTING PIPING SYSTEMS

PART 1 GENERAL

1.01 DESCRIPTION

A. This section covers the requirements for CONTRACTOR's testing gravity and pressure piping systems not specified under other specification sections.

B. Tests shall be performed on but not limited to the following:

1. Pressure Leachate Collection Pipes
2. Force Mains
3. Leachate Collection Pipes
4. Gravity Manholes

C. All tests require the presence of the CQA ENGINEER or his representative.

D. If the installation fails to meet test requirements, the CONTRACTOR shall, at his expense, determine the source of leakage and make repairs as necessary to eliminate leakage and retest as directed.

E. All costs for the testing shall be borne by the CONTRACTOR.

F. Advise the CQA ENGINEER at least 48 hours before tests are to be conducted.

PART 2 PRODUCTS

2.01 GENERAL

A. All equipment shall be the best of their particular class and suited for the intended use.

PART 3 EXECUTION

3.01 GENERAL

A. If the specified rate of leakage is exceeded, on testing, the CONTRACTOR shall locate the points of excessive leakage and institute appropriate measure of correction, whereupon the length of pipeline shall be retested and this procedure continued until test requirements are met.

B. Unless specified otherwise the following tests shall be performed as directed by CQA ENGINEER.

1. Exfiltration Testing

   a. All gravity leachate piping constructed under this Contract.
   b. All HDPE manholes and other fabricated structures.

2. Hydrostatic Testing

   a. Pressure Leachate Pipes
   b. Force Mains

3.02 EXFILTRATION TESTING

A. The CQA ENGINEER shall require exfiltration tests on all HDPE manholes and on gravity piping.

B. The section to be tested and the manner of test will be determined by the CQA ENGINEER.

C. Procedure for Exfiltration Testing:

1. Plug each end of section or all openings to manhole to be tested with watertight bulkheads.

2. Insert in each bulkhead at the top of the pipeline a two (2") inch pipe with 90° elbow, that will extend four (4') feet vertically above the top of the pipeline or above the groundwater line, whichever is higher. Manholes shall be tested at full depth with the water level at the cover ring.

3. The elevations of the top of the two (2") inch pipe at each bulkhead shall be the same.

4. Fill the pipeline with clear water until the water level is at the top of the two (2") inch pipe at the upper end of section or at the manhole ring.

5. Maintain the water level by adding accurately measured amounts of water for a period of thirty minutes, not allowing the lower pipe to overflow. The exfiltration test is to run for a minimum 24 hour period.

D. The maximum length of a section of pipeline to be tested by means of an exfiltration test at one time shall be limited to 1,000 linear feet.

E. The maximum permissible leakage determined by exfiltration shall be the rate of 25 gallons per inch interval diameter of pipe per mile of pipe line per 24 hours, inclusive of all appurtenances within the section such as manholes, house connections, etc. The length of pipe used in the computation shall be the horizontal distance between manhole centerlines of the section being tested. The maximum permissible leakage for manholes shall be 0.01 gallons per vertical foot per day.

F. Once infiltration is found to be within allowable limits, remove all bulkheads.

3.03 HYDROSTATIC TESTING

A. The following piping system shall be Hydrostatically tested:

1. Leachate Force Mains; and

2. All other pressure piping systems not specifically requiring testing under other specification sections.

Do not test piping systems with water where water testing will be harmful to the system operations, such as for air and gas piping systems.

B. After the pipe has been laid and backfilled between fittings, and before any fittings are covered, unless this requirement is waived by the CQA ENGINEER, all newly laid pipe, above ground or below ground, or any valved section thereof, shall be subjected to a hydrostatic gauge pressure as hereinafter tabulated.

1. All piping that will be considered inaccessible or impossible to repair after the completion of all work shall be hydrostatically tested while still accessible.

2. Examples of such piping are those near or under basins, paved roads, concrete structures and concrete foundations.

3. Note: All piping shall have reaction blocking (thrust blocks) in place before testing, as required.

C. Tests shall be under the direction of the CQA ENGINEER. The CONTRACTOR shall furnish a pressure gauge for measuring the pressure on the pipeline, shall provide a corporation cock to attach gauge or pump connection, and shall provide plugs to seal taps after use in testing, and shall also furnish a suitable pump, pipe, appliances, and other appurtenances necessary to make these tests.

D. Each section of pipe shall be filled slowly with water and the specified test pressure, measured at the point of lowest elevation, shall be applied to the pipe in a satisfactory manner. The CONTRACTOR will furnish all test water.

E. Before applying the specified water test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made, as directed by the CQA ENGINEER, if necessary, at points of highest elevation, and afterward tightly plugged.

F. The test pressure shall be maintained for a sufficient length of time prior to the test to allow for thorough examination of joints and elimination of leakage where necessary. The pipe line shall be made watertight under the test pressure.

G. All exposed pipes, fittings, valves, hydrants, and joints will be carefully examined during the open trench test. Any cracked or defective pipes, fittings, valves, or hydrants discovered in consequence of this pressure test shall be removed and replaced by the CONTRACTOR with sound material and the test shall be repeated until satisfactory to the CQA ENGINEER.

H. Hydrostatic test pressures shall be as follows:

System	Pressure Test Rating (psi)
Miscellaneous pressure pipe	50
Pressure leachate piping (force main)	100
Secondary Containment Pipe	Actual Maximum Pressure plus 5 psi

1. The test shall be pressurized to the required test pressure.

2. The test shall be conducted for a minimum of six (6) hours.

I. The tested section will not be accepted if it has any observed leakage or test pressure drops more than one (1) psi during the leakage study.

--END OF SECTION--

SECTION 02110

CLEARING AND GRUBBING

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. Extent of site clearing is shown on Construction Drawings.

B. Site clearing work includes, but is not limited to:

1. Protection of trees outside of clearing limits.
2. Removal of trees and other vegetation within site clearing limits.
3. Grubbing within the clearing limits.
4. Stripping topsoil.
5. Removal of debris on the site.

1.02 RELATED DOCUMENTS

A. Section 02930 - Grassing

B. Construction Drawings and general provisions of Contract, including General and Supplementary Conditions, and Detailed Specification sections, apply to work of this section.

1.03 JOB CONDITIONS

A. Examine areas for conditions under which work is to be performed. Report to the DESIGN ENGINEER all conditions contrary to those shown on the Construction Drawings or specified herein and all other conditions that will affect satisfactory execution of the work. Do not proceed with work until unsatisfactory conditions have been corrected and authorization has been given by OWNER's representative.

B. Conduct site clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks, or other occupied or used facilities without permission from authorities having jurisdiction.

C. Provide protection necessary to prevent damage to existing improvements indicated to remain in place on adjoining properties and on OWNER's. Restore damaged improvements to their original condition, as acceptable to parties having jurisdiction, without additional cost to the OWNER.

D. Keep dirt, dust, noise, and other objectionable nuisances to a minimum. Use temporary enclosures, coverings, and sprinkling, or a combination thereof, as necessary to limit dust to lowest practicable level, except do not use water to the extent of causing flooding, contaminated runoff, or icing.

E. Protect existing trees and other vegetation indicated to remain in place, against unnecessary cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, access foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary guards to protect trees and vegetation to be left standing.

1. Water trees and other vegetation to remain within limits of the contract work as required to maintain their health during course of construction operations.

2. Repair or replace trees and vegetation indicated to remain which are damaged by construction operations, in a manner acceptable to OWNER, without additional cost to OWNER. Employ licensed arborist to repair damages to trees and shrubs.

3. Replace trees which cannot be repaired and restored to full-growth status, as determined by arborist.

F. Property corners, iron pipe and/or monuments, shall be located and protected before beginning clearing operations.

1.04 QUALITY ASSURANCE

A. Obtain copy of Land Disturbing Permit and maintain at the site.

B. Obtain the required permits and conform to applicable codes for disposal of debris off-site and burning of debris on-site.

C. Perform all work in accordance with requirements of OSHA and the Environmental Protection Agency in addition to State and local requirement.

PART 2 PRODUCTS

2.01 TOPSOIL

A. Is defined as natural, friable soil, characteristic of representative soils that produce heavy growth of crop, grass, or other vegetation is generally that soil strata found to 24 inches depth.

B. Topsoil for placement on graded areas shall be free from roots, stones, and other materials that may hinder grading, planting, and maintenance operations, and shall be free from objectionable weed seeds and toxic substances.

PART 3 EXECUTION

3.01 CLEARING

A. Clearing shall consist of the cutting, removal, and satisfactory disposal of all trees and shrubs within the clearing limits as designated on the plans and/or within easements and right-of-ways which will require construction work during the project.

B. Clear only those areas required to install the soil erosion control devices as shown on the plans and outlined in Section 01560 - Erosion and Sediment Control of these specifications prior to starting overall clearing operations.

C. Repair and maintain erosion control devices during construction in order to always assure their efficiency.

D. Trees to remain shall be trimmed of branches which will obstruct the new construction or as directed by the DESIGN ENGINEER or CQA ENGINEER. Branches to be trimmed shall be neatly cut close to the bole of the tree or main branch. Cuts more than 1 ½" in diameter shall be painted with a tree wound paint formulated for use on damaged plant tissues.

3.02 GRUBBING

A. Grubbing shall consist of the removal and disposal of stumps, roots larger than three (3) inches in diameter and matted roots from the designated clearing limits to a depth of 18 inches below the original surface level of the ground.

B. For trees to remain, provide protection for roots over 1 ½" in diameter which are cut during grubbing. Coat cut faces with a tree wound paint formulated for use on damaged plant tissues. Temporarily cover exposed roots with wet burlap to prevent roots from drying out, cover with earth as soon as possible.

C. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform with the original adjacent surface of the ground, unless further excavation is indicated.

D. Use only hand methods for grubbing inside drip line of trees indicated to be left standing.

3.03 TOPSOIL STRIPPING, STOCKPILING AND SPREADING

A. All topsoil within the clearing limits shall be stripped and stockpiled as directed by the OWNER.

B. Topsoil shall be placed on all shoulders, slopes, stormwater conveyance channels, and other earth areas graded under this contract, unless otherwise specified on the plans. Topsoil shall be uniformly placed on these areas to a compacted depth of not less than 4 inches or more than 6 inches. Topsoil depth on landscape areas shall be no less than 6 inches. The material shall be placed, leveled, and lightly compacted with at least one pass of a cultipacker, or other approved equipment weighing 100 to 160 pounds per linear foot of roller, to required cross sections.

3.04 REMOVAL OF DEBRIS

A. Removal of debris shall consist of the satisfactory disposal of any garbage or rubble within the clearing limits, easements, right-of-way or as specifically designated on the plans.

3.05 DISPOSAL OF MATERIAL

A. All vegetation and debris within the areas to be cleared shall become the property of the CONTRACTOR upon the start of work and shall be removed from the site and properly disposed.

B. Burning of combustible materials removed by clearing and grubbing operations will be allowed providing the CONTRACTOR obtains such permits and approvals required by local authorities, if available. In addition to obtaining approval from local authorities, the Solid Waste Section approval is required for burning of any cleared debris within the facility boundary. The CONTRACTOR will be responsible for controlling fires in compliance with all Federal, State, and Local laws and regulations. The securing of necessary burning permits shall be the responsibility of the CONTRACTOR. All burning shall be under the constant care of competent watchmen. All materials resulting from clearing and grubbing operations and disposed of by burning on the site shall be thoroughly and completely reduced to ashes.

--END OF SECTION--

SECTION 02210

GRADING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Excavation, fill, and preparation of subgrade for landfill, roadways, embankments, building foundations, and detention basins.

B. All excavation shall conform with the lines and grades as shown on the plans or established by the DESIGN ENGINEER.

1.02 RELATED WORK

Drawings and general provisions of Contract, including General and Supplementary Conditions, and Detailed Specification sections, apply to work specified in this section.

1.03 QUALITY ASSURANCE

A. Perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction.

B. OWNER will engage soil testing and inspection service, for quality control testing during earthwork operations.

C. Test reports for the following items shall be given to the DESIGN ENGINEER and will be available for the CONTRACTOR directly responsible for earthwork being tested:

1. Field Density Test Reports

2. One (1) optimum moisture-density curve for each type of soil encountered.

3. Other field inspection reports as deemed appropriate.

1.04 APPLICABLE STANDARDS

The most recent publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

American Society for Testing and Materials (ASTM) Publications (Latest Version):

D 422	Method of Particle-Size Analysis of Soils
D 698	Moisture Density Relations of Soils and Soil Aggregate Mixtures Using 5.5 lb. Rammer/12 inch drop
D 1556	Density and Unit Weight of Soil in Place by the Sand-Cone Method
D 2922	Density of Soil in Place by the Nuclear Gage
D 2937	Density of Soil in Place by the Drive-Cylinder Method.
D 4318	Test Method For Liquid Limit, Plastic Limit and Plasticity Index of Soils

1.05 SUBMITTALS

Proposed technique for rock excavation (Blasting not allowed).

PART 2 - PRODUCTS

2.01 SUITABLE MATERIAL

A. Shall be free from construction material, debris, frozen material, organic matter or unstable material.

B. Shall be suitable for the formation of embankments, subgrades, backfill, shoulders and other places requiring structural fill as may be indicated on the contract drawings or directed by the CQA ENGINEER.

C. No rock greater than 6 inches in diameter shall be placed in any portion of the landfill embankment. Small rock less than 6 inches, if used, shall be incorporated into the embankment in such a fashion to completely avoid bridging or voids.

2.02 UNSTABLE MATERIAL

The CQA ENGINEER will designate material unstable for the formation of embankments and subgrades. Unstable material may also be referred to as unsuitable. Moisture content of material alone shall not render material unstable or unsuitable. It is CONTRACTOR's responsibility to raise or lower material moisture content to achieve specified compaction densities or remove and replace at CONTRACTOR's expense.

2.03 UNSUITABLE MATERIAL

Areas deemed unstable or unsuitable by the CQA ENGINEER for subsequent embankment formation operations or other operations due to the presence of unstable or unsuitable materials as determined by proof rolling. Material shall be removed, replaced, and compacted using a suitable material.

2.04 BORROW EXCAVATION

Borrow material is available on site which is suitable for formation of embankment and subgrades as determined by the CQA ENGINEER, and shall be obtained from areas designated on the Contract Drawings.

2.05 CLAY LINER SUBGRADE

This area includes the designated thickness of compacted materials, to the limits indicated below the compacted clay liner.

2.06 SELECT SOILS FOR MUNICIPAL SOLID WASTE LANDFILL

The CQA ENGINEER shall classify soils suitable for compacted clay liner construction, drainage blanket (protective cover) and daily waste cover during the site excavation. The CONTRACTOR shall stockpile the materials at stockpile areas designated by the CQA ENGINEER.

2.07 GRADED AGGREGATE

Graded aggregate for access road construction shall comply with State Department of Transportation specifications for graded aggregate base.

2.08 GEOTEXTILE FABRIC

The geotextile fabric for access road construction shall be a high modulus, woven geotextile suitable for road base stabilization, soil separation, and reinforcement. The fabric shall be Amoco Style 2006, Nicolon Mirafi 600X or equal.

PART 3 - EXECUTION

3.01 PREPARATION OF GROUND SURFACE FOR FILL

Before embankment and roadway construction are begun, all vegetation and rubbish shall be removed from the area within the limits of the embankment and roadway.

Following stripping, those areas at grade or designated to receive fill or subsequent materials placement shall be proof rolled in the presence of the CQA ENGINEER with a loaded dump truck or similar piece of heavy equipment to identify those areas needing repair due to pumping or yielding. Any area which ruts or pumps excessively in the opinion of the CQA ENGINEER shall be undercut to firm bearing and backfilled with properly compacted soil fill.

Topsoil shall be stockpiled and utilized in areas to be seeded after completion of grading. Excess topsoil shall be hauled to designated areas.

3.02 DETERMINATION OF IN-PLACE SOIL PROPERTIES

A. Determination of Density

Testing shall be provided by the CQA ENGINEER for the OWNER. Testing shall be performed by an approved commercial testing laboratory. The number of laboratory moisture-density tests and field density tests shall be in accordance with Paragraph 3.02, C to insure the specified density is obtained. Laboratory tests for moisture-density relations shall be performed in accordance with ASTM D698. Field tests for density and moisture content shall be performed in accordance with ASTM D1556, ASTM 2937, or ASTM 2922. Copies of all tests results will be furnished to the CONTRACTOR and the DESIGN ENGINEER. All testing shall comply with minimum construction quality assurance requirements of the State.

B. Classification Tests:

Liquid Limit, Plastic Limit, and Plasticity Index will be determined in accordance with ASTM D4318. Sieve Analysis will be made as specified in ASTM D422.

C. Number of Density Tests:

The following tests will be performed and are considered to be the number of tests. Additional tests may be required contingent upon weather and/or soil conditions.

1. One (1) laboratory moisture-density relation test and companion classification test for each type of soil encountered.

2. A minimum of one (1) density test shall be performed per 1,000 cubic yards of fill subgrade and other embankment fills.

3.03 DRAINAGE

Satisfactory methods for dewatering and stormwater control during construction shall be installed as required. Cost of dewatering shall be included in the lump sum price in the proposal. The disposal of water after removal shall be in keeping with the intents of the soil erosion control plan.

3.05 GENERAL COMPACTION/FILL REQUIREMENTS

Excavation, fill and compaction requirements for this project vary as to the respective subgrade being constructed. Any subgrade not specifically detailed herein or any subgrade requirements that references this section shall meet the requirements of this section.

A. COMPACTION

1. When tested, embankment and fill material shall be compacted to not less than 95% Standard Proctor (ASTM D698) of the maximum dry density, or as specified in the schedule below. All subgrades will be proof-rolled prior to acceptance of subgrade by the CQA ENGINEER. Proof-rolling will be in accordance with procedures in Section 3.01 of this specification. The number of tests shall be in accordance with Section 3.01, C.

DESCRIPTION	GENERAL COMPACTION	TOP 12"
Roadways	95%	98%
Shoulders & Embankments	95%	95%
Sediment Pond Enbankments	95%	95%
Utilities Under Structures	95%	98%
Other Areas	90%	95%

2. If, in the opinion of the CQA ENGINEER (based upon testing reports, or inspection), subgrade or fills which have been placed are below specified density, the CONTRACTOR shall then provide additional compaction or repairs at no additional cost to OWNER. Retests may be charged to the CONTRACTOR as determined by the CQA ENGINEER.

3. Subgrade materials shall be compacted at a moisture content within plus or minus 4% of optimum unless more or less moisture is allowed by the CQA ENGINEER. The CONTRACTOR shall dry or add moisture to the subgrade material when required to provide a uniformly compacted subgrade.

B. PROTECTION OF SUBGRADES

Stormwater conveyance channels and drains shall be provided and maintained when required to satisfactorily drain the subgrade. Where previously approved subgrade is damaged by natural causes, by hauling equipment, or by other traffic, the CONTRACTOR shall restore the subgrade to the required lines, grades, and typical sections and to the required density at no additional cost to the OWNER.

C. EMBANKMENT FORMATION:

1. Areas to receive embankment formations or fill shall be stripped to suitable base material as required in Section 02110 - Clearing and Grubbing.

2. The material shall be deposited and spread in successive, uniform, approximately horizontal layers of not more than 10 inches in depth, loose measurement, for the full width of the cross section, and shall be kept approximately level by the use of effective spreading equipment. Each layer of the embankment shall be satisfactorily compacted as hereinafter specified.

3. Hauling shall be distributed over the full width of the embankment, and in no case will deep ruts be allowed to form during the construction of the embankment. The embankment shall be properly drained at all times.

4. Where embankments are to be constructed across wet sandy soil which will not support the weight of trucks or other hauling equipment due to near surface ground water, the first layer of the embankment may be constructed as a bridging lift by placing successive truck or other equipment loads in a uniform distributed layer of a thickness not greater than that necessary to support the trucks or hauling equipment while placing subsequent layers as determined by the DESIGN ENGINEER and CQA ENGINEER. The remainder of such embankments shall then be constructed in layers as above specified.

D. EMBANKMENT COMPACTION:

1. All embankment material shall be compacted to 95% Standard Proctor compaction unless otherwise provided in the Contract Documents or directed by the CQA ENGINEER. Compaction equipment used by the CONTRACTOR shall be adequate to produce the required compaction and produce a uniformly constructed embankment with all layers uniformly bound to all preceding layers.

2. Embankment materials shall be compacted at a moisture content within plus or minus 4% of optimum unless other moisture range is approved by the

CQA ENGINEER. The CONTRACTOR shall dry or add moisture to the embankment material when required to provide a uniformly compacted and stable embankment.

3.06 GENERAL GRADING TOLERANCES

Grading tolerances shall be as specified below:

LANDFILL(S)

Soil Liner Subgrade (-0.1')

Compacted Soil Liner

A. Rough Grading (+ 0 to 0.2')
B. Fine Grading (+ 0 to 0.1')

Embankment (± 0.1')
Protective Cover (+ 0.1')

ROADWAYS AND STRUCTURES

Roadway Subgrade

A. Rough Grading (± 0.12')
B. Fine Grading (± 0.04')

Other

A. Rough Grading (± 0.12')
B. Fine Grading (± 0.04')

3.07 ROADWAY SUBGRADE

A. Preparation of Subgrade

The roadway subgrade shall be shaped to the lines, grades and typical sections shown on the plans. Where the CQA ENGINEER directs that areas of the subgrade are to be stabilized, the subgrade surface in such areas may be left uniformly below grade to provide for the addition of the stabilizer material.

All unsuitable material, boulders, and all vegetative matter shall be removed and replaced with suitable material. Suitable material, when not available from the subgrade work, shall be taken from general excavation or borrow sources.

Material excavated in preparing the subgrade shall be stored or stockpiled in such a manner as to not interfere with the proper drainage or any subsequent placement of base or pavement.

B. Compaction of Subgrade

When tested, fill material shall be compacted to not less than the following percent of the maximum dry density:

1. Under paved roads 95%; top 12 inches to 98%.

2. Under shoulders and stoned road 95%.

The subgrade shall be compacted at a moisture content which is approximately that required to produce the maximum density indicated. The CONTRACTOR shall dry or add moisture to the subgrade when required to provide a uniformly compacted and acceptable subgrade.

C. Protection of Subgrade

Stormwater conveyance channels and drains shall be provided and maintained when required to satisfactorily drain the subgrade. Where previously approved subgrade is damaged by natural causes, by hauling equipment, or by other traffic, the CONTRACTOR shall restore the subgrade to the required lines, grades, and typical sections and to the required density at no cost to the OWNER.

D. Rough Grading

The roadway subgrade surface shall be graded to within the specified tolerance of the grades indicated on the Contract Drawings. The final rough grade surface shall meet the compaction requirements and be graded and sealed to properly drain storm water prior to acceptance by the CQA ENGINEER.

E. Fine Grading

CONTRACTOR shall fine grade all roadway surfaces to within the specified tolerance of the grades indicated on the Contract Drawings. Compaction requirements shall be as described in Section 3.05.

3.08 LANDFILL CELL

The landfill cell shall be excavated to achieve the subgrade elevations equal to the specified liner thickness below the lines and grades indicated on the drawings as the top of clay elevation. The subgrade then shall be scarified to a depth of 6" and compacted to 95% Standard Proctor before acceptance and subsequent placement of the compacted soil liner.

Fine Grading:

CONTRACTOR shall fine grade the subgrade prior to placement of the soil liner.

3.09 BUILDING FOUNDATION SUBGRADES

Foundation subgrades shall be excavated to the lines and grades indicated on the plans. Footing subgrades shall be firm, backfill shall be to 95% of Standard Proctor at $\pm$2% of optimum moisture content.

3.10 STOCKPILE AREAS

Surplus and unsuitable excavation shall be hauled, placed and sloped to drain for each material classification.

Material stockpile areas are indicated on the Contract Drawings. All excavation material shall be placed or stockpiled by one of the means listed below. All material types and classifications shall be subject to the interpretation of the CQA ENGINEER and shall be stockpiled or used for fill as directed by the CQA ENGINEER.

- Used for structural fill
- Stockpiled as topsoil
- Stockpiled as soil liner material
- Stockpiled as daily cover
- Stockpiled as drainage blanket (protective cover) material

Material stockpile areas for excess excavation shall be provided within 500 feet of the cell. No compaction of stockpiled material will be required.

3.11 MOISTURE CONTROL

Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade or layer of soil material to prevent free water appearing on surface during or subsequent to compaction operations.

The CONTRACTOR shall furnish equipment for modifying the moisture content of the fill material and at times when the moisture content is not within the specified range, shall operate such equipment so as to achieve the necessary correction with minimum loss of time.

The addition of water shall be accomplished by methods which will distribute the added water evenly and in a controlled manner over the fill. Reduction in water content shall be accomplished by methods which are effective for promoting aeration of the fill material. No fill shall be placed until approved types of equipment for aeration and for addition of water are on the job and are demonstrated to be satisfactory of watering and/or dewatering operations.

During placement operations, CONTRACTOR shall keep surfaces from drying by addition of water or placement of additional materials.

Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.

Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to a satisfactory value.

3.12 PROTECTION OF SUBGRADES AND FILL SURFACES

Newly graded areas shall be protected from traffic and erosion, and all settlement or washing away that may occur from all causes, prior to acceptance, shall be repaired and grades re-established to the required elevations and slopes. Embankments and excavations shall be kept shaped and drained. Stormwater conveyance channels and drains along subgrade shall be maintained in such a manner as to drain effectively at all times. The finished subgrade shall not be disturbed by traffic or other operations and shall be protected and maintained by the CONTRACTOR in a satisfactory condition until sub-base, base, or pavement is placed. The storage or stockpiling of materials on the finished subgrade will not be permitted.

3.13 WORK ON EXISTING ROADWAY RIGHT-OF-WAY

All dirt spilled from the CONTRACTOR's trucks on existing pavements over which it is hauled or which has otherwise been deposited thereon shall be removed by the CONTRACTOR. Whenever, in the opinion of the DESIGN ENGINEER, the accumulation is sufficient to cause the formation of mud, dust, interference with traffic, or create a hazard, the CONTRACTOR will be directed to remove such accumulations without delay. Existing site roadways used by the CONTRACTOR shall be restored to their preconstruction condition.

Shoulders of roadways shall be left in good, acceptable condition and all topsoil and grass that is disturbed shall be replaced.

--END OF SECTION--

SECTION 02220

TRENCHING, BACKFILLING AND COMPACTION

PART 1 GENERAL

1.01 DESCRIPTION

The work under this section includes all excavation, backfill, compaction, pavement removal, site restoration and cleanup for the construction of underground pipelines, and their related structures.

1.02 RELATED WORK

A. Section 02745 - Leachate Piping

1.03 DEFINITIONS

A. Pipeline Embedment:

1. Backfill material encasement extending from the full depth of bedding to a distance of twelve (12") inches above the top of the pipe.

2. Embedment is composed of bedding, initial backfill and foundation.

B. Foundation:

1. The load bearing portion of the embedment which underlines the bedding material.

2. Normally the excavated trench bottom except where unstable conditions exist and then alternate methods of foundation stabilization are required.

C. Bedding: Backfill material between a pipe and the foundation on which it rests.

D. Initial Backfill: Backfill placed from the top of the bedding and along the sides of the pipe to a distance of twelve (12") inches above the top of the pipe.

E. Final Backfill: Backfill placed from a distance of twelve (12") inches above the top of the pipe to the finished grade.

F. Embankment: Fill material placed above original ground surface to provide cover over a conduit which is fully or partially exposed.

G. Rock: Where "Rock" is used as the name of an excavated material, it shall mean boulders or pieces of rock, concrete or masonry measuring one (1) cubic yard or more, hard shale or solid ledge rock and masonry which, in the opinion of the CQA ENGINEER, requires for its removal the continuous use of pneumatic tools.

1.04 QUALITY ASSURANCE

A. Tests required by this section shall be performed by a qualified independent testing laboratory meeting the requirements of Section 01400 – Quality Control.

B. The CONTRACTOR shall insure that all testing laboratory personnel contact the project representative prior to conducting tests to mutually select the test site. No testing shall commence without this contact.

C. All work shall comply with local development standards and state department of transportation specifications.

D. Regulatory Requirements:

1. Comply with applicable requirements of Federal, State, and Local laws, regulations and codes having jurisdiction at project site.

E. Reference Standards: Applicable requirements of standards and specifications referenced herein apply to the work of this section.

1.05 SUBMITTALS

A. A minimum of two (2) copies of all test results shall be submitted to the DESIGN EGINEER, and one copy to CONTRACTOR.

PART 2 PRODUCTS

2.01 BACKFILL MATERIAL

A. The requirements of this section shall apply to all backfill materials unless otherwise specified.

B. All material shall be suitable and free from roots, wood, scrap material, and other vegetable matter and refuse.

C. Acceptable material shall generally be a natural or artificial mixture of soil types normally found in natural deposits in the project vicinity or material obtained from the CONTRACTOR's excavations.

D. All material shall be sufficiently dry for compaction and shall not contain excessive amounts of soft or highly plastic clays.

E. Maximum size of stone shall not exceed four (4") inches.

2.02 BEDDING MATERIAL

A. Fine granular bedding:

1. Materials for fine granular bedding shall consist of well graded fine to course sands or gravel meeting the gradation requirements of ASTM C 33 for fine aggregates.

2. Natural materials or artificial mixtures, consisting largely of a mixture of sand and clay, found in natural deposits in the project vicinity may be utilized as long as the material meets the proper proportions and gradation requirements.

3. The material shall generally pass a 3/8" sieve with no more than 10% passing a No. 100 sieve, and shall be non-plastic.

B. Gravel bedding:

1. Materials used for gravel bedding shall consist of natural rounded or angular, graded stone or crushed rock, with little or no fines.

2. Generally, the aggregate size shall range from 1 1/2" to 3/8".

3. ASTM classification shall be No. 57 stone.

2.03 UNSUITABLE MATERIALS

A. General: Any material, which in the opinion of the CQA ENGINEER, contains vegetable matter, muck, (soft silts or clays), roots, and rubbish shall be considered unsuitable.

B. The following, as defined in the United Soils Classification System, shall be considered the basis for classifying unsuitable material unless specifically noted in other sections of the specifications:

1. Highly plastic clay soils of the CH and MH descriptions with moisture contents more than 10% over the standard proctor optimum moisture.

2. Border line soils of the SC-CH description with moisture contents more than 10% over the standard proctor optimum moisture.
3. Organic soils of the OL and OH description with over 5% organics.
4. Highly organic soils of the PT description.

PART 3 EXECUTION

3.01 SITE PREPARATION

A Clearing and Care of Surface Materials:

1. Topsoil shall be stockpiled at a suitable location so that it can be replaced.

B. Trees, plants, and existing structures and utilities shall be protected with appropriate barriers prior to construction.

3.02 GENERAL TRENCH EXCAVATION

A. The requirements of this section shall apply to all trench excavation unless otherwise specified.

B. Trench excavation shall be of such depth to enable proper installation of embedment materials that will result in construction of the pipeline to the alignment and grade, or depth of cover, as shown on the Construction Drawings.

1. Over-excavation and replacement of materials with proper bedding material shall be required where specified by the CQA ENGINEER.

2. If during the course of construction, the trench is inadvertently over-excavated, that area shall be backfilled with fine granular bedding material, unless gravel bedding is required where unsuitable materials are encountered in the subgrade or where specified by the CQA ENGINEER.

C. All such related structures and appurtenances shall be constructed to the alignment, grade, and position as shown on the Construction Drawings.

D. In all cases where materials are deposited along open excavation they shall be placed so that in the event of rain, no damage will result to the work or adjacent property.

E. Unstable trench bottom:

1. Where an unstable trench bottom condition is encountered due to the presence of muck, quicksand, or other unsuitable materials, the unstable soil

material shall be removed to a depth which is sufficient to produce a firm foundation.

2. The unstable soil material shall then be replaced with Class B embedment for the full depth of unstable material excavation.

3. The depth of unstable soil excavation and bedding replacement will be dependent upon the severity of the trench bottom soil conditions.

4. Depths of bedding shall be as a minimum those specified for Class B embedment, contained in Section 3.07(c).

5. Alternate foundations shall be used where required as specified in Section 3.08.

F. Regardless of the type of embedment used, all bell holes for bell and spigot pipe shall be excavated at proper intervals so that the barrel of the pipe will rest for its entire length upon the bottom of the trench or bedding material.

G. All bedding materials shall achieve the required densities by tamping with suitable tools and shaped to receive the pipe and support it at the exact elevation and line as shown on the Construction Drawings.

H. Wet excavation:

1. Where the excavation area shown on the Construction Drawings falls under the water surface near the banks of a flowing stream or other body of water or in high ground water areas, the CONTRACTOR may adopt and carry out any method he may deem feasible for the performance of the excavation work and for the protection of the work thereafter; provided the method and equipment to be used has received prior approval of the CQA ENGINEER.

2. During the selected method of construction, the excavation area shall be effectively protected from damage during the excavation period and until all contemplated construction work therein has been completed to the satisfaction of the CQA ENGINEER.

3. The cost of all temporary construction work necessary or incidental thereto, including the cost of installing and removing sand bags, coffer dams, sheet piling, excavation and backfill, pumping and dewatering, shall be considered as an integral part of the cost of excavation and no separate payment therefore shall be allowed or made.

I. Disposal of materials:

1. Disposal of waste materials and smoothing of disturbed material during trenching operations shall be performed as the pipe is laid and shall not be allowed to lag more than 500 feet behind the pipe laying operations.

2. All materials removed by excavation which are suitable for the purpose shall be used whenever practicable for backfilling pipe trenches, foundations and footings, and for such other purposes as may be shown on the Construction Drawings or directed by the CQA ENGINEER.

3. All materials not used for backfilling, foundations, or footings shall be considered as waste materials and disposed of by the CONTRACTOR in an approved manner.

4. Waste materials may be deposited in spoil banks at locations as shown on the Construction Drawings.

5. If no disposal areas are shown on the Construction Drawings, the CONTRACTOR shall provide at his own expense disposal areas satisfactory to the CQA ENGINEER.

6. Waste materials shall not be left in unsightly piles, but shall be spread in uniform layers and neatly leveled and shaped.

7. Spoil banks shall be provided with adequate openings to permit surface drainage of adjacent lands.

8. On completion of any part of the work proper disposal shall be made of all surplus or unused materials left within the construction limits of such work and the surface of the work left in a neat and workmanlike condition.

3.03 WATER IN TRENCHES

A. Trenches shall be reasonably free from water while the pipes are being laid.

1. The CONTRACTOR shall remove and dispose of any water (including storm water), sewage, or any other liquid which may be found or may accumulate in the excavations.

2. This may be done by pumping, an adequate well point system, or other means of dewatering approved by the CQA ENGINEER.

B. The CONTRACTOR shall examine the site after excavating, and before proceeding with the work he shall notify the CQA ENGINEER of any evidence of water rising in such areas.

C. Static water levels shall be drawn down below the bottom of the excavation sufficiently to allow for placement of bedding and backfill.

1. Under certain conditions, the CQA ENGINEER may permit the CONTRACTOR to remove the water with the use of trenchside pumps through the use of an approved bedding.

2. The depth of bedding material will depend upon the amount of water, but care shall be taken to ensure that the trench wall soil material is such that it will not be removed from the area adjacent to the bedding.

D. The CONTRACTOR shall not open up more trench than the available pumping facilities are able to dewater.

E. The CONTRACTOR shall assume responsibility of disposing of all water so as not to injure or interfere with the normal drainage of the territory in which he is working.

F. In no case shall the pipe lines be used as drains for such water, and the ends of the pipe shall be kept properly and adequately blocked during construction by the use of approved stoppers and not by improvised equipment.

G. All necessary precautions shall be taken to prevent the entrance of mud, sand, or other obstructing matters into the pipe lines, and on completion of the work, any such material which may have entered the pipe lines must be cleaned out so that the entire system will be left clean and unobstructed.

H. Release of groundwater to its static level shall be performed in a manner to maintain undisturbed state of natural foundation soils, prevent disturbance of compacted backfill or bedding, and prevent flotation of pipelines.

I. The CONTRACTOR shall at all times have on hand sufficient pumping equipment and machinery in good working condition for all ordinary emergencies, and shall have available at all times competent workmen for operation of pumping equipment.

J. Dewatering systems shall be designed and operated to prevent removal of natural soils and to prevent excessive reductions in the groundwater outside the excavation to the extent that it would damage or endanger adjacent structures or property.

K. All dewatering activities shall be completed in accordance with the approved Erosion and Sedimentation Control Plan with special emphasis given to any temporary pump discharges.

3.04 ROCK EXCAVATION

A. Where rock is encountered in the process of trench excavation it shall be completely uncovered and stripped of all loose material over the area as specified herein.

B. Ledge rock, boulders, and large stones shall be removed to provide a clearance of not less than six (6") inches in every horizontal direction from all parts of pipe, fittings, and other appurtenances.

C. Where rock is encountered at grade in trenches, the trench shall be excavated not less than six (6") inches below the bottom of the pipe bell, refilled with fine, granular material thoroughly tamped in-place and shaped to the pipe.

D. Excavated rock shall not be mixed with material selected for tamped backfilling under and around the pipe or up to a level at least two (2') feet above the pipe.

3.05 TRENCH SIZE

A. Gravity piping:

1. As soil conditions will permit, the sides of trenches shall be cut in vertical, parallel planes from the bottom of the trench to the top of the pipe and have maximum width of two (2') feet plus the outside diameter of the pipe as shown on the Construction Drawings.

2. The width of the remaining depth of the trench may be as wide as necessary except as restricted by limits of right-of-way or existing improvements that are to be protected; the sides, however, shall be as nearly vertical as practicable or allowable.

3. If the trench width from the bottom of the trench to the top of the pipe is over-excavated in excess of that specified, sewers shall be laid on a gravel bedding at no extra cost to the OWNER.

B. Pressure piping:

1. Trenches for pressure piping shall provide a minimum of 30 inches cover over the barrel of the pipe, except as otherwise shown.

2. Width of trench at and below top of the pipe shall not exceed twelve (12") inches on either side of pipe.

3. Width of trench above top of pipe may be as wide as necessary within limits of right-of-way, with banks as nearly vertical as practicable or allowable, and except as restricted by existing improvements, that are to be protected.

3.06 EXCAVATION FOR APPURTENANCES AND STRUCTURES

A. Excavation for appurtenances shall be made to a size that will allow at least twelve (12") inches between the outer surfaces of the appurtenance and the excavation wall or shoring.

B. Excavation for precast manholes and other precast structures shall be undercut six (6") inches below the bottom of the precast structure and shall be backfilled with gravel bedding as specified under the bedding material in this section.

C. Undercutting and providing a bedding for structures shall be considered as an integral part of the work and no separate payment shall be allowed or made.

3.07 EMBEDMENT OF PIPE

A. Pipeline embedment shall consist of all bedding materials, including concrete, foundation and initial backfill as shown on the Construction Drawings.

B. Class A Embedment:

1. Concrete cradle: The pipe shall be embedded in a monolithic cradle of plain or reinforced concrete.

   a. The minimum thickness shall be one-fourth (1/4) the inside pipe diameter or a minimum of four (4") inches under the barrel and extending up the sides for a height equal to one-fourth (1/4) the outside diameter.

   b. The cradle shall have a width at least equal to the outside diameter of the pipe barrel plus eight (8") inches or poured to the full width of the trench.

2. Concrete arch: The pipe shall be embedded in carefully compacted gravel bedding with a monolithic plain or reinforced concrete arch.

a. The gravel bedding shall have a thickness of one-fourth (1/4) the outside diameter or three (3") inches minimum between the barrel and bottom of trench excavation extending to the springline of the pipe.

b. The concrete arch shall have a minimum thickness of one-fourth (1/4) the inside diameter at the crown and have a minimum width equal to the outside pipe diameter plus eight (8") inches or poured to the full width of the trench.

C. Class B Embedment:

1. Class B embedment shall be used where an unstable trench bottom condition is encountered or where established by the CQA ENGINEER or where shown on the Construction Drawings.

2. The pipe shall be laid on gravel bedding placed on a flat trench.

3. The gravel bedding shall have a minimum thickness of one-fourth (1/4) the outside pipe diameter.

4. The gravel bedding shall extend to the springline of the pipe barrel, or one-half (1/2) the outside diameter of the pipe.

D. Class C Embedment:

1. Class C embedment shall be used as the normal or ordinary embedment and shall be used unless unstable trench conditions are present or where otherwise shown on the Construction Drawings.

2. The pipe shall be embedded in fine granular material on a trench bottom which shall be level in cross-section except that a continuous trough shall be shaped in the bedding which will fit the pipe barrel with reasonable closeness.

3. The bedding shall have a minimum thickness beneath the pipe of six (6") inches or one-eighth (1/8) of the outside diameter of the pipe, whichever is greater.

4. The bedding shall extend up the sides of the pipe one-sixth (1/6) of the outside diameter of the pipe.

E. Initial backfill material, which is from the bedding to one (1') foot above the pipe:

1. Shall be carefully deposited in successive horizontal layers of not more than twelve (12") inches in loose depth on each side of the pipe.

2. Shall be thoroughly and carefully tamped or rammed around the pipe with approved tools until reaching a minimum cover of not less than one (1') foot over the top of the pipe.

3.08 ALTERNATE FOUNDATIONS

A. Where the bottom of the trench is found to consist of material which is unstable to such a degree that, in the opinion of the CQA ENGINEER, it cannot be removed and replaced with an adequate bedding material, alternative foundations methods may be required.

B. The CQA ENGINEER may require, depending upon the severity of the unstable soil, the CONTRACTOR to provide special foundations such as piling, concrete mats (or a combination thereof), sheeting with keyed-in plank foundation, or other means of stabilization.

C. The type of alternative foundation methods shall be constructed in accordance with the Construction Drawings or as approved by the CQA ENGINEER.

D. Should additional instructions or Detailed Drawings be required; they will be furnished in accordance with the Supplemental General Conditions.

3.09 BACKFILLING TRENCHES

A. The backfilling of sewer or other pipe line trenches shall be started immediately after the pipe work and embedment preparation has been inspected by the CQA ENGINEER.

B. Final backfill material, which if from a height of one (1') foot above the pipeline upward:

1. Shall be backfilled in well compacted layers.

2. If the trench extends along or across streets, roadways, useable alleys, or sidewalks or any areas to be paved in new construction, the remainder of the trench shall be backfilled and tamped to its full depth in the manner specified for initial backfill.

3. Shall be backfilled in the manner specified for initial backfill where indicated on the Construction Drawings.

C. Placement of backfill material in layers greater than twelve (12") inches loose fill shall require prior approval of compaction methods and equipment.

D. All backfilling shall be done in such manner as will not disturb or injure the pipe or structure over or against which it is being placed.

E. Any pipe or structure injured, damaged or moved from its proper line or grade during backfilling operations shall be opened up and repaired and then re-backfilled as herein specified.

F. Where excavation has been made, the top one (1') foot of backfill material shall consist of fine, loose earth, free from large clods, vegetable matter, debris, stone, or other objectionable materials.

G. Temporary surfaces:

1. Where pipe trenches are cut across or along existing pavement, the CONTRACTOR shall construct a temporary surface over the cut by filling and tamping the upper six (6") inches of the cut with selected gravel, crushed stone or reef which will not disintegrate under traffic and which shall be maintained in good condition under traffic until the permanent pavement has been constructed.

2. No specific payment will be allowed for temporary surfacing.

3.10 COMPACTION AND TESTING

A. Compaction and testing for quality control shall be in conformance with Section 01400 – Quality Control and the specific requirements of this section.

B. Minimum tests required on all materials to prove compliance with the specifications shall be as follows:

1. A determination of soil classification, sieve analysis, maximum dry density as per ASTM D-698 and optimum moisture content shall be made from each material source.

2. In-place density test shall be made on all materials under roadways, streets, useable alleys, or other similar areas as required by the CQA ENGINEER.

C. Compaction requirements:

1. Unless otherwise specifically noted elsewhere in these specifications or on the Construction Drawings, material shall meet the following compaction requirements.

   a. Bedding and initial backfill material shall be well compacted.

   b. Final backfill and embankments shall be compacted to a density equal to or greater than the surrounding undisturbed soil.

   c. Compaction on total (initial & final) backfill and base material under roadways shall meet density requirements as indicated on the Construction Drawings.

   d. Embedment shall be well compacted.

2. The theoretical maximum density shall be arrived at in the manner prescribed under applicable documents.

3. Material containing excessive moisture shall not be placed.

4. Its placement may be delayed until it has dried out to the proper moisture content, or it may be thoroughly mixed with a drier material to obtain the desired water content.

5. Material with insufficient moisture shall be wetted sufficiently before compaction to obtain the desired moisture content.

6. Adequate equipment for furnishing and sprinkling water shall be kept available at all times during the progress of the work.

--END OF SECTION--

SECTION 02250

COMPACTED CLAY LINER

PART 1 - GENERAL

1.01 SCOPE OF WORK

The CONTRACTOR shall furnish all labor, material, supervision, and equipment to complete the Clay Liner for the cell, including hauling, processing, compacting, wetting or drying, removal of rainfall and removal of all previously placed material unsuitable due to moisture or freezing conditions, final grading and sealing and all necessary and incidental items as detailed or required to complete the compacted liner, all in accordance with the plans and specifications.

1.02 QUALITY ASSURANCE

A. Quality assurance shall be in accordance with the requirements of Section 01400 Quality Control and the testing program requirements of this section.

B. A representative of the CQA ENGINEER shall be present at all times during soil liner construction activities.

PART 2 PRODUCTS

2.01 CLAY LINER MATERIAL

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

1. Soil shall be classified according to the Unified Soil Classification System (USCS) as ML, MH, SC, CL, or CH (ASTM D2487-83). Liquid limit, plasticity index (PI), and percent passing the No. 200 sieve will be considered for proper classification.

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 liner

placement operations and materials, and will consult with the site personnel on suitable liner materials and locations of such.

4. The low permeability soil liner shall be compact, uniform, smooth, and substantially free of debris, rock, plant materials, and other foreign material. The clay liner shall meet the following criteria:

UPPER 6" CLAY LINER

Percentage of Material Passing (by weight)	Screen Size
95% (all tests)	1"
100% (avg. of all tests)	3"

LOWER 18" CLAY LINER

Percentage of Material Passing (by weight)	Screen Size
100% (avg. of all tests)	3"

PART 3 - EXECUTION

3.01 TEST PAD

A. A test pad shall be constructed prior to beginning installation of the clay liner. A separate pad shall be constructed for each soil exhibiting a significant change in material properties as determined by the CQA ENGINEER

B. The test pad shall be constructed at a location selected by the CQA ENGINEER. The location, subgrade slope, equipment, liner thickness, lift thickness, and subgrade condition shall be representative of full scale construction. The test pad shall be constructed in accordance with Section 3.03.

C. The test pad shall have a minimum surface area of 600 square feet (± 20' x 30') or as directed by the CQA ENGINEER. For each of four (4) lifts, a minimum of three test locations shall be established for testing moisture content, density and a composite sample for recompacted lab permeability. At least one shelby tube sample for lab permeability testing shall be obtained per lift.

D. Acceptance and rejection criteria shall be verified in accordance with the tests specified for full scale construction.

3.02 SUBBASE PREPARATION

A. The 6" in-situ clay liner subbase for the clay liner shall be compacted to 95% (or as otherwise directed by the CQA ENGINEER) as determined by the Standard Proctor

Test, ASTM D698. The clay liner subbase shall be free of rocks, roots, stumps, and other debris.

B. Existing and future drainage channels shall be cleaned so that all sediment, vegetation, and deleterious material is removed prior to placement of the compacted clay liner in these areas.

3.03 CONSTRUCTION OF CLAY LINER

A. Select soil fill lift thickness (after compaction) shall be no greater than 6". Thinner lifts are permissible to achieve design grade.

B. Prior to compaction, each lift of select clay liner material shall be theoroughly processed to uniformly distribute moisture and natural in-place stratification and reduce clod size.

C. 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 in subparagraph F 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. The select fill should be sprinkled or sprayed with water (from a water truck) and dozed, wind-rowed, and/or disc-plowed, tilled or processed, to uniformly increase the moisture content of the soil if the material is below the required moisture content. The select soil fill should be dozed, wind-rowed, and/or disc-plowed, tilled or processed, to help air dry the soil if the moisture content is too high.

D. Each lift will be thoroughly compacted and must satisfy moisture and density controls through field testing before a subsequent lift is placed.

E. Compaction of lifts shall be as follows:

1. Compaction of lifts shall be performed with an appropriately heavy, properly ballasted penetrating-foot compactor (such as a CAT 815 or equivalent) subject to approval of the CQA ENGINEER. A minimum of six passes will be required on each lift regardless of whether the lift meets density specifications. A pass is defined as one trip of the compacting equipment over the lift and back to the starting point by a single drum roller or one trip across the lift surface from one side to the other if the compacting equipment has front and back compacting rollers. This requirement is to allow thorough remolding of the soil by kneading action and to reduce clod size. Clod size shall not exceed one-half of the lift thickness. The final lift shall have clods no larger than one inch.

2. 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 not be allowed. The surface shall be continuously sprinkled with water as necessary for maintenance.

3. 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 and density before placement of a subsequent lift.

4. Transition from full depth liner 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.

5. The cell bottom shall be constructed initially and completed over the width of the base before beginning the slope. The transition between the bottom and side slopes shall be accomplished by compacting parallel to the slope by running up and down the slope.

6. Dozer or scraper equipment shall not be used for primary compaction efforts, except as specified in subparagraph C above.

F. During compaction, the placement clay moisture content and dry density shall be maintained within the limits specified below.

1. To confirm that the moisture content and dry density requirements of the compacted clay are being satisfied, field drive tube (ASTM D2937) or nuclear gage (ASTM D2922) tests shall be made at locations designated by the CQA ENGINEER at the frequency specified in Section III.G. of the CQA Manual and the nuclear gage calibrated in accordance with Section II.E. of the CQA Manual.

2. Compaction moisture content shall be at least 2 percent wet of OMC or wetter as required by the CQA ENGINEER. Should wetter material be used, the CQA ENGINEER may allow density reduction as appropriate.

G. The select fill shall be compacted to a minimum dry density of 95 percent (or as determined by test strip) of the maximum dry density determined by the Standard Proctor Test, ASTM D698. Densities less than 95 percent of the maximum dry density determined from the Standard Proctor Test shall be recompacted and/or removed and reworked to meet density objectives. In addition, the compacted materials dry density/moisture content shall lie within the 90 percent saturation line, to be established from tested specific gravities.

H. The clay liner shall have permeability of $k \leq 1.0 \times 10^{-7}$ cm/sec as determined by ASTM D5084-90. One (1) sample per acre per each lift of clay liner component will be selected by the CQA ENGINEER for permeability testing (ASTM D5084-90).

I. No select fill shall be placed or compacted during sustained periods of temperatures below 32°F. Select fill may not be placed during freezing conditions.

J. During construction, finished lifts or sections of clay liner must be sprinkled with water as needed to prevent drying and desiccation. Completed sections of clay liner awaiting geomembrane placement shall be sprinkled with water to prevent desiccation. Should desiccation occur, the last lift shall be reconstructed in accordance with the specifications.

K. At the end of each construction day's activities, completed lifts or sections of clay liner shall be sealed by rolling with a rubber tired or smooth drum rollers and sprinkled with water as needed.

L. The clay liner shall be 24 inches thick across the bottom and sideslopes of the cell. Thickness of the clay liner on the sideslopes shall be measured perpendicular to the slope face.

M. Perforations in the clay liner resulting from sampling or testing procedures, survey stakes or other activities shall be identified and backfilled by the CQA ENGINEER. The perforations shall be filled with a soil-bentonite mix consisting of 10% minimum by weight bentonite powder or granules mixed with clay liner material. The perforations shall be backfilled with the soil-bentonite mixture in 3-inch loose lifts and thoroughly compacted by hand tamping by the CQA ENGINEER.

N. The as-built thickness of the clay liner shall be determined by non-destructive survey methods as described below. Samples of the in-place clay liner shall be tested and evaluated prior to acceptance.

O. After completion of a segment (one landfill cell) of clay liner, but before installation of the geomembrane liner, the surface of the clay liner shall be surveyed to ensure:

1. The specified thickness of clay liner has been achieved.

2. The top of the clay liner slopes diagonally across the cell toward the collection assembly at grades specified on the Contract Drawings; and

3. The top of the clay liner in the collection assembly area is at the grades and elevations specified on the Contract Drawings.

Clay liner placed beyond the limits of the lines and grades as shown on the Contract Drawings will not be accepted and must be removed at the CONTRACTOR's expense. Such material which has been determined suitable for liner construction may be re-incorporated into liner if needed.

This work shall be performed by a Surveyor registered in the State the services will be performed in and shall be provided by the OWNER.

--END OF SECTION--

SECTION 02252

PROTECTIVE SOIL COVER ON LANDFILL CAP

PART 1 GENERAL

1.01 SCOPE OF WORK

The CONTRACTOR shall furnish all labor, material, supervision, and equipment to install the Protective Soil Cover on the Landfill Cap, including hauling, spreading and final grading and all necessary and incidental items as detailed or required to complete the cover, all in accordance with the plans and specifications.

PART 2 PRODUCTS

2.01 SOIL COVER MATERIAL

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

1. Soil shall be classified according to the Unified Soil Classification System (USCS) as , SC, ML, MH, CH, or CL (ASTM D2487-83). Liquid limit, plasticity index (PI), and percent passing the No. 200 sieve will be considered for proper classification.

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 site personnel on suitable materials and locations of such.

4. The lower 18" of protective soil cover shall be uniform, smooth, and free of debris, rock, plant materials, and other foreign material larger than 1 inch in diameter. The material should contain no sharp edges.

5. The top 6" of soil cover must be capable of supporting growth of vegetative cover.

PART 3 EXECUTION

3.01 CONSTRUCTION OF SOIL COVER

A. Soil for the cover shall be placed and spread with light weight rubber tired or track equipment. When spreading the soil shall be stockpiled at depths of a minimum four feet and thence spread to the thickness indicated utilizing light weight rubber tired or track equipment so as not to damage the geocomposite or geomembrane.

B. The soil cover shall be a total of 18" thick as shown in the details of the Engineering Plans. On slopes the thickness shall be measured perpendicular to the slope of face.

C. After completion of the soil cover the cap shall be surveyed to ensure the specified thickness has been achieved.

D. Soil berms should be compacted to 95% dry density standard proctor.

E. After the specified soil cover thickness has been achieved and verified the CONTRACTOR shall proceed immediately with the grassing.

F. Any damage to the geomembrane and/or geonet shall be repaired in accordance with Section 02755 – Geomembrane (FML) Cap and under the direction of the CQA ENGINEER.

--END OF SECTION--

SECTION 02253

PROTECTIVE COVER - ON LINER - NATIVE SANDY SOIL

PART 1 - GENERAL

1.01 SCOPE OF WORK

This section covers the material and placement of the protective cover system for the base liner system.

1.02 QUALITY ASSURANCE

A. Quality assurance shall be in accordance with the requirements of Section 01400 Quality Control and the testing program requirements of this section.

B. A representative of the CQA ENGINEER shall be present at all times during soil cover construction activities.

1.03 RELATED WORK

A. Section 02747 - Leachate Collection System

PART 2 - PRODUCTS

2.01 SOIL COVER MATERIAL

A. Soil that meets all of the following requirements shall be classified as select protective cover native sandy soils for use in construction of the liner protective cover.

1. Soil shall be classified according to the United Soil Classification System (USCS) as SW, SP, SM, or SC (ASTM D2487-83). Liquid limit, plasticity index (PI), and percent passing the No. 200 sieve will be considered for proper classification.

   Construction Quality Assurance shall meet the following minimum requirements:

Test	Minimum Frequency	Criteria
Permeability (ASTM D2434)	3,000 yd^3	$k \geq 1 \times 10^{-3}$ cm/sec

2. Soil 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 CQA ENGINEER 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 site personnel on suitable materials and locations of such. All material shall be taken from select sources or stockpiles.

4. The protective cover native sandy soils shall be uniform, smooth, and reasonably free of debris, rock, plant materials, and other foreign material larger than ¾ inch in diameter. The material should contain no sharp edges.

PART 3 - EXECUTION

3.01 CONSTRUCTION OF PROTECTIVE COVER

A. Soil for the cover shall be placed and spread with light weight rubber-tired or tracked equipment. All tracked equipment used in placement of the protective soil cover shall be low ground pressure equipment having a ground contact pressure less than 6 psi. Tracked equipment must be operated in such a manner that sharp turns that cause dragging of the tracks over the protective cover are minimized. Haul trucks delivering sand or stone to the cell shall operate over a minimum thickness of 4 feet of protective cover while in the cell. When spreading, the soil shall be stockpiled at depths of a minimum four feet and thence spread to the thickness indicated utilizing light weight rubber-tired or track equipment, so as not to damage the low permeability soil liner, geomembrane, geotextile, or leachate collection system piping.

B. The soil cover on the floor and side slopes shall be 24 inches thick. The thickness shall be measured perpendicular to the slope of face.

C. After completion of the protective cover, the protective cover system shall be surveyed to ensure the specified thickness has been achieved.

--END OF SECTION--

SECTION 02255

PROTECTIVE COVER - ON LINER - SANDY SOILS

PART 1 - GENERAL

1.01 SCOPE OF WORK

This section covers the material and placement of the protective cover system for liner systems utilizing a sandy soil drainage blanket with a permeability of $k \geq 1x10^{-2}$ cm/sec.

1.02 QUALITY ASSURANCE

A. Quality assurance shall be in accordance with the requirements of Section 01400 – Quality Control and the testing program requirements of this section.

B. A representative of the CQA ENGINEER shall be present at all times during protective cover construction activities.

1.03 RELATED WORK

A. Section 02747 – Leachate Collection System

PART 2 - PRODUCTS

2.01 SANDY SOIL COVER MATERIAL

Material for the sandy soil (protective cover) shall be a loose granular material resulting from the disintegration of rocks, shall be capable of 98% passage through a ½" screen and shall have no more than 5% by weight passing the No. 200 sieve. The protective cover material shall contain no aggregate rocks, debris, plant material, material with sharp edges, lignite, coal, ash, or carbonaceous material. By-products of industrial processes, with the exception of quarry grinding operations, shall not be accepted. The sandy soil (protective cover) material shall have a permeability of not less than $1x10^{-2}$ cm/sec.

Construction Quality Assurance shall meet the minimum requirements for the Granular Drainage Media as follows:

Test	Minimum Frequency	Criteria
Grain size to No. 200 sieve (ASTM D 422)	1,500 yd^3	78M
Permeability (ASTM D 2434)	3,000 yd^3	$k \geq 1x10^{-2}$ cm/sec

PART 3 - EXECUTION

3.01 CONSTRUCTION OF PROTECTIVE COVER

A. The CONTRACTOR shall maintain the sand and stone stockpiles from the time he mobilizes to the job site.

B. Sandy soils for the protective cover shall be placed and spread with light weight rubber-tired or tracked equipment. All tracked equipment used in placement of the protective cover shall be low ground pressure equipment having a ground contact pressure less than six (6) psi. Tracked equipment must be operated in such a manner that sharp turns that cause dragging of the tracks over the protective cover are minimized. Haul trucks delivering sand or stone to the cell shall operate over a minimum thickness of 4 feet of protective cover while in the cell. The delivered material shall be stockpiled at depths of a minimum four feet and thence spread to the thickness indicated utilizing light weight rubber- tired or track equipment so as not to damage the geomembrane liner, geotextile, or leachate collection system piping. Material inadvertently tracked into the cell by the haul trucks which does not meet Section 2.01 above, must be removed.

C. The sandy soils on the floor and side slopes shall be 24 inches thick. The thickness shall be measured perpendicular to the slope of face. Payment quantity shall be equal to the quantity of underlying geomembrane times 24 inches.

D. After completion of the protective cover, the protective cover system shall be surveyed to ensure the specified thickness has been achieved.

E. Any damage to the geomembrane shall be repaired in accordance with Section 02750 HDPE Geomembrane Liner and under the direction of the CQA ENGINEER.

--END OF SECTION--

SECTION 02260

COMPACTED SOIL CAP

PART 1 GENERAL

1.01 SCOPE OF WORK

The CONTRACTOR shall furnish all labor, material, supervision, and equipment to construct the Compacted Soil Cap (infiltration layer) for the cell, including hauling, 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 compacted cap, all in accordance with the plans and specifications.

1.02 QUALITY ASSURANCE

A. Quality assurance shall be in accordance with the requirements of Section 01400 Quality Control and the testing program requirements of this section.

B. A representative of the CQA ENGINEER shall be present at all times during the soil cap construction activities.

PART 2 PRODUCTS

2.01 SOIL CAP MATERIAL

A. Soil that meets all of the following requirements shall be classified as select soil fill for use in construction of the secure cell compacted soil cap.

1. Soil shall be classified according to the Unified Soil Classification System (USCS) as SC, ML, MH, CH, or CL (ASTM D2487-83). Liquid limit, plasticity index (PI), and percent passing the No. 200 sieve will be considered for proper classification.

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 cap placement operations and materials, and will consult with the site personnel on suitable cap materials and locations of such.

PART 3 EXECUTION

3.01 TEST PAD

A test strip may be constructed using the same construction methods, equipment and material to be used for the compacted soil cap. The test fill construction must proceed the beginning of placement of the compacted soil cap by a minimum of two (2) weeks. Samples from the test strip must exhibit a permeability of $k \leq 1.0 \times 10^{-5}$ cm/sec.

3.02 CONSTRUCTION OF COMPACTED SOIL CAP

A. Select soil fill lift thickness (after compaction) shall be no greater than six (6") inches. Thinner lifts are permissible to achieve design grade after first lift.

B. Prior to compaction, each lift of select soil fill material shall be thoroughly disced. Equipment or truck trafficking on the surface shall not be permitted during the period between scarifying and placement of the following lift.

C. 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 in subparagraph F 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. The select fill should be sprinkled or sprayed with water (from a water truck) and dozed, wind-rowed, and/or disc-plowed to uniformly increase the moisture content of the soil if the material is below Optimum Moisture Content (OMC). The select soil fill should be dozed, wind-rowed, and/or disc-plowed to help air dry the soil if the moisture content is too high.

D. Each lift will be thoroughly compacted and must satisfy moisture and density controls through field testing before a subsequent lift is placed.

E. Compaction of lifts shall be as follows:

1. Compaction of lifts shall be performed with an appropriately heavy, properly ballasted penetrating-foot compactor (such as a CAT 815 or equivalent) subject to approval of the CQA ENGINEER. A minimum of six (6) passes will be required on each lift regardless of whether the lift meets density specifications. A pass is defined as one (1) trip of the compacting equipment over the lift and back to the starting point by a single drum roller or one trip across the lift surface from one side to the other if the compacting equipment has front and back compacting rollers. This requirement is to allow thorough remolding of the soil by kneading action.

2. 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.

3. 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.

4. Transition from full depth cap 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.

5. Dozer or scraper equipment shall not be used for primary compaction efforts, except as specified in subparagraph C above.

F. During compaction, the placement soil moisture content and dry density shall be maintained within the limits specified below.

1. To confirm that the moisture content and dry density requirements of the compacted soil are being satisfied, field and laboratory tests on shelby tube samples shall be made at locations designated by the CQA ENGINEER and at the frequency specified in the CQA Manual.

2. Compaction moisture content shall be at least two (2%) percent wet of OMC or wetter as required by the CQA ENGINEER.

G. The select fill shall be compacted to a minimum dry density of 95 percent (or as determined by test strip) of the maximum dry density determined by the Standard Proctor Test, ASTM D698. Densities less than 95 percent of the maximum dry density determined from the Standard Proctor Test shall be recompacted and/or removed and reworked to meet density objectives. In addition, the compacted materials dry density/moisture content shall lie within the 90 percent saturation line, to be established from tested specific gravities.

H. The compacted soil cap shall have a maximum permeability of $k \leq 1.0 \times 10^{-5}$ cm/sec as determined by ASTM D5084-90.

I. No select fill shall be placed or compacted during sustained period of temperatures below 30° F. Select fill may be placed and compacted during periods of early morning and evening freezing temperatures with warming trends above freezing during the day.

J. During construction, finished lifts or sections of compacted soil cap must be sprinkled with water as needed to prevent drying and desiccation.

K. At the end of each construction day's activities, completed lifts or sections of compacted soil cap shall be sealed by rolling with a rubber tired or smooth drum rollers and sprinkled with water as needed.

L. The compacted soil cap shall be 18 inches thick. Thickness of the compacted soil cap shall be measured perpendicular to the slope face.

M. Perforations in the compacted soil cap resulting from sampling or testing procedures, survey stakes or other activities shall be identified and backfilled by the CQA ENGINEER. The perforations shall be filled with a soil-bentonite mix consisting of 10% minimum by weight bentonite powder or granules mixed with soil cap material. The perforations shall be backfilled with the soil-bentonite mixture in 3-inch loose lifts and thoroughly compacted by hand tamping by the CQA ENGINEER.

N. The as-built thickness of the compacted soil cap shall be determined as described below. Samples of the in-place compacted soil cap shall be tested and evaluated prior to acceptance.

O. After completion of the compacted soil cap, but before installation of the vegetative growth soil, the cap shall be surveyed to ensure:

1. The specified thickness of compacted soil cap has been achieved.

2. The top of the soil cap slopes at grades specified on the Construction Drawings.

--END OF SECTION--

SECTION 02720

STORM SEWER SYSTEM

PART 1 GENERAL

1.01 WORK INCLUDED

A. Installation of storm sewer lines, flared end sections and other appurtenances.

1.02 RELATED WORK

A. Section 02220 - Trenching, Backfilling and Compaction

B. Construction Drawings and General Provisions of Contract, including General and Supplementary Conditions, Special Conditions, and Detailed Specification Sections, apply to work specified in this section.

PART 2 PRODUCTS

2.01 REINFORCED CONCRETE PIPE (RCP)

Reinforced concrete pipe used for the drainage system shall conform to AASHTO Specifications M-170 and ASTM C76. Diameter and class of pipe shall be as indicated.

2.02 JOINT MATERIAL

Joint material shall be as manufactured by Ram-Nek or equal, and which meets or exceeds all requirements of Federal Specifications SS-S-00210 "Sealing Compound, Preformed Plastic for Pipe Joints, Type I, Rope Form".

2.03 DROP INLETS AND HEADWALLS

Drop inlets and headwalls shall be in accordance with the details in the Construction Drawings.

2.04 ALUMINUM CARRIER PIPE

Corrugated aluminum pipe for carrier pipe and riser pipe shall have annular – corrugated interior and exterior and shall meet the requirements of AASHTO M196.

2.05 CORRUGATED POLYETHYLENE PIPE (CPEP)

Corrugated Polyethylene Pipe for downdrains shall have an annular - corrugated exterior and a smooth interior and shall meet the requirements of AASHTO M294 Type S. Joints shall have silt-tight (gasketed) connections incorporating a rubber gasket meeting the requirements of ASTM D1056 Grade 2A2. Fittings shall conform to AASHTO M294. Pipe and fitting material shall be high density polyethylene meeting the requirements of ASTM D3350 Cell Classification 324420C.

PART 3 EXECUTION

3.01 PIPE INSTALLATION

Pipe shall be protected during handling against impact shocks and free fall. The pipe shall be laid so as to produce a straight line of pipe on a uniform grade, each pipe laid to form a closed joint with the preceding pipe and so as to form a smooth inside flow line.

--END OF SECTION--

SECTION 02745

LEACHATE PIPING

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. This section covers the materials and the installation of all leachate piping.

1.02 RELATED WORK

A. Section 02220 - Trenching, Backfilling and Compaction
Section 02747 - Leachate Collection System

B. Construction Drawings and General Provisions of Contract, including General and Supplementary Conditions, and Detailed Specification Sections, apply to work specified in this section.

1.03 QUALITY ASSURANCE

Quality Assurance shall be in accordance with Section 01400, Quality Control and the Construction Quality Assurance Manual.

1.04 APPLICABLE PUBLICATIONS AND STANDARDS

American Society for Testing and Materials (ASTM Publications)

ASTM D256	Test Methods For Impact Resistance of Plastics and Electrical Insulating Materials
ASTM D638	Test Method For Tensile Properties of Plastics
ASTM D696	Test Method For Coefficient of Line at Thermal Expansion of Plastics
ASTM D746	Test Method For Brittleness Temperature of Plastics and Elastomers By Impact
ASTM D1238	Test Method For Flow Rates of Thermoplastics By Extrusion Plastometer
ASTM D1248	Polyethylene Plastics Molding and Extrusion Materials

ASTM D1505	Test Method For Density of Plastics By The Density-Gradient Technique
ASTM D1525	Test Method For Vicat Softening Temperature of Plastics
ASTM D1693	Test Method For Environmental Stress Cracking of Ethylene Plastics
ASTM D2240	Test Method For Rubber Property - Durometer Hardness
ASTM D2321	Underground Installation of Flexible Thermoplastic Sewer Pipe
ASTM D2412	External Loading Properties of Plastic Pipe by Parallel - Plate Loading
ASTM D2837	Obtaining Hydrostatic Design Basis For Thermoplastic Pipe Materials
ASTM D3350	Polyethylene Plastics Pipe and Fittings Materials also Gasket for push-on Joints

1.05 SUBMITTAL REQUIREMENTS

A. All submittals shall be clearly marked as to what is being provided. Submittals not so marked shall be returned. CONTRACTOR shall submit shop drawings with the following information on each of the pipe types provided:

1. indicate compliance with applicable ASTM standard
2. unit weight
3. SDR
4. diameter
5. physical dimensions
6. method of jointing with instructions
7. nominal pipe joint lengths
8. recommended bedding and installation details
9. instructions and tables or information on strength of each pipe type versus bury conditions of depth and traffic loadings

B. Manufacturer's certificate of compliance.

The DESIGN ENGINEER requires certified lab data from the manufacturer to verify the physical properties of the materials supplied under this specification and at the OWNER's expense may take random samples for testing by an independent laboratory. The DESIGN ENGINEER requires certification that the pipe produced is represented by the quality assurance data.

PART 2 PRODUCTS

2.01 PIPE SCHEDULE

FUNCTION	SDR	DIAMETER	TYPE	MINIMUM PIPE LENGTH
Perforated Leachate Collection Pipe	11	8", 4"	HDPE Smooth Wall	40 Feet
Solid Leachate Collection Pipe	11	8"	HDPE Smooth Wall	40 Feet
Miscellaneous Piping	As Noted on Construction Drawings			

2.02 HIGH DENSITY POLYETHYLENE (HDPE) PIPE

A. Pipe and Fittings Resin

The pipe supplied under this specification shall be high performance, very high molecular weight, high density polyethylene pipe. All pipe and fitting resins shall be manufactured by the same company which manufactures the pipe itself in accordance with these specifications to ensure complete resin compatibility and total product accountability. The fittings supplied under this specification shall be molded or manufactured from a polyethylene compound having a cell classification equal to or exceeding the compound used in the pipe.

B. Resin physical properties shall comply with the Plastic Pipe Institute (PPI) recommended material Designation PE 3408 and conform to Material Cell Classification (ASTM D3350) or 345464C.

C. Standards

Polyethylene pipe and fittings shall meet all the requirements of NSF listed pipe but are not required to be NSF listed.

D. Quality Control

The resin used for the manufacture of the pipe shall be manufactured by the pipe manufacturer, thus maintaining complete control of the pipe quality. The pipe shall contain no recycled compound except that which is generated in the manufacturer's own plant form the same raw material. The pipe shall be homogenous throughout and free of visible cracks, holes, foreign inclusions, or other deleterious defects, and

shall be identifiable in color, density, melt flow and other physical properties throughout.

The polyethylene resin used shall have all ingredients precompounded prior to extrusion of pipe. In-plant blending is not acceptable.

The DESIGN ENGINEER requires certification that the pipe produced is represented by the quality assurance data. Additionally, test results from the manufacturer's testing which show the pipe does not meet appropriate ASTM standards of manufacturer's representation, will be cause for rejection of the pipe represented by the testing. These tests may include density and flow rate measurements form samples taken at selected locations within the pipe wall and thermal stability determinations according to ASTM 3350, 10.1.9.

E. The CQA ENGINEER requires certified lab data from the manufacturer to verify the physical properties of the materials supplied under this specification and at OWNER's expense may take random samples for testing by an independent laboratory.

F. Rejection

Polyethylene pipe and fittings which do not meet the requirements of this specification shall be rejected.

G. Perforations shall be as detailed, factory machined and trimmed by the manufacturer or pipe supplier in the shop under controlled conditions. No pipe perforating will be allowed in the field. All perforated pipe shall be free of trimmings and debris when delivered and prior to installation.

2.03 VALVES

A. Gate valves shall be ASAHI Type O or equal.

PART 3 EXECUTION

3.01 PIPE INSTALLATION

A. All pipe shall be installed in accordance with the manufacturer's recommendations and the requirements of these specifications.

B. Perforations shall be constructed by the manufacturer as detailed in the Construction Drawings no field perforating will be allowed. Perforated leachate pipe shall be laid in the trench as detailed in the Construction Drawings. The CQA ENGINEER shall be allowed to review the perforated leachate pipe prior to backfill and prior to acceptance for payment.

C. The pipe interior shall be kept clean before and after laying. Pipe shall be kept clean before installation by proper storage and handling. After installation by proper storage and handling, pipe shall be encapsulated in geotextile fabric and covered with stone. Any open pipe ends shall be plugged and covered with clean fabric.

3.02 HANDLING OF PIPE

A. Pipe shall be stored on clean, level ground to prevent undue scratching and gouging of the pipe. Polyethylene pipe shall be protected from direct sunlight. If the pipe must be stacked for storage, such stacking shall be done in accordance with the pipe manufacturer's recommendations. The handling of polyethylene pipe shall be done in such a manner that it is not damaged by dragging over sharp objects or cut by chokers or lifting equipment.

3.03 REPAIR OF DAMAGED SECTIONS

A. Polyethylene Pipe (HDPE)

Sections of polyethylene pipe having cuts or gouges in excess of 10% of the wall thickness of the pipe shall be removed. New polyethylene pipe section shall be rejoined using the butt fusion joining method. It is the DESIGN ENGINEER's intent to reduce the number of joints. The CQA ENGINEER shall reject pipe installations where in his opinion installation methodology of CONTRACTOR does not meet this objective.

3.04 PIPE JOINING

A. Perforated and Non-Perforated Leachate Pipe (HDPE)

Sections of polyethylene pipe and fittings shall be joined into continuous lengths on the job site above ground. The joining method shall be the butt fusion method and shall be performed by qualified persons and in strict accordance with the pipe manufacturer's recommendations. The butt fusion equipment used in the joining procedures shall be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements, alignment and fusion pressures. Pipe will be fused at approximately 500°F with 150 psi fusion pressure.

3.05 HANDLING OF FUSED PIPE

Fused segments of polyethylene pipe shall be handled so as to avoid damage to the pipe. When lifting fused sections of pipe, chains or cable type chokers must be avoided. Nylon slings are required. Spreader bars are recommended when lifting long fused sections. Care shall be exercised to avoid cutting or gouging the pipe.

3.06 TRENCHING AND BACKFILL

Leachate collection pipe shall be laid as detailed in the Construction Drawings. Force main and gravity pipe (outside the cell) shall be laid in accordance with Section 02220 – Trenching, Backfill and Compaction.

3.07 HDPE PIPE CLEANOUTS

HDPE pipe cleanouts shall be installed as detailed on the Construction Drawings.

3.08 INSPECTION AND ACCEPTANCE

All work shall be subject to inspection and approval prior to final acceptance and payment. Final acceptance shall be contingent upon the following:

A. OWNER accepts polyethylene pipe installation when the installation is finished, all testing results are satisfactory, installation documentation and site inspection is completed, and pipes have been flushed.

B. CONTRACTOR shall clean by water flushing all HDPE pipe beginning at cleanouts. Lines shall be flushed until completely free of debris. CONTRACTOR shall recover and remove all debris from system and dispose of in an environmentally safe manner.

C. Final cleanup shall meet the approval of the CQA ENGINEER and the OWNER.

--END OF SECTION--

SECTION 02747

LEACHATE COLLECTION SYSTEM

PART 1 GENERAL

1.01 SCOPE OF WORK

The CONTRACTOR shall furnish all labor, material, supervision, and equipment to complete the perforated leachate piping collection systems for the cells including collection piping, gravel, and geotextile.

1.02 RELATED WORK

A. Section 02745 - Leachate Piping

B. Section 02253 - Protective Cover - On Liner - Native Sandy Soils

C. Section 02255 -Protective Cover - On Liner -Sandy Soils

D. Section 02757 - Geotextile

1.03 QUALITY ASSURANCE

A. Quality assurance shall be in accordance with the requirements of Section 01400 Quality Control and the testing program requirements of this section.

PART 2 PRODUCTS

2.01 LEACHATE COLLECTION PIPING

A. Leachate collection piping shall be in accordance with Section 02745 - Leachate Piping.

2.02 GRAVEL

Gravel for encasing leachate pipe shall be a clean washed hard non-carbonaceous mineral such as granite. Gravel size shall be No. 57 in accordance with ASTM D448-86.

2.03 TRANSITION FILTER

Gravel for the transition filter shall be a clean, washed, hard, non-carbonaceous mineral such as quartz. Gravel size shall be No. 89 in accordance with ASTM D448-86 or NC DOT size No. 89 or No. 78M.

2.04 CUSHION GEOTEXTILE FABRIC

Geotextile shall be a 24 oz./s.y. non-woven geotextile of polypropylene fibers or polyester yarns which is intended to be and shall be suitable for cushion and separation.

2.05 GEOTEXTILE FABRIC WRAP

Geotextile shall be a 6.0 oz./s.y. non-woven geotextile of polypropylene fibers or polyester yarns which is intended to be and shall be suitable for filtration and separation.

PART 3 EXECUTION

3.01 INSTALLATION

A. The leachate collection system shall be installed in accordance with the construction details in the Construction Drawings. The leachate pipe shall be embedded in gravel with the gravel providing separation of the pipe from the protective cover.

B. The OWNER shall provide the services of a Registered Land Surveyor to certify that the thickness of the material required by the plans and specifications is actually in place. This Surveyor shall also prepare an "As-Built" drawing of the site which shows the in-place location of the collection system.

--END OF SECTION--

SECTION 02748

HDPE FABRICATION

PART 1 - GENERAL

1.01 SCOPE OF WORK

This section covers the materials and fabrication of HDPE structures used for penetration assemblies.

1.02 RELATED WORK

A. Section 02745 - Leachate Piping

1.03 QUALITY ASSURANCE

The resin used for the manufacture of the pipe and plate products shall be manufactured by the producer of the products, thus maintaining complete control of the quality. The products shall contain no recycled compound except that which is generated in the manufacturer's own plant from the same raw material. The products shall be homogenous throughout and free of visible cracks, holes, foreign inclusions or other deleterious defects, and shall be identifiable in color, density, and other physical properties throughout.

The manufacturer shall provide certification that the products produced are represented by the quality assurance data.

1.04 APPLICABLE PUBLICATIONS AND STANDARDS

American Society for Testing and Materials (ASTM Publications)

ASTM D256	Test Methods For Impact Resistance of Plastics and Electrical Insulating Materials
ASTM D638	Test Method For Tensile Properties of Plastics
ASTM D696	Test Method For Coefficient of Line at Thermal Expansion of Plastics
ASTM D746	Test Method For Brittleness Temperature of Plastics and Elastomers By Impact

ASTM D1238	Test Method For Flow Rates of Thermoplastics By Extrusion Plastometer
ASTM D1248	Polyethylene Plastics Molding and Extrusion Materials
ASTM D1505	Test Method For Density of Plastics By the Density-Gradient Technique.
ASTM D1525	Test Method For Vicat Softening Temperature of Plastics
ASTM D1693	Test Method For Environmental Stress Cracking of Ethylene Plastics
ASTM D2240	Test Method For Rubber Property - Durometer Hardness
ASTM D2321	Underground Installation of Flexible Thermoplastic Sewer Pipe
ASTM D2412	External Loading Properties of Plastic Pipe by Parallel - Plate Loading
ASTM D2837	Obtaining Hydrostatic Design Basis For Thermoplastic Pipe Materials
ASTM D3350	Polyethylene Plastics Pipe and Fittings Materials also Gasket for push-on Joints

1.05 SUBMITTAL REQUIREMENTS

Submittals on fabricated products shall be clearly marked as to what is being provided. CONTRACTOR shall submit fabricator's shop drawings with the following information on each product provided:

1. indicate compliance with applicable ASTM Standard
2. unit weight of material
3. physical dimensions including material thickness
4. method of joining
5. recommended bedding and installation details
6. anti-flotation anchor requirements

PART 2 - PRODUCTS

2.01 BASIC MATERIALS

A. Pipe: The pipe shall be in accordance with Section 02745 - Leachate Piping. The pipe shall be made of high density, high molecular weight polyethylene pipe material meeting the requirements of Type III, Class C, Category 5, Grade P34, as defined in ASTM D-1248 Standard Specification for Polyethylene Plastics Molding and Extrusion Materials. Clean rework material generated by the manufacturer's own production may be used so long as the pipe or fittings produced meet all the requirements of this specification. The pipe shall be Spirolite as manufactured by Chevron Chemical Company or equal.

B. HDPE Plate: Plate used for fabrication shall be made of the same high density, high molecular weight polyethylene material used for pipe to insure compatibility of polyethylene resins in the fabrication process.

2.02 FABRICATION

A. Experience: Products shall be constructed by a fabricator or manufacturer with at least five (5) years experience in the construction of products similar to those being provided.

B. Joining: Pipe and plate material shall be joined by the extrusion weld method or the butt fusion method in strict accordance with the manufacturer's recommendations. The equipment used in the joining procedures shall be capable of meeting all conditions of the pipe or plate material manufacturer.

C. Stub-outs: Products shall have HDPE pipe penetrations and stub-outs for flange or butt fusion connections as shown in the construction plans. Penetrations shall be extrusion welded to the wall of the product. All stub-outs and penetrations shall be installed by the manufacturer or fabricator.

D. Testing: Structures shall be tested in accordance with Section 01666 - Testing Piping Systems, and certification shall be provided by the CQA ENGINEER for the OWNER.

PART 3 - EXECUTION

3.01 INSTALLATION

Fabricated products shall be installed in accordance with the fabricator's / manufacturer's recommendations and as shown in the plans.

--END OF SECTION--

SECTION 02750

HDPE GEOMEMBRANE LINER

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The CONTRACTOR shall furnish all labor, materials, supervision and equipment to complete the installation of the HDPE Geomembrane Liner, including, but not limited to, liner layout, seaming, patching, and all necessary and incidental items required to complete the work, in accordance with the Construction Drawings and these Specifications.

B. Sufficient liner material shall be furnished to cover all lined areas shown on the Construction Drawings, including overlaps at field seams and anchor trenches.

C. It is the intent of these specifications to ensure a quality finished product. It shall be the responsibility of the CONTRACTOR to ensure that this requirement is met.

1.02 QUALITY

A. The CONTRACTOR will be required to submit a quality control program to the CQA ENGINEER prior to initiating field work.

B. The OWNER shall employ and pay for the services of a third-party CQA ENGINEER, in accordance with Section 01400 - Quality Control, to confirm the installation of the liners.

C. All installation procedures and testing shall be in accordance with these specifications and OWNER's Independent Construction Quality Assurance (CQA) Manual. A copy of this manual is attached.

D. All field destructive and non-destructive testing will be performed by the CONTRACTOR. Samples for laboratory testing will be taken by the CONTRACTOR for testing at the CONTRACTOR's laboratory as well as the CQA ENGINEER's laboratory.

1.03 SUBMITTALS

A. The geomembrane manufacturers shall submit certification that all sheets manufactured for the project have been produced in accordance with these specifications along with results from a quality control program. This information must be submitted for review prior to material delivery. The CQA ENGINEER reserves the right to halt installation until proper certification is submitted and determined acceptable for use.

B. The CONTRACTOR shall submit to the CQA ENGINEER, six (6) full sets of panel layout Construction Drawings. Field welds and panels shall have an identification system. Construction Drawings shall be submitted to the CQA ENGINEER at least two (2) weeks prior to installation.

C. The manufacturer of the geomembrane used in this work shall approve all shop drawings and a proposed liner layout to cover the lined area shown on the Construction Drawings.

D. Details shall be included to show the termination of the liner at the perimeter of lined areas, the methods of sealing around penetrations and methods of anchoring.

E. The CONTRACTOR shall submit to the CQA ENGINEER a physical sample of the liner to be used. The samples shall be labeled with the manufacturer's name, product identification, lot number and roll number.

F. The CONTRACTOR shall also submit to the CQA ENGINEER inventory tickets, roll numbers or batch identifications, packing papers and invoices for the liner used.

G. The CONTRACTOR shall provide personnel resumes demonstrating compliance with the following requirements:

1. A minimum of one (1) field superintendent per shift shall be designated by the CONTRACTOR and approved by the CQA ENGINEER. Each field superintendent shall have a minimum of three years and five million square feet of field experience in installing HDPE geomembranes. Any change or replacement of superintendent during the project must be approved by the CQA ENGINEER.

2. The weld technicians shall have a minimum of one year and one million square feet HDPE geomembrane welding experience.

1.04 WARRANTY

A. Material

The MANUFACTURER is responsible for guaranteeing its product. The warranty shall include all that is listed below:

1. Shall begin at the time of issuance of CQA ENGINEER's Certification of Substantial Completion.

2. The material shall be free from defects and be able to withstand normal weathering and use from the date of installation for a period of 20 years under normal uses and services for which it is designed and manufactured.

3. This limited warranty does not include damages or defects resulting from acts of God, casualty or catastrophe such as, but not limited to earthquake, flood, piercing hail, or tornado.

4. "Normal Use" excludes: exposure to harmful chemicals, mechanical abuse by machinery, equipment, or people, excessive pressure beyond that indicated by the final overburden or municipal refuse and cover indicated on the Construction Drawings.

PART 2 - PRODUCTS

2.01 GEOMEMBRANE LINER

A. The geomembrane shall comprise HDPE material manufactured of new, first-quality products designed and manufactured specifically for the purpose of municipal waste leachate containment in sanitary landfills.

B. The geomembrane material shall be so produced as to be free of holes, blisters, undispersed raw materials or any sign of contamination by foreign matter. Any such defect shall be repaired in accordance with the manufacturer's recommendations. The DESIGN ENGINEER or CQA ENGINEER may reject all or portions of units (or rolls) of geomembrane if significant quantities of production flaws are observed.

C. The geomembrane material shall meet the material properties as specified in the Geosynthetic Research Institute GRI Test Method GM-13, as latest revised for 60 mil HDPE geomembrane. The minimum thickness requirement shall be for the lowest individual measurement, not the average.

D. The geomembrane liner shall be the required minimum liner thickness as shown on the Construction Drawings.

E. If natural colored, the manufacturer shall add carbon black per ASTM D 1248 Specifications, Section 3.1.2.3, Class C.

F. The manufacturer's quality control program shall include the following inspections and tests:

1. Inspection for: Appearance on both sides, manufacturing defects, and thickness at 10 random locations across each sample strip.

2. Testing in accordance with the Geosynthetic Research Institute GRI Test Method GM-13, as latest revised, for 60 mil HDPE Geomembrane. The minimum thickness requirement shall be for the lowest individual measurement, not the average. The results shall be reported.

2.02 PACKAGING AND STORAGE

A. The geomembrane shall be shipped rolled. Folded or otherwise creased liner will not be accepted. The liner shall be marked and tagged with the following information:

1. Serial Number
2. Resin Type
3. Roll Length
4. Gross Weight
5. Inspected By
6. Date of Manufacture
7. Resin Lot Number
8. Roll Width
9. Net Weight

B. Liner which has been delivered to the project site shall be stored in a dry area and protected from precipitation and direct sunlight.

C. Care shall be taken to keep the materials clean and free from debris prior to installation.

PART 3 - EXECUTION

3.01 GENERAL

The geomembrane liner shall be constructed as soon as practical after completion of the compacted clay liner and after certification in writing of the clay liner by the CQA ENGINEER and the CONTRACTOR. The geomembrane liner shall be installed following the manufacturer's printed recommendations, using sound, accepted engineering practices.

All liner installation shall be completed by one crew and shall be installed in no more than 30 calendar days from the date of initiation of installation. The installing crew shall be approved by the manufacturer/fabricator for installation of 60 mil HDPE synthetic liners.

A manufacturer's technical representative shall be at the Pre-Deployment Meeting and on-site at the time of installation.

A. Geomembrane Liner

1. No horizontal seams are allowed within five (5) feet of the toe of the slope.

2. Unroll only those factory-packaged sections which are to be anchored or seamed together in one day. Panels should be positioned with the overlap recommended by the manufacturer, but not less than two (2) inches.

3. After panels are initially in place, remove as many wrinkles as possible. Unroll several panels and allow the liner to "relax" before beginning field seaming. The purpose of this is to make the edges which are to be bonded as smooth and free of wrinkles as possible.

4. Once panels are in-place and smooth, commence field seaming operations.

5. Personnel working on the geomembrane shall not smoke, wear damaging shoes or engage in any activity which damages the geomembrane.

6. The anchor trench shall be excavated, backfilled and compacted. Care should be taken when backfilling the trench to prevent any damage to the geomembrane.

7. Damaged and sample coupon areas of geomembrane shall be repaired by the CONTRACTOR. Any damage to the soil / clay liner component while coupons are open is the responsibility of the CONTRACTOR. Repaired areas will be tested for seam integrity by the CONTRACTOR. Damaged materials are the property of the CONTRACTOR and will be removed from the site at the CONTRACTOR's expense. The CONTRACTOR will retain all ownership and responsibility for the geomembrane until acceptance by the OWNER.

3.02 SEAMING

A. Geomembrane Liner

1. Field Seaming

a. All foreign matter (dirt, water, oil, etc.) shall be removed from the area to be bonded. If the seam is to be bonded by the extrusion process, the bonding surfaces must be thoroughly cleaned by mechanical abrasion or alternate methods approved by the CQA ENGINEER to remove surface cure and prepare the surfaces for bonding. No solvents shall be used to clean the geomembrane liner.

b. Tack welds, if used, shall use heat only; no double-sided tape, glue or other method will be permitted. The geomembrane should be seamed completely to the ends of all panels to minimize the potential of tear propagation along the seam. Seaming of the bottom membrane to the sidewall membrane shall be conducted when conditions minimize thermal expansion effects. The completed liner shall not exhibit "trampolining" and shall be in full contact with the underlying soil liner.

c. At the end of each day or installation segment, all unseamed edges shall be anchored by sand bags or other approved device. Sand bags shall weigh approximately 20 pounds and shall be placed no further apart than 20 foot spacing along the open end of the geomembrane. If high winds are expected, boards along the edge of unseamed panels, with weighted sand bags on top, should be used to anchor the geomembrane on the bottom of the cell. Staples, U-shaped rods, or other penetrating anchors shall not be used to secure the geomembrane. The temporary anchoring of the geomembrane is fully the responsibility of the CONTRACTOR. Any material damaged as the result of weather effects, shall be repaired or replaced at no cost to the OWNER.

d. It is imperative to keep surface water runoff from beneath the geomembrane at all times during installation. The CONTRACTOR's panel placement and seam welding technique and welding schedule shall minimize or eliminate the accumulation of water beneath the geomembrane. Any water found ponded beneath the geomembrane after the geomembrane has been installed shall be removed by the CONTRACTOR at no cost to the OWNER. Any compacted soil liner beneath installed geomembrane that has become excessively

moist, soft or unsuitable to perform its intended function shall be replaced at no cost to the OWNER.

e. After field seaming is complete in a given area, liner edges in the anchor trench should be buried. Do not bury the liner edge in the anchor trench within 30 feet of an incomplete or unbounded field seam.

2. Field seaming may be extrusion or fusion welding or a combination of these methods. Solvent welding is not acceptable. The DESIGN ENGINEER or CQA ENGINEER reserves the right to reject any proposed seaming method believed unacceptable.

a. Extrusion welding applies a molten bead of material to preheated sheets of geomembrane. The sheets are then joined by pressure.

b. The fusion welding process heats the area to be joined to the melting point and then applies pressure to join the melted surfaces.

c. The sheets to be joined shall be overlapped at least two (2) inches after the necessary aligning and cutting.

d. In general, seams should be oriented parallel to the line of maximum slope, i.e., oriented up and down, not across, the slope. In corners and odd shaped geometric locations, the number of field seams should be minimized.

e. No horizontal seams should be within five (5) feet from the toe of the slope.

f. No seaming should be attempted above 40 degrees C (104 degrees F) ambient air temperature. Below five (5) degrees C (41 degrees F) ambient air temperature, preheating of the geomembrane may be required. It shall be the responsibility of the CONTRACTOR to demonstrate that conditions are favorable for seaming by acceptable test (start-up) seams which duplicate, as closely as possible, actual field conditions. Preheating may be achieved by natural and/or artificial means (shelters and heating devices).

g. A moveable protective layer of plastic may be required, as recommended by the CQA ENGINEER, to be placed directly below each overlap of geomembrane that is to be seamed. This is to prevent any moisture build-up between the sheets to be welded.

h. Seaming will extend to the outside edge of panels to be placed in anchor trenches.

i. If required, a firm substrata should be provided by using a flat board, a conveyor belt, or similar hard surface directly under the seam overlap to achieve proper support.

j. Grinding prior to welding shall be as recommended by the geomembrane manufacturer and shall be done perpendicular to the sheet edge. Overground or improperly ground areas shall be replaced at the CONTRACTOR's expense.

k. No folds, wrinkles or "fish-mouths" shall be allowed within the seam area. Where wrinkles or folds occur, the material shall be cut, overlapped and an extrusion-weld shall be applied. During wrinkle or fold repairs, adjacent geomembrane may not necessarily be required to meet the two (2) inch minimum overlap, if approved by the CQA ENGINEER. All welds on completion of the work shall be tightly bonded and sealed.

3.03 TESTING OF HDPE GEOMEMBRANE

A. General

1. Samples of the field seams shall be taken and tested in accordance with ASTM D6392 ensure that tensile strength at yield and break, elongation at yield and break meet the minimum specifications. A quality control certificate shall be issued with the material.

2. The CONTRACTOR shall employ on-site physical non-destructive testing on all welds.

3. A quality control technician employed by the CONTRACTOR shall inspect each sheet and seam. Any area showing a defect shall be marked and repaired in accordance with HDPE repair procedures.

B. Test seams shall be made each day prior to commencing field seaming. The seams shall be made on fragment pieces of geomembrane under the same surface and environmental conditions as the production seams to verify that seaming conditions are adequate. The test seams shall be made at the beginning of each seaming period; at changes of equipment, equipment settings, operator, weather, or sheet temperature; at the CQA ENGINEER's discretion, and at least once every four to six hours during continuous operation of each welding machine; or at change in material type (i.e., smooth-to-smooth seam versus smooth-to-textured seam).

1. The test seam sample will be at least 1.5 m (5 feet) long by 0.3 m (1 foot) wide with the seam centered lengthwise. Ten (10) adjoining specimens 25 mm (1-inch) wide each will be die cut from the test seam sample. These specimens, which will be tested with a tensiometer in the field for shear (five samples) and peel (five smples) by the CONTRACTOR and witnessed by the CQA ENGINEER, should not fail in the seam. If a test seam fails, the entire operation will be repeated. If the additional test seam fails, the seaming apparatus or seamer will not be accepted and will not be used for seaming until the deficiencies are corrected and two (2) consecutive successful full test seams are achieved. Test seam failure is defined as failure of any one of the specimens tested in shear or peel.

2. The CQA ENGINEER will observe all test seam procedures. The remainder of the successful test seam sample will be assigned a number and marked accordingly by the CQA ENGINEER, who will also log the date, hour, ambient temperature, number of seaming unit, name of seamer and pass or fail description. At least one (1) tested specimen from each test as selected by the CQA ENGINEER will be retained by the CQA ENGINEER. The CQA ENGINEER will transmit these specimens to the OWNER following acceptance of the geomembrane materials and installation by the OWNER.

3. The criteria for determining a passing seam shall be the properties shown in the "Seam Strength" table of Geomembrane Liner Section of the CQA Manual.

C. Field Seams: Field seams will be tested by the CONTRACTOR continuously using non-destructive techniques and at specified intervals using destructive tests. Requirements for non-destructive and destructive testing are as follows:

1. Single Weld Seams: The CONTRACTOR shall maintain and use equipment and personnel at the site to perform continuous vacuum box testing on all single weld production seams or when the geometry of the weld makes pressure testing impractical.

a. Equipment for Vacuum Testing:

1. Vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft neoprene gasket attached to the bottom, port hole or valve assembly, and a vacuum gauge.

2. Vacuum pump assembly equipped with a pressure controller and pipe connection.

3. A rubber pressure/vacuum hose with fittings and connections.

4. A bucket and means to apply a soapy solution.

b. Procedure for Vacuum Testing:

1. Trim excess overlap from seam, if any.

2. Turn on the vacuum pump to reduce the vacuum box to approximately five (5) inches of mercury, i.e., three (3) psi gauge.

3. Apply a generous amount of solution of strong liquid detergent and water to the area to be tested.

4. Place the vacuum box over the area to be tested and apply sufficient downward pressure to "seat" the seal strip against the liner.

5. Close the bleed valve and open the vacuum valve.

6. Apply a minimum of five inches Hg. vacuum to the area as indicated by the gauge on the vacuum box.

7. Ensure that a leak tight seal is created.

8. For a period of not less than five (5) seconds, examine the FML through the viewing window for the presence of soap bubbles.

9. If no bubbles appear after 15 seconds, close the vacuum valve and open the bleed valve, move the box over the next adjoining area with a minimum three (3) inch overlap, and repeat the process.

10. Mark all areas where soap bubbles appear and repair the marked areas. After repairs are made, retest these areas.

2. Double Weld Seams: The CONTRACTOR shall maintain and use equipment and personnel to perform air pressure testing of all double weld seams. The system shall be capable of applying a pressure of at least 30 psi for not less than five minutes. The CONTRACTOR shall perform all pressure and vacuum testing under the supervision of the CQA ENGINEER.

Pressure loss tests shall be conducted in accordance with the procedures outlined in "Pressurized Air Channel Test for Dual Seamed Geomembranes", Geosynthetic Research Institute Test Method GM-6. As outlined by the test method, following a two minute pressurized stabilization period, pressure losses over a measurement period of five (5) minutes shall not exceed the following: 40 mil - 4 psi, 60 mil - 3 psi, 80 mil - 2 psi.

3. Destructive testing will be performed on an average of every 500 linear feet of field seam. The locations will be selected by the CQA ENGINEER. Sufficient size samples will be obtained by the CONTRACTOR to provide one sample to the archive, one sample to the CQA ENGINEER for laboratory testing, and two samples to be retained by the CONTRACTOR for both field and laboratory testing. Testing requirements are as follows: Each sample shall be large enough to test five (5) specimens in peel and five specimens in shear. The criteria for passing seams are shown in the "Seam Strength" table in the Geomembrane Liner Section of the CQA Manual. If unresolved discrepancies exist between the CQA ENGINEER's and CONTRACTOR's test results, the archived sample may be tested by the CQA ENGINEER. Samples which do not pass the shear and peel tests will be re-sampled from locations at least 10 feet on each side of the original location. These two re-test samples must pass both shear and peel testing. If these two samples do not pass, then additional samples will continue to be obtained until the questionable seam area is defined.

   The CQA ENGINEER will observe all production seam field test procedures. The remainder of the successful test seam sample will be assigned a number and marked accordingly by the CQA ENGINEER, who will also log the date, seam number, approximate location in the seam, and field test pass-or-fail description, if applicable. The CQA ENGINEER will be responsible for the archive specimen.

3.04 REPAIRS

A. Repair of failing test seams, damage from pressure testing and sample coupons: Damaged and sample coupon areas, and other damaged areas of geomembrane shall be repaired by the CONTRACTOR by construction of a cap strip. No repairs shall be made to seams by application of an extrusion bead to a seam edge previously welded by integrity. Damaged materials are the property of the CONTRACTOR and will be removed from the site at the CONTRACTOR's expense.

B. Make repairs as follows:

   1. Abrade surfaces of the geomembrane that are to be repaired no more than 20 minutes prior to the repair,

2. Clean and dry all geomembrane surface immediately prior to repair,

3. Only use approved seaming equipment,

4. Extend patches or caps at least 6 inches beyond the edge of the defect, and round corners of patches to a radius of at least 3 inches, and

5. Cut the geomembrane below large caps to avoid potential for water and gas collection between the two sheets.

3.05 ANCHOR TRENCH BACKFILLING

The anchor trench will be backfilled and compacted to a dry density not less than 90 percent of the maximum dry density determined by the Standard Proctor (ASTM D-698). Care should be taken when backfilling the trench to prevent any damage to the geomembrane. Anchor trench spoil shall be used as backfill material, wherever possible.

3.06 PROTECTION OF LEADING EDGES

Between construction of partial sections of the membrane liner, leading edges of the membrane may be exposed or buried for extended periods of time prior to their joining to adjacent, subsequent membrane sections. The combined action of abrasive soil and equipment impact stresses may "etch" unprotected membrane surfaces sufficiently to affect seam strengths. Therefore, it is necessary to protect leading edges in high activity areas with sacrificial layers of HDPE sheet until they are ready for final seaming. As a minimum, each leading edge to be seamed that must be buried or which must be exposed for periods of one (1) month or longer shall be continuously covered by a layer of geotextile overlain by a layer of HDPE sheet. The geotextile shall be non-woven and have a minimum weight of 6 oz. per square yard. The sacrificial HDPE sheet shall have a nominal thickness equal to that of the membrane liner to be protected. Both protective cover sheets layers shall have a minimum width of two feet. The protective cover sheets shall be either covered with soil or weighted with sand bags to prevent displacement by wind. The edge of the sheet to be protected shall be approximately centered beneath the overlying protective layers prior to burial or weighing with sandbags. Leading edges located in areas expected to receive direct traffic from construction equipment shall be buried under a minimum thickness of three feet of buffer soil.

3.07 HDPE LINER ACCEPTANCE

The CONTRACTOR shall retain ownership and responsibility for the geosynthetic lining system until acceptance by the OWNER.

The lining system shall be accepted by the OWNER when:

- The installation is complete as determined by the CQA ENGINEER;
- Verification of the adequacy of all seams and repairs, including associated testing, is complete;
- All documentation of installation is completed, including all CQA reports;
- The CONTRACTOR provides the OWNER with record drawings of the panel layout and seam locations with reference numbers for test locations;
- The CONTRACTOR, the Manufacturer and the CQA ENGINEER provide written certification that the installation was in accordance with the manufacturer's general recommendations, the OWNER's CQA plan, and specifications, with exceptions noted.

--- END OF SECTION ---

SECTION 02754

GEOCOMPOSITE DRAINAGE MEDIA (GDM)

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The CONTRACTOR shall furnish all labor, materials, tools, supervision, transportation, and installation equipment necessary for the installation of the geocomposite drainage media (GDM), as specified herein, as shown on the Construction Drawings, and in accordance with the Construction Quality Assurance (CQA) Manual.

B. The CONTRACTOR shall be prepared to install the GDM in conjunction with the geomembrane cap and other components of the cap system.

1.02 REFERENCES

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 D413 or ASTM D7005	Standard Test Methods for Rubber Property - Adhesion to Flexible Substrate or Determining Bond Strength of Geocompsites (or GRI GC7)
ASTM D792	Standard Test Methods for Density and Specific Gravity of Plastic by Displacement.
ASTM D1505	Standard Test Method for Density of Plastics by the Density-Gradient Technique.
ASTM D1777	Standard Test Method for Measuring Thickness of Textile Materials.
ASTM D4716	Standard Test Method for Constant Head Hydraulic Transmissivity (In-Plane Flow) of Geotextiles and Geotextiles Related Products.
ASTM D5199	Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembrane

1.03 CONSTRUCTION QUALITY ASSURANCE (CQA) TESTING

A. The CONTRACTOR shall comply with all terms and requirements of the Construction Quality Assurance Manual (contained in this document).

B. GDM that is rejected upon testing shall be removed from the project site and replaced at CONTRACTOR's cost. Sampling and quality assurance testing of GDM supplied as replacement for rejected material shall be performed by the CQA ENGINEER at CONTRACTOR's cost.

1.04 SUBMITTALS

A. Prior to shipping to the site, the CONTRACTOR shall submit to the CQA ENGINEER two (2) copies of a mill certificate or affidavit signed by a legally authorized official of the Manufacturer. The CONTRACTOR shall also submit two samples, one yard square in size each, with the mill certificate. The mill certificate or affidavit shall attest that the GDM meets the required properties stated in these specifications. The samples shall be labeled with the Manufacturer's lot or batch number, machine directions, date of sampling, project number, and Manufacturer and product names.

B. For GDM delivered to the site, quality control certificates, signed by the Manufacturer's quality assurance manager shall be provided for every 50,000 square feet of GDM. Each certification shall have roll identification number(s), sampling procedures, frequency, and test results.

C. The CONTRACTOR shall furnish the CQA ENGINEER a copy of delivery tickets or other approved receipts as evidence for materials received that will be incorporated into the construction.

PART 2 PRODUCTS

2.01 MATERIALS

A. The Geonet shall be manufactured by extruding two (2) sets of polyethylene strands to form a three dimensional structure to provide planer water flow.

B. A filter geotextile shall be heat bonded to both sides of the Geonet. Heat bonding shall be performed by the Manufacturer prior to shipping to the site. The filter geotextile shall have a minimum weight of 6 oz/sy.

C. The Geonet shall contain UV inhibitors to prevent ultraviolet light degradation.

D. The Geonet conforms to the following minimum properties:

REQUIRED GEOCOMPOSITE DRAINAGE MEDIA PROPERTIES AND MANUFACTURER'S QUALITY CONTROL TEST DATA

PROPERTY	TEST METHOD	UNITS	VALUE	FREQUENCY
Thickness (geonet only)	ASTM D 5199	inches	0.25	Every roll
Resin Design (geonet only)	ASTM D 1505	g/cm^3	0.92	50,000 ft^2
Ply Adhesion	ASTM D 413 or ASTM D7005 or GRI GC7	lb/inch	2.0 (TYP) 1.0 min avg	50,000 ft^2
Transmissivity	ASTM D 4716	m^{-3}/s	$1x10^{-3}$	100,000 ft^2

Notes: Conduct test for transmissivity at a normal compressive load of 500 psf and at a hydraulic gradient of 0.25 after a seating period of at least 100 hours. Boundary conditions are soil interface on the upper filter Geotextile and smooth geomembrane against the lower filter Geotextile.

E. Each roll of GDM delivered shall have the following identification information:

1. Manufacturer's name
2. Product identification
3. Thickness
4. Roll number
5. Lot number
6. Roll dimensions

PART 3 EXECUTION

3.01 SHIPPING, HANDLING AND STORAGE

A. During periods of shipment and storage, all GDM shall be protected from direct sunlight, temperature greater than 140° F, water, mud, dirt, dust, and debris. To the extent possible, the GDM shall be maintained wrapped in heavy-duty protective covering until use. GDM delivered to the project site without protective wrapping shall be rejected.

B. GDM that are damaged during shipping or storage shall be rejected and replaced at CONTRACTOR's expense.

3.02 INSTALLATION

A. GDM shall be placed to the lines and grades shown on the Construction 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 accepted by the CQA ENGINEER.

C. The CONTRACTOR shall provide temporary anchorage of the GDM 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. In general, seams shall be oriented parallel to the line of maximum slope, i.e., oriented up and down the slope.

E. Adjacent rolls of GDM shall be overlapped a distance of at least three (3) inches and secured using polyethylene ties. Tie spacing shall be every ten (10) feet.

The overlaying filter geotextile, where applicable, shall extend at least six (6) inches past the geonet joint and shall be permanently bonded by heat bonding or sewing as approved by the CQA ENGINEER.

F. 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 twelve (12) inches from any point of the rupture. The patch shall be connected to the Geonet using polyethylene ties at a five (5) foot spacing.

-- END OF SECTION --

SECTION 02755

GEOMEMBRANE (FML) CAP

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The CONTRACTOR shall furnish all labor, materials, supervision and equipment to complete the installation of the Linear Low Density Polyethylene (LLDPE) Geomembrane Cap, including, but not limited to, layout, seaming, patching, and all necessary and incidental items required to complete the Work, in accordance with the Contract Drawings and these specifications.

B. Sufficient material shall be furnished to cover all lined areas shown on the Construction Drawings, including overlaps at field seams and anchor trenches.

C. It is the intent of these specifications to ensure a quality finished product. It shall be the responsibility of the CONTRACTOR to ensure that this requirement is met.

1.02 QUALITY

A. The CONTRACTOR will be required to submit a quality control program to the CQA ENGINEER prior to initiating field work.

B. The OWNER shall employ and pay for the services of a third-party CQA ENGINEER, in accordance with Section 01400 - Quality Control, to confirm the installation of the liners.

C. All installation procedures and testing shall be in accordance with these specifications and OWNER's independent Construction Quality Assurance (CQA) Manual. A copy of this manual is enclosed.

D. All field destructive and non-destructive testing will be performed by the CONTRACTOR. Samples for laboratory testing will be taken by the CONTRACTOR for testing at the CONTRACTOR's laboratory as well as the CQA ENGINEER's laboratory.

1.03 SUBMITTALS

A. The geomembrane manufacturer shall submit certification that all materials manufactured for the project have been produced in accordance with these specifications along with results from a quality control program. This information

must be submitted for review prior to material delivery. The CQA ENGINEER reserves the right to halt installation until proper certification is submitted and determined acceptable for use.

B. The CONTRACTOR shall submit to the CQA ENGINEER, six full sets of panel layout construction drawings. Field welds and panels shall have an identification system. Construction Drawings shall be submitted to the CQA ENGINEER at least two weeks prior to installation.

C. The manufacturer of the geomembrane used in this work shall approve all shop drawings and a proposed cap layout to cover the cap area shown on the Construction Drawings.

D. Details shall be included to show the termination of the geomembrane at the perimeter of capped areas, the methods of sealing around penetrations and methods of anchoring.

E. The CONTRACTOR shall submit to the CQA ENGINEER a physical sample of the geomembrane and geonet to be used. The samples shall be labeled with the manufacturer's name, product identification, lot number and roll number.

F. The CONTRACTOR shall also submit to the CQA ENGINEER inventory tickets, roll numbers or batch identifications, packing papers and invoices for the geomembrane and geonet used.

G. The CONTRACTOR shall provide personnel resumes demonstrating compliance with the following requirements:

1. A minimum of one field superintendent per shift shall be designated by the CONTRACTOR and approved by the CQA ENGINEER. Each field superintendent shall have a minimum of three years and five million square feet of field experience in installing geomembranes. Any change or replacement of superintendent during the Project must be approved by the CQA ENGINEER.

2. The weld technicians shall have a minimum of one year and one million square feet geomembrane welding experience.

1.04 WARRANTY

A. Material

The MANUFACTURER is responsible for guaranteeing it's product. The warranty shall include all that is listed below:

1. Shall begin at the time of issuance of CQA ENGINEER's Certification of Substantial Completion.

2. The material shall be free from defects and be able to withstand normal weathering and use from the date of installation for a period of 20 years under normal uses and services for which it is designed and manufactured.

3. This limited warranty does not include damages or defects resulting from acts of God, casualty or catastrophe such as, but not limited to earthquake, flood, piercing hail, or tornado.

4. "Normal Use" excludes: exposure to harmful chemicals, mechanical abuse by machinery, equipment, or people, excessive pressure beyond that indicated by the final overburden or municipal refuse and cover indicated on the drawings.

PART 2 PRODUCTS

2.01 GEOMEMBRANE CAP

A. The geomembrane shall comprise linear low density polyethylene material manufactured of new, first-quality products designed and manufactured specifically for the purpose of capping in landfills.

B. The geomembrane material shall be so produced as to be free of holes, blisters, undispersed raw materials or any sign of contamination by foreign matter. Any such defect shall be repaired in accordance with the manufacturer's recommendations. The CQA ENGINEER may reject all or portions of units (or rolls) of geomembrane if significant quantities of production flaws are observed.

C. The geomembrane material shall meet the material properties and testing frequencies as specified in the Geosynthetic Research Institute GRI Test Method GM-17, as latest revised, for 40 mil Liner Low Density Polyethylene (LLDPE) geomembrane. The minimum thickness requirement shall be the lowest individual measurement, not the aversage.

D. The geomembrane cap shall be the required minimum liner thickness as shown on the Construction Drawings.

E. If natural colored, the manufacturer shall add carbon black per ASTM D 1248 Specifications, Section 3.1.2.3, Class C.

F. The manufacturer's quality control program shall include the following inspections and tests:

1. Inspection for: Appearance on both sides, manufacturing defects, and thickness at 10 random locations across each sample strip.

2. Testing shall be conducted in accordance with the Geosynthetic Research Institute GRI Test Method GM-17, as latest revised, for 40 mil Liner Low Density Polyethylene (LLDPE) geomembrane. The minimum thickness requirement shall be the lowest individual measurement, not the average. The results shall be reported.

3. A quality chart of each roll of sheet shall be prepared and a copy attached to the roll. Information plotted on the chart shall include the location and type of defect, if any.

G. The geomembrane shall be shipped rolled. Folded or otherwise creased material will not be accepted. The material shall be marked and tagged with the following information:

1. Serial Number
2. Resin Type
3. Roll Length
4. Gross Weight
5. Inspected By
6. Date of Manufacture
7. Resin Lot Number
8. Roll Width
9. Net Weight

H. Material which has been delivered to the project site shall be stored in a dry area and protected from precipitation and direct sunlight.

I. Care shall be taken to keep the materials clean and free from debris prior to installation.

PART 3 EXECUTION

3.01 GENERAL

The geomembrane cap shall be constructed as soon as practical after filling of the cell. The cap shall be installed following the manufacturer's printed recommendations, using sound, accepted engineering practices. The entire geomembrane cap installation shall be completed by one crew. The installing crew shall be approved by the manufacturer/fabricator for installation of 40 mil geomembrane and geonet.

A manufacturer's technical representative shall be at the Pre-Deployment Meeting and on site at the time of installation.

A. Geomembrane

1. No horizontal seams are allowed within five feet of the toe of the slope.

2. Unroll only those factory-packaged sections which are to be anchored or seamed together in one day. Panels should be positioned with the overlap recommended by the manufacturer, but not less than 2-inches.

3. After panels are initially in place, remove as many wrinkles as possible. Unroll several panels and allow the geomembrane to "relax" before beginning field seaming. The purpose of this is to make the edges, which are to be bonded, as smooth and free of wrinkles as possible.

4. Once panels are in-place and smooth, commence field seaming operations.

5. No support equipment used by any CONTRACTOR shall be allowed on the geomembrane. Personnel working on the geomembrane shall not smoke, wear damaging shoes or engage in any activity which damages the geomembrane.

6. The anchor trench shall be excavated, backfilled and compacted. Care should be taken when backfilling the trench to prevent any damage to the geomembrane.

7. Damaged and sample coupon areas of geomembrane shall be repaired by the CONTRACTOR. Repaired areas will be tested for seam integrity by the CONTRACTOR. Damaged materials are the property of the CONTRACTOR and will be removed from the site at the CONTRACTOR's expense. The CONTRACTOR will retain all ownership and responsibility for the geomembrane until acceptance by the OWNER.

3.02 SEAMING

A. Geomembrane

1. Field Seaming

a. All foreign matter (dirt, water, oil, etc) shall be removed from the area to be bonded. If the seam is to be bonded by the extrusion process, the bonding surfaces must be thoroughly cleaned by mechanical abrasion or alternate methods approved by the CQA

ENGINEER to remove surface cure and prepare the surfaces for bonding. No solvents shall be used to clean the geomembrane.

b. Tack welds, if used, shall use heat only; no double-sided tape, glue or other method will be permitted. The geomembrane should be seamed completely to the ends of all panels to minimize the potential of tear propagation along the seam. The completed cap shall not exhibit "trampolining" and shall be in full contact with the underlying soil cap.

c. At the end of each day or installation segment, all unseamed edges shall be anchored by sand bags or other approved device. Sand bags shall weigh approximately 20 pounds and shall be placed no further apart than 20 foot spacing along the open end of the geomembrane. Sand bags securing the geomembrane on the side slopes should be connected by a rope fastened at the top of the slope by a temporary anchor. If high winds are expected, boards along the edge of unseamed panels, with weighted sand bags on top, should be used to anchor the geomembrane. Sand bags fastened by rope should be used to secure unseamed edges on the side slopes. Staples, U-shaped rods or other penetrating anchors shall not be used to secure the geomembrane. The temporary anchoring of the geomembrane is fully the responsibility of the CONTRACTOR. Any material damaged as the result of weather effects, shall be repaired or replaced at no cost to the OWNER.

d. It is imperative to keep surface water runoff from beneath the geomembrane at all times during installation. The CONTRACTOR's panel placement and seam welding technique and welding schedule shall minimize or eliminate the accumulation of water beneath the geomembrane. Any water found ponded beneath the geomembrane after the geomembrane has been installed shall be removed by the CONTRACTOR at no cost to the OWNER. Any soil subgrade beneath installed geomembrane that has become excessively moist, soft or unsuitable to perform its intended function shall be replaced at no cost to the OWNER.

e. After field seaming is complete in a given area, geomembrane edges in the anchor trench should be buried. Do not bury the geomembrane edge in the anchor trench within 30 feet of an incomplete or unbounded field seam.

2. Field seaming may be extrusion or fusion welding or a combination of these methods. Solvent welding is not acceptable. The CQA ENGINEER reserves the right to reject any proposed seaming method believed unacceptable.

   a. Extrusion welding applies a molten bead of material to preheated sheets of geomembrane. The sheets are then joined by pressure.

   b. The fusion welding process heats the area to be joined to the melting point and then applies pressure to join the melted surfaces.

   c. The sheets to be joined shall be overlapped at least 2-inches after the necessary aligning and cutting.

   d. In general, seams should be oriented parallel to the line of maximum slope, i.e. oriented up and down, not across, the slope. In corners and odd shaped geometric locations, the number of field seams should be minimized.

   e. No horizontal seams should be within 5 feet from the toe of the slope.

   f. No seaming should be attempted above 40 degrees C (104 degrees F) ambient air temperature. Below five (5) degrees C (41 degrees F) ambient air temperature, preheating of the geomembrane may be required. It shall be the responsibility of the CONTRACTOR to demonstrate that conditions are favorable for seaming by acceptable test (start-up) seams which duplicate, as closely as possible, actual field conditions. Preheating may be achieved by natural and/or artificial means (shelters and heating devices).

   g. A moveable protective layer of plastic may be required, as recommended by the CQA ENGINEER, to be placed directly below each overlap of geomembrane that is to be seamed. This is to prevent any moisture build-up between the sheets to be welded.

   h. Seaming will extend to the outside edge of panels to be placed in anchor trenches.

   i. If required, a firm substrata should be provided by using a flat board, a conveyor belt, or similar hard surface directly under the seam overlap to achieve proper support.

   j. Grinding prior to welding shall be as recommended by the geomembrane manufacturer and shall be done perpendicular to the sheet edge. Overground or improperly ground areas shall be replaced at the CONTRACTOR's expense.

k. No folds, wrinkles or "fish-mouths" shall be allowed within the seam area. Where wrinkles or folds occur, the material shall be cut, overlapped and an extrusion-weld shall be applied. During wrinkle or fold repairs, adjacent geomembrane may not necessarily be required to meet the 2-inch minimum overlap, if approved by the CQA ENGINEER. All welds on completion of the work shall be tightly bonded and sealed.

3.03 TESTING OF GEOMEMBRANE

A. General

1. Samples of the field seams shall be taken and tested in accordance with ASTM D6392 to ensure that tensile strength at yield and break, elongation at yield and break meet the minimum specifications. A quality control certificate shall be issued with the material.

2. The CONTRACTOR shall employ on-site physical non-destructive testing on all welds.

3. A quality control technician shall inspect each sheet and seam. Any area showing a defect shall be marked and repaired in accordance with geomembrane repair procedures.

B. Test Seams: Test seams will be made each day prior to commencing field seaming. These seams will be made on fragment pieces of geomembrane to verify that seaming conditions are adequate. Such test seams will be made at the beginning of each seaming period and, at the CQA ENGINEER's discretion, at least once every four hours, for each seaming apparatus used that day. Also, each seamer will make at least one test seam each day.

1. The test seam sample will be at least 1.5 m (5 feet) long by 0.3 m (1 foot) wide with the seam centered lengthwise. Six adjoining specimens 25 mm (1-inch) wide each will be die cut from the test seam sample. These specimens, which will be tested with a tensiometer in the field for shear (three samples) and peel (three samples) by the CONTRACTOR and witnessed by the CQA ENGINEER, should not fail in the seam. If a test seam fails, the entire operation will be repeated. If the additional test seam fails, the seaming apparatus or seamer will not be accepted and will not be used for seaming until the deficiencies are corrected and two consecutive successful full test seams are achieved. Test seam failure is defined as failure of any one of the specimens tested in shear or peel.

2. The CQA ENGINEER or his representative will observe all test seam procedures. The remainder of the successful test seam sample will be assigned a number and marked accordingly by the CQA ENGINEER, who will also log the date, hour, ambient temperature, number of seaming unit, name of seamer and pass or fail description. At least one tested specimen from each test as selected by the CQA ENGINEER will be retained by the CQA ENGINEER. The CQA ENGINEER will transmit these specimens to the OWNER following acceptance of the geomembrane materials and installation by the OWNER.

3. The criteria for determining passing welded seams shall be as stated in the "Seam Strength" table in the Geomembrane Liner Section of the CQA Manual.

C. Field Seams: Field seams will be tested by the CONTRACTOR continuously using non-destructive techniques and at specified intervals using destructive tests. Requirements for non-destructive and destructive testing are as follows:

1. Single Weld Seams: The CONTRACTOR shall maintain and use equipment and personnel at the site to perform continuous vacuum box testing on all single weld production seams or when the geometry of the weld makes pressure testing impractical.

a. Equipment for Vacuum Testing:

1. Vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft neoprene gasket attached to the bottom, port hole or valve assembly, and a vacuum gauge.

2. Vacuum pump assembly equipped with a pressure controller and pipe connection.

3. A rubber pressure/vacuum hose with fittings and connections.

4. A bucket and means to apply a soapy solution.

b. Procedure for Vacuum Testing:

1. Trim excess overlap from seam, if any.

2. Turn on the vacuum pump to reduce the vacuum box to approximately 5 in. of mercury, i.e. 3 psi gauge.

3. Apply a generous amount of solution of strong liquid detergent and water to the area to be tested.

4. Place the vacuum box over the area to be tested and apply sufficient downward pressure to "seat" the seal strip against the liner.

5. Close the bleed valve and open the vacuum valve.

6. Apply a minimum of 3 psi vacuum to the area as indicated by the gauge on the vacuum box.

7. Ensure that a leak tight seal is created.

8. For a period of not less than 5 seconds, examine the geomembrane through the viewing window for the presence of soap bubbles.

9. If no bubbles appear after 15 seconds, close the vacuum valve and open the bleed valve, move the box over the next adjoining area with a minimum 3 inch overlap, and repeat the process.

10. Mark all areas where soap bubble appear and repair the marked areas. After repairs are made, retest these areas.

2. Double Weld Seams: The CONTRACTOR shall maintain and use equipment and personnel to perform air pressure testing of all double weld seams. The system shall be capable of applying a pressure of at least 30 psi for not less than five minutes. The CONTRACTOR shall perform all pressure and vacuum testing under the supervision of the CQA ENGINEER. Pressure loss tests shall be conducted in accordance with the procedures outlined in "Pressurized Air Channel Test for Dual Seamed Geomembranes", Geosynthetic Research Institute Test Method GM-6. As outlined by the test method, following a two minute pressurized stabilization period, pressure losses over a measurement period of five minutes shall not exceed the following: 40 mil - 4 psi.

3. Destructive testing will be performed on a maximum of every 500 linear feet of field seam. The locations will be selected by the CQA ENGINEER. Sufficient size samples will be obtained by the CONTRACTOR to provide one sample to the archive, one sample to the CQA ENGINEER for laboratory testing, and two samples to be retained by the CONTRACTOR for both field and laboratory testing. Testing requirements are as follows: Each sample

shall be large enough to test five specimens in peel and five specimens in shear. The criteria for determining passing welded seams shall be as stated in the "Seam Strength" table in the Geomembrane Liner Section of the CQA Manual.

a. Tests shall be conducted in peel and shear using a tensiometer. No strain measurements from field tests of seams will be accepted. Field tests will be evaluated for the criteria described above in paragraph B. 3. or 4.

b. The CQA ENGINEER will observe all production seam field test procedures. The remainder of the successful test seam sample will be assigned a number and marked accordingly by the CQA ENGINEER, who will also log the date, seam number, approximate location in the seam, and field test pass-or-fail description, if applicable. The CQA ENGINEER will be responsible for the archive specimen.

3.04 REPAIRS OF DAMAGED AND SAMPLED AREAS

A. Damaged and sample coupon areas of geomembrane shall be repaired by the CONTRACTOR by construction of a cap strip. No repairs shall be made to seams by application of an extrusion bead to a seam edge previously welded by integrity. Damaged materials are the property of the CONTRACTOR and will be removed from the site at the CONTRACTOR's expense. The CONTRACTOR will retain all ownership and responsibility for the geomembrane until acceptance by the OWNER.

3.05 ANCHOR TRENCH BACKFILLING

The anchor trench will be backfilled and compacted to a dry density not less than 90 percent of the maximum dry density determined by the Standard Proctor (ASTM D-698). Care should be taken when backfilling the trench to prevent any damage to the geomembrane. Anchor trench spoil shall be used as backfill material, wherever possible.

3.06 PROTECTION OF LEADING EDGES

Between construction of partial sections of the membrane cap, leading edges of the membrane may be exposed or buried for extended periods of time prior to their joining to adjacent, subsequent membrane sections. The combined action of abrasive soil and equipment impact stresses may "etch" unprotected membrane surfaces sufficiently to affect seam strengths. Therefore, it is necessary to protect leading edges in high activity areas with sacrificial layers of geomembrane sheet until they are ready for final seaming. As a minimum, each leading edge to be seamed that must be buried or which must be exposed for periods of one month or longer shall be continuously covered by a layer of geotextile overlain by a layer of geomembrane sheet. The geotextile shall be nonwoven and have a minimum weight of 6 oz. per square yard. The sacrificial geomembrane sheet shall have a minimum thickness equal to that of the membrane

liner to be protected. Both protective cover sheet layers shall have a minimum width of 2 feet. The protective cover sheets shall be either covered with soil or weighted with sand bags to prevent displacement by wind. The edge of the sheet to be protected shall be approximately centered beneath the overlying protective layers prior to burial or weighing with sandbags. Leading edges located in areas expected to receive direct traffic from construction equipment shall be buried under a minimum thickness of one foot of buffer soil.

3.07 CAP ACCEPTANCE

The CONTRACTOR shall retain ownership and responsibility for the geomembrane cap system until acceptance by the OWNER.

The cap system shall be accepted by the OWNER when:

- The installation is complete as determined by the CQA ENGINEER;
- Verification of the adequacy of all seams and repairs, including associated testing, is complete;
- All documentation of installation is completed, including all CQA reports;
- The CONTRACTOR provides the OWNER with record drawings of the panel layout and seam locations with reference numbers for test locations;
- The CONTRACTOR, the Manufacturer and the CQA ENGINEER provide written certification that the installation was in accordance with the manufacturer's general recommendations, the OWNER's CQA plan, and specifications, with exceptions noted.
- The cap system has been accepted by the North Carolina Division of Environment and Natural Resources Solid Waste Section.

--END SECTION--

SECTION 02757

GEOTEXTILE

PART 1 - DESCRIPTION

1.01 SCOPE OF WORK

A. The CONTRACTOR shall furnish all labor, materials, tools, supervision, transportation, and installation equipment necessary for the installation of the geotextile layer, as specified herein, as shown on the Construction Drawings, and in accordance with the Construction Quality Assurance (CQA) Manual.

B. The CONTRACTOR shall be prepared to install the geotextile in conjunction with the earthwork and other components of the liner system.

1.02 REFERENCES

(Note: For geotextile test standards please refer to the current ASTM Annual Book of ASTM Standards, Volume 04.08 Section 4 for the Latest version of the American Society for Testing and Materials (ASTM) Standards.)

PART 2 - PRODUCTS

2.01 MATERIALS

A. This section sets forth the requirements for geotextiles.

B. Physical Properties

The geotextile shall be manufactured using a spunbonded process in which continuous polypropylene filaments are mechanically needled to produce a non-woven geotextile. Manufacturer's certification shall be required stating the geotextile has been inspected for broken needles. This inspection shall be via metal detectors permanently installed on-line at the production facility.

The geotextile shall meet or exceed the properties listed in Table 1. Unless noted otherwise, all numerical values indicate minimum average roll values (i.e., test results from any sampled roll in the lot, when tested in accordance with ASTM D 4759-88 shall meet or exceed the minimum average roll value listed). All strength values are for the weaker principle direction.

TABLE 1

Physical Property	Test Method	Unit	Minimum Value
Mass Per Unit Area	ASTM D 3776	oz/sy	6.0
Puncture Resistance	ASTM D4833	lbs.	95.00

ASTM - American Society for Testing and Materials

C. Submittals

Prior to bid, the CONTRACTOR shall submit the geotextile manufacturer's specification sheet(s) which indicate the property values of the product(s) that are submitted for use on the project. A swatch (12" x 12") of each geotextile shall be submitted along with the specification sheets.

Prior to arrival of the geotextile(s) on site, upon request the geotextile manufacturer shall supply quality control/quality assurance documents to the OWNER's representative.

Quality control/quality assurance sampling and testing shall be conducted in accordance with ASTM D 4354 and applicable test standards as found in Table 1. Recommended tests and test frequencies are found in Table 2.

TABLE 2

Property	Minimum Frequency
Mass Per Unit Area	every 100,000 ft^2
Puncture Resistance	every 400,000 ft^2

Additional Supporting Documentation: CONTRACTOR shall supply additional documentation which shall include: supporting test date and EPA 9090 test data which will assist the DESIGN ENGINEER in determining the suitability of the geotextile for the intended application.

D. Plant Inspection

A representative of the OWNER may visit the manufacturing plant at any time during the project to observe and inspect the manufacturing process and quality control monitoring, sampling and testing. The OWNER will notify the CONTRACTOR at least forty-eight (48) hours in advance of the intended visit. The CONTRACTOR shall be responsible for making all necessary arrangements for the visit with the manufacturer. All costs of travel, lodging and meals incurred by the OWNER's representative will be borne by the OWNER.

2.02 SHIPPING, STORAGE AND HANDLING

A. General

Geotextile shall be shipped, stored and handled in accordance with ASTM D 4873, and as specified herein. CONTRACTOR shall be completely responsible for shipping, storage and handling of all geotextiles.

B. Roll Identification

Each roll shall be labeled (by printing directly on the geotextile) or tagged with roll identification number, lot identification number, name of manufacturer, product type and grade, and physical dimensions. The label or tag information shall be affixed or attached to the roll at all times during deployment of the roll. The roll identification number and manufacturer name shall also be marked on the protective covering.

C. Shipping

Geotextile shall be shipped and stored in opaque protective covering. CONTRACTOR shall notify the CQA ENGINEER at least 24 hours prior to schedule delivery. No materials shall be unloaded without the presence of the OWNER's representative. Geotextile(s) delivered to the site shall be inspected for damage, unloaded and stored with minimal handling. CONTRACTOR shall assist the OWNER's representative in conducting inventory, handling and sampling of geotextile at no additional cost to the OWNER.

D. Handling

No hooks, tongs or other sharp tools or instruments shall be used for handling geotextile roll(s). CONTRACTOR shall use slings or a pole which extends a minimum of 1 foot beyond each end to unload or handle individual rolls. Geotextile shall not be dragged along the ground.

E. Site Storage

Geotextile roll(s) whose protective covering has been damaged during handling shall be protected from ultraviolet light exposure, precipitation or other inundation, soil, mud, dirt, debris, puncture, cutting or other damaging or deleterious conditions. Geotextile shall not be stored directly on the ground.

2.03 CONFORMANCE TESTING

A. Sampling Procedures

Upon delivery to the site, samples of the geotextile(s) shall be removed and sent to a laboratory, chosen by the OWNER, for testing to ensure conformance to these specifications. Samples shall be selected by the OWNER's representative in accordance with these specifications. Conformance testing, as detailed, in subparagraph1.05 C, Table 2 shall be performed.

B. Interpretation of Conformance Test Results

Test specimens will be obtained from each conformance sample. The minimum number of specimens tested per conformance sample for each tested geotextile property will be determined in accordance with the respective ASTM Standard. The average value will be calculated from the specimen test values of each conformance sample and compared to the minimum average roll value of the tested geotextile property. A conformance sample that yields an average number which is less than the specified minimum average roll property, will be recorded as a failure. If two conformance samples fail, all rolls within the sampled 100,000 square feet or lot will be rejected for use on the project unless the manufacturer would like to have additional testing performed at no cost to the OWNER. If only one (1) conformance test fails, the roll that yielded the failure will be rejected and a subsequent conformance sampled from the same 100,000 square feet or lot will be tested. All rolls within the sampled 100,000 square feet or lot will be rejected for use on the project if the subsequent conformance test fails. Only the roll which yielded a failure will be rejected from use on the project if the subsequent conformance test passes.

2.04 GEOTEXTILE INSPECTION

A. Material Inspection

The CONTRACTOR shall visually inspect all geotextile rolls for imperfections, faulty areas and possible damage prior to installation. All defective rolls shall be marked and repaired in accordance with approved methods.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Placement

Geotextile(s) shall be installed as shown on the Construction Drawings, approved installation drawings, and as specified herein or in accordance with the approved installation procedures. No geotextile roll shall be installed without approval of the CQA ENGINEER. Geotextile rolls shall be placed in such a manner as to minimize field sewing.

Geotextile shall be cut only with an approved geotextile cutter.

All changes to approved installation drawings and procedures shall be approved by the CQA ENGINEER prior to implementation.

The CONTRACTOR shall exercise extreme care during geotextile installation to prevent damage to the prepared supporting subgrade surface or to other installed geosynthetics. The CONTRACTOR shall exercise care to prevent the entrapment of rocks, clods of earth or other matter which could damage the geotextile or other geosynthetic, clog the geotextile or hamper seaming. Any geotextile surface showing damage to penetration by foreign objects or distress shall be replaced or repaired.

No foot traffic shall be allowed on the geotextile except with approved smooth - sole shoes. No vehicular traffic shall be allowed on the geotextile. The CONTRACTOR shall not use the geotextile as a work area or storage area for tools and supplies.

The CQA ENGINEER shall have the authority to order the immediate stoppage of work as a result of improper installation procedures or for any reason which may result in defective and improper installation.

Cleanup within the work area shall be an ongoing responsibility of the CONTRACTOR. Particular care shall be taken to ensure that no trash, tools or other materials are trapped beneath the geotextile.

B. Repairs

Geotextile repairs shall be made with patches of the same geotextile material, using approved sewing systems, equipment and techniques. The patch size shall be 24 inches larger in all directions that the area to be repaired. All corners shall be rounded. All stitches shall be located no closer than 1 inch from the edge of the patch.

C. Joining Methods

Thread used to sew panels of geotextiles together shall be UV stabilized polypropylene. The tread color shall contrast with the geotextile color to assist in inspection of the seam.

Geotextile seams shall be prayer or flat seams for non-woven geotextiles. All seams shall be formed by mating the edges of the geotextile panels, and sewn together with continuous stitches located a minimum of 3 inches from the mated edges. A two - thread, type 401k double - locked stitch shall be used for all sewing work. Sewing procedures shall conform to the latest procedures recommended by the geotextile manufacturer. Thermal welding can also be performed on geotextiles with mass per unit area greater than 7.9 ounces per square yard. For both forms of seaming the CONTRACTOR shall demonstrate that the seam efficiency meets requirements found in Table 1.

D. Cover

All geotextile should be covered within 14 days. If the geotextile will be left exposed for more than 14 days, the manufacturer, prior to shipping, shall provide field U.V. test data and written recommendations for the maximum time of U.V. exposure. Geotextiles which will be left exposed for more than 14 days shall be routinely sampled and tested for tensile strengths every 4 weeks. Samples should be taken from the exposed geotextile and these areas properly repaired. If within the time frame of recommended exposure the tensile strength of the geotextile falls below 80% of the original values, the manufacturer shall replace the detective material assuming all cost for removal of the detective material and installation of the replacement material.

E. Socks

Geotextile fabric socks for wrapping pipe shall be constructed with the fabric specified in this section. The sock shall be constructed by forming a cylinder and stitching the seam in accordance with the joining methods specified in this section. The sock diameter shall be sufficient size to slip easily over the pipe and connecting sleeve.

-- END OF SECTION --

SECTION 02930

GRASSING

PART 1 GENERAL

1.01 WORK INCLUDED

Provide seedbed preparation, liming, fertilizing, seeding, and mulching of all newly graded finish earth surfaces, unless indicated otherwise, and all areas inside or outside the limits of construction that are disturbed by the CONTRACTOR's operation. Areas shall be hydroseeded, except small areas that are inaccessible to the hydroseeding equipment, which shall be drilled seedbed.

1.02 SUBMITTALS

A. CONTRACTOR shall furnish Certificates of Conformance from manufacturers or agencies.

1. Seed
2. Fertilizer
3. Lime
4. Soil Testing Recommendation - County Extension Service

B. Manufacturer's Literature

Including physical characteristics, application and installation instructions, and recommendations:

1. Hydraulic Mulch Material
2. Erosion Control Material

1.03 DELIVERY

A. Fertilizer and Lime

Deliver materials to the site in the original, unopened containers bearing the manufacturer's chemical analysis, name, trade name, trademark, and indication of conformance to state and federal laws. In lieu of containers, furnish fertilizer and lime in bulk with a certificate indicating the above information accompanying each delivery.

B. Seed

Deliver seed to the site in original sealed packages bearing the producer's guaranteed analysis for percentages of mixtures, purity, germination, weedseed content, and inert material. Label in conformance with USDA Federal Seed Act 53 Stat. Rules and Regulations and applicable state seed laws. Wet, moldy, or otherwise damaged seed will be rejected.

1.04 STORAGE AND HANDLING

Store lime, fertilizer, and seed in dry locations away from contaminants. Protect seed from drying out. When handling materials, do not drop or dump from vehicles.

PART 2 PRODUCTS

2.01 SEED

Permanent seeding shall be in accordance with the following schedule:

SPECIES	RATES/ACRE (lb/acre)	PLANTING DATES
Common Bermuda Grass (Hulled)	8 - 12 lbs	Apr. 15 - Jul 30
Common Bermuda Grass	8 - 10 lbs.	Jan - Apr
German Millet	10 lbs.	Apr 1 - Jul 1
Pensacola Bahiagrass	50 lbs.	Apr 1 - Jul 15

Mulch shall be applied to seeded areas within 24 hours after temporary and permanent seeding operations. Mulch shall be essentially free of noxious weeds and applied at a rate of approximately 70 lbs/1,000 square feet (3,000 lbs/acre).

On areas where ground surface exceeds approximately five (5%) slopes, the mulch shall be tacked using a sufficient amount of asphalt or similar binding material to hold mulch in place.

Seedbed Preparation

1. Work lime and fertilizer into the soil where conventional equipment can be used. Use disk or similar equipment to prepare to depth of 3-4 inches. Use ripper if necessary.

2. Lime and fertilizer may be applied with seed mixture when a hydroseeding used and where mulch will be applied. Seedbed preparation may not be necessary where hydroseeding equipment is used.

3. Slopes that are too steep for conventional equipment (2:1 or steeper) should be seeded with hydroseeding equipment.

Where hydroseeding equipment is not available for use on steep slopes, scarify the soil surface with a chain harrow, pick chain, grader blades with chisels, hand tools, or other equipment that will pit the soil or make trenches approximately 1-2 inches deep, 6-12 inches apart across the slope in which the seed can lodge and germinate.

2.02 LIME

ASTM C 602, commercial agricultural limestone containing a minimum of 94 percent of total carbonates, 52 percent calcium, and 42 percent magnesium. Provide the following ASTM E 11 gradation: minimum 100 percent passing the No. 20 sieve and 75 percent passing the No. 100 sieve. Application rates shall be as recommended by the North Carolina Department of Agriculture through standard soil testing procedures.

2.03 FERTILIZER

Commercial grade, free flowing, uniform in composition and bearing the manufacturer's guaranteed statement of analysis. Analysis of fertilizer and application rates shall be as recommended by the North Carolina Department of Agriculture through soil testing procedures, and in accordance with this schedule:

(Continued on next page)

FERTILIZER REQUIREMENTS				
TYPE OF SPECIES	**YEAR**	**ANALYSIS OR EQUIVALENT N-P-K**	**RATE**	**N TOP DRESSING RATE**
1. Cool season grasses	First	6-12-12	1,500 lbs/ac	50-100 lbs/ac (1)(2)
2. Cool season grasses and legumes	First	6-12-12	1,500 lbs/ac	0-50 lbs/ac (1)
3. Ground covers	First	10-10-10	1,300 lbs/ac (3)	- -
4. Temporary cover crops seeded alone	First	10-10-10	500 lbs/ac	30 lbs/ac (4)
5. Warm season grasses	First	6-12-12	1,500 lbs/ac	50-100 lbs/ac (2)(5)

(1) Apply in spring following seeding
(2) Apply in split applications when high rates are used
(3) Apply in three (3) split applications
(4) Apply to grass species only
(5) Apply when plants grow to a height of 2 to 4 inches

2.04 MULCH

Free from noxious weeds, mold, or other deleterious material. Provide wood cellulose fiber when hydroseeding.

A. Straw

Stalks from oats, wheat, rye, barley, or rice. Furnish air-dry condition and of proper consistency for placing with commercial mulch-blowing equipment.

B. Wood Cellulose Fiber

Processed to contain no growth or germination-inhibiting factors and dyed an appropriate color to facilitate visual metering of materials application. Composition on air-dry weight basis: 9-15 percent moisture, pH range 3.5 to 5.0.

2.05 WATER

Suitable quality for irrigation.

PART 3 EXECUTION

3.01 SEED BED PREPARATION

Areas required to be seeded shall have been brought to the required subgrade. New areas to be seeded shall be thoroughly tilled to a minimum depth of four (4) inches by scarifying, disk harrowing, or other approved methods. Remove debris and stones larger than one inch remaining on the surface after tillage.

A. Fertilizer and Lime

Apply fertilizer and lime at the rates recommended by North Carolina Department of Agriculture.

B. Drill Seeding For New Seeding

Incorporated fertilizer and lime into the soil to a minimum depth of four (4) inches. Application may be performed as part of the tillage operations.

C. Hydroseeding

Apply liquid fertilizer in amounts recommended by North Carolina Department of Agriculture. Apply lime manually.

3.02 SEEDING

A. Seeding Conditions

Immediately before seeding, restore soil to the proper grade. Do not seed when the ground is muddy or in any unsatisfactory condition for seeding.

B. Seeding Method

Apply seed within 24 hours after seedbed preparation. Sow seed with approved sowing equipment using one or a combination of the following methods. Sow one-half the seed in one direction and sow remainder at right angles to the first sowing.

C. Drill Seeding

Use cultipacker seeders or grass seed drills. Drill seed uniformly to maximum depth of ¼" clay soils and ½" in sandy soils. Cover seed by spike-tooth harrow, cultipacker, or other approved devices.

D. Hydroseeding

Mix seed, fertilizer, and wood cellulose fiber in required amount of water to produce a homogenous slurry. After seed, water, and fertilizer have been thoroughly mixed, add 1,500 pounds of wood cellulose fiber per acre (dry weight) and apply the slurry. Seed shall not remain in water containing fertilizer for more than one (1) hour prior to application and shall be agitated during application.

3.03 PROTECTION OF SEEDED AREAS

Immediately after seeding, protect the area against traffic and other use by erecting barricades, as required, and placing approved signs at appropriate intervals until final acceptance.

3.04 RESTORATION

Restore to original condition existing lawn areas which have been damaged during seeding operations. Clean paving when work in adjacent areas is complete.

3.05 TURF

A. Duration

Turf establishment period will be in effect until final acceptance.

B. Maintenance

During turf establishment period, mow the seeded area to an average height of two (2") inches whenever the average height of grass becomes four (4") inches. Remove excess clippings, eradicate weeds, apply water and/or fertilizer, overseed, and perform other operations necessary to promote turf growth.

3.06 FINAL ACCEPTANCE

A. Final Inspection and Acceptance

At the end of the turf establishment period, final inspection will be made upon written request at least 10 days prior to the anticipated date. Final acceptance will be based upon a satisfactory stand of turf, defined as 95 percent ground cover of the established species.

B. Replanting

In areas which do not have a satisfactory stand of turf, replant as directed.

--END OF SECTION--

V. OPERATION PLAN

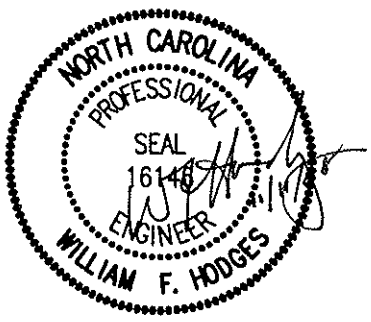
OPERATION PLAN

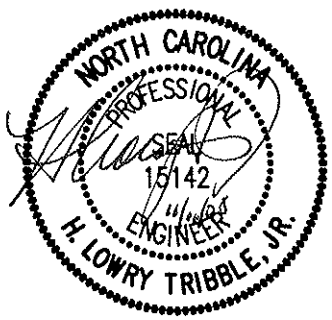
EAST CAROLINA REGIONAL LANDFILL – PHASE 5
BERTIE COUNTY, NORTH CAROLINA

FOR

REPUBLIC SERVICES OF NORTH CAROLINA, LLC
dba
EAST CAROLINA ENVIRONMENTAL

APRIL 2008
REVISED OCTOBER 2008
REVISED NOVEMBER 2008





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I. INTRODUCTION

The East Carolina Regional Landfill site is located north of Windsor, N.C. The MSW landfill is discussed in this Operation Plan.

The Landfill Operation Plan is a document to guide the facility operators in their daily activities. As such, it should be as comprehensive and as up-to-date as possible. The document should be updated during the construction period and during the facility operating life. As the Section rules change, revisions should be reflected in the updated document. Before operations begin, additional guidance documents on employee safety, environmental protection and monitoring, emergency procedures, fire fighting and prevention, hazardous waste identification, leachate pump/haul management, record keeping, and other subjects may be appended to this document.

This Operation Plan describes how the Facility, Engineering, and Closure Plans prepared for the East Carolina Regional Landfill will be implemented during the life of the facility. The plan has been prepared in compliance with Rules .1625 and .1626 of the North Carolina Solid Waste Management Regulations and consists of drawings and accompanying text that illustrates existing conditions, cell progression, waste placement and daily operations, leachate management, special waste management, buffer zones and soil borrow procedures.

A. Ownership and Operation

Ownership of the facility will be in the name of Republic Services of North Carolina, LLC, DBA East Carolina Environmental. Operational responsibilities will be handled by Mr. Bill Cooksey, General Manager, 252-348-3322 (phone), 252-348-3395 (fax). This facility is located at 1922 Republican Road, Aulander, North Carolina 27805.

The landfill is open to private and public waste haulers and the general public from 7:00 a.m. to 5:00 p.m. Monday through Friday, and on Saturday from 7:30 a.m. to 2:00 p.m. Three holidays are observed; Thanksgiving, Christmas and New Year's Day. These hours may be adjusted to meet unusual circumstances, operational needs or emergencies.

B. Objectives

The objectives of the Landfill Operation Plan are to:

1. Protect the environment.

2. Provide the operator with the intended methodology for operating the landfill efficiently.

3. Provide information about the site.

4. Provide operational parameters for State review.

5. Appropriately manage leachate at the facility.

C. Regulatory Authority

The Division of Waste Management - Solid Waste Section (Section) is the principal permitting and regulatory authority in North Carolina for solid waste management and disposal.

D. Landfill Restrictions

The East Carolina Regional Landfill can only accept those solid wastes which it is permitted to receive. The landfill owner or operator shall notify the Section within 24 hours of attempted disposal of any waste the landfill is not permitted to receive, including waste from outside the area the landfill is permitted to serve. A description of wastes which may be disposed of at this facility is included in this document. Also included in this document is a description of the Waste Screening Program for the site and a description of prohibited wastes.

The proposed landfill is permitted to receive municipal solid waste from North Carolina Counties and businesses. No radioactive waste, hazardous waste, yard waste, white goods, regulated PCB contaminated waste, lead acid batteries, or liquid waste material shall be disposed of on the landfill site. Any waste suspected of containing free liquids must be subjected to the "Paint Filter Liquids Test", and any material with free liquids shall not be disposed of in this facility. Any liquid containers five gallons or larger shall be empty, flattened, perforated, or rendered unable to contain liquids before they are accepted at the landfill for disposal.

Liquid/semi-solid materials may be solidified in accordance with the Waste Solidification Plan, attached in the Appendix. Only non-hazardous materials may be solidified. Following solidification, material will be subjected to a paint filter liquids test and, if the material no longer contains any free liquids, it may then be placed in the active landfill.

Asbestos waste that is packaged in accordance with 40 CFR 61, which is adopted by reference in accordance with G.S. 150B-14(c), may be disposed at the facility. In accordance with Section .1626(1),(d), the asbestos waste shall be covered immediately with soil in a manner that will not cause airborne conditions and must be disposed of separate and apart from the other solid waste at the bottom of the

working face or in an area not contiguous with other disposal areas. Separate areas shall be clearly designated so that asbestos is not exposed by future land disturbing activities. A copy of 40 CFR Part 61 Subpart M – National Emission Standards for Asbestos will be utilized for guidance.

Spoiled foods, animal carcasses, abattoir waste, hatchery waste, and other animal waste delivered to the facility should be covered immediately. This immediate attention will reduce odors and the potential for vector feeding.

Wastewater treatment sludges may only be accepted for disposal in accordance with the following conditions:

- Utilized as a soil conditioner and incorporated into or applied onto the vegetative growth layer of the final or intermediate cover, in no case greater than 6" in depth.

- Co-disposed with Municipal Solid Waste since the facility meets the requirements of Rule .1624.

Industrial solid waste means solid waste generated by manufacturing or industrial processes that is not a hazardous waste regulated under Subtitle C of RCRA. Such waste may include, but is not limited to, waste resulting from the following manufacturing processes: electric power generation; fertilizer/agricultural chemicals; food and related products/by-products; inorganic chemicals; iron and steel manufacturing; leather and leather products; nonferrous metals manufacturing/ foundries; organic chemicals; plastics and resins manufacturing; pulp and paper industry; rubber and miscellaneous plastic products; stone, glass, clay, and concrete products; textile manufacturing; transportation equipment; and water treatment. This term does not include mining waste, or oil and gas waste.

The operator should utilize the Waste Screening Plan for non-MSW type waste acceptance.

Republic Services of North Carolina has developed a Waste Screening Program in accordance with North Carolina's Solid Waste Management Regulations, Rule .1626(1)(f). This rule states that owners/operators of MSWLFs must implement a program at the facility for detecting and preventing the disposal of hazardous and liquid wastes, except as specifically authorized by the facility permit or by the Section. This program includes:

- Random inspections of incoming loads unless the owner or operator takes other steps to ensure that incoming loads do not contain regulated hazardous or liquid wastes, or regulated PCB wastes;
- Records of any inspections;
- Training of facility personnel to recognize regulated hazardous waste, liquid waste, and PCB wastes; and
- Development of a contingency plan to properly manage any identified hazardous and/or liquid wastes.

The Random Inspection Program is detailed in Section V. (F) of this Operation Plan.

E. Landfill Operator Responsibilities

The landfill operator has the authority and responsibility to accept or reject wastes as he deems necessary to comply with requirements of the permit and Section rules. The operator also has the authority to control waste received to ensure that unauthorized, difficult to manage, or prohibited waste will not be disposed of in the landfill. Responsibilities of the operator are to:

1. Determine whether waste brought to the landfill is to be placed in the landfill,
2. Provide proper maintenance,
3. Provide for satisfactory monitoring, and
4. Inform the Section within 24 hours of operational problems or violations, and maintain records in accordance with permit requirements and Section rules.

In accordance with NCGS 130A-309.09D, on or before August 1 of each year, Republic Services of North Carolina will report to the Solid Waste Section the amount of waste received in tons at this facility and disposed in the landfill units. Data will be transmitted on forms prescribed by the Section. The report will include the following:

- The reporting period shall be for the previous year beginning July 1 and ending on June 30.
- The amount of waste received and landfilled in tons, compiled on a monthly basis by county or transfer station of origin and by specific waste type if diverted to a specific unit within the permitted facility; and
- The completed report shall be forwarded to the Regional Waste Management Specialist for the facility.

F. Owner Responsibilities

An agreement exists between Republic Services of North Carolina, LLC and the Bertie County Board of Commissioners. In the agreement, Republic Services of North Carolina, LLC is responsible for developing and operating the Landfill and related facilities.

Tipping fees will be set according to type of waste and quantity of waste. Other responsibilities of Republic Services of North Carolina, LLC are to provide

manpower and equipment for the landfill directly or through contract operations, and to set operations policy.

G. Training

Republic Services of North Carolina, LLC will utilize both internal company training and outside continuing education for the landfill operations personnel. The operations personnel operating the site will be supervised and trained by certified landfill operators. These personnel will receive internal company training in operations, reporting, monitoring, environmental compliance, and facility maintenance.

This internal training will be repeated and updated on a periodic basis.

Off-site outside training will be scheduled as course offerings are announced.

Operation of the site will include specialized training in the operation and maintenance of the following:

1. Leachate pump stations / sideslope riser pumps / gravity leachate sewer collection systems.
2. Leachate storage tanks/secondary containment system.
3. Stormwater management.
4. Hazardous waste identification.
5. Prohibited waste identification.
6. Leachate recirculation
7. Waste solidification
8. Tipper operation
9. Landfill gas operations

Records of personnel training shall be maintained in the facility operating record.

II. SITE OPERATION & MAINTENANCE

A. Landfill Equipment

Operation and maintenance of the site will be the responsibility of the landfill General Manager. Typical heavy equipment available are as follows:

1. An Excavator with an off-road haul truck
2. Water Truck
3. Farm Tractor, and Mower
4. Steel Wheel Compactors
5. Dozers
6. Pick-up Trucks
7. Trailer Tippers
8. Mechanic's Service Truck
9. Posi-Shell Application Equipment (optional)

Other equipment will be purchased or rented as required for the facility operations.

B. Facilities Maintenance

The following is a list of maintenance duties of the operator:

1. Maintain paved, graveled, and temporary roads in and to landfill operations to ensure safe and unencumbered movement of traffic.

2. Maintain condition, visibility, and integrity of informational signs.

3. Maintain physical barriers to discourage unauthorized entry onto landfill property by unauthorized vehicles.

4. Maintain slopes by filling and (re)establishing vegetative cover to prevent erosion and/or exposure of refuse.

5. Maintain grassed areas.

6. Maintain drainage features such as swales, stormwater conveyance channels, and slope drains to ensure efficient management of stormwater.

7. Maintain site in a sanitary condition.

8. Maintain windscreens and keep blown litter from leaving site by frequent policing efforts within landfill and on adjacent property.

9. Maintain effective rodent and vector control measures.

10. Maintain communication with fire department personnel and establish a plan of operations for fighting fires.

11. Maintain and protect landfill cells and embankments against erosion and damage.

12. Maintain (regrade subsided) or settlement fill areas.

13. Maintain sediment storage volume of sediment basins.

14. Maintain the landfill scales.

15. Maintain and operate the leachate management system.

16. Maintain appropriate records and operations demonstrations.

17. Use temporary control measures to prevent stormwater from contacting the waste and becoming leachate.

18. Maintain support facilities.

19. Maintain the landfill gas system.

20. Maintain wetland boundaries.

III. ANTICIPATED LAND USE DURING POST-CLOSURE

After completion of the landfill, the projected land use will be to return the land to greenway and to woodlands, grasslands, or wetlands elsewhere on the property. The final closure will be completed to reduce maintenance during the post-closure care period. All areas of the closed site will be vegetated to reduce the long term potential of erosion.

IV. ANTICIPATED LIFE EXPECTANCY

Based upon available data provided by the State of North Carolina, a waste generation rate of 5 lbs/capita/day was used to calculate yearly volume of waste. A projected waste volume compaction rate of 1,400 lbs/cy of in-place waste was used to calculate the volume needed in the landfill to dispose of the waste. The life of the landfill was calculated by using waste stream projections. It has been estimated that the total life of the landfill will be over 21 years. The life for Phase 5 will be approximately five years. During the next five years, it has been estimated that Bertie County and the region serving the facility will generate approximately 1,043,000 cy/year of compacted solid waste to be landfilled at the site. The

area to be served by the facility includes all cities, counties and commercial / industrial facilities in North Carolina.

V. METHOD OF OPERATION - MSW LANDFILL

A. Landfilling/Operations

The landfilling operation will be comprised of solid waste being deposited on the working face of the landfill. Steel wheel compactors will be used to obtain maximum compaction of the waste by compacting at two to six foot depths of waste at a time, and by confining the area to be compacted daily. The exception to this is the first lift which will be installed approximately eight feet deep with limited steel wheel compaction. This initial eight foot lift (known as a fluff lift) will generally be placed with dozers since this greatly reduces the risk to the liner system. Once fill reaches approximately eight feet, steel wheel compactors will be used to place and compact the waste. If the working face is confined to a minimum area on a daily basis, this will economize the amount of daily cover or alternative daily cover (ADC) required. Per North Carolina State Regulations, a daily cover of six inches of compacted soil or an alternative daily cover must be placed on top of the daily landfill operation to protect the landfilled garbage from exposure to rain and becoming windborne, and to prevent rodent and insect propagation or infestation. Once an area of the landfill is complete, that is, achieves final grades, a cover system (cap) will be placed as final cover and this will be seeded and stabilized. A sequence or phasing of the filling operations and final cover (cap) cross-sections are indicated in the Engineering Plans. Compost materials may be included in the final cover top layer if first demonstrated to the Section, then approved by the Section.

B. Daily Operations

1. Placement of solid waste will begin in the initial fill area of the landfill.

2. Wastes should be kept to the minimum surface area possible and compacted via numerous passes of the steel-wheel compactor. Surface area (active landfill area) should be kept to a minimum for two reasons: (1) to minimize the amount of daily cover soils or ADC needed and, (2) to maximize the amount of garbage (not soils) being placed; thereby, increasing the life of the landfill.

Waste placed against the outer berms along the permanent outer edge of the cell shall be no closer than 15' to this edge of liner. By stopping at the inside edge of this berm, the operator will be placing waste no closer than 15' from the permanent edge. Waste placed against the interior berms between cells, shall be no closer than 10' to this edge. This will allow ample room for new liner to be tied to existing liner in the future cells.

After the first lift is in place, compaction berms may be installed at the outer edge. Trucks will unload their waste at the working face. The waste will be compacted against the compaction berm and up the working face. These outside compaction berms will serve several purposes:

a. The small berms give the operator guidance on where to place waste to ensure that the outside slope can be constructed quickly and accurately and,

b. The small berms give the operator a structure to compact against, keeping him from pushing waste out and over the outer slope of the landfill.

The phasing plan in the Engineering Plans should be followed. It is the intent (to the extent that safe operations on a sloped surface allow) that an area be

brought to the maximum elevation possible before moving landfilling operations into an adjacent area. Further, it is intended that final contours be achieved as early as possible so as to direct run-off of stormwater away from the working area.

Sequencing of areas in the proper order is necessary to manage the storm water.

3. It is important to remember that decaying wastes will eventually generate leachate and methane (landfill gas). Methane is an explosive gas which is lighter than air and thus can be trapped underneath structures and equipment. The operator should have the landfill boundaries and structures tested for methane gas concentrations at least quarterly and instruct all personnel in its dangers. Methane is a component of landfill gas that is odorless and thus cannot be detected except by proper equipment.

Gas Monitoring Procedures:

Landfill gas monitoring at the East Carolina Regional Landfill will be performed during the active life of the landfill and throughout the post-closure care period. At a minimum, quarterly monitoring will be conducted at all subsurface methane gas monitoring probes and in all structures located on the landfill property.

Methane gas monitoring probes will be installed on the site as additional phases are constructed. They will be designed to extend to a depth at least equal to the maximum depth of waste in the area of the monitoring point or the water table, whichever is encountered first. Probe locations will likely be field engineered due to varying topography adjacent to expansion areas that may limit access with a

drill rig. A methane gas monitoring probe detail can be found in the Engineering Plans. Construction records for the methane gas monitoring probes will be submitted to the Section upon completion.

Active landfill gas extraction wells have been and will continue to be installed in the waste mass prior to closure in accordance with the facility's Air Quality Title V Operation Permit and Air Quality Permit No. 08849T03 dated February 10, 2006. Construction details of these wells is included in the NSPS design plans. Any expansion or addition to the existing landfill gas collection system will be submitted to the Solid Waste Section prior to implementation.

Record Keeping: The operator will record the date, time, location, sampling personnel, atmospheric temperature, reported barometric pressure, and general weather conditions at the time of sampling, in addition to the concentration of combustible gases. The records will be maintained in the facility operating record.

On-site Structures: Gas monitoring in on-site structures will attempt to identify the "worst case" concentrations. The monitoring locations will be in corners along floors and ceilings, at cracks in the floor, and at other areas likely to accumulate gas. Gas monitoring will also be conducted in any confined space requiring the entry of personnel for maintenance or inspection. The monitoring will take place prior to entry by personnel in accordance with OSHA regulations.

Methane gas monitoring probes: Gas monitoring in probes will consist of attaching the combustible gas monitor to each tubing within the probes, and recording both the initial concentration and steady state concentration of combustible gases.

Equipment: A portable combustible gas monitor, measuring the concentration of combustible gases in units of percent of lower explosive limit, shall be used to conduct gas monitoring. Lower explosive limit (LEL) means the lowest percent by volume of a mixture of combustible gas in air that will propagate a flame at 25 degrees Celsius and atmospheric pressure. The gas monitor shall be calibrated to methane using the manufacturer's calibration kit and procedure before the monitoring activities begin.

Response to Landfill Gas Exceedances

The regulatory maximum levels for explosive gas are the LEL at the facility boundary and 25% LEL in on-site structures. At a minimum, the following actions will be taken if methane gas levels exceed those standards:

1) The Section will be notified immediately;

2) Immediate steps necessary to protect human health will be identified and implemented. If the standard in structures is exceeded, these will include:
   - Elimination of smoking materials and all ignition sources;
   - Evacuation of all personnel;
   - Ventilation of the structure;
   - Personnel will not be allowed to re-enter the building except to perform gas monitoring until the results of additional monitoring indicate that methane concentrations are stabilized below 25% LEL;

- Assessing the origin and pathways of the gas migration.

Within seven days of detection, the monitoring results will be placed in the facility operating record, and Republic Services of North Carolina will indicate actions taken and actions proposed to resolve the problem. Within 60 days of detection, Republic Services of North Carolina will develop and implement a landfill gas remediation plan for the combustible gas releases, place a copy of the plan in the operating record, and notify the Section that the plan has been implemented. The plan will describe the nature and extent of the problem and the proposed remedy.

4. Daily cover soil for operations will be obtained from the future cell areas or other sources. A grading plan has been developed to define excavation limits (see Phase 5 Engineering Drawings) and to designate the three principal soils applications: (1) topsoils, (2) clays for liner construction, and (3) soils for daily cover. Prudent excavation and control of drainage from the excavation will save considerable construction costs on the landfill.

The operator may also choose to use alternative daily cover. Alternative cover will not be allowed in place of intermediate or final cover. Use of alternative cover will be specified in the permit and is subject to the Operator's demonstrations and the Section's approval. Currently at this facility, tarps and petroleum contaminated soils (PCS) are approved for use as alternate daily cover (ADC). The site may use additional alternative daily covers, such as posi-shell, yard waste type compost/mulch, automotive shredder residue (ASR), foam, shredded wood, crushed gypsum, C&D fines, foundary sand,

paper pulp sludge, and alum sludge in the future. However, these additional ADC's must be approved by the Section in accordance with 15A NCAC 13B .1626(2)(b) prior to any use of such.

The daily working face shall be minimized at all times. This working face will include the top surface and sloped face to be covered at the end of each day.

ADC is intended to reduce the facility's reliance on soil cover and to reduce the air space consumption by daily soil cover. However, should the ADC prove unsuccessful, the daily cover consisting of a minimum of 6" of soil must be utilized.

Alternative covers may be approved by the Section if the owner or operator demonstrates that the alternative material and thickness control disease vectors, fires, odors, blowing litter, and scavenging without presenting a threat to human health and the environment.

Republic Services of North Carolina may utilize tarps and approved PCS as described below.

- If a tarp ADC is used, the cover shall be deployed over the deposited solid waste at the end of each day by pulling the cover into position by the available heavy equipment and anchoring by placing soil over the corners of the fabric. The tarps are not expected to exceed 250 feet by 250 feet in size and can be easily placed by the available personnel and equipment. Multiple smaller tarps may also be used in accordance with the method described above. Prior to depositing solid waste the next working day, the tarp will be

pulled from the waste with the available heavy equipment and stored in accordance with the manufacturer's recommendation.

- Use of Petroleum Contaminated Soil (PCS) as daily cover materials is a beneficial reuse of soil with relatively low levels of petroleum in the soil. The approved maximum petroleum contaminant level of soil will be 3,000 parts per million (ppm). Conditions for the use of petroleum contaminated soils as alternate daily cover (ADC) are included in Section XII of this Operation Plan. A form for use during acceptance of PCS soils is attached in the Appendix.

When weather and soil conditions so dictate, daily cover soils are available from the stockpiles. The operator should replenish depleted stockpiles by excavating from the future cell areas or permitted borrow areas to the limits indicated.

5. It will be necessary for operators to grade, repair and smooth the landfill surface as needed and to capture and replace soils that may have migrated to the surface drainage features or sediment basins and traps. These materials should be stockpiled, allowed to drain and utilized for daily cover.

C. Cell Filling/Stormwater Management

The landfill cells will be typically filled from the lower elevations toward the upper elevations in initial lifts of approximately eight feet. No steel wheel compaction equipment shall be placed in the landfill cell until there is an eight foot (plus or minus) mat of waste in that portion of the cell. Care shall be used to assure that the

material placed in this initial lift will not be capable of penetrating the 24 inches of protective cover over the liner. Penetration of waste through this protective cover could damage the FML liner component.

The operator must use extreme care in managing the initial cell filling. In the area of the cell above the waste being placed in an initial lift, the operator shall have installed stormwater rain flaps to prevent stormwater from flowing onto the cell area being filled.

The stormwater rain flaps should be placed so no area larger than two acres can drain directly into the leachate collection system. Based on a 5 inch storm event, up to 272,000 gallons could enter the leachate collection and storage system. It is unlikely that this full amount of rainfall would enter the system since any open cell will have some waste in it and even limited amounts of waste and sand will retain a percentage of the rainfall event.
Stormwater above each of these rain flaps shall either be diverted, or pumped from the cell. Once this initial lift of waste is in place with an intermediate layer of soil, gravity drainage on top of the intermediate cover will be used.

The stormwater rain flaps will be removed as the waste filling progresses to their location. In addition to their removal, the leachate collection pipe shall be connected to drain the leachate from that next portion of the cell. The stormwater rain flaps serve only the initial lift of the landfill.

As a rule, any water that directly contacts waste will be defined as leachate. Any water that is diverted away from the waste, and does not contact any waste, is defined as stormwater. Leachate will be managed in the leachate management system and stormwater shall be directed to the stormwater management system.

D. Leachate Management

Leachate is the liquid waste generated as stormwater passes through the landfill waste mass. In the landfill, this leachate is collected by a system of perforated pipes and sand media on top of the base liner system. In cells 3 through 11, the leachate flows by gravity through this system to a leachate penetration assembly and then leaves the lined landfill via gravity mains to leachate pumping stations. The leachate is pumped from the pumping stations to one of two leachate storage tanks. In cells 12 through 14, leachate will flow by gravity to a leachate sump where it will be pumped through a force main into a leachate manhole located due west of cell 11. From there it will travel via gravity mains to existing leachate pumping stations and from there to the leachate storage tanks. Leachate will be stored in the tanks until it is periodically transported to an acceptable treatment facility, or is recirculated or irrigated onto the lined cell areas. The leachate storage tanks are glass lined steel tanks capable of holding at least thirty days volume of leachate. For this site, a 250,000 gallon tank and a 162,000 gallon tank are provided. These tanks have separate secondary containment structures capable of holding 110% of the tank volume. This is a sealed containment so it will be the operator's responsibility to pump off uncontaminated stormwater from the secondary containment. These tanks have been designed so that leachate may be transferred from one tank to the other to aid in leachate management.

The chemical composition of untreated leachate generated will be analyzed, at a minimum, semi-annually. The leachate samples will be collected from the leachate storage tank sampling port and shall be analyzed for the Detection Monitoring constituents (EPA Appendix I list for Detection Monitoring as incorporated by reference in Rule.1633), as well as pH, specific conductance, BOD, COD, TSS, phosphate, nitrate, sulfate. Test results will be submitted to the Section.

The leachate management system is sized based on the "Hydraulic Evaluation of Landfill Performance Model" (HELP Model), developed by the U.S. Army Corp of

Engineers for the Environmental Protection Agency. The HELP Model cases, runs, and results are included with the leachate system design calculations.

In addition to using the HELP Model to size the leachate management systems, the following design standards, which exceed the North Carolina minimum design standards, shall be incorporated.

1. All leachate collection lines shall be a minimum of 8" diameter instead of the North Carolina minimum of 6" diameter.

2. All leachate lines shall have a minimum 8' wide leachate collection column of ASTM #57 stone to serve as both a filter for the leachate pipe and as a redundant flow path for leachate in the event the leachate pipe somehow becomes clogged. This column shall extend from the base liner upward for at least the height of the protective cover or 24". This gravel redundant flow area is roughly 50 percent void space of the 16 square foot gravel column for an 8 square foot flow area, which is many times the area of the 8" diameter leachate pipe and an even greater ratio when compared to the North Carolina standard 6" diameter leachate collection pipe.

3. Where a protective cover system which utilizes natural sand, manufactured sand, or native soils is used, there shall be a 2 foot minimum thickness of ASTM #78 or #89 stone filter media to assure fines in the protective cover system do not enter the ASTM #57 gravel column.

4. All sideslope riser sumps shall have a double layer of Geosynthetic-Clay Liner (GCL) above the clay or low permeability soil liner and below the Flexible Membrane Liner (FML).

5. All sideslope riser pumps shall have a flow meter which shall be monitored no less than weekly, with the results to be placed in a tabular chart in the Facility Operating Record.

6. Leachate collection lines shall be cleaned with jet action within 12 months of permit issuance and then once every five years thereafter. If a blockage is encountered, camera monitoring of the line shall be done.

7. If at any time North Carolina Department of Environmental and Natural Resources – Solid Waste Section has evidence of a line blockage, based on their observations and review of the records, the landfill will upon receipt of a written request for a camera inspection, conduct same within 90 days of such written request, with the tape/disk of the inspection made available to the Solid Waste Section.

The site currently contracts with GunnCo Pump & Control, Inc. to perform inspections and maintenance on the pump and control system on a semi-annual basis. In addition, the facility will continue monitoring leachate flows in those cells with sideslope riser pumps and the tank levels on a weekly basis. The pump inspections will record flow data, pump hours, and leachate levels on a leachate pump log. This log will continue to be reviewed on a monthly basis for flow and pump issues. This data is compared to historical leachate generation data to understand and predict existing and future flows. In cells with sideslope riser pumps, monitoring of the pump hour meter and flow meter provides a good early warning system when pumps are down. If the pump hour meter is changing and the flow meter is not, this indicates a possible blockage at the check valve. If neither the pump hour meter nor the flow meter are changing, this indicates a possible electrical or pump control issue. Leachate flows in cells with penetration assemblies will be monitored by visual observation at each manhole. Valves in these gravity lines will be tested to ensure proper functioning.

Pump drawdown tests are performed in cells with sideslope riser pumps when observations indicate a significant drop in daily flows from a particular cell or when pump hour meter readings are higher in a given month than normal. The test is performed by manually operating the pump and timing the drawdown to a lower level and then timing how long it takes for the level to recharge back to the higher level. The test is repeated three to four times. A fast drawdown and recharge time typically indicates sediment build-up and reduced storage volume in the sump area. When this condition is encountered, a vacuum truck is scheduled to come and vacuum out the sump. The pump drawdown tests are repeated to verify proper functioning. If pump drawdown tests results have not improved, jet cleaning of the sump and lines may be performed.

On a five year interval, a high pressure water jet cleaning device shall be introduced into the leachate lines to irrigate and renew the filter pack around the perforated leachate line. Debris dislodged by this effort shall be removed from the leachate line / sump with a vacuum truck. The dislodged material and associated cleaning water shall be disposed of properly.

The site currently contracts with GunnCo Pump & Control, Inc. for semi-annual maintenance inspection of leachate collection pumps and leachate transfer area pumps. These inspections included a detailed checklist of the control panel, electrical, pump, flow meter, risers, wet wells, and additional items. All data collected is compared to the last system inspection report and a detailed service report record is generated for each pump. These reports will be included in the facility operating record.

The operations of the leachate storage and treatment plan should include the following:

1. The tank filling is handled by automatic level controls on the leachate pumps.

2. When the combined tank capacity reaches 50%, removal of leachate should begin.

3. Should the tank filling exceed 60% of the capacity of both tanks during normal operations, the operator should utilize additional measures to expedite removal of the leachate.

4. Unless other provisions are made, all leachate shall be transported to an approved wastewater treatment facility, or it shall be recirculated into the waste mass.

5. On a weekly basis, inspect the secondary containment systems and the tanks for any leaks. If none are present, record the inspection, and then pump off any accumulated stormwater. Place the inspection reports in the operating record.

6. Records shall be maintained by the landfill operator of the following:

    a. Daily volume of leachate generated
    b. Daily volume of leachate recirculated into the waste mass
    c. Analytical records of leachate quality
    d. Records of days when stormwater is pumped from the secondary containment systems
    e. Weekly inspections of the leachate tanks
    f. Daily inspections of the leachate pump stations or sideslope riser pumps
    g. Weekly volume of leachate in the tank
    h. Records of any equipment breakdowns

i. Maintenance records

Special attention should be given to managing rainfall events to reduce, as much as possible, the surge volumes caused by these events. A major part of this leachate management is discussed in item C - Cell Filling/Stormwater Management. In that discussion, it is recognized that it is possible that a 5 inch rainfall event (over a 2 acre subcell) could create a surge of up to approximately 272,000 gallons of stormwater (initial lift only) that would require treatment as leachate. This event could be handled by all components of the leachate management system including the storage tanks if leachate is removed from the tanks during and immediately following the rainfall event.

Operations require the normal level of the combined tanks to be below 50% full. And in addition, the operations require expedited removal of leachate any time the tanks approach a 60% full condition. The 50% full tanks would have a remaining volume of about 206,000 gallons. This, along with short term storage available in the cells, would be adequate to hold the surge volumes discussed in this section.

Should this storm surge occur when the filling was being done in the initial lift of a cell, it would produce a very low strength or very dilute leachate. As a contingency, Republic Services of North Carolina, LLC will continue discussions with alternative wastewater treatment facilities to accept this potential surge volume of dilute leachate. Also, this leachate can be recirculated through the waste mass. Leachate recirculation will be accomplished by returning the leachate to the landfill where it will be distributed through a leachate recirculation trench or irrigated onto grassed areas of the lined cells.

Also, Republic Services of North Carolina, LLC may negotiate contracts with commercial handlers of industrial wastewater for the treatment of any surge volumes.

Areas of special attention by the landfill operator include:

1. Maintain the cell internal stormwater rain flaps to assure segregation of stormwater from the leachate. The operator should use reasonable measures to minimize leachate generation throughout the landfill operating life.

2. Maintain cross slope and surface drainage on the landfill top to promote run-off of stormwater. Any stormwater that can be drained from the surface above the waste will not contribute to the leachate generation.

3. Pump off stormwater in the cell that is segregated from contact with the waste fill area.

4. Inspect the leachate storage tanks and the secondary containment systems. Maintain removal of leachate from the tanks, and pump off stormwater from the secondary containment system.

   With aggressive leachate management activities by the operations personnel, stormwater surges caused by rainfall events as great as the 25 year rainfall event can be handled by the system. Contingency for events that potentially exceed this event include:

   a. Establish relationships with other leachate treatment facilities to handle potential surge volumes of leachate.

   b. Establish a relationship with a commercial wastewater handler for potential surge volumes of leachate.

Should this contingency plan ever be activated, records should be kept documenting all activities related to the event. These should be maintained in the operating record of the site.

E. Leachate Recirculation

The Section approved leachate recirculation at the East Carolina Landfill as a liquids management tool in a letter dated May 28, 2003. At that time, no further reports regarding leachate recirculation were required to be submitted to the Section, although the right to ask for future reports was reserved.

1. The following conditions will be met and followed by East Carolina Environmental prior to and during the leachate recirculation:

   a. Rain gauge and thermometer

      A rain gauge and thermometer will be installed near the landfill office. These instruments will be read daily at the start of business. The amount of rainfall and temperature will be recorded on the leachate recirculation log.

   b. Base line sampling of leachate

      The base line sampling of the leachate has been performed. This sampling and testing will continue on a semi-annual basis. The reports will be kept on file at the landfill office in the Facility Operating Record.

c. Operational procedures

Recirculation will be accomplished by pumping leachate from the leachate storage tank through dual contained piping from outside the leachate tank secondary containment to the landfill cell. Once inside the landfill cell, the pipe will not be dual contained. The leachate will be injected into a leachate recirculation trench (4' to 6' below top of waste surface) consisting of pipe, stone, and fabric. Alternatively, leachate may be used for irrigation of vegetated areas over the composite liner system.

Leachate will only be recirculated over composite liner systems having a 2' thick clay liner with permeability $\leq 1x10^{-7}$ cm/sec, a minimum of 60 mil FML liner, and a 2' protective cover with permeability $\geq 1x10^{-2}$ cm/sec. Leachate recirculation will not be allowed over alternate liner systems unless specifically approved by the Section.

i. The procedures to be used for injection into the recirculation system are as follows:

(a) Check the operation of the pump and valves at the leachate tank and the leachate recirculation trench.

(b) Calculate the volume of leachate that the waste mass can accept.

(c) Record the volume and method of leachate being recirculated into the landfill on the leachate recirculation log.

(d) Distribute the leachate through the force main into the leachate recirculation entry point. This entry point will be either an above grade sprinkler system or an above grade vertical 8" diameter solid pipe where leachate can be discharged for entry into the subsurface leachate recirculation system. Care should be used to assure the pump's discharge rate does not exceed the entry point's capability to accept the leachate. Overflow of the entry point is not allowed.

(e) At conclusion of recirculation activity, inspect cell for excess leachate concentrations or blow-outs. The recirculation system will be inspected daily to check for leachate overflows. These inspections will be recorded and maintained in the Facility Operating Record and the leachate recirculation log. Do not allow discharge of leachate outside the cell under any circumstances.

ii. Complete the Leachate Recirculation Log Form and make notes of problems or corrections needed. A copy of this form can be found in the Appendix of this Operation Plan. (Copies of these logs will also be maintained on-site for review by the Section.)

iii. The recirculation system and the area in which leachate is being recirculated will be inspected daily during recirculation operations to check for excess leachate concentrations, leachate run-off, or blow-outs. Results of these inspections

will be recorded and maintained in the Facility Operating Record and the leachate recirculation log.

iv. Should run-off or side seepage be noticed, leachate recirculation will be ceased. Discharge of leachate outside the cell will not be allowed in any circumstances. Any seepage will be covered and compacted with 12" of soil and these remedial activities will be recorded and placed in the Facility Operating Record.

Recirculation will be accomplished by one of three methods: recirculation via subsurface infiltration trenches, irrigation of grassed areas, or direct application to the working face using spray on methods.

Leachate will also be recirculated using an agricultural irrigation system which sprays leachate on areas of the landfill which have received intermediate cover and are grassed. Recirculation rates shall vary based on season and recent precipitation rates. Leachate will only be recirculated over cells with the composite liner systems having a 2' thick compacted clay liner with a maximum permeability of $1x10^{-7}$ cm/sec, a minimum of 60 mil FML, and a 2' thick protective cover with a permeability $\geq 1x10^{-2}$. Leachate recirculation will not be allowed over alternate liner systems unless specifically approved by the Section.

d. Equipment Required

The following equipment will be used for leachate recirculation (at a minimum):

i. Centrifugal pump (mounted inside secondary containment of the leachate tank) with force main to landfill cell.

ii. Drawings showing the recirculation lines, injection point and orientation to cell sideslopes.

iii. Agricultural irrigation sprinkler system

e. Recordkeeping Forms

Logs will be maintained for leachate production and leachate recirculation. These logs will be kept in the Facility Operating Record for review by the Section.

i. Daily/weekly record of leachate generated.

Daily, the volume of leachate in the leachate storage tanks will be recorded on the leachate log. The leachate log will be made part of the Facility Operating Record.

ii. Daily/weekly record of leachate recirculated.

Daily, the volume of leachate recirculated will be recorded on the leachate log. The leachate log will be made part of the Facility Operating Record.

iii. Weather conditions and other pertinent daily information.

Daily, the weather conditions along with any other data pertinent to leachate recirculation will be recorded on the leachate log.

f. Log for reporting operating or other unusual problems

A log will be kept for reporting operating or any other unusual problems for leachate recirculation. All actions taken to remediate any problems due to leachate recirculation will be documented and recorded in the Facility Operating Record. A trained landfill operator will be responsible for overseeing the leachate recirculation operation.

g. Other forms or procedures, etc. that owner/operators will use

Any additional forms or procedures (as required) not found in this plan will be maintained in the Facility Operating Record.

h. Analysis of the field capacity of the waste where leachate is to be applied

Based on previously submitted information, the capacity of the leachate collection system will allow a maximum of 2,188 gallons per acre per day for cell areas with a waste depth greater than or equal to 50'. The average daily recirculation rate should not exceed this rate. These values are based on values obtained from previous HELP Model evaluations on the existing liner system. It is estimated that the existing leachate recirculation system will impact approximately

2.3 acres of liner. Therefore, a conservative maximum daily recirculation rate for the leachate recirculation system is set at 5,000 gallons per day.

Expansion of the leachate recirculation system will allow for an increase in the maximum recirculation rate. The leachate recirculation plan section of the Operation Plan will be amended if expansion becomes necessary.

2. East Carolina Regional Landfill will follow these additional operational conditions during leachate recirculation:

a. Records will be kept on a daily/weekly basis and will be maintained in the Facility Operating Record.

b. No leachate will be recirculated when it is raining, or when the waste is too wet. A rain gauge will be installed on-site and monitored daily.

c. No run-off or side seepage will be allowed. Should run-off or side seepage be noticed, leachate recirculation will be ceased. Any areas of seepage will be covered and compacted with 12" of soil and these remedial activities will be recorded and placed in the Facility Operating Record.

d. Odors will be controlled. Should odors be present at levels determined undesirable by the facility Operator, leachate recirculation will cease.

e. Leachate will be recirculated or irrigated during daylight hours only.

f. The application system will be properly maintained and documented. All records dealing with the application system will be maintained in the Facility Operating Record.

g. Plans of the subsurface leachate recirculation system will be kept in the Facility Operating Record. The operation of this system has previously been discussed. Maintenance of the system will include:

i. Assure force main and valves do not leak. In the event any leaks are observed, the force main or valves will be repaired as necessary.

ii. Any spills at the recirculation entry point(s) will immediately be cleaned up to prevent seepage of leachate outside the limits of waste. Clean up activities may include use of absorbent materials or soil cover. Any clean up activities will be recorded and placed in the Facility Operating Record.

iii. Replace the subsurface recirculation lines if they become clogged or damaged.

iv. Record any irregular maintenance requirements in the Facility Operating Record.

F. Random Inspection Program

The landfill is permitted as a municipal solid waste landfill and as such must not receive regulated hazardous or nuclear wastes. It is important that such wastes not enter the landfill because of the potential damage and liability these wastes could cause should they enter the environment.

Random inspection of vehicles will be conducted on a regular basis. The selection must be at a frequency of at least one vehicle per week. The frequency of random inspections may be increased at the General Manager's discretion. The personnel conducting the inspection will randomly select the load at the working face of the landfill and the inspection will be completed in a designated area near the working face. A random truck and time will be selected (e.g., the second load after 8:00 a.m.) on the day of inspections. In addition, any suspicious load shall be inspected.

Results of random inspections shall be recorded; report forms are included in the Appendix. One form shall be completed for each inspection. All reports and resulting correspondence are to be maintained in the East Carolina Regional Landfill facility operating record for the life of the landfill and during the post-closure period. The presence of any regulated hazardous, liquid or regulated PCB wastes or otherwise prohibited wastes identified during random inspections shall be reported to the Section. Inspections shall include truck identification, driver's name, source of material(s) if possible, or route and what, if any, prohibited material(s) were included. If none were observed, or only normal quantities of household hazardous waste, this too should be logged.

Inspections will be carried out and supervised by landfill staff trained to identify and manage hazardous and liquid waste. Landfill operators responsible for screening waste are trained in waste screening.

The following action plan required by Rule .1626(1)(f)(iv) addresses identification, removal, storage, and final disposition of wastes, and details the procedure for conducting random waste inspections.

- Stop the selected vehicle prior to the working face of the landfill.

- Notify the driver of the inspection.

- Direct the vehicle to the inspection area. The inspection area may be either a permanently designated location or a temporary location adjacent to the working face.

- If possible, perform a visual observation of the waste prior to unloading. If unauthorized waste is observed, or suspected, the vehicle shall be prohibited from unloading, and shall be directed out of the facility.

- If no unauthorized waste is observed or suspected from the visual observation, or if a visual observation is not possible, the vehicle shall discharge the load at the inspection area. The driver shall remain at the inspection area while the inspection is performed, unless a safety concern requires evacuation of the area. Equipment shall spread and turn the waste to facilitate a visual observation of the load contents. If no unauthorized waste is identified, the waste shall be transferred to the working face for disposal.

- If unauthorized waste is identified in the load, and the unauthorized waste is not a regulated hazardous waste, a regulated medical waste, a regulated nuclear waste, or a waste which requires special handling, the waste shall be loaded back into the vehicle and removed from the facility.

- If acceptability of the waste can not be determined by visual observation, the waste can either be rejected and loaded back into the vehicle and removed from the facility, or samples of the waste can be taken to determine acceptability. Testing shall be selected based on the reason for the suspicion of unacceptability.

- Unauthorized wastes suspected of being a regulated hazardous waste, a regulated medical waste, or a regulated nuclear waste shall be managed in accordance with all applicable federal, state and local regulations. Republic Services of North Carolina will contact the proper authorities if any of the above prohibited wastes are received at the facility. This includes the Section, County Emergency Personnel and the local HAZMAT by calling 911. In addition, responsible parties will be notified of all rejected loads, if possible.

G. Waste Solidification

Refer to the Permit to Operate and the Waste Solidification Plan, which are both attached in the Appendix.

H. Storm Drainage

The landfill is divided into several areas with peripheral earthen diversion berms and stormwater conveyance channels. The diversion berms/channels allow for stormwater run-off to exit at the low side of each area. Exterior diversion channels via surface drainage will carry the surface stormwater flow to a sediment basin (stormwater management basin). The sediment basins are used for final trapping and settlement of sediment. The basins are generally designed in accordance with the NCDENR Stormwater Best Management Practices Manual. As an area's operations progress, the back surfaces should be sloped away from the active (working) face of the landfill to minimize the amount of stormwater flowing into the active cell and thus minimize the potential for leachate generation.

Care should always be used to assure that stormwater and leachate do not mix. In cases where they mix, the entire volume of mixed water must be treated as leachate. The operator may use temporary devices such as berms, stormwater conveyance

channels, etc. to divert surface water away from the working face to avoid leachate generation.

I. Monitoring

Groundwater was tested before any waste filling began at the landfill site to establish "background" quality of the groundwaters. Upgradient and down gradient monitoring wells were provided for initial groundwater quality testing and for routine groundwater quality monitoring during the life of active landfill operations and for monitoring groundwater quality during Post-Closure.

Monitoring wells, located downgradient from landfilling operations, will be used to monitor the quality of the groundwater. Depth, location and screening interval(s) of the groundwater monitoring wells will be determined during construction of the facility. Monitoring wells are located upgradient and downgradient of the landfill for detection of leachate contamination and movement. Routine monitoring results and records are to be placed in the operating record and submitted to the Section. Monitoring data, quality assurance / quality control data, statistical analyses, chain of custody records, and any other required information should be submitted to the Section within 60 days of the respective sampling event in accordance with the general conditions in the permit to operate.

1. Groundwater Monitoring

A Water Quality Monitoring Plan, including information on the proposed groundwater monitoring system(s), sampling and analysis requirements, and detection monitoring requirements that fulfills the requirements of Rules .1633 through .1637 is included as Appendix E of the *Design Hydrogeologic Report, East Carolina Regional Landfill, Phase 5.* Groundwater monitoring

shall continue throughout the Post-Closure period in accordance with the approved Plan.

2. Surface Water Monitoring

A Surface Water Monitoring Plan has been designed to detect the effects of the facility on surface water in the area. This plan is included as part of the Water Quality Monitoring Plan as referenced above. Surface Water monitoring shall continue throughout the Post-Closure period in accordance with the approved Plan.

3. Leachate Monitoring

Leachate Monitoring is part of the facility Operation Plan. Leachate management will continue at the facility during the Post-Closure period as long as leachate continues to be generated or until the owner or operator demonstrates that the leachate no longer poses a threat to human health and the environment.

4. Landfill Gas Monitoring

Landfill Gas Monitoring is included as part of the facility Operation Plan. Landfill Gas Monitoring shall continue throughout the Post-Closure period in accordance with the approved Plan.

J. Final Grades

It is important that the final grades indicated on the Engineering Plans for the landfill are achieved as early as practicable throughout the filling operations so that stormwater run-off can be controlled. Stable compost and soils in conjunction with

an FML will comprise the final cover cap. If the final grades on the cap are too steep, then erosion problems may occur. If the final grades on the cap are too flat, then ponding may occur and the amount of stormwater penetrating the landfill could increase; thereby, increasing the potential for generating leachate. The operator should also realize that subsidence (or settlement) of the landfill surface will likely occur, which may affect drainage patterns. Thus Post-Closure maintenance of the landfill must include surveillance of drainage capability on the crown and slopes. As intermediate grades are achieved, the operator will construct side slope drainage berms with sideslope drain pipes at intervals of approximately 20 feet vertical. The drainage berms will be routed to side slope drain pipes. Maintaining adequate vegetative cover is critical.

K. Seeding

The specifications for seeding of disturbed areas must be followed to minimize erosion. Solid waste will have a completed elevation below final cover surface elevations on the top of the facility. This will allow the operator to install a soil infiltration layer (where required), an FML top liner, a drainage layer, an 18" thick root zone/protective media, and a 6" thick vegetative growth media. The 6" thick growth media shall be placed to final grade and the area seeded. Seeding specifications are included in the Technical Specifications.

L. Maintenance

Maintenance of the erosion control measures will be required throughout the life of the landfill and during the Post-Closure care period. After rain events and when slope conditions allow, it will be necessary for the landfill operator to check silt fences and sediment basins for silt buildup, or any type of damage or loss of functionality that may have occurred. The operator shall inspect the cover after rainfall and on a monthly basis during operations. Repairs must be made in a timely

manner. Restoration of eroded areas on the surface is important to minimize the amount of water entering the landfill. Slopes providing drainage from the cap or crown surface must be maintained as well as vegetation to prevent cracks or fissures in the surface cap or crown due to erosion.

M. Fire Hazard

By keeping the landfill clean and the waste covered daily, the potential for fire can be lessened. If a fire occurs within the waste, it may be controlled by digging out the burning material, spreading and then recovering it with soil. Fire extinguishers should also be readily available. Arrangements should be made with local fire departments to establish procedures for extinguishing landfill fires. The Windsor Fire Department would serve the landfill site should there be a fire.

Incoming waste loads shall be observed by site operators for evidence of fire, such as flames, smoke, or the odor of burning material. Burning loads will be extinguished before dumping if possible. If there is evidence of fire in the landfill itself, the general manager will be notified immediately. If possible, the waste will be removed or segregated from other waste in the disposal area. The landfill general manager will evaluate the situation to determine whether the fire can be extinguished using fire extinguishers or equipment present at the site, or if off-site equipment will be needed. If necessary, the local fire department (The Windsor Fire Department) will be called to render assistance in extinguishing the fire.

If there is a fire at the landfill, the operator must notify the Section and report if the fire has been controlled and what (if any) environmental damage may have occurred. The Section Rule .1626(5)(d) requires that any fires that may occur at the landfill be reported verbally to the Section within 24 hours and in writing within 15 days. A copy of the NCDENR Fire Occurrence Notification Form can be found in the Appendix.

Fire extinguishers shall be located on each piece of equipment on site as required by Rule 1626(5)(c). Equipment operators shall be trained in the use of these extinguishers. Fire extinguishers will be used for small, localized fires. A stockpile of soil shall be maintained near the working face to be used for extinguishing small surface fires that may be too large to control with the fire extinguishers carried on the landfill equipment.

Emergency equipment will be called in the case of fires too large to be extinguished with fire extinguishers or soil as described above. Water contained in the sedimentation basins or inactive borrow areas can be used in an emergency to aid local firefighters in extinguishing large fires.

N. Open Burning

Open burning of solid waste including yard waste and brush is prohibited at the landfill. Infrequent burning of land clearing debris generated on-site including brush and/or stumps or debris from emergency clean-up operations would only be requested on an infrequent basis in conjunction with clearing or construction events. Any such burning shall be approved by the Section prior to commencing burning activities.

O. Fire Prevention

The landfill operator will be responsible for prohibiting acceptance of burning materials in the landfill. Cigarettes, lighters or any type of burning shall be prohibited in the active areas.

P. Odor Control

Odors are best controlled by daily cover, as well as by adequate compaction. Diligent and effective daily covering of the compacted wastes should prevent odors.

Q. Vector Control

Solid waste shall be covered daily with a minimum of six inches of soil or an approved alternative cover material to ensure that all food sources and potential habitats are buried.

R. Insect Control

Keeping the landfill clean and the solid waste covered daily, along with surveillance for and the elimination of any standing water in the waste filling areas, should prevent insect problems.

S. Litter Control

Use of movable screens or fences to capture windborne litter, followed by routine manual cleaning of the litter fence is strongly recommended. Fences should be cleaned on a regular basis. Frequent soil coverings during particularly windy days, and immediately covering and/or compacting and mixing light debris, should be performed to lessen the chances of blowing litter. During periods of high winds >25 mph, the landfill operator will collect blown trash, which primarily consists of plastic bags, in a reasonable time period following the event in a safe, orderly manner. Putresubles will be collected immediately.

T. Dust Control

Dust should be controlled by wetting down or applying calcium chloride, or polymer based solutions or adding stone to problem areas to mitigate dust problems. Calcuim chloride absorbs moisture from the air. Oil cannot be used for dust control.

U. Landfill Gas Management

The facility has a landfill gas collection and control system currently in place. This system is operated in accordance with the New Source Performance Standards (NSPS) and will be expanded in accordance with applicable regulations. Any expansion or addition to the existing landfill gas collection system will be submitted to the Solid Waste Section prior to implementation. In the future, the facility may choose to operate a gas to energy facility instead of burning the collected gas.

V. Access Roads

The access roads are to provide smooth hauling conditions from entrance of the site through the weigh station to the landfill cell. It will be the responsibility of the landfill operator to maintain the paved, temporary dirt, and graveled access roads within the site. Keeping haul routes open for safe and efficient traffic movement is a key factor in achieving smooth landfilling operations. As landfilling operations achieve higher elevations, the operator will need to adjust road locations in such a manner that temporary access roads are run up the slopes gradually in ramp fashion.

Access in the operations area may pose problems during wet weather. Therefore, it is suggested that temporary roads be constructed using stone and sloped to shed water away from the temporary access roads in the landfill. Shredded tires or other inert

material may also be used for temporary road construction. Reuse of stone and replenishment of stone should be practiced when constructing new access roads.

W. Equipment

The equipment listed under Site Operation & Maintenance should be adequate for efficient operation of the landfill. Regular maintenance of the equipment will reduce repair problems, downtime and unnecessary costs.

X. Buildings and Structures

A Scale House is provided to house the scales and ticket operations. The Operations Office and Maintenance Building are also located on-site.

Y. Security

Fencing and natural barriers are provided to discourage vandalism, scavenging or trespassing from occurring when the landfill is not open. Screening by trees located along the property line should discourage 4-wheelers and other unauthorized vehicles from entering the site. Site boundaries should be checked regularly for evidence of unauthorized personnel and vehicle entry. The front gate should be locked when the landfill is closed to operations. Scavenging must be prohibited and enforced by the operator. Lines of communication should be established with the Sheriff's Department to perform routine surveillance of the facility.

Z. Signs

Posting of "No Trespassing" signs around the periphery of the landfill will help to discourage scavengers and unauthorized entry. A sign containing information required in Rule .1626(6)(e) (i.e., dumping procedures, hours, permit number, etc.) is

posted at the landfill entrance. Traffic signs and markers are posted to promote orderly traffic patterns to and from the disposal area and to maintain efficient operating conditions. Signs are posted stating that no hazardous or liquid waste can be accepted.

AA. Phasing and Sequence of Fill

The East Carolina Regional Landfill will be developed in a series of phases, each designed to handle waste disposal for periods of five years. The fifth phase (Phase 5) consists of two cells (13 & 14).

VI. COMPLIANCE WITH THE SEDIMENTATION POLLUTION CONTROL ACT OF 1973

Erosion and sediment will be controlled on the site to prevent the discharge of pollutants into waters of the United States, including wetlands, that violates any requirements of the Clean Water Act. This includes, but is not limited to, the National Pollutant Discharge Elimination System (NPDES) requirements, Section 402. In addition, the site shall not cause the discharge of nonpoint sources of pollution to waters of the United States, including wetlands, that violates any requirement of an area-wide or State-wide water quality management plan that has been approved under Section 208 or 319 of the Clean Water Act, as amended. Surface water shall be diverted from the operational area and shall not be impounded over or in waste.

All vegetative and structural erosion and sediment control practices have been designed and shall be constructed and maintained according to the North Carolina Erosion and Sediment Control Planning and Design Manual. A copy of the *East Carolina Regional Landfill, Phase 5, Erosion and Sediment Control Plan* has been prepared incorporating adequate measures to control surface water run-off and run-on generated from the 24-hour, 25-year storm event and sent to the Land Quality Section for Approval.

VII. COMPLIANCE WITH DESIGN REQUIREMENTS

A. Compliance with Explosive Gas Requirements

The proposed landfill operations will involve various amounts of municipal solid wastes on a daily basis. Considering the large lateral slope (surface area) which will allow the produced gas to easily escape and disperse, conditions should not develop that would produce explosive concentrations. Routine monitoring for gas concentration should be performed. Methane gas monitoring probes are shown on the plans.

These monitoring probes shall be installed according to the detail shown on the Engineering Plans. The points shall be monitored on a quarterly basis during the operating life. Results shall be recorded and placed in the permanent operating record of the site. Any time the monitoring indicates the Lower Explosive Limit (LEL) is being approached, a plan shall be developed to assure that the LEL is not exceeded at the landfill boundary. Any on-site structures (eg. Scale House, etc) shall also be evaluated for methane concentrations on a quarterly basis. Should the levels of methane approach 25% of the LEL, immediate action shall be taken to see that 25% of the LEL is not exceeded. Temporary points may be bar punch holes.

B. Compliance With Surface Water Requirements

Sediment basins have been designed to prevent migration of sediment off-site. Preventing migration of contaminants from a landfill is a continuous concern. Design features and proper operational procedures should prevent surface waters from becoming contaminated. Four surface water monitoring points have been established to monitor water quality upstream and downstream to determine the effects from the landfill.

All inspections of surface water and sediment control structures shall be documented, and copies of these reports shall be placed in the operating record.

C. Compliance With Groundwater Requirements

Groundwater protection has been considered in the siting and design of the landfill. Groundwater monitoring wells will ascertain compliance with the groundwater quality standards. Groundwater monitoring well locations are indicated on the Environmental Monitoring Plan. Groundwater is monitored on a semi-annual basis during operations and will continue into post-closure.

D. Compliance With Permit Requirements

A copy of the landfill Engineering Plans and Permit To Operate from the North Carolina Division of Waste Management - Solid Waste Section shall be kept in the landfill office. The operator is responsible for being familiar with the permit requirements and ensuring compliance therewith.

VIII. SOIL MATERIAL TYPES AVAILABLE FOR BORROW

A combination of on-site borrow soils and imported soils may be required for the facility. Imported soils are being identified for use in projects at the appropriate times. It should be noted that the estimates of material types are based on both soil borings and backhoe pit excavations. Actual material types will be determined as the material is excavated.

IX. CLOSURE AND POST-CLOSURE PLANS

A. Purpose

The purpose of closure and post-closure plans is to meet the requirements of Rule .1617 and to provide the operator guidance on how the plans will be carried out. Site closure can occur at any time during the life of the facility and the closure plan should recognize that by evaluating a worst case scenario. A worst case scenario assumes that the facility is closed on the date when the effort to close would be the greatest. See Item B below. The post-closure activities are detailed in Item C below.

B. Closure Plan

Individual cells of the East Carolina Regional Landfill may be closed after the final deposition of waste within that landfill cell occurs.. Complete closure will occur once all landfill units reach final grade. Prior to closure of that unit, the operator will either cover portions of the cells with one foot of compacted earth cover (intermediate cover) or will install the final cap (final cover) on that section. This cap detail is labeled the final cover system.

1. Upon closure of any unit, or portion of a unit, the operator shall:

    a. Notify the Section in writing in order that a site inspection may be made to determine compliance with closure procedures.

2. An inspection shall be made by a representative of the Section and a written statement will be supplied to the operator concerning the closure of the site.

3. When a solid waste disposal site has been closed in accordance with the requirements of the Section, future necessary maintenance and water quality

monitoring shall be the responsibility of the owner and/or the operator and will be specified in the closure letter.

4. Final Cover -- The capping system for final cover will include the following components:
   a. 18 inch thick cohesive soil layer with a permeability no greater than $1x10^{-5}$ cm/sec (this is not required on side slopes);
   b. 40 mil LLDPE or equivalent flexible membrane liner;
   c. Drainage layer above the 40 mil liner (i.e. geocomposite drainage media);
   d. Geotextile non-woven drainage fabric above the drainage layer;
   e. A minimum of 18 inch thick soil layer that will provide an erosion layer.
   f. A 6" thick topsoil layer.

The 18 inch thick cohesive soil layer (with a permeability no greater than 1 x 10^{-5} cm/sec) will be placed on slopes less than 10% using a maximum of 8-inch thick loose lifts and compacted to at least 90% of Standard Proctor maximum dry density at a moisture content no more than 2% below or 5% above optimum moisture content for that soil.

The total airspace of Phases 1 through 4 (Cells 3-12) has been estimated as 12,500,000 cubic yards. An estimate of the total airspace in Phase 5 is 3,854,000 cubic yards. After allowing for daily/intermediate cover, cap and soil protective cover, a total of 3,425,000 cubic yards (2,400,000 tons) of waste will have been disposed of in the Phase 5 portion of the facility. Supporting calculations are included in the Narrative Appendix. The calculation is based on the volume between proposed top of protective cover grades and the base of the landfill cap, and assumptions regarding the density of waste and amount of cover soil in the fill.

The permitted East Carolina Regional Landfill encompasses approximately 662 acres, 150 acres of which are approved for lined capacity by the Solid Waste Section. The approved lined capacity acreage has been subdivided into seven (7) five-year Phases containing 24,200,000 cubic yards of waste. The facility is currently operating in Phase 4, which includes cells 11 and 12. Construction of cell 11 was completed in early 2006 and a Permit To Operate was issued by the Solid Waste Section on June 15, 2006.

The facility will be closed in accordance with the requirements of Rule .1627 of the North Carolina Solid Waste Management Rules (15A NCAC 13 B). The landfill cap shall be placed over a completed cell area within 180 days of receipt of final waste in that cell, weather permitting. Construction of the cap shall conform to the final grades shown on the plans. An approximate 4.5 acre area of the facility has already been capped. The remainder of the facility may be capped in one construction event or in phases.

Prior to beginning closure of a completed cell or an entire unit, the operator shall notify the Section of the intent to close the area.

Following closure of each unit (i.e.: An area that is discreet from other waste units), or portions of units, the operator shall notify the Section that a certification, signed by a professional engineer verifying that closure has been completed in accordance with the closure plan, and applicable solid waste regulations and laws as required by Rule .1627(c)(7) has been placed in the operating record.

Following closure of all the MSWLF units, the operator shall record a notation on the deed to the landfill facility property, or some other instrument that is normally examined during a title search, and notify the Section that the notation has been recorded and a copy has been placed in the operating record.

The notation on the deed shall in perpetuity notify any potential purchaser of the property that:

1. The land has been used as a landfill facility; and

2. Its use is restricted under the closure plan approved by the Section.

Once closure is complete, a survey plat will be prepared by a registered land surveyor showing the locations and dimensions of the landfill disposal areas, the locations of groundwater monitoring wells and methane gas monitoring probes, and the restrictions on future disturbance of the site.

The costs for closure of the facility are indicated in the estimate following. These costs represent the estimated cost of closure for the Phase 1, 2, 3, 4, and 5 areas.

EAST CAROLINA REGIONAL LANDFILL
BERTIE COUNTY
CLOSURE CARE COST ESTIMATE

GENERAL

Largest Area: Cells No. 3 - 14 = (121 acres)

CLOSURE CARE COST ESTIMATE

1	6" Topsoil													
	5,270,760	s.f.	x	0.5	ft.	÷	27	ft³/cy	=	97,607	c.y.	@	$2.60	=	$253,777.33
	(soil cost $0.50/ c.y. - Haul Cost $1.80 / c.y. - Placement Cost $0.30 / c.y.)														
2	18" Cover Soil													
	5,270,760	s.f.	x	1.5	ft.	÷	27	ft³/cy	=	292,820	c.y.	@	$2.00	=	$585,640.00
	(soil cost $0.25 / c.y. - Haul Cost $1.00 / c.y. - Placement Cost $0.30 / c.y.)														
3	18" Infiltration Layer (1 x 10^{-5} cm/sec)													
	1,366,605	s.f.	x	1.5	ft.	÷	27	ft³/cy	=	75,923	c.y.	@	$8.50	=	$645,345.50
4	Drainage Layer (Geofabric Geonet)													
	Material									5,270,760	s.f.	@	$0.33	=	$1,739,350.80
	Labor									5,270,760	s.f.	@	$0.10	=	$527,076.00
5	FML	Material & Installation								5,270,760	s.f.	@	$0.34	=	$1,792,058.40
6	Seed	121	ac	x	70	#/ac	=			8,470	#	@	$3.50	=	$29,645.00
7	Fertilizer	0.75	tons/ac	x	121	ac	=			91	tons	@	$200.00	=	$18,200.00
8	Lime	1	ton/ac	x	121	ac	=			121	tons	@	$40.00	=	$4,840.00
9	Mulch									121	ac	@	$100.00	=	$12,100.00
10	Labor for Seeding, Fertilizing, Liming & Mulching									121	ac	@	$200.00	=	$24,200.00
11	Silt Fence									1,800	l.f.	@	$3.00	=	$5,400.00
12	Final Disposal of Waste & Cleanup									225	tons	@	$30.00	=	$6,750.00
13	Downdrain Construction									6,256	l.f.	@	$12.00	=	$75,072.00
14	Ditch Lining (Gunite)									6,975	s.y.	@	$0.25	=	$1,743.75
15	Sediment Basin Cleanout									3,375	c.y.	@	$2.50	=	$8,437.50
16	Methane Collection System (1 boot per acre)														
		1	boot/ac	x	121	ac	=			121	boots	@	$600.00	=	$72,600.00
17	Leachate Tank, Containment System & Pumping Station Alarm System									2	Ea.	@	$4,000.00	=	$8,000.00
18	Waste Limit Survey									1	L.S.	@	$2,500.00	=	$2,500.00
19	Engineering and Closure Certification									121	ac	@	$3,000.00	=	$363,000.00
													TOTAL CLOSURE COST		**$6,175,736.28**

C. Post-Closure Activities

The landfill operator will be responsible for 30 years of post-closure care of the East Carolina Regional Landfill, after final closure of the landfill facility. These post-closure activities insure the environmental integrity of the facility. The planned use for this landfill facility after closure will be as a "greenspace" consisting of vegetated areas and buffers. The facility post-closure will be carried out in a manner that promotes non-destructive use by wildlife. (eg: landfill surface will be grassed, etc.)

The operator shall perform the following activities during the post-closure period:

1. Maintain the integrity and effectiveness of the cap system, including making repairs to the cover as necessary to correct the effects of settlement, subsidence, erosion, or other events, and preventing run-on and run-off from eroding or otherwise damaging the cap system;

2. Maintain and operate the leachate collection system in accordance with the requirements in Rules .1624 and .1626. (The Section may allow the owner or operator to stop managing leachate if the owner or operator demonstrates that leachate no longer poses a threat to human health and the environment);

3. Monitor the groundwater and surface water in accordance with the requirements of Rules .1631 through .1637, and maintaining the groundwater monitoring system, if applicable; and monitoring the surface water in accordance with the requirements of Rule .0602; and

4. Maintain and operate the gas monitoring system in accordance with the requirements of Rule .1626 of this Section.

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

The post-closure monitoring required above shall be performed at the following frequency:

Monitoring Activity	Monitoring Interval
Cap System Inspection, Stormwater Control & Corrective Action	Monthly until vegetation is established, then quarterly.
Leachate Quality Monitoring	Semi-Annually
Groundwater & Surface Water Monitoring	Semi-Annually
Gas Monitoring	Quarterly

The person responsible for the facility during the post-closure care period is:

General Manager
East Carolina Regional Landfill
1922 Republican Road
Aulander, NC 27805

The planned end use of this site will not damage the various landfill closure systems. In particular, no activity is planned, nor will any activity be allowed, which disturbs the integrity of the cap system, base liner system, or any other components of the containment system, or the function of the monitoring systems unless necessary to comply with the requirements of Section .1629 of the rules. Any disturbance must be approved by the Section. Only those disturbances which will not increase the potential threat to human health or the environment, as fully demonstrated by the Operator, will be approved.

The cost of the post-closure activities is included in the cost-estimate shown below:

EAST CAROLINA REGIONAL LANDFILL
BERTIE COUNTY
POST CLOSURE CARE COST ESTIMATE

1	Water Monitoring & Statisitcs (Includes Appendix I sampling, analysis & reporting for 2 events per year.)									
	Groundwater	20	wells	@	2	event/yr	@	$1,764.00	=	$70,560.00
	Surface Water	4	wells	@	2	event/yr	@	$900.00	=	$7,200.00
2	Methane Gas Monitoring	13	wells	@	4	events/yr	@	$80.00	=	$4,160.00
3	Sediment & Erosion Control, Including Inspections, Repairs to Cap, Slope & Vegetation				1	L.S.	@	$1,500.00	=	$1,500.00
4	Sediment Basin Cleanout				800	C.Y.	@	$2.50	=	$2,000.00
5	Leachate Collection Treatment & Analysis (Average over 30 years)				1	L.S.	@	$15,000.00	=	$15,000.00
6	Alarm System Monitoring				1	L.S.	@	$500.00	=	$500.00
7	Engineering Inspections				4	yr	@	$1,000.00	=	$4,000.00
8	Air Emissions Testing				1	yr	@	$2,000.00	=	$2,000.00
9	Maintenance and Testing of the Methane Gas System				1	yr	@	$110,000.00	=	$110,000.00
						ANNUAL POST CLOSURE CARE COST				**$216,920.00**
10	Leachate System Decommissioning (one-time cost)				2	Ea.	@	$18,000.00	=	$36,000.00
						30 Year Post Closure Care Cost				**$6,543,600.00**

X. OTHER ISSUES

A. Borrow Areas

Republic Services of North Carolina, LLC owns or leases nearby tracts which are available for soil borrow.

B. Engineering Plan

1. Analytical Methods Used to Evaluate the Design:

   a. Storm Drainage - see **Section VI – E&S Design Calculations**, for narrative of all calculations and analytical methods used to size piping, structures, sediment basins, downdrains, side slope berms and stormwater conveyance channels.

   b. Leachate Production and Collection - see **Section VII – Leachate Design Calculations** for discussion of all calculations and analytical methods used to perform HELP models, size all leachate piping, leachate pumping stations and leachate storage tanks.

2. Definition of Critical Condition Evaluated and Assumptions mode - slope stability analysis and settlement analysis are included in reports by geotechnical engineers.

3. Technical References

   - North Carolina Erosion and Sediment Control Planning and Design Manual.
   - Driscopipe System Design Manual

- How To Meet Requirements for Hazardous Waste Landfill Design, Construction and Closure by U.S. EPA
- Soil Conservation Service Drainage Design Charts
- Bureau of Public Roads Drainage Design Charts
- Federal Highway Administration Drainage Design Charts
- Computer Program
  - Hydrographs Hydraflow 2004 – SCS Method
  - Flowmaster - open channel and pipe
  - Hydraulic Evaluation of Landfill Performance

4. Completion of Any Applicable Location Restriction Demonstrations

All applicable location restriction demonstrations were made in either the Site Application or the Design Hydrogeologic Report.

C. Storm Debris Storage

Areas of the site may be utilized for temporary storm debris storage as approved by the Section.

XI. CLOSURE OF LEACHATE STORAGE FACILITIES

Upon completion of the post-closure period, the leachate storage facilities shall be removed from the landfill site. This closure must be complete within 180 days of cessation of operations of the leachate collection system.

The leachate storage facility closure shall include removal of:

A. The steel leachate tanks with appurtances

B. The concrete tank foundations

C. The pump connections

D. The secondary containment structures

E. The floor to the secondary containment structures

F. Any soil that has been contacted by the leachate

Any components not destined for reuse shall be properly handled and disposed according to Federal and State requirements. Any above-ground or below-ground piping that remains shall be securely capped and tagged with the date of capping. The site shall be graded and grassed upon completion of all closure activities noted above.

XII. PETROLEUM CONTAMINATED SOIL ALTERNATE DAILY COVER

Petroleum Contaminated Soil (PCS) is a beneficial reuse of soil with relatively low levels of petroleum in the soil. The approved maximum petroleum contaminant level of soil will be 3,000 parts per million (ppm). Forms for use during acceptance of PCS soils are attached in the Appendix. These forms can be used to record the amount of PCS utilized as Alternative Daily Cover (ADC).

Conditions for ADC usage are listed below. These conditions are to be strictly followed.

1. Soils contaminated to a maximum level of 3,000 ppm of Total Petroleum Hydrocarbons (TPH) or less are approved for use as ADC. Only soil contaminated with the following may be considered for ADC.

   - Class I - Low boiling point fuels such as gasoline, aviation fuel, and gasohol.
   - Class II - Medium / high boiling point fuels such as jet fuels, kerosene, diesel fuel, varsol, mineral spirits, naptha, fuel oils no. 1 through no. 6, and motor oils (new and used).

   Soils contaminated with the following are not acceptable for use as ADC.

- Chlorinated solvents, organic acids, or hazardous waste.
- Tars and asphalt.

2. The ADC will be used in the same manner as soil daily cover. The ADC will be placed six-inches thick over the daily working face of the landfill.

3. The PCS utilization rate shall not exceed ten percent (10%) of the average monthly permitted disposal rate of the landfill.

4. The facility shall calculate the values corresponding to 10% of the average monthly volume of waste they are permitted to receive and the average amount of daily cover that is required under normal operating conditions (i.e., 6" of soil over the working face/daily). The amount of PCS that may be received by the facility is limited by the lesser of those two numbers.

5. PCS shall be stockpiled in the cell away from daily traffic and operations in such a way that run-off shall not leave the limits of the lined cell area. These soils shall be covered with a tarp or similar material for storage, or maintained at a moisture level sufficient to prevent blowing dust. Berms shall be constructed around the stockpile to direct run-off to the leachate collection system if the run-off is not already directed there. ADC shall be stored over the lined areas of the site so run-off from the stockpile will be contained within the leachate collection area for the cells.

6. PCS may be stored for a maximum of 45 days.

7. Use of ADC shall be allowed only for volumes of material placed in a manner that does not exceed the regulatory requirement of six inches of daily cover. PCS is prohibited from disposal, so excess PCS should not be accepted at the facility.

8. The facility shall maintain records in the facility operating record indicating how much waste was received, how much PCS was received, and how much PCS was utilized for ADC, on a monthly basis.

9. PCS for use as Alternative Daily Cover must be generated in the facility's permitted service area.

10. Samples of leachate shall be collected on a semi-annual basis and analyzed for TPH (both diesel and gasoline fractions) and BTEX. This sampling shall be performed in addition to the leachate sampling requirements from NCDENR. One sample will be collected semi-annually from the leachate storage tanks.

XIII. APPENDIX

PERMIT TO OPERATE

NCDENR

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

Dexter R. Matthews, Director | Division of Waste Management | Michael F. Easley, Governor
William G. Ross Jr., Secretary

STATE OF NORTH CAROLINA
DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF WASTE MANAGEMENT
SOLID WASTE SECTION

MUNICIPAL SOLID WASTE LANDFILL FACILITY PERMIT
Permit No. 08-03

REPUBLIC SERVICES OF NORTH CAROLINA, LLC, a wholly owned subsidiary of
REPUBLIC SERVICES, INC. of Ft. Lauderdale, FL, d.b.a.
EAST CAROLINA ENVIRONMENTAL, Operator
are hereby issued a

PERMIT to OPERATE
EAST CAROLINA REGIONAL LANDFILL
MUNICIPAL SOLID WASTE LANDFILL FACILITY
PHASE IV (CELL 12)

Located north of the intersection of Republican and Harmon Roads, south of Aulander, Bertie County, North Carolina 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. The facility is located and described by the legal description of the site or the property map contained within the approved application.

Edward F. Mussler III, P.E.
cn=Edward F. Mussler III, P. E., c=US, o=Division of Waste Management, ou=Solid Waste Section, email=ed.mussler@ncmail.net
I have reviewed this document and am approving this document
2008.06.17 15:22:20 -04'00'

Edward F. Mussler, III, P.E.,
Permitting Branch Supervisor
Solid Waste Section

ATTACHMENT 3

PART I: PERMITTING HISTORY

Issuance	Date
Original Issue (PTC)	August 6, 1993
Original Issue (PTO)	October 8, 1993
Modification (PTO)	December 2, 1994
Amendment (PTO)	April 18, 1997
Version 1 (PTO)	November 8, 2000
Modification (PTO) –Sludge Solidification	June 3, 2003
Version 2 (PTO) Cell 10	September 23, 2003
Modification (PTO)	February 19, 2004
Version 3 (PTO & PTC) New Rate & Size	June 17, 2005
Version 4 (PTC) Cells 11 and 12	July 14, 2005
Version 5 (PTO) Cell 11A – Lower End	March 28, 2006
Version 6 (PTO) Cell 11B	June 15, 2006
PTO Cell 12	June 17, 2008

ART II:

PART II: MUNICIPAL SOLID WASTE LANDFILL DOCUMENTS

1. *Technical Specification for Alternative Protective Cover, Construction of Cell No. 10, East Carolina Regional MSW Landfill, Bertie County, North Carolina.* Prepared for: Republic Services of North Carolina, LLC. Prepared by: Hodges, Harbin, Newberry & Tribble, Inc., Macon, GA. November 2002. Includes revised Sheets 2 and 4 of 7, PTC Drawings.

2. *Construction Quality Assurance Report. Cell No. 10, East Carolina Regional MSW Landfill, Bertie County, North Carolina.* Prepared for: Hodges, Harbin, Newberry & Tribble, Inc., Macon, GA. Prepared by: Bunnell-Lammons Engineering, Inc. Greenville, SC. August 2, 2003 as amended through September 12, 2003. Volumes 1 – 3. BLE Project Number J03-1001-41.

3. *Permit to Construct, Expanded East Carolina Regional MSW Landfill. Bertie County, North Carolina.* Prepared for: Republic Services of North Carolina, LLC. Prepared by: Hodges, Harbin, Newberry and Tribble, Inc. Macon, GA. April 2004.

4. *Construction Quality Assurance Report. Cell No. 11 Lower End, East Carolina Regional MSW Landfill, Bertie County, North Carolina.* Prepared for: Hodges, Harbin, Newberry & Tribble, Inc., Macon, GA. Prepared by: Bunnell-Lammons Engineering, Inc. Greenville, SC. November 29, 2005 as amended through March 15, 2006. BLE Project

Number J05-1001-52.

5. *Construction Quality Assurance Report. Cell No. 11 Upper End, East Carolina Regional MSW Landfill, Bertie County, North Carolina.* Prepared for: Hodges, Harbin, Newberry & Tribble, Inc., Macon, GA. Prepared by: Bunnell-Lammons Engineering, Inc. Greenville, SC. May 18, 2006. BLE Project Number J06-1001-55.

6. *Construction Quality Assurance Report. Construction of Cell No. 12, East Carolina Regional MSW Landfill, Bertie County, North Carolina.* Prepared for: Hodges, Harbin, Newberry & Tribble, Inc., Macon, GA. Prepared by: Bunnell-Lammons Engineering, Inc. Greenville, SC. April 29, 2008, revised on June 02, 2008. BLE Project Number J07-1001-58.

PART III: CONSTRUCTION AND DEMOLITION LANDFILL DOCUMENTS
(NOT APPLICABLE)

PART IV: LAND CLEARING AND INERT DEBRIS LANDFILL DOCUMENTS
(NOT APPLICABLE)

PART V: YARD WASTE FACILITY DOCUMENTS
(NOT APPLICABLE)

PART VI: MISCELLANEOUS TREATMENT AND PROCESSING FACILITY DOCUMENTS

1. *Expanded East Carolina Regional MSW Landfill Facility Plan, Waste Solidification Process Modification, Republic Services of North Carolina, LLC, Bertie County, North Carolina.* Prepared for: Republic Services of North Carolina, LLC. Prepared by: Hodges, Harbin, Newberry, and Tribble, Inc. March 27, 2003.

PART VII: GENERAL PERMIT CONDITIONS

1. This permit shall expire June 15, 2011. Pursuant to 15A NCAC 13B .0201(e), no later than February 15, 2011, the owner or operator must submit a request to the North Carolina Department of Environment and Natural Resources, Division of Waste Management, Solid Waste Section ("Section") for permit review and must update pertinent facility plans including, but not limited to, the facility operation and waste screening plans.

2. The persons to whom this permit is issued ("permittee") are the owners and operators of the solid waste management facility.

3. (Intentionally blank)

4. When this property is sold, leased, conveyed, or transferred in any manner, the deed or other instrument of transfer must 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 and a reference by book and page to the recordation of the permit.

5. By receiving waste at this facility the permittee shall be considered to have accepted the terms and conditions of this permit.

6. Operation of this solid waste management facility must be in accordance with the Solid Waste Management Rules, 15A NCAC 13B, Article 9 of the Chapter 130A of the North Carolina General Statutes (NCGS 130A-290, et seq.), the conditions contained in this permit; and the approved plan. Should the approved plan and the rules conflict, the Solid Waste Management Rules shall take precedence unless specifically addressed by permit condition.

7. This permit is issued based on the documents submitted in support of the application for permitting the facility including those identified in Attachments 1 and 3, "List of Documents for Approved Plan," and which constitute the approved plan for the facility. Where discrepancies exist, the most recent submittals and the Conditions of Permit shall govern.

8. This permit may be transferred only with the approval of the Section, through the issuance of a new or substantially amended permit in accordance with applicable statutes and rules. In accordance with NCGS 130A-295.2(g) the permittee must notify the Section thirty (30) days prior to any significant change in the identity or business structure of either the owner or the operator, including but not limited to a proposed transfer of ownership of the facility or a change in the parent company of the owner or operator of the facility.

9. The permittee is responsible for obtaining all permits and approvals necessary for the development of this project including approval from appropriate agencies for a General or Individual NPDES Stormwater Discharge Permit. Issuance of this permit does not remove the permittee's responsibilities for compliance with any other local, state or federal rule, regulation or statute.

- End of Section -

ATTACHMENT 4
CONDITIONS OF PERMIT TO OPERATE

PART I: GENERAL FACILITY CONDITIONS

1. This permit approves the operation of Phase IV, Cell 12, and the continued operation of Phases I, II, III, IV (Cells 1 through 11), as well as the on-site environmental management and protection facilities as describe in the approved plans. Future Phases V - VII have not been approved for operation.

2. Phases I through IV have a permitted disposal capacity of approximately 12,192,000 cubic yards. Phase IV (Cells 11 and 12) has a disposal capacity of approximately 3,925,000 cubic yards. Cell 12 encompasses approximately 15 acres (approximately 650,400 square feet).

3. The total facility has an approved gross volume of approximately 24,200,000 cubic yards consistent with the approved final contours. Gross volume must be calculated as the volume between the top of the protective cover and the top of the final cover. Actual waste disposal capacity may vary depending upon waste compaction and amount and type of operational cover.

4. This facility is permitted for an average annual disposal rate of approximately 584,000 tons. This corresponds to an approximate disposal rate of 1600 tons per day based on 365 operating days per year, with a maximum variance of 10% facility total within any one annual reporting year as set forth in Document 9, Part II, Attachment 1.

5. The MSW landfill is permitted to receive solid waste generated by and in counties of North Carolina, consistent with local government waste management plans, local government approval and contract and franchise agreement, and as defined in N.C.G.S. §130A-290(a)(35), except where prohibited by North Carolina General Statutes Article 9 of Chapter 130A, and rules adopted by the Commission for Health Services.

6. The owner or operator of the landfill facility must not knowingly dispose of any type or form of municipal solid waste that is generated within the boundaries of a unit of local government that by ordinance:

   a. Prohibits generators or collectors of municipal solid waste from disposing of that type or form of municipal solid waste.

   b. Requires generators or collectors of municipal solid waste to recycle that type or form of municipal solid waste.

7. The facility operator must have completed an approved operator training course in compliance with G.S. 130A-309.25.

   a. A responsible individual certified in landfill operations must be on-site at all times during all operating hours of the facility that it is open for public use to ensure compliance with operational requirements.

   b. All pertinent landfill-operating personnel must receive training and supervision necessary to properly operate the landfill units in accordance with G.S. 130A-309.25 and addressed by memorandum dated November 29, 2000.

8. On or before August 1 annually, the Permittee must submit an annual facility report to the Solid Waste Section, on forms prescribed by the Section.

   a. The reporting period shall be for the previous year beginning July 1 and ending June 30.

   b. The annual report must list the amount of waste received and landfilled in tons and be compiled:

      i) On a monthly basis,
      ii) By county, city or transfer station of origin,
      iii) By specific waste type,
      iv) By disposal location within the facility, and
      v) By diversion to alternative management facilities.

   c. A measurement of the volume utilized in the MSW cells must be performed during the second quarter of the calendar year. The date and volume, in cubic yards, must be included in the report.

   d. The amount of waste, in tons, from scale records, disposed in the MSW cells since October 8, 1993 through the date of the annual volume survey must be included in the report.

   e. The completed report must be forwarded to the Regional Waste Management Specialist for the facility by the date due on the prescribed annual facility report form.

   f. A copy of the completed report must be forwarded to the County Manager for each county from which waste was received at the facility. Documentation that a copy of the report has been forwarded to the county managers must be sent to the Regional Waste Management Specialist by the date due on the prescribed annual facility report form.

9. The facility must maintain records for all solid waste materials accepted as alternative cover material and used as alternate daily cover. The records must include: the date of receipt, weight of material, general description of the material, identity of the generator and transporter, and county of origin. Such records must be made available to the Solid Waste

Section upon request.

10. Ground water quality at this facility is subject to the "Classifications and Water Quality Standards Applicable to the Groundwater of North Carolina", 15A NCAC 2L. This includes, but is not limited to, provisions for detection monitoring, assessment, and corrective action.

PART II: MUNICIPAL LANDFILL UNIT SPECIFIC CONDITIONS

MONITORING AND REPORTING

11. Ground water monitoring at this unit must be as prescribed by the appropriate requirements of 15A NCAC 13B .1630-.1637 and the approved monitoring plan.

12. A readily accessible unobstructed path must be cleared and maintained so that four-wheel drive vehicles may access monitoring well locations at all times.

13. A field log book which details all development, sampling, repair, and all other pertinent activities associated with each monitoring well and all sampling activities associated with each surface water and leachate sampling location must be kept as part of the permanent facility record.

14. Records of all ground-water, surface water and leachate analytical data must be kept as part of the permanent facility record.

15. Ground water monitoring wells and surface water sampling locations must be sampled for Appendix I constituents at least semi-annually according to the specifications outlined in the approved water quality monitoring plan and the current policies and guidelines of the Section in effect at the time of sampling.

16. Reports of the analytical data for each water quality sampling event must be submitted to the Section within 60 days of the respective sampling event. Analytical data must be submitted in a manner prescribed by the Section.

17. The four independent samples which comprise the initial baseline sampling event must be collected from each ground water monitoring well and the report must be submitted to the Section within six months after issuance of the Permit to Operate.

18. Untreated leachate must be sampled and analyzed at least semi-annually concurrently with the ground and surface water sampling. The leachate must be analyzed for all Appendix I constituents, pH, specific conductance, BOD and COD, phosphate, nitrate, and sulfate. Test results must be submitted to the Section along with ground and surface water test results. In the event leachate is recirculated, additional leachate sampling may

be required.

OPERATIONAL CONDITIONS

19. The use of tarps and petroleum contaminated soil as alternative daily cover is approved. Use must be consistent with prior approved plans. The use of different alternative daily cover requires approval, prior to implementation, by the Solid Waste Section. Requests for alternative daily cover approval must include a plan detailing the comprehensive use and a demonstration of the effectiveness of the alternative daily cover. The plan must be developed according to Section guidelines. Plans which are approved by the Section will be incorporated into, and made a part of, the approved documents found in Attachments 1 or 3.

20. The use of leachate recirculation as a leachate management tool is approved. Leachate recirculation will be conducted according to the approved plan, Document 1, Attachment 1.

21. The landfill facility is permitted to co-dispose of wastewater treatment sludge generated within the facility's approved service area, subject to the terms and procedures of the approved plan.

22. Closure or partial closure of any MSW landfill unit must be in accordance with the Closure Plans described in the approved plans and 15A NCAC 13B .1629. Final Closure Plans must be submitted to the Division at least 90 days prior to implementation. Closure and Post-closure plans, including financial instruments must be updated annually pursuant to 15A NCAC 13B .1628.

PART III: CONSTRUCTION AND DEMOLITION DEBRIS UNIT SPECIFIC CONDITIONS
(NOT APPLICABLE)

PART IV: LAND CLEARING AND INERT DEBRIS UNIT SPECIFIC CONDITIONS
(NOT APPLICABLE)

PART V: YARD WASTE UNIT SPECIFIC CONDITIONS
(NOT APPLICABLE)

PART VI: MISCELLANEOUS FACILITIES SPECIFIC CONDITIONS

LIQUID AND SLUDGE SOLIDIFICATION PROCESSING UNIT

23. Operations must be in accordance with Document 1, Part VI, Attachment 3 and the following conditions.

24. Approval for Operation shall be for a one-year period beginning March 28, 2006. The solidification process shall be reviewed on an annual basis. The facility must meet any update to the rules or policies of the Section in place at the time of the renewal. The operational approval shall automatically be renewed unless the owner is notified in writing by the Section.

25. Records of the following, at a minimum, must be maintained: waste material description, solidification agent(s) utilized, waste determination records, tons of waste and solidification agents disposed, date and time of receipt of liquid or sludge waste, date and time of solidification. Records must be kept in the facility operating record and made available to the Section on request.

26. Liquid and sludge waste must be processed within 24 hours of receipt. Drums may be stored for 24 hours before processing. Liquid waste must not be stored, unprocessed, over the weekend.

27. Bulking agents must be stored on an impervious surface. Dust and leachate formation must be prevented.

28. Petroleum contaminated soils must not be used as bulking agents.

29. All liquids, sludge and bulking agents must be weighed and reported as solid waste for purposes of the Solid Waste Annual Report reporting requirements.

30. Spills must be cleaned up immediately.

31. No odors, vectors or nuisances are allowed in the processing area.

32. Spills that are not to the impervious surface, spills that are not cleaned in a timely manner, vector, odors, incomplete records, accepting wastes or bulking agents that the facility is not permitted to receive, shall be among the minimum reasons that the processing may be ordered by the facility waste management specialist to cease.

- End of Section -

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

June 18, 2008

Mr. Ray Hoffman
Republic Services of North Carolina, LLC
P O Box 2943
Hickory NC 28603

Re: Permit to Operate (PTO): Phase IV, Cell 12
East Carolina Regional Landfill
Bertie County, North Carolina
Permit No. 08-03
Document ID No.4887

Dear Mr. Hoffman:

The Solid Waste Section has determined that Republic Services of North Carolina, LLC has met the pre-operative conditions of Solid Waste Permit No. 08-03, Part 1: Permit to Construct for Phase IV, Cell 12 and associated facility infrastructure. Solid Waste Permit No. 08-03, Part 2: Permit to Operate for Phase IV, Cell 12 is enclosed.

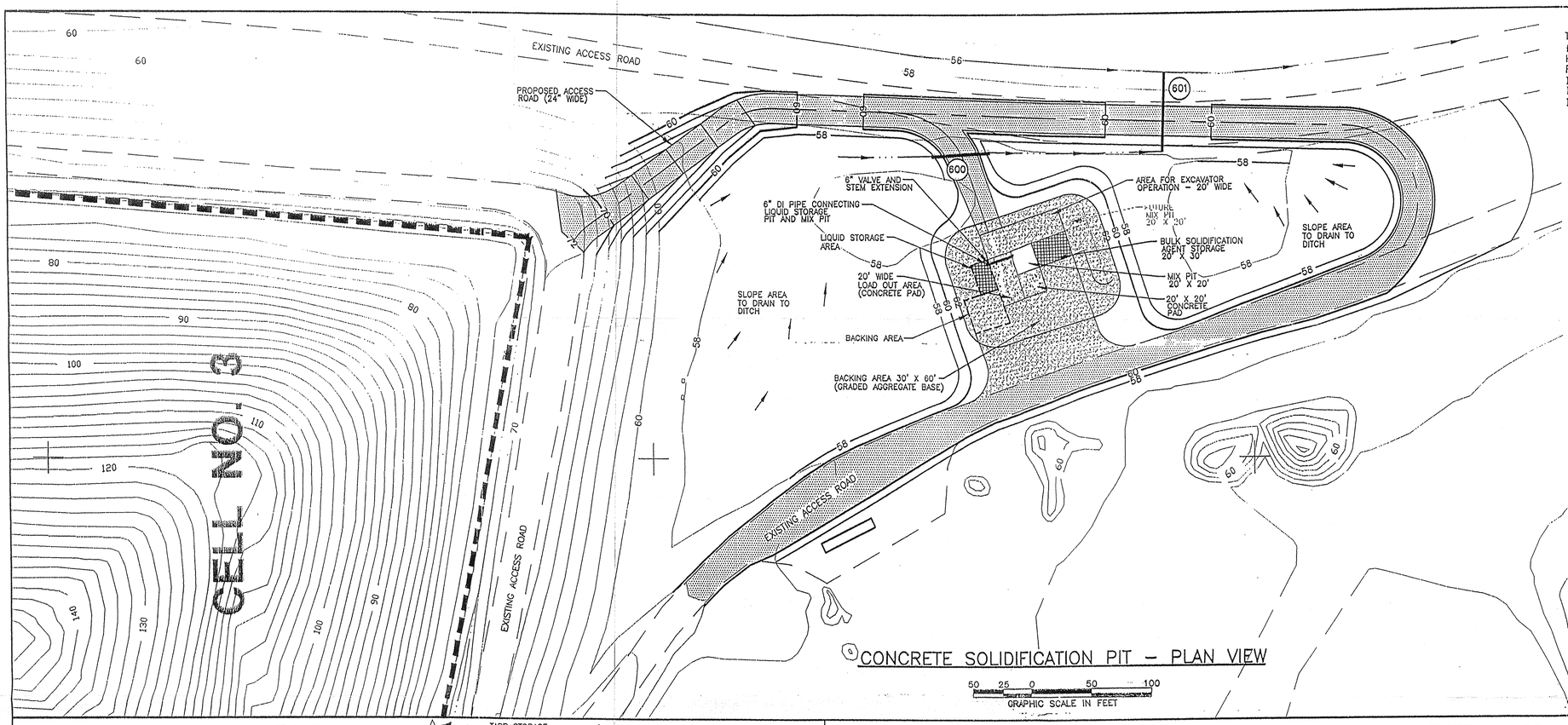
If you have any questions regarding the permit or conditions, please contact me at (919) 508-8507.

Sincerely,

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

Enclosure
Cc: William F. Hodges, P.E. of Hodges, Harbin, Newberry & Tribble, Inc.
Daniel B. Bunnell, P.E. of Bunnell-Lammons Engineering, Inc.
Dennis Shackelford – Eastern District Supervisor
Chuck Boyette – Waste Management Specialist
Central Files

WASTE SOLIDIFICATION PLAN



CONCRETE SOLIDIFICATION PIT - PLAN VIEW

50 25 0 50 100
GRAPHIC SCALE IN FEET

This topographic base map was produced by BEI Aerial Mapping, Peachtree City, Georgia for Hodges, Harbin, Newberry & Tribble, Inc.
HHNT PROJECT # 1001-100-01 (East Carolina Regional MSWLF)
PERMIT # 08-03, BERTIE COUNTY, NC
BEI PROJECT # 97-11186
DATE OF PHOTOGRAPHY: JANUARY 1, 1998
DATE OF SUBMITTAL: JANUARY 19, 1998

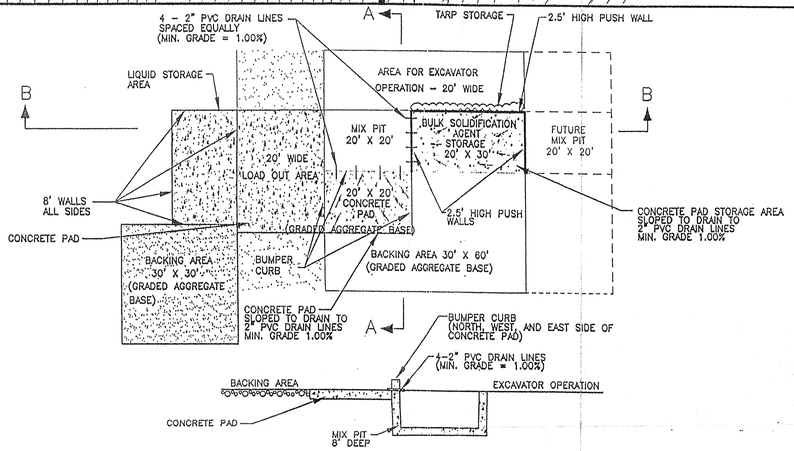
NEW DRAINAGE STRUCTURES

PIPE NO.	SIZE	LENGTH	SLOPE	INLET INVERT	OUTLET INVERT	MATERIAL
600	18"	50'	0.50%	57.29	57.04	RCP OR CMP
601	18"	64'	0.50%	56.32	56.00	RCP OR CMP

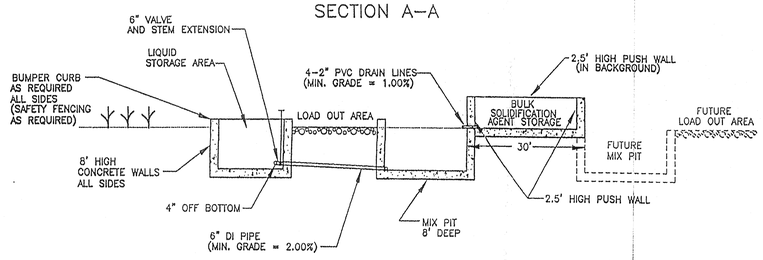
DRAINAGE NOTES:
1. INVERT AND OUTLET ELEVATIONS MAY BE FIELD ADJUSTED TO MATCH EXISTING DITCH LINE.

LEGEND

- EXISTING 10' CONTOUR — 60
- EXISTING 2' CONTOUR
- EXISTING ROAD
- PROPOSED ROAD
- EXISTING CELL LINER
- PROPOSED 10' CONTOUR — 70
- PROPOSED 2' CONTOUR
- PROPOSED STORM PIPE — 600
- EXISTING STRUCTURE
- PROPOSED DRAINAGE DITCH



SECTION A-A



SECTION B-B

EAST CAROLINA REGIONAL LANDFILL SOLIDIFICATION SCHEMATIC

NOT TO SCALE

OPERATION AND GENERAL NOTES NARRATIVE

OPERATION NOTES:

1. THE WASTE SOLIDIFICATION PIT SHALL BE LOCATED NEAR THE LEACHATE TANK SO THAT CONSTANT OBSERVATION AND SUPERVISION CAN BE PROVIDED DURING THE MIXING OF THE LIQUID / SEMI-SOLID MATERIAL WITH THE SOLIDIFYING AGENT(S).

2. THE CONCRETE SOLIDIFICATION PIT WILL SERVE AS THE PRIMARY AND SECONDARY CONTAINMENT FOR THE MIXING OPERATION.

3. ALL LOADS OF MATERIAL TO BE SOLIDIFIED WILL FIRST BE APPROVED BY THE LANDFILL AS NON-HAZARDOUS MATERIAL THAT IS ACCEPTABLE FOR DISPOSAL ACCORDING TO THE PERMIT CONDITIONS FOR THIS SITE.

4. EACH LOAD TO BE SOLIDIFIED, ONCE APPROVED, WILL BE PLACED INSIDE THE WASTE SOLIDIFICATION PIT WHICH WILL BE LOCATED NEAR THE LEACHATE TANK. ALL WASTE TO BE SOLIDIFIED WILL BE PROCESSED ACCORDING TO THE PROHIBITED WASTE EXCLUSION PLAN APPLICABLE TO THIS SITE.

5. SOLIDIFICATION AGENTS TO BE USED WILL INCLUDE ONE OR MORE OF THE FOLLOWING: WOOD BARK, WOOD CHIPS, SAW DUST, FLY ASH, BOTTOM ASH, KILN DUST, AUTOFLUFF, SOILS, OR OTHER SIMILAR ABSORBENT MATERIALS. SOLIDIFICATION AGENTS WILL THEN BE ADDED TO THE LIQUID OR SEMI-SOLID WASTE MATERIAL AND STIRRED AND THOROUGHLY MIXED WITH A BACKHOE, EXCAVATOR, OR SIMILAR PIECE OF EQUIPMENT. SINCE DUSTY MATERIALS MAY BE UTILIZED AS SOLIDIFICATION AGENTS, PROPER TARPING AND DUST CONTROL PROCEDURES WILL BE USED TO ASSURE DUST IS MINIMIZED.

6. ONCE SOLIDIFIED, EACH LOAD WILL BE SUBJECTED TO A "PAINT FILTER TEST" BY QUALIFIED PERSONNEL TO ASSURE ITS ACCEPTABILITY FOR DISPOSAL.

7. A LOG WILL BE KEPT AT THE LANDFILL WHICH WILL HAVE AT A MINIMUM THE FOLLOWING INFORMATION:
   A. WASTE MATERIAL DESCRIPTION
   B. SOLIDIFICATION AGENT(S) UTILIZED
   C. TIME OF SOLIDIFICATION
   D. APPROXIMATE VOLUME OF SOLIDIFIED WASTE
   E. DATE OF SOLIDIFICATION

   THIS LOG WILL BE MADE PART OF THE FACILITY OPERATING RECORD AND WILL BE MADE AVAILABLE TO NCDENR UPON REQUEST.

8. ONCE APPROVED FOR DISPOSAL, THE WASTE SHALL BE HAULED AND PLACED IN THE ACTIVE LANDFILL CELL ALONGSIDE OTHER MUNICIPAL SOLID WASTE.

GENERAL NOTES:

1. REMOVABLE RAILING WILL BE INSTALLED AROUND THE PIT. (AS REQUIRED) ALSO LINKS OF CHAIN OR ORANGE PLASTIC LITTER FENCE WILL BE ATTACHED TO RAILINGS. THE REMOVABLE RAILING WILL ALSO BE AROUND THE WASTE SOLIDIFICATION PIT WHEN THE MIXING OPERATION IS NOT ON-GOING.

APPROVED
DIVISION OF WASTE MANAGEMENT
SOLID WASTE SECTION
DATE 6/3/03 BY
W0803 PTO
A3 PII Doc8

NORTH CAROLINA PROFESSIONAL SEAL 16146 ENGINEER WILLIAM F. HODGES 3/24/03

NORTH CAROLINA PROFESSIONAL SEAL 28063 ENGINEER WILLIAM W. STUBBS 3/25/03

MAR 2003

WASTE SOLIDIFICATION PLAN

EXPANDED EAST CAROLINA REGIONAL MSW LANDFILL
FACILITY PLAN
WASTE SOLIDIFICATION PROCESS MODIFICATION
REPUBLIC SERVICES OF NORTH CAROLINA, LLC
BERTIE COUNTY, NORTH CAROLINA

HODGES, HARBIN, NEWBERRY & TRIBBLE, INC.
CONSULTING ENGINEERS
(478) 743-7175
484 MULBERRY ST. - STE. 265
MACON, GEORGIA 31201

PROJ. NO.	1001-344-01	DWG. ECFP3-WS1	EDIT 3-19-03
SCALE	AS SHOWN	SHEET	1 OF 1
DATE	MARCH, 2003		

dwg_proj\East Carol\mxds\ECFP3-WS1.mxd Tue Mar 25 13:42:14 2003 CMTE

RANDOM WASTE INSPECTION FORMS

WASTE INSPECTION FORM

FACILITY: _____ PERMIT NO.: _____

LOCATION: _____ DATE: _____

INSPECTOR: _____ COMPANY: _____

Waste Name(s) & Address(es)

1. _____
2. _____
3. _____
4. _____
5. _____

Waste Hauler: _____

Address: _____

Driver's Name: _____

Waste Accepted ☐ Waste Rejected ☐ Waste Held ☐

Notified: Waste Source ☐ Hauling Management ☐ Site Management ☐

State ☐ Federal ☐

Loader Operator: _____

Personnel Conducting the Inspection: _____

_____

Supervisor Conducting the Inspection: _____

SIGNATURE: _____

Witness: _____

SIGNATURE: _____

Driver: _____

SIGNATURE: _____

Other: _____

Company: _____ Title: _____

SIGNATURE: _____

DATE: _____ Time: _____ AM☐ PM☐

ADDITIONAL COMMENTS: see page 2

INSPECTION CHECK LIST: (Check all that apply)

(If "YES", please explain in the space provided below)

FACILITY: _____ PERMIT NO.: _____

LOCATION: _____ DATE: _____

INSPECTOR: _____ COMPANY: _____

	YES	NO
1. Powders/Dusts	____	____
Identified: _____		
Unknown	____	____
2. Unacceptable Saturation	____	____
3. Odor/Fumes	____	____
Strong	____	____
Faint	____	____
Describe: _____		
4. Heat	____	____
Item: _____		
5. Battery	____	____
6. Oil	____	____
7. Biomedical	____	____
8. Radioactivity	____	____
9. Ashes/Residue	____	____
10. Sod/Soil	____	____
11. Asbestos (not properly contained)	____	____
12. PCB	____	____
13. Out of Area Waste	____	____

Explanation:

_____

_____

_____

_____

_____

_____

CONTAINER INVENTORY

FACILITY: _____ PERMIT NO.: _____

LOCATION: _____ DATE: _____

INSPECTOR: _____ COMPANY: _____

Container:

Drum ☐ Metal ☐ Cardboard ☐ Plastic ☐ Other ☐

Other: _____

Contents:

Full ☐ Partially Full ☐ Empty ☐

Crushed ☐ Punctured ☐

Labeled ☐ Hazardous ☐

Identified: _____

Additional Information:

_____

_____

_____

_____

Container:

Drum ☐ Metal ☐ Cardboard ☐ Plastic ☐ Other ☐

Other: _____

Contents:

Full ☐ Partially Full ☐ Empty ☐

Crushed ☐ Punctured ☐

Labeled ☐ Hazardous ☐

Identified: _____

Additional Information:

_____

_____

_____

_____

REFUSE/UNIDENTIFIED WASTE INSPECTION FORM

FACILITY: _____ PERMIT NO.: _____

LOCATION: _____ DATE: _____

INSPECTOR: _____ COMPANY: _____

REJECTABLE WASTE DESCRIPTION: _____

_____

_____

_____

WASTE: Rejected ☐ Accepted ☐

NOTIFIED: Waste Source ☐ Hauling Management ☐

Site Management ☐ State ☐ Federal ☐

REFUSED WASTE TRANSPORTED BY:

Hauler Address: _____

_____

Destination: _____

_____

ACCEPTED WASTE:

Contained area: _____

Secured by: _____

Lab to complete testing: _____

ADDITIONAL COMMENTS: _____

_____

_____

_____

_____

_____

PETROLEUM CONTAMINATED SOIL MONTHLY ACCEPTANCE LOG

East Carolina Regional MSW Landfill
Republic Services of North Carolina, LLC

Petroleum Contaminated Soil Monthly Acceptance Log

Month/Year: _____

	Tonnage MSW		Tonnage of Petroleum Contaminated Soil		Concentration TPH in PPM
Date	Daily Amount	Running Total	Daily Amount	Running Total	

Monthly Running Average: % TPH Soil _____

Notes:
If TPH soils are accepted from different sources on the same day, then a separate entry needs to be made for each source.

PLAN OF OPERATION FOR FIGHTING FIRES

In the event of a fire at the landfill, the following plan of operation for fighting fires may be used.

- Notify the general manager or operations manager immediately.

- If possible, move all equipment and personnel clear of the burning material.

- Mobilize on-site equipment including fire extinguishers, compacters or dozers to try and extinguish the fire. All on-site personnel attempting to extinguish the fire using on-site equipment shall be trained in its proper use. The use of soil is often the best method for extinguishing landfill fires.

- If necessary, contact the local Windsor Fire Department for assistance.

- Once the fire has been extinguished, notify the Section verbally within 24 hours and in writing within 15 days. A copy of the Fire Occurrence Notification Form has been included in this Appendix.

SOLID WASTE MANAGEMENT FACILITY
FIRE OCCURRENCE NOTIFICATION

NC DENR Division of Waste Management
Solid Waste Section

NCDENR
North Carolina Department of Environment and Natural Resources

Notify the Section verbally within 24 hours and submit written notification within 15 days of the occurrence.
(If additional space is needed, use back of this form)

NAME OF FACILITY: _____ PERMIT #_____

DATE AND TIME OF FIRE: ____/____/____ @ ____: ____ AM / PM (circle one)

HOW WAS THE FIRE REPORTED AND BY WHOM: _____

LIST ACTIONS TAKEN: _____

WHAT WAS THE CAUSE OF THE FIRE: _____

DESCRIBE AREA, TYPE, AND AMOUNT OF WASTE INVOLVED: _____

WHAT COULD HAVE BEEN DONE TO PREVENT THIS FIRE: _____

CURRENT STATUS OF FIRE: _____

DESCRIBE PLAN OF ACTIONS TO PREVENT FUTURE INCIDENTS: _____

NAME_____ TITLE_____ DATE_____

****

THIS SECTION TO BE COMPLETED BY SOLID WASTE SECTION REGIONAL STAFF

DATE RECEIVED_____

List any factors not listed that might have contributed to the fire or that might prevent occurrence of future fires:

FOLLOW-UP REQUIRED:

☐ NO ☐ PHONE CALL ☐ SUBMITTAL ☐ MEETING ☐ RETURN VISIT BY:_____ (DATE)

ACTIONS TAKEN OR REQUIRED:

Revised 6/29/01

LEACHATE RECIRCULATION LOG FORM

EAST CAROLINA REGIONAL MSW LANDFILL OPERATING RECORD
LEACHATE RECIRCULATION LOG

DAY:_____ DATE:_____ SITE MANAGER:_____

WEATHER CONDITIONS

Wind Speed:_____ Temperature:_____ Other:_____ 24 Hour Rainfall:_____ 24 Hour Snowfall:_____

ACCIDENTS / INCIDENTS:

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Accident Report Filed: Yes No

LEACHATE RECIRCULATION

Gallons of leachate added to waste: _____

Location of leachate application: Cell No._____

Problem Areas:

Seeps: Yes No Other:_____

Corrective action:_____

_____

_____

Comments:_____

_____

_____

Site Operator Notes_____

_____

_____

_____

_____

_____

Location of Active Fill Area:_____

- Please complete an operating record for each day, or partial day of operations. Include other operating information such as environmental monitoring nts, NCDNR inspections, East Carolina Environmental Staff site visits, etc. USE REVERSE SIDE IF NEEDED.