

42-04



CONTRACT SPECIFICATIONS HALIFAX COUNTY ASH MONOFILL

HALIFAX COUNTY SOLID WASTE DEPARTMENT

HAZEN AND SAWYER
Environmental Engineers & Scientists
RALEIGH, NORTH CAROLINA

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SECTION 1 - GENERAL CONDITIONS

A. Preliminary Matters

1. Definitions

The words and terms used in the Contract and Specifications will have the meanings given below:

- 1.1 **Owner:** Halifax County, North Carolina (the County) or its authorized representatives.
- 1.2 **Engineer:** Hazen and Sawyer, P.C. acting directly through a registered professional engineer or through any assistant having the particular duties entrusted to him.
- 1.3 **Inspector:** Hazen and Sawyer, P.C. acting directly through its technician(s), approved by the Owner, to inspect the Contractor's work and materials and to perform certain quality assurance tests.
- 1.4 **General Contractor:** The person, persons, partnership, company or corporation entering into the Contract for the performance of the required work. No part of this work may be contracted without the written permission of the Owner. The General Contractor shall be an independent contractor.
- 1.5 **General Contract:** All of the covenants, terms and stipulations contained in the Bid Documents, Proposal, Specifications, Drawings, Bond and Agreement.

- 1.6 Contract Specifications:** All of the terms and stipulations contained (1) in the provisions described in the Contract Documents (2) in the addenda and revisions which may be made in them, and (3) in all written agreements, made or to be made, pertaining to the method and manner of performing the work or to the quality and quantity of the material to be furnished.
- 1.7 Contract Drawings:** All of the drawings attached to the Contract, and those supplementary or additional drawings which the Engineer may issue to clarify or further detail the contract drawings or work.
- 1.8 Proposal:** The Contractor's offer to do the specified work at certain stipulated prices or costs.
- 1.9 Unit Price Bid:** The Contractor's price to complete a given unit of construction or to supply a unit of material. The Unit Price Bids are contained in the Contractor's proposal.

2. Location of Work

- 2.1** The work, as specified, is for the preparation and installation of pertinent facilities associated with the development the Halifax Ash monofill (the cell). The Halifax landfill facility is located on State Road 1417 approximately 3 miles NW of Aurelian Springs, North Carolina in Halifax County.

3. Scope of Work

3.1 The work to be performed by the General General Contractor shall consist of furnishing all labor, materials, equipment, tools, supplies, transportation and all other goods and services required for the preparation of the Halifax landfill as indicated on the Contract Drawings. The Contract work includes, but is not limited to, the following principal features:

- Site Preparation
- Excavation
- Rock Removal
- Compacted Embankment
- Access Road Construction
- Secondary Settling Basin Construction
- Stormwater Basin Construction
- Geomembrane Installation
- Geotextile Installation
- Internal Stormwater Control System Construction
- External Stormwater Control System Construction
- Erosion And Sedimentation Control
- Seeding

4. Commencement of Contract Time, Notice to Proceed

4.1 The Contract Time will commence to run on the day after the Notice to Proceed is given.

5. Starting the Project

5.1 The General Contractor shall start to perform the Work within 14 days of the Contract Time commencing to run, but no Work shall be done at the site prior to the date on which the Contract Time commences to run.

5.2 Construction Schedule: Within ten (10) days after the execution of the Agreement, the General Contractor shall deliver to the Owner a construction progress schedule in a form satisfactory to the Owner, showing the proposed dates of commencement of each of the various subdivisions of Work.

B. Existing Utilities

1. Special precautions shall be taken by the General Contractor to avoid damage to existing overhead and underground utilities owned and operated by the Owner or by public or private utility companies.
2. When existing utilities or appurtenant structures, either underground or above ground are encountered, they shall not be displaced or molested unless necessary, and in such case shall be replaced in as good or better condition than found as quickly as possible. Permanent or temporary relocation and replacement of all utilities and appurtenant structures to accommodate the construction work shall be at the General Contractor's expense.
3. The General Contractor shall make all arrangements and payments necessary for the securing and use of any utilities required for execution of the Contract provisions such as water, fuels, electric power, telephones, and other similar or related items.

C. Time for Completion and Liquidated Damages

1. If all of the work or any portion thereof is not completed by the date inserted by the General Contractor on the Bid Form, or any extension thereof, damage will be sustained by the Owner and it will be difficult to determine the actual damage which the Owner will sustain by reason of such delay. Therefore the General Contractor shall pay to the Owner, as liquidated damages, the amount specified herein for each day's delay in completing the work or any portion thereof beyond the time specified on the Bid Form by the General Contractor, or any extension thereof. The Owner may deduct any amount of such liquidated damages from any money due or that may become due the General Contractor under the Contract. If the Engineer is responsible for any portions of a delay in completing the work or any portion thereof beyond the time specified therefore, extension of time and adjustments in compensation will be made, and the General Contractor shall pay liquidated damages to the Owner for the remaining portion of the delay in accordance with the foregoing provisions.
2. Pursuant to the provisions herein, the General Contractor shall complete the work by the date specified by him on the Bid Form.
3. Liquidated damages for failure to complete the portion of the work as described above within the time specified shall be \$500.00 per calendar day. (The General Contractor is reminded that the date he specifies forms a part of his bid and will have a value to be determined by the Owner during bid selection.)
4. The Owner will not be responsible for any damages, hindrances, or delays arising from rain, any sort of adverse weather, or from similar

contingencies. The General Contractor shall bear the expense caused by such circumstances and shall be fully prepared to plan and perform work required with prudent regard for delays and difficulties which may be normally encountered.

5. Other delays and hindrances for which he is not responsible may entitle the General Contractor to a contract-time extension, the length of which will be determined by the Engineer. Requests for time extension arising from such circumstances shall be made in writing and submitted to the Engineer within 14 days of requirements for such extensions. Such requests shall outline the cause and character of the delays or hindrances involved.

D. Subsurface Data

1. The Engineer has performed a subsurface investigation program for the project. A copy of the Report of Subsurface Investigation is available for review and a copy will be kept at the project during construction and will be available for inspection by the General Contractor. The subsurface data, in any form and wherever shown, are not intended as a representation by the Owner or warranty by the Engineer, but are furnished for information only. It is expressly understood that the Owner will not be responsible for the accuracy of the subsurface data, nor for any deduction, interpretation, or conclusion drawn therefrom by the General Contractor. The Test Boring Records represent the Soils Engineer's interpretation of the field logs based on examination of the field samples. The lines designating the interfaces between various strata represent approximate boundaries and the transition between strata may be gradual. The Soils Engineer does not guarantee that materials other than those disclosed by the borings will not be encountered or that

the proportions and character of the various materials between the borings will not vary from those indicated on the Test Boring Records.

E. General Contractor's Responsibilities

1. Supervision and Superintendence

1.1 The General Contractor shall supervise and direct the Work efficiently and with his best skills and attention. He will be solely responsible for the means, methods, techniques, sequencing and procedures of construction for his forces as well as those of his Subcontractors. The General Contractor will be responsible to see that the finished Work complies accurately with the Contract Documents.

1.2 The General Contractor will keep on the Work, at all times during its progress, a competent Resident Project Superintendent, who shall be named at the start of the Work and who shall not be replaced without written notice to the Owner and the Engineer except under extraordinary circumstances. The superintendent Will be the General Contractor's representative at the site and shall have authority to act on behalf of the General Contractor. All communications given to the superintendent shall be as binding as if given to the General Contractor. Whenever the General Contractor or his superintendent is not present on any part of the work where it may be desired to give directions, the General Contractor shall designate a responsible supervisory employee to receive and execute such orders as the Engineer or his representative may give.

- 1.3** Without limiting the scope of this Agreement, the General Contractor shall repair, restore, or replace damaged articles and areas disturbed by construction to their original or better condition.
- 1.4** The binding of each Subcontractor to the terms of the Contract Documents by the General Contractor in no way causes an implied contract between the Owner and the Subcontractor or the Engineer and the Subcontractor or the Engineer and the General Contractor.
- 1.5** All workmen engaged on special or skilled work shall have had sufficient experience in such work to properly and satisfactorily perform it and operate the equipment involved.
- 1.6** The General Contractor shall maintain current progress records which show the percentage of work scheduled for completion at any time and the actual percentage of work completed. The General Contractor shall immediately submit 4 copies of the progress reports to the Engineer at the end of each month or at such intervals as directed by the Engineer.

2. Safety and Protection

- 2.1** The General Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. He shall be responsible for the safety of the following and shall provide the necessary protection to prevent damage, injury or loss to the following:

2.1.1 All employees and Subcontractors on the Work and other persons who may be affected thereby.

2.1.2 All the Work and all materials or equipment to be incorporated therein, whether in storage on or off site, and

2.1.3 Other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designed for removal, relocation or replacement in the course of construction.

2.2 The General Contractor shall comply with all applicable laws, ordinances, rules, regulations and orders of any public body having jurisdiction for the safety of persons or property or to protect them from damage, injury or loss. He shall erect and maintain, as required by the conditions and progress of the Work, all necessary safeguards for safety and protection, and in addition he will comply with all applicable recommendations of the Manual of Accident Prevention in Construction of the Associated General Contractors of America, Inc. He shall notify owners of adjacent utilities when prosecution of the Work may affect them, All damage, injury or loss to any property caused, directly or indirectly, in whole or in part, by the General Contractor, any Subcontractor or anyone directly or indirectly employed by any of them or anyone whose acts any of them may be liable, will be remedied by the General Contractor; except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of the Owner or Engineer or anyone employed by either of them or anyone for whose acts either of them may be liable, and not

attributable, directly or indirectly, in whole or in part, to the fault or negligence of the General Contractor.

- 2.3 The General Contractor shall designate a responsible member of his organization at the site whose duty shall be the prevention of accidents. This person shall be the General Contractor's superintendent unless otherwise designated in writing by the General Contractor to the Owner.
- 2.4 The General Contractor shall continuously maintain adequate protection of all his work from damage, and shall protect the Owner's property from injury or loss arising in connection with this Contract. He shall make good any such damage, injury or loss, except such as may be directly due to errors in the Contract Documents or caused solely by agents or employees of the Owner. He shall adequately protect adjacent and downstream property as provided by law and the Contract Documents.
- 2.5 The General Contractor shall assume all risks of loss, injury or damage of any kind to any vehicle, equipment, materials, apparatus or machinery which he will provide in doing the Work.
- 2.6 The General Contractor shall comply with applicable local laws and ordinances governing the disposal of surplus excavation, materials, debris and rubbish on or off the Project Area and commit no nuisance or trespass on the any public or private property in any operation arising from or connected with the improvements embraced in this Contract.

3. Emergencies

3.1 In emergencies affecting the safety of persons or the Work or property at the site or adjacent thereto, the General Contractor, without special instruction or authorization from the Engineer or the Owner, is obligated to act, at his discretion, to prevent threatened damage, injury or loss. The General Contractor shall give the Engineer prompt written notice of any significant changes in the Work or deviations from the Contract Documents caused thereby, and a Change Order shall thereupon be issued covering the changes and deviations involved. If the General Contractor believes that additional work done by him in an emergency which arose from causes beyond his control entitles him to an increase in the Contract Price or an extension of the Contract Time, he shall immediately make a claim to the Owner in writing, setting off the amount of and justification for the claim.

4. Project Coordination Meetings

4.1 The General Contractor will participate in Project Coordination Meetings to be held on the site monthly, or more often if conditions warrant, to establish the current state of completion and revise the schedule as necessary. The Project Coordination Meeting will be conducted by the Engineer.

F. Owner's Responsibilities

1. The Owner will furnish the data required of him under the Contract Documents promptly and shall make payments to the General Contractor as they are due.

2. The Owner will furnish land and boundary surveys. The General Contractor will furnish or indicate location and limit marks necessary for construction of the project. All such marks and stakes shall be carefully preserved by the General Contractor, and he shall be responsible for the proper building of the work to those lines and grades.

G. Engineer's Status During Construction

1. The Engineer is Hazen and Sawyer, P.C. Their address is 4011 WestChase Blvd., Raleigh, North Carolina. Their telephone number is (919) 833-7152.
2. The Engineer shall be the Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of the Engineer as the Owner's representative during construction are set forth in the following paragraphs.
3. **Visits to Site**
 - 3.1 The Engineer will make periodic visits to the site to observe the progress and quality of the expected work and to determine, in general, if the Work is proceeding in accordance with the Contract Documents. His efforts will be directed toward providing assurance for the Owner that the completed Project will conform to the requirements of the Contract Documents. On the basis of his on-site observations as an experienced and qualified design professional, he will keep the Owner informed of the progress of the Work and will endeavor to guard the Owner against defects and deficiencies in the Work.

4. Clarifications and Interpretations

4.1 The Engineer will issue with reasonable promptness such written clarification or interpretations of the Contract Documents (in the form of Drawings or otherwise) as he may determine necessary, which shall be consistent with or reasonably inferable from the overall intent of the Contract Documents. If the General Contractor believes that a written clarification and interpretation entitles him to an increase in the Contract Price, he may make a claim.

5. Resident Inspector

5.1 The Inspector will monitor the quality of earthwork operations for work performed within the scope of these specifications with a program of inspection, sampling, and testing to verify conformance with provisions of the specifications and determine other engineering characteristics for the Owner's design requirements. This program will include quality assurance monitoring during completion of the Work as outlined in these Contract Specifications.

H. Changes in the Work

1. Without invalidating the Agreement, the Owner may at any time order additions, deletions, or revisions in the Work; these will be authorized by written Change Orders. Upon receipt of an approved written Change Order, the General Contractor will proceed with work involved. All such work will be executed under the applicable conditions of the Contract Documents. If any Change Order causes

an increase or decrease in the Contract Price or an extension or shortening of the Contract time, an equitable adjustment will be made.

2. The Engineer may authorize minor changes or alterations in the Work not involving extra cost, not lengthening the Contract time and not inconsistent with the overall intent of the Contract Documents. If the General Contractor believes that any minor changes or alterations authorized by the Engineer entitles him to an increase in the Contract Price, he may make a claim in writing, stating the amount of and justification for the claim.
3. Additional work performed by the General Contractor without authorization of a Change Order will not entitle him to an increase in the Contract Price or an extension of the Contract time, except in the case of an emergency.

I. Tests and Inspections: Correction, Removal or Acceptance of Defective Work

1. Access to Work

- 1.1 The Engineer and the Engineer' representatives, other representatives of the Owner, testing agencies and governmental agencies with jurisdictional interests will have access to the Work at reasonable times for their observation, inspection and testing. The General Contractor shall provide proper and safe conditions for such access.

2. Tests and Inspections

- 2.1** The General Contractor shall give the Engineer timely notice of readiness of Work for all required inspections, tests or approvals.
- 2.2** If any law, ordinance, rule, regulation, code or order of any public body having jurisdiction requires any Work (or part thereof to specifically be inspected, tested or approved, the General Contractor shall assume full responsibility therefore, pay all costs in connection therewith and furnish the Engineer the required certificates of inspection, testing or approval. The cost of all other inspections, tests and approvals required by the Contract Documents shall be paid by the Owner (unless otherwise specified), provided, however, the necessity and authority for such inspections, tests and approvals shall be determined and approved by the Engineer and Owner.
- 2.3** All inspections, tests, or approvals other than those required by local ordinance, rule, regulation, code or order of any public body having jurisdiction shall be performed by organizations acceptable to the Owner, the General Contractor, and the Engineer.
- 2.4** Any work that the General Contractor covered before being tested or inspected by the Engineer may be requested to be uncovered for observation or testing.

3. Stopping the Work

- 3.1** If the Work is defective, or the General Contractor fails to supply sufficient skilled workmen or suitable materials or

equipment, or if the General Contractor fails to make prompt payments to Subcontractors for labor, materials or equipment, the Owner may order the General Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of the Owner to stop the Work shall not give rise to any duty on the part of the Owner to exercise the right for the benefit of the General Contractor or any other party.

4. Correction or Removal of Defective Work

4.1 If required by the Engineer, the General Contractor shall promptly, without cost to the Owner and as specified by the Engineer, either correct all defective work, whether or not fabricated, installed or completed, or, if the Work has been rejected by the Engineer, remove it from the site and replace it with nondefective Work.

J. Acceptance and Payment

1. The Engineer will perform all necessary surveys and computations for measurement of quantities of materials to be used as a basis for payment. The General Contractor or his designee may be present when final cross-sections are taken and computations are performed. The General Contractor may inspect previously taken cross-sections by appointment. Field books will be retained by the Engineer.
2. Field surveys will utilize methods normally employed to obtain horizontal and vertical measurements. Volumes of materials will be determined using average-end-area methods if applicable.

3. Monthly payments to the General Contractor will be based on estimates as agreed upon by the General Contractor and Engineer. Weight scales used by the General Contractor as a basis of payment for truck weight tickets shall be calibrated to the satisfaction of the Engineer. The Engineer shall be allowed to check the calibration of such scales at any time and may refuse payment for weight tickets which have serious errors. Weight tickets will be presented to the Owner's representative at time of delivery,

4. The Owner may retain a portion of the amount otherwise due the General Contractor. The amount retained by the Owner shall be limited to the following:
 - 4.1 Withholding of not more than ten percent (10%) of the payment claimed by the General Contractor on his Application for Payment.

 - 4.2 If the work is fifty percent (50%) complete (not including the value of stored material), the General Contractor may request in writing to the Owner and the Engineer that retainage be reduced on all future Applications for Payment, The Engineer will have fifteen (15) calendar days to review the General Contractor's request and to either approve or reject the request in writing. The criteria on which the Engineer will base his decision are as follows:
 - 4.2.1. The job must be progressing on time and in accordance with the General Contractor's schedule.

4.2.2. The dollar value of work completed must be greater than fifty percent (50%) of the total contract amount. This dollar value of work completed will not include stored material.

4.2.3. There must be no other specific reason to maintain ten percent (10%) retainage.

- 5.** If the General Contractor claims additional cost because of any additional or changed contract work, and requests extra compensation therefor, he shall give the Engineer advance written notice of such costs, submitting a complete and detailed estimate thereof. Before starting such extra work, he shall secure a written order from the Owner covering such additions or changes. All claims not so established will be void. The extra-work cost estimates submitted for extra compensation shall be made on the basis of the unit prices named in the contract price schedule or, if not included in the unit cash bid, as mutually agreed upon.

- 6.** The General Contractor shall keep the work and grounds free from rubbish and waste material during the progress of the work. Immediately upon completion of the project, and before final payment is made, the General Contractor shall remove all rubbish, temporary structures, equipment, and excess materials and shall leave the work and premises in a neat and orderly condition acceptable to the Engineer.

SECTION 2 - SITE PREPARATION

A. Definitions

1. **Clearing:** Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including down timber, snags, brush, and rubbish occurring in the areas to be cleared.
2. **Grubbing:** Grubbing shall consist of the removal and disposal of stumps, roots, matted roots, and other protruding obstructions from the designated grubbing areas.
3. **Stripping:** Stripping shall consist of the removal and disposal of topsoil and other soils containing fibrous, organic, or other perishable matter that will decompose over time from areas to be filled.

B. Scope of Work

1. The General Contractor shall furnish all labor, material and equipment to complete the site preparation for Cell 1 of the Halifax County Ash Monofill ("The Cell"), including clearing, grubbing, stripping and all necessary and incidental items as detailed or required to complete the site preparation, all in accordance with the Contract Drawings and these Contract Specifications, except as noted below.
2. All borrow areas and spoil areas required during the course of the work.

3. Areas not included in the above, which are not otherwise required for the prosecution of the work, shall be maintained in their undisturbed state.

C. **Material and Construction**

1. Clearing shall be accomplished as follows: Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface. Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by the erection of barriers or by such other means as circumstances require. Clearing shall also include the removal and disposal of structures that obstruct, encroach upon, or otherwise obstruct the work.
2. Grubbing shall be accomplished as follows: Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be removed to the full depth of the obstruction below the original surface level of the ground in areas indicated to be grubbed and in areas indicated as construction areas under this contract. Depressions made by grubbing areas not to be excavated shall be filled with suitable material and compacted to make the surface conform with the original adjacent surface of the ground.
3. Stripping shall be accomplished as follows: In areas to be stripped, all materials shall be removed to a depth necessary to eliminate topsoil and other soils containing more than 5 percent by weight fibrous organic matter, rubbish, vegetable matter, roots, and all other perishable or objectionable matter. The minimum stripping depth shall be 6 inches. Stripped material shall be placed in storage areas for topsoil materials as designated by the Engineer or the County.

D. Disposal of Materials

1. That portion of salable timber and pulpwood, if any, after the County's timber removal operations, shall be cut and stockpiled as directed by the Engineer and will remain the property of the County. Other trees and underbrush shall be cleared, in so far as possible, by bulldozers or other equipment. In other areas clearing may be accomplished by hand cutting.
2. Vegetation materials shall be disposed of in a manner designated by the Engineer or the County.

E. Measurement and Payment

1. Payment for work covered under Section 2 - Site Preparation, shall be based upon the unit price for Site Preparation, per acre. The estimated quantity of acres for Section 2 was calculated by the Engineer using a take-off of anticipated areas requiring Site Preparation. Final payment shall be based on actual area prepared approved and measured by the Engineer.

SECTION 3 - EXCAVATION

A. Scope of Work

1. The General Contractor shall furnish all labor, material and equipment to complete the excavation of the landfill cell and related structures, including excavating, sealing, discing, drying, hauling, scraping, undercutting, stockpiling, and all necessary and incidental items as detailed or required to complete the excavation, all in accordance with the contract drawings and these Contract Specifications, except as noted below.
 - 1.1 Clearing and grubbing and removal of topsoil is addressed in Section 2 - Site Preparation, of these Contract Specifications.
 - 1.2 Removal of rock shall be covered under Section 4 - Rock Removal, of these Contract Specifications.

B. Material and Construction

1. The General Contractor shall strip all topsoil from the cell area, including perimeter berms and roadway as shown on the Contract Drawings, or as directed by the Engineer. The topsoil shall be placed in the topsoil stockpile as designated by the Engineer.
2. The General Contractor shall excavate to the lines and grades shown on the Contract Drawings and stockpile all excavated materials. As the excavation is made, the materials will be closely examined and identified by the Engineer. The General Contractor shall stockpile the materials in the appropriate stockpiles as directed by the Engineer. The General Contractor shall use equipment and methods as

necessary to maintain the moisture content of soils stockpiled (excluding topsoil) at or near their optimum moisture content.

2.1 Stockpiles shall be assigned for topsoil, Compacted Embankment, and for unsuitable natural on-site soils to be used as daily cover during MSW landfill operations as required by the County.

3. Sand and/or gravel layers encountered within the Cell shall be overexcavated as directed by the Engineer.
4. Stockpiles shall be properly sloped and the surfaces sealed by the General Contractor at the end of each working day, or during the day in the event of heavy rain, to the satisfaction of the Engineer.
5. The General Contractor shall protect all existing facilities including, but not limited to, existing utilities, and monitoring wells during the grading and stockpiling operations.
6. The General Contractor shall protect all finished lines and grades of the completed excavation.
 - 6.1 Any areas excavated below design subgrade elevations by the General Contractor, unless directed by the Engineer, shall be brought back to design elevations at no cost to the County. The General Contractor shall place and compact such material in accordance with Section 5 - Compacted Embankment of these Contract Specifications.
7. At the direction of the Engineer or County, the General Contractor may be required to leave designated portions of the subgrade above

design elevations a distance of 6 to 12 inches in order to protect the subgrade against erosion or other damage. Such areas shall be trimmed to design elevations just prior to placement of the overlying material.

8. Calculations made by the General Contractor necessary to locate the various items to be incorporated into the Cell shall be furnished to the Engineer for review prior to staking the location of the items. The General Contractor shall give the Engineer sufficient notice so he may observe the staking activities.

C. Measurement and Payment

1. Payment for work covers under Section 3 - Excavation, shall be based upon the Unit Price Bid for Excavation, per cubic yard. The estimated quantity of cubic yards of excavation was calculated by the Engineer using a take-off of existing grades compared to anticipated final excavation grades. Final payment shall be based on actual excavated quantities approved and measured by the Engineer. Additional or lesser payment under this section shall only be for the calculated volume corresponding to a higher or lower bottom Cell elevation and for excavation of sand and/or gravel layers beyond the limits of the design excavation lines, as described in paragraph C.2 below.
2. Additional payment for excavation of sand and/or gravel layers beyond the limits of the design excavation grades shall be on the basis of the Unit Price Bid for Excavation, per cubic yard. The Engineer shall measure the dimensions and calculate the volume of each excavation of a sand and/or gravel layer and submit this volume to the General Contractor for his concurrence.

SECTION 4 ROCK REMOVAL

A. Definitions

1. **Rock:** Any material occupying an original volume of at least one cubic yard which cannot be excavated with a single-tooth ripper drawn by a crawler tractor having minimum draw bar pull rated at not less than 56,000 pounds (Caterpillar D 8K, D9 or equivalent) or by a Caterpillar 977 front-end loader or equivalent. Excavation of material with larger equipment will be paid as Earth excavations unless Contractor demonstrates inability to excavate with above specified equipment.

B. Scope of Work

1. The General Contractor shall furnish all labor, material and equipment to remove any rock encountered during construction of Cell 1 deemed unsuitable by either the Engineer or the Owner. This section shall include removal and stockpiling of the unsuitable rock as well as the backfill and compaction required to bring the subgrade back to existing surrounding ground level.
2. No rock shall be removed prior to authorization by the Owner or Engineer.
3. Where rock is encountered above design subgrade elevations, rock shall be removed to approximately 2 feet below the lines and grades indicated on the excavation plans as approved by the Engineer.
4. The subgrade will be brought back up to grade by placing compacted Embankment as described in Section 5 of these Contract Specifications.

C. Material and Construction

1. Blasting operations shall be conducted in accordance with all existing ordinances and regulations. All structures shall be protected from the effects of the blast. The blasting shall be done by experienced workmen. Dispose of excavated rock in accordance with applicable local, state and federal regulations.
2. Any damage done shall be promptly repaired by the General Contractor at his expense.
3. Storage of explosive materials on the site will not be permitted.
4. A licensed blaster shall conduct all blasting operations, and no shot shall be fired without his approval.
5. When conducting blasting operations within one hundred fifty feet of an uninhabited structure or within three hundred feet of any inhabited structure, copies of a pre-blast survey shall be furnished to the Engineer prior to commencement of work. This survey should include noting and photographing of any existing cracks or other irregularities. In addition, all blasts within the above distances shall be monitored with a direct reading velocity seismograph. At the immediate location of an uninhabited structure the maximum peak particle velocity shall not exceed two inches per second. At the immediate location of an inhabited structure the maximum peak particle velocity shall not exceed one inch per second.
6. Copies of all blasting and seismograph reports, on forms acceptable to the Division Of State Fire Marshal, shall be submitted to the Engineer within three working days of each blast.

7. Where blasting is performed prior to removal of overburden, the Engineer shall be provided with drilling logs on twenty-five foot centers prior to excavation. The Engineer shall confirm this schedule as the excavation proceeds.

D. Measurement and Payment

1. Payment for work covered under Section 4 - Rock Removal, shall be based upon the unit price for Rock Removal, per cubic yard. Final payment shall be based on actual excavated quantities, if any, as approved and measured by the Engineer. Measurement will be made by computing the volume of rock removed as determined by before and after surveys.

SECTION 5 COMPACTED EMBANKMENT

A. Scope of Work

1. The General Contractor shall furnish all labor, material, and equipment to complete placement of Compacted Embankment including hauling, discing, drying, compaction, control of surface and subsurface water, final grading and sealing, and all necessary and incidental items as detailed or required to complete the Compacted Embankment, all in accordance with the Contract Drawings and these Contract Specifications.
2. Compacted Embankment shall be placed to the lines and grades shown on the Contract Drawings. Placement of Compacted Embankment outside the construction limits shall occur only as directed and approved by the Engineer.
3. The General Contractor shall protect all existing facilities including, but not limited to, utilities and monitoring wells.

B. Materials and Construction

1. All construction shall be performed in the presence of the Engineer or his representative at the discretion of the Engineer. The General Contractor shall inform the Engineer of the General Contractor's intention to perform such work.
2. Calculations made by the General Contractor necessary to locate the various items to be incorporated into the works shall be furnished to the Engineer for review prior to staking the location of the items. The

General Contractor shall give the Engineer sufficient notice so he may observe the location activities.

3. The Engineer or his representative shall inspect the exposed subgrade prior to placement of Compacted Embankment to assure that all topsoil, vegetation, roots, debris, or other deleterious materials have been removed.
4. The Compacted Embankment shall consist of on-site, clean natural soil classified as SM, SP, SC, ML, CL-ML, or CH using the Unified Soil Classification System (USCS) containing no topsoil or other deleterious material.
5. The Compacted Embankment shall be placed in maximum 10-inch thick horizontal lifts (loose measure) and shall be compacted to a density of at least 95% maximum standard dry density (ASTM D 698).
 - 5.1 Rock fragments, cobbles and boulders shall not exceed 3 inches in any dimension. Each lift shall be compacted prior to placement of succeeding lifts. In confined areas, mechanical equipment, suitable for small areas and capable of achieving the density requirements, shall be required.
 - 5.2 Lift compaction shall be performed with an appropriately heavy, properly ballasted, penetrating-foot or smooth-drum vibratory compactor. Compaction equipment shall be subject to approval by the Engineer.
6. The General Contractor shall be responsible for control and removal, as required, of groundwater seepage and surface water within the

construction area prior to and during placement of the Compacted Embankment. Methods of temporary seepage or surface water control shall be approved by the Engineer prior to operation of temporary systems.

7. Compacted Embankment that becomes soft or otherwise unsuitable shall be removed or repaired by the General Contractor as directed by the Engineer, at no cost to the County.
8. The General Contractor shall be responsible for preparing the materials for the Compacted Embankment, including but not limited to, in-place drying or wetting of the soil necessary to achieve the compaction criteria of these Contract Specifications.
9. Quality Assurance Service shall be provided by the Engineer and paid for by the County. The frequency of field compaction tests shall be determined by the Engineer. No fill or compaction work shall be performed unless the Engineer or his representative is present on the project site and is informed of the intent to perform such work. The General Contractor shall cooperate with the Engineer or his representative when compaction or other required tests are taken and make adjustments, as requires, in the filling and compacting operations to meet the compaction specifications. If the compaction test results do not meet the above specified requirements, the Contractor shall add water or dry the material, as may be necessary and continue compaction to achieve the compaction requirements, at his own expense.
10. The exposed surface of Compacted Embankment shall be rolled with a flat drum roller at the end of each work day to protect from adverse weather conditions.

11. The surfaces of the Compacted Embankment to be lined with geomembrane shall be free of roots or other deleterious material, sharp objects, or debris. Such materials shall be removed from the soil liner surface prior to geomembrane installation. Embedded, non-protruding smooth rocks or stones may remain in place on the soil liner surface, unless otherwise directed by the Engineer. The subgrade surface shall provide a firm, unyielding foundation for the geomembrane with no sudden or abrupt changes or breaks in grade. Geomembrane shall not be installed over subgrade containing standing water, frost, excessive moisture, or on subgrade exhibiting evidence of deep rutting from construction equipment wheels or tracks.

12. The soil surfaces to be lined with geomembrane, including slopes 3-horizontal to 1-vertical or gentler, shall be rolled and sealed with a smooth drum compactor. All geomembrane subgrade shall be approved by the Engineer prior to geomembrane placement.
 - 12.1 Slopes steeper than 3-horizontal to 1-vertical that will be lined with geomembrane shall be prepared by raking or other method approved by the Engineer.

13. The General Contractor shall maintain the surface of the Compacted Embankment until installation of the geomembrane is complete. Temporary covering of the bottom may be required prior to installation of the geomembrane.

14. Surfaces not properly maintained shall be repaired by the General Contractor at no cost to the County. A suitable surface for geomembrane construction shall be a surface at a specified compaction and moisture content criteria provided in these Contract Specifications.

15. Locations of control stakes in the Compacted Embankment in areas to be covered with geomembrane shall be scarified to the depth that the stakes were driven and recompacted to the requirements outlined above.
16. For Compacted Embankment placed for dike construction, the Engineer may require that the Compacted Embankment be overbuilt a distance of approximately 6 inches to protect against erosion or other damage. Such overbuilt areas shall be trimmed just prior to placement of geomembrane.

C. Measurement and Payment

1. Payment for work covered under Section 5, Compacted Embankment, shall be based upon the Unit Price Bid for Compacted Embankment, per cubic yard in-place for on-site soil sources.
2. Payment quantities shall be based on actual in-place quantities measured and approved by the Engineer.
3. Compacted Embankment placed outside the limits shown on the Contract Drawings shall not be included in payment quantities unless approved by the Engineer.
4. Quantities shall be determined by the Engineer. The total quantity shall not include the volume required for normal benching as detailed on the Contract Drawings. This quantity shall also not include replacement volumes for areas which have become unsuitable due to weather, construction disturbance or the overfill thickness required for erosion protection.

SECTION 6 - 60 MIL HDPE GEOMEMBRANE

A. Scope of Work

1. The General Contractor shall furnish all labor, material and equipment to install geomembrane including all necessary and incidental items as detailed or required to complete the installation in accordance with the Contract Drawings and these Contract Specifications. The General Contractor shall be responsible for timely submittals to the Engineer as required in Section 6 - 60-MIL HDPE Geomembrane in this Contract Specifications.
2. The anchor trench shall be excavated, maintained and backfilled by the General Contractor.

B. Material

1. The material for the Geomembrane shall be an approved High Density Polyethylene (HDPE) geomembrane in strict accordance with the Contract Drawings and these Contract Specifications. The geomembrane shall be approved by the Engineer and the County prior to Contract award.
2. The Manufacturer of the geomembrane described herein shall have previously demonstrated his ability to produce the required geomembrane by having successfully manufactured a minimum of ten million square feet of High Density Polyethylene geomembrane for hydraulic containment purposes. The General Contractor shall provide a certification to the above requirements.

3. Material for the geomembrane shall include pure High Density Polyethylene and carbon black, added for ultraviolet radiation resistance, and a maximum of 1 percent of other additives by weight. The geomembrane shall be manufactured of new, first quality products designed, manufactured and furnished by means consistent with National Sanitation Foundation (NSF) Standards. The geomembrane manufacturer shall have demonstrated, by successful prior use, that said material is suitable and dependable for such purposes.

4. The High Density Polyethylene used in the manufacture of the geomembrane shall be of high molecular weight and in accordance with the physical property requirements of the Contract Specifications. The geomembrane shall be produced so as to be free of holes, blisters, undispersed raw materials or any sign of contamination by foreign matter. Any such defect shall be repaired as approved by the Engineer. The Engineer may reject all or portions of units (or rolls) of geomembrane if significant quantities of production flaws are observed. The physical properties of the geomembrane shall be as described on Table 1 at the end of this Contract Specifications Section 6- 60 MIL HDPE Geomembrane.

5. The geomembrane producer shall submit a certification and supporting test data stating that each resin used for geomembrane production meets or exceeds the environmental stress cracking criteria outlined below.
 - 5.1 The resin shall exhibit a ductile/brittle transition time of greater than 100 hours using the Notched Constant Load Test (GRI - GM5 Condition A). The transition shall occur at a stress less

than 35% of the geomembrane yield stress as determined using ASTM D638.

6. A written certification shall be provided by the geomembrane manufacturer stating the producer, product designation, lot or batch number, and production date of all resin used in manufacture of all HDPE materials shipped to the site.
 - 6.1 This certification shall be submitted to the Engineer by the Geomembrane Contractor prior to or coincident with shipment of the geomembrane. Geomembrane shall not be accepted or approved unless all required certifications have been received by the Engineer.
7. Thickness of the finished Geomembrane shall be -4% to +10% of the nominal thickness value specified.
8. The outside of each roll shall identify product designation, the thickness of the sheet, panel number, if applicable, the length and width of each roll and manufacturer's batch or lot number.
 - 8.1 Labels or marking shall be located so that each roll of geomembrane can be identified by examining the roll or core edges. Markings or labels shall be weather proof.
9. No factory seaming of HDPE Geomembrane panels shall be accepted.
10. All compound ingredients (raw material) for HDPE geomembrane shall be randomly sampled and tested by the Geomembrane Manufacturer. A test result summary shall be furnished to the Engineer to assure compliance with the material requirements of this specification item.

The sampling frequency and testing procedures shall comply with the requirements as outlined in Table 1, Section 6 - 60 mil HPDE Geomembrane, of these Contract Specifications. A copy of the testing program, including frequency of tests per quantity of raw material and test method procedures, shall be submitted to the Engineer with the General Contractor bid. The summary of test results reflecting actual test frequency shall be furnished to the Engineer prior to or coincident with shipment of the geomembrane to the project site.

11. During production, the HDPE geomembrane manufacturer shall sample and test the manufactured sheet in accordance with applicable ASTM Standards. The minimum sampling frequency, testing procedures, and sheet physical properties, shall comply with the requirements as outlined in Table 1 Section 6 - 60 MIL HDPE Geomembrane, of these Contract Specifications.
12. The General Contractor shall submit a certification stating the percent of reclaimed polymer, by weight, that was incorporated into production of the lots or batches of geomembrane delivered to the project site. Reclaimed polymer shall not exceed 2% by weight for geomembrane or extrudate.
 - 12.1 At the option of the County, the Engineer may inspect the geomembrane manufacturing process on a full-time basis. The inspection program includes conformance sampling as required. The geomembrane manufacturer shall submit a production schedule to the County if requested and cooperate with the County during plant inspection.

13. The General Contractor shall submit a certification to the Engineer, prior to installation, that all HDPE geomembrane manufactured for the project has been produced in accordance with these specifications, and that a Quality Control testing program, in accordance with the Contract Specifications and approved by the Engineer, has been in effect, and that all required tests have been performed.
14. The certified summary of all raw material and sheet material tests including testing frequency and test methods used shall be issued to the Engineer prior to geomembrane delivery. No HDPE geomembrane shall be installed until the Engineer has reviewed the certified test summary and determined the geomembrane delivered is acceptable for use. Records, including test data, shall be maintained by the geomembrane manufacturer for one year and shall be made available upon request.
15. The General Contractor shall submit Quality Control Certificates reviewed and signed by the responsible representative of the geomembrane manufacturer. A Quality Control Certificate shall be submitted to the Engineer for each roll of geomembrane delivered to the project site prior to installation. Any roll not represented by a completed Quality Control Certificate shall not be approved for installation by the Engineer.
16. Quality assurance conformance testing of the geomembrane shall be performed by the Engineer and paid for by the County. Conformance sampling shall be completed at a minimum frequency of one sample every 100,000 square feet of geomembrane delivered and at least one sample per lot or batch as directed by the Engineer.

16.1 Conformance testing of the geomembrane shall include but not be limited to the following properties:

- 16.1.1** Density, ASTM D792
- 16.1.2** Melt Flow Index, ASTM D1238
- 16.1.3** Thickness, ASTM D1593
- 16.1.4** Tensile Properties, ASTM D638
- 16.1.5** Tear Resistance, ASTM D1004
- 16.1.6** Carbon Black Content, ASTM D1603
- 16.1.7** Carbon Black Dispersion, ASTM D3015

16.2 The Engineer may revise the test methods used for determination of conformance properties to allow for use of improved methods.

17. All geomembrane conformance test data as well as geomembrane manufacturer Quality Control testing shall meet or exceed requirements outlined in Table 1 Section 6 - 60 MIL HDPE Geomembrane, of these Contract Specifications prior to installation. Any materials that do not conform to these requirements shall be retested or rejected at the direction of the Engineer.

17.1 Geomembrane that is rejected shall be removed from the project site and replaced at General Contractor's cost. Sampling and conformance testing of geomembrane supplied as replacement for rejected material shall be performed by the Engineer at the General Contractor's cost.

C. Installation - Geomembrane Preparation and Placement

1. The Geomembrane Contractor must be approved by the Engineer and the County prior to Contract award. General Contractor qualifications shall be submitted for approval with the Geomembrane Contractor's bid, certifying he has installed a minimum of five million square feet of HDPE geomembrane for hydraulic containment purposes.
 - 1.1 The General Contractor shall be responsible for timely submittals to the Engineer and the County.

2. Approximately two weeks prior to arrival at the job site, the Geomembrane Contractor shall provide personnel resumes demonstrating compliance with the following requirements:
 - 2.1 A minimum of one field superintendent per shift shall be designated by the Geomembrane Contractor and approved by the Engineer and the County. Each field superintendent shall have a minimum of one year of field experience in installing HDPE geomembranes. Any change or replacement of superintendents during the project must be approved in advance by the Engineer and the County.
 - 2.2 Each seaming crew shall have a designated foreman. Said foreman must have a minimum one year HDPE geomembrane installation experience and must work continuously with the seaming crew.

3. The Geomembrane Contractor shall submit for the Engineer's approval, approximately two weeks prior to geomembrane shipment, six full sets of field erection drawings showing geomembrane panel

layout with proposed length and width, number and position of all geomembrane panels and indicating the location of all field welds. Field welds shall have a distinct identification system. Erection drawings shall also show complete details for field seaming and repairs, anchoring the geomembrane at the perimeter of the installation area, joining to structures, and attachments to other penetrations as required.

4. Prior to scheduled geomembrane installation, the General Contractor, Engineer and General Contractor shall be required to attend a pre-construction meeting at the project site. This meeting shall be scheduled by the County after receipt of field erection drawings.
 - 4.1 The General Contractor shall be represented by both the project field superintendent and the project manager.
 - 4.2 At the pre-construction meeting, site safety and rules of operation, quality assurance, scheduling and methods of installation shall be discussed. The General Contractor and Engineer shall at this time agree to the required welding, testing and repair procedures.
5. A daily field record shall be maintained by the General Contractor of actual placement of each panel, noting the condition of subgrade, weather, seaming parameters, panel numbers placed, seams welded, samples taken and tests run. A copy of each day's field record shall be submitted to the Engineer or his representative no later than the following work day.
6. The surfaces that are to receive the geomembrane shall be prepared in accordance with the Contract Drawings and Contract Specifications.

Once the subgrade has been approved by the Engineer, any additional surface preparation that the General Contractor feels necessary to meet the requirements of the Contract Specifications, shall be the responsibility of the General Contractor. The General Contractor shall install geomembrane only on approved subgrade that has been approved in writing by the General Contractor and the Engineer.

6.1 The geomembrane shall be placed only on subgrade that is free from rutting or other evidence of damage caused by vehicle traffic, erosion or other causes. Subgrade surface requirements, including allowances for desiccation cracking shall be as outlined in Section 5 - Compacted Embankment or other applicable section of these Contract Specifications.

6.2 Areas exhibiting deficient subgrade surface shall be reported to the Engineer and the County for repair.

7. It is imperative to keep surface water runoff from beneath the geomembrane at all times during installation. The General Contractor's panel placement, seam welding technique, placement and welding schedule shall minimize or eliminate the potential for accumulation of water beneath the geomembrane. Any water found ponded beneath the geomembrane after the geomembrane has been installed shall be removed by the General Contractor at no cost to the County as directed by the Engineer. Any soil subgrade beneath installed geomembrane that has become excessively moist, soft, or unsuitable to perform its intended function shall be removed and replaced by the General Contractor, as directed by the Engineer, at the General Contractor's expense.

8. Under no circumstances shall any construction or vehicular traffic be allowed to drive over the exposed geomembrane. Geomembrane showing evidence of traffic shall be inspected by the General Contractor and Engineer to determine damage, if any. At the direction of the Engineer, any such material shall be tested, rejected or repaired at no cost to the County.

9. Extreme care shall be taken by personnel while handling unwrapping, transporting, positioning, and seaming the geomembrane. The Engineer shall have the option of inspecting all geomembrane panels, prior to final placement, to assure that all defects or damages are identified for repair. This shall not replace final inspection by the General Contractor after installation is complete. Damage to geomembrane incurred during delivery, storage, or installation shall be repaired or replaced at General Contractor expense.
 - 9.1 Geomembrane shall be stored in a suitable area designated by the County. Geomembrane delivered on pallets or with folds or creases of any kind shall be rejected and removed from the site.

 - 9.2 Geomembrane shall be protected during storage so that roll labels remain in-tact and readable. Any roll of geomembrane that has no label or where the label is damaged or otherwise illegible may be rejected by the Engineer.

10. The General Contractor shall provide temporary anchorage of the geomembrane during installation in a manner approved by the Engineer. Any geomembrane exhibiting damage from wind or other causes shall be removed by the General Contractor at no cost to the County.

11. The General Contractor shall be responsible for excavation and maintenance of the geomembrane anchor trench as well as backfilling of the anchor trench.
 - 11.1 The anchor trench shall be "daylighted" to allow drainage while the trench is open. The General Contractor shall be responsible for preventing surface water runoff from accumulating beneath or over top of geomembrane while the anchor trench is open.
12. The geomembrane shall be installed so as to eliminate "trampolining" of the geomembrane at the toe of slopes at temperatures as low as 0°F. If trampolining is observed, the Engineer shall direct required repair in affected areas to be performed by the General Contractor at General Contractor's expense.
13. Extrusion or fusion welds of adjacent panels shall extend continuously along the full length of panels and into the geomembrane anchor trench.
14. The General Contractor shall place the geomembrane in such a manner that no seams exist in any sump bottom, or, as applicable, within 5 ft. laterally of sidewall riser pipe locations.
15. The General Contractor shall place and seam geomembrane panels in order to assure adequate, well distributed slack exists to account for expansion or contraction of the geomembrane. For this purpose, the General Contractor may use a working range of liner temperatures from 0 to 150°F to determine the required techniques.

- 15.1 In critical areas such as sidewalls, sumps, and corners, the General Contractor may propose slack control techniques for approval by the Engineer.
16. Seams shall be oriented in a direction parallel to the line of maximum subgrade slope and shall be placed in a manner that minimizes the number and length of field seams.
17. For geomembranes placed on slopes, the panels shall be placed such that the "upstream" panel forms the upper panel and overlaps the "downstream" panel in order to minimize infiltration potential.
18. All longitudinal seams shall be at least 10 ft. from the toe of the sideslope, except in the sump area as directed by the Engineer.

D. Installation - Production Seaming of Geomembrane

1. All seaming, sealing and welding material shall be of a type or types recommended by the Geomembrane Manufacturer and shall be delivered in the original sealed containers, each with an indelible label bearing the brand name, manufacturer's batch or lot number, and complete directions as to proper storage.
2. No production seaming shall commence until trial seaming, as outlined in Section 6.E of these Contract Specifications, is successfully completed and approved by the Engineer.
3. The Engineer and the County, in conjunction with the General Contractor, shall establish site-specific limits of weather conditions - including, but not limited to, temperature, humidity, precipitation and wind speed and direction - within which geomembrane panel

placement and seaming can be conducted. In the absence of site-specific criteria, the following limitations shall apply:

- 3.1 No seaming shall be conducted in the presence of precipitation, such as rain, snow, sleet, dew or fog, in or below the seam area.
 - 3.2 No seaming shall be conducted in the presence of high winds, when dirt or debris is blown into seam areas, or when seam temperatures cannot be adequately monitored and controlled.
 - 3.3 Seaming shall not be conducted when ambient temperature falls below 35°F unless approved by the Engineer. In order for seaming to be approved, the General Contractor shall be required, at a minimum, to perform an additional trial seam to demonstrate conformance with these Contract Specifications. The Engineer reserves the right to require additional destructive seam testing when seaming is conducted at ambient temperatures below 35°F.
 - 3.3.1 The General Contractor shall be prepared to pre-heat the seam area prior to production seaming in accordance with the Geomembrane Manufacturer recommendations.
 - 3.4 Seaming shall not be conducted when ambient temperature exceeds 104°F unless approved by the Engineer. Criteria for demonstration of conformance shall be outlined by the Engineer.
4. For purposes of monitoring production geomembrane seaming, ambient temperature shall be monitored by the Engineer. Ambient

temperature shall be recorded at multiple locations along the seam at a distance of 6-inches above the geomembrane surface.

5. Lap joints shall be used to weld panels of HDPE geomembrane together in the field. A minimum overlap of 3-inches shall be used. Seams shall be fusion or extrusion-welded and as prescribed by the Geomembrane Manufacturer and approved by the Engineer. For production seaming of geomembrane panels, fusion seaming is the preferred method. Panels shall be held in position in a manner approved by the Engineer, to prevent movement during welding, and to maintain a "flat" lap of panels. The weld area shall be prepared to provide a suitable surface for adherence to panels to be welded. The weld area shall be free of dirt, dust, moisture, or other foreign material, and the cleaning process shall be approved by the Engineer. The weld shall be applied as soon as is practical after preparation and cleaning is completed. No glue or tape shall be used to temporarily hold panels together before welding. No solvents shall be used to clean panels prior to welding.
6. Temporary bonding of geomembrane panels or patches to be extrusion welded may be completed using hot air equipment, such as a "Leister". Overheating of the geomembrane during temporary bonding shall result in rejection of the seam or patch in question and repair as directed by the Engineer.
7. All Geomembrane panels placed shall be seamed on the same day that they are placed except where explicitly approved by the Engineer.
8. 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 a patch shall be applied. During wrinkle or fold

repairs, adjacent geomembrane may not necessarily be required to meet the 3-inch minimum overlap, if approved by the Engineer.

9. Engineer shall observe areas to be prepared by grinding, where applicable, to assure that excessive grinding does not occur and that the upper sheet is properly beveled, where applicable.
 - 9.1 Grinding shall be considered to be excessive when the sheet is deeply scored or when abrasion is evident more than 1/4-inch outside the completed extrusion weld area. The Engineer may require repair of such areas, which may include removal and replacement of the affected geomembrane.

10. The General Contractor shall not cause excessive overheating of the geomembrane. Excessive overheating shall be defined as any of the following:
 - 10.1 Application of seaming temperatures or seaming rates that result in visible warping or deformation of the bottom surface of the lower geomembrane in the seam area.
 - 10.2 Seaming over an existing weld ("piggybacking"), except for seam cross tee patches over fusion seams,
 - 10.3 Seaming using temperatures in excess of the manufacturer's recommended seaming temperature as defined at the pre-construction meeting.

11. Application of a bead of extrudate over damaged geomembrane (bead repairs) shall be prohibited, except where explicitly approved by the Engineer in advance.

- 11.1** Surface defects, small tears, punctures, etc. shall be repaired using a patch with a minimum size of 12 inches by 12 inches and having rounded edges.
- 12.** Fusion seams shall not be repaired by placing extrusion welds directly over previously seamed areas. Seam end tabs for fusion seams shall not be removed by cutting or tearing.
- 12.1** Under no circumstances shall seams be placed over existing seams for repair purposes unless the affected area is less than 5 ft. in length and is approved by the Engineer in advance.
- 12.2** Fusion seams shall be repaired by using a patch or cap strip approved by the Engineer.
- 13.** The Engineer may require repair or replacement of any area where excessive grinding, overheating, or unacceptable preparation, seaming or testing techniques are observed. Such repair or replacement may be required even if samples removed from affected areas pass destructive peel or shear testing.
- 13.1** All required repairs shall be completed by the General Contractor at no expense to the County.
- 14.** Any geomembrane area showing damage due to excessive scuffing, puncture or distress from any cause, shall, as directed by the Engineer, be replaced or repaired.
- 15.** All patches for repair of the geomembrane shall have rounded corners such that the repair may be completed with a continuous extrusion weld.

16. Each extrusion welding machine shall be purged of old extrudate prior to the start of each weld run. The extruders used shall be capable of continuously monitoring and controlling the temperatures of the extrudate and the zone of contact (nozzle), to assure compliance with these Contract Specifications and General Contractor field welding recommendations.

E. Geomembrane Seaming - Test Welds and Test Weld Sampling

1. The General Contractor shall be responsible for performing field testing of all test welds. The General Contractor shall submit for Engineer's review and approval at the time of bid submittal, a test weld quality control testing program. The General Contractor shall modify the quality control testing program to comply with the Engineer's requirements for testing, sampling and resampling of test welds.
2. Test welds shall be performed for each welder whenever any of the following conditions occur: (1) shift start-up, (2) "cold" restart of the welder, (3) change in welding technician, (4) significant change in ambient temperatures, or (5) as required by the Engineer.
3. Test welds shall at least 5-ft in length and be conducted using the same personnel, equipment and seaming parameters as will be used during production seaming.
4. Sampling of the test weld shall be conducted from the center two-thirds of the seam length once an appropriate cooling period has passed.

5. The General Contractor shall obtain duplicate "preweld" test samples, suitable for testing. One sample shall be kept by the General Contractor for testing at the project site in the presence of the Engineer. The duplicate sample shall be furnished to the Engineer for the project record and/or possible future testing. The duplicate sample shall be marked with date, time, ambient temperature, welder, weather conditions, and welding parameters (heat, rate of travel, etc.). Specimens tested by the General Contractor shall be marked and stored on the project site for inspection by the County or the Engineer.
6. Test results acceptable to the Engineer shall be obtained prior to performing any installation production welding. This may require resampling completed test seams or repeating the trial seam process. The results of tests shall be noted in the General Contractor's "preweld" test summary log or daily diary and a copy furnished to the Engineer not later than the next work day.
7. The trial seam test specimens shall be tested in peel in accordance with the approved quality control testing program. A minimum of three specimens shall be tested for each trial seam. Qualification criteria for all destructive prewelding testing shall be the Film Tear Bond (FTB) criteria. The failure of the seam specimen shall be in the parent sheet, not the weld. Under certain conditions, a partial disbond observed during peel testing of 20% of the weld width or less, may be accepted by the Engineer. Testing of additional specimens shall be performed as required by the Engineer. A failure within the weld area as designated by the Engineer shall constitute disqualification and require a new trial seam test of the welding equipment, as directed by the Engineer.

7.1 For double hot wedge type seams, both seams shall be tested for all field and laboratory destructive testing.

F. Geomembrane Seaming - Production Seam Testing

1. The General Contractor shall be responsible for completing nondestructive testing of the entire length (100%) of all field seams, including cap strips, and verifying that all seams are watertight. The testing method shall be a vacuum test, air-pressure test, or approved equal. The test procedure shall be described in writing by the General Contractor and submitted with the bid and approved by the Engineer prior to installation. Upon completion of the vacuum testing, air-pressure test, or approved equal, a written report shall be submitted to the Engineer by the General Contractor certifying that all seams were tested.

1.1 Seams or portions of seams that cannot be nondestructively tested due to access constraints or other reasons may be required to be covered with a cap-strip as required by the Engineer.

2. The Engineer shall approve procedures proposed by the General Contractor for nondestructive testing of geomembrane seams including, but not limited to, the following items:

2.1 Vacuum Test (as required)

2.1.1 Test device

2.1.2 Vacuum pressure

2.1.3 Vacuum duration at each location

2.2 Air Pressure Testing (as required)

2.2.1 Maximum pressure

2.2.2 Test duration

2.2.3 Maximum allowable pressure drop

2.2.4 Allowance for geomembrane expansion or contraction during pressure testing

2.2.5 Retesting procedures

3. Where practical, the General Contractor or Engineer shall sample the ends of production seams at the panel ends. Field destructive testing for these samples shall be performed on-site by the General Contractor using the test method and approval criteria outlined in Paragraph E.7 for test weld samples.

3.1 If the end samples do not exhibit acceptable failures, the Engineer may require that the General Contractor sample additional locations on the same seam and/or adjacent seams for laboratory destructive testing.

4. The General Contractor shall obtain duplicate samples of production welds suitable for destructive testing. The samples shall be obtained at a rate of one pair (sample and duplicate) per 500 linear feet of welded seam. Additional samples shall be removed by the General Contractor from areas of questionable integrity, as directed by the Engineer. The Engineer shall be responsible for destructive testing one of the sample pairs as described in Paragraph F.5. The duplicate sample shall be furnished to the Engineer for the project record and/or possible future testing. These samples shall be obtained from locations as directed by the Engineer and shall be repaired by the addition of a patch to the sampling location. Each sample size shall

not be less than 12 inches by 24 inches with the longer dimension measured parallel to the seam. The seam shall be in the center of the sample parallel to the longer dimension of the sample. The seam repair at destructive test sample location shall be nondestructively tested by the General Contractor to verify its integrity.

4.1 An additional duplicate sample may be retained for testing by the General Contractor. This testing, if performed, shall be completed at no cost to the County.

5. The weld in the destructive sample shall be laboratory tested in peel (ASTM D413) and shear (ASTM D3083). Qualification criteria for all destructive seam testing shall be the Film Tear Bond (FTB) as well as load criteria outlined below. The failure of the seam specimen shall be in the parent sheet, not the weld. Under certain conditions, a partial disbond observed during peel testing of 10% of the weld width or less, may be accepted by the Engineer. A failure within the weld area as designated by the Engineer shall require resampling and retesting, as directed by the Engineer.

5.1 Five specimens from each laboratory destructive test sample shall be tested for Bonded Seam Strength using ASTM D3083 as modified in NSF Standard Number 54 using 1-inch wide by 6-inch long die cut specimens and a strain rate of 2-inches per minute. The load at failure shall be at least 90 percent of the yield strength (in pounds per inch width) of the parent geomembrane. Failures exhibited in areas prepared by grinding outside of the extruded areas of extrusion seams may require resampling and retesting.

- 5.2 At least five specimens from each laboratory destructive test sample shall be tested for Peel Adhesion using ASTM D413 as modified in NSF Standard Number 54 using a minimum of 1-inch wide by 6-inch long die cut specimens and a strain rate of 2-inches per minute. The load at failure shall be 60 percent of the yield strength of the parent geomembrane (in pounds per inch width) or greater. Strain at failure shall be at least 30 percent.
- 5.3 In order for the destructive sample to be considered qualified at least four of the five peel and four of the five shear specimens shall meet all load, strain and FTB criteria. If any specimens fail, the Engineer may test additional specimens in order to determine seam conformance. The Engineer shall determine conformance of each sample in cases of dispute.
6. Destructive laboratory conformance testing shall be the responsibility of the Engineer, and associated costs shall be performed at County expense. The General Contractor shall be responsible for all sampling and repair of sample locations for laboratory and field destructive testing.
7. Should the test results of any destructive test samples removed from production welds not meet the conformance criteria outlined in these Contract Specifications, the Engineer may require that additional samples be taken from welds performed during the same work shift as the failing weld sample. If a destructive sample fails to meet the physical properties required by the Contract Specifications, the General Contractor shall obtain additional test samples a distance of approximately 10-feet in both directions from the original sample for laboratory destructive testing. All resampling, repairing, and retesting

shall be the responsibility of the General Contractor and shall be performed at the General Contractor's expense. Depending on the results of these retests, the Engineer shall approve the repair procedure.

7.1 In order to be considered qualified, each failed destructive seam sample shall be bounded by two passing destructive seam samples. Alternatively, the entire length of the seam in question may be repaired by placement of a cap strip.

8. The Engineer or the County may require additional random samples be taken for destructive testing in areas that visually appear defective and/or not in accordance with these Contract Specifications. Testing of these samples shall be completed by the Engineer, but obtaining the samples and repairing the sample areas shall be the responsibility of the General Contractor.
9. A final visual examination of all welds and in-place geomembrane shall be completed by the Engineer. The General Contractor shall repair, in accordance with these Contract Specifications, any area designated by the Engineer as not in accordance with the Contract Specifications. The General Contractor shall be responsible for cleaning, sweeping, or other measures necessary to provide a thoroughly visible geomembrane surface for the Engineer's inspection. The Engineer's inspection shall be performed following a complete inspection and approval by the General Contractor's foreman or designated quality control technician.

G. Warranty

1. The General Contractor shall guarantee the integrity within the realm of the limitations of the General Contractor's responsibility of the installed geomembrane for its intended use, from material or installation defects, for a period of two years from the date of acceptance.
2. Such written warranty shall provide for the total and complete repair and/or replacement of any defect or defective areas of geomembrane upon written notification and demonstration by the County of the specific nonconformance of the geomembrane or installation with the Contract Specifications. Such defects or nonconformance shall be repaired and/or replaced expeditiously, at no cost to the County.
3. The General Contractor shall be responsible for obtaining any necessary guarantees or certifications from the Geomembrane Manufacturer and submitting them to the Engineer and Company prior to acceptance of the installed geomembrane.

H. Measurement and Payment

1. Payment for work covered under Section 6 - 60 MIL HDPE Geomembrane shall be on the basis of the Unit Price Bid for Geomembrane, per square foot in-place including material and installation.
2. Installed quantities shall be determined by the Engineer. Said areas shall be the actual area of lined surface, including the required rubsheets, cap sheets, and geomembrane placed in the anchor trench. This quantity shall not include overlap at seams, cap strip repairs or other repair areas.

3. Payment for geomembrane material shall be made following appropriate storage on site and following approval of all required certification submittals in accordance with these Contract Documents.
4. Delivery date of the geomembrane to the jobsite shall be approved by the County prior to shipment. The General Contractor shall be responsible for unloading and stockpiling materials at time of delivery and in areas approved by the Engineer and the County.
5. Payment for geomembrane installation shall be based upon approved installation quantities through regular progress payments and in accordance with these Contract Specifications.
6. Final payment for geomembrane material and installation shall be withheld by the County until all required documents have been submitted to the Engineer by the General Contractor.

TABLE 1

REQUIRED PHYSICAL PROPERTIES OF 60 MIL HDPE GEOMEMBRANE⁽¹⁾

PROPERTY (UNITS)	TESTING FREQUENCY	TEST METHOD ⁽²⁾	MIN/MAX VALUES
Thickness (mils)	each roll	ASTM D751	57-66
Density, (g/cc)	each roll	ASTM D792, Method A-1	0.935 min
Melt Index (g/10 min)	one per lot or batch (railcar)	ASTM D1238, condition 190/2.16	1.0 max
Carbon Black Content (%)	each roll	ASTM D1603	2.00 - 3.00
Carbon Black Dispersion (Grade)	each roll	ASTM D3015	A1 (3)
Minimum Tensile Properties, each direction	each roll	ASTM D638, type IV, specimen @ 2 ipm	
1. Tensile Stress @ Yield (lb/in.)	test in each principal sheet direction		120 min
2. Tensile Stress @ Break (lb/in.)			180 min
3. Elongation @ Yield (%)			10 min
4. Elongation @ Break (%)			600 min
Tear Resistance (pounds)	each roll	ASTM D1004, die C	40 min
Brittleness Temperature (deg F)	one per lot	ASTM D746, Procedure B	-40° F no failures
Notched Constant Load Test	one per resin	GRI GM 5	Transition time > 100 hours at < 35% of yield stress
Environmental Stress Crack	one per lot	ASTM D1693, Condition C	0 failures @ 1000 hours

NOTE (1): The required physical properties specified herein may be revised by the Engineer to reflect new or revised test methods or to conform with improvements on the current state-of-the practice.

NOTE (2): Number of specimens per test established in applicable test method unless otherwise noted.

NOTE (3): Grading Observation Standard to be agreed upon between manufacturer and Engineer.

SECTION 7 - GEOTEXTILE

A. Scope of Work

1. For the proposed construction, three distinct geotextile types are specified: a Filter Geotextile, a Cushion Geotextile and a Separator Geotextile. The Filter Geotextile will be installed around riser pipes. The Cushion Geotextile will be placed beneath the riser and aggregate to provide geomembrane protection. The Separator Geotextile will be placed between soil subgrade and aggregate for unpaved access roads and surface water control structures constructed outside of the landfill.

1.1 For the location of each type of geotextile see the Contract Drawings.

2. The General Contractor shall furnish all Geotextiles including all necessary and incidental items as detailed or required for the General Contractor to complete the installation in accordance with the Contract Drawings and these Contract Specifications, except as noted below.

2.1 Geotextile used as a Silt Fence is covered under Section 12 - Erosion and Sedimentation Control, of these Contract Specifications.

B. Materials

1. The Filter Geotextile shall be a minimum 6-ounce per square yard nonwoven needlepunched synthetic fabric consisting only of continuous filament polyester or polypropylene manufactured in a

manner approved by the Engineer and the County. The geotextiles shall be inert and unaffected by long-term exposure to chemicals or liquids with a Ph range from 3 to 10. The geotextiles shall have a minimum threshold water head of 0.25-inches in the "as received" condition.

2. The Cushion Geotextile shall be a minimum 16-ounce per square yard nonwoven needlepunched synthetic fabric consisting only of polyester or polypropylene manufactured in a manner approved by the Engineer and the County. The geotextiles shall be inert and unaffected by long-term exposure to chemicals or liquids with a Ph range from 3 to 10.
3. The Separator Geotextile shall be a woven or nonwoven spunbonded or needlepunched synthetic fabric consisting of polyester or polypropylene manufactured in a manner approved by the Engineer and the County.
4. All geotextiles shall conform to the properties listed using the test methods listed in Table 7-1. The General Contractor shall be responsible for timely submittals of all confirmation test data for Geotextiles at the time of bid submittal.
5. Prior to shipping to the site, the General Contractor shall submit to the Engineer two copies of a mill certificate or affidavit signed by a legally authorized official of the Manufacturer for each type of Geotextile. The Supplier shall also submit three geotextile samples of each product, 1 yard square each, with the mill certificate for each geotextile type supplied. The mill certificate or affidavit shall attest that the geotextile meets the chemical, physical and manufacturing requirements stated in the specifications. The samples shall be

labeled with the manufacturer's lot number, machine direction, date of sampling, project number, specifications, manufacturer and product name.

6. During periods of shipment and storage, all geotextiles shall be protected from direct sunlight, temperature greater than 140°F. water, mud, dirt, dust, and debris. To the extent possible, the geotextile shall be maintained wrapped in heavy-duty protective covering until use. Geotextile delivered to the project site without protective wrapping shall be rejected.
7. The County shall approve the shipping and delivery schedule prior to shipment. The County shall designate the on-site storage area for the geotextiles.
8. The Engineer shall be furnished copies of the delivery tickets or other approved receipts as evidence for materials received that will be incorporated into construction.

C. **Quality Assurance Conformance Testing**

1. Representative samples of Geotextiles shall be obtained and tested by the Engineer to assure that the material properties conform with these Contract Specifications. Conformance testing shall be conducted by the Engineer and paid for by the County.
2. Conformance testing shall be completed at a minimum frequency of one sample per 100,000 square feet of geotextile delivered to the project site. Sampling and testing shall be as directed by the Engineer.

3. Conformance testing of the geotextiles shall include but not be limited to the following properties:

- 3.1 Geotextile

- 3.1.1 Mass Per Unit Area (ASTM D3776)

- 3.1.2 Thickness (ASTM D5199)

- 3.1.3 Grab Tensile Strength (ASTM D4632)

- 3.1.4 Burst Strength (ASTM D3786)

- 3.1.5 Puncture Resistance (ASTM D4833)

4. The Engineer may add to, remove or revise the test methods used for determination of conformance properties to allow for use of improved methods.

5. All geotextile conformance test data shall meet or exceed requirements outlined in Table 7-1, Section 7 - Geotextile, of these Contract Specifications for the particular category of geotextile prior to installation. Any materials that do not conform to these requirements shall be retested or rejected at the direction of the Engineer.

- 5.1 Geotextile that is rejected shall be removed from the project site and replaced at General Contractor's cost. Sampling and conformance testing of geotextile supplied as replacement for rejected material shall be performed by the Engineer at General Contractor's cost.

D. Construction

1. Geotextiles shall be placed to the lines and grades shown on the Contract Drawings. At the time of installation, the geotextile shall be rejected by the Engineer if it has defects, rips, holes, flaws, evidence of deterioration, or other damage.
2. The surface receiving the Separator Geotextile shall be prepared to a relatively smooth condition, free of obstructions, excessive depressions, debris and very soft or loose pockets of soil. This surface shall be approved by the Engineer prior to geotextile placement.
3. The geotextiles shall be placed smooth and free of excessive wrinkles.
4. When the Filter or Cushion Geotextiles are placed with upslope and downslope portions, the upslope fabric portion shall be lapped such that it is the upper or exposed geotextile.
5. Geotextiles shall be temporarily secured in a manner approved by the Engineer prior to placement of overlying materials. Where applicable, geotextile shall be overlapped and heat bonded (tacked) at the joints on the sideslopes as shown on the Contract Drawings.
6. Overlaps of adjacent rolls of Separator Geotextile shall be at least 12-inches but not to exceed 18-inches. The General Contractor may sew adjacent panels using methods approved by the Engineer. If sewing is used, overlap distances may be reduced.
7. Overlaps of adjacent rolls of Filter or Cushion Geotextiles shall be at least 6-inches but not to exceed 12-inches. If heat bonding is used to

join adjacent panels, the General Contractor may reduce overlaps to 3-inches.

8. Any geotextile that is torn or punctured shall be repaired or replaced as directed by the Engineer by the General Contractor at no additional cost to the County. The repair shall consist of a patch of the same type of geotextile placed over the failed areas and shall overlap the existing geotextile a minimum of 12-inches from any point of the rupture.

E. Measurement and Payment

1. Payment for Filter Geotextile (material and installation) shall be on the basis of the Unit Price Bid for Filter Geotextile, per square yard in-place.
2. Payment for Separator Geotextile (material and installation) shall be on the basis of the Unit Price Bid for Separator Geotextile, per square yard in-place.
3. Payment for Cushion Geotextile (material and installation) shall be on the basis of the Unit Price Bid for Cushion Geotextile, per square yard in-place.
4. The quantity of each type of Geotextile required for the project has been estimated based upon the dimensions shown on the Contract Drawings. Payment shall be based upon the quantity ordered by the County and delivered to the project site and installed at the respective Unit Price Bid for Geotextile, per square yard.

5. In-place quantities shall be verified by the Engineer and shall not include overlap material, repair areas or waste material.
6. The General Contractor shall be responsible to pay for additional materials required, at no cost to the County, to replace geotextile damaged by the General Contractor or to make up for excessive overlaps and waste during installation. The replacement material shall be the exact same brand and type as that it is replacing unless the Engineer approved and accepts another brand and type.
7. The County reserves the option to purchase geotextile directly from the supplier or to provide geotextile to the General Contractor for installation. For these cases, payment shall be made to the General Contractor for installation of the geotextiles only.

TABLE 7-1 - REQUIRED GEOTEXTILE PROPERTIES

GEOTEXTILE PROPERTY*	FILTER GEOTEXTILE	CUSHION GEOTEXTILE	SEPARATOR GEOTEXTILE
Geotextile Construction	Nonwoven Needlepunched	Nonwoven Needlepunched	Woven or Nonwoven
Mass per Unit Area (Unit Weight), ASTM D3776 (oz/yd ²)	5.5	15	N/A
Ultraviolet Resistance, (500 hrs.) ASTM D4355, Average % Strength Retention	70	70	70
Grab Tensile Strength (lbs.), ASTM D4632	130	300	200
Grab Tensile elongation (%) ASTM D4632	25	25	N/A
Wide Width Tensile Strength, (lbs./in.) ASTM D4595	N/A	N/A	N/A
Wide Width elongation (%) at Break, ASTM D4495	N/A	N/A	N/A
Burst Strength, ASTM D3786, Diaphragm Method (psi)	200	675	400
Apparent Opening Size (AOS), (mm), ASTM D4751	0.2 - 0.35	N/A	N/A
Permittivity at 50 mm constant head (sec ⁻¹), ASTM D4491	1	N/A	N/A
Puncture Resistance, ASTM D4833 (lb)	40	150	75

* Minimum Values

SECTION 8 - SYNTHETIC DRAINAGE MEDIA (GEONET)

A. Scope of Work

1. The General Contractor shall furnish all labor, material and equipment to install Synthetic Drainage Media (SDM) including all necessary and incidental items, as shown on the Contract Drawings and these Contract Specifications.
2. Requirements for the overlying geotextile and heat bonding to the geonet, if applicable, are not included in this section.

B. Material

1. The Synthetic Drainage Media (SDM) shall consist of the following material as approved by the Engineer:
 - 1.1 A geonet manufactured of polyethylene having a minimum density of 0.92 gm/cc at least 5 mm in thickness. Foamed geonets shall not be accepted.
2. The SDM shall exhibit a hydraulic transmissivity of 0.5 gpm/ft (1×10^{-4} m²/sec) or greater at a normal compressive stress of 15,000 psf at a hydraulic gradient of 0.25 after a seating period of at least 100 hours. Testing shall be in accordance with ASTM D4716 using the single normal compressive stress and hydraulic gradient stated above. Testing shall be conducted with the specimen placed between two rigid plates. Testing shall be performed at no expense to the County.
 - 2.1 The Engineer may require additional hydraulic transmissivity testing using a specimen that more closely represents the

proposed facility cross section. Such testing may include the use of geotextile(s), soil and/or additional normal compressive stresses and hydraulic gradients. This testing, if required, shall be performed by the Engineer at County expense. The General Contractor shall supply the required SDM samples to the Engineer for testing as required.

3. The results of the hydraulic transmissivity testing performed by the geonet supplier shall be submitted to the Engineer with the General Contractor's bid. At that time, two samples of each Synthetic Drainage Media, 1 yard square each, shall be furnished for possible confirmation testing by the Engineer.
4. Prior to shipping to the site, the General Contractor shall submit to the Engineer two copies of a mill certificate or affidavit signed by a legally authorized official of the manufacturer. The General Contractor shall also submit one sample, one yard square in size, with the mill certificate for each material. The mill certificate and affidavits shall attest that the Synthetic Drainage Media meets the chemical, physical and manufacturing requirements stated in these specifications. The samples shall be labeled with the manufacturer's lot or batch number, machine direction, if applicable, date of sampling, project number, manufacturer and product name.
5. The General Contractor shall submit for the Engineer's approval, two full sets of field erection drawings showing panel layout for SDM at least two (2) weeks prior to installation. The erection drawings shall show panel lengths, locations, overlaps, method of securing joints, jointing to structures and attachments to penetrations as shown in the Contract Drawings.

6. The County shall approve the shipping and delivery schedule prior to shipment. The County shall designate the on-site storage area for the SDM.
7. The General Contractor shall furnish the Engineer a copy of delivery tickets or other approved receipts evidence for materials received that will be incorporated into the construction.

C. Quality Assurance Conformance Testing

1. At the option of the County, representative samples of Synthetic Drainage Media shall be sampled and tested to assure that the material properties conform with these Contract Specifications. Conformance testing will be conducted by the Engineer and paid for by the County.
2. Conformance testing shall be completed at a minimum frequency of one sample per 100,000 square feet for each type of SDM delivered to the project site. Sampling and testing shall be as directed by the Engineer.
3. Conformance testing of the geonet for Synthetic Drainage Media shall include, but not be limited to the following properties:
 - 3.1 Density, ASTM D792
 - 3.2 Melt Flow Index, ASTM D1238
 - 3.3 Thickness, ASTM D1777
4. Conformance sampling of the geonet shall be completed on site by the Engineer.

5. The Engineer may add to or revise the test methods used for determination of conformance properties to allow for use of improved methods.
6. All geonet conformance test data shall meet or exceed requirements outlined in these Contract Specifications prior to installation. Any materials that do not conform to these requirements shall be retested or rejected at the direction of the Engineer.

6.1 Geonet that is rejected shall be removed from the project site and replaced at General Contractor's cost. Sampling and conformance testing of SDM supplied as replacement for rejected material shall be performed by the Engineer at General Contractor's cost.

D. Construction

1. SDM shall be placed to the lines and grades shown on the Contract Drawings. At the time of installation, the SDM shall be rejected, if it has defects, rips, holes, flaws, evidence of deterioration or other damage.
2. The SDM shall be placed only on geomembrane that has been approved by the General Contractor and accepted by the Engineer. The General Contractor shall coordinate with the General Contractor for optimum scheduling.
3. The General Contractor shall provide temporary anchorage of the SDM at the top of perimeter and interior berms during installation to prevent movement during construction. Such anchorage may include

sandbags and the like, as approved by the Engineer. Permanent bonding to the geomembrane shall be prohibited.

4. Adjacent rolls of geonet shall be overlapped a distance of at least 3-inches and secured using polyethylene ties. For geonet placed on slopes, the ties shall be placed every 5-ft. For geonet placed on the facility floor, tie spacing shall be every 10-ft.
 - 4.1 The overlying protective geotextile, where applicable, shall extend at least 6-inches past the geonet joint and shall be either temporarily secured in place or permanently bonded in a manner approved by the Engineer.
 - 4.2 No end (transverse) SDM joints shall be constructed on landfill sideslopes or within 10 feet of the toe of the sidewall slope, except where approved in advance by the Engineer.
5. Any SDM that is torn, crushed or punctured shall be repaired or replaced by the General Contractor at no additional cost to the County. The repair shall consist of a patch of the same type of material, placed over the failed area and shall overlap the existing material a minimum of 12-inches from any point of the rupture. The patch shall be connected to the geonet using polyethylene ties at a 5-ft spacing.
6. The General Contractor shall remove debris, including sediment to the degree possible, from the sump areas prior to placement of the SDM. The sump areas shall be approved by the Engineer prior to SDM placement.

E. Measurement and Payment

1. Payment for Synthetic Drainage Media shall be based upon the Unit Price Bid for Synthetic Drainage Media Installation, per square foot in-place including material. Installed quantities shall be determined by the Engineer and shall be the actual area covered, including material placed in the anchor trench where applicable. Payment quantity shall not include overlap at seams, repairs or waste SDM.
2. The quantity of Synthetic Drainage Media required for the project has been estimated based upon the dimensions shown on the Contract Drawings. Payment for material shall be based upon the quantity ordered by the County, delivered to the project site, and installed by the General Contractor.
3. The General Contractor shall be responsible to pay for additional materials required, at no cost to the County, to replace Synthetic Drainage Media damaged by the General Contractor or to make up for excessive overlaps and waste during installation.

SECTION 9 - OPERATIONAL COVER

A. Scope of Work

1. The General Contractor shall furnish all labor, material, and equipment to complete the Operational Cover, including hauling, removal of surface water and removal of all previously placed material that is unsuitable due to weather conditions, final grading and sealing and all necessary and incidental items as detailed or required to complete the Operational Cover, all in accordance with the Contract Drawings and these Contract Specifications, except as noted below.

B. Materials and Construction

1. The General Contractor shall place Operational Cover within the Cell to the lines and grades as shown on the Contract Drawings. Calculations made by the General Contractor necessary to locate the various items to be incorporated into the works shall be furnished to the Engineer for review prior to field location of the items. The General Contractor shall give the Engineer sufficient notice so he may observe the field location activities.
2. The General Contractor shall place Operational Cover a minimum of 12-inches thick and a maximum of 16-inches thick.
3. Rock fragments, cobbles and boulders present in the Operational Cover shall not exceed 3-inches in any dimension.
4. The Operational Cover shall consist of either available on-site clean, natural, free draining soil containing no topsoil or other deleterious

material or select coal ash containing no deleterious material, as depicted on the Contract Drawings.

5. Any damage to the Geomembrane during placement or compaction of the Operational Cover shall be repaired at General Contractor's expense.
6. Nominal compaction of the entire surface of the Operational Cover using tracked construction equipment (not compactors) shall be performed by the General Contractor.

C. **Measurement and Payment**

1. Payment for work covered under Section 9 - Operational Cover, shall be based on the Unit Price Bid for Section 9 - Operational Cover, per cubic yard in place.
2. Payment for additional constructed Operational Cover as directed by the Engineer to complete the project, and in addition to that shown on the Contract Drawings shall be on the basis of the Unit Price Bid for Section 9 - Operational Cover, per cubic yard in place.
3. Payment quantities shall be determined by the Engineer. This quantity shall not include material rejected by the Engineer or replacement volumes for areas which have become unsuitable due to weather.

SECTION 10 - POLYETHYLENE PIPING

A. Scope of Work

1. The General Contractor shall furnish all labor, materials, equipment and incidentals required, and install polyethylene pipe, fittings and appurtenances as shown on the Contract Drawings and as specified in these Contract Specifications.
 - 1.1 The Contractor shall submit to the Engineer within ten days after signing the Contract, a list of materials to be furnished, the names of the suppliers and the date of delivery of materials to the site.
 - 1.2 The Contractor shall submit for approval, complete, detailed shop drawings of all polyethylene pipe, and fittings.
 - 1.3 The Contractor shall submit and shall comply with pipe Manufacturer's recommendations for handling, storing and installing pipe, and fittings.
 - 1.4 The Contractor shall submit pipe Manufacturer's certification of compliance with these Specifications.
 - 1.5 The Contractor shall submit a Manufacturer's certification that the pipe was manufactured from resins in compliance with these Specifications. The certificate shall state the specific resin, its source, and the specific information required by ASTM 1248. The pipe shall contain no recycled compound except that generated in the Manufacturer's own plant from resin of the same specification from the same raw material. The pipe

shall be homogenous throughout and free of visible cracks, holes (other than manufactured perforation), foreign inclusions, or other deleterious defects, and shall be identical in color, density, melt index and other physical properties.

- 1.6 The polyethylene pipe Manufacturer shall provide certification that stress regression testing has been performed on the specific product. This stress regression testing shall have been done in accordance with ASTM D2837, and the manufacturer shall provide a product supplying a minimum Hydrostatic Design Basis (HDB) of 1,600 psi, as determined in accordance with ASTM D2837.

B. Materials

1. The material for the Polyethylene Pipe shall be an approved Polyethylene Pipe in strict accordance with the Contract Drawings and these Contract Specifications.
 - 1.1 The Polyethylene Pipe shall have smooth inside walls with a design Mannings Roughness Coefficient of at most 0.012.
 - 1.2 The pipe may have either corrugated or smooth outside walls as specified on the Contract Drawings.
2. The Polyethylene Pipe resins shall be high performance, high molecular weight, high density virgin polyethylene compounds conforming to the requirements of Type III, Category 4 or 5, Grade P 33, Class C, or Grade P 34, Class C, as defined in ASTM D1248.

- 2.1 Clean, reworked material generated from the Manufacturer's own production, when used by the Manufacturers, shall meet the requirements for the type, category, grade and class as described in 2.
3. The pipe and fittings shall be free of foreign inclusions and visible defects as defined here.
 - 3.1 Visible defects are defined as cracks, creases, unpigmented or non-uniformly pigmented areas and are not permissible in the pipe as furnished.
4. Pipe Dimensions
 - 4.1 The pipe diameter specified on the Contract Drawings is the nominal inside pipe diameter.
 - 4.1.1 The tolerance on the specified inside diameter shall be 3% oversize and 1.5% undersize but not more than 1/2-inch either oversize or undersize.
 - 4.1.2 The P.E. size shall be furnished in standard lengths not to exceed 50 feet as approved by an Engineer. Length shall not be less than 99 percent of the stated quantity.
5. Where perforated pipe is specified, the perforations shall be cleanly cut so as not to restrict the inflow of water and uniformly spaced along the length and circumference of the pipe.
6. Pipe ends where a bolt-flange is specified shall be cut squarely and cleanly. Both flanges shall be of 1-inch nominal thickness HDPE plate

which meets all specifications of this project. Flanges shall be extrusion or fusion welded to pipe ends as approved by the Engineer.

7. Each length of pipe shall be marked with a printline with the name of the Manufacturer, size and class.

C. **Construction**

1. The General Contractor shall place Polyethylene Pipe as shown on the Contract Drawings. Calculations made by the Contractor necessary to locate the various items to be incorporated into the works shall be furnished to the Engineer for review prior to field location of the items. The General Contractor shall give the Engineer sufficient notice so he may observe the field location activities.
2. Pipe Connections.
 - 2.1 General pipe sections shall be butt-fusion welded according to the Manufacturer's recommendations and shall be performed by the manufacturers authorized, trained fusion technician.
 - 2.2 Specified bolt together pipe connections shall be made as specified on the Contract Drawings using stainless steel hardware and neoprene gaskets.
3. The Contractor shall use care in handling, storage, and installation of the pipe. Storage of pipe on the job site shall be done in accordance with the pipe Manufacturer's recommendation. Under no circumstances shall pipe be dropped into the trench. Pipe perforations shall be drilled prior to delivery at job site.

4. Pipe shall be laid to line and grade shown on the drawings with bedding, backfill and perforations as shown on the drawings.
5. Pipe shall be stored on clean, level ground to prevent undue scratching or gouging. The handling of the pipe shall be in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects. The maximum allowable depth of cuts, scratches or gouges on the exterior of the pipe is 10% of wall thickness. The interior pipe surface shall be free of cuts, gouges or scratches.
6. Sections of pipe with cuts, scratches or gouges deeper than allowed shall be removed completely and the ends of the pipeline rejoined.
7. The design of the embedment shall be such to ensure that external loads will not subsequently cause a decrease in the vertical cross-section dimension (deflection) no greater than the percentage listed below:

<u>SDR</u>	<u>ALLOWABLE RING DEFLECTION</u>
26	6.5%
21	5.2%
19	4.7%
17	4.2%
15.5	3.9%
13.5	3.4%
11.0	2.7%

8. Polyethylene stub ends and flanges must be at the ambient temperature of the surrounding soil at the time they are bolted tight to prevent relaxation of the flange bolts and loosening of the joint due to Thermal Contraction of the Polyethylene.

D. Measurement and Payment

1. Payment for work covered under Section 10 - Polyethylene Piping, shall be based on the Unit Price Bid for Section 10 - Polyethylene Piping, per linear foot in-place, including labor and materials.
2. Payment quantities shall be determined by the Engineer. This quantity shall not include materials rejected by the Engineer or replaced due to installation damage.

SECTION 11 - PREFABRICATED HDPE SUMPS

A. Scope of Work

1. The General Contractor shall furnish all labor, material and equipment to install the prefabricated HDPE Sumps including excavation, installation, bedding, protection and all necessary and incidental items as detailed or required to complete installation of the Prefabricated HDPE Sumps all in accordance with the Contract Drawings and the Contract Specifications.

B. Materials

1. The materials for the Prefabricated HDPE Sumps shall be an approved prefabricated HDPE sump in strict accordance with these Contract Specifications.
 - 1.1 The prefabricated HDPE sump shall be constructed by an approved Polyethylene Fabricator as detailed in the Contract Drawings and these Contract Specifications.
 - 1.2 The HDPE material shall be high performance, high molecular weight, high density, virgin polyethylene.
 - 1.3 The sump shall be constructed of 1" nominal thickness HDPE and plates as shown on the Contract Drawings. All necessary pieces shall be extrusion welded in place.
 - 1.4 The assembled sump shall be wet tested by filling with clean water and checking for weld leaks. Any and all leaks shall be repaired using extrusion welds.

D. Measurement and Payment

1. Payment for work covered under Section 11 - Prefabricated HDPE Sump, shall be based on the Unit Price Bid for Section 11, per sump.

Section 12 - EROSION AND SEDIMENTATION CONTROL

A. Scope of Work

1. The General Contractor shall furnish all labor, equipment and materials to provide and construct erosion and sedimentation control facilities, including but no limited to, site grading, ditches, piping, outlet protection, check dams, sediment traps, silt fences, sedimentation control basins and other construction in accordance with the Contract Drawings and these Contract specifications.
2. All work under this Contract shall be done in conformance with the subject to the limitations of the North Carolina Rules and Regulations for Erosions and Sedimentation control as adopted by the North Carolina Sedimentation Control Commission (15 NCAC, Chapter 4), except where explicitly referred in the Contract Drawing on these Contract Specifications.
3. The location of temporary erosion and sedimentation control devices may be revised by the Engineer or the County prior to construction.

B. MATERIALS AND CONSTRUCTION

1. Erosion and sedimentation control devices shall be constructed at the locations shown on the Contract Drawings, except as amended by the Engineer or the County.
2. Crushed stone or screened gravel shall be used for pipe bedding, foundation material and/or drainage layers beneath structures, and wherever else shown on the Contract Drawings and specified herein.

ABC shall be used where indicated on the Contract Drawings or as specified herein.

2.1 Pipe bedding aggregate shall meet the requirements of Aggregate standard size No.57 or No.67, as defined by NCDOT Standard Specifications. The thickness of the stone shall be as indicated on the Contract Drawings.

3. Select sand shall be placed where shown on the Contract Drawings and where specified elsewhere in the Contract Specifications. The sand shall meet the requirements of Sections 1005 and 1014 of the NCDOT Standard Specifications for materials and gradation. The size used shall be Standard Size No. 2S or 2MS as listed and defined in Table 1005-2, "Aggregate Gradation", of the NCDOT Standard Specifications.
4. The General Contractor shall place rip rap as shown on the Contract Drawings, as specified herein and as specified in Section 868 of the NCDOT Standard specifications for plain Rip Rap. The stone for rip rap shall consist of field stone or rough unhewn quarry stone. The stone shall be sound, tough, dense, and resistant to the action of air and water. Neither the width nor thickness of individual stones shall be less than one-third their length. The rip rap shall be Class I as specified in the NCDOT Standard Specifications, Section 1042, unless noted otherwise herein or shown on the Contract Drawings.
5. The General Contractor shall place Stone for Erosion Control as shown on the Contract Drawings, as specified herein and as specified in Section 1042-2 of the NCDOT Standard Specifications. The Stone for Erosion Control shall be Class (A) or Class (B), as shown on the Contract Drawings.

6. The General Contractor shall place ditch liner as shown on the Contract Drawings, as specified here in and as specified in Section 851 of the NCDOT Standard Specifications except that Articles 851-4 and 851-5, shall be deleted.

7. The Silt Fence shall be a woven geotextile made specifically for sediment control. Filter fabric shall not rot when buried and shall resist attack from soil chemicals, alkalies and acids in the PH range from 2 to 13, and shall resist damage due to prolonged ultraviolet exposure. The Geotextile shall conform to the minimum physical and mechanical properties outlined below:
 - 7.1 Tensile Strength - Minimum 90 lb Grab Tensile Strength using ASTM D4632

 - 7.2 Tensile Elongation - Minimum 50% at break using ASTM D4632

 - 7.3 Burst Strength - Minimum 190 psi (Mullen Method) using ASTM D3786

 - 7.4 Opening Size - Apparent Opening Size (AOS) ranging from 0.425 mm to 0.180 mm (US Sieve #40-80), using ASTM D4751

 - 7.5 Ultraviolet light Resistance - Average strength retained of at least 90% at 500 hrs exposure using ASTM D4355 Xenon Arc device.

8. The posts shall be T-Type steel posts or 2.5-in. by 2.5-in wooden posts. The posts shall be embedded at least 16-inches below the ground surface adjacent to the downstream side of the silt fence.
9. Post spacing shall be 4-ft. The top of the silt fence shall be 1.5-ft above the ground surface adjacent to the downstream side of the silt fence.
10. The silt fence shall be anchored on the upstream face of the silt fence. Anchorage shall be in the form of a continuous trench measuring 8-in deep by 4-in (nominal) wide.
11. No geotextile joints shall be permitted except at roll ends where approved by the Engineer.
12. Silt fence shall be erected around all temporary catch basins constructed by the General Contractor which are located downstream from any construction work. For those catch basins to be relocated or modified, silt fence shall be used until work is done on the catch basins. Upon completion of the modification, the area shall be rough graded, as shown on the Contract Drawings, until the end of the project, at which time final grading shall occur.
 - 12.1 After the completion of the project, the General Contractor shall remove all temporary silt fence in areas where a good stand of grass has been established, and erosion is no longer evident, or as approved by the Engineer.
13. The construction schedule adopted by the General Contractor will impact the placement and need for specific devices required for the control of erosion. The General Contractor shall develop and

implement such additional techniques as may be required to minimize erosion and off site sedimentation. The location and extent of erosion and sedimentation control devices shall be revised at each phase of construction that results in a change in either the quantity or direction of surface runoff from construction areas. All deviations from the erosion and sedimentation control provisions shown on the Contract Drawings shall have the prior approval of the Engineer.

14. The General Contractor shall furnish the labor, materials and equipment required for routine maintenance of all erosion and sedimentation control devices during cell construction. Maintenance shall be scheduled as required for a particular device to maintain the removal efficiency and intent of the device. Maintenance shall include but not be limited to 1) the removal and satisfactory disposal of trapped sediments from basins or silt barriers and 2) replacement of filter fabrics used for silt fences.

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

15. Rip rap shall be graded so that the smaller stones are uniformly distributed through the mass. The General Contractor may place the stone by mechanical methods, augmented by hand placing where necessary or required by the Engineer. The placed rip rap shall form a properly graded, dense, neat layer of stone. The placed rip rap shall have a minimum depth of 18-inches.
16. Stone for erosion control shall be dumped and placed in such manner that the larger rock fragments are uniformly distributed throughout the rock mass and the smaller fragments fill the voids between the larger

fragments. Rearranging of individual stones by equipment or by hand shall only be required to the extent necessary to secure the results specified above and to protect structures from damage when rock material is placed against the structures.

17. The General Contractor shall provide the Engineer for review and approval, material specifications and samples, where applicable, for materials to be used as erosion and sedimentation controls.
18. The Engineer shall be furnished copies of delivery tickets or other approved receipts as evidence for materials received for incorporation into construction.

C. Measurement and Payment

1. Payment for silt fence (material and installation) shall be on the basis of the Unit Price Bid for Silt Fence, per linear foot in-place.
2. Payment for ditches shall be on the basis of the Unit Price Bid for ditch construction, per linear foot in-place. Payment unit price shall include excavation, grading and construction and maintenance of ditch linings.
3. Payment for construction of pipe outlet protection shall be on the basis of the Unit Price Bid for Outlet Protection, lump sum per outlet, including earthwork, geotextile, rip rap, other materials, as applicable and installation.
 - 3.1 Payment for drainage piping is not included in this item. See Section 10- Polyethylene Piping of these Contract Specifications.

4. Payment for drop inlets shall be on the basis of the Unit Price Bid for Drop Inlets, per unit, including materials and installation.
5. Payment for sedimentation basins and secondary settling basin shall be on the basis of the Unit Price Bid for Sedimentation Basins, per unit, including outlet works, materials and installation. Outlet works include all labor, equipment and materials to construct spillway riser, trash rack, geotextile wrap, anti-flotation block, CMP barrel, and anti-seep collar as shown on the Contract Drawings.
6. Payment quantities shall be verified by the Engineer based upon the actual quantities installed in accordance with the Contract Drawings and these Contract Specifications.
7. Payment for items approved in advance by the Engineer that are in addition to the quantities estimated by the Engineer shall be on the basis of the appropriate unit price bid for the item in question.

