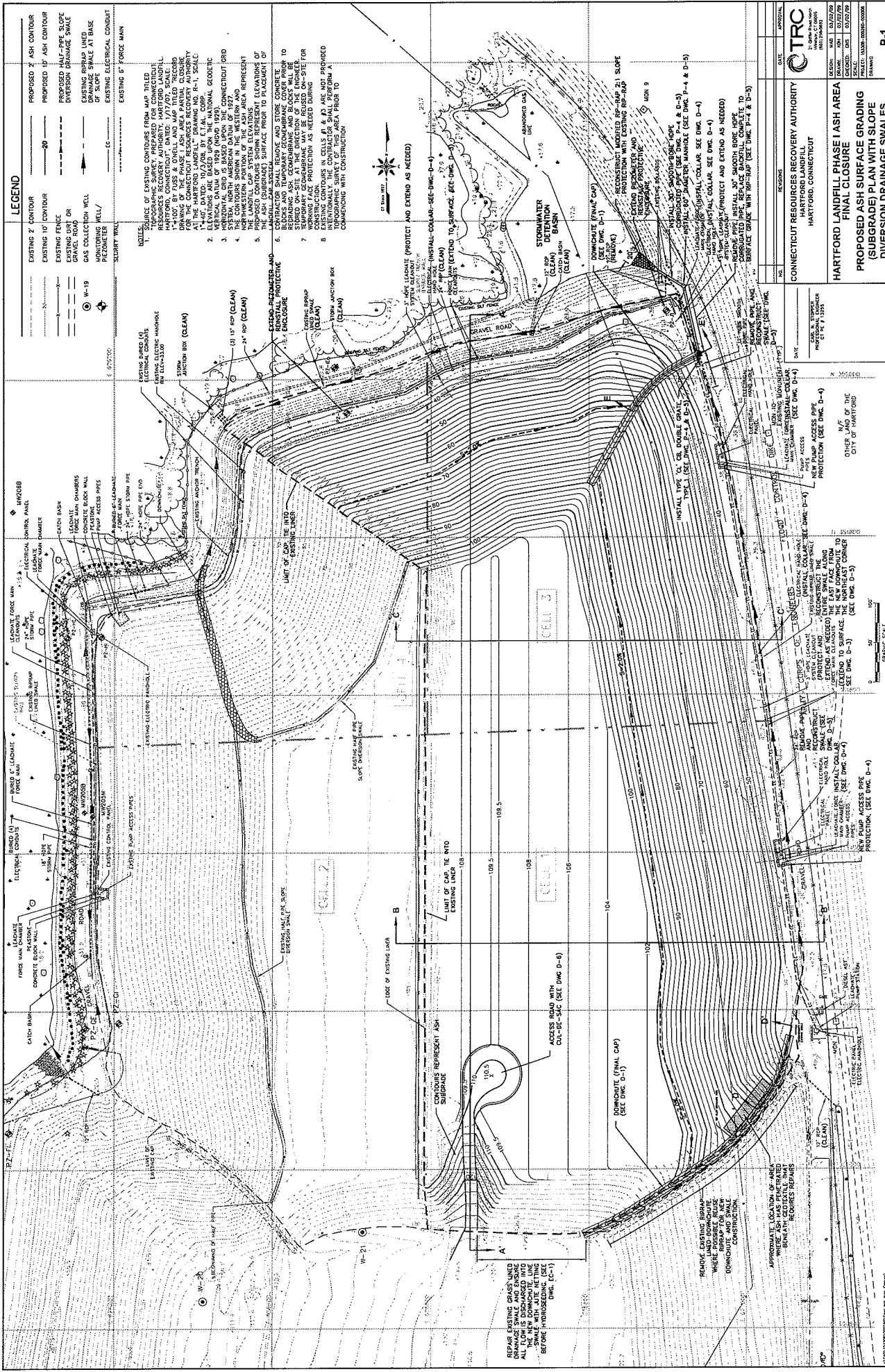


EXHIBIT A
To
AGREEMENT
FOR
COMPLETION OF CLOSURE OF THE PHASE 1 ASH AREA
AT THE
HARTFORD LANDFILL
PLANS



LEGEND

EXISTING 2' CONTOUR	PROPOSED 2' ASH CONTOUR
EXISTING FENCE	PROPOSED 1/2\"/>
EXISTING GAS OR GAS COLLECTION WELL	PROPOSED 1/2\"/>
MONITORING WELL	EXISTING RIP-RAP LINED DIVERSION SWALE AT BASE OF EXISTING ELECTRICAL CONDUIT
SLURRY WALL	EXISTING 5' FORCE MAIN

- NOTES:**
- SOURCE OF EXISTING CONTOURS FROM MAP TITLED "RECONSTRUCTION OF HARTFORD LANDFILL" BY THE CONNECTICUT DEPARTMENT OF ENVIRONMENT & NATURAL RESOURCES RECOVERY AUTHORITY, HARTFORD, CONNECTICUT, 1989. THIS RECORD DRAWING OF THE PHASE I ASH AREA PARTIAL CLOSURE IS A REVISION OF THE RECORD DRAWING OF THE PHASE I ASH AREA PARTIAL CLOSURE AT THE HARTFORD LANDFILL DRAWING NO. R-1, SCALE 1\"/>

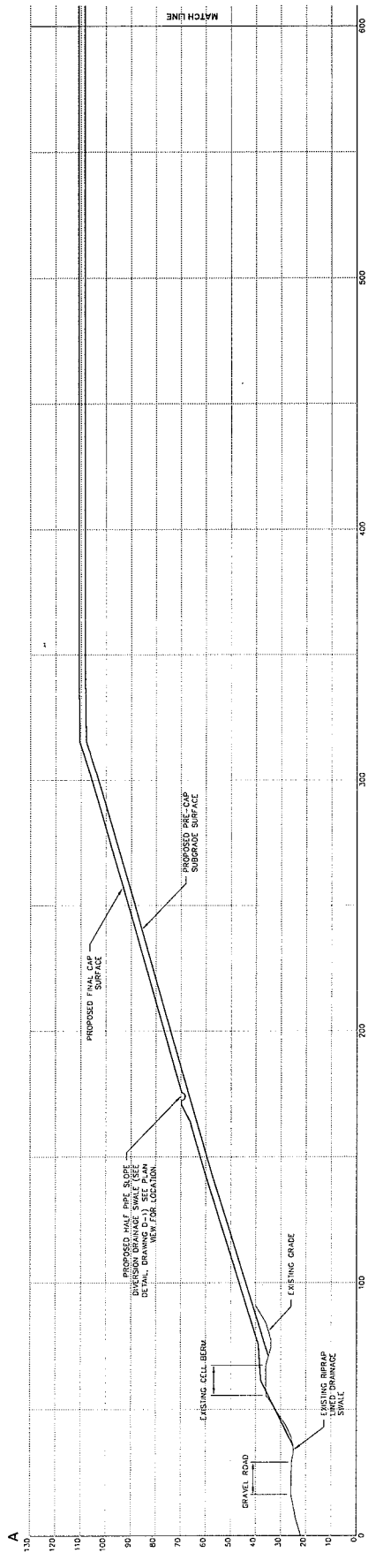
TRC	
CONNECTICUT RESOURCES RECOVERY AUTHORITY	
HARTFORD LANDFILL	
HARTFORD, CONNECTICUT	
DATE	03/27/09
SCALE	AS SHOWN
DRAWN	03/27/09
CHECKED	03/27/09
PROJECT	10000-0000-0000
DRAWING	P-1

HARTFORD LANDFILL PHASE I ASH AREA FINAL CLOSURE
PROPOSED ASH SURFACE GRADING (SUBGRADE) PLAN WITH SLOPE DIVERSION DRAINAGE SWALES

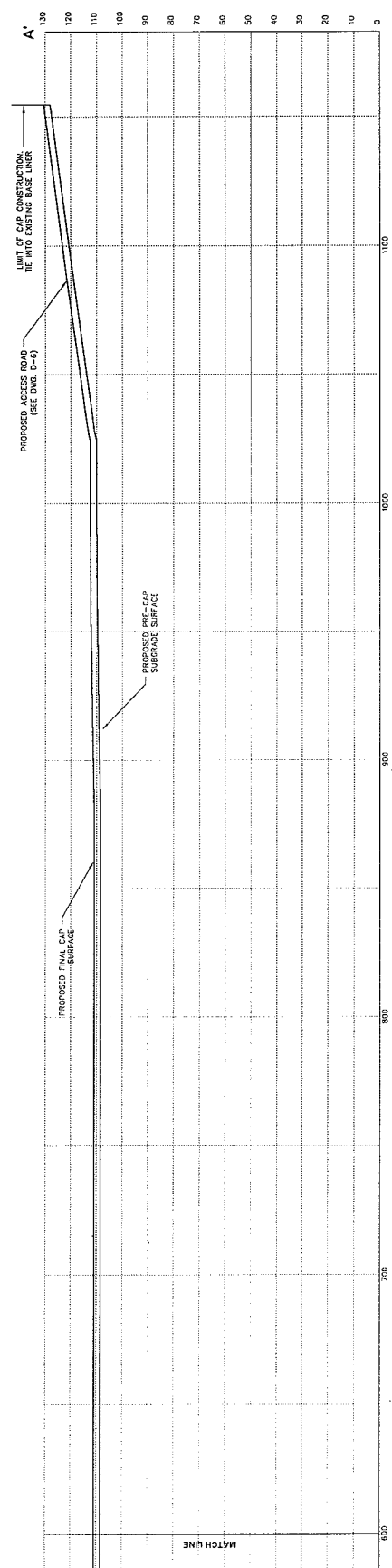
REPAIR EXISTING GRASS AND DRAINAGE SWALE AND DRAINAGE SWALE ALLOWING DOWNCUTTING SWALE WITH JUTE NETTING BEFORE FINISHING (SEE DWG. CC-1)

APPROXIMATE LOCATION OF AREA WHERE EXISTING RIP-RAP LINED DIVERSION SWALE REQUIRES REPAIR

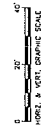
GRAPHIC SCALE
 0 50 100
 FEET



SECTION A-A'

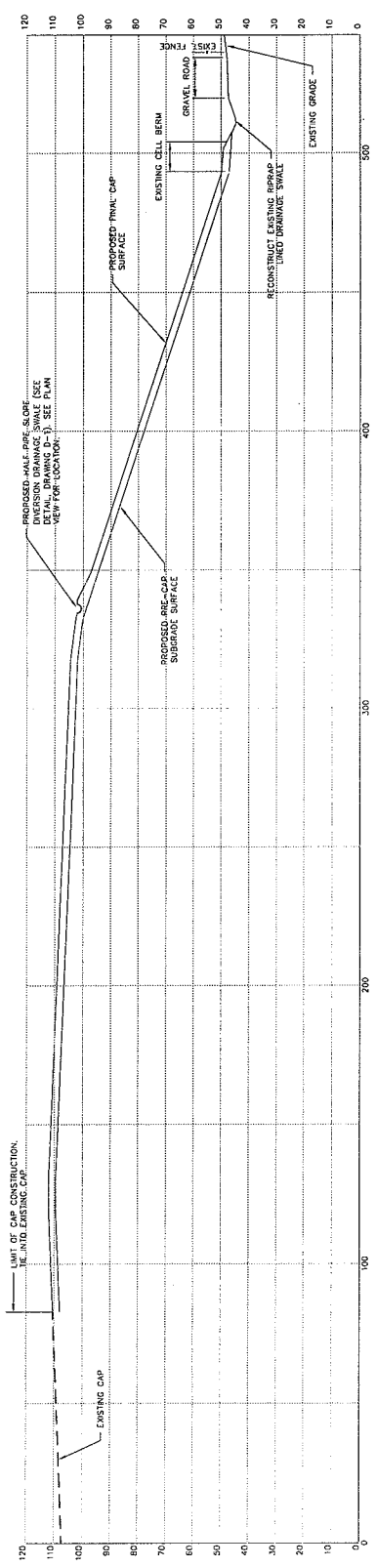


SECTION A-A'

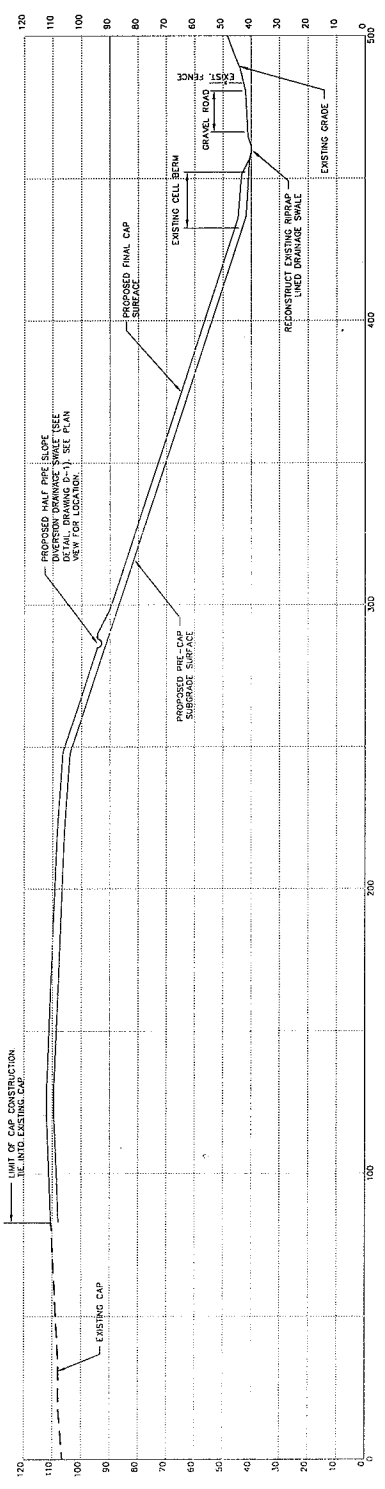


NOTES:
 1. SEE PLAN SHEET FOR PLAN SHOWING SECTION LOCATION.

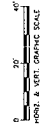
DATE	REVISIONS	DATE	APPROVAL
CONNECTICUT RESOURCES RECOVERY AUTHORITY HARTFORD LANDFILL HARTFORD, CONNECTICUT			
DATE: 01/17/2019 PREPARED BY: PROFESSIONAL ENGINEER CITY: CT		TRC 2000 W. MAIN ST. HARTFORD, CT 06105 TEL: 860-234-1100 FAX: 860-234-1101 WWW.TRC-CT.COM	
HARTFORD LANDFILL PHASE I ASH AREA FINAL CLOSURE SECTION A-A'			
DESIGN: JMB DRAWN: DM CHECKED: DM PROJECT: 13000-00000-20000		DATE: 03/22/09 DATE: 03/22/09 PROJECT: 13000-00000-20000 DRAWING:	



SECTION B-B

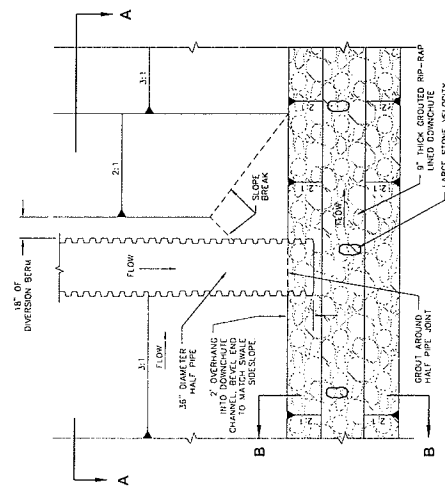


SECTION C-C

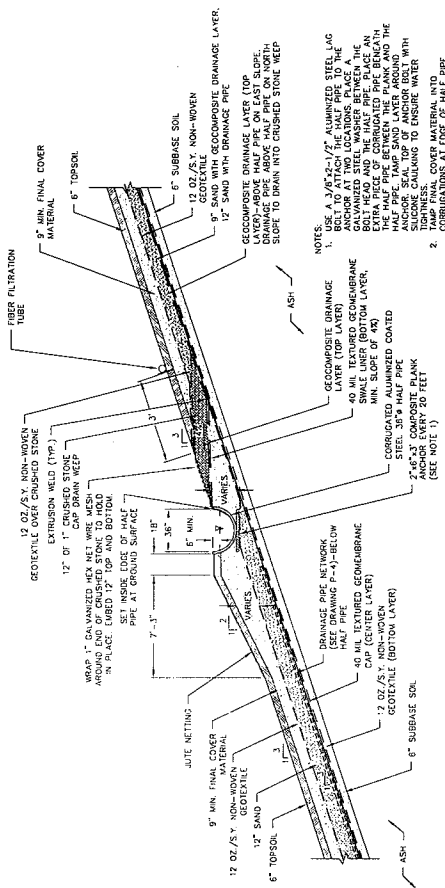


NOTES:
 1. SEE PLAN FOR PLAN SHOWING SECTION LOCATION.

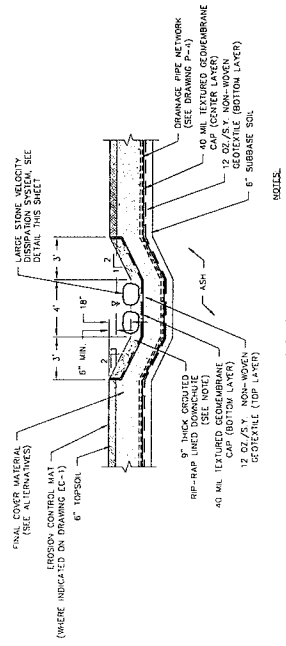
DATE	REVISIONS	DATE	REVISIONS
CONNECTICUT RESOURCES RECOVERY AUTHORITY HARTFORD, CONNECTICUT			
HARTFORD LANDFILL PHASE I ASH AREA FINAL CLOSURE SECTIONS B-B' AND C-C'			
DESIGN: MAS	DATE: 03/02/78	TRC	
DRAWN: JPH	DATE: 03/02/78	1000 Main Street	
CHECKED: JPH	DATE: 03/02/78	1000 Main Street	
PROJECT: TRAC 00000-0000	DRAWING		



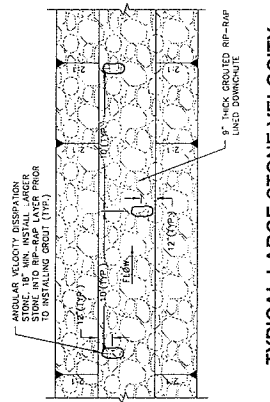
TYPICAL PLAN-HALF PIPE SWALE INTO DOWNCHUTE SWALE



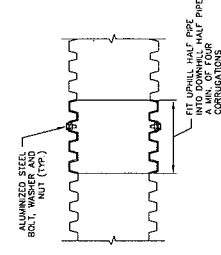
SECTION A-A HALF PIPE SLOPE DIVERSION SWALE



SECTION B-B TRAPEZOIDAL DOWNCHUTE ON FINAL COVER



TYPICAL LARGE STONE VELOCITY DISSIPATION SYSTEM SPACING DETAIL



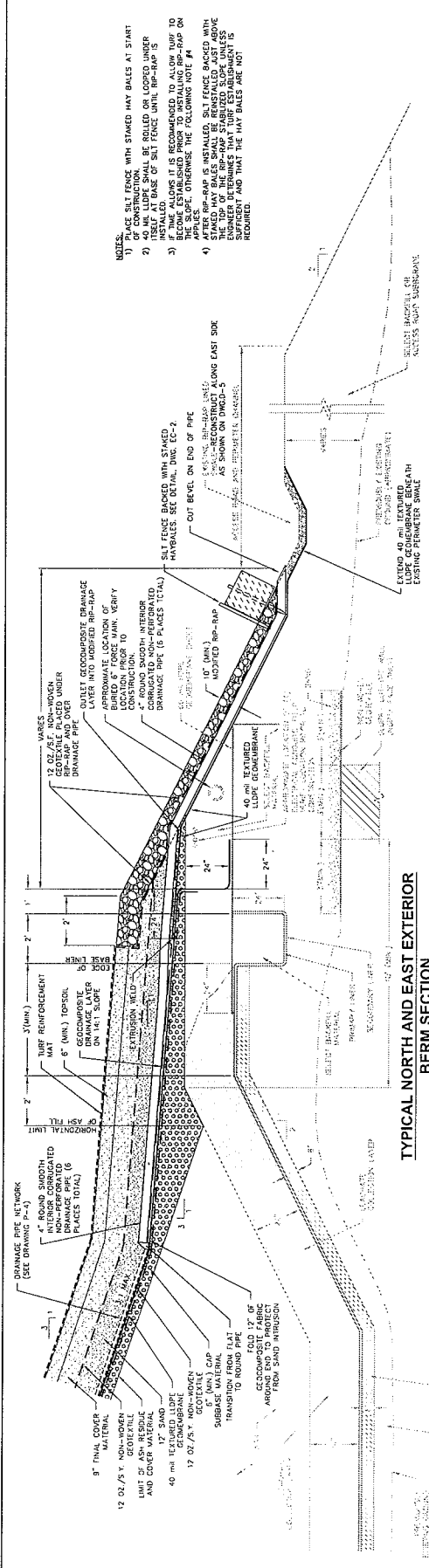
HALF PIPE CONNECTION DETAIL

- NOTES:**
1. USE A 3/8"x1/2" ALUMINIZED STEEL LAG ANCHOR AT TWO LOCATIONS PLACE GALVANIZED STEEL WASHER BETWEEN THE ANCHOR AND THE SUBBASE. PLACE AN EXTRA PIECE OF CORRUGATED PIPE BENEATH HALF PIPE TAP SAND LAYER AND ANCHOR SEAL TOP OF ANCHOR BOLT WITH THICKNESS CORRESPONDING TO SUBBASE.
 2. CORRUGATIONS AT EDGE OF HALF PIPE.
 3. EXTEND 48 MIL TEXTURED GEOMEMBRANE 12" BEYOND THE EDGE OF THE STEEL HALF PIPE.

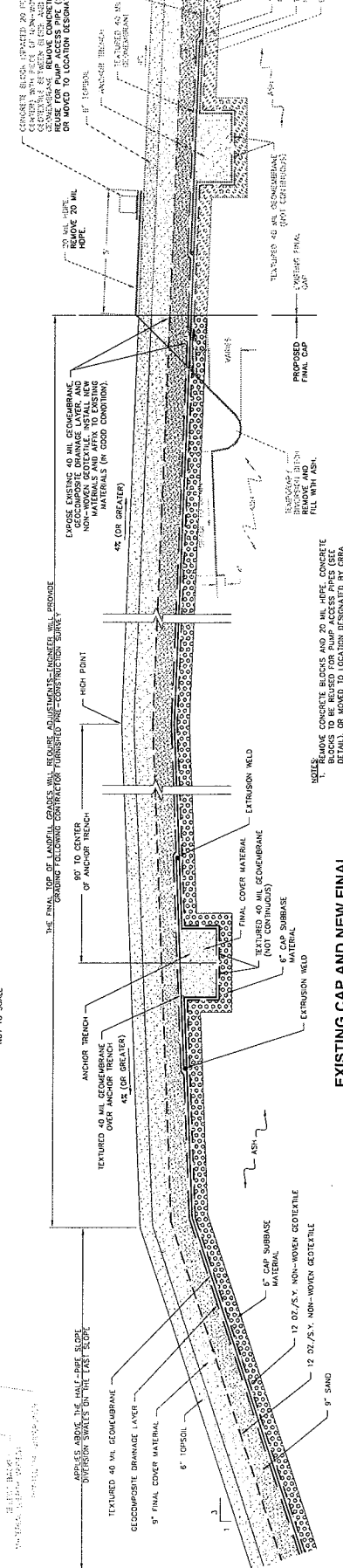
DATE	REVISIONS	APPROVAL
CONNECTICUT RESOURCES RECOVERY AUTHORITY HARTFORD LANDFILL HARTFORD, CONNECTICUT		
DESIGN	NOV 1 2017/09	
CONSTRUCTION	NOV 1 2017/09	
SCALE	AS SHOWN	
PROJECT NUMBER	15000-0000	
DRAWN BY		
CHECKED BY		
DATE		

HARTFORD LANDFILL PHASE I ASH AREA
FINAL CLOSURE
LANDFILL CAP
DRAINAGE DETAILS

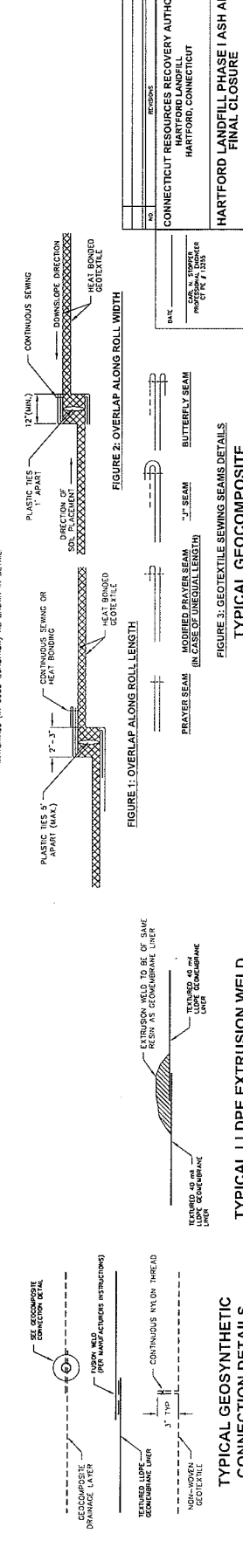
D-1



TYPICAL NORTH AND EAST EXTERIOR BERM SECTION
NOT TO SCALE



EXISTING CAP AND NEW FINAL CAP INTERFACE
NOT TO SCALE



TYPICAL GEOSYNTHETIC CONNECTION DETAILS
NOT TO SCALE

TYPICAL LLDPE EXTRUSION WELD
NOT TO SCALE

- NOTES:**
- 1) ALL SILT FENCE WITH STAKED HAY BALES AT START OF CONSTRUCTION SHALL BE ROLLED OR LOADED UNDER 40 MIL LLDPE SHALL BE ROLLED OR LOADED UNDER 40 MIL LLDPE UNTIL RP-RAP IS INSTALLED.
 - 2) IF THIS ALLOWS IT IS RECOMMENDED TO ALLOW TOP OF RP-RAP TO BE 1\"/>

- NOTES:**
1. REMOVE CONCRETE BLOCKS AND 20 MIL HDPE CONCRETE GEOMEMBRANE TO EXPOSE EXISTING GEOMEMBRANE AND AFTK TO EXISTING MATERIALS (IN GOOD CONDITION) AND EXPOSE EXISTING GEOMEMBRANE, GEOMEMBRANE AND AFTK TO EXISTING MATERIALS (IN GOOD CONDITION) AND
 2. EXPOSE EXISTING GEOMEMBRANE, GEOMEMBRANE AND AFTK TO EXISTING MATERIALS (IN GOOD CONDITION) AS SHOWN IN DETAIL

NO.	REVISION	DATE	APPROVAL

CONNECTICUT RESOURCES RECOVERY AUTHORITY HARTFORD, CONNECTICUT			
HARTFORD LANDFILL PHASE I ASH AREA FINAL CLOSURE		DESIGN: MAR 15, 2022/20 DRAWING: APR 15, 2022/20 SCALE: 1/8\"/>	
LANDFILL CAP DETAILS		PROJECT: 13346-0000-0000 DRAWING:	

EXHIBIT B
To
AGREEMENT
FOR
COMPLETION OF CLOSURE OF THE PHASE 1 ASH AREA
AT THE
HARTFORD LANDFILL
GENERAL REQUIREMENTS

EXHIBIT B
GENERAL REQUIREMENTS

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01000 WORK COVERED BY CONTRACT DOCUMENTS

A. Project Title

The project is entitled "Completion of Closure of the Phase I Ash Area at the Hartford Landfill." The landfill is located in Hartford, Connecticut. It is to be completed and ready for use by the Owner within the Contract Time specified in Exhibit D of the Contract Documents.

B. The Project Description

1. Installation of the following Final Cover System components:
 - a. Landfill Cap System (soils/geomembranes)
 - b. Stormwater Control Structures

01001 OWNER AND REGULATORY AUTHORITY

A. Owner

The Owner is the Connecticut Resources Recovery Authority (CRRA).

1. CRRA has the administrative authority for the facility and site where the work is being performed. The authorized representative for CRRA acts in matters involving revoking, altering, enlarging or relaxing any requirement of the contract documents.
2. The Owner's Representative is David Bodendorf, Senior Environmental Engineer. The Owner's Representative is located at 100 Constitution Plaza, 6th Floor, Hartford, CT 06103. Phone 860-757-7721; email dbodendorf@crra.org.

B. Property Owner

The current property owner is the City of Hartford. The City of Hartford has no authority over the work being performed under this contract.

C. Regulatory Authority

The Regulatory Authority is the Connecticut Department of Environmental Protection (CTDEP).

01002 ENGINEER

A. The Engineer

1. The Engineer or their accredited representative is referred to in the Contract Documents as "Engineer" or "Engineers" or by pronouns which imply them. As information for the Contractor, the Engineer's status is defined as follows:
 - a. The Engineer will not make interpretations or decisions directly to the Contractor. All interpretations or decisions will be conveyed through the Construction Administrator.
 - b. As the authorized agent of CRRA, the Engineer is responsible for review of shop drawings, materials, and equipment intended for the work, in accordance with the "General Conditions", and the "Supplementary Conditions".
2. Wherever the Engineer is mentioned in the documents in connection with an administrative function, it shall include the Construction Administrator in that function except for shop drawings.

01003 CONSTRUCTION ADMINISTRATOR

A. The Construction Administrator

1. The Construction Administrator is referred to in the Contract Documents as "Construction Administrator" or "Construction Manager" or by pronouns which imply it. All communications

concerning the project will be directed through the Construction Administrator or a designated representative(s).

2. As information to the Contractor, the Construction Administrator's status is defined as follows:
 - a. The Construction Administrator is the Owner's Agent who will, among other things, monitor the General Contractor's performance, scheduling and construction, process shop drawings, material, and equipment submittals, review and process periodic billings, review and recommend cost changes.
 - b. The Construction Administrator will process all requests for information, interpretations and decisions regarding the meaning and intent of the Contract Documents, consulting with appropriate parties prior to rendering the interpretations or decisions to the Contractor. All such requests and replies shall be in writing.
3. Limitations on Construction Administrator's Authority and Responsibilities.
 - a. Construction Administrator will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Construction Administrator will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.
 - b. Construction Administrator will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.
 - c. Construction Administrator shall not authorize any deviation from the Contract Documents or substitution of materials or equipment, unless authorized by the Owner.
 - d. Construction Administrator shall not undertake any of the responsibilities of Contractor, subcontractors or Contractor's superintendent.
 - e. Construction Administrator shall not advise on, issue directions relative to or assume control over any aspect of the means, methods, techniques, sequences or procedures of construction unless such advice or directions are specifically required by the Contract Documents.
 - f. Construction Administrator shall not advise on, issue directions regarding or assume control over safety precautions and programs in connection with the Work.
 - g. Construction Administrator shall not accept Shop Drawing or Sample submittals from anyone other than Contractor.
 - h. Construction Administrator shall not participate in specialized field or laboratory tests or inspections conducted by others except as specifically authorized by the Engineer or Owner.

01010 SUMMARY OF WORK

A. Part 1 – General

1. Related Documents
 - a. Contract Documents and general provisions of the Contract, including General and Supplementary Conditions and other Technical Specifications, apply to this Section.
2. Work Covered By Contract Documents
 - a. The Project is entitled, "Completion of Closure of the Phase 1 Ash Area at the Hartford Landfill." The remainder of the inactive landfill, as shown on the Contract Drawings, will be capped and landscaped. The work involves mobilization and establishing temporary fa-

cilities, an initial survey of existing grades, preparation of the site, installing and maintaining sediment and erosion controls, construction stormwater management, ash earthwork, constructing the surface cap and drainage layers, placing cover material and topsoil, constructing new and rehabilitating existing drainage systems, landscaping, and all work necessary to provide a finished stable site.

- b. The CONTRACTOR shall include in his bid, all items required in order to carry out the intent of the Work as described, shown, and implied in the Contract Documents.
- c. It shall be the CONTRACTOR's responsibility upon discovery to immediately notify CRRA in writing, of errors, omissions, discrepancies, and instances of non-compliance with applicable codes and regulations within the documents. Any additional costs arising from the CONTRACTOR's failure to provide such notification shall be borne by the CONTRACTOR.
- d. The CONTRACTOR shall include in his bid all items required in order to carry out the intent of the Work as described, shown, and implied in the Contract Documents.

3. Work Sequence

- a. Prior to mobilization, the CONTRACTOR shall provide CRRA with all the required testing and analytical data for materials and soils to be brought onsite for the construction of the landfill cap.
- b. The CONTRACTOR shall mobilize all equipment, labor, tools, materials, and incidentals to the site. Temporary facilities shall include a construction trailer, sanitary facilities, and a materials, equipment, and soil storage area as shown on the Contract Drawings. The CONTRACTOR shall demobilize following the completion of work and shall restore all storage areas to their condition prior to commencing work.
- c. Prior to initiating any construction, the CONTRACTOR shall have a Connecticut licensed surveyor perform a survey to determine surface elevations within the area to be capped and provide this information to CRRA and the ENGINEER. At a minimum, the survey shall consist of cross-sections spaced every 50 feet and oriented east-west perpendicular to the east slope. Spot elevations shall be taken every 25 feet and at grade changes for every section. The survey limits shall coincide with the cap limits plus 50 feet. The ENGINEER shall determine the final surface grades for the ash and modify the drawings accordingly. A meeting will be held between CRRA, the ENGINEER, and the CONTRACTOR to discuss the changes in the final grades prior to commencing regrading work.
- d. The CONTRACTOR shall prepare the site for construction by installing sediment and erosion controls as shown on the Contract Drawings prior to performing any work involving the removal of temporary cover materials or regrading. Once the sediment and erosion controls are in place and have been approved by the ENGINEER, the CONTRACTOR shall remove temporary cover materials in place within the Work Area. Temporary liner used to cover the working face shall be disposed of appropriately. Concrete blocks securing the liner shall be moved to an onsite location as indicated by CRRA. The CONTRACTOR shall repair the surface beneath the temporary liner as damage due to erosion is anticipated.
- e. The CONTRACTOR shall repair an area, indicated on Drawing P-1, where ash has penetrated beneath geotextile and is resting on the base liner geomembrane. The CONTRACTOR shall cut the geotextile covering the approximately 1,600 square foot area such that all of the ash is exposed. The ash will be removed from the surface of the geomembrane using hand tools or other methods that will protect the geomembrane. The CONTRACTOR shall repair any penetrations through the geomembrane as described in Section 06643 Geomembranes. The CONTRACTOR shall repair any penetrations caused by the actions of the CONTRACTOR at their own expense.
- f. The CONTRACTOR shall perform all grading of the ash within the Work Area to achieve the required subgrade surface. The CONTRACTOR will be responsible for regrading the surface to achieve the final grade. All grades prior to placement of sub base shall be no

greater than 33%, nor less than 4%. CONTRACTOR shall remove all visible pieces of metal prior to placement of sub base.

- g. The CONTRACTOR shall manage surface runoff from the work areas in strict accordance with the sediment and erosion control drawings and specifications. The CONTRACTOR shall be solely responsible for management of surface runoff as it impacts erosion of ash and cap materials. The CONTRACTOR shall include in its bid pricing all means, methods, and materials that are necessary to prevent and minimize damage to ash and cap materials until a completely stabilized site condition is achieved. The CONTRACTOR shall not be entitled to any extra compensation to implement such measures and shall not be entitled to extra compensation for repairs to ash and cap materials resulting from erosion.
 - h. The CONTRACTOR shall furnish, place, and compact 6 inches of subbase soil in accordance with the provisions of the Contract Documents. The CONTRACTOR shall furnish and install the nonwoven geotextile, geomembrane, geocomposite drainage layer, and drainage piping in accordance with the provisions of the Contract Documents. The CONTRACTOR shall provide a final as-built survey of the limits of the liner showing topography and spot elevations, prepared and sealed by a Connecticut licensed surveyor. Copies of all field notes shall accompany the as-built survey.
 - i. The CONTRACTOR shall furnish, place, and compact final cover material and topsoil as specified and shown on the Contract Drawings.
 - j. The CONTRACTOR shall construct surface water drainage control structures, half-pipe diversion swales, rip-rap perimeter swales, and downchute swales, in accordance with the provisions of the Contract Documents. The CONTRACTOR shall provide a final as-built survey of the surface drainage control structures showing topography and spot elevations, prepared and sealed by a Connecticut licensed surveyor. Copies of all field notes shall accompany the as-built survey.
 - k. The CONTRACTOR shall place surface erosion control materials, turf reinforcement mat and jute matting, and fiber filter tubes, in accordance with the provisions of the Contract Documents. Vegetation shall be established by applying the flexible growth media mixed with the specified grass seed mixture to the entire Work Area. The CONTRACTOR shall ensure that vegetation is established by maintaining sediment and erosion controls and water as necessary until the work is accepted by CRRA. The CONTRACTOR shall provide a final as-built survey of the final surface grades showing topography and spot elevations, prepared and sealed by a Connecticut licensed surveyor. Copies of all field notes shall accompany the as-built survey.
 - l. The CONTRACTOR shall reestablish drainage swales along the eastern perimeter as shown on the Contract Drawings and clean accumulated sediments from stormwater drainage pipes and other stormwater drainage features as shown on the Contract Drawings and described in Specification Sections 02271 and 02630.
4. Miscellaneous Provisions
- a. Examination of the Site:
 - 1. It is not the intent of the Contract Documents to show all existing conditions. All contractors are required to attend the Pre-Bid Conference prior to submitting their Bid Proposal. This is the only opportunity to visit and examine the site with CRRA.
 - 2. CONTRACTORS should investigate and satisfy themselves as to the conditions affecting the work, including but not restricted to those bearing upon transportation, handling, and storage of materials, availability of labor, water, electric power, uncertainties of weather, roads or similar physical conditions of the ground, and facilities needed preliminary to and during the prosecution of the Work. Any failure by the CONTRACTOR to acquaint himself with the available information shall not relieve him from the responsibility for estimating properly the difficulty and cost of successfully performing the Work.

b. Decontamination of Vehicles

1. The CONTRACTOR shall be responsible for decontaminating vehicles used on ash surfaces. Vehicles used in the relocation and regrading of ash prior to the construction of the final cap may be washed in the vehicle wash facility onsite. Exposure to ash surfaces will be limited during cap construction, however, the CONTRACTOR must take measures to limit the transport of ash from the disposal area and the CONTRACTOR will be required to decontaminate vehicles leaving the ash area. Dry decontamination methods will be allowed if sufficient.

5. Contractor Use Of Premises

- a. General: The CONTRACTOR shall have full access to the Work Area. The CONTRACTOR shall not access areas already capped and will be responsible for repairing any damages to capped areas if due to actions of the CONTRACTOR. Access to other areas immediately surrounding the Work Area shall be limited to allow for other closure operations of the facility. The CONTRACTOR shall not be allowed to interfere with other closure operations unless prior approval is received from CRRA.
- b. Use of the Site: Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.
 1. The CONTRACTOR shall confine his operations, including storage or materials, supplies, equipment, and incidentals to the areas specified in the Contract Documents.
 2. Existing access roads, drives, walks, and parking areas are to be kept free and clear at all times. All deliveries for the project are to enter the Hartford Landfill property between 7 AM and 3 PM, Monday through Friday. All CONTRACTORS are to check all roadways for accessibility and clearances for deliveries of all large material and equipment. Only designated areas shall be used for parking and storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
 3. The CONTRACTOR shall be responsible for keeping the work area clean and shall pick up rubbish and debris generated by the CONTRACTOR and promptly remove from the site.
 4. CONTRACTOR's daily access to the site shall be as indicated on the Contract Documents. Parking for the CONTRACTOR's employees shall be limited to an area designated by CRRA and the CONTRACTOR may be required to provide identification stickers for all vehicles.
 5. Special precautions shall be taken to protect all drainage systems near the Work Area. Prevent any and all sediment, debris, or other materials from getting into these systems. Should any sediment, debris, or other materials get into these systems or if any damage occurs to them, the CONTRACTOR shall immediately contact CRRA. The CONTRACTOR shall be fully responsible for all costs associated with additional cleaning and repairs caused by neglecting to protect the drainage systems.
 6. No signs, other than those approved by CRRA, shall be visible on the premises.

B. Part 2 – Products

None

C. Part 3 - Execution

None

01015 OCCUPANCY REQUIREMENTS

A. Full Owner Occupancy During Construction

The Owner will occupy the site during the entire construction period. Cooperate with the Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with the Owner's operations.

01019 CONTRACT CONSIDERATIONS

A. Allowances

1. None.

B. Measurement and Payment - General

1. Lump Sum Price and Unit Price Schedules, refer to and are the same pay items listed in the Bid Form. They constitute all of the pay items for the completion of the Work. No direct or separate payment will be made for providing miscellaneous temporary or accessory works, plant, services, Contractor's or Contractor's field offices, layout surveys, job signs, sanitary requirements, testing, safety devices, approval and record drawings, water supplies, power, maintaining traffic, removal of waste, watchmen, bonds, insurance, and all other requirements of the General Conditions and Supplementary Conditions. Compensation for all such services, things and materials shall be included in the prices stipulated for the lump sum and unit price pay items listed on the bid form.
2. Each lump sum and unit bid price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item

01027 APPLICATION FOR PAYMENT

A. Schedule of Values

Submit the "Schedule of Values" to the Construction Administrator at the earliest possible date but no later than (20) twenty Calendar Days after the Contract Start Date.

1. Format and Content: Use the Bid Form as a guide to establish the format for the "Schedule of Values". Provide at least one line item for each of line item on the Bid Form on electronic media printout.
2. Identification: Project identification on the Schedule of Values shall include, but not be limited to, the following:
 - a. Owner
 - b. Project Number
 - c. Project Name
 - d. Project Location
 - e. Contractor's name and address.
3. Arrange the "Schedule of Values" in tabular format as required by the Owner, containing separate columns including, but not limited to, the following Items:
 - a. Item Number.
 - b. Description of Work with Related Specification Section or Division Number.
 - c. Scheduled Values broken down by description number, type material, units of each material.
 - d. Name of subcontractor.

- e. Name of manufacturer or fabricator.
 - f. Name of supplier.
 - g. Retainage.
 - h. Contract sum in sufficient detail.
4. Percentage of Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
 5. Provide a breakdown of the Contract Sum in sufficient detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Break principal subcontract amounts down into several line items.
 6. Round amounts to nearest whole dollar; the total shall equal the Contract Sum.
 7. Unit-Cost Allowances: Show the line-item value of unit-cost allowances, as a product of the unit cost, multiplied by the measured quantity. Estimate quantities from the best indication in the Contract Documents.
 8. General Conditions: Show line items for indirect costs and margins on actual costs only when such items are listed individually in Applications for Payment. Each item in the Schedule of Values and Applications for Payment shall be complete. Include the total cost and proportionate share of general overhead and profit margin for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at the Contractor's option.

B. Applications for Payment – General

Each Application for Payment shall be consistent with previous applications and payments as certified by the Engineer and Construction Administrator and paid for by the Owner. The initial "Application for Payment", the "Application for Payment", at time of "Substantial Completion", and the final "Application for Payment", involve additional requirements.

1. Payment-Application Terms: The Owner will process monthly progress payments. The Contractor may submit applications for payment on a monthly basis.
2. Payment-Application Forms: Use the "Application for Payment" form as required by the Owner. Present the required information on electronic media printout or approved Owner Form, multiple pages should be used if required.
3. For each item, provide a column including but not limited to the following items:
 - a. Item Number.
 - b. Description of Work and Related Specification Section or Division.
 - c. Scheduled Value, break down by units of material and units of labor.
 - d. Work completed from previous application.
 - e. Work completed this period.
 - f. Materials presently stored.
 - g. Total completed and stored to date of application,
 - h. Percentage of Completion.
 - i. Balance to Finish.
 - j. Retainage.
4. Application Preparation: Complete every entry on the form. Include final payment only and execution by a person authorized to sign legal documents on behalf of the Contractor. The Construction Administrator will return incomplete applications without action.

- a. Entries shall match data on the "Schedule of Values".
 - b. Include amounts of Change Orders issued prior to the last day of the construction period covered by the application.
5. Transmittal: Submit 4 signed and notarized original copies of each Application for Payment to the Construction Administrator by a method ensuring receipt. One copy shall be complete, including waivers of lien and similar attachments, when required.
- a. Transmit each copy with a transmittal form listing attachments and recording appropriate information related to the application, in a manner acceptable to the Engineer.
6. Applications for Payment: Administrative actions and submittals, that must precede or coincide with submittal of the first Application for Payment and all subsequent Application for Payments including, but not limited to, the following items:
- a. List of subcontractors and suppliers' name, FEIN/Social Security numbers, and Connecticut Tax Registration Numbers.
 - b. List of principal suppliers and fabricators.
 - c. Schedule of Values.
 - d. Contractor's Construction Schedule (preliminary if not final).
 - e. Schedule of principal products.
 - f. Submittal Schedule (preliminary if not final).
 - g. List of Contractor's staff assignments.
 - h. List of Contractor's principal consultants.
 - i. Copies of all applicable permits.
 - j. Copies of authorizations and licenses from governing authorities for performance of the Work.
 - k. Initial as-built survey and damage report, if required.

C. Application for Payment at Substantial Completion

Following issuance of the Certificate of Substantial Completion submit an Application for Payment form, use the form as required by the Owner. Present the required information on electronic media printout.

- 1. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- 2. Administrative actions and submittals that shall precede or coincide with this application include, but are not limited to, the following:
 - a. Occupancy permits and similar approvals.
 - b. Warranties (guarantees) and maintenance agreements.
 - c. Test/adjust/balance records.
 - d. Maintenance instructions.
 - e. Meter readings.
 - f. Startup performance reports.
 - g. Changeover information related to Owner's occupancy, use, operation, and maintenance,
 - h. Final cleaning.
 - i. Application for reduction of retainage and consent of surety.

- j. Advice on shifting insurance coverage.
- k. Final progress photographs.
- l. List of incomplete Work, recognized as exceptions to Engineer's Certificate of Substantial Completion.

D. Final Payment Application

Administrative actions and submittals that must precede or coincide with submittal of the final Application for Payment include, but are not limited, to the following:

- 1. Completion of Project Closeout requirements.
- 2. Completion of list of items remaining to be completed as indicated on the attachment to the Certificate of Substantial Completion.
- 3. Ensure that unsettled claims will be settled.
- 4. Ensure that incomplete Work is not accepted and will be completed without undue delay.
- 5. Transmittal of required Project construction records to the Owner.
- 6. Certified final as-built and topographic survey.
- 7. Proof that taxes, fees, and similar obligations were paid.
- 8. Removal of temporary facilities and services.
- 9. Removal of surplus materials, rubbish, and similar elements.
- 10. Change of locks to Owner's access.
- 11. The requirements of the General Conditions and Supplementary Conditions for Final Acceptance, Final Completion, Final Inspection, and Final Payment.
- 12. Completion of "Building Contractor Reporting Form" as supplied by the Owner, for all Contractors, Subcontractors, Vendors, Suppliers, etc. who work on the Contract. The form includes the following information:
 - 13. Contractor/Subcontractor name.
 - 14. FEIN/Social Security Numbers.
 - 15. Connecticut Tax Registration Numbers.
 - 16. Type of work.
 - 17. Name of business and address.
 - 18. Remittance address.

01030 SUPPLEMENTAL BIDS

- A. None

01035 MODIFICATION PROCEDURES

- A. Summary

This Section specifies administrative and procedural requirements for handling and processing contract modifications.

- B. Minor Changes in the Work

The Engineer, through the Construction Administrator, will issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or Contract Time, on the "Supplemental Instructions" form as required by the Owner.

C. Proposal Request

1. Engineer/Owner-Initiated Requests For Proposals: The Engineer or Owner will issue a detailed description of proposed changes in the Work via the Construction Administrator that will require adjustment to the Contract Sum or Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications. Such requests shall be on a "Proposal Request" form as required by the owner.
2. "Proposal Request" is issued for information only. Do not consider them as an instruction either to stop work in progress or to execute the proposed change.
3. Within Fourteen (14) Calendar Days of receipt of a "Proposal Request", submit a "Change Order Proposal" with the required information necessary to execute the change to the Construction Administrator for the Engineer's/Owner's review.
4. Include a list of quantities of products required and unit costs, with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.
 - a. Indicate applicable delivery charges, equipment rental, and amounts of trade discounts.
 - b. Include a statement indicating the effect the proposed change in the Work will have on the Contract Time.
 - c. The Owner is tax exempt. All Contractor and Subcontractor services provided under your contract with the State of Connecticut may not be exempt from taxes. The Department of Revenue Services can guide you as to which services are exempt and which are not. Please contact the State of Connecticut, Department of Revenue Services at 1-800-382-9463 or 566-7033.
 - d. Dollar values shown on the Schedule of Values shall not be the governing (or deciding) final amounts for change orders involving either additional charges or deletions.

D. Requests for Information

1. In the event that the contractor or subcontractor, at any tier, determines that some portion of the drawings, specifications, or other contract documents requires clarification or interpretation by the Engineer, the contractor shall submit a "Request for Information" in writing to the Engineer via Construction Administrator. "Requests for Information" may only be submitted by the contractor and shall only be submitted on the "Request for Information" forms as required by the owner. In the "Request for Information", the contractor shall clearly and concisely set forth the issue for which clarification or interpretation is sought and why a response is needed from the Engineer.
 - a. In the "Request for Information", the contractor shall set forth an interpretation or understanding of the requirement along with reasons why such an understanding was reached.
 - b. The owner acknowledges that this is a complex project. Based upon the owner's past experience with projects of similar complexity, the owner anticipates that there will probably be some "Requests for Information" on this project.
 - c. The Engineer will review all "Requests for Information" to determine whether they are "Requests for Information" within the meaning of this term. If it is determined that the document is not a "Request for Information", it will be returned to the contractor, unreviewed as to content, for resubmittal on the proper form and in the proper manner.
 - d. A "Requests for Information Response" shall be issued within seven (7) Calendar Days of receipt of the request from the contractor unless the owner determines that a longer time is necessary to provide an adequate response. If a longer time is determined necessary by the Owner, the Owner will, within seven (7) Calendar Days of receipt of the request, notify the contractor of the anticipated response time. If the contractor submits a "Request for Information" on an activity with seven (7) Calendar Days or less of float on the current project schedule, the contractor shall not be entitled to any time extension due to the time it takes

the Engineer to respond to the request provided that the Engineer responds within the seven (7) Calendar Days set forth above.

- e. A "Requests for Information Response" from Engineer will not change any requirement of the contract documents. In the event the contractor believes that the "Requests for Information Response" will cause a change to the requirements of the contract document, the contractor shall immediately give written notice to the Construction Administrator stating that the contractor believes the "Requests for Information Response" will result in "Change Order" and the Contractor intends to submit a "Change Order Proposal" request. Failure to give such written notice immediately shall waive the contractor's right to seek additional time or cost under the requirement these Requirements.

E. Change Order Proposal

1. When either a "Request for Information" from the Contractor or a "Proposal Request" from the Engineer or Owner results in conditions that may require modifications to the Contract, the Contractor may propose changes by submitting a request for a "Change Order Proposal" to the Engineer via the Construction Administrator on forms as required by the Owner. These forms shall also include "Change Order Proposal Worksheets" as required by the Owner.
 - a. Include statements outlining the reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and Contract Time.
 - b. Include a list of quantities of products required and unit costs, with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities as directed by Article 13 of the General Conditions of the Contract for Construction.
 - c. Indicate applicable delivery charges, equipment rental, and amounts of trade discounts.
 - d. Comply with requirements in Section 01631 Equals and Substitutions if the proposed change requires an equal or substitution of one product or system for a product or system specified.
2. The State of Connecticut construction contract has the following tax exemptions:
 - a. Purchasing of materials which will be physically incorporated and become a permanent part of the project.
 - b. Tools, supplies and equipment used in fulfilling the construction contract are not exempt.
 - c. Services that are resold by the contractor are exempt, i.e. if a General Contractor hires a plumber, carpenter or electrician, a resale certificate may be issued to the subcontractor because these services are considered to be integral and inseparable component parts of the building contract
3. "Change Order Request" Forms: Use "Change Order Proposal" and "Change Order Proposal Worksheets" forms as required by Owner.
4. "Change Order Proposal" cannot be submitted without the Contractor either prior submission of a "Request for Information" from the Contractor or as a response to a "Proposal Request" submitted by the Engineer or Owner.
5. Any "Change Order Request" submitted without a prior submittal of a "Request for Information" or as a response to a "Proposal Request" will be immediately rejected and returned to the Contractor.

F. Construction Change Directive

1. "Construction Change Directive": When the Owner and the Contractor disagree on the terms of a "Change Order Proposal" resulting from either a "Request for Information" or "Proposal Request", then the Engineer through the Construction Administrator may issue a "Construction Change Directive" on a "Construction Change Directive" as authorized by the Owner on the

form required by the Owner. The "Construction_Change Directive" instructs the Contractor to proceed with a change in the Work, for subsequent inclusion in a "Change Order".

- a. The "Construction Change Directive" contains a complete description of the change in the Work. It also designates the method to be followed to determine change in the Contract Sum or Contract Time.
2. Documentation: The Contractor shall maintain detailed records on a time and material basis of work required by the "Construction Change Directive".
 - a. After completion of the change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.
 - b. The final value shall be negotiated based on the supporting data to determine the value of the work.

G. Change Order Procedures

1. Upon the Owner's approval of a Contractor's "Change Order Proposal", the Construction Administrator will issue a "Change Order" for signatures of the Engineer, Owner and the Contractor on "Change Order" form as required by the Owner.

01040 COORDINATION

A. Construction Administrator

1. The Construction Administrator is identified in Section 01003 Construction Administrator.
2. Construction Mobilization:
 - a. Cooperate with the Construction Administrator in the allocation of mobilization areas of the site, for field offices and sheds, for Owner facility access, traffic, and parking facilities.
 - b. During Construction, coordinate use of site and facilities through the Construction Administrator.
 - c. Comply with Construction Administrators procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.
 - d. Comply with instructions of the Construction Administrator for use of temporary utilities and construction facilities.
 - e. Coordinate field engineering layout as specified in Section 01050 "Field Engineering" for work under the instructions of the Construction Administrator.

B. Construction Operations

Coordinate construction operations included in various Sections of these Specifications to assure efficient and orderly installation of each part of the Work. Coordinate construction operations included under different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in the sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to assure maximum accessibility for required maintenance, service, and repair.
3. Make provisions to accommodate items scheduled for later installation.

C. Special Procedures

Where necessary, prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings.

1. Prepare similar memoranda for the Construction Administrator, Owner and separate contractors where coordination of their work is required.

D. Administrative Procedures

Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and assure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of schedules.
2. Installation and removal of temporary facilities.
3. Delivery and processing of submittals.
4. Progress meetings.
5. Project closeout activities.

E. General Coordination Provisions

1. Inspection of Conditions: Require the Installer of each major component to inspect both the substrate and conditions under which Work is to be performed and coordinate such inspections with the Construction Administrator and authorities having jurisdictions. If unsatisfactory conditions exist notify the Construction Administrator immediately. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.
2. The Contractor shall coordinate temporary enclosures with required inspections and tests to minimize the necessity of uncovering completed construction for that purpose.

01045 CUTTING AND PATCHING

- A. All cutting, coring and rough patching shall be performed by the Contractor or subcontractor requiring the opening. Finish patching shall be the responsibility of the Contractor and shall be performed by the trade associated with the application of the particular finish.
- B. Provide cutting, coring, fitting and patching, including attendant excavation and backfill required to complete the Work, or to:
 1. Remove and replace defective Work or Work not conforming to requirements of the Contract Documents.
 2. Remove samples of installed Work as specified or required for testing.
 3. Remove all constructions required to provide for specified alterations or addition to existing work.
 4. Uncover Work to provide for Engineer's observation of covered Work or observation by regulatory agencies having jurisdiction.
 5. Connect to completed Work that was not accomplished in the proper sequence.
 6. Remove or relocate existing utilities and pipes which obstruct the Work in locations where connections must be made.
 7. Make connections or alterations to existing or new facilities.
- C. Replace, patch and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials in such a manner as to not void required or existing warranties.

- D. Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to fullest extent possible. If identical materials are unavailable or cannot be used, use materials whose installed performance will equal or surpass that of existing materials.
- E. Perform all cutting and coring in such a manner as to limit the extent of patching.
- F. Core drill all holes to be cut through concrete and masonry walls, slabs or arches, unless otherwise approved.
- G. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed before cutting.
- H. Report unsatisfactory or questionable conditions to Engineer in writing. Do not proceed with work until the Engineer has provided further instructions.
- I. Provide temporary support as required to maintain structural integrity of Project, to protect adjacent Work from damage during cutting, and to support the work to be cut.
- J. Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that will be exposed during cutting and patching operations.
 - 1. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
 - 2. Do not cut existing pipe, conduit or ductwork serving facilities scheduled to be removed or relocated until provisions have been made to bypass them.
- K. Cut existing construction using methods least likely to damage elements retained or adjoining construction, and that will provide proper surfaces to receive installation or repair.
 - 1. In general, use hand or small power tools designed for sawing or grinding, not hammering and chopping.
 - 2. Cut through concrete and masonry using a concrete wall saw with diamond saw blades.
 - a. Provide for control, on both sides of walls, of slurry generated by sawing.
- L. Patch construction by filling, repairing, refinishing, closing-up and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified, in other Sections of these Specifications.
- M. See also General Conditions Article 23.

01050 FIELD ENGINEERING

- A. Provide field engineering services to establish and record grades, lines and elevations.
- B. The Contractor shall retain a Professional Engineer or Land Surveyor registered by the State of Connecticut acceptable to the Contractor and the Owner to lay out the site work and installations and to establish and record the necessary elevations, at no additional cost to the State.
- C. The Contractor shall forward a letter from his Land Surveyor or Professional Engineer stating that the control information furnished by the Owner, if any, is accurate or shall identify inaccuracies, if they exist. Such letter shall be submitted prior to the start of any construction activities. The Contractor shall not take advantage of errors, which may be included in the control information. Stakes and markings shall be preserved.
- D. The Contractor shall:
 - 1. Provide civil, structural or other professional engineering services specified, or required to execute Contractor's construction methods.
 - 2. Develop and make all detail surveys and measurements needed for construction including slope stakes, batter boards, piling layouts and all other working lines, elevations and cut sheets.

3. Keep a transit and leveling instrument on the Site at all times and a skilled instrument man available whenever necessary for layout of the Work.
 4. Provide all material required for bench marks, control points, batter boards, grade stakes, and other items.
 5. Be solely responsible for all locations, dimensions and levels, and for all surveying done at the site. No data other than written orders of the Engineer shall justify departure from the dimensions and levels required by the Contract Documents.
 6. Rectify all Work improperly installed because of not maintaining, not protecting or removing without authorization such established points, stakes, marks and monuments.
 7. Provide such facilities and assistance as may be necessary for Engineer to check line and grade points placed by Contractor. Contractor shall not do any excavation or embankment work until all cross-sectioning necessary for determining pay quantities has been completed and checked by Engineer.
 8. Contractor shall establish two (2) permanent benchmarks and three (3) survey control points located within and near the perimeter of the landfill in positions unlikely to be disturbed by vehicular traffic or construction operations.
 9. Contractor shall take measures to protect site reference and survey control points prior to starting site work, and must preserve permanent reference points during construction. Site reference points may not be relocated without prior written notice to Owner.
 10. The Owner shall be immediately notified of loss, damage or destruction of any reference point, or relocation required because of changes in grades or other reasons. Contractor shall replace disturbed survey control points based on original survey control at no extra cost.
 11. X, Y, and Z coordinates of benchmarks and survey control points shall be determined (and recorded) with a maximum permissible error of 0.10 feet (\pm) in any coordinate direction. All X and Y coordinates are to be referred to the Connecticut State coordinate system (NAD 27). All Z coordinates are to be referred to nearest USGS benchmark with an accuracy of 0.10 feet (\pm) (NGVD 29).
 12. Contractor shall reference survey and data reference points to permanent benchmarks and record locations of survey control points, with horizontal and vertical data, on Project Record Documents.
- E. Employ and retain at the Site a field engineer with experience and capability of performing all engineering tasks required of the Contractor. Tasks included are:
1. Providing daily construction reports as specified in Section 01300.
 2. Furnish all required lines and grades for construction operations.
 3. Check all formwork, reinforcing, inserts, structural steel, bolts, sleeves, piping, other materials and equipment.
 4. Maintain field office files and drawings, Record Drawings, and coordinate engineering services with Subcontractors. Prepare layout and coordination drawings for construction operations.
 5. Check and coordinate Work for conflicts and interferences and immediately advise Engineer of all discrepancies noted.
 6. Cooperate with Engineer in field inspections as required.
- F. Records: Maintain a complete, accurate log of all control and survey work as it progresses.
- G. On completion of the project, prepare a Certified Final As-built and Topographic Survey showing all dimensions, locations, angles and elevations of construction. The certified survey shall be prepared at a scale of 1"=40' and be signed by a Land Surveyor licensed in the State of Connecticut. Contractor shall provide three (3) sets of signed and sealed final survey plans, one set of mylar signed and sealed

final survey plans and one diskette with the electronic version of the final survey plans prepared in Autocad release 13, 14 or latest version with site features on separate layers as appropriate. Detail of mapping shall include, but not be limited to, two (2) foot and ten (10) foot contour intervals of the entire capped landfill, including all stormwater basins, landfill access roads, all stormwater drainage swales, downchutes and other drainage improvements including all appropriate invert elevations.

H. Submittals:

1. Submit name and address of surveyor or engineer to Engineer.
2. On request of Engineer, submit documentation to verify accuracy of field engineering work.
3. When requested by Engineer, submit certificate signed by registered engineer or surveyor certifying that elevations and locations of Work are in conformance with Contract Documents. Explain all deviations.

01095 REFERENCE STANDARDS & DEFINITIONS

- A. For products specified by association or trade standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. References to standard specifications and codes refer to the editions current at the bid due date. An exception is, buildings exceeding the threshold limit must be in substantial compliance with the requirements of the effective code at the time of receipt of completed application to the Office of State Building Inspector (OSBI). References include their addenda and errata, if any, and shall be considered a part of these specifications as if they were printed herein in full.
- C. The manufacturers' standard warranties or guarantees shall apply when their products are used on this project.
- D. Flame Spread Ratings - all materials that are required or obligated to meet specified standards shall be submitted to the owner for their records as part of the shop drawing submittal process for their construction records.

01120 RENOVATION/DEMOLITION PROJECT PROCEDURES

A. Products For Patching And Extending Work

1. New materials: As specified in product sections; match existing Products and Work for patching and extending Work.
2. Type and Quality of Existing Products: Determine by inspecting and testing Products where necessary, referring to existing Work as a standard.

B. Inspection - General

1. Verify that demolition is complete and areas are ready for installation of new Work.
2. Beginning of restoration Work means acceptance of existing conditions.

C. Preparation

1. Cut, move, or remove items as are necessary for access to alterations and renovation Work. Replace and restore at completion.
2. Remove unsuitable material not marked for salvage, such as rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for finished Work.
3. Remove debris and abandoned items from area and from concealed spaces.
4. Prepare surface and remove surface finishes to provide for proper installation of new Work and finishes.

5. Close openings in exterior surfaces to protect existing Work and salvage items from weather and extremes of temperature and humidity. Insulate ductwork and piping to prevent condensation in exposed areas.

D. Installation

1. Coordinate Work of alterations and renovations to expedite completion and if required sequence Work to accommodate Owner occupancy.
2. Remove, cut and patch Work in a manner to minimize damage and to provide restoring Products and finishes to original and or specified condition in accordance with Section 01045 "Cutting and Patching".
3. In addition to specified replacement of equipment, restore existing plumbing, ventilation, and electrical systems to full operational condition.
4. Recover and refinish Work that exposes mechanical and electrical Work exposed accidentally during the Work.
5. Install Products as specified in individual sections.

E. Transitions

1. Where new Work abuts or aligns with existing, perform a smooth and even transition. Patch work to match existing adjacent Work in texture and appearance.
2. When finished surfaces are cut so that a smooth transition with new Work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Engineer.

F. Adjustments

1. Fit Work at penetrations of surfaces as specified in Section 01045 "Cutting and Patching".

G. Repair of Damaged Surfaces

1. Patch or replace portions of existing surfaces that are damaged, lifted, discolored, or showing imperfections.
2. Repair substrate prior to patching finish.

H. Finishes

1. Finish surfaces as specified in individual Product sections.
2. Finish patches to produce uniform finish and texture over entire area. When finish cannot be matched, refinish entire surface to nearest intersections.

01200 PROJECT MEETINGS

A. Pre-construction Conference:

1. The Contractor will attend a Pre-construction Conference before starting construction, as scheduled by the Construction Administrator convenient to the Owner, the Construction Administrator, Engineer, and Contractor. This meeting will take place within fourteen (14) Calendar Days after the written Notice to Proceed and before the Contract Start Date. Hold the conference at the Project Site or another convenient location as directed by the Construction Administrator. The Construction Administrator shall conduct the Pre-construction Conference to review the Contractor and Subcontractor responsibilities and personnel assignments.
2. Attendees: Authorized representatives of the Construction Administrator, Owner, Engineer, and their consultants: the Contractor and its superintendent; major subcontractors; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with the Project and authorized to conclude matters relating to the Work.

3. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Critical work sequencing.
 - c. Progress meeting schedule.
 - d. Designation of responsible personnel.
 - e. Subcontractors.
 - f. Procedures for processing field decisions and Change Orders.
 - g. Procedures for processing Applications for Payment.
 - h. Distribution of Contract Documents.
 - i. Insurance in force.
 - j. Schedule of values.
 - k. Submittal of Shop Drawings, Product Data, and Samples.
 - l. Preparation of record documents.
 - m. Use of the premises.
 - n. Parking availability.
 - o. Office, work, and storage areas.
 - p. Equipment deliveries and priorities.
 - q. Safety procedures.
 - r. First aid.
 - s. Security.
 - t. Housekeeping.
 - u. Working hours.

B. Progress Meetings

1. The Construction Administrator will conduct progress meetings, bi-weekly, at the Project Site or at regular intervals as agreed upon at the Pre-construction Conference. The Construction Administrator will notify the Owner, the Engineer, the Regulatory Authority, and the Contractor of the scheduled Progress Meeting dates. Coordinate dates of Progress Meetings with preparation of Application for Payment requests.
2. Attendees: In addition to representatives of the Contractor, Construction Administrator, Owner and the Engineer, subcontractor, supplier, or other entity concerned with current progress or involved in planning, coordination, or performance of future activities may be requested to attend these meetings on an as needed basis. All participants at the meeting shall be familiar with the Project and authorized to conclude matters relating to the Work. The Contractor shall include the site superintendent as a minimum.
3. Agenda: Progress Meetings shall review and correct or approve minutes of the previous Progress Meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to the status of the Project.
 - a. Construction Schedule: Review progress since the last Progress Meeting. Determine where each activity is in relation to the required Contractor's "Construction Schedule" and whether each activity is on time or ahead or behind Schedule. Determine how Work that is behind Schedule will be expedited; secure commitments from parties involved to do so. Discuss whether Schedule revisions are required to insure that current and subsequent ac-

tivities will be completed within the Contract Time. Determine if any Change Orders are needed, the status of existing Change Orders, and alterations to the project schedule due to Change Orders.

- b. Review the present and future needs of each entity present
4. Reporting: The Construction Administrator will distribute minutes of the meeting to each party present, promptly and before the next scheduled meeting, and to parties who should have been present.
5. A schedule of regular Project Meetings will be established at the Pre-construction Conference.

01300 SUBMITTALS

A. Summary

1. This Section includes administrative and procedural requirements for submittals required for performance of the Work, including but not limited to the following:
 - a. Submittal schedule.
 - b. Shop Drawings.
 - c. Product Data.
 - d. Samples.
 - e. Quality assurance submittals.
 - f. Proposed "Substitutions Request" form.
 - g. Warrantee samples.
 - h. Coordination Drawings.
 - i. O & M Manuals.
 - j. Health and Safety Plan. Contractor shall prepare a Health and Safety Plan to address potential hazards to the on-site personnel and the surrounding community.

B. Administrative Submittals

Refer to other Division 1 Sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to, the following:

1. Permits.
2. Applications for Payment.
3. Performance and payment bonds.
4. Contractor's construction schedule.
5. Daily construction reports.
6. Construction Photographs.
7. Insurance certificates.
8. List of subcontractors.
9. Subcontractors/Suppliers FEIN #'s and Connecticut tax registration #.

C. Definitions

1. Coordination Drawings show the relationship and integration of different construction elements that require careful coordination during fabrication or installation to fit in the space provided or to function as intended and as identified in the Specification Division 2 through 16.

- a. Preparation of Coordination Drawings is specified in Division 1 Section "Coordination" and may include components previously shown in detail on Shop Drawings or Product Data.
2. Field samples are full-size physical examples erected on-site to illustrate finishes, coatings, or finish materials. Field samples are used to establish the standard by which the Work will be judged.
3. Mockups are full-size assemblies for review of construction, coordination, testing, or operation; they are not Samples.

D. Submittal Procedures:

1. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.
2. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that requires sequential activity.
3. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination.
4. The Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until all related submittals are received.
5. The Engineer reserves the right to reject incomplete submitted packages.
6. Processing: To avoid the need to delay installation as a result of the time required to process submittals, allow sufficient time for submittal review, including time for resubmittals.
 - a. Allow (2) two weeks for initial review. Allow additional time if the Engineer must delay processing to permit coordination with subsequent submittals.
 - b. If an intermediate submittal is necessary, process the same as the initial submittal.
 - c. Allow (2) two weeks for reprocessing each submittal.
 - d. No extension of Contract Time will be authorized because of failure to transmit submittals to the Engineer sufficiently in advance of the Work to permit processing.

E. Submittal Preparation

Place a permanent label, title block or 8-1/2 inches x 11 inches cover page approved by the Engineer, on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.

1. The minimum number of copies required for each submittal shall be at a minimum 4 copies or as determined otherwise at the pre-construction conference or by the Construction Administrator.
2. Provide a space approximately 4 inches by 5 inches on the label, beside the title block or on the cover page on Shop Drawings to record the Contractor's review and approval markings and the action taken.
3. Include the following information on the label for processing and recording action taken.
 - a. Project Name and State of Connecticut Project Number.
 - b. Date.
 - c. Name and address of the Engineer, Construction Administrator, and Owner Representative.
 - d. Name and address of the Contractor.
 - e. Name and address of the subcontractor.
 - f. Name and address of the supplier.

- g. Name of the manufacturer.
- h. Number and title of appropriate Specification Section.
- i. Drawing number and detail references, as appropriate.
- j. Indicate either initial or resubmittal.
- k. Indicate deviations from Contract Documents.
- l. Indicate if "equal" or "substitution".

F. Submittal Transmittal

Package each submittal appropriately for transmittal and handling. Transmit each submittal from the Contractor to the Engineer using a transmittal form. Copy the Construction Administrator on the transmittal. The Engineer will return all submittals to the Contractor after action is taken with a complete copy of the submittal package and one complete copy of the submittal package. The Engineer will not accept submittals received from sources other than the Contractor.

- 1. On the transmittal, record relevant information and requests for data. On the form, or separate sheet, record deviations from Contract Document requirements, including variations and limitations. Include Contractor's certification that information complies with Contract Document requirements.

G. Submittal Schedule

- 1. After development and review by the Owner and Engineer acceptance of the Contractor's Construction Schedule prepare a complete schedule of submittals. Submit the schedule to the Construction Administrator within 30 days of Contract Award.
- 2. Coordinate Submittal Schedule with the list of subcontracts, Schedule of Values, and the list of products as well as the Contractor's Construction Schedule
- 3. Prepare the schedule in chronological order. Provide the following information:
 - a. Schedule date for the initial submittal.
 - b. Related section number.
 - c. Submittal category (Shop Drawings, Product Data, or Samples).
 - d. Name of Subcontractor.
 - e. Description of the part of Work covered.
 - f. Scheduled date for resubmittal.
 - g. Scheduled date for the Engineer's final release of approval.

H. Distribution

Following response to the initial submittal, print and distribute copies to the Construction Administrator, Engineer, Owner, subcontractors, and other parties required to comply with submittal dates indicated. Post copies in the Project meeting room and field office.

- 1. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in construction activities.

I. Schedule Updating

Revise the schedule after each meeting or activity where revisions have been recognized or made. Issue the updated schedule concurrently with the report of each meeting.

J. Daily Construction Reports

1. Prepare a daily construction report recording the following information concerning events at the site, and submit duplicate copies to the Construction Administrator at weekly intervals:
 - a. List of subcontractors at the site.
 - b. Approximate count of personnel at the site.
 - c. Breakdown of employees by trade.
 - d. High and low temperatures, general weather conditions.
 - e. Accidents and unusual events or safety violations.
 - f. Meetings and significant decisions.
 - g. Stoppages, delays, shortages, and losses.
 - h. Meter readings and similar recordings.
 - i. List of equipment on site and identify if idle or in use.
 - j. Location of all areas in which construction was done,
 - k. Materials and equipment received,
 - l. Work, inspections and tests performed,
 - m. Orders and requests of governing authorities.
 - n. Change Orders received, start and end dates,
 - o. Services connected, disconnected.
 - p. Equipment or system tests and startups,
 - q. Partial Completion's, occupancies,
 - r. Substantial Completion's authorized,
 - s. Equals or Substitutions approved or rejected.

K. Shop Drawings

1. Submit newly prepared information drawn accurately to scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not a Shop Drawing.
2. Shop Drawings include fabrication and installation Drawings, setting diagrams, schedules, patterns, templates and similar Drawings. Include the following information:
 - a. Dimensions.
 - b. Identification of products and materials included by sheet and detail number.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Sheet Size: Except for templates, patterns and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 36 by 48 inches.
 - g. Submit one (1) reproducible media and seven (7) prints as directed by the Construction Administrator. The Contractor's submittal shall identify the specification section and/or drawing number applicable to the submittal.
 - h. Details shall be large scale and/or full size.

3. The Contractor shall review the Shop Drawings, stamp with this approval, and submit them with reasonable promptness and in orderly sequence so as to cause no delay in his Work or in the Work of any subcontractor. Shop Drawings shall be properly identified as specified for item, material, workmanship, and project number. At the submission, the Contractor shall inform the Engineer, in writing of any deviation in the shop drawings from the requirements of the Contract Documents.
4. The Engineer will review and comment on shop drawings with reasonable promptness so as to cause no delay, but only for conformance with the design concept of the project and with the information given in the Contract Documents. Refer to Article 5 of General Conditions. Shop Drawings received by the Engineer that indicate insufficient study of drawings and specifications, illegible portions or gross errors, will be rejected outright. Such rejections shall not constitute an acceptable reason for granting the Contractor additional time to perform the work.
5. The Contractor shall make any corrections required by the Engineer and shall resubmit the required number of corrected copies of shop drawings until fully reviewed.
6. Upon final review submit four (4) additional prints, same as submitted, to the Construction Administrator for his use.
7. The Engineer's review and comments on shop drawings shall not relieve the Contractor of responsibility for any deviation from the requirements of the Contract Documents.
8. Only final reviewed shop drawings are to be used on the project site.
9. The Work installed shall be reviewed in accordance with the shop drawings and the drawings and specifications. Final Review of the shop drawings by the Engineer shall constitute acceptance by the State and the Engineer of a variation or departure that is clearly identified. Final reviewed shop drawings shall not replace or be used as a vehicle to issue or incorporate change orders.

L. Product Data

1. Collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information, schedules, such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams, and performance curves.
2. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products that are not required, mark copies to indicate the applicable information. Include the following information:
 - a. Manufacturer's printed recommendations.
 - b. Compliance with trade association standards.
 - c. Compliance with recognized testing agency standards.
 - d. Application of testing agency labels and seals.
 - e. Notation of dimensions verified by field measurement.
 - f. Notation of coordination requirements.
3. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed.
4. Preliminary Submittal: Submit a preliminary single copy of Product Data where selection of options is required.
5. Submittals: Submit 4 copies of each required submittal; submit 5 copies where required for maintenance manuals. The Engineer will retain one and will return the other marked with action taken and corrections or modifications required.

- a. Unless noncompliance with Contract Document provisions is observed, the submittal may serve as the final submittal.
6. 6. Distribution: Furnish copies of final submittal to installers, subcontractors, suppliers, manufacturers, fabricators, and others required for performance of construction activities. Show distribution on transmittal forms.
 - a. Do not proceed with installation until a copy of Product Data is in the Installer's possession.
 - b. Do not permit use of unmarked copies of Product Data in connection with construction.

M. Samples

1. Submit full-size, fully fabricated Samples cured and finished as specified and physically identical with the material or product proposed. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture, and pattern.
2. Store, mount or display Samples on site in the manner to facilitate review of qualities indicated. Prepare Samples to match the Engineer's sample. Include the following:
 - a. Specification Section number and reference.
 - b. Generic description of the Sample.
 - c. Sample source.
 - d. Product name or name of the manufacturer.
 - e. Compliance with recognized standards.
 - f. Availability and delivery time.
3. Submit Samples for review of size, kind, color, pattern, and texture. Submit Samples for a final check of these characteristics with other elements and a comparison of these characteristics between the final submittal and the actual component as delivered and installed.
 - a. Where variation in color, pattern, texture, or other characteristic is inherent in the material or product represented, submit at least three (3) multiple units that show approximate limits of the variations.
 - b. Refer to other Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation, and similar construction characteristics.
 - c. Refer to other Sections for Samples to be returned to the Contractor for incorporation in the Work. Such Samples must be undamaged at time of use. On the transmittal, indicate special requests regarding disposition of Sample submittals.
 - d. Samples not incorporated into the Work, or otherwise designated as the Owner's property, are the property of the Contractor and shall be removed from the site prior to Substantial Completion.
4. Preliminary Submittals: Submit a full set of choices where Samples are submitted for selection of color, pattern, texture, or similar characteristics from a range of standard choices, unless otherwise noted in specification section.
 - a. The Engineer will review and return preliminary submittals with the Engineer's notation, indicating selection and other action.
5. Submittals: Except for Samples illustrating assembly details, workmanship, fabrication techniques, connections, operation, and similar characteristics, submit three (3) sets. The Engineer will return one set marked with the action taken.

6. Maintain sets of Samples, as returned, at the Project Site, for quality comparisons throughout the course of construction.
 - a. Unless noncompliance with Contract Document provisions is observed, the submittal may serve as the final submittal.
 - b. Sample sets may be used to obtain final acceptance of the construction associated with each set.
7. Distribution of Samples: Prepare and distribute additional sets to subcontractors, manufacturers, fabricators, suppliers, installers, and others as required for performance of the Work. Show distribution on transmittal forms.
 - a. Field samples are full-size examples erected on-site to illustrate finishes, coatings, or finish materials and to establish the Project standard.

N. Quality Assurance Submittals

1. Submit quality-control submittals, including design data, certifications, manufacturer's instructions, manufacturer's field reports, and other quality-control submittals as required under other Sections of the Specifications.
2. Certifications: Where other Sections of the Specifications require certification that a product, material, or installation complies with specified requirements, submit a notarized certification from the manufacturer certifying compliance with specified requirements.
 - a. Signature: Certification shall be signed by an officer of the manufacturer or other individual authorized to sign documents on behalf of the company.
3. Inspection and Test Reports: Requirements for submittal of inspection and test reports from independent testing agencies are specified in Division 1 Section "Quality Control."

O. Engineer's Action

1. Except for submittals for the record or information, where action and return is required, the Engineer will review each submittal, mark to indicate action taken, and return promptly.
 - a. Compliance with specified characteristics is the Contractor's responsibility.
2. Action Stamp: The Engineer will stamp each submittal with a uniform, action stamp. The Engineer will mark the stamp appropriately to indicate the action taken, as follows:
 - a. Final Unrestricted Release: When the Engineer marks a submittal "Approved for fabrication," the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents. Final payment depends on that compliance.
 - b. Final-But-Restricted Release: When the Engineer marks a submittal "Incorporate Notations," the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents. Submit corrected copies for record. Final payment depends on that compliance.
 - c. Returned for Resubmittal: When the Engineer marks a submittal "Rejected, or Revise and Resubmit," do not proceed with Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal according to the notations; resubmit without delay. Repeat if necessary to obtain different action mark.
 - d. Do not use, or allow others to use, submittals marked "Rejected, or Revise and Resubmit" at the Project Site or elsewhere where Work is in progress.
 - e. Other Action: Where a submittal is for information or record purposes or special processing or other activity, the Engineer will return the submittal marked "Action Not Required."
3. Unsolicited Submittals: The Engineer will discard unsolicited submittals without action.

P. Cutting and Patching

1. Submit a written request to Engineer well in advance of executing any cutting or alteration which affects:
 - a. Design function or intent of Project.
 - b. Work of Owner or any other contractor.
 - c. Structural value or integrity of any element of the Project.
 - d. Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
 - e. Efficiency, operational life, maintenance or safety of operational elements.
 - f. Visual qualities of sight-exposed elements.
2. Request shall include:
 - a. Identification of Project.
 - b. Description of affected Work of Contractor and work of others.
 - c. Necessity for cutting.
 - d. Effect on work of Owner or any other contractor, or on structural or weatherproof integrity of Project.
 - e. Description of proposed Work, describing:
 1. Scope of cutting and patching.
 2. Trades who will be executing the work.
 3. Products proposed to be used.
 4. Extent of refmishing.
 5. Schedule of operations.
 - f. Alternatives to cutting and patching, if any.
 - g. Designation of party responsible for cost of cutting and patching, when applicable.
 - h. Written permission of any other contractor whose work will be affected.
3. Should conditions of Work, or schedule, indicate a change of materials or methods, submit written recommendation to Engineer, including:
 - a. Conditions indicating change.
 - b. Recommendations for alternative materials or methods.
 - c. Submittals as required for substitutions.

01310 CONSTRUCTION SCHEDULE

A. Definitions

1. Construction Schedule: A method of planning and scheduling a construction project utilizing a horizontal bar chart with a separate bar for each major portion of the Work or operation to make the schedule an effective tool for planning and monitoring the progress of the work.

B. Format

1. Format: Utilize a horizontal bar chart (gant) with a separate bar for each major portion of the Work or operation, identifying first work day of each week.
2. Program: Use Microsoft Project, latest version, or approved equal.
3. Sequence of Listings: Utilize the Table of Contents of this Project Manual and the chronological order of the start of each item of work.

4. Scale and Spacing: Provide space for notations and revisions.
5. Sheet Size: To be coordinated with Construction Administrator.

C. Quality Assurance

The Contractor's Consultant: Retain a consultant to provide planning, evaluating, and reporting by CPM scheduling.

1. In-House Option: The Owner may waive the requirement to retain a consultant if the Contractor can demonstrate that:
 - a. The Contractor has the computer equipment required to produce construction schedules.
 - b. The Contractor employs skilled personnel with experience in construction scheduling and reporting techniques.
2. Program: Use "Microsoft Project" compatible, latest version, or approved equal.
3. Standards: Comply with procedures contained in AGC's "Construction Planning & Scheduling."

D. Content

1. Show complete sequence of construction by activity, with dates beginning and completion of each element of construction.
2. Identify each item by specification section number.
3. Identify work of separate phases other and other logically grouped activities.
4. Show accumulated percentages of completion of each item, and total percentage of Work completed, as of the first day of each month.
5. Provide separate schedule of submittal dates for shop drawings, product data, and samples, Owner furnished products and any products identified as under Allowances, and dates reviewed submittals will be required from Engineer. Indicate decision dates for selection of finishes.
6. Indicate delivery dates for Owner furnished products and any products identified as under Allowances.
7. Coordinate content with Schedule of Values specified in Section 01027.

E. Submittals and Revisions To Schedules

1. Indicate progress of each activity to date of submittal, and projected completion date of each activity.
2. Identify activities modified since previous submittal, major changes in scope, other identifiable changes.
3. Provide narrative report to define problem areas, anticipated delays, and impact on Schedule. Report corrective action taken, or proposed, and its effect.
4. An initial bar graph (gant) schedule is to be prepared by the General Contractor and submitted to the Construction Administrator within seven (7) calendar days of award of contract. This schedule is to cover all items of work from the start of the project up to the completion of the project. After review, resubmit required revised data within five (5) calendar days. This schedule must be revised monthly and when the actual schedule of significant items varies more than one (1) week from the proposed schedule.
5. Submit revised Construction Schedules each Application for Payment.
6. Submit four (4) copies of the Construction Schedule to the Construction Administrator.

F. Distribution

1. Distribute copies of the Construction Schedules to Construction Administrator, Engineer, Owner, Subcontractors, suppliers, and other concerned parties.
2. Instruct recipients to promptly report, in writing, problem anticipated by projections indicated in schedules.

01380 CONSTRUCTION PHOTOGRAPHS

- A. On the date the work is begun and every thirty (30) days thereafter (until the work is at least 95 percent complete), the Contractor shall have photographs of the construction taken by a qualified photographer.
- B. Take a minimum of (24) 35 mm 4x6 color photographs each time. Note on each photograph the date the picture was taken, the project number, the subject matter and the direction of the view. Deliver photographs to the Construction Administrator. The photographs are to be delivered in 8 V-z-inch x 11-inch sleeved clear pages for binding in a 3-ring binder.
- C. As photographs are a record of the work progress, they shall be taken each month, whether or not they show work done during the preceding month. Deliver photographs to the Construction Administrator within 10 days of their taking.

01400 QUALITY CONTROL

A. Independent Testing Agencies

Contractor shall select and employ and pay for independent testing agencies, approved by Owner, to perform all required analyses on proposed materials and other quality-control services specified elsewhere in the Contract Documents and required by authorities having jurisdiction. All field tests, inspections, sampling and testing required by the individual specification sections will be performed by an independent testing agency retained by the Contractor. The Contractor shall inform the Construction Administrator 48 hours in advance of areas ready for field testing as applicable. Costs for these services are included in the Contract Sum. In addition to tests required to be performed by the Contractor's testing laboratory, the Owner reserves the right to hire their own testing laboratory and conduct any and all tests appropriate or necessary to check conformance of the Work with the Contract Documents.

1. Materials for this project will be tested and construction operations inspected as the work progresses. Failure to detect any defective work or material shall not in any way prevent later rejection when such defect is discovered nor shall it obligate the State for final acceptance.

B. Retesting

The Contractor is responsible for field retesting where results of inspections, tests, or other quality-control services provide unsatisfactory results and indicate noncompliance with Contract Document requirements.

1. The cost of retesting construction, revised or replaced by the Contractor, is the Contractor's responsibility where required tests performed on original construction indicated noncompliance with Contract Document requirements.
2. The Owner will issue a deduct change order to cover all costs incurred related to all re-tests/re-inspection due to non-compliance to the contract documents, including but not limited to the Owners costs and the Engineers costs.

C. Associated Services

Contractor shall cooperate with agencies performing required inspections, field tests, and similar services, and provide reasonable auxiliary services as requested. Notify the agency sufficiently in advance of operations to permit assignment of personnel. Auxiliary services required include but are not limited to, the following:

1. Provide access to the Work.
2. Furnish incidental labor and facilities necessary to facilitate inspections and tests.
3. Take adequate quantities of representative samples of materials that require testing or assist the agency in taking samples.
4. Provide facilities for storage and curing of test samples.
5. Deliver samples to testing laboratories, if requested by Owner.
6. Provide an approved design mix proposed for use for material mixes that require control by the testing agency.
7. Provide security and protection of samples and test equipment at the Project Site.

D. Duties of the Testing Agency

The independent field testing agency engaged by the Contractor to perform inspections, sampling, and testing of materials and construction specified in individual Sections shall cooperate with the Construction Administrator, Engineer and Contractor in performance of the testing agency's duties. The testing agency shall provide qualified personnel promptly to perform required inspections and tests.

1. The field testing agency shall notify the Owner, the Construction Administrator and the Contractor promptly of any irregularities or deficiencies observed in the Work during performance of its services.
2. The field testing agency is not authorized to release, revoke, alter, or enlarge requirements of the Contract documents or approve or accept any portion of the Work.
3. The field testing agency shall not perform any duties of the Contractor.
4. The field testing agency shall perform specified inspections, sampling and testing of materials and methods of construction and ascertain compliance with requirements of the Contract Documents.
5. The field testing agency shall perform additional tests and services as required to assure compliance with the Contract Documents.

E. Payment

Owner will pay for the services of the Contractor's independent testing agency laboratory, to perform at the Owner's discretion, additional inspections, tests and other services beyond those required by the Specifications, in which case the Owner will issue a credit change order to cover the cost associated with these tests. The Owner will not pay for additional testing in the following cases.

1. When the Contractor notifies the Construction Administrator and/or Testing Agency less than 24 hours before the expected time of testing.
2. When the Contractor requires testing for his own convenience.
3. When the Contractor schedules a test and is not ready for the required test.

F. Reports

Reports of test that are part of the submittal requirements which indicate compliance or non-compliance with the specified standard.

G. See also General conditions Article 16

H. Submittals

1. The Contractor shall submit the name and qualifications of any independent testing agencies to be used on this project for approval by the Owner.
2. Unless the Contractor is responsible for this service, the independent testing agency shall submit a certified written report, in duplicate, of each inspection, test, or similar service to the Construc-

tion Administrator. If the Contractor is responsible for the service, submit a certified written report, in duplicate, of each inspection, test, or similar service through the Contractor.

3. Submit additional copies of each written report directly to the governing authority, when the authority so directs.
4. Report Data: Written reports of each inspection, test, or similar service include, but are not limited to, the following:
 - a. Date of issue.
 - b. Project title and number.
 - c. Name, address, and telephone number of testing agency.
 - d. Dates and locations of samples and tests or inspections.
 - e. Names of individuals making the inspection or test.
 - f. Designation of the Work and test method.
 - g. Identification of product and Specification Section,
 - h. Complete inspection or test data.
 - i. Test results and an interpretation of test results.
 - j. Ambient conditions at the time of sample taking and testing.
 - k. Comments or professional opinion on whether inspected or tested Work complies with Contract Document requirements.
 - l. Name and signature of laboratory inspector.
 - m. Recommendations on re-testing.

I. Quality Assurance

1. Qualifications for Service Agencies: Engage inspection and testing service agencies, including independent testing laboratories, that are pre-qualified as complying with the National Voluntary Laboratory Accreditation Program and that specialize in the types of inspections and tests to be performed.
 - a. Each independent inspection and testing agency engaged on the Project shall be authorized by authorities having jurisdiction to operate in the state where the Project is located.
 - b. Where applicable, meet ““Recommended Requirements for Independent Laboratory Qualification”, latest edition, published by American Council of Independent Laboratories and the basic requirements of ASTM E 329, “Standards of Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction”.
 - c. Submit copy of report of inspection of facilities made by Materials Reference Laboratory of National Bureau of Standards during most recent tour of inspection; with memorandum of remedies of any deficiencies reported by inspection.
 - d. Testing Equipment:
 1. Calibrated at maximum 12 month intervals by devices of accuracy traceable to either National Bureau of Standards or accepted values of natural physical constants.
 2. Submit copy of certificate of calibration, made by accredited calibration agency.

J. Repair and Protection

1. General: Upon completion of inspection, testing, sample taking and similar services, repair damaged construction and restore substrates and finishes.

2. Protect constructions exposed by or for quality-control service activities, and protect repaired construction.
3. Repair and protection is Contractor's responsibility, regardless of the assignment of responsibility for inspection, testing, or similar services.

01505 TEMPORARY ELECTRICITY AND LIGHTING

- A. Power and lighting may be taken from the power company's nearest pole with temporary poles, if needed, to extend the line to project. If permanent power lines have been installed before beginning project, then temporary lines can be brought in from the last pole.
- B. Provide service required for construction with branch wiring and distribution boxes located to provide power and lighting by construction-type extension cords. Meter shall be provided and installed by the Contractor.
- C. All costs of temporary power and light shall be paid by the Contractor.

01515 TEMPORARY TELEPHONE

- A. General Contractor shall provide telephone service in his office and a separate telephone in the Owner's Field Office, if provided. It is preferred the Contractor use a cellular phone. Local calls will be paid by the Contractor and toll calls by the respective users.

01520 TEMPORARY WATER

- A. Water is not available on site. Transport water to the project. Cost shall be paid by the General Contractor.

01525 TEMPORARY SANITARY FACILITIES

- A. The Contractor shall provide, where directed, chemical toilets with toilet tissue, plus wash basins with water, soap and paper towels. The Contractor shall maintain the facilities in a sanitary condition.
- B. If women are employed in the work, provide separate, designated facilities for them of the same kind. Provide an adequate number of each kind of facility for each gender.

01530 FIRE PROTECTION

- A. The Contractor, during construction, shall be responsible for loss or damage by fire to the work of the Contract until completion. Any fire used within the structure for working purposes shall be extinguished when not in use. Bitumen or tar shall be melted on the ground only. No flammable material shall be stored in the structure in excess of amounts allowed by the authorities. No gasoline shall be stored in or close to on-site buildings at any time. The Contractor shall assign a responsible employee to be in charge of fire protection measures.

01535 CONSTRUCTION EQUIPMENT

- A. The Contractor shall furnish tools, apparatus and appliances, hoists and/or cranes and power for same, scaffolding, runways, ladders, temporary supports and bracing and similar work or material necessary to insure convenience and safety in the execution of the Contract except where this is otherwise specified in any Specification Section. All such items shall meet the approval of the Owner but responsibility for design, strength and safety shall remain with the Contractor. All such items shall comply with Federal OSHA regulations and applicable codes, statutes, rules and regulations, including compliance with the requirements of the current edition of the "Manual of Accident Prevention in Construction" published by the A.G.C. and the standards of the State Labor Department.

- B. Staging, exterior and interior, required for the execution of this Contract, shall be furnished, erected, relocated if necessary and removed by the General Contractor. Staging shall be maintained in a safe condition without charge to and for the use of all trades as needed.

01540 BARRIERS AND ENCLOSURES

- A. Provide barriers to prevent public entry into construction areas and to protect existing facilities from damage by construction operations.
- B. Provide a fence around construction site; equip with vehicular and pedestrian gates with locks.
- C. Provide covered walkways as required by governing authorities for public rights-of-way and for public access to existing buildings.
- D. Provide barriers around trees and plants designated to remain. Protect against vehicular traffic, materials' dumping, chemically injurious materials, puddling or running water.
- E. Provide temporary, insulated, weathertight closures at openings to the exterior to provide acceptable working conditions and protection for materials, to allow for temporary heating and to prevent entry of unauthorized persons. Provide doors with self-closing hardware and locks.
- F. Barriers and enclosures shall be in conformance with code requirements. Do not block egress from occupied buildings unless necessary to further the work of the Contract. In this case, secure the Department's approval of an alternate egress plan.
- G. See also General Conditions Article 19.

01545 PROTECTION

- A. Protect buildings, equipment, furnishings, grounds and plantings from damage. Any damage shall be repaired or otherwise made good at no expense to the State.
- B. Provide protective coverings and barricades to prevent damage. The Contractor shall be held responsible for, and must make good at his own expense, any water or other type of damage due to improper coverings. Protect the public and building personnel from injury.
- C. Provide temporary protection for installed products. Control traffic in immediate area to minimize damage.
- D. Provide protective coverings for walls, projections, jambs, sills and soffits of openings. Protect finished floors and stairs from traffic, movement of heavy objects and storage. Prohibit traffic and storage on waterproofed and roofed surfaces and on lawn and landscaped areas.
- E. Provide temporary partitions and ceilings to separate work areas from Owner-occupied areas to prevent penetration of dust and moisture into Owner-occupied areas and equipment. Erect framing and sheet materials with closed joints and sealed edges at intersections with existing surfaces.
- F. See also General Conditions Article 19.

01550 SECURITY

- A. Provide security program and facilities to protect work, existing facilities and Owner's operations from unauthorized entry, vandalism and theft. Coordinate with Owner's security program.
- B. The Contractor shall be solely responsible for damage, loss or liability due to theft or vandalism.

01555 TRAFFIC WAYS

- A. The Contractor may use on-site paved roads and parking areas but shall not encumber same or their access. Public highways shall not be blocked by standing trucks, parked cars, material storage, construction operations or in any other manner.

- B. Public roads and existing paved roads, drives and parking areas on Owner's property shall be kept free from scrap or debris due to construction operations and any damage to their surface caused by the Contractor shall be repaired by him at his own expense.
- C. If the work of the Contract affects public use of any street, road, highway or thoroughfare, the General Contractor shall confer with the police authority having jurisdiction to determine if and how many police are needed for public safety in addition to any barriers and signals that may be needed. The General Contractor will be responsible for payment of any needed police services.

01560 TEMPORARY CONTROLS

A. Temporary Environmental Controls:

Contractor is to provide the following controls.

1. Dust Control (construction and demolition): Contractor shall be responsible for controlling objectionable dust caused by his operation of vehicles and equipment, clearing or for any reason. The Contractor shall apply water and calcium chloride or use other methods subject to the Engineer's approval for keeping airborne dust to a minimum.
2. Noise Control: Contractor's vehicles and equipment shall be such as to minimize noise to the greatest degree practicable. Noise levels shall conform to the latest OSHA standards and in no case will noise levels be permitted which interfere with the work of the Owner or others.
3. Erosion and Sediment Control:
 - a. Provide a Stormwater Pollution Control Plan in accordance with Section 01565. Provide a Leachate Control Plan in accordance with Section 02220.
 - b. Plan and execute construction and earth work by methods to control surface drainage from cuts and fills, and from borrow source and waste disposal areas, to prevent erosion and sedimentation.
 1. Hold the areas of bare soil exposed at one time to a minimum.
 2. Provide temporary control measures such as berms, dikes, and drains.
 - c. Construct fills and waste areas by selective placement to eliminate surface silts or clays that will erode.
 - d. Periodically inspect earthwork to detect any evidence of the start of erosion, apply corrective measures as required to control erosion.
 - e. All Contractor's equipment used during construction shall conform to all current federal, state, and local laws and regulations.
4. Pollution Control:
 - a. Provide methods, means and facilities required to prevent contamination of soil, water, or atmosphere by the discharge of noxious substances from construction operations.
 - b. Provide equipment and personnel, perform emergency measure required to contain any spillages, and to remove contaminated soils or liquids.
 1. Excavate and dispose of any contaminated earth offsite, and replace with suitable compacted fill and topsoil.
 - c. Take special measures to prevent harmful substances from entering public waters.
 1. Prevent disposal of wastes, effluents, chemicals, or other such substances adjacent to streams, or in sanitary or storm sewers.
 - d. Provide systems for control of atmospheric pollutants.
 1. Prevent toxic concentrations of chemicals.

- 2. Prevent harmful dispersal of pollutants into the atmosphere.
- e. All of the Contractor's equipment used during construction shall conform to all current federal, state and local laws and regulations.
- 5. Water Control:
 - a. Provide methods to control surface water and water from excavations and structures to prevent damage to the Work, the site, or adjoining properties.
 - 1. Control fill, grading and ditching to direct water away from excavations, pits, tunnels and other construction areas; and to direct drainage to proper runoff courses so as to prevent any erosion, damage or nuisance.
 - b. Provide, operate, and maintain equipment and facilities of adequate size to control surface water.

01565 STORM WATER CONTROL

- A. Assume responsibility for Storm Water pollution control by strictly complying with the "General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities" (General Permit) for the site that has been prepared by the Engineer.
- B. Sign, and cause to be signed by each appropriate subcontractor, the Certification Statement required by the General Permit.

01570 CLEANING

- A. Maintain areas under Contractor's control free of waste materials, debris and rubbish. Maintain in a clean and orderly condition.
- B. Execute cleaning during progress of the Work, at completion of the Work, and as required by the General Conditions.
- C. Control cleaning operations so that dust and other particulates will not adhere to wet or newly-coated surfaces and so that dust, wash water or other contaminants generated during such operations do not damage or mar painted or finished surfaces.
- D. Remove waste materials, debris and rubbish from site daily and dispose of legally off-site. No scrap/debris shall remain inside the building or anywhere on site upon final acceptance of the project.
- E. See also General Conditions Article 24.
- F. Requirements of Regulatory Agencies:
 - 1. In addition to the requirements herein, maintain the cleanliness of the Work and surrounding premises within the Work limits so as to comply with federal, state, and local fire and safety laws, ordinances, codes and regulations.
 - 2. Comply with all federal, state and local anti-pollution laws, ordinances, codes and regulations when disposing of waste materials, debris and rubbish.
- G. Cleaning Materials:
 - 1. Use only cleaning materials recommended by manufacturer of surface to be cleaned.
 - 2. Use each type of cleaning material on only those surfaces recommended by the cleaning material manufacturer.
 - 3. Use only materials which will not create hazards to health or property.
- H. During Construction:
 - 1. Keep the Work and surrounding premises within work limits free of accumulations of dirt, dust, waste materials, debris and rubbish.

2. Keep dust generating areas wetted down.
 3. Provide suitable containers for storage of waste materials, debris and rubbish until time of disposal.
 4. Dispose of waste, debris and rubbish off site at legal disposal areas.
- I. When Project is Completed:
1. Remove and dispose of all excess or waste materials, debris, rubbish, and temporary facilities from the site, structures and all facilities.
 2. Repair pavement, roads, sod, and all other areas affected by construction operations and restore them to original condition or to minimum condition specified.
 3. Remove spatter, grease, stains, fingerprints, dirt, dust, labels, tags, packing materials and other foreign items or substances from interior and exterior surfaces, equipment, signs and lettering.
 4. Repair, patch and touch up chipped, scratched, dented or otherwise marred surfaces to match specified finish.
 5. Remove paint, clean and restore all equipment and material nameplates, labels and other identification markings.
 6. Wash and shine mirrors, glazing and polished surfaces.
 7. Clean all floors, slabs, pavements, and ground surfaces.
 8. Maintain cleaning until acceptance and occupation by Owner.

01575 PROJECT SIGNS

- A. Project Signs: The Contractor shall not post any signs.

01580 FIELD OFFICES AND SHEDS

A. Field Offices

1. The Contractor shall provide an office for his own use which may be a trailer type facility with electric lighting, air conditioning, and heat. It shall have ample natural light, a table, chairs, counter, shelf, plan racks and file cabinets. Provide a 5 lb. ABC fire extinguisher and an OSHA-approved first aid kit. If the contract amount is \$2,500,000 or more, the Contractor shall provide a facsimile machine in his office and shall also provide his superintendent with a message beeper.
2. The Contractor shall provide a field office for the Construction Administrator of not less than 150 sq. ft. which may be a trailer type facility. The field office shall have ample natural light, a heater of sufficient capacity to maintain 70 degrees (F) in winter and an air conditioner of sufficient capacity to maintain 75 degrees (F) in summer. The Contractor shall provide a 5-lb. ABC fire extinguisher, and an OSHA-approved first aid kit. The contractor shall furnish the following furniture, which will remain his property. Furniture may be used but shall be in good condition, as judged by the Construction Administrator.
 - a. (1) one two pedestal desk
 - b. (1) One plan table.
 - c. (3) Three chairs.
 - d. (1) One file cabinet (lockable four drawer letter size).
 - e. (1) One bookshelf w/10 L.F. of 12" wide shelving.
 - f. (1) One large capacity waste receptacles.

- g. (1) One Fax Machine with telephone line,
- h. (1) One telephone with telephone line.
- i. (1) One Answering Machine with telephone line.
- j. (1) One Computer having PC with telephone line and internet connection capabilities using fastest connection capabilities locally available: 200 MHz. (minimum) Pentium II with operating software, including but not limited to, Windows 95 (or more recent version), AutoCAD (latest version), Microsoft Office 97, Microsoft Project (latest version), or approved equal.
- k. (1) One Laser printer with supplies.
- l. (1) One Copy Machine with supplies.

01600 MATERIALS AND EQUIPMENT CONTROLS

A. Materials and Equipment

Shall be delivered, stored and handled to prevent intrusion of foreign matter and damage by weather or breakage. Packaged materials shall be delivered and stored in original, unbroken packages.

- 1. Promptly inspect shipments to assure that products comply with requirements, that quantities are correct and products are undamaged.
- 2. Packages, materials and equipment showing evidence of damage will be rejected and replaced at no additional cost to the Owner.

B. Storage and Protection

- 1. Store products in accordance with manufacturers' instructions with seals and labels intact and legible. Store sensitive products in weathertight enclosures; maintain within temperature and humidity range required by manufacturer.
- 2. For exterior storage of fabricated products, place on sloped supports above ground. Cover products subject to deterioration with impervious sheet covering; provide ventilation to avoid condensation.
- 3. Store loose granular material on solid surfaces in a well-drained area; prevent mixing with foreign matter.
- 4. Arrange storage to provide access for inspection. Periodically inspect to insure products are undamaged and are maintained under required conditions. Keep log showing date, time and problems, if any.
- 5. Stone, masonry units and similar materials shall be stored on platforms or dry skids and shall be adequately covered and protected against damage.
- 6. The Contractor shall prepare, as directed by the Owner, one area or space in the building for storage of State-owned equipment.

01631 EQUALS AND SUBSTITUTIONS

A. Definitions

Definitions in this Article do not change or modify the meaning of other terms used in the Contract Documents.

- 1. Equals or Substitutions General: Changes in products, materials, equipment, and methods of construction required by the Contract Documents proposed by the Contractor after award of the Contract.

2. **Equal:** Any deviation from the specification which is defined as follows: A replacement for the specified material, device, procedure, equipment, etc., which is recognized and accepted as substantially equal to the first listed manufacturer or first listed procedure specified, after review, by the Engineer and may be rejected or approved at the sole discretion of the owner. All equals must be substantially equivalent to the first manufacturer or first procedure listed in the Specifications with reference to all of the following areas: the substance and function considering quality, workmanship, economy of operation, durability and suitability for purposes intended; size, rating and cost. The equal does not constitute a modification in the scope of Work, the Schedule or Engineer's design intent of the specified material, device, procedure, equipment, etc.
3. **Substitution:** Any deviation from the specified requirements, which is defined as follows: A replacement for the specified material, device, procedure, equipment, etc., which is not recognized or accepted as equal to the first manufacturer or procedure listed in the Specification after review by the Engineer and may be rejected or approved by the Owner. The Substitution is not equal to the specified requirement in comparison to the first manufacture or first procedure listed in the Specifications in one or more of the following areas: the substance and function considering quality, workmanship, economy of operation, durability and suitability for purposes intended; size; cost and rating. The Substitution constitutes a modification in the scope of Work, the Schedule or the Engineer's design intent of the specified material, device, procedure, equipment, etc.
4. The following are not considered to be requests for Equals or Substitutions:
 - a. Revisions to the Contract Documents requested by the Owner or Engineer.
 - b. Specified options of products and construction methods included in the Contract Documents.
 - c. The Contractor's determination of and compliance with governing regulations and orders issued by governing authorities having jurisdiction.

B. Submittals

1. **Equals and Substitution Request Submittals:** The Owner will consider requests for equals or substitutions if received within time period designated in the General Conditions Article 15. Requests received more than the days specified in Article 15 after the start date of the contract will be rejected.
 - a. The Contractor is required to prepare and submit 3 copies of the required data for the first manufacturer listed or procedure listed in the specifications section with reference to all of the following areas: the substance and function considering quality, workmanship, economy of operation, durability and suitability for purposes intended including the size, rating and cost. All submissions must include all the required data for the first listed manufacturer or procedure as specified, as well as the required data for the proposed Equal or Substitution. This will enable the Owner and Engineer to determine that the proposed Equal or Substitution is or is not substantially equal to the first listed manufacturer or procedure.
2. Identify the product or the fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing numbers.
3. Provide complete documentation showing compliance with the requirements for equals or substitutions, and the following information, as appropriate on a "Substitution Request" form as required by the Owner:
 - a. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Owner and separate contractors, that will be necessary to accommodate the proposed Equal or Substitution.
 - b. A detailed comparison chart of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements, such as performance, weight, size, durability, and visual effect.

- c. Product Data, including Shop Drawings and descriptions of products and fabrication and installation procedures.
 - d. Samples, where applicable or requested.
 - e. A statement indicating the effect on the Contractor's Construction Schedule or CPM Schedule compared to the schedule without approval of the Equal or Substitution. Indicate the effect on overall Contract Time.
 - f. Cost information, broken down, including a proposal of the net change, if any in the Contract Sum.
 - g. The Contractor's certification that the proposed Equal or Substitution conforms to requirements in the Contract Documents in every respect and is appropriate for the applications indicated.
 - h. The Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the Equal or Substitution to perform adequately.
4. Engineer's Action: If necessary, the Engineer will request additional information or documentation for evaluation within one week of receipt of the original request for equal or substitution request. The Engineer will notify the Construction Administrator who will notify the Owner of recommended acceptance or rejection of the proposed equal or substitution, within two (2) weeks of receipt of the request, or one (1) week of receipt of additional information or documentation, whichever is later. The Construction Administrator will give final acceptance or rejection by the Owner not less than one (1) week after notification.
- a. Any request deemed an "Equal" and accepted by the Construction Administrator, Engineer, and Owner will result in written notification to the Contractor and will not be in the form of a change order for an "Equal".
 - b. Any request deemed a "Substitution" and rejected or approved by Construction Administrator, Engineer, and Owner may result in written notification to the Contractor and may be in the form of a change order if the "Substitution" is approved.

C. Equal or Substitutions

1. Conditions: The Engineer will consider the Contractor's request for Equal or Substitution of a product or method of construction when one or more of the following conditions are satisfied, as determined by the Engineer. If the following conditions are not satisfied, the Engineer will return the requests to the Construction Administrator without action except to record noncompliance with these requirements.
- a. The proposed request does not require extensive revisions to the Contract Documents.
 - b. The proposed request is in accordance with the general intent of the Contract Documents.
 - c. The proposed request is timely, fully documented, and/or properly submitted.
 - d. The proposed request can be provided within the Contract Time. However, the Engineer will not consider the proposed request if it is a result of the Contractor's failure to pursue the Work promptly or coordinate activities properly.
 - e. The proposed request will offer the Owner a substantial advantage, in cost, time, energy conservation, or other considerations, after deducting additional responsibilities the Owner must assume. However, if the proposed request requires the Owner to incur additional responsibilities, including but not limited to, additional compensation to the Engineer for re-design and evaluation services, increased cost of other construction by the Owner or similar considerations, then the Owner will have just cause to reject the request for Equal or Substitution.
 - f. The proposed request can receive the necessary approvals, in a timely manner, required by governing authorities having jurisdiction.

- g. The proposed request can be provided in a manner that is compatible with the Work as certified by the Contractor.
 - h. The proposed request can be coordinated with the Work as certified by the Contractor.
 - i. The proposed request can uphold the warranties required by the Contract Documents as certified by the Contractor.
2. The Contractor's submission and the Engineer's review of Submittals, including but not limited to, Samples, Manufacturer's Data, Shop Drawings, or other such items, which are not clearly identified as a request for an Equal or Substitution, will not be considered or accepted as a valid request for an Equal or Substitution, nor does it constitute an approval.

01650 STARTING OF SYSTEMS

A. General:

1. Coordinate schedule for start-up of various equipment and systems.
2. Provide written notification the Construction Administrator thirty (30) Calendar Days prior to start-up of each item.
3. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, and control sequence for other conditions that may cause damage.
4. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
5. Verify in wiring and support components are complete and tested.
6. Execute the start-up under supervision of manufacturer's representative, in accordance with manufacturer's instructions.
7. When referenced in individual specification sections, require manufacturer to provide an authorized representative to be present at the site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
8. Submit a written report in accordance Section 01400 "Quality Control" that the equipment or system has been properly installed and is functioning properly.

B. Demonstration and Instructions:

1. Demonstrate operation and maintenance of Products to Owner and Personnel two (2) weeks prior to substantial completion.
2. Demonstrate Project equipment and instruct in a classroom environment at location designated by the Construction Administrator and instructed by a qualified manufacturer's representative who is knowledgeable about the project.
3. For equipment or systems requiring seasonal operation perform demonstration for season within six (6) months.
4. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner and Personnel in detail to explain all aspects of operation and maintenance.
5. Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, and maintenance, and shutdown of each item at agreed upon scheduled time and at equipment or designated location.
6. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during demonstration.

C. Testing Adjusting, and Balancing

1. The Contractor will employ and pay for the testing services of an independent consultant to verify the testing, adjusting, and balancing.
2. Reports will be submitted by the independent testing consultant to the Construction Administrator indicating observations and results of tests and indicating compliance or non-compliance with the requirements of the Contract Documents.
3. The Owner may employ and pay for the services of an independent consultant to verify testing, adjusting, and balancing which was performed by the Contractor.

01700 CONTRACT CLOSEOUT

A. Substantial Completion

1. Preliminary Procedures: Before requesting inspection for Certification of Substantial Completion, complete the following. List exceptions in the request.
 - a. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100 percent completion for the portion of the Work claimed as substantially complete.
 1. Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.
 2. If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the Work is not complete.
 - b. Advise the Owner of pending insurance changeover requirements, if applicable.
 - c. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications, and similar documents.
 - d. Obtain and submit releases enabling the Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - e. Submit record drawings, maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
 - f. Deliver tools, spare parts, extra stock, and similar items.
 - g. Make final changeover of permanent locks and transmit keys to the Owner. Advise the Owner's personnel of changeover in security provisions.
 - h. Demonstration, through operation and testing, the functions of all systems and/or equipment to the satisfaction of the Owner for compliance to the contract. Complete testing of systems, and instruction of the Owner's operation and maintenance personnel. Discontinue and remove temporary facilities from the site, along with mockups, construction tools, and similar elements.
 - i. Complete final cleanup requirements, including touchup painting,
 - j. Touch up and otherwise repair and restore marred, exposed finishes.
2. Inspection Procedures: The Contract shall be ready and prepared when they request a Substantial Completion inspection. If the inspection reveals that the work is not complete, there are extensive punchlist items and as the items listed above are not complete, the Construction Administrator, Engineer, and Owner will determine the inspection has failed.
3. The Contractor is responsible for all costs to re-inspect due to a failed inspection. The Owner will issue a deduct change order to cover all costs for re-inspection.
 - a. The Engineer will repeat inspection when requested and assured that the Work is substantially complete.

- b. Results of the completed inspection will form the basis of requirements for final acceptance.

B. Final Acceptance

1. Preliminary Procedures: Before requesting final inspection for certification of final acceptance and final payment, complete the following. List exceptions in the request.
 - a. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include insurance certificates for products and completed operations where required.
 - b. Submit an updated final statement, accounting for final additional changes to the Contract Sum.
 - c. Submit a certified copy of the Engineer's final inspection list of items to be completed or corrected, endorsed and dated by the Engineer. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance and shall be endorsed and dated by the Engineer.
 - d. Submit final meter readings for utilities, a measured record of stored fuel, and similar data as of the date of Substantial Completion or when the Owner took possession of and assumed responsibility for corresponding elements of the Work.
 - e. Submit consent of surety to Final Payment.
 - f. Submit evidence of final, continuing insurance coverage complying with insurance requirements, if applicable.
2. Reinspection Procedure: The Inspection Group will re-inspect the Work upon receipt of notice from the Construction Administrator that the Work, including inspection list items from earlier inspections, has been completed, except for items whose completion is delayed under circumstances acceptable to the Owner.
 - a. Upon completion of reinspection, the Construction Administrator will prepare a certificate of final acceptance. If the Work is incomplete, the Construction Administrator will advise the Contractor of Work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.

C. Record Document Submittals

1. General

Do not use record documents for construction purposes. Protect Record Documents from deterioration and loss in a secure, fire-resistant location. Provide access to record documents for the Engineer's reference during normal working hours. Keep documents current; do not permanently conceal any work until required information has been recorded. Failure to keep documents current is sufficient cause to withhold progress payments.

- a. The Contractor shall also hire the services of a Surveyor registered in the State of Connecticut to conduct a final survey as specified in Section 01050, and to record the results, and update existing electronic media
- b. The Record Drawings shall be prepared upon completion of the work and in accordance with Section 01050 and copies submitted to the Owner as required in Section 01700. The Record Drawings shall bear the seal of the Land Surveyor and a statement of accuracy.

2. Record Drawings

The Contractor shall maintain one clean, complete undamaged set of blue or black line white-prints of Contract Drawings and Shop Drawings. Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown. Mark which drawing is most capable of showing conditions fully and accurately. Where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract Drawings. Give particular

attention to concealed elements that would be difficult to measure and record at a later date.

- a. Mark record sets with erasable pencil to distinguish between variations in separate categories of the Work.
- b. Mark all new information that is not shown on Contract Drawings.
- c. Note related change-order numbers where applicable.
- d. Organize record drawing sheets into manageable sets. Bind sets with durable-paper cover sheets; print suitable titles, dates, and other identification on the cover of each set.
- e. Upon completion of the work, the Contractor shall submit Record Drawings to the Construction Administrator and shall submit the Certified Final As-built and Topographic Survey (as detailed in Section 01050) to the Construction Administrator for the Owner's Records. Contractor shall provide the Certified Final As-built and Topographic Survey on mylar and electronically as required in Section 01050.
- f. Submit electronic format data of all revised drawings on CD-ROM format and in AutoCAD (latest version) compatible format.

3. Record Specifications

The Contractor shall maintain one complete copy of the Project Manual, including Addenda. Include with the Project Manual one copy of other written construction documents, such as Change Orders and modifications issued in printed form during construction.

- a. Mark these documents to show substantial variations in actual Work performed in comparison with the text of the Specifications and modifications.
- b. Give particular attention to equals and substitutions and selection of options and information on concealed construction that cannot otherwise be readily discerned later by direct observation.
- c. Note related record drawing information and Product Data.
- d. Upon completion of the Work, submit record Specifications to the Construction Administrator for the Owner's records.

4. Record Product Data

The Contractor shall maintain one copy of each Product Data submittal. Note related Change Orders and markup of record drawings and Specifications.

- a. Mark these documents to show significant variations in actual Work performed in comparison with information submitted. Include variations in products delivered to the site and from the manufacturer's installation instructions and recommendations.
- b. Give particular attention to concealed products and portions of the Work that cannot otherwise be readily discerned later by direct observation.
- c. Upon completion of markup, submit complete set of Record Product Data to the Construction Administrator for the Owner's records.

5. Record Sample Submitted

Immediately prior to Substantial Completion, the Contractor shall meet with the Construction Administrator, Engineer and the Owner's personnel at the Project Site to determine which Samples are to be transmitted to the Owner for record purposes. Comply with the Owner's instructions regarding delivery to the Owner's Sample storage area.

6. Miscellaneous Record Submittals

Refer to other Specification Sections for requirements of miscellaneous record keeping and submittals in connection with actual performance of the Work. Immediately prior to the date or

dates of Substantial Completion, complete miscellaneous records and place in good order. Identify miscellaneous records properly and bind or file, ready for continued use and reference. Submit to the Construction Administrator for the Owner's records.

7. Maintenance Manuals

Organize operation and maintenance data into suitable sets of manageable size. Bind properly indexed data in individual, heavy-duty, 2-inch (51-mm), 3-ring, vinyl-covered binders, with pocket folders for folded sheet information. Mark appropriate identification on front and spine of each binder according to section 01730. Included but not limited to the following types of information:

- a. Emergency instructions.
- b. Spare parts list.
- c. Copies of warranties.
- d. Wiring diagrams.
- e. Recommended "turn-around" cycles.
- f. Inspection procedures.
- g. Shop Drawings and Product Data.
- h. Fixture lamping schedule.

D. Closeout Procedures

1. Operation and Maintenance Instructions: Arrange for each Installer of equipment that requires regular maintenance to meet with the Owner's personnel to provide instruction in proper operation and maintenance. Provide instruction by manufacturer's representatives if installers are not experienced in operation and maintenance procedures. Include a detailed review of the following items:
 - a. Maintenance manuals.
 - b. Record documents.
 - c. Spare parts and materials.
 - d. Tools.
 - e. Lubricants.
 - f. Fuels.
 - g. Identification systems.
 - h. Control sequences.
 - i. Hazards.
 - j. Cleaning.
 - k. Warranties and bonds.
 - l. Maintenance agreements and similar continuing commitments.
2. As part of instruction for operating equipment, demonstrate the following procedures:
 - a. Startup.
 - b. Shutdown.
 - c. Emergency operations.
 - d. Noise and vibration adjustments.

- e. Safety procedures.
- f. Economy and efficiency adjustments.
- g. Effective energy utilization.

E. Final Cleaning

1. General: The General Conditions requires general cleaning during construction. Regular site cleaning is included in Division 1 Section 01570 "Cleaning".
2. Comply with manufacturer's instructions. Complete the following cleaning operations before requesting inspection for Certification of Substantial Completion.
3. Exterior:
 - a. Clean the site, including landscape development areas, of rubbish, litter, and other foreign substances. Sweep paved areas broom clean; remove stains, spills, and other foreign deposits. Rake grounds that are neither paved nor planted, to a smooth, even-textured surface.
 - b. Clean exposed exterior hard-surfaced finishes to a dust-free condition, free of stains, films, and similar foreign substances
 - c. Clean roofs, gutters and downspouts.
 - d. Remove waste and surplus materials, rubbish and construction equipment and facilities from the site, and deposit it legally elsewhere.
 - e. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Remove paint spots; wash and polish glass.
4. Removal of Protection: Remove temporary protection and facilities installed for protection of the Work during construction.
5. Compliance: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property, unless authorized by Owner. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from the site and dispose of lawfully, unless authorized by Owner to leave on-site.
 - a. Where extra materials of value remain after completion of associated Work, they become the Owner's property. Dispose of these materials as directed by the Construction Administrator.
 - b. If the Contractor fails to clean up, the Owner may do so, with the cost charged to the Contractor. The Owner will issue a credit change order to cover the costs.

01730 OPERATION AND MAINTENANCE DATA

- A. The Contractor shall instruct the State's designated personnel in the operation of new equipment and shall provide manuals and if required, provide video tapes of this basic maintenance of the equipment for training purposes. Provide qualified personnel for as long as necessary to instruct the State's personnel.
- B. Submit four (4) copies of the manuals in 3-ring, loose-leaf notebooks to the Engineer for approval. Manuals may consist of plain paper copies of approved shop drawings and catalog cuts. Upon completion and approval, 3 copies will be forwarded to the State and one copy retained by the Engineer.
- C. Manuals shall include:
 1. Operating Procedures:

- a. Typewritten procedures for each mode of operation of each piece of equipment. Procedures shall indicate the status of each component of a system in each operating mode.
 - b. Procedures shall include names, symbols, valve tags, circuit numbers, schematic wiring diagrams, locations of thermostats, manual starters, control cabinets and other controls of each system.
 - c. Emergency shut-down procedures for each piece of equipment or system, both automatic and manual, as appropriate.
2. Maintenance Schedule:
- a. Typewritten schedule describing manufacturers schedule of maintenance and maintenance procedures.
3. Catalog Cuts:
- a. To illustrate each piece of installed equipment, including options.
 - b. Include equipment descriptions including physical, electrical and mechanical; performance characteristics; installation or erection diagrams.
 - c. Include spare parts numbers and names, address and phone number of manufacturer; name, address and phone number of local representative or service department.
 - d. Typewritten list of all subcontractors on the project, including name, address and phone number of local representative or service department.
4. Manuals shall be indexed with dividers indicating each system or piece of equipment.

01740 WARRANTIES AND GUARANTEES

- A. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products. Manufacturer's disclaimers and limitations on product warranties do not relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.
- B. Related Damages and Losses: When correcting failed or damaged warranted construction, remove and replace construction that has been damaged as a result of such failure or must be removed and replaced to provide access for correction of warranted construction.
- C. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
- D. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of the Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.
- E. Owner's Recourse: Expressed warranties made to the Owner are in addition to implied warranties and shall not limit the duties, obligations, rights, and remedies otherwise available under the law. Expressed warranty periods shall not be interpreted as limitations on the time in which the Owner can enforce such other duties, obligations, rights, or remedies.
 - 1. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
- F. Where the Contract Documents require a special warranty, or similar commitment on the Work or part of the Work, the Owner reserves the right to refuse to accept the Work, until the Contractor presents evidence that entities required to countersign such commitments are willing to do so.

- G. The Contractor shall guarantee all materials and workmanship for a period of eighteen months from the date of acceptance of the Work. In addition, the Contractor shall furnish the warranties listed below. Submit four (4) copies of each to the Construction Administrator in the supplier's standard form or in the form given below if there is no standard form available.
1. Section 06643, Geomembranes: Pipe penetration seals and field seams shall be included in the warranty. The warranty shall guarantee materials for a minimum of 20-year materials, and labor for a minimum period of 5-years.
 2. Section 13200, Underground Storage Tanks: 30-year manufacturer's corrosion warranty on tanks and 1 year manufacturer's warranty on tanks against failure due to defective materials or workmanship.
- H. Submit certification that finish materials are fire rated as specified.
- I. Form of Guarantees and Warranties:

Connecticut Resources Recovery Authority
 100 Constitution Plaza, 6th Floor
 Hartford, Connecticut 06103-1702
 (Hartford Lined Ash Area Landfill Closure; Project Number [Insert No. Here])

I (We) hereby guarantee and warranty the work on the referenced project for a period of _____ years from _____, 20__ against failures of workmanship and materials in accordance with the requirements of Section __, Page __, Paragraph __, of the Specifications.

Signed _____

General Contractor (or authorized agent) _____

- J. Bonds shall be by approved Surety Companies, made out to the Owner on company's standard form.
- K. Guarantees, warranties or bonds supplied by Subcontractors, Suppliers or Manufacturers shall reference the project name, number, and location and be certified by the General Contractor to be for the product and installation on the project and must be countersigned by the General Contractor.
- L. Submittals:
1. Submit written warranties prior to the date certified for Substantial Completion. If the Engineer's Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the Engineer.
 2. Forms for special warranties are included in this Section. Prepare a written document utilizing the appropriate form, ready for execution by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Submit a draft to the Owner, through the Construction Administrator, for approval prior to final execution.
 - a. Refer to Divisions 2 through 16 Sections for specific content requirements and particular requirements for submitting special warranties.
 3. Form of Submittal: At Final Completion compile two (2) copies of each required warranty properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.
 4. Bind warranties and bonds in heavy-duty, commercial-quality, durable 3-ring, vinyl-covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (115-by-280-mm) paper.
 - a. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or

installation, including the name of the product, and the name, address, and telephone number of the Installer.

- b. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project title or name, and name of the Contractor.

When warranted construction requires operation and maintenance manuals, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

EXHIBIT C
To
AGREEMENT
FOR
COMPLETION OF CLOSURE OF THE PHASE 1 ASH AREA
AT THE
HARTFORD LANDFILL
TECHNICAL SPECIFICATIONS

TECHNICAL SPECIFICATIONS SECTIONS

Section Number	Section Name
02112	Erosion and Sediment Control
02220	Excavation, Backfill and Ash Regrading
02225	SubBase Material
02227	Cover Soil Material and Drainage Sand
02228	Topsoil Material
02230	Gravel
02271	Riprap
02721	Corrugated Metal Pipe (CMP)
02900	Landscaping
03600	Grout
06642	Erosion Control Geosynthetics
06643	Geomembranes
06645	Geosynthetics
06647	Cold Weather Installation - Geomembrane

SECTION 02112

EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.1 DESCRIPTION

- A. The work described herein and as shown in the details on the Contract Drawings shall consist of furnishing all labor, material and equipment and performing all operations required for furnishing and installing the erosion and sediment controls during construction activities. Silt fence shall be required where indicated on the Project Drawings. Also maintain the erosion and sediment controls through the construction period until the site has been stabilized, as determined by the ENGINEER. The CONTRACTOR shall be responsible for maintaining compliance with all applicable erosion and sediment control regulations.
- B. The work shall conform to the Soil Erosion and Sediment Control Plan as defined below. Site soil erosion and sediment controls must be in place before proceeding with any site demolition activity.
- C. The CONTRACTOR is solely responsible for the management of surface water runoff. The ENGINEER shall verify that all required sediment and erosion controls have been installed to specifications prior to the CONTRACTOR starting any construction activities at the site. The ENGINEER shall also periodically inspect sediment and erosion controls, including after rainfall events, and inform the CONTRACTOR of repairs or removal of accumulated sediments that are required to maintain the effectiveness of the sediment and erosion controls. The CONTRACTOR shall promptly perform these repairs and removal actions as directed by the ENGINEER. The CONTRACTOR is responsible for the costs associated with these repairs and removal actions.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 185	(1997) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
ASTM C 33	(1997) Concrete Aggregates
ASTM D 3787	(1989) Bursting Strength of Knitted Goods – Constant-Rate-or-Transverse (CRT) Ball Burst Test

ASTM D 4355	(1992) Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)
ASTM D 4533	(1991; R 1996) Trapezoid Tearing Strength of Geotextiles
ASTM D 4632	(1991; R 1996) Grab Breaking Load and Elongation of Geotextiles
ASTM D 5141	(1996) Determining Filtering Efficiency and Flow rate of a Geotextile for Silt Fence Application Using Site-Specific Soil

CT Public Act No. 83-388 An Act Concerning Soil Erosion and Sediment Control

CT Council on Soil and Water Conservation (2002) Connecticut Guidelines for Soil Erosion and Sediment Control

1.3 SUBMITTALS

The CONTRACTOR will be furnished with copies of and must comply with the following documents:

- A. Stormwater Pollution Control Plan for the Hartford Landfill Closure – Lined Ash Area, prepared by TRC and Dated February 2009
- B. Quality Assurance Plan for the Hartford Landfill Closure – Lined Ash Area, prepared by TRC and dated February 2009

PART 2 PRODUCTS

2.1 SILT FENCE FABRIC

- A. Fabric used in silt fence construction shall be non-rotting, ultraviolet light resistant woven polyester geotextile with sufficient strength for the purpose intended. The grab tensile strength shall exceed 150 pounds and puncture strength shall exceed 50 pounds.

2.2 STRAWBALES

- A. Bales used in sedimentation control system shall be made of straw with forty pounds minimum weight and one hundred and twenty pounds maximum.

2.3 WOOD STAKES

- A. Wood stakes used in sedimentation control system shall be a minimum 1 inch by 2 inch nominal size by a minimum 3 feet long.

2.4 SILT SACKS/FILTER FABRIC CATCH BASIN TRAPS

- A. Filter fabric catch basin traps shall utilize filter fabric of the type described in 02112-2.1 and shall be constructed as shown on the Contract Drawings. Proprietary silt sacks may also be used with approval from the ENGINEER.

2.5 FIBER FILTRATION TUBES

- A. The Fiber Filtration Tubes (FFT) shall consist of an engineered composite of wood fibers, man-made fibers and performance-enhancing polymers encased within cylindrical tubes composed of a heavy-duty, knitted, high density polyethylene mesh. The photodegradable mesh shall be oriented in diamond or hexagonal patterns and shall move freely at all knitted yarn intersections. The FFT shall allow water to flow freely through its matrix, provide three-dimensional filtration of soil particles and facilitate the release of flocculants to coagulate and aggregate suspended soil particles. Stakes and staples shall be as recommended by the manufacturer.
- B. Product and Manufacturer
1. Terra-Tubes by Profile Products, LLC
 2. or Equal

2.6 JUTE NETTING

- A. Jute netting shall be a jute netting woven from undyed and unbleached plain, single jute yarn, loosely twisted with approximately uniform diameter yarn in both length and width directions. The finished cloth physical requirements are as follows:
- Width – Nominal 48 inches
 - Length – Convenient lengths; 50 yard minimum
 - Weight – 1.05 pounds – 1.70 pounds per linear yard of 48 inch wide material
 - Mass – 0.5 to 0.769 kg/m of 1200 mm wide material
 - Openings – Approximately ½” to 1” in width and length
1. The use of either staples or stakes shall be as recommended by the manufacturer of the erosion control netting.
 2. Staples used to fasten the erosion control netting to the soil surface shall be steel, U-shaped and shall be approximately 6 inches long and 1 inch wide. Machine made staples shall be of No. 11 gauge or heavier steel wire. Hand made staples shall be made from 13 inch lengths of No. 9 gauge or heavier steel wire.
 3. Stakes used to fasten the erosion control netting to the soil surface shall be of a type, shape and length as recommended by the manufacturer unless designated otherwise by the plans.

PART 3 EXECUTION

3.1 CONSTRUCTION METHODS

Construction of erosion and sediment control practices shall be sequenced to coordinate with the construction schedule. Perimeter erosion and sediment controls shall be in place and be completely functional prior to start of any land disturbing activities. All erosion and sediment controls shall be constructed and installed in accordance with the Contract Drawings and Soil Erosion and Sediment Control Plan approved by the Owner's Representative.

A. Silt Fence and Straw Bales

1. Furnish and install silt fence and staked straw bales where indicated on the Project Drawings and as required by the Soil Erosion and Sediment Control Plan. The silt fence shall remain in place during the duration of the project and shall be removed with the approval of the ENGINEER.

B. Catch Basin Protection

1. For catch basins in paved roadways and within the perimeter drainage swale, provide a filter fabric sediment trap as shown on the Drawings.

C. Furnish and install Fiber Filtration Tubes (FFT) where indicated on the Contract Drawings.

1. Install FFTs as shown on the Contract Drawings. The FFTs shall be installed after final grading but before hydroseeding and remain until turf is firmly established.

D. Jute Netting

1. Jute netting strips shall be rolled out flat, parallel to the direction of flow, in flumes and ditches and perpendicular to the direction of flow on backslopes. When two or more strips are required to cover an area, they shall overlap 3 inches (minimum); and staples placed with half of each staple located in each of the adjoining blankets. Ends of strips shall overlap a minimum of 6 inches with the upgrade section on top. The upslope end (anchor slot) of each strip shall be buried in 6 inch vertical slots, and soil tamped firmly against it.

E. Maintenance

1. The erosion and sediment control measures shall remain in place for the duration of the construction period and until turf has been established pursuant to Section 02900. The CONTRACTOR shall inspect all erosion and sediment control measures after each rainfall event and replace or repair as necessary for measures to remain functional and as directed by the ENGINEER. Sediment that accumulates behind silt fence to within fifty percent of the fence height shall be immediately removed.

3.2 BEST MANAGEMENT PRACTICES

A. Erosion and Sediment Control Devices

1. Soil erosion and sediment controls are measures that are used to reduce the amount of soil particles that are carried off of a land area and deposited in a receiving water. This

section provides a general description of the most appropriate measures planned for this project. All applicable soil erosion and sediment control measures shall be implemented in accordance with the guidelines contained herein prior to commencement of construction activities. Measures shall be maintained during and after the demolition activity until final stabilization is accomplished, after which time all temporary soil erosion and sediment control measures will be removed.

a. Temporary Stabilization

Temporary stabilization consists of terracing, mulching, or reseeding vegetation in all disturbed, unvegetated areas that are exposed during prolonged periods of inactivity. Due to the relatively short nature of the proposed project activities, it is not likely that temporary stabilization will be required. However, temporary stabilization measures shall be implemented if construction halts for more than 14 days, where construction will not resume within 21 days, and where the area is not subject to traffic.

b. Permanent Stabilization

Permanent stabilization for the footprint of the landfill cap consists of turf establishment as described in Section 02935.

c. Temporary Erosion Control Practices

Prior to initiating construction, all temporary erosion and sediment control practices shall be in place. This section discusses all temporary erosion and sediment control practices that are necessary for the construction practices.

1. Construction Access

Any material which is transported outside the contract boundaries and is deposited on public roadways shall be removed immediately. Material may be removed by shoveling, wet mopping, wet sweeping, or wet power brooming and shall be transported to the appropriate stockpile within the contract boundaries. Road washing shall be allowed only after the sediment is removed in the above manner and approved by the ENGINEER. Dry sweeping or dry power brooming shall not be allowed.

2. Silt Fence and Straw Bales

Silt Fence and straw bales will be used to intercept and retain small amounts of sediment carried by sheet flow from the disturbed areas during construction activities in order to prevent sediment runoff from the project site. Silt fence and straw bales shall be placed within or around the work zones as shown on the Contract Drawings. Silt fence and straw bales are to be used in areas with slope except in drainageways. Silt fence and straw bales shall be placed perpendicular to the flow of runoff and parallel to the contours. The devices shall be placed down slope of disturbed areas where erosion would occur in the form of sheet or rill erosion. Construct silt fence and straw bale applications as shown on the Contract Drawings.

END OF SECTION 02112

SECTION 02220

EXCAVATION, BACKFILL AND ASH REGRADING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, tools, equipment tests and incidentals required to perform all surveys, excavations, backfilling, compaction, and disposing of earth materials as shown, specified, and required for the purpose of constructing the landfill cap, structures, pipelines, drainage structures, embankments, roads, grading, and other facilities and reworking eroded areas required to complete the Work in every respect. Finish grades for the ash material and the final cap shown on the Contract Drawings are subject to revision following the initial survey as described within this Section.
2. The CONTRACTOR is solely responsible for the management of surface water runoff. The ENGINEER shall verify that all required sediment and erosion controls have been installed to specifications prior to the CONTRACTOR starting any construction activities at the site. The ENGINEER shall also periodically inspect sediment and erosion controls, including after rainfall events, and inform the CONTRACTOR of repairs or removal of accumulated sediments that are required to maintain the effectiveness of the sediment and erosion controls. The CONTRACTOR shall promptly perform these repairs and removal actions as directed by the ENGINEER. The CONTRACTOR is responsible for the costs associated with these repairs and removal actions.
3. After the CONTRACTOR has performed the initial survey and provided the survey information to the ENGINEER and CRRA, the ENGINEER will determine final ash grades. All of the drawings and other associated documents associated with completion of the work will be provided to the CONTRACTOR at a meeting to be held with CRRA, the ENGINEER, and the CONTRACTOR.
4. All of the necessary excavation, backfilling and compaction of ash and soil material to achieve the landfill cap subgrade contours as shown on the Contract Drawings.
5. All temporary means needed to maintain the site in a continuously dewatered condition.
6. All necessary testing of materials as required in the Contract Documents.
7. All necessary preparation of subgrade for the landfill cap, pavements, roadways, soil and fill material, geosynthetics and geomembranes is included.
8. All necessary work and materials required to repair displaced and eroded soil materials on ash, subgrade, drainage layer, cover material layer, and topsoil layer prior to final acceptance is included.
9. All temporary means needed to prevent discharge of ash or sediment to water courses due to dewatering systems or erosion during construction are included. Such means shall be included in a Stormwater Pollution Control Plan to be prepared by the ENGINEER prior to mobilization.
10. No classification of excavated materials will be made. Excavation includes all materials regardless of type, character, composition, moisture, or condition.

11. All necessary earthwork required to load and transport off-site soil material; unload, place, compact and grade the subgrade material, embankment fill, structural fill, barrier protection material, drainage material, and topsoil is included.
12. All necessary earthwork required to cut, fill and grade existing grade to within 1-inch of specified subgrade is included.
13. All necessary earthwork required to excavate, load and temporarily stockpile existing on-site soil material; unload, place, compact and grade the ash, subgrade material, and all cap component soil materials.

B. Related Sections:

1. Section 02225, Subbase Material
2. Section 02227, Cover Soil Material and Drainage Sand
3. Section 02228, Topsoil
4. Section 02230, Crushed Stone and Gravel
5. Section 02900, Turf Establishment, Landscaping

C. General:

1. The CONTRACTOR shall be required to excavate ash and temporary soil cover from the site as directed by the ENGINEER and use the same as compacted backfill to achieve the landfill cap subgrade contours shown on the Contract Drawings. Subgrade contours may need to be adjusted due to the amount of material available. The ENGINEER shall direct the CONTRACTOR as to any changes in the subgrade contours.
2. CONTRACTOR is required to use approved clean material from off-site sources as shown on the Drawings to achieve final landfill configuration.
3. Fill materials and their respective applications include, but are not limited to the following:

<u>Fill Material</u>	<u>Application</u>
1) Subbase	Subbase Layer
2) Cover Soil and Drainage Sand	Layers overlying Geomembrane
3) Topsoil	Vegetative Layer
4) Relocated Ash & Temporary Cover	Cap Subgrade

4. Prior to mobilization to the site to construct the landfill cap, CRRA will perform a survey of the Work Area to determine areas that will require cut or fill to achieve the final ash surface grade. The CONTRACTOR will be responsible for regrading the surface of the Work Area to achieve this final grade. It may be necessary for the CONTRACTOR to move large amounts of fill to achieve the final grades. Payment will be made on a unit price basis. CONTRACTOR will determine means and methods to achieve final grades. All grades prior to placement of subbase shall be no greater than 33%, nor less than 4%. CONTRACTOR shall remove all visible pieces of metal within the ash layer prior to placement of subbase.
5. CONTRACTOR shall provide a final as-built survey of lines and grades showing topography and spot elevations prepared and sealed by a Connecticut licensed surveyor for top of liner and finished grades. Copies of all field notes shall accompany the as-built surveys and shall be submitted prior to the request for payment.

6. CONTRACTOR'S test field data must indicate compliance with the Contract Documents in order to be accepted. The data must be presented to and accepted by the ENGINEER prior to placement of the next lift. CONTRACTOR must assist the ENGINEER in doing periodic conformance testing while the work is in progress. The field data must be certified and sealed by a Connecticut licensed Professional ENGINEER.
- D. CONTRACTOR shall provide ENGINEER with access to the borrow pit or material source upon request for the purposes of observing material source operations and obtaining samples.
- E. CONTRACTOR shall maintain open access to roads at all times during landfill cap construction. CONTRACTOR shall not block the existing roads at any time. If access needs to be temporarily blocked during construction, the CONTRACTOR shall provide written notice to the OWNER at least one week prior to needing to block this access.

1.2 QUALITY ASSURANCE

A. Tests:

1. The services of a qualified testing laboratory shall be engaged by the CONTRACTOR to make tests and determine acceptability of the fill or material as listed below. The laboratory shall be acceptable to the ENGINEER.
2. Required Tests:
 - a. Topsoil, cover material, drainage sand, and subbase samples from Off-Site: Gradation, ASTM D 422, Priority Pollutant Semivolatile Organic Compounds (SVOCs), EPA Method 8270, Priority Pollutant Volatile Organic Compounds (VOCs), EPA Method 8260, Priority Pollutant Metals, EPA Method 6010 (HG Method), PCB's/Pesticides, EPA Method 8081, Herbicides, EPA Method 8151. All environmental test results shall be in conformance with the criteria for Residential Direct Exposure Criteria (RDEC) and Class GB Groundwater Pollutant Mobility Criteria (GBPMC) of the CTDEP's Remediation Standard Regulations (RSRs), 22a-133k-1 to k-3 of the Regulations of Connecticut State Agencies.
 - b. Compacted in place cover material, drainage sand, and subbase samples: Compaction, Modified Proctor ASTM D 1557, ASTM D 1556, ASTM D 2922 and ASTM D3017.

B. Permits and Regulations:

1. CONTRACTOR shall obtain all necessary permits for work.
2. CONTRACTOR shall perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction and any other permits required for this project.
3. CONTRACTOR shall comply with the CTDEP's General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities.

C. Reference Standards: Comply with applicable provisions and recommendations of the following except as otherwise shown or specified.

1. ASTM D 422, Particle-Size Analysis of Soils

2. ASTM D 1556, Density of Soil in Place by the Sand-Cone Method.
3. ASTM D 1557, Moisture-Density Relations of Soils, using 10.0 lb (4.5 kg) Rammer and 18-in. (457 mm) Drop
4. ASTM D 2922, Density of Soil in Place by Nuclear Methods.
5. ASTM D 3017, Water Content of Soil and Rock in Place by Nuclear Methods
6. Priority Pollutant Semivolatile Compounds by EPA Method 8270
7. Priority Pollutant Volatile Organic Compounds by EPA Method 8260
8. Priority Pollutant Metals by EPA Method 6010 (HG Method)
9. Pesticides, EPA Method 8081
10. Herbicides, EPA Method 8151
11. PCB, EPA Method 8082

Note: Items 6 through 11 as noted above will be referred to as "environmental testing" throughout these Specifications.

1.3 SUBMITTALS

A. Test Reports:

1. Submit six (6) copies of the following reports directly to ENGINEER from the testing service, with copy to the CONTRACTOR:
 - a. All tests for cover material, subbase, and topsoil.
 - b. Compliance testing during construction.
 - c. Field density tests.
 - d. Optimum moisture - maximum density curve for each soil.
2. Testing shall conform to the requirements as indicated in the specific material specification sections.

B. Submit six (6) samples for each material required to construct the cap.

C. ENGINEER shall prepare a Stormwater Pollution Control Plan in accordance with the CTDEP's General Permit for the Discharge of Stormwater and Dewatering Wastewaters Associated with Construction Activities. This plan shall address temporary means needed to prevent discharge of sediment to water courses because of dewatering systems or erosion and off-site removal and disposal of all water that has contacted exposed solid waste material as a result of construction activities.

1.4 JOB CONDITIONS

A. Existing Structures: Shown on the Drawings are certain surface and underground structures adjacent to the Work. This information has been obtained from existing records. It is not guaranteed to be correct or complete and is shown for the convenience of the CONTRACTOR. CONTRACTOR shall explore ahead of the required excavation to determine the exact location of all structures. They shall be supported and protected from injury by the CONTRACTOR. If they are damaged, broken or injured, they shall be restored immediately by the CONTRACTOR at his expense.

- B. Existing Utilities: Locate existing underground utilities in the areas of Work. If utilities are to remain in place, provide adequate means of protection during earthwork operations.
1. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult the ENGINEER immediately for directions as to procedure. Cooperate with OWNER and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.
 2. Do not interrupt existing utilities serving facilities occupied and used by OWNER or others, except when permitted in writing by ENGINEER and then only after acceptable temporary utility services have been provided.
- C. Use of Explosives:
1. The use of explosives will not be permitted.
- D. Protection of Persons and Property: Barricade open excavations occurring as part of this Work and post with warning lights. Operate warning lights during hours from dusk to dawn each day and as otherwise required.
1. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.
- E. Dust Control: CONTRACTOR shall conduct all of his operations and maintain the area of his activities, including sweeping and sprinkling of roadways, so as to minimize creation and dispersion of dust. Calcium chloride shall be used to control serious or prolonged dust problems, subject to approval of ENGINEER.
- F. Protection of Previously Capped Area: The CONTRACTOR shall not be permitted to operate equipment or store materials on any area of the site previously capped. Any disturbance of these areas shall be repaired to the satisfaction of the ENGINEER at the soil expense of the CONTRACTOR.

PART 2 – PRODUCTS

2.0 ACCEPTABLE MANUFACTURERS

- A. Not Applicable.

2.1 SOIL MATERIALS

- A. Cover Material and Drainage Sand:
1. Cover material and drainage sand shall be used where shown and specified, including, but not limited to subgrade preparation of access roads.
 2. Cover material and drainage sand in accordance with Section 02227.
 3. All cover material and drainage sand must adhere to the range of cohesion/internal friction angle properties (i.e. 0 psf, 37°) specified below:

Cohesion, psf	Peak Internal Friction Angle Φ
0	37
10	36
20	34
35	32
45	30

4. Provide approved soil materials for cover material, free of contaminated soil, clay, rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetable and other deleterious matter.

B. Topsoil:

1. Topsoil shall be placed where shown or specified or directed by ENGINEER.
2. Provide approved soil materials for Topsoil, free of contaminated soil, clay, rock or gravel larger than 1 inch in any dimension, debris, waste, frozen materials, vegetable and other deleterious matter.
3. All Topsoil materials must adhere to the range of cohesion/internal friction angle properties (i.e. 0 psf, 37°) specified below:

Cohesion, psf	Peak Internal Friction Angle Φ
0	37
10	36
20	34
35	32
45	30

4. See Section 02900 "Landscaping" for full specifications.

C. Subbase Material:

1. Subbase shall be provided to cover the waste areas achieving final grades. Subbase shall be placed where shown or specified on the Drawings, or as directed by ENGINEER.
2. See Section 02225 "Subbase Material", for detailed specifications related to Subbase.

PART 3 - EXECUTION

3.1 SURVEY

- A. CONTRACTOR shall have a pre-construction initial survey performed by a Connecticut licensed Land Surveyor. At a minimum, the survey shall consist of cross-sections spaced every 50 feet and oriented east-west perpendicular to the east slope. Spot elevations shall be taken every 25 feet and at grade changes for every section. The survey limits shall

coincide with the cap limits plus 50 feet. The survey information shall be submitted to CRRA and the ENGINEER.

- B. The ENGINEER shall determine final ash grades based upon the survey information provided by the CONTRACTOR and shall modify all Contract Documents as necessary for the Work.

3.2 INSPECTION

- A. ENGINEER will examine the areas and conditions under which excavating, filling, and grading are to be performed and notify the CONTRACTOR of conditions he may find that are detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in an acceptable manner.
- B. CONTRACTOR shall provide the ENGINEER with clean, unused, scalable 5 gallon pails with handles and lids to obtain samples. CONTRACTOR shall assist ENGINEER while taking samples.

3.3 SITE PREPARATION

- A. Temporary cover will be removed from the work area. Liner and concrete blocks may be reused, if approved by the engineer, for construction of the cap/working face protection barrier. CONTRACTOR will grade ash surface to achieve final grades prior to construction of the landfill cap. The CONTRACTOR shall grade ash and temporary cover soil to achieve the subgrade contours on the final adjusted Contract Drawings. Ash that is excavated and reused to fill low spots shall be compacted in loose lifts not exceeding 8 inches thickness with four passes of a vibratory roller.

3.4 EXCAVATION

- A. CONTRACTOR shall perform all excavation required to complete the Work as directed by the engineer. Excavations shall include ash only and shall not require drilling and blasting to remove.
- B. Material Storage: Stockpile satisfactory excavated materials in approved areas, until required for backfill or fill. Place, grade and shape stockpiles for proper drainage.
 1. Locate and retain soil materials at locations indicated on Contract Drawings.
 2. Dispose of excess soil material and waste materials as specified hereinafter.
 3. CONTRACTOR shall ensure temporary erosion & sediment control measures are taken in accordance with the Stormwater Management Plan.

3.5 UNAUTHORIZED EXCAVATION

- A. All excavation outside the lines and grades shown, and which is not approved by the ENGINEER, together with the removal and disposal of the associated material shall be at the CONTRACTOR'S expense. The unauthorized excavation shall be filled and compacted with select backfill by the CONTRACTOR at his expense.

- B. Any damage, disturbance, or settlement that occurs as a result of the CONTRACTOR's stockpiling of material or equipment on site shall be the responsibility of the CONTRACTOR to repair and/or supply additional materials to compensate for settlement caused by the CONTRACTOR'S actions.

3.6 GRADING

- A. General: Uniformly grade areas within limits of grading under this Section, including adjacent transition areas. Smooth subgrade surfaces within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.
- B. Compaction:
 - 1. After grading, compact subgrade surfaces to the depth and percentage of maximum density for each area classification.

3.7 FIELD QUALITY CONTROL

- A. Quality Control Testing During Construction:
 - 1. CONTRACTOR shall establish and maintain a 50 foot grid for control of field density testing.
 - 2. Compaction testing shall be performed by contractor on a 50 foot grid in the presence of the ENGINEER.
 - 3. Compaction testing shall be performed according to ASTM D 2922, Density of Soil in Place by Nuclear Methods.
 - 4. Compaction testing shall be presented and accepted by the ENGINEER prior to placement of the next lift. Fill compaction test results on the 50 foot grid interval to be signed and stamped by a professional engineer licensed in the State of Connecticut prior to submission to the ENGINEER.
 - 5. Field compaction testing shall be included in each of the bid items. Field compaction testing for reworked or damaged areas shall be included in the respective bid items.

PART 4 - ASH REGRADING MEASUREMENT AND PAYMENT

- A. Method of Measurement
 - 1. The CONTRACTOR will retain the services of a licensed Connecticut Land Surveyor to survey the pre-construction grades and the grades of the top of the finished cap subgrade. At a minimum, the survey shall consist of cross-sections spaced every 50 feet and oriented east-west perpendicular to the east slope. Spot elevations shall be taken every 25 feet and at grade changes for every section. The survey limits shall coincide with the cap limits plus 50 feet.
 - 2. Measurement for payment for ash regrading shall only be within the limits of grading shown for the subgrade for the cap area shown on the Contract Drawings. The volume of excavation and filling shall be calculated using the average end area method based upon the pre-construction and finished cap subgrade sections.

B. Basis for Payment

1. The CONTRACTOR shall be paid at the contract unit price for pre-construction and final as-built surveys. The price shall include all labor, equipment, materials and tools incidental to the relocation and regrading of ash and temporary cover soil to achieve the landfill cap subgrade shown on the final adjusted Contract Drawings.
2. The CONTRACTOR shall be paid at the contract unit price for “ash relocation and regrading” on a cubic yard basis for the combined volume of excavation and fill as defined in the method of measurement above. The price shall include all labor, equipment, materials and tools incidental to the relocation and regrading of ash and temporary cover soil to achieve the landfill cap subgrade shown on the final adjusted Contract Drawings.

END OF SECTION 02220

SECTION 02225

SUBBASE MATERIAL

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:

1. The work to be performed under this Section shall include materials, all labor, tools, equipment, and testing for furnishing, placing, grading, and compacting subbase material over the prepared and accepted ash subgrade as shown on the Contract Drawings or as otherwise directed by the ENGINEER.
2. The CONTRACTOR is solely responsible for the management of surface water runoff. The ENGINEER shall verify that all required sediment and erosion controls have been installed to specifications prior to the CONTRACTOR starting any construction activities at the site. The ENGINEER shall also periodically inspect sediment and erosion controls, including after rainfall events, and inform the CONTRACTOR of repairs or removal of accumulated sediments that are required to maintain the effectiveness of the sediment and erosion controls. The CONTRACTOR shall promptly perform these repairs and removal actions as directed by the ENGINEER. The CONTRACTOR is responsible for the costs associated with these repairs and removal actions.
3. All necessary testing of materials as required in the Contract Documents.
4. CONTRACTOR field test data shall indicate compliance with the Contract Documents in order to be accepted. The field data shall be certified by the ENGINEER.
5. CONTRACTOR shall provide the ENGINEER with access to the borrow pits or material sources upon request for the purposes of observing material source operations and obtaining samples. The CONTRACTOR shall be responsible for supplying all required samples for testing.
6. All soil layer thicknesses referenced in this Section represent the installed compacted thickness.
7. Items listed in Section 02220, Part 1 - General, 1.1 Description also apply.

B. Related Sections:

Section 02220, Excavation, Backfill and Ash Regrading

Section 02228, Topsoil

Section 06643, Geomembranes.

Section 06645, Geosynthetics.

1.2 QUALITY ASSURANCE

A. Tests:

1. The services of a qualified testing laboratory shall be engaged by the CONTRACTOR

to make tests and determine acceptability of the fill or material as listed below. The laboratory shall be acceptable to the ENGINEER.

2. Required Tests:

- a. Subbase material Samples from Off-Site: Gradation, ASTM D 422, Priority Pollutant Semivolatile Compounds, EPA Method 8270, Priority Pollutant Volatile Organic Compounds, EPA Method 8240, Priority Pollutant Metals, EPA Method 6010 (HG Method), Pesticides, EPA Method 8081, PCBs, EPA Method 8082, Herbicides, EPA Method 8150. All test results shall be in conformance with the criteria for Industrial Direct Exposure Criteria (IDEC) and Class GB Groundwater Pollutant Mobility Criteria (GBPMC) of the CTDEP's Remediation Standard Regulations (RSRs), 22a-133k-1 to k-3 of the Regulations of Connecticut State Agencies.
- c. Compacted Subbase material: Compaction, ASTM D 1557, ASTM D 1556, ASTM D 2922 and ASTM D3017.

B. Permits and Regulations:

1. CONTRACTOR shall obtain all necessary permits.

C. Reference Standards: Comply with applicable provisions and recommendations of the following except as otherwise shown or specified.

1. ASTM D 422, Particle-Size Analysis of Soils.
2. ASTM D 4318, Liquid Limit, Plastic Limit and Plasticity Index of Soils.
3. ASTM D 1557, Moisture-Density Relations of Soils, using 10.0 lb (4.5 kg) Rammer and 18-in. (457 mm) Drop.
4. ASTM D 2922, Density of Soil in Place by Nuclear Methods.
5. ASTM D 3017, Water Content of Soil and Rock in Place by Nuclear Methods.
6. Priority Pollutant Semivolatile Compounds by EPA Method 8270.
7. Priority Pollutant Volatile Organic Compounds by EPA Method 8240.
8. Priority Pollutant Metals by EPA Method 6010 (HG Method).
9. Pesticides, EPA Method 8081.
10. Herbicides, EPA Method 8150.
11. PCBs/EPA Method 8082.

Note: Items 6 through 11 as noted above will be referred to as "environmental testing" throughout these Specifications.

1.3 SUBMITTALS

A. Test Reports:

1. Submit six (6) copies of the following reports directly to ENGINEER from the testing service, with copy to the CONTRACTOR:
 - a. All tests for subbase material.
 - b. Compliance testing during construction.
 - c. Field density tests.
 - d. Optimum moisture - maximum density curve for each soil.
2. Testing shall conform to the following as a minimum.
 - a. Tests on material
 - 1) Subbase material: Environmental, particle size, modified proctor, and

interface and internal friction angle tests for Subbase material from off-site shall be performed at a frequency of 1 per 3,000 cubic yards if from a natural borrow source or 1 per source, whichever is more stringent. Material that is not from a natural borrow source shall be tested at a frequency of 1 per 1,000 cubic yards.

b. Field density tests:

- 1) Subbase material: CONTRACTOR shall conduct one (1) test every 10,000 square feet per 6 inch lift. A Troxler Nuclear Moisture-Density gauge shall be used for all field density tests. Test locations shall be tied into a site grid system 50 foot square. Test reports shall note the grid location point and lift for each test. CONTRACTOR shall establish and maintain grid points for each lift of material placed.

c. Moisture-density curve for each Subbase material used in construction.

B. Submit six (6) samples of all Subbase materials required.

C. ENGINEER shall prepare prior to mobilization, a Stormwater Pollution Control Plan prepared in accordance with the CTDEP's General Permit for the Discharge of Stormwater and Dewatering Wastewaters Associated with Construction Activities. This plan shall address temporary means needed to prevent discharge of sediment to water courses because of dewatering systems or erosion and off-site removal and disposal of all water that has contacted exposed solid waste material as a result of construction activities.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Not Applicable.

2.2 SUBBASE

A. SUBBASE

1. Subbase shall be provided to cover the waste areas and for supporting the overlying geomembrane. Subbase shall be placed where shown or specified on the Drawings, or as otherwise directed by ENGINEER.
2. Subbase shall be low plasticity inorganic soil borrow with adequate shear strength properties. The material shall be an earthen soil which is free of vegetation, ice or frozen material, wood, glass, metal, or other deleterious material. The maximum particle size shall be 1/4-inch and free of sharp edges.
3. The Subbase shall meet or exceed the following requirements:
 - a. Internal Shear Strength:
All Subbase material must adhere to the range of cohesion/internal friction angle properties (i.e. 0 psf, 37°) specified below:

Cohesion, psf	Peak Internal Friction Angle Φ
0	37
10	36
20	34
35	32
45	30

The tests shall be performed for a minimum of three normal tresses that simulate field loading conditions. The following normal loads shall be used:

- i. Condition No. 1 - 100psf, 300psf, 500psf.
 - b. U.S. Standard Sieve analysis parameters:
 - i. 100% passing 1/4-inch square sieve.
 - ii. Less than or equal to 30% passing #200 sieve.
 - c. Plasticity index (PI) < 5.
 - d. The CONTRACTOR shall submit to the ENGINEER engineering calculations prepared by a licensed Connecticut Professional Engineer, shop drawings, proposed quality assurance and quality control measures, product information, laboratory test results and all other necessary and applicable data to the ENGINEER.
 - e. The Subbase shall be tested in accordance with ASTM D5321, based on soil type and geosynthetics used and shall exhibit an interface friction angle >30°. Refer to Section 06643 and 06645 for testing requirements.
4. Provide approved soil materials for Subbase, free of contaminated soil, clay, rock or gravel larger than 0.25 inches in any dimension, debris, waste, frozen materials, vegetable and other deleterious matter. Soil material acceptable for use as Subbase shall be classified as SW, SP or SM according to the Unified Soil Classification System.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The ENGINEER or his representative will examine the areas and conditions under which excavating, filling, and grading are to be performed and notify the CONTRACTOR of conditions CONTRACTOR may encounter that are detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in an acceptable manner.
- B. CONTRACTOR shall provide the ENGINEER or his representative with clean, unused, scalable 5-gallon pails with handles and lids to obtain samples. CONTRACTOR shall provide personnel to the ENGINEER or his representative to collect samples.
- C. Prior to procurement of material and starting construction, the ENGINEER shall have submitted and received approvals for the materials based on the testing required in this Section.

- D. Subbase material shall be pushed up side slopes, never down slope or sideways. It is imperative that the CONTRACTOR makes every reasonable effort to minimize the potential for Subbase to adversely affect the overlying proposed geomembrane via penetration. Therefore, a crew of 3 workers shall work near the earthmoving equipment and remove all rocks, stones, roots or other debris in excess of 1/4-inch in any dimension that could cause damage to the proposed overlying geomembrane. Equipment operators shall not be permitted to make sharp turns or quick stops.
- E. Subbase shall be placed on all areas as shown on the Drawings or as directed by the ENGINEER and as described in these Specifications. The thickness of each lift prior to compaction of the Subbase shall be no greater than eight (8) inches. Total compacted thickness of the Subbase shall be as shown on the Drawings. Compaction of the Subbase shall be accomplished by suitable compaction equipment, subject to approval by the ENGINEER.
- F. The Subbase shall be placed and compacted as necessary to achieve the required shear strength (internal friction angle). The Subbase shall be compacted to 95 percent of Modified Proctor. The moisture content of the material shall be maintained within 3 percent of optimum moisture. Contractor shall not work wet cover material that cannot support equipment. Subbase material that becomes wet and soft from rainfall shall be allowed to dry and firm before placing geomembrane.
- G. The existing on-site material or material delivered to the site shall be visually inspected by the ENGINEER during construction to check that it is consistently the same as the materials previously existent or delivered to the site. If changes in the material occur, the ENGINEER shall verify the material is from an approved source and the ENGINEER may require additional testing in accordance with Paragraph 1.3, Part A (2) of this Section. If the material is not from an approved source or if the material is determined to not be acceptable by the ENGINEER, the CONTRACTOR shall be notified that the material is not approved. The ENGINEER shall reject any work performed by the CONTRACTOR using the new material until the appropriate testing is conducted and the material is approved by the ENGINEER.
- H. The thickness of the in-place Subbase will be checked after the completion of the work on a grid pattern not to exceed 50-foot by 50-foot by digging, by hand, in the presence of and as directed by the ENGINEER. The size of the test hole shall not be less than one-foot in diameter. Measurements shall be made perpendicular to the slope. The CONTRACTOR shall be responsible for digging holes in the Subbase to allow for the measurements to be taken by the ENGINEER. After measurements have been made, the CONTRACTOR shall backfill the holes with Subbase, and hand tamp.
- I. The CONTRACTOR shall be responsible to repair damage to the Subbase between testing and acceptance. Rills and gullies shall be repaired before placing the geomembrane.
- J. All soil samples are to be obtained under the direction of the ENGINEER.
- K. Final acceptance of Subbase is dependent upon:

- a. Satisfying the minimum requirement of compacted thickness (6 inches) of the Subbase layer measured perpendicular to the slope.
 - b. Subbase meeting all the physical/analytical properties listed in Section 02225.
 - c. Final inspection conducted by the ENGINEER ensuring that the final state of the Subbase and Subbase surface will not puncture, wrinkle, or damage the proposed overlying geomembrane in any manner. If the compacted Subbase does not meet the ENGINEER'S requirements to ensure the integrity of the proposed overlying geomembrane, then the CONTRACTOR will perform all work necessary to mitigate to acceptable Subbase conditions, at no additional cost to the OWNER.
- L. Any damage, disturbance, or settlement that occurs as a result of the CONTRACTOR'S stockpiling of material or equipment on site shall be the responsibility of the CONTRACTOR to repair and/or supply additional materials to compensate for settlement caused by the CONTRACTOR'S actions.

3.2 SOURCE QUALIFICATION TESTING

- A. Prior to acceptance of the borrow or stockpile site, the CONTRACTOR shall provide the following soil analyses to the ENGINEER:
1. Results of interface friction test performed for the interface between the proposed Subbase and proposed geotextile material in accordance with ASTM Standard Test Method D 5321 (latest revision) performed under saturated conditions, with a 24-hour saturation period prior to the test, Determining the Coefficient of Soil/Geosynthetic Friction by the Direct Shear Method. The test shall be performed for a minimum of three normal stresses applied to bracket the normal stress of 300 psf at the interface being tested. The CONTRACTOR shall take particular note that this test shall be repeated for every proposed geotextile and Subbase combination used in the construction.
 2. Results of compaction tests conducted in accordance with ASTM D 1557 (latest revision), Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.
 3. Results of Atterberg limits, plastic and liquid limit, and plasticity index conducted in accordance with ASTM D 4318 (latest revision), Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
 4. Results of the particle-size analysis conducted in accordance with ASTM D 421/422 (latest revision). Standard Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants/Test Method for Particle Size Analysis of Soils.
 5. Results of chemical analyses conducted in accordance with the requirements of Section 02225.

3.3 SUBBASE

- A. Subbase Material:
1. Quality Control Testing:
 - a. The ENGINEER shall perform quality control testing during construction. This testing is in addition to all other tests required to be conducted by the CONTRACTOR.

- b. The ENGINEER shall collect representative samples from each material source of Subbase for testing at a frequency determined by the ENGINEER.
- c. The Subbase shall exhibit an interface friction angle in accordance with the values as specified in paragraph 2.2 A.3.e of this specification. Materials tested by the ENGINEER exhibiting results not meeting the interface friction angle requirements will be rejected, or the CONTRACTOR may be required to furnish additional test data, at his expense, to demonstrate acceptability of the material.

END OF SECTION 02225

SECTION 02227

COVER SOIL MATERIAL AND DRAINAGE SAND

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:

1. The work to be performed under this Section shall include all materials, labor, tools, equipment, and testing for furnishing, placing, grading, and compacting Cover Soil and Drainage Sand as shown on the Drawings or as otherwise directed by the ENGINEER.
2. The CONTRACTOR is solely responsible for the management of surface water runoff. The ENGINEER shall verify that all required sediment and erosion controls have been installed to specifications prior to the CONTRACTOR starting any construction activities at the site. The ENGINEER shall also periodically inspect sediment and erosion controls, including after rainfall events, and inform the CONTRACTOR of repairs or removal of accumulated sediments that are required to maintain the effectiveness of the sediment and erosion controls. The CONTRACTOR shall promptly perform these repairs and removal actions as directed by the ENGINEER. The CONTRACTOR is responsible for the costs associated with these repairs and removal actions.
3. All necessary testing of materials as required in the Contract Documents.
4. CONTRACTOR field test data shall indicate compliance with the Contract Documents in order to be accepted. The field data shall be certified by the ENGINEER.
5. CONTRACTOR shall provide the ENGINEER with access to the borrow pits or material sources upon request for the purposes of observing material source operations and obtaining samples. The CONTRACTOR shall be responsible for supplying all required samples for testing.
6. All soil layer thicknesses referenced in this Section represent the installed compacted thickness.
7. Items listed in Section 02220, Part 1 - General, 1.1 Description also apply.
8. Two Cover Soil types will be used, as shown on the Contract Drawings, and the Contractor shall provide bid for the construction of each type. Cover Soil Type 1, to be placed on the north and east 3:1 slopes where flat drainage pipes are employed, requires placing 12 inches of sand and 9 inches of suitable cover material separated by a geotextile and 6 inches of topsoil. Cover Soil type 2; to be placed on 4% slopes and south 3:1 slope where a geocomposite drainage layer is employed, requires placing 9 inches of sand and 9 inches of suitable cover material separated by a geotextile, and 6 inches of topsoil. Section 06645 provides geotextile details. Requirements for suitable material and sand for each alternative are specified within this section. Section 02228 provides the requirements for topsoil.

B. Related Sections:

Section 02220, Excavation and Backfill and Ash Regrading
Section 02225, Subbase
Section 02228, Topsoil
Section 06643, Geomembranes
Section 06645, Geosynthetics

1.2 QUALITY ASSURANCE

A. Tests:

1. The services of a qualified testing laboratory shall be engaged by the CONTRACTOR to make tests and determine acceptability of all fill or material as listed below. The laboratory shall be acceptable to the ENGINEER.
2. Required Tests:
 - a. Cover Soil and Drainage Sand material Samples from Off-Site: Gradation, ASTM D 422, Priority Pollutant Semivolatile Compounds, EPA Method 8270, Priority Pollutant Volatile Organic Compounds, EPA Method 8240, Priority Pollutant Metals, EPA Method 6010 (HG Method), Pesticides, EPA Method 8081, PCB, EPA Method 8082, Herbicides, EPA Method 8150. All test results shall be in conformance with the criteria for Residential Direct Exposure Criteria (RDEC) and Class GB Groundwater Pollutant Mobility Criteria (GBPMC) of the CTDEP's Remediation Standard Regulations (RSRs), 22a-133k-1 to k-3 of the Regulations of Connecticut State Agencies.
 - b. Compacted Cover Soil and Drainage Sand material: Compaction, ASTM D 1557, ASTM D 1556, ASTM D 2922 and ASTM D3017.

B. Permits and Regulations:

1. CONTRACTOR shall obtain all necessary permits for work.
2. CONTRACTOR shall perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction.

C. Reference Standards: Comply with applicable provisions and recommendations of the following except as otherwise shown or specified.

1. ASTM D 422, Particle-Size Analysis of Soils.
2. ASTM D4318, Liquid Limit, Plastic Limit and Plasticity Index for Soils.
3. ASTM D 1556, Density of Soil in Place by the Sand-Cone Method.
4. ASTM D 1557, Moisture-Density Relations of Soils, using 10.0 lb (4.5 kg) Rammer and 18-in. (457 mm) Drop.
5. ASTM D 2922, Density of Soil in Place by Nuclear Methods.
6. ASTM D 3017, Water Content of Soil and Rock in Place by Nuclear Methods.
7. Priority Pollutant Semivolatile Compounds by EPA Method 8270.
8. Priority Pollutant Volatile Organic Compounds by EPA Method 8240.
9. Priority Pollutant Metals by EPA Method 6010 (HG Method).
10. Pesticides, EPA Method 8080.
11. Herbicides, EPA Method 8150.
12. PCBs, EPA Method 8082.

Note: Items 6 through 11 as noted above will be referred to as "environmental testing" throughout these Specifications.

1.3 SUBMITTALS

A. Test Reports:

1. Submit six (6) copies of the following reports directly to ENGINEER from the testing service, with copy to the CONTRACTOR:
 - a. All tests for cover soil and drainage sand material.
 - b. Compliance testing during construction.
 - c. Field density tests.
 - d. Optimum moisture - maximum density curve for each soil.
2. Testing shall conform to the following as a minimum.
 - a. Tests on material
 - 1) Cover Soil and Drainage Sand material: Environmental, hydraulic conductivity, particle size, modified proctor, and interface and internal friction angle tests for Cover Soil material from off-site shall be performed at a frequency of 1 per 5,000 cubic yards if from a natural borrow source or 1 per source, whichever is more stringent. Material that is not from a natural borrow source shall be tested at a frequency of 1 per 1,000 cubic yards.
 - b. Field density tests:
 - 1) Cover Soil and Drainage Sand material: CONTRACTOR shall conduct one (1) test every 10,000 square feet per 6 inch lift. A Troxler Nuclear Moisture-Density gauge shall be used for all field density tests. Test locations shall be tied into a site grid system 50 foot square. Test reports shall note the grid location point and lift for each test. CONTRACTOR shall establish and maintain grid points for each lift of material placed.
 - c. Moisture-density curve for each cover soil and drainage sand material used in construction.

B. Submit six (6) samples of all Cover Soil and Drainage Sand materials required.

C. ENGINEER shall prepare prior to mobilization, a Stormwater Pollution Control Plan prepared in accordance with the CTDEP's General Permit for the Discharge of Stormwater and Dewatering Wastewaters Associated with Construction Activities. This plan shall address temporary means needed to prevent discharge of sediment to water courses because of dewatering systems or erosion and off-site removal and disposal of all water that has contacted exposed solid waste material as a result of construction activities.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Not Applicable.

2.2 COVER SOIL AND DRAINAGE SAND

A. Cover Soil and Drainage Sand

1. Cover Soil and Drainage Sand shall be placed where shown or specified on the Drawings, or as otherwise directed by ENGINEER.
2. Cover Soil and Drainage Sand shall be low plasticity inorganic soil borrow with adequate shear strength properties. The material shall be an earthen soil which is free of vegetation, ice or frozen material, wood, glass, metal, or other deleterious material. The maximum particle size shall be ¼ inch for all soil placed within 6 inches of the geomembrane and shall be free of sharp edges. The maximum particle size shall be 3 inches and free of sharp edges for all other cover soil.
3. The Cover Soil and Drainage Sand material shall meet the following requirements:
 - a. Cover Soil over Drainage Geocomposite
 - 1) Permeability: The coefficient of hydraulic conductivity, k, for sand shall be more permeable than 1.0×10^{-3} cm/s and the hydraulic conductivity of suitable overlying material shall be less permeable than 2.0×10^{-4} cm/s.
 - 2) Internal Shear Strength: All Cover Soil material must adhere to the range of cohesion/internal friction angle properties specified below:

Cohesion (psf)	Peak Internal Friction Angle (Φ)
0	37
10	36
20	34
35	32
45	30

The tests shall be performed for a minimum of three normal stresses that simulate field loading conditions. The following normal loads shall be used, 100 psf, 300 psf, 500 psf.

- 3) U.S Standard Sieve analysis parameters:
 - i. 100% passing ¼ inch or 3-inch square sieve (see A2 above)
 - ii. Less than or equal to 5% passing No. 200 sieve for sand and less than or equal to 20% passing No. 200 sieve for suitable overlying material
 - 4) Plasticity index (PI) <15 for all Cover Materials
 - 5) The Contractor shall submit to the Engineer engineering calculations prepared by a licensed Connecticut Professional Engineer, shop drawings, proposed quality assurance and quality control measures, product information, laboratory test results and all other necessary and applicable data to the Engineer.
 - 6) The Cover Soil material shall be tested in accordance with ASTM D 5321, based on soil type and geosynthetics used and shall exhibit an interface friction angle of >30°.
- a. Cover Soil and Drainage Sand over Flat Pipe Drains
- 1) Permeability: The coefficient of hydraulic conductivity, k, for sand shall be more permeable than 1.0×10^{-2} cm/s and the hydraulic conductivity of suitable overlying material shall be less permeable than 2.0×10^{-4} cm/s.

- 2) Internal Shear Strength: All Cover Soil material must adhere to the range of cohesion/internal friction angle properties specified below:

Cohesion (psf)	Peak Internal Friction Angle (Φ)
0	37
10	36
20	34
35	32
45	30

The tests shall be performed for a minimum of three normal stresses that simulate field loading conditions. The following normal loads shall be used, 100 psf, 300 psf, 500 psf.

- 3) U.S Standard Sieve analysis parameters:
 - i. 100% passing ¼ inch or 3-inch square sieve (see A2 above)
 - ii. Less than or equal to 5% passing No. 200 sieve for sand and less than or equal to 20% passing No. 200 sieve for suitable overlying material
 - 4) Plasticity index (PI) <15 for all Cover Materials
 - 5) The Contractor shall submit to the Engineer engineering calculations prepared by a licensed Connecticut Professional Engineer, shop drawings, proposed quality assurance and quality control measures, product information, laboratory test results and all other necessary and applicable data to the Engineer.
 - 6) The Cover Soil and Drainage Sand material shall be tested in accordance with ASTM D 5321, based on soil type and geosynthetics used and shall exhibit an interface friction angle of >30°.
4. Provide approved soil materials for cover soil, free of contaminated soil, clay, rock or gravel larger than ¼ inch or 3 inches (see A2 above) in any dimension, debris, waste, frozen materials, vegetable and other deleterious matter.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The ENGINEER or his representative will examine the areas and conditions under which excavating, filling, and grading are to be performed and notify the CONTRACTOR of conditions CONTRACTOR may encounter that are detrimental to the proper and timely completion of the Work. The CONTRACTOR shall not proceed with the Work until unsatisfactory conditions have been corrected in an acceptable manner.
- B. CONTRACTOR shall provide the ENGINEER or his representative with clean, unused, scalable 5-gallon pails with handles and lids to obtain samples. CONTRACTOR shall provide personnel to the ENGINEER or his representative to collect samples.
- C. Prior to procurement of material and starting construction, the CONTRACTOR shall have submitted and received approvals for the materials based on the testing required in this

Section.

- D. Cover Soil and Drainage Sand material shall be pushed using low pressure equipment and a minimum of 12 inches of material shall be kept beneath the tracks at all times. It is imperative that the CONTRACTOR makes every reasonable effort to minimize the potential for Cover Soil and Drainage Sand to adversely affect the underlying geomembrane and drainage layer via penetration. Therefore, low pressure equipment shall be used to place cover materials. Equipment operators shall not be permitted to make sharp turns or quick stops.
- E. Cover material and drainage sand shall be placed on all areas as shown on the Drawings or as directed by the ENGINEER and as described in these Specifications. The thickness of each lift prior to compaction of the cover material shall be no greater than twelve (12) inches. Total compacted thickness of the cover material shall be as shown on the Drawings. Compaction of the Cover Soil material shall be accomplished by suitable compaction equipment, subject to approval by the ENGINEER.
- F. The cover material and drainage sand shall be placed and compacted as necessary to achieve the required permeabilities and shear strength. The cover material shall be compacted to 90 percent of Modified Proctor. The moisture content of the material shall be maintained within 3 percent of optimum moisture. Contractor shall not work wet cover material that cannot support equipment.
- G. If changes in the material occur, the ENGINEER shall verify the material is from an approved source and the ENGINEER may require additional testing in accordance with Paragraph 1.3, Part A (2) of this Section. If the material is not from an approved source or if the material is determined to not be acceptable by the ENGINEER, the CONTRACTOR shall be notified that the material is not approved. The ENGINEER shall reject any work performed by the CONTRACTOR using the new material until the appropriate testing is conducted and the material is approved by the ENGINEER.
- H. The thickness of the in-place materials will be checked after the completion of the work on a grid pattern not to exceed 50-foot by 50-foot by digging, by hand, with a plastic shovel in the presence of and as directed by the ENGINEER. The size of the test hole shall not be less than one-foot in diameter. Measurements shall be made perpendicular to the slope. The CONTRACTOR shall be responsible for digging holes in the cover material to allow for the measurements to be taken by the ENGINEER. After measurements have been made, the CONTRACTOR shall backfill the holes with cover material, and hand tamp. During digging and backfill of test holes, the CONTRACTOR shall use plastic shovels and exercise care not to damage any materials. Any such damage shall be repaired at the expense of the CONTRACTOR.
- I. The CONTRACTOR shall be responsible to repair damage to the cover material between testing and acceptance.
- J. All soil samples are to be obtained under the direction of the ENGINEER.

- K. Final acceptance of cover material is dependent on:
 - a. Satisfying the minimum requirement of thickness from the selected alternative as shown on the Contract Drawings measured perpendicular to the slope.
 - b. Cover material and drainage sand meeting all the physical/analytical properties listed in Section 02227.

- L. Any damage, disturbance, or settlement that occurs as a result of the CONTRACTOR'S stockpiling of material or equipment on site shall be the responsibility of the CONTRACTOR to repair and/or supply additional materials to compensate for settlement caused by the CONTRACTOR'S actions.

3.2 SOURCE QUALIFICATION TESTING

- A. Prior to acceptance of the borrow or stockpile site, the CONTRACTOR shall provide the following soil analyses to the ENGINEER:
 - 1. Results of interface friction test performed for the interface between the proposed Cover Soil and Drainage Sand with proposed geosynthetics in accordance with ASTM Standard Test Method D 5321 (latest revision) performed under saturated conditions, with a 24-hour saturation period prior to the test, Determining the Coefficient of Soil/Geosynthetic Friction by the Direct Shear Method. The test shall be performed for a minimum of three normal stresses applied to bracket the normal stress of 300 psf at the interface being tested. The CONTRACTOR shall take particular note that this test shall be repeated for every proposed geosynthetic and Cover Soil and Drainage Sand combination used in the construction.
 - 2. Results of compaction tests conducted in accordance with ASTM D 1557 (latest revision), Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort.
 - 3. Results of Atterberg limits, plastic and liquid limit, and plasticity index conducted in accordance with ASTM D 4318 (latest revision), Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
 - 4. Results of the particle-size analysis conducted in accordance with ASTM D 421/422 (latest revision). Standard Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants/Test Method for Particle Size Analysis of Soils.
 - 5. Results of hydraulic conductivity testing conducted in accordance with ASTM D 5084 (latest revision), Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.
 - 6. Results of chemical analyses conducted in accordance with the requirements of Section 02227.

3.3 COVER SOIL AND DRAINAGE SAND

- A. Cover Soil and Drainage Sand
 - 1. Quality Control Testing:
 - a. The ENGINEER shall perform quality control testing during construction. This testing is in addition to all other tests required to be conducted by the CONTRACTOR.

- b. The ENGINEER shall collect representative samples from each material source of Cover Soil and Drainage Sand for testing at a frequency determined by the ENGINEER.
- c. The Cover Soil and Drainage Sand shall exhibit an interface friction angle in accordance with the values as specified in Section 2.2(A) of this specification. Materials tested by the ENGINEER exhibiting results not meeting the interface friction angle requirements will be rejected, or the CONTRACTOR may be required to furnish additional test data, at his expense, to demonstrate acceptability of the material.

END OF SECTION 02227

SECTION 02228

TOPSOIL MATERIAL

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall furnish and place topsoil as shown on the Contract Drawings.
2. The CONTRACTOR is solely responsible for the management of surface water runoff. The ENGINEER shall verify that all required sediment and erosion controls have been installed to specifications prior to the CONTRACTOR starting any construction activities at the site. The ENGINEER shall also periodically inspect sediment and erosion controls, including after rainfall events, and inform the CONTRACTOR of repairs or removal of accumulated sediments that are required to maintain the effectiveness of the sediment and erosion controls. The CONTRACTOR shall promptly perform these repairs and removal actions as directed by the ENGINEER. The CONTRACTOR is responsible for the costs associated with these repairs and removal actions.

B. Related Sections:

1. Section 02220, Excavation and Backfill and Ash Regrading.
2. Section 02900, Landscaping.

C. General:

1. CONTRACTOR is required to use approved material from off-site sources.

D. CONTRACTOR shall provide ENGINEER with access to the material source upon request for the purposes of observing material source operations and obtaining samples.

1.2 QUALITY ASSURANCE

A. Tests:

1. The services of a qualified testing laboratory shall be engaged by the CONTRACTOR to make tests and determine acceptability of the material as listed below. The laboratory shall be acceptable to the ENGINEER.
2. Required Tests:
 - a. Topsoil from Off-Site: Gradation, ASTM D 422, Priority Pollutant Semivolatile Organic Compounds (SVOCs), EPA Method 8270, Priority Pollutant Volatile Organic Compounds (VOCs), EPA Method 8260, Priority Pollutant Metals, EPA Method 6010 (HG Method), Pesticides, EPA Method 8081, PCBs, EPA Method 8082, Herbicides, EPA Method 8151, Soil pH, EPA Method 9045D. All environmental test results shall be in conformance with the criteria for Residential Direct Exposure Criteria (RDEC) and Class GB Groundwater Pollutant Mobility Criteria (GBPMC) of the CTDEP's Remediation Standard Regulations (RSRs), 22a-133k-1 to k-3 of the Regulations of Connecticut State

Agencies.

1.3 SUBMITTALS

A. Test Reports:

1. Submit six (6) copies of the following reports directly to ENGINEER from the testing service, with copy to the CONTRACTOR:
 - a. Environmental, particle size, pH, and internal friction angle tests for Topsoil material from off-site shall be performed at a frequency of 1 per 3,000 cubic yards if from a natural borrow source or 1 per source, whichever is more stringent. Material that is not from a natural borrow source shall be tested at a frequency of 1 per 1,000 cubic yards.
 - b. Written statement giving the location of the properties from which the Topsoil is to be obtained, the names and addresses of the suppliers, and, if applicable, crops grown on the properties during the past 2 years.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Topsoil:

1. Topsoil shall be placed where shown or specified or directed by ENGINEER.
2. Provide approved soil materials for Topsoil, free of contaminated soil, clay, rock or gravel larger than 1 inch in any dimension, debris, waste, frozen materials, vegetable and other deleterious matter.
3. All Topsoil materials must adhere to the range of cohesion/internal friction angle properties (i.e. 0 psf, 37°) specified below:

Cohesion, psf	Peak Internal Friction Angle (Φ)
0	37
10	36
20	34
35	32
45	30

4. See Section 02900 "Landscaping" for full specifications and additional topsoil properties and testing requirements.

PART 3 - EXECUTION

3.1 PLACING

- #### A. ENGINEER will examine the areas and conditions under which Topsoil placing is to be performed and notify the CONTRACTOR of conditions he may find that are detrimental to the proper and timely completion of the Work. Do not proceed with the Work until

unsatisfactory conditions have been corrected in an acceptable manner. Placing of Topsoil shall conform to the requirements of Section 02900. The CONTRACTOR shall not be permitted to have more than 2 acres of Topsoil without the final landscaping materials suitably installed in accordance with Section 02900

- B. The thickness of the in-place Topsoil material will be checked after the completion of the work on a grid pattern not to exceed 50-foot by 50-foot by digging, by hand, with a plastic shovel in the presence of and as directed by the ENGINEER. The size of the test hole shall not be less than one-foot in diameter. Measurements shall be made perpendicular to the slope. The CONTRACTOR shall be responsible for digging holes in the Topsoil to allow for measurements to be taken by the ENGINEER. After measurements have been made, the CONTRACTOR shall backfill the holes with cover material, and hand tamp. During digging and backfill of test holes, the CONTRACTOR shall use plastic shovels and exercise care not to damage any materials. Any such damage shall be repaired at the expense of the CONTRACTOR.

3.2 INSPECTION AND EROSION REPAIR

- A. ENGINEER will examine the areas and conditions of the Topsoil after it is placed on a periodic basis including after all rain events. The ENGINEER will instruct the CONTRACTOR to repair rills in the Topsoil that are greater than ½-inch deep and 1-wide. The CONTRACTOR shall be responsible for promptly performing the repairs and will be responsible for all costs associated with performing the Work.

END OF SECTION 02228

SECTION 02230

GRAVEL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall furnish and place gravel of the types specified at locations shown on the Drawings including, weeps into drainage swales, diversion swale and perimeter or as otherwise directed by the ENGINEER.

B. Related Sections:

1. Section 02220, Excavation and Backfill and Ash Regrading.

1.2 SUBMITTALS

- ###### A. CONTRACTOR shall advise the ENGINEER of the source location and provide a representative sample.

PART 2 - PRODUCTS

2.1 MATERIALS

- ###### A. Angular stone for weeps: The materials shall be angular, well-graded, clean, screened crushed rock obtained from an approved source and conforming to the specifications of ASTM C-33. Maximum size shall be 1-inch, 85 percent shall pass a 1/2-inch sieve and a maximum 5 percent shall pass a #10 sieve.
1. CONTRACTOR shall submit a sample meeting the above requirements to an approved commercial testing laboratory for sieve analysis. The laboratory analysis results shall be approved by the ENGINEER before any material is ordered.
 2. After the materials are delivered to the job site, the ENGINEER will take two samples from each shipment of material. The CONTRACTOR shall have a sieve analysis performed on these samples by a commercial testing laboratory. If the results of the samples taken in the field do not conform to those previously approved, the material will be rejected and shall be modified or removed from the job site.
 3. CONTRACTOR shall furnish and place gravel as shown and specified or as directed by the ENGINEER.

PART 3 - EXECUTION

3.1 PLACING

- ###### A. Gravel shall be spread in layers of uniform thickness not exceeding 12 inches and shall be thoroughly compacted with suitable power driven tampers or other power driven equipment. The placing of gravel shall conform to applicable requirements of Section

02220 except as noted above. Care shall be exercised to prevent damage to the underlying geomembrane, geocomposite, and geotextile materials during placement of the stone.

END OF SECTION 02230

SECTION 02271

RIPRAP

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, tools, equipment, testing, and incidentals required to furnish and place riprap to construct grouted riprap drainage downchutes and the northern toe of slope, to repair/reconstruct drainage swales along the eastern edge of the landfill, or as otherwise specified by the ENGINEER.

B. Related Work Sections:

1. Section 02220, Excavation and Backfill and Ash Regrading.
2. Section 03600, Grout.
3. Section 06645 Geosynthetics.
4. Section 06643, Geomembranes

PART 2 - PRODUCTS

2.1 RIPRAP – GROUTED DOWNCHUTES

- A. Riprap shall consist of hard, durable, angular field or quarry stone. All stones shall be between 6 inches and 10 inches with 75% greater than 8 inches. The stones shall be free of dirt, debris, or deleterious material. Stones salvaged from excavation and meeting the above requirements maybe used for riprap if approved by the ENGINEER. Larger stones measuring 18 inches, maximum dimension, shall be used for the velocity dissipation stones shown on the Contract Drawings.

2.2 RIPRAP – MODIFIED

- A. Riprap for drainage swales, northern toe of slope, and pipe outfalls shall be Modified Riprap conforming to Section M12.02 of the State of Connecticut Department of Transportation Standards Specifications for Roads, Bridges, and Incidental Construction – Form 816. Riprap gradation shall be as follows:

Stone Size	Percent (%) of the Weight
10 inches	0
6 to 10 inches	20-50
4 to 6 inches	30-60
2 to 4 inches	30-40
1 to 2 inches	10-20
Less than 1 inch	0-10

PART 3 - EXECUTION

3.1 PLACING

- A. Minimum total thickness of the riprap layer shall be as shown on the Contract Drawings.
- B. The stones shall be placed so that the weight of the stone is carried by the underlying material and not by the adjacent stones. Riprap shall be of proper size to form a compact solid blanket to protect the slopes. Stones placed over geosynthetics and geomembranes shall be done in a manner to prevent damage to these materials.
- C. Riprap shall be placed so as to conform as closely as practicable in size and character to existing riprap, if any.
- D. Riprap may be placed with equipment, however, care shall be taken in placing to obtain a good gradation of materials so that the riprap will be firm and solid. Surfaces shall be leveled to the required alignment and slopes by hand placing the stone so as to fill large voids and to make the surface even.
- E. Riprap for downchutes, swales, and slope protection shall be placed on a layer of 40-mil textured LLDPE membrane and 12 oz/sq. ft non-woven geotextile as shown on the Contract Drawings.

END OF SECTION 02271

SECTION 02721

CORRUGATED METAL PIPE (CMP)

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope: CONTRACTOR shall provide all labor, materials, tools, equipment and incidentals required to furnish, install, and test the half-pipe diversion swales as shown on the Drawings and specified herein.
- B. Included hereunder are all pipe, couplings, bolts, nuts, factory- applied painting, and appurtenances required for installation and testing.
- C. General:
 - 1. Pipe shall be furnished in nominal lengths and the diversion swales constructed with a minimum number of couplings. Corrugations on the pipe shall be annular and the pipe should be delivered ready to use. Whole pipe sections cut in half in the field shall have newly exposed surfaces coated to prevent corrosion.
 - 2. Pipe shall be free of fractures and surface roughness.
 - 3. All joint surfaces shall be smooth and free of spalls, cracks, or fractures and all imperfections that would affect the watertightness and performance of the joint.
- D. Related Sections:
 - 1. Section 02220, Excavation and Backfill and Ash Regrading.

1.2 QUALITY ASSURANCE

- A. Manufacturer Qualifications: CMP shall be the standard product in regular production by the manufacturer whose product has proven reliable in similar service.
- B. Design Criteria:
 - 1. Diversion Swales: As shown on the Drawings.
- C. Reference Standards: Comply with applicable provisions and recommendations of the following:
 - 1. Standards of the American Society for Testing and Materials, ASTM.
 - 2. Standards of the American Iron and Steel Institute, AISI.
 - 3. Standards of the American Association of State Highway and Transportation Officials, AASHTO.

1.3 SUBMITTALS

- A. Shop Drawings: Shop Drawing submittals shall consist of six (6) copies and shall include the following:
 - 1. Manufacturer's instructions and recommendations for installation of the couplings.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery, storage, and handling of materials shall be in accordance with the manufacturer's instructions. CONTRACTOR shall inspect shipments for damage and content well in advance of the date scheduled for incorporation in the Work.

1.5 JOB CONDITIONS

- A. Job conditions are as discussed in Section 02220, "Excavation and Backfill".

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Corrugated Metal Half Pipe:
1. Half pipe shall be minimum 16 gage corrugated (annular) aluminized coated steel pipe fabricated from steel sheet conforming to ASTM A 929 and AASHTO No. M-218. Connect half-pipe sections as shown on the Contract Drawings.
 2. Coatings: All pipe and couplings shall be hot dip aluminized in accordance with ASTM A 123.
 3. Size and Extent: Refer to Drawings.
 4. Anchors: Half-pipe will be anchored in the diversion swale as indicated on the Contract Drawing.

PART 3 - EXECUTION

3.1 INSPECTION

- A. CONTRACTOR shall inspect CMP piping to ensure that it is free of defects in material and workmanship. The compatibility of the CMP pipe, couplings, and coatings shall be verified.

3.2 PREPARATION

- A. Line and Grade:
1. Pipe shall be laid according to lines and grades shown on the Drawings or approved by ENGINEER by sloping pipe uniformly between elevations given.
 2. CONTRACTOR shall be responsible for maintaining lines and grades.
 3. Compact and shape fill supporting the pipe.
- B. Diversion Swale:
1. Construct as shown on the Contract Drawings
 2. Set anchors in bedding and lay pipe such that the anchors and barrel receives bearing pressure from the trench bottom.
 3. Blocking under the CMP will not be permitted unless specifically approved by ENGINEER.

- C. Pipe:
 - 1. Completely remove and clean all foreign material from pipe interior.
 - 2. Clean pipe joints thoroughly.

3.3 INSTALLATION

- A. Laying CMP:
 - 1. Pipe shall be installed only in the presence of ENGINEER.
 - 2. Lower pipe into the swale with suitable power equipment.
 - 3. Bolt sections together with couplings and completely tighten.
 - 4. Bevel ends of half-pipes where they enter downchutes.
 - 5. Install membrane flaps and crushed stone cap drain weeps as shown on the Contract Drawings.

END OF SECTION 02721

SECTION 02900

LANDSCAPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, tools, materials, testing, equipment and incidentals as shown, specified and required to furnish and perform landscaping work.
2. The extent of the landscaping Work shall be performed as shown and as specified in schedules. All areas covered by topsoil and other areas disturbed by the Contractor shall receive landscaping.
3. The landscaping Work required includes the following:
 - a. Importing topsoil from off-site sources if existing cover soils are unacceptable.
 - b. Maintenance Work as specified until completion of the Contract.
 - c. Soil amendments.
 - d. Fertilizers.
 - e. Grass materials.
 - f. Hydromulch – Flexible Growth Media (FGM).
 - g. Green Armor System
 - h. Miscellaneous landscape materials.
 - i. Guarantees.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with the landscaping.
2. Notify other contractors in advance of the installation of the landscaping to provide the other contractors with sufficient time for the installation of items included in their contracts that must be installed before landscaping.

C. Related Sections:

1. Section 02220, Excavation and Backfill.
2. Section 06642, Erosion Control Geosynthetics.

1.2 QUALITY ASSURANCE

A. Landscape Subcontractor Qualifications:

1. Subcontract the landscape Work to a single firm specializing in landscape Work.
2. The landscape subcontractor shall have a minimum of five years of experience of performing substantially similar work.

B. Source Quality Control:

1. General:
 - a. Ship landscape materials with certificates of inspection as required by governmental authorities.

- b. Comply with governing regulations applicable to landscape materials.
 - c. ENGINEER will request inspection of delivery slips for materials to verify specified quantities of bulk deliveries of soil amendments and fertilizers.
2. Analysis and Standards: Package standard products with manufacturer's certified analysis. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Analytical Chemists, wherever applicable or as further specified.
 3. Off-Site Topsoil: Obtain topsoil from local sources or from areas having similar soil characteristics to that found at the site of the Work. Obtain topsoil only from naturally well-drained sites where topsoil occurs in depth of not less than 4- inches; do not obtain from bogs or marshes.
 4. Topsoil stockpiled for reuse: Existing cover soils will be inspected by ENGINEER prior to particle size testing to determine suitability for reuse. At the time of inspection ENGINEER will require representative soil samples to be tested for physical properties, pH value, organic matter, and available phosphoric acid and potassium if proposed for use as topsoil. Contractor shall supply twenty pound samples and perform tests at no additional expense to OWNER.
 5. All Topsoil shall meet the testing requirements of Paragraph 1.3B.
- C. Reference Standards: Comply with the applicable provisions and recommendations of the following, except as otherwise shown or specified.
1. ASTM C 602, Agricultural Liming Materials.
 2. ASTM D 422, Method for Particle Size Analysis of Soils.
 3. ASTM D 2487, Classification of Soils for Engineering.
 4. Association of Official Analytical Chemists, Official Methods of Analysis.
 5. American Joint Committee on Horticultural Nomenclature, Standardized Plant Names.
 6. Official Seed Analysts of North America, Standards of Quality.
 7. FSO-F-241D, Fertilizer, Mixed, Commercial.
 8. FSO-F-166E, Peat Moss; Peat, Humus; and Peat, Reed-sedge.

1.3 SUBMITTALS

- A. Shop Drawings: The CONTRACTOR shall submit six (6) copies of the following for approval:
1. Planting schedule showing scheduled dates for work in each area of site.
 2. Before delivery of off-site topsoil, written statement giving the location of the properties from which the topsoil is to be obtained, the names and addresses of the suppliers, the depth to be stripped and the crops grown during the past 2 years.
 3. Manufacturer's specifications and installation instructions for all materials required.
 4. Leachate/Stormwater Management Plan in accordance with Section 02220, Part 1.3 Paragraph C.
- B. Test Reports: Submit for approval the following:
1. Topsoil test reports as required in Section 02228.
- C. Certificates: Submit for approval the following:
1. Certificates of inspection as may be required by governmental authorities to accompany

shipments, and manufacturer's or vendors certified analysis for soil amendments and fertilizer materials. For standard products submit other data substantiating that materials comply with specified requirements.

2. Certificates from seed vendors certified statement for each seed mixture required, stating botanical and common name, percentage by weight and percentages of purity, germination, and weed seed for each species.

D. Operation and Maintenance Data: Submit for approval the following:

1. Typewritten instructions recommending procedures to be established by OWNER for the maintenance of landscape Work for one full year. Submit prior to expiration of required maintenance period(s). Include moisture requirements of each type of planting and insect prevention measures including types of spray and application instructions, and special winter protection measures required for each planting.

E. Guarantee: Submit for approval a written guarantee, in the terms specified under "Guarantee" provision of these Specifications, signed by CONTRACTOR.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials:

1. Deliver packaged materials in original, unopened containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery.
2. Furnish seed in sealed, standard containers.
3. Notify ENGINEER of delivery schedule in advance so materials may be inspected upon arrival at job site.
4. Remove unacceptable material immediately from project site.

B. Storage of Materials:

1. Store and cover materials to prevent deterioration. Remove packaged materials which have become wet or show deterioration or water marks from the site. Replace at no further cost to OWNER.
2. Seed that is wet or moldy or that has been otherwise damaged in transit or storage is not acceptable. Replace at no further cost to OWNER.

1.5 JOB CONDITIONS

A. Environmental Requirements:

1. Proceed with and complete the Work as rapidly as portions of the Site become available, working within the seasonal limitations for each kind of landscape Work required. The Contractor shall not have more than 2 acres of Topsoil without the final landscaping materials applied.
2. Do not spread seed when wind velocity exceeds 5 miles per hour.
3. Do not plant when drought, or excessive moisture, or other unsatisfactory conditions prevail.

B. Scheduling:

1. Plant or install materials only during normal planting seasons for each type of

landscape Work required. Correlate planting with specified maintenance periods to provide maintenance until occupancy by OWNER.

C. Wetlands

1. Work in wetlands shall not be permitted.

1.6 ALTERNATIVES

- A. Substitutions are not allowed.

1.7 GUARANTEE

- A. Guarantee turf through the specified maintenance period, until Final Acceptance of the Work.
- B. Immediately remove and replace turf found to be dead or in unhealthy condition during guarantee period and through the specified maintenance period. Make replacements during growth season following end of guarantee period. Furnish and plant replacements which comply with requirements shown and specified. ENGINEER will make another inspection at end of extended guarantee period, if any, to determine acceptance or rejection. Only one replacement will be required at end of guarantee period, except for losses or replacements due to failure to comply with specified requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil:

1. Existing cover soils shall be analyzed in accordance with Part 1.2 B Paragraph 4 of the Section to determine the suitability for reuse as topsoil. Soils approved by the ENGINEER for use as topsoil shall be stockpiled by the CONTRACTOR for reuse in landscape Work. If quantity of stockpiled topsoil is insufficient, the CONTRACTOR shall provide additional topsoil as required to complete landscape Work.
2. Provide off-site topsoil as required, which is fertile, friable, natural loam, surface soil, capable of sustaining vigorous plant growth, free of any admixture of subsoil, clods of hard earth, plants or roots, sticks or other extraneous material harmful to plant growth. Supply topsoil with the following analysis:
 - a. 1 -inch Mesh: 100 percent passing.
#4 Sieve: 90 to 100 percent passing.
#200 Sieve: 0 - 10 percent passing.
 - b. Clay content of material passing #200 sieve not greater than 60 percent, as determined by hydrometer tests.
 - c. pH 5.0 to pH 6.5. If approved by ENGINEER, natural topsoil not having the pH value specified may be amended by CONTRACTOR at his own expense.
 - d. Organic content not less than 5 percent, as determined by ignition loss.
 - e. Free of pests and pest larvae.

B. Soil Amendments:

1. Lime: Natural limestone containing not less than 85 percent of total carbonates, ground so that not less than 90 percent passes a 10-mesh sieve and not less than 50 percent passes a 100-mesh sieve.
2. Peat Humus: Provide peat humus which is a natural product of with sphagnum moss, reed, or sedge peat, taken from a fresh water site. Supply shredded material, free from lumps, roots, stones and other extraneous foreign matter, capable of passing through a 1/2-inch screen, which can easily be incorporated with the topsoil. Supply material which has been conditioned in storage piles after excavation for at least 6 months, including one freezing and thawing period. Supply peat humus with the following analysis:
 - a. Not less than 90 percent organic matter by weight on an oven dry basis.
 - b. pH range 5 to 7.5.
 - c. Moisture content 35 percent at time of incorporation into soil.
 - d. Water absorbing ability 150 percent to 350 percent by weight.
3. Sand: Washed of fine to medium texture.
4. Ferrous Sulfate: Commercial grade and unadulterated.

C. Commercial Fertilizers:

1. Complete fertilizer of neutral character, with a minimum of 75 percent nitrogen derived from natural organic sources or ureaform; 40-50 percent of the nitrogen shall be water soluble. Available phosphoric acid derived from superphosphate, bone, or tankage. Potash derived from muriate of potash, containing 60 percent potash. Uniform in composition, freeflowing and suitable for application with approved equipment. Provide fertilizer with the following percentages of available plant nutrients.
 - a. For lawns, provide fertilizer with not less than 4 percent phosphoric acid and not less than 2 percent potassium, and the percentage of nitrogen required to provide not less than 1.5 pounds of actual nitrogen per 1000 square feet of lawn area. Provide nitrogen in a form that will be available to the lawn during the initial period of growth.
2. Hydroseeding Fertilizer:
 - a. Commercial designation of 18-24-6. Provide a complete fertilizer of neutral character with a minimum of 75 percent nitrogen derived from natural organic sources.
 - b. Minimum 40-50 percent of nitrogen shall be water soluble.
 - c. Uniform in composition, free-flowing and suitable for application with approved equipment.
 - d. Product and Manufacturer: Provide one of the following:
 - 1) Scotts Starter Fertilizer by the Scotts Company.
 - 2) Or equal.

D. Grass Materials:

1. Grass Seed Mixture: Provide fresh, clean, new-crop seed complying with the, tolerance for purity and germination established by the Official Seed Analysts of North America. Provide seed of the grass species, proportions and minimum percentages of purity, germination, and maximum percentage of weed seed, as specified. Birdsfoot trefoil shall be inoculated before planting.
2. The "Schedule of Grass Seed Requirements" is as follows:

GRASS SEED MIX SEEDING SCHEDULE			
BOTANICAL NAME	COMMON NAME	MIXTURE PERCENT BY WEIGHT	MINIMUM PERCENT PURITY/ GERMINATION
Agrastis tenuis	Colonial Bentgrass	5%	95/90%
Festuca rubra	Chewings Fescue	35%	97/80%
Festuca longifolia	Hard Fescue	30%	96/85%
Lotus corniculatus	Birdsfoot Trefoil	10%	96/90%
Lolium perenne	Perennial Ryegrass	20%	98/90%

The seeding rate for the mixture shall be 175 pounds per acre. The acceptable planting periods are from April 1 through June 15 and September 1 through October 15.

- E. Hydromulch:
 - 1. Hydromulch:
 - a. Apply on all areas and slopes within the Limit of Cap as shown on Contract Drawings, provide a hydraulically applied flexible growth medium (FGM) which includes an organic polymer binding agent at the rate of 3,500 pounds per acre.
 - b. Provide the following:
 - 1) Product and manufacturer:
 - a) Flexterra FGM by Profile Products, LLC
 - b) or equal.
 - 2. Water: Potable.
- F. Green Armor System:
 - 1. Combination of Hydromulch (FGM) and Turf Reinforcing Mat (TRM) – Section 06642.

PART 3 - EXECUTION

3.1 INSPECTION

- A. CONTRACTOR and his installer shall examine the subgrade, verify the elevations, observe the conditions under which Work is to be performed, and notify ENGINEER of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to the ENGINEER.

3.2 PREPARATION

- A. Soil Preparation:
 - 1. Loosen subgrade of turfbed areas as required to prepare seedbed. Remove debris over 1-1/2 inches in any dimension and sticks, roots, rubbish and other extraneous matter. Limit preparation to areas which will be planted promptly after preparation.
 - 2. Spread topsoil to minimum depth of 6-inches after natural settlement and light rolling to 85 percent Modified Proctor density.
 - a. Do not spread topsoil while in frozen condition or when moisture content is so great

that excessive compaction will occur nor when so dry that dust will form in the air or that clods will not break readily.

3. Install fiber filtration tubes immediately following the topsoil placement.
 4. Apply ground limestone, by machine, over all areas to receive turf, as required, to bring the soil to a neutral pH. Work lightly into the top 3 inches of topsoil at least five days before applying the commercial fertilizers.
 5. Apply commercial fertilizers in the following quantities:
 - a. For grass apply only at a rate sufficient to supply 1.5 pounds of nitrogen per 1000 square feet. For 5-10-5 use 30 pounds per 1000 square feet.
 5. Apply commercial fertilizers within 10 days of seeding.
 6. Apply commercial fertilizers in 2 operations except when Hydroseeding as fertilizer can be applied as part of the mixture. First application shall be 3/4 of total amount.
 7. Thoroughly and evenly incorporate commercial fertilizers with the soil to depth of 3 inches by discing, or other approved method.
 - a. In areas inaccessible to power equipment, use hand tools.
 8. Grade turfed areas to smooth, even surface with loose, uniformly fine texture-Remove all stones and extraneous foreign material in excess of 3/4 inch in diameter. Roll and rake and remove ridges and fill depressions, as required to meet finish grades. Limit fine grading to areas which can be planted immediately after grading.
 9. Apply a second dressing of fertilizer. Use 1/4 of the total amount.
 10. Moisten prepared turfed areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting. Do not create a muddy soil condition.
 11. Restore turfed areas to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.
- B. Adequate sedimentation and erosion control management measures, practices and devices, such as phased construction, vegetated filter strips, geotextile silt fences, or other devices shall be installed and properly maintained to reduce erosion and retain sediment on-site during and after construction in accordance with the CONTRACTOR'S Leachate Control Plan and Stormwater Pollution Control Plan. These devices shall be capable of preventing erosion, of collecting sediment, suspended and floating materials, and of filtering fine sediment. These devices shall be removed upon completion of work and the disturbed areas shall be stabilized. The sediment collected by these devices shall be removed and placed at an upland location, in a manner that will prevent its later erosion into a waterway or wetland. If the ENGINEER determines that the on-site placement of the collected sediment may adversely affect the integrity of the site, the collected sediment will be removed and disposed of at no additional cost to the OWNER. All exposed soil and other fills shall be permanently stabilized at the earliest practicable date. See Section 02112 "Sedimentation and Erosion Controls".

3.3 INSTALLATION

- A. Hydroseeding
1. Strictly comply with manufacturer's installation instructions and recommendations. For optimum pumping and application performance use approved mechanically agitated, hydraulic seeding/mulching machines with a fan-type nozzle (50-degree tip). Apply FGM from opposing directions and to achieve best soil coverage. The ENGINEER shall inspect all areas prior to, during, and following the application of

the hydroseed mix and instruct the CONTRACTOR to reapply the seed mix to areas that are not acceptable. The CONTRACTOR shall be responsible for the Work and costs associated with additional Hydroseed application.

- 2 Erosion Control and Revegetation:
 - a. For maximum performance, apply FGM in a two-step process:
 - b. Step One: Mix and apply seed and soil amendments with small amount of FGM for visual metering.
 - c. Step Two: Mix and apply FGM at a rate of 50 lb per 125 gallons (23 kg/475 liters) of water over freshly seeded surfaces. Confirm loading rates with equipment manufacturer. Do not leave seeded surfaces unprotected, especially if precipitation is imminent.
 - d. Depending upon site conditions FGM may be applied in a one-step process where all seed components may be mixed together in single tank loads. Consult with manufacturer for further details.
- 3 Mixing:

A mechanically agitated hydraulic-application machine is recommended:

 - a. Fill tank to middle of agitator shaft or tank about 1/3 full of water. Turn on pump to wet or purge lines. Begin agitating. Keep adding water slowly while adding the FGM at a steady rate.
 - b. Consult application and loading charts to determine number of bags to be added. Mix at a rate of 50 lbs. of FGM per 125 gallons (23kg/475 liters). Contact equipment manufacturer to confirm optimum FGM mixing rates.
 - c. All FGM should be loaded when the tank is approximately 3/4 full.
 - d. Fertilizer should be added once the tank is nearly full.
 - e. Before applying, mix the slurry for at least 10 minutes after adding the last amount of FGM. This is very important to fully activate the bonding additives and to attain proper viscosity.
 - f. Turn off recirculation valve to minimize potential for air entrainment within the slurry.
4. Application:
 - a. Use a fan-type nozzle (50-degree tip) whenever possible for best soil surface coverage. Apply FGM from opposing directions to soil surface, reducing the "shadow effect" and assuring a minimum of 95% of soil surface coverage. Slope interruption devices or water diversion techniques are recommended when slope lengths exceed 100 ft (30m).
 - b. Green Armor System: FGM shall be sprayed down into the topsoil and erosion netting surface and shall not be sprayed in a broad pattern that does not impregnate the FGM into the soil surface.
 - b. Install materials at an application rate of 3500 pounds per acre.
 - c. Increase application rates on highly erosive soils or chiseled, disked, furrowed or tracked slopes. Contact Manufacturer for additional details.
 - d. Material should not be applied in channels, swales or other areas where concentrated flows are anticipated, unless installed in conjunction with a temporary erosion control blanket or non-degradable turf reinforcement mat.
 - e. After application, thoroughly flush the tank, pumps and hoses to remove all FGM material. Wash all material from the exterior of the machine and remove any slurry spills. FGM will be more difficult to remove once it dries.

5. Prevent foot or vehicular traffic, or the movement of equipment over the seeded areas. Reseed areas damaged as a result of such activity.
6. Prevent the seeded areas from drying out. After seedlings appear in about 2-3 weeks reseed all bare spots larger than 18-inches in diameter. Areas to be reseeded shall be hand raked to scarify the surface and seed shall be applied by cyclone spreader. Lightly rake the seed into the soil.

B. Reconditioning Existing Turf:

1. Recondition existing turf areas damaged by CONTRACTOR'S operations including storage of materials and equipment and movement of vehicles. Also recondition existing turf areas where minor regrading is required.
2. Provide fertilizer, seed or sod, soil amendments, and erosion control matting as specified for new turf and as required to provide a satisfactorily reconditioned turf.
3. Cultivate bare and compacted areas thoroughly to provide a satisfactory planting bed.
4. Remove diseased and unsatisfactory turf areas; do not bury into soil. Remove topsoil containing foreign materials resulting from CONTRACTOR'S operations including, but not limited to oil drippings, stone, gravel and other loose building materials.
5. In areas approved by ENGINEER, where substantial turf remains (but is thin), mow, rake, aerate if compacted, fill low spots, remove humps and cultivate soil, fertilize, and seed. Remove weeds before seeding or if extensive, apply selective chemical weed killers as required. Apply a seedbed mulch, if required, to maintain moist conditions.
6. Water newly planted areas and keep moist until new turf is established.

C. Second Fertilizer Application:

1. The CONTRACTOR shall make a second application of fertilizer over the entire site three months following the initial application. The fertilizer shall be 10-10-10 fertilizer applied at a rate of 10 pounds per 1,000 sq. ft..

3.4 MAINTENANCE

- A. Begin maintenance immediately after planting.
- B. Maintain turf for not less than the period stated below, and longer as required to establish an acceptable stand, as determined by ENGINEER.
 1. Grass seed lawns, not less than 60 days.
 2. If seeded in fall and not given a full 60 days maintenance, or if not considered acceptable at that time, continue maintenance the following spring until acceptable lawn is established.

3.5 CLEANUP AND PROTECTION

- A. During landscape Work, store materials and equipment where directed. Keep pavements clean and work area in an orderly condition.
- B. Protect landscape Work and materials from damage due to landscape operations, operations by other contractors and trades and trespassers. Maintain production during installation and maintenance periods. Treat, repair or replace damaged landscape Work as directed.

- C. Take all precautions to insure that hydroseed slurry, is only placed on the areas designated. Completely clean any overspray, on areas not designated to receive slurry, to the satisfaction of ENGINEER.
- D. Remove all rubbish, equipment and rejected materials from the site.
- E. Protection includes all temporary fences, barriers and signs and other Work incidental to proper maintenance.

3.6 INSPECTION AND ACCEPTANCE

- A. When the landscape Work is completed, including maintenance, the ENGINEER will make an inspection to determine acceptability.
- B. Where inspected landscape Work does not comply with the requirements, replace rejected Work and continue specified maintenance until reinspected by ENGINEER and found to be acceptable. Remove rejected plants and materials promptly from the project site.
- C. Any damage, disturbance, or settlement that occurs as a result of the CONTRACTOR'S stockpiling of material or equipment on site shall be the responsibility of the CONTRACTOR to repair and/or supply additional materials to compensate for settlement caused by the CONTRACTOR'S actions.
- D. The thickness of the in-place Topsoil will be checked by the CONTRACTOR after the completion of the work on a grid pattern not to exceed 50-foot by 50-foot by digging, by hand, with a plastic shovel in the presence of and as directed by the ENGINEER. The size of the test hole shall not be less than one-foot in diameter. Measurements shall be made perpendicular to the slope. The CONTRACTOR shall be responsible for digging holes in the Topsoil to allow for the measurements to be taken by the ENGINEER. After measurements have been made, the CONTRACTOR shall backfill the holes with Topsoil, and hand tamp. During digging and backfill of test holes, the CONTRACTOR shall use plastic shovels and exercise care not to damage any materials. Any such damage shall be repaired at the expense of the CONTRACTOR.

END OF SECTION 02900

SECTION 03600

GROUT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
1. CONTRACTOR shall provide all labor, tools, materials, equipment, testing, and incidentals as shown, specified and required to furnish and install grout at the base of the drainage downchute.
- B. Related Sections:
1. Section 02271, Riprap

1.2 QUALITY ASSURANCE

- A. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
1. ASTM C 150, Portland Cement.

1.3 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery of Materials: Grout materials from manufacturers shall be delivered in unopened containers and shall bear intact manufacturer's labels.
- B. Storage of Materials: Grout materials shall be stored in a dry shelter and shall be protected from moisture.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Rip-Rap Grout:
1. Use a design mix for Class "A" grout with a 28-day compressive strength of 4,000 psi, a maximum water-cement ratio by weight of .45, air content of 0.9 percent, and a minimum cement content of 658 pounds per cubic yard.

PART 3 - EXECUTION

3.1 INSPECTION

- A. CONTRACTOR shall examine the substrate and conditions under which grout is to be placed, and notify ENGINEER in writing of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 INSTALLATION

A. General:

1. Place grout as shown and in accordance with manufacturer's instructions. If manufacturer's instructions conflict with the Specifications do not proceed until ENGINEER provides clarification.
2. Drypacking will not be permitted.
3. Placing grout shall conform to temperature and weather limitations as specified by the Manufacturer.

END OF SECTION 03600

SECTION 06642

EROSION CONTROL GEOSYNTHETICS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: CONTRACTOR shall provide all labor, materials, tools, equipment, and incidentals necessary for the placement of erosion control geosynthetics and Turf Reinforcement Mats (TRM) on slopes and drainage swales as shown and specified on the Drawings, or as otherwise directed by the ENGINEER. TRM shall be installed wherever the Green Armor System is shown on the Contract Drawings.
- B. Related Sections:
 - 1. Section 02900, Landscaping.

1.2 QUALITY CONTROL

- A. Manufacturer Qualifications: Erosion control geosynthetic manufacturer shall be a specialist in the manufacture of the particular geosynthetic.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. Submit six (6) copies of manufacturer data, specifications, dimensions and installation instructions for erosive soils and high runoff velocities.
 - 2. Submit six (6) copies of an affidavit certifying that each geosynthetic furnished complies with all requirements specified herein.
 - 3. No geosynthetic shall be shipped until the affidavit is submitted to ENGINEER.

PART 2 - PRODUCTS

2.1 ACCEPTABLE PRODUCTS

- A. Turf Reinforcement Mat (TRM)
 - 1. TRM shall be non-biodegradable turf reinforcing erosion control material mesh matrix with stabilizer (as necessary to protect from ultraviolet radiation), supplied in rolls. Permanent Erosion control geosynthetic shall be:
 - a. Enkamat 7010 produced by Colband Geosynthetics, Inc..
 - b. Or equal.
- B. The TRM shall be made from 100% synthetic material and contain no biodegradable or photodegradable components or materials.
- C. The TRM shall be a three-dimensional matrix and maintain the three dimensional stability without laminated or stitched layers. The TRM shall have a sufficient Area Holding

Capacity and a minimum 90% open space available for soil and root interaction. The TRM shall not lose its structural integrity and shall not unravel or separate when TRM is cut in the field.

- D. The TRM shall exhibit no buoyancy factor (i.e., the specific gravity of the fibers used should be greater than 1.0) so as to allow the TRM to maintain intimate contact with the soil (particularly between fasteners) under low flow conditions.
- E. The TRM shall meet the requirements of Table 1.

TABLE 1 – PERMANENT TURF REINFORCEMENT MAT

Property	Test Method	Units	Value
Mass/Unit Area	ASTM D 5261	oz/yd ²	8.0
Thickness	ASTM D 5199	inches	0.4
Tensile Strength (MD)	ASTM D 5035 mod	lb/ft	160.0
Area Holding Capacity	Calculated	in ³ /yd ²	450
Porosity	Calculated	%	>95
UV Stability	ASTM D 1682 mod	%	80
Velocity	Flume Testing ¹	ft/sec	19.0
30 min. Vegetated			
50 hr. Vegetated			14.0
Shear	Flume Testing ¹	lb/ft ²	8.0
30 min. Vegetated			
50 hr. Vegetated			6.0

1 – Acceptable facilities include Utah State University, Colorado State University

- F. Anchoring Devices
 - 1. The TRM shall be secured in place using heavy-duty metal staples. The metal staples shall be U-shaped, a minimum of 6 inch long (each leg), one and one half (1-1/2) inches wide, and shall be fabricated from 9 gauge diameter metal wire. If difficulties arise installing the staples, then 10 inch pins fabricated from 9 gauge with one and one half (1-1/2) inch diameter washer or 7 inch gutter spike with one and one half (1-1/2) inch diameter washer shall be used. In some cases where loose soil conditions exist and anchors of stated length do not properly secure the TRM to the ground, then longer staple should be used such as a 8-12 inch long staples or pins.

PART 3 - EXECUTION

3.1 PREPARATION

- A. The TRM product will be installed explicitly according to the manufacturer recommendations. The installation site shall be prepared by filling the area to the design grade.
- B. The surface to receive the TRM shall be prepared to relatively smooth conditions free of obstructions, depressions, debris and soft or low density pockets of material. The material

shall be capable of supporting a vegetative cover.

- C. Erosion features such as rills, gullies, etc. must be graded out of the surface before TRM deployment. Smooth roll drum compaction may be required before deploying TRM to make sure the TRM makes immediate contact with the soil.
- D. Cut trenches for initial anchor trenches, termination trench and longitudinal anchor trenches (6 inches wide and 9 inches in depth).
- E. CONTRACTOR shall place all cover materials in such a manner to ensure: the erosion control geosynthetics are not damaged; minimal slippage of the erosion control geosynthetics or underlying layers; and no excess tensile stresses are introduced into the erosion control geosynthetic.
- F. CONTRACTOR shall consult with manufacturer regarding recommendation as to the sequence for seeding and placement of the erosion control geosynthetic. Following seeding and placement of the erosion control geosynthetic, CONTRACTOR may be directed by the ENGINEER to mulch the surface in accordance with directions for mulching in Section 02900 Landscaping.

3.2 INSTALLATION - SLOPES

- A. Install Erosion control geosynthetics as per Manufacturer's installation procedure, or as described below.
- B. Grade subgrade to be stable and firm, but not crusted.
- C. Apply erosion control geosynthetic with the length of roll laid perpendicular to the slope.
- D. Install an anchor slot at the up slope and down slope ends of the geosynthetic placement. Bury at least 12 inches of the end of the geosynthetic horizontally in the anchor slots. Secure the geosynthetic in the anchor slot by stakes at intervals of 3 feet or less prior to burying. Tamp the soil against the geosynthetic in the slot.
- E. Overlap successive lengths of the erosion control geosynthetic at least 3 feet, with the up slope length on top. Stake the overlap by placing 3 staples spaced across the end of each of the overlapping lengths and by placing 3 staples across the width of the center of overlap area.
- F. Construct check slots by placing a fold at least 6 inches vertically into the soil. Staple the geosynthetic at each check slot edge, overlap and in the center of the geosynthetic. Coordinate check slots with adjacent rolls such that check slots are not staggered. Check slots shall be placed at a frequency of every 25 feet.
- G. Place 1 row of staples, spaced 10 inches on center on each side of check slot and place staples on all longitudinal overlaps at a maximum spacing of 3 feet.

- H. Maintain the geosynthetic until all Work has been completed and accepted. CONTRACTOR shall repair areas where damaged by any cause until vegetation final acceptance.
- I. Place additional staples to maintain contact of geosynthetic with ground surface as required by manufacturer.

END OF SECTION 06642

SECTION 06643

GEOMEMBRANES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall furnish all labor, materials, tools, testing, equipment and incidentals required to supply, install and test textured linear low density (LLDPE) polyethylene flexible geomembrane as shown on the Drawings and specified herein. Only one type of LLDPE geomembrane shall be used for the entire project, and will at a minimum be utilized within the entire limit of waste
2. The textured LLDPE geomembrane shall be textured on both sides.
3. Subgrade preparation is included under Section 02220 and Section 02225.
4. Refer to Section 06647 for additional requirements relating to cold weather construction and installation.

B. Related Sections:

1. Section 06645, Geosynthetics.
2. Section 06646, Geocomposite Drainage Layer
3. Section 06647, Cold Weather Installation - Geomembrane.
4. Section 06641, Flat Pipe.
5. Section 02227, Cover Soil and Drainage Sand.
6. Section 02271, Riprap

C. CONTRACTOR shall supply field enclosures, field tensiometers, arbor presses and all other equipment and appurtenances for completing and testing the work.

1.2 DEFINITIONS

A. Roll: One roll shall be a length of liner material delivered to the site, packaged or rolled in some manner as to prevent kinks, creases, pinholes or cold bends in the material.

1.3 QUALITY ASSURANCE

A. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:

1. Standards of American Society for Testing and Materials (ASTM).

B. Single Source:

1. All liner material shall be obtained from a single material supplier and all liner sheets shall be manufactured by a single liner manufacturer.

C. Liner Manufacturer's Qualifications and Experience:

1. Liner manufacturer shall be a specialist in the manufacture of textured PE liners and

shall demonstrate:

- a. At least five years experience in the manufacture of textured PE liners.
 - b. At least 10 million square feet of textured PE liner.
 - c. At least 10 completed projects.
2. Liner Manufacturers:
- a. GSE, Inc.
 - b. Or equal.

D. Liner Installer's Qualifications and Experience:

1. Liner installer shall be a specialist in the installation of textured PE liners and shall have installed at least 10 million square feet of PE liner during the last five years. The installer is responsible for field handling, placing, seaming, loading (against wind) and other aspects of geomembranes and geosynthetics.
 - a. Installer's field crew shall include at least one "master seamer", whose experience conforms to Article 3.4 of this Section.
 - b. Submit resume of master seamers.
 - c. Submit resume of field superintendent.

E. Liner Installer's Field Services and Reports:

1. Retain services of liner installer's factory trained representatives with demonstrated ability and experience in the field seaming, field testing and all other pertinent aspects of PE liner installation to perform the services listed below:
 - a. Inspect the drainage layer material and supervise any corrective work required. Prepare an inspection report.
 - 1) Identify ASTM methods and values that result from repairs.
 - 2) Describe corrective work.
 - b. Supervise the unloading handling, and storage of all liner sheets.
 - c. Supervise the handling, unrolling and placement of all liner sheets.
 - d. Perform all field seaming and testing of liner.
 - e. Perform all repairs to damaged liner sections.
 - f. Supervise the placement of top drainage layer/liner cover material.
 - g. Conduct startup seam testing.
 - h. Conduct field destructive and non-destructive seam tests.
 - i. Prepare detailed test reports and submit copies of these reports to ENGINEER daily.
 - j. Prepare a written report at the completion of the work which includes the following:
 - 1) Complete identification of flexible membrane liner, including but not limited to, resin type, physical properties and other pertinent data.
 - a. Identify ASTM methods and values.
 - 2) Complete description of field seaming system used including material, method, temperatures, seam overlap width and cure or aging time.
 - 3) Complete description of field sampling and testing including test equipment used, location of field tests, copy of test results, conditioning procedure prior to destructive seam testing, method of recording loading and determining average load for destructive test methods and type of failure in tests (i.e. within the seam, within the sheet material, clamp edge, seam edge). Copies

of all non-destructive test results for seam and repair areas and discussions on repair methods used for failed seams.

- 4) "As-built" drawings showing actual layout of liner sheets, destructive sample locations, patch/repair locations, pipe penetration details and anchor trench details.
- 5) An affidavit of compliance from the liner manufacturer, per Article 3.11.A.5.

F. Quality Control During Manufacturing:

1. Prior to the installation of any geomembrane material, the CONTRACTOR shall submit for approval to the ENGINEER information obtained from the manufacturer.
 - a. origin (Resin Supplier's name, resin production plant), identification (brand name, number) and production date of the PE resin;
 - b. copy of quality control certificates issued by the PE Resin Supplier; and
 - c. reports on the test conducted by the PE Resin Supplier and/or liner Manufacturer to verify the quality of the PE resin used to manufacture the geomembrane rolls tests shall include, specific gravity (ASTM D792 Method A or ASTM D1505), melt index (ASTM D1238 Condition E) density (ASTM D1505) and percent carbon.
2. Random sampling shall be performed by the Liner Manufacturer, at no additional cost to the OWNER, throughout the liner production run to assure proper quality control. The minimum frequency of such sampling shall be as follows:
 - a. Two (2) samples taken from each day's production, and
 - b. One (1) sample per two (2) rolls, and
 - c. All non-consecutive rolls delivered to the project.
 - d. Other sampling as proposed by the CONTRACTOR and approved by the ENGINEER.
3. The samples shall be tested for the following properties:
 - a. Uniformity: Visual inspection to assure the material is free of holes, blisters, undispersed raw material, or foreign matter.
 - b. Thickness: Measurement along the sample to assure that the sheet is within the specified tolerances of thickness (ASTM D 1593).
 - c. Carbon Black: The proper amount, grade and degree of dispersion are imperative to assure proper U.V. radiation protection (ASTM D 1248).
 - d. Tensile Properties: One (1) dimensional tensile testing which measures tensile strength at yield and at break and elongation at yield and at break shall be made (ASTM D 638).
4. All pre-assembled panel seams shall be tested at the factory in accordance with the destructive and nondestructive testing specified in Paragraph 3.8 and 3.9 of this Section.
5. The CONTRACTOR shall provide the OWNER and ENGINEER with certified copies of the manufacturer's test results.
6. The OWNER and ENGINEER, at their discretion, may employ and pay for an independent testing laboratory to perform additional testing of the liner materials. This testing may also include all properties specified in Paragraph 2.2E and need not be limited to the testing performed by the Manufacturer. The CONTRACTOR shall, at no additional cost, provide field destructive samples to the OWNER or ENGINEER as required.

7. The CONTRACTOR shall be solely responsible to the OWNER for the quality of the material provided. Should any of the tests performed on the material yield unsatisfactory results, the CONTRACTOR will be responsible for replacing the material with satisfactory material without delaying the total project time and without any cost to the OWNER.

G. Testing Laboratory:

1. The services of a qualified testing laboratory shall be engaged by the CONTRACTOR to make tests and determine the acceptability of the liner materials. CONTRACTOR shall be responsible for coordinating and scheduling all testing with the laboratory so as not to delay completion of the Work.

H. Friction Angle Tests:

Prior to placement of the textured PE geomembranes, CONTRACTOR shall provide ENGINEER with laboratory test results as described below. These tests are intended to verify the side slope stability of the landfill.

1. Textured PE liner, geosynthetics and cover soils; PE liners, geosynthetics and cover soils shall be fabricated, and soils shall be chosen, to achieve a minimum peak friction angle of:
 - a. Textured PE and either Drainage Sand and Drainage Geocomposite; 30 degrees with a normal stress of 150 psf between the textured PE liner and the drainage sand and the proposed drainage geocomposite,
 - b. Textured PE and Geotextile Fabric: 30 degrees with a normal stress of 150 psf between the textured PE liner and the proposed geotextile fabric.
 - c. Drainage net composite and Drainage Sand; 30 degrees with a normal stress of 150 psf between the drainage net composite and Drainage Sand.
 - d. 30 degrees with a normal stress of 150 psf between the all other interfaces including, but not limited to Subbase material and Ash Fill, Subbase Material and Geotextile, Drainage Sand and Geotextile, Cover Soil and Geotextile, and between Cover Soil Material and Topsoil.
2. During construction and before completion, CONTRACTOR shall repeat the above tests with the materials used on-site, if the ENGINEER determines that the materials have changed, or if the test materials used in the preparation of the Shop Drawings are not identical to those used in construction.
3. The friction angle testing outlined above shall be conducted using ASTM D5321 and ASTM 3080 modified to be in general accordance with the following requirements is intended to indicate the performance of the various components by attempting to model the field conditions:
 - a. The shear box shall be a minimum of 12 inches square in plan dimensions.
 - b. Each half of the shear box shall be a minimum of three inches in depth.
 - c. Proposed soils shall be compacted to approximately 90 percent Modified Proctor Density, with a moisture content, determined through the laboratory testing and topsoil shall be compacted to approximate 80 percent Modified Proctor density.
 - d. The geosynthetics shall be placed in the same sequence as shown on the Drawings. The interface geosynthetics in questions shall be connected to the respective upper or lower shear box frame.
 - e. The test shall be performed for a minimum of three normal stresses applied to the

geosynthetic to bracket the normal stresses defined above, as required to define the failure plane friction angle. The peak and residual shear stresses shall be recorded and plotted against the normal compressive stresses used. A best fit straight line shall be constructed for each test series.

- f. All samples shall be normally consolidated under the applied load.
- g. The direction of shear for each interface tested shall be in the direction of manufacture (machine direction) for each geosynthetic sample.
- h. Apply the shear force using a constant rate of displacement not to exceed .01 in./min.
- i. All tests shall be continued until a constant shearing force is recorded,
- j. All tests shall be conducted with the soil and geosynthetics in a wet condition, by saturating and maintaining the specimen in water for 24 hours prior to and during testing.

The actual test methods and equipment shall be proposed by the CONTRACTOR and approved by the ENGINEER.

In addition to the prequalification testing, a minimum of three tests shall be performed by the CONTRACTOR during the course of the work to confirm that the frictional characteristics of the products continues to meet the requirements of this specification. Testing shall be performed in accordance with paragraph 1.3.H of this section.

1.4 SUBMITTALS

A. Shop Drawings:

- 1. Submit shop drawings for approval as soon as possible after award of Contract.
- 2. Shop drawings shall include:
 - a. Drawings showing layout of liner sheets, anchor trench details and pipe penetration details. Layout diagram indicating the location of pre-assembled panels. Shop drawings need not identify each sheet and panel by number, per Article 3.2 of this Section; however, quality assurance record shall do so.
 - b. Complete description of field seaming procedures.
 - c. Work plan for liner installation including manpower and equipment requirements.
 - d. Detailed description of field testing methods to be performed.
 - e. Name of liner installer and written description of at least three (3) recent liner installation projects completed by liner installer
 - g. Provide a list of at least three (3) references for liner installer
 - h. Resume(s) of master seamers for liner installer
 - i. Resume(s) of field superintendent for liner installer
 - j. Liner installers QA/QC plan and cold weather installation procedures.
 - k. Provide friction angle test results.

B. Affidavit of Compliance:

- 1. Provide 6 copies of an affidavit, certifying that all liner materials furnished for this project (reference project title and number) comply with all requirements specified in the Contract Documents.
- 2. No liner material shall be shipped until the affidavits are submitted to the ENGINEER.

- C. Test Reports: Provide 6 copies of all factory and field quality control test reports.
- D. Pre-weld seaming records, vacuum and pressure test records, and daily as-built information and sketches shall be submitted to the ENGINEER daily for review. Destructive seam testing, results shall be submitted to the ENGINEER as soon as available.

1.5 WARRANTY

- A. The Bidder shall submit 3 copies of the liner manufacturer's offer of warranty with his bid. Pipe penetration seals and field seams, shall be included in the warranty. The warranty shall guarantee materials for a minimum period of 20 years and labor for a minimum period of 5 years.
- B. CONTRACTOR shall provide the OWNER with a sample warranty in accordance with offer of warranty submitted with his bid.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery including unloading, storage and handling shall be performed in accordance with the liner manufacturer's recommendations and shall be done in such a manner as to prevent damage to the liner.
- B. CONTRACTOR shall provide all labor and equipment required to assist ENGINEER in inspection and sampling of liner materials upon delivery to the site, or as requested by the ENGINEER.

PART 2 - PRODUCTS

2.1 PE RESIN

- A. 1. The PE geomembrane shall be manufactured of virgin, first-quality resin and shall be compounded and manufactured specifically for the intended purpose. No regrinded or reprocessed materials shall be used in the manufacturing of the geomembrane. The resin manufacturer shall certify each batch for the specified properties.
- 2. The Polyethylene (Compounded) resin shall conform to the following properties:

<u>Property</u>	<u>Test Method</u>	<u>Requirements</u>
Specific Gravity	(ASTM* D 792 or ASTM D 1505)	>.915
Melt Index	(ASTM D 1238 Condition E)	<1.0/10min
Carbon Black Content	(ASTM D 1503)	2-3%

- B. The resin used for extrusion bonded seams shall be identical in all respects to the PE resin used to manufacture the liner sheets. The installer shall provide certifications for welding rod and/or resin used to manufacture the rod prior to installation.

2.2 PE SHEET MANUFACTURING

- A. The PE liner materials shall be formulated from the appropriate polymers and compounding ingredients to form an PE sheet material that meets all requirements for use as a liner for a municipal waste landfill. The sheet material shall be capable of being bonded to itself by thermal bonding in accordance with the sheet manufacturer's recommendations and instructions.
- B. Liner sheets which have repair patches upon delivery to the site shall not be accepted.
- C. Sheets shall be at least ten feet (10') in width. Individual liner sheets may be pre-assembled at the factory into larger panels to minimize field seams. Liner sheet and pre-assembled panel sizes shall consider access to site and materials handling constraints.
- D. Each roll shall be identified by a number and date of manufacture. The number shall identify roll number and batch or lot number as a minimum.
- E. The completed sheet, upon thorough quality control testing specified herein, must demonstrate the following properties:
1. General Sheet Properties:

Property	Test Method	Minimum Value	Units
1. Specific Gravity	ASTM D 1505 Method A	0.92	g/cm ³
2. Melt Flow Rate	ASTM D1238	<1.0	g/10 Min
3. Coefficient of Linear Thermal Expansion, nominal	ASTM D 696	1.2x10 ⁻⁴	C ⁻¹
4. Water Absorption	ASTM D 570	.10 max.	%wt. change
5. Modulus of Elasticity, Min.	ASTM D 638	80,000	psi
6. Carbon Black Content	ASTM D 1603	2 Min. 3 Max.	% %
7. Dimensional Stability maximum change percent)	ASTM D 1204 212°F 1 hr.	+2	each dir. %change max.
8. Resistance to Soil Burial	ASTM D 3083		% change max. in original value

- a. Tensile Strength
Yield and Break ±10
 - b. Elongation at Yield and Break ±10
9. Environmental Stress ASTM D 1693 1,500 Min. hours
2. Sheet Properties for Specific Sheet Applications:

<u>Property</u>	<u>Test Method</u>	<u>Units</u>	<u>Minimum Values⁽²⁾</u>
1. Textured			Yes
a. One side			No
b. Two sides			Yes
2. Thickness, (min. average)	ASTMD1593	mils	38
3. Tear Resistance, min. (MD & CMD) ⁽¹⁾	ASTMD1004 DieC	lbs	22
4. Tensile Strength, min. a. Break (MD & CMD) ⁽¹⁾	ASTM D 638*	lbs/inch width	60
5. Elongation, min. a. Break (MD&CMD) ⁽¹⁾	ASTM D 638*	%	250

Notes:

A. Primary Liner

(1) MD = Machine Direction

CMD = Cross Machine Direction

(2) The minimum values presented are for use as a guide only and represent the absolute minimum properties for the sheet. The critical property will be the minimum friction angle specified and may result is a thicker geomembrane necessary to comply with these specifications.

*Speed 2 ipm, Test Specimen

<u>Property</u>	<u>Test Method</u>	<u>Value</u>	<u>Units</u>
<u>Field Seam Requirements</u>			
1. Bonded Seam Strength	ASTM D 4437	FTB ⁽¹⁾ and 76 ⁽²⁾ minimum	Breaking factor lbs/inch mm.
2. Peel Adhesion lb/inch min.	ASTM D 4437	FTB ⁽¹⁾ and 60 ⁽²⁾	
(1) FTB - Film Tear Bond, and shall have a maximum of 10% peel in seam or portion of seam tested.			

- (2) Required minimum failure value for seam.
- (3) Both halves of split wedge seams will be tested.

2.3 PIPE PENETRATION MATERIALS

- A. Extrusion Joining Resin: Resin used for extrusion joining sheets and sheet to pipe shall be PE produced from the same as the sheet resin. Physical properties shall be the same as those of the resin used in the manufacture of the PE liner. The resin shall be supplied in black.
- B. Extrusion weld on pipe shall be non-destructively tested and repaired in accordance with the procedures outlined in paragraph 3.8 of this section or as approved by ENGINEER.
- C. Factory fabricated boots will be considered as an alternative by ENGINEER providing:
 - 1. The boot assembly has sufficient length of pipe and PE sheeting to facilitate field installation
 - 2. The manufacturer certifies the materials used conform to the applicable portions of these specifications.
 - 3. The manufacturer provides non-destructive test results on the prepared boot assembly.
 - 4. Any boots that appear to be damaged shall be replaced or repaired as required by the ENGINEER.

PART 3 - EXECUTION

3.1 PREPARATION FOR GEOMEMBRANE INSTALLATION

- A. Prepare base material to receive the geomembrane in accordance with geomembrane manufacturer's recommendations. Refer to Section 02220 "Excavation, Backfill, and Ash Regrading," Section 02227 "Cover Soil and Drainage Sand," Section 02225 "Subbase" for additional requirements relating to preparation of subbase material and overlying Cover Soil material layer. As a minimum, this certification shall include date, job name, material used, base composition, roll or panel number, and signature of manufacturer's representative.
- B. The geomembrane Manufacturer shall certify in writing that the surface on which the geomembrane will be installed is acceptable. This certificate of acceptance shall be given to the ENGINEER prior to commencement of geomembrane installation.

3.2 GEOMEMBRANE PLACEMENT

- A. Panel Identification: A panel is the unit area of geomembrane which is to be seamed in the field. A panel is a roll or a portion of roll cut in the field. Each panel shall be given an "identification code" (number or letter-number) consistent with the layout plan. This identification code shall be agreed upon by the ENGINEER and CONTRACTOR. This identification code shall be as simple and logical as possible. The CONTRACTOR shall

establish a table or chart showing correspondence between roll numbers and identification codes. The identification code shall be used for all quality assurance records.

B. Panel Placement:

1. The CONTRACTOR shall verify that panels are installed at the location indicated on the Drawings.
2. Panels placed prior to field seaming shall begin at the low point and proceed upward and outward with "shingle" overlaps to facilitate drainage in the event of precipitation.
3. CONTRACTOR shall record on a drawing the identification code, roll number, location, and date of installation of each panel.

C. Weather Conditions:

1. Geomembrane placement shall not proceed at an ambient temperature above 40°C (104°F) unless otherwise specified or approved by the ENGINEER. For temperatures below 5°C (41°F) refer to Section 06647 Cold Weather Installation - Flexible Membrane Liner. Geomembrane placement shall not be conducted during any precipitation, in the presence of excessive moisture (e.g., fog, dew, or frost), in an area of ponded water, or in the presence of excessive winds, as determined by the ENGINEER.
2. CONTRACTOR shall verify that the above conditions are fulfilled. Additionally, the CONTRACTOR shall verify that the supporting soil has not been damaged by weather conditions.

D. Method of Placement:

1. Use no equipment that could damage the geomembrane by handling, trafficking, leakage of hydrocarbons, or other means;
2. Prohibit all personnel on the geomembrane from smoking, wearing damaging shoes, or engaging in other activities which could damage the geomembrane;
3. Use methods to unroll the panels that do not cause scratches, folds or crimps in the geomembrane and do not damage the subgrade;
4. Use methods to place the panels that minimize wrinkles (especially differential wrinkles between adjacent panels);
5. Place adequate loading (e.g., sand bags), not likely to damage the geomembrane, to prevent uplift by wind; and
6. Minimize direct contact with the geomembrane (i.e., the geomembrane in traffic areas is protected by geotextiles, extra geomembrane, or other suitable materials).

E. Damage: The ENGINEER shall inspect each panel, after placement and prior to seaming, for damage. The ENGINEER shall advise the CONTRACTOR which panels, or portions of panels, shall be rejected, repaired, or accepted. Damaged panels or portions or damaged panels which have been rejected shall be marked and removed from the work area. The damaged materials shall become the property of the CONTRACTOR.

1. Alternatives for disposition of damaged liner with approval of ENGINEER:
 - a. Remove from site at expense of CONTRACTOR.
 - b. Use as slip sheets.
 - c. Use as protective pads beneath vehicles.

- d. Use as spill protection.
- e. Use as chafe strips along berms.

3.3 ANCHOR TRENCH

- A. Excavate anchor trenches to the lines and width shown on the Drawings, prior to geomembrane placement, and as follows:
 - 1. Top of each slope.
 - 2. At end of rolls on slopes.
 - 3. At other points as recommended by manufacturer.
- B. Round trench edge to avoid sharp bends in the geomembrane. No loose soil shall be allowed to underlie the geomembrane in the anchor trench.
- C. Backfill the anchor trench in accordance with Section 02220, Excavation and Backfill.

3.4 FIELD AND SHOP FABRICATED SEAMING

- A. Seam Layout: CONTRACTOR shall provide the ENGINEER with a drawing of the facility to be lined showing shop fabricated seams and field seams in a manner which differentiates the seam types. Field seams should be oriented parallel to the line of maximum slope (e.g., oriented along, not across, the slope). In corners and odd-shaped geometric locations, the number of field seams should be minimized. No horizontal seam shall be constructed on the slope. The seam at the toe of the slope shall be no less than five (5) feet from the toe of the slope.
- B. Requirements of Personnel: All personnel performing seaming operations shall be qualified by experience or by successfully passing seaming tests. At least two seamers shall have experience seaming a minimum of 2,000,000 square feet of PE geomembrane using the same type of seaming apparatus in use at the site. The most experienced seamer, the "master seamer", shall provide direct supervision, as required, over less experienced seamers. No field seaming shall take place without the master seamer being present.

3.5 OVERLAPPING AND TEMPORARY BONDING

- A. Overlap panels by a minimum of three (3) inches for extrusion welding and 125 mm (5 inches) for fusion welding, or as approved by ENGINEER.
- B. Assure that the procedure used to temporarily bond adjacent panels together does not damage the geomembrane; in particular, the temperature of hot air at the nozzle of any spot welding apparatus is controlled such that the geomembrane is not damaged.
- C. No solvent or adhesive shall be used unless the product is approved in writing by the ENGINEER.

3.6 SEAM PREPARATION

- A. Prior to seaming, confirm that the seam area is clean and free of moisture, dust, dirt, debris of any kind, and foreign material; and clean seam area as necessary to permit seaming.
- B. Where seam overlap bonding is required, the process shall be according to the Manufacturer's instructions and in a way that does not damage the geomembrane.
- C. Seams shall be aligned with the fewest possible number of wrinkles and "fishmouths".
 - 1. Where more than five "fishmouth" per 500 linear feet of seam occur, replace the seam and:
 - a. retrain the operator, or
 - b. repair seaming equipment.

3.7 SEAMING EQUIPMENT AND PRODUCTS

- A. General:
 - 1. Approved processes for field seaming are extrusion welding and fusion welding.
 - 2. Use only apparatus which have been specifically approved by make and model.
- B. Extrusion Process:
 - 1. Welding apparatus shall be equipped with gauges giving the temperature in the apparatus and at the nozzle. CONTRACTOR shall provide documentation regarding the PE extrudate to the ENGINEER and shall record and certify that the extrudate temperatures, ambient temperatures, and geomembrane surface temperatures as specified at appropriate intervals.
 - 2. CONTRACTOR shall comply with the following:
 - a. spare operable seaming apparatus is available on-site;
 - b. equipment used for seaming is not likely to damage the geomembrane;
 - c. the extruder is purged prior to beginning a seam until all heat degraded extrudate has been removed from the barrel;
 - d. the electric generator is placed on a smooth base such that no damage occurs to the geomembrane;
 - e. splash protection is provided beneath equipment;
 - f. fuel cans are stored off the geomembrane;
 - g. a smooth insulating plate or fabric is placed beneath the welding apparatus after usage;
 - h. the geomembrane is protected from damage in heavily trafficked areas; and
 - i. Any comers of panels or areas where two or more seams meet shall be capped with a minimum 1 foot diameter patch.
- C. Fusion Process:
 - 1. Fusion-welding apparatus must be automated vehicular-mounted devices which produce a double seam with an enclosed space. The seaming apparatus shall be equipped with gauges giving the applicable temperatures and pressures. The

CONTRACTOR shall log ambient, seaming apparatus, and geomembrane surface temperatures as well as seaming apparatus pressures.

2. CONTRACTOR shall comply with the following:
 - a. spare operable seaming apparatus is available on-site;
 - b. equipment used for seaming is not likely to damage the geomembrane;
 - c. for cross seams, the edge of the cross seams is ground to a smooth incline (top and bottom) prior to welding;
 - d. the electric generator is placed on a smooth base such that no damage occurs to the geomembrane;
 - e. a smooth insulating plate or fabric is placed beneath the hot welding apparatus after usage; and
 - f. the geomembrane is protected from damage in heavily trafficked areas.

D. Weather Conditions for Seaming:

1. Field seaming is prohibited during precipitation, in presence of moisture, or when winds are in excess of 20 miles per hour.
2. Unless authorized in writing by the ENGINEER, no seaming shall be attempted below 5°C (41 °F) nor above 40°C (104°F).
 - a. Refer to Section 06647.
3. Between 5°C (41°F) and 10°C (50°F), seaming is possible if the geomembrane is preheated by either sun or hot air device, and if there is not excessive cooling resulting from wind (as determined by the ENGINEER).
4. Above 10°C (50°F), no preheating is required.
5. In all cases, the geomembrane shall be dry and protected from wind damage.

E. Test Seams:

1. Test seams shall be made on fragment pieces of geomembrane liner to verify that seaming conditions are adequate. Make test seams:
 - a. Each day prior to commencing field seaming, a test weld 3 feet long shall be run from each welding machine under the same conditions as exist for the liner welding.
 - b. During field seaming, one 1-inch seam test sample shall be prepared and field peeled for every 500 feet of field seam.
 - c. Each seamer shall make at least one (1) test seam each day and one test seam at least once every four hours, or at any time equipment is shut down and cooled.
2. Test seam sample shall be at least three (3) feet long by one (1) foot wide with the seam centered lengthwise. Cut five (5) adjoining specimens one (1) inch wide each from each end of the test seam sample. Test specimens in peel and shear by tensiometer, and the specimens shall not fail in the seam. If test seam fails, repeat the entire seam test operation. If the additional test seam fails, the seaming apparatus or seamer shall not be accepted and shall not be used for seaming until the deficiencies are corrected and two (2) consecutive, successful, full test seams are achieved.
3. ENGINEER shall observe all test seam procedures. The remainder of the successful test seam sample shall be assigned a number and marked accordingly by the CONTRACTOR, who shall also log the date, hour, ambient temperature, number of seaming unit, welding temperatures, equipment speed, name of seamer, and pass or fail description. The sample itself shall be labeled and submitted to the ENGINEER.

4. All test seam apparatuses shall be as close to the operations as possible to permit continuous observation of construction activities by the ENGINEER.

F. General Seaming Procedure:

1. Extend seaming to the outside edge of panels to be placed in the anchor trench.
2. As required, a firm substrate shall be provided by using a flat board, a conveyor belt, or similar hard surface directly under the seam overlap to achieve proper support.
3. Fishmouths or wrinkles at the seam overlaps shall be cut along the ridge of the wrinkle in order to achieve a flat overlap. The cut fishmouths or wrinkles shall be seamed and patched with an oval or round patch of the same geomembrane extending a minimum of six (6) inches beyond the fishmouth or wrinkle in all directions.
4. All seams shall be marked by the seamer with the seamer name, date, equipment number, and starting time. The liner installer shall mark each seam with a number to identify the seam. This number will be used by the installer to record all QA/QC data associated with the seam.
5. All tee seams or intersections where 3 or more panels are joined shall be capped with a patch 6 inches beyond the intersection in all directions.
6. CONTRACTOR shall take samples from the start and stop of each seam welded. Samples shall be one inch wide and shall be tested in peel and shear. Any seam failed shall be reconstructed.
7. Areas of seams which show evidence of overheating or degradation of liner properties due to seaming shall be patched or replaced by the CONTRACTOR at no expense to the OWNER.

3.8 NON-DESTRUCTIVE SEAM TESTING

A. General:

1. CONTRACTOR shall test all field seams non-destructively using a vacuum test unit or air pressure to verify seam continuity.
2. CONTRACTOR shall cap-strip with same geomembrane all locations where seams cannot be non-destructively tested.
3. CONTRACTOR shall correct all inadequate seams or portions thereof in accordance with approved method.
4. CONTRACTOR shall provide copies of the non-destructive test results to the ENGINEER.

B. Vacuum Box Testing:

1. Inspect all field seams for unbonded areas by applying a vacuum to a soaped section of seam.
2. Apply the vacuum by a vacuum box equipped with a vacuum gage, a clear glass view panel in the top, and a soft rubber gasket on the periphery of the open bottom. The vacuum box shall be similar to the Series A 100 Straight Seam Tester as supplied by the American Parts and Service Company, 2201 West Commonwealth Avenue, P.O. Box 702, Alhambra, California 91802.
3. Thoroughly soap a section of the seam, place the inspection box over the soaped seam section and seal the gasket sealed to the liner.
4. Apply a vacuum of between eight (8) and ten (10) inches of mercury (Hg) to the box for not less than thirty (30) seconds by use of a gasoline or electric driven power-

vacuum pump apparatus. Mark areas that bubble (unbonded areas) for repair by the CONTRACTOR.

5. Box shall have a minimum overlap of three (3) inches when advancing to the next test.
- C. Air Pressure Testing: Test all double fusion seams with an air pressure test by sealing both ends and applying air to a pressure between twenty-five (25) and thirty (30) psi. Seam failure will be determined if loss of pressure exceed two (2) psi or does not stabilize. Two gauges shall be used to measure continuity of the air channel, one at each end of the seam. Both gauges shall be observed and recorded. Pressure differential between the two gauges shall be no more than 1 psi. The seam tester shall record on the report forms and on the liner the tester name, the start and end times, start and end pressures at each gauge, and the result of the test.

3.9 DESTRUCTIVE SEAM TESTING

A. Location and Frequency of Samples:

1. ENGINEER shall determine locations where seam samples shall be cut out for laboratory testing. Samples shall be taken at a minimum frequency of one test location per 500 feet of seam length and a maximum frequency shall be agreed upon by the ENGINEER and CONTRACTOR.
2. Additional test locations shall be determined during seaming at the ENGINEER'S discretion. Selection of such locations may be prompted by suspicion of excess crystallinity, contamination, offset welds, or any other potential cause of imperfect welding. The CONTRACTOR shall not be informed in advance of the additional locations where the seam samples will be taken.
3. Cut samples as the seaming progresses in order to have laboratory test results before completion of geomembrane installation. Assign a number to each sample, mark it accordingly, record sample location on layout drawing, and record reason for taking the sample at this location.
4. ENGINEER shall witness all field tests and mark all samples and portions with their number. CONTRACTOR shall log the date and time, ambient temperature, number of seaming unit, name of seamer, welding apparatus temperatures and pressures, and pass or fail description, and attach a copy to each sample portion.
5. Samples shall be eighteen (18) inches wide by forty-seven (47) inches long with the seam centered lengthwise. Cut one 1-inch wide strip from each end of the sample and test in the field, by tensiometer, at a separation rate of 2 inches per minute for peel and shear. The remaining sample shall be cut into three (3) parts and distributed as follows:
 - a. One portion to the testing laboratory, 18 inches x 15 inches;
 - b. One portion to the ENGINEER for archive storage, 18 inches x 15 inches; and
 - c. One portion to the installer, 18 inches x 15 inches.

B. Laboratory Testing:

1. CONTRACTOR will forward test samples to an independent laboratory selected by the ENGINEER. Testing shall include "Seam Strength" (ASTM D4437) and "Peel Adhesion" (ASTM D4437). The minimum acceptable values shall be as specified in Section 2.2. Copies of all laboratory test results shall be submitted by the laboratory

to the ENGINEER as soon as they become available. CONTRACTOR shall account for a minimum turnaround time for tests to be 3 business days.

C. Procedures for Destructive Test Failure:

1. The following procedures shall apply whenever a sample fails the field destructive test:
 - a. Reconstruct the seam between the failed location and any passed test location, at ten (10) feet, minimum, from the location of the failed test.
 - b. Take a sample for an additional field test:
 - 1) If this additional sample passes the test, reconstruct seam between that location and the original failed location.
 - 2) If this sample fails, then the process is repeated.
 - c. In any case, all acceptable seams must be bounded by two passed test locations (e.g., the above procedure shall be followed in both directions from the original failed location), and
 - d. One (1) test must be taken within the reconstructed area.
2. With samples that fail a laboratory destructive test, follow the above procedures, considering laboratory tests exclusively. Since the final seam must be bounded by two (2) passed test locations, it may then be necessary to take one or more new samples for laboratory testing in addition to the one required in the reconstructed seam area.
3. CONTRACTOR may perform additional testing for his purposes, subject to the following restrictions at a minimum:
 - a. OWNER will not pay for tests.
 - b. Test results will be nonbinding for all purposes upon the OWNER, ENGINEER and laboratory.
 - c. PE installation shall proceed in the absence of results of CONTRACTOR'S additional testing; untimely results from CONTRACTOR'S additional testing shall not be cause for delay claim.
 - d. CONTRACTOR may only test the installer's sample, obtained and distributed per Article 3.9.A.4.C.

3.10 DEFECTS AND REPAIRS

- A. Sweep and wash the geomembrane surface prior to inspection. Inspect all seams and non-seam areas of the geomembrane for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. Non-destructively test each suspect location, both in seam and non-seam areas, using the methods specified herein. Mark and repair each location which fails the non-destructive testing.
- B. Repair procedures should be agreed upon between ENGINEER and CONTRACTOR. Unless otherwise agreed, the procedures shall be as follows:
 1. Defective seams shall be repaired by reconstruction as described below.
 2. Tears or pinholes shall be repaired by seaming or patching.
 3. Blisters, larger holes, undispersed raw materials, and contamination by foreign matter shall be repaired by patches.

4. Surfaces of PE geomembrane which are to be patched shall be abraded no more than one (1) hour prior to the repair.
 5. All seams used in repairing procedures must be approved extrusion welded seams and shall be subjected to the same non-destructive test procedures as outlined for all other seams.
 6. Each patch shall be numbered and logged. Patches shall be round or oval in shape, and made of the same geomembrane, and extend a minimum of six (6) inches beyond the edge of defects in each direction.
 7. Patches shall be applied using approved methods only.
 8. Where excessive extrudate surface occurs, the affected seam length shall be cap-stripped.
 9. Any cold rudded areas shall be patched.
- C. Seam reconstruction for the extrusion welding process shall be achieved by grinding the existing seam and rewelding a new seam or patching as determined by ENGINEER. Seam reconstruction for the fusion process shall be achieved by cutting out the existing seam and welding in a replacement strip.
- D. Each repair shall be non-destructively tested using the methods specified herein, as appropriate. Repairs which pass the non-destructive test shall be taken as an indication of an adequate repair. Failed tests indicate that the repair shall be redone and retested until a passing test results. The ENGINEER shall observe all non-destructive testing of repairs and the CONTRACTOR shall record the number of each patch, date, name of patcher, and test outcome. The CONTRACTOR will identify each patch and repair on the as-built drawing.

3.11 GEOMEMBRANE ACCEPTANCE

- A. At the conclusion of placement of the PE geomembrane, prepare and submit six (6) copies of a written report of the work which includes the following:
1. Complete identification of PE geomembrane liner, including, but not limited to, resin type, physical properties and other pertinent data.
 2. Complete description of failed seaming system used including material, method, temperatures, seam overlap width and cure or aging time.
 3. Complete description of field sampling and testing including test equipment used, location of field tests, copy of all field laboratory test results, conditioning procedure prior to destructive seam testing, method of recording loading and determining average load for destructive test methods, and type of failure in tests (i.e., within the seam, within the sheet material, clamp edge, seam edge).
 4. "As-built" drawings showing actual layout of liner sheets, pipe penetration details, patches, repairs, destructive samples and anchor trench details. "As-built" drawings shall also provide invert and spot elevations for each sump, pipe penetration and at 100-foot intervals along each anchor trench.
 5. An affidavit of compliance from the liner manufacturer, containing the following wording:

"I (name and title), as the duly authorized representative of (Company name), hereby certify that the installation of the textured LLDPE geomembrane has been completed in accordance with the terms and conditions of the Contract Documents.

6. Completed warranty for the installed items in accordance with paragraph 1.4 of this section.

By: _____
(signature)

(Corporate Seal) Witness: _____
(signature)

Date: _____

END OF SECTION 06643

SECTION 06645

GEOSYNTHETICS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: CONTRACTOR shall provide all labor, materials, tools, equipment, testing, and services necessary for the placement of geotextile as liner protection cushion, and a geocomposite drainage layer within the cap system, and weed control fabric in the enclosed flare area as shown on the Drawings and specified, or as otherwise directed by the ENGINEER.
- B. Related Sections:
 - 1. Section 06643, Geomembranes.
 - 2. Section 02271, Riprap

1.2 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
 - 1. Geosynthetic manufacturer shall be a specialist in the manufacture of the particular geosynthetic.
- B. Submittals:
 - 1. Shop Drawings:
 - a. CONTRACTOR shall submit six (6) copies of manufacturer's data, specifications, installation instructions and dimensions.
 - b. CONTRACTOR shall submit six (6) copies of an affidavit certifying that each geosynthetic furnished complies with all requirements specified herein.
 - c. No geosynthetic shall be shipped until the affidavit is submitted to ENGINEER.

1.3 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Each roll of geosynthetic delivered to the site shall be labeled by the manufacturer identifying the manufacturer's name, product identification, lot number, roll number and roll dimensions.
- B. All geosynthetics shall be protected from ultraviolet light exposure, precipitation or other inundation, mud, dirt, dust, puncture, cutting or any other damaging or deleterious conditions. Geosynthetic rolls shall be shipped and stored in relatively opaque and watertight wrappings.
- C. CONTRACTOR shall provide all labor and equipment required to assist ENGINEER in inspection of materials upon delivery to the site.

PART 2 - PRODUCTS

2.1 GEOTEXTILE

- A. Geotextile shall be a needle punched, nonwoven fabric composed of filaments which are formed into a stable network such that the filaments retain their relative position. Filter fabric shall be inert to biological degradation and naturally encountered chemicals, alkalis, and acids. The geotextile shall conform, as a minimum, to the following:

Fabric Property	Unit	Typical Test Method	Value ⁽¹⁾
Unit Weight (mass per unit area)	oz/yd ²	ASTM D 5261	12
Thickness	mils	ASTM D 5199	110
Grab Tensile Strength	lb	ASTM D 4632	320
Grab Tensile/Elongation	%	ASTM D 4632	50
Puncture Strength	lb	ASTM D 4833	190
Trapezoid Tear Strength (MD)	lb	ASTM D 4533	125
Apparent Opening Size	mm	ASTM D 4751	0.150
Falling Head Permeability, "k"	cm/sec	ASTM D 4491	0.29
UV Resistance (500 hrs)	%	ASTM D 4355	70

NOTES:

1. Values listed represent minimum values each roll delivered to the site shall meet when tested in accordance with the specified ASTM test method.

- B. Geotextile filter fabric shall be:
1. NW12 produced by GSE Lining Technology, Inc.
 2. Or equal.

2.2 GEOCOMPOSITE

- A. The Geonet Drainage Layer (GDL) shall be:
1. Tenflow 770-2 manufactured by Tenax Corporation
 2. Or equal.
 - a. For any natural drainage material alternative, design and performance demonstration must be submitted for ENGINEER's approval. Any alternative GDL material for ENGINEER approval must be submitted together with transmissivity testing with 1,000 hours at the specified boundary conditions, and demonstrate performance equivalency to all the property requirements and testing methods as indicated in Tables 1 & 2, as well as Part B below.
- B. The manufacturer of the GDL shall submit documents for the ENGINEER's review that the GDL to be supplied to the project site has proven installation. As a minimum, the manufacturer shall certify that:
1. The proposed GDL has been installed at least 10 million square feet. The proposed GDL has been installed at least 10 projects that are in operations for a minimum two years.

- C. The polymer used to manufacture the Geonet core of the GDL shall be polyethylene. Manufacturer shall certify that no regrind material is used in the geonet manufacturing process.
- D. The drainage core of the GDL shall be manufactured by extruding polyethylene to form a triaxial void maintaining structure. The geonet shall meet the property requirements listed in Table 1.
- E. The geotextile of the GDL shall be UV resistant, continuous filament, needle punched, nonwoven polypropylene geotextile. The geotextile shall meet the property requirements listed in Table 2.

TABLE 1: REQUIRED GEOCOMPOSITE DRAINAGE LAYER PROPERTIES

PROPERTY	TEST METHOD	UNITS	VALUE
Geonet			
Structure		Triaxial	
Thickness (min.)	ASTM D 5199	mil	340 ± 10%
Tensile Strength (min.)	ASTM D 4595	lb/ ft	425 ± 10%
Density (min.)	ASTM D 1505	g/cm ³	0.94
Melt Flow Index (max.)	ASTM D 1238	g/10 min	1.0
Carbon Black Content (min.)	ASTM D 4218	%	2
Creep Reduction Factor ¹	GRI- GC8	-	1.1
Geocomposite			
Ply Adhesion (min.)	ASTM D7005	lb/inch	0.5
Transmissivity ² –Machine Direction (min.) @1000psf load	ASTM D 4716 GRI –GC8	(m ² /sec)	7.0E-03 @ gradient 0.1 4.0E-03 @ gradient 0.33

Notes:

1. The creep reduction factor is determined from 10,000 hour test duration, extrapolated to 30 years and using a compressive load of 1,000 psf.
2. For both MQC and CQA, transmissivity tests shall be conducted at the frequency of 200,000 square feet per test. The normal compressive load shall be 1,000 psf at hydraulic gradients of 0.1 and 0.33. Testing boundary conditions from the top to bottom are: upper steel load plate/Ottawa sand/Geocomposite/Geomembrane/ lower load plate (the flat side of the geocomposite facing the soil boundary), with a minimum seating period of 100 hours.

TABLE 2: REQUIRED GEOTEXTILE PROPERTIES

PROPERTY	TEST METHOD	UNITS	VALUE
Serviceability Class	Class 2		
UV Resistance @500 Hours (MIN)	ASTM G 154 or D 4355	%	70
Grab Tensile Strength (MARV)	ASTM D4632	lbs	160
Grab Elongation (MARV)	ASTM D4632	%	50
Trapezoid Tear (MARV)	ASTM D4533	lbs	60
Puncture Strength (MARV)	ASTM D4833	lbs	90
AOS (MaxARV)	ASTM D4751	US Sieve (mm)	70 (0.21)
Permittivity (MARV)	ASTM D4491 Falling head	sec ⁻¹	1.1

TABLE 3: REQUIRED MANUFACTURER'S QUALITY CONTROL TEST DATA

PROPERTY	TEST METHOD	UNITS	FREQUENCY
<i>Resin Tests</i>			
DENSITY	ASTM D1505	g/cm ³	Per Lot
MELT FLOW INDEX	ASTM D1238	g/10 min	Per Lot
<i>Geonet Tests</i>			
THICKNESS	ASTM D5199	mm	50,000 ft ²
CARBON BLACK CONTENT	ASTM D4218	%	50,000 ft ²
TENSILE STRENGTH-MD	ASTM D4595	lbs/ft	50,000 ft ²
<i>Geotextile Tests</i>			
WEIGHT	ASTM D3776	Oz/sy	100,000 ft ²
AOS	ASTM D4751	US Sieve (mm)	500,000 ft ²
PERMITTVITY	ASTM D4491 Falling head	sec ⁻¹	500,000 ft ²
GRAB TENSILE STRENGTH	ASTM D4632	lbs	100,000 ft ²
TRAPEZOID TEAR	ASTM D4533	lbs	100,000 ft ²
PUNCTURE STRENGTH	ASTM D4833	lbs	100,000 ft ²
<i>Geocomposite Tests</i>			
PLY ADHESION	ASTM D7005	lbs/in	100,000 ft ²
TRANSMISSIVITY-MD	ASTM D4716	m ² /sec	200,000 ft ²

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

- A. All geosynthetics shall be weighted with sandbags or the equivalent when required. Such sandbags shall be installed during placement and shall remain until replaced with cover material or geomembrane.
- B. If white or light colored geotextile is used, precautions shall be taken against "snowblindness" of personnel.
- C. CONTRACTOR shall take any necessary precautions to prevent damage to underlying layers during placement of each geosynthetic.
- D. During placement of geosynthetics, care shall be taken not to entrap in the geosynthetics stone, excessive dust, or moisture that could damage the geomembrane, generate clogging, or hamper subsequent seaming.
- E. Geosynthetics shall not be exposed to precipitation prior to being installed, and shall not be exposed to direct sunlight for more than 15 days. Any materials not complying with this requirement shall be removed and replaced at no cost to the OWNER.
- F. CONTRACTOR shall not operate equipment on geosynthetics without the specified depth of cover.
- G. Excavation of fill material over geosynthetics shall be completed by hand with plastic shovels.

3.2 GEOTEXTILE

- A. Geotextile fabrics shall be deployed in the direction of the slope unless otherwise directed by ENGINEER.
- B. Geotextile fabrics shall be overlapped 3 inches and sewn as detailed on Contract Drawings unless otherwise approved by ENGINEER. Overlaps shall be oriented in the direction of filling.
- C. Any bum mark, material defect or tear in the fabric shall be repaired as follows:
 - 1. A fabric patch shall be sewn into place using a double sewn lock stitch (1/4 inch to 3/4 inch apart and no closer than 1 inch from any edge).
 - 2. On slopes with a grade less than 8%, the CONTRACTOR may use a fabric patch heat welded in place with a minimum of 24 inches overlap in all directions.
 - 3. Should any damaged area exceed 10 percent of the width of the roll, the roll shall be cut, overlapped and sewn to form a new seam.

3.3 GEOCOMPOSITE

A. Handling and Placement of GDL

1. After the substratum/geomembrane has been installed/ constructed, tested and approved by the ENGINEER, the surface shall be cleaned and free of excess dirt and debris.
2. The CONTRACTOR and the Installer shall handle all geocomposite in such a manner as to ensure it is not damaged in any way. Precautions shall also been taken to prevent damage to underlying layers during placement of the geocomposite.
3. The geocomposite roll should be installed in the direction of the slope, following the labeled instructions as provided by the manufacturer with respect to the top/bottom sides.
4. If the project contains long, steep slopes, special care shall be taken so that only full-length rolls are used at the top of the slope.
5. In the presence of wind, all geocomposite shall be weighted with sandbags or the equivalent. Such sandbags shall be installed during placement and shall remain until replaced with cover material.
6. If necessary, the geocomposite shall be positioned by hand after being unrolled to minimize wrinkles.
7. The geocomposite shall be properly anchored to resist sliding. Anchor trench compacting equipment shall not come into direct contact with the geocomposite.
8. If there are any obstructions (such as outlet pipes or monitoring wells) while deploying the geocomposite, the geocomposite shall be cut to fit around the obstruction. Care shall be taken as to make sure there is no gap between the obstruction and the geocomposite. The geocomposite shall be cut in a way that the lower geotextile and geonet core is in contact with the obstruction and the upper geotextile has an excess overhang. There must be enough of the upper geotextile to be able to tuck the upper geotextile back under the geocomposite to protect the exposed geonet core, and prevent soil particles from migrating into the geonet core flow channels.

B. Seams and Overlaps

1. Each component of the geocomposite (geotextile(s) and geonet) shall be secured or seamed to the like component at overlaps.
2. Adjacent edges of geonet along the length of the geocomposite, shall be overlapped 2-3 inches, as shown on the Contract Drawings. These overlaps shall be joined by tying the geonet cores together with white or yellow cable ties or plastic fasteners. These ties shall be spaced at a maximum of every 5 feet along the roll length, or a maximum of 2 feet if the geocomposite is installed vertically.
3. Adjoining geocomposite rolls (end to end) along the roll width shall be shingled down in the direction of the slope, with the geonet portion of the top geocomposite overlapping the geonet portion of the bottom geocomposite a minimum of 12 inches across the roll width as shown on the Contract Drawings. Geonet shall be tied every 12 inches across the roll width and every 6 inches in the anchor trench or as specified by the ENGINEER.
4. The bottom layer of geotextile (if any) shall be overlapped.
5. The top layers of geotextile shall be sewn together, or at the discretion of the ENGINEER may be heat bonded or wedge welded. Geotextiles shall be overlapped

a minimum of 4 inches prior to seaming or heat bonding, geotextile sewing seams to be used are Prayer, "J", or Butterfly, as shown on the Contract Drawings. The seam shall be a two-thread, double-lock stitch, or a double row of single-thread, chain stitch. If heat bonding is to be used, care must be taken to avoid burn through of the geotextile. It is important that the geotextiles be joined continuously along to the roll as to prevent any fugitive particle migration into the geonet core flow channels.

C. Repair

1. Any small holes or tears in the top geotextile shall be patched with an 8" x 8" geotextile piece. The patching geotextile shall be the same as the original one. Apply the spray adhesive (*3M Super 77 adhesive is the recommended*) to one side of the 8" x 8" textile patch. Center and apply the 8" x 8" textile patch over the blemish, hole, tear or thin spot in the geotextile. Firmly press 8" x 8" textile patch over the repair area. If the damaged area of the geotextile is greater than this standard patch size, a bigger size patch is recommended using a multitude of 8" x 8" patches. If the geotextile is damaged beyond 50 percent of the width of the roll, a continuous piece of fabric the same width as the geocomposite may be cap-stripped directly to the adjacent seams by sewing a portion of the new geotextile in place.
2. Any large rips, tears or damage areas on the deployed geocomposite core shall be removed and patched by placing a patch extending 12" beyond the edges of the damaged areas. The patch shall be secured to the original geonet tying every 6 inches with approved tying devices. If the hole or tear width across the roll is more than 50% percent the width of the roll, the damaged area shall be cut out.

3.4 PLACEMENT OF COVER SOIL MATERIALS

- A. Placement of the cover soil is recommended to proceed immediately following placement and inspection of the geocomposite.
- B. When applying Cover Soil Material, no equipment generally speaking shall drive directly across geocomposite. If a vehicle has to be driven on top of the geocomposite, the vehicle shall be driven in a fashion not to damage the geotextile, geonet or geocomposite. Acceleration or deceleration shall be in a smooth and gentle manner. Operator shall not make any sudden turns or stops when driving on the geonet or geocomposite. If any tear or local damage occurs to the geotextile, geonet or geocomposite, patching technique as described in the above section shall be used.
- C. The specified fill material shall be placed and spread utilizing vehicles with a low ground pressure (LGP). The cover soil shall be placed on the geocomposite from the bottom of the slope proceeding upwards and in a manner, which prevents instability of the cover soil or damage to the geocomposite. Unless otherwise specified by the ENGINEER, all equipment for spreading fill material overlying the geocomposite shall comply with the following:

<u>Maximum Equipment Ground Pressure (psi)</u>	<u>Minimum Separation Thickness (inches)</u>
< 5	12
5 - 10	18
>10	24

- D. Compaction of the initial lift placed over the geocomposite must be performed in a manner that does not damage the geocomposite.

END OF SECTION 06645

SECTION 06647

COLD WEATHER INSTALLATION - GEOMEMBRANE

PART I - GENERAL

1.1 DESCRIPTION

A. Scope:

1. The Work covered by this section consists of cold weather installation requirements and supplements Section 06643. The CONTRACTOR may be required to work through cold weather months. If cold weather conditions prevail, the CONTRACTOR shall adjust the storage, handling, and installation procedures and conduct all necessary Work to ensure the integrity of the installed bottom and top liners. All of the provisions of Section 06643 will be strictly adhered to, except as modified herein.
2. All necessary Work required for snow and ice removal is included herein.
3. No direct or separate payment will be made for cold weather storage and installation of liners, snow or ice removal and for providing all other labor, materials, tools, equipment and services necessary to meet the requirements specified in this Section.
4. CONTRACTOR shall supply an outdoor thermometer for each welding enclosure.

B. Related Sections:

1. Section 02220, Excavation and Backfill.
2. Section 06643, Geomembrane.

1.2 SUBMITTALS

A. The CONTRACTOR may be required to work through cold weather months. Therefore, six (6) copies of the proposed methods of cold weather installation construction shall be submitted in sufficient detail for the OWNER and ENGINEER to evaluate the proposed cold weather methods and techniques, such as preheating materials, the use of portable, heated enclosure shacks for field seaming, and other special equipment.

B. The CONTRACTOR shall pre-submit acceptable evidence (to be approved by the OWNER and ENGINEER) that his performance standards will be maintained at lower temperatures.

C. Submittals for Cold Weather Installation:

1. Seaming shall be suspended when temperatures are below 41°F or above 104°F. At his option, the CONTRACTOR shall submit a cold weather installation plan for the review and approval of the ENGINEER.
2. The CONTRACTOR shall submit to the ENGINEER the following additional cold weather construction items and information for approval, not later than 5 days after the notice to proceed from the OWNER:
 - a. Field seaming and fabrication details during cold weather when temperatures

- are below 41°F.
- b. Work plan for liner installation during cold weather including manpower and equipment requirements.
 - c. Shop Drawings and installation diagrams for liner panel sections layout and penetration details.
3. The ENGINEER will return all submittals to the CONTRACTOR within 10 working days of receipt.
 4. The CONTRACTOR shall also specify any additional proposed method of testing the field seams. This testing is to be performed by the Liner Installer who will be required to provide a written report in accordance with Section 06643.
 5. The CONTRACTOR shall present a schedule of cold weather operations to the ENGINEER and obtain the ENGINEER'S approval in writing of the same. This schedule shall be submitted sufficiently in advance of the proposed work as to afford a reasonable amount of time for the ENGINEER to review and approve the schedule.
 6. The CONTRACTOR shall submit shop drawings for the welding enclosures.
 7. The CONTRACTOR shall not install liner at ambient temperatures less than 41°F without an approved cold weather installation plan.

PART 2 - PRODUCTS

(Refer to Section 06643)

PART 3 - EXECUTION

3.1 COLD WEATHER STORAGE OF LLDPE GEOMEMBRANE MATERIALS

- A. CONTRACTOR shall store and protect materials in accordance with manufacturer's recommendations and requirements of the Specifications. Additionally, all liner materials shall be stored inside heated areas, if the site temperature is, or is expected to drop, below 41 °F at any time during the storage period. The CONTRACTOR shall make his own provisions for heated storage.

3.2 LINER SUBBASE

- A. Liner shall not be placed over water, ice, snow or frozen precipitation of any kind. Liner shall not be placed over frozen subbase which in the opinion of the ENGINEER may be detrimental to the integrity of the liner installation. Unacceptable subbase shall be reworked and replaced as necessary by the CONTRACTOR to provide adequate liner support.

3.3 COLD WEATHER INSTALLATION REQUIREMENTS FOR LLDPE FLEXIBLE MEMBRANE LINER

- A. The CONTRACTOR shall be required to implement the previously approved cold weather installation methods when the air temperature reaches 41°F or below. As a minimum the cold weather construction methods to be implemented shall include:

1. Providing additional labor, seaming crews, materials and equipment as required to pursue the work.
 2. Adjustment of field seaming pre-heat to control heat loss prior to field welding to accommodate temperature, wind and humidity conditions.
 3. Adjustment of the rate of field welding to accommodate temperature, wind and humidity conditions.
 4. Exercising extra care in preparing panel edges prior to seaming to insure that edges to be seamed are dry, clean and free of all dirt, snow, ice, slush or water.
- B. When the outside ambient temperature drops below 41°F, the CONTRACTOR shall conduct field seaming in heated, portable shelters to minimize liner heat loss and to maintain dry, clean panel edges during seaming.
- C. In addition to the quality assurance sampling and testing specified in Section 06643, the CONTRACTOR shall provide and operate a portable pull test machine at the site during field seaming operations. The CONTRACTOR shall sample the liner seam and conduct pull tests during the seaming to insure that acceptable weld seams are being fabricated and to gauge the effectiveness of the cold weather construction methods. Field tested seams must achieve 100 percent of the strength of the base liner material. CONTRACTOR shall sample and perform pull tests a minimum of 4 times per shift and as ordered by the ENGINEER. CONTRACTOR shall adjust the seaming and construction methods to achieve acceptable field seams.
- D. CONTRACTOR shall place Geosynthetics and Cover Soil Materials over liner as soon as field seams have cured, been tested and accepted.
- E. No Geosynthetics and Cover Soil Materials shall be placed over ice, snow or frozen precipitation. CONTRACTOR will be responsible for ensuring that surfaces are clean and dry prior to placement.

END OF SECTION 06647