Exhibit B – Technical Specifications

Hartford Landfill Closure
MSW / Interim Ash Disposal Area
(RFQ Number 2007E005)

Connecticut Resources
Recovery Authority
Hartford, Connecticut

August 2007

Fuss & O Neill
146 Hartford Road
Manchester, CT 06040

EXHIBIT B
TECHNICAL SPECIFICATIONS
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DIVISION 1
GENERAL REQUIREMENTS

SECTION 01100 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. Project Identification: Project consists of construction related to closing of existing landfill in phased construction.

1. Project Location: Hartford, CT.

2. Owner: The property owner is the City of Hartford. However, for the purposes of this contract, the term "Owner" shall mean the Connecticut Resources Recovery Authority (CRRA).

B. Engineer Identification: The Contract Documents, dated May 2007, were prepared for Project by Fuss & O'Neill, Inc. 146 Hartford Road, Manchester, CT 06040.

C. The Work includes: mobilization, temporary and permanent erosion and sedimentation control measures; clearing of vegetation; a geomembrane and soil cap system; landfill drainage system and components; gas vents extensions; earthwork; vegetative support layer; phase limit markers; landfill limit markers; bituminous concrete and gravel access drives; and miscellaneous site work.

D. The Contractor shall follow the requirements of the Quality Assurance Plan (QAP), which is appended to these specifications.

E. The Contractor shall sign the General Permit Registration Form for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities, sign the certification statement located in the Stormwater Pollution Control Plan, and shall be required to implement action items identified in the Stormwater Pollution Control Plan, which is appended to these specifications.

1.3 CONTRACT

A. Project will be constructed under a general construction contract.

1.4 USE OF PREMISES

A. General: Contractor shall have full use of premises for construction operations, including use of Project site, during construction period.

1. During Phase I construction

a. The Contractor shall have access to the entire landfill but will be required to limit operations within the Phase II area.

b. Owner reserves the right to limit the Contractor's use of the Phase II area

B. Field Office: Locate field offices for Contractor use as shown on the Drawings.

1.5 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Format: The Specifications are organized into Divisions and Sections using the 16-division format and CSI/CSC's "MasterFormat" numbering system.

1. Section Identification: The Specifications use section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of sections in the Contract Documents.

B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.

2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.

a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

1.6 CALL BEFORE YOU DIG

A. The Contractor shall be responsible for complying with all applicable Call Before You Dig Rules.

B. Contact Call Before You Dig at 1-800-922-4455 at least 2 working days prior to the start of construction (excluding weekends and holidays), to mark out the utility locations.

1.7 ACCESS TO SITE

A. Minimize damage to access routes, and restore damaged areas to their original condition or better.

B. Acquire necessary permits, authorizations and approvals for working in, on or from property, rights-of-way or easements owned by others. The Contractor shall secure access rights of his own for such work.

C. Remove and restore to original condition walls, fences, structures, utility lines, poles, guy wires, anchors, and other improvements required to be relocated for construction of the Work. Costs for such activity shall be borne by the Contractor unless otherwise indicated. Notify the Engineer, Owner, and Utility company of intended modification or disruption to their property prior to the start of construction and cooperate with them in the scheduling and performance of operations.

D. If the Contractor, by direct negotiation and bargain with any land owner, lessee or tenant, has secured any right to use more space or greater privileges in the space provided by the Owner for purposes incidental to the performance of the Contract, upon request of the Engineer, furnish to the Engineer proper evidence that such additional rights have been properly secured and assurance that no damage to or claim upon the Owner or Engineer will arise therefrom. Neither the Owner nor the Engineer shall be liable in any way for any expense incurred by the Contractor in securing any such right to use additional property.

E. The Contractor shall be responsible for and reimburse the Owner and others for any and all losses, damage or expense which the Owner or those others may suffer, either directly or indirectly or through any claims of any person or party, for any trespass outside the spaces and rights of way provided by the Owner to the Contractor or any violation or disregard of the terms and conditions established for the use or occupancy of those rights or for negligence in the exercise of those rights. The Owner may retain or deduct from any sum or sums due or to become due to the Contractor such amount or amounts as may be proper to insure the Owner against loss or expense by reason of the failure of the Contractor to observe the limits and conditions of the rights-of-way, rights-of-access, easements, etc., provided by the Owner.

1.8 SCHEDULE OF CONSTRUCTION

A. Submit construction schedule to the Engineer at the earliest possible time but no later than 10 Days prior to beginning the Work.

1. Incorporate erosion control provisions into construction schedule.

1.9 SITE CONDITIONS

A. The Work is to be performed at a municipal solid waste landfill. Landfill gases, including methane, may be present in potentially combustible concentrations. Leachate may be generated by the landfill during the course of the Work.

1. Take necessary precautions to protect and ensure the health and safety of employees, agents, subcontractors, suppliers, including employees of the Owner and Engineer during the performance of the Work.

2. Prohibit the use of open flames, sparks, smoking or other activity which may ignite methane gas at the site.

B. The underground utilities and structures at the site have been located primarily from information furnished by others and the locations as depicted on the Drawings are considered approximate as to size and location. There may be additional underground utilities and structures that are not shown on the Drawings. Locate all existing utilities and structures and protect same from damage or harm. Restore utilities interfered with or damaged, at the expense of the Contractor, and to the satisfaction of its Owner.

C. Ensure that construction activities do not impact the activities or properties of the Owner and its agents without prior coordination and consent of these entities.

D. Immediately notify the Engineer upon encountering archaeological material, including "charcoal," "bone," "shell," "cultural objects" (e.g., fire cracked stones/stone flaking material), "middens," or any other artifacts or related items of historical significance.

PART 2 - PRODUCTS

2.1 Field Office

A. A.Common-Use Field Office: Provide an insulated, weathertight, air-conditioned field office for use as a common facility by all personnel engaged in construction activities; of sufficient size to accommodate required office personnel and meetings of 10 persons at Project site. Keep office clean and orderly.

1. Provide designated work space for the Owner's Quality Assurance Consultant

2. Furnish and equip offices as follows:

a. Revise subparagraph below by adding items of furniture as needed.

b. Desks and chairs, four-drawer file cabinet and bookcase.

c. Retain subparagraph below for large projects with long construction periods.

d. Water cooler.

3. Provide a room of not less than 240 sq. ft. for Project meetings. Furnish room with conference table, 12 folding chairs, and 4-foot square tack board.

4. Provide utility services in the field office at no additional cost to the Owner as follows:

a. Revise subparagraph below by adding items of furniture as needed.

b. Electricity

c. Telephone voice service

d. Telephone facsimile service (dedicated line)

e. High speed internet

5. Provide an electric heater with thermostat capable of maintaining a uniform indoor temperature of 68 deg F. Provide an air-conditioning unit capable of maintaining an indoor temperature of 72 deg F.

6. Provide overhead fluorescent light fixtures.

7. Provide 110- to 120-V duplex outlets spaced at not more than 12-foot intervals, 1 per wall in each room.

2.2 Sanitary Facilities

A. Self-Contained Toilet Units: Single-occupant units of chemical, aerated recirculation, or combustion type; vented; fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.

1. Install in close proximity to work area.

2. Service and replenish supplies weekly.

PART 3 - EXECUTION

3.1 GENERAL

A. The following is a general recommended sequence of construction operations. Submit a detailed construction schedule to the Engineer prior to the initiation of Work. Deviation from Contractor's schedule will require the Contractor to submit notification of such change in schedule to the Engineer.

1. Obtain required permits, authorizations and approvals from Federal, State and local authorities, as well as private entities including the Owner, having jurisdiction over the Project. Make required notifications to regulatory authorities. Provide copies of such permits, authorizations, approvals and notifications to the Engineer.

2. Mobilize to project Site.

3. Install erosion controls and other temporary protective measures to ensure the safety of persons on the site and to mitigate injury to environmental receptors.

4. Construct landfill cap system

5. Perform surface restoration in disturbed areas.

6. Demobilize from project Site.

3.2 PROTECTION

A. Assume full responsibility for the protection of public or private buildings, structures and utilities in the streets, gas pipes, water pipes, hydrants, sewers, drains and electric and telephone cables, whether or not they are shown on the Drawings. Carefully support and protect structures and utilities from damage of every description. Repair or otherwise make good such damage, as acceptable to the Engineer, and at no additional cost to the Owner.

B. Open Excavation. Provide temporary barricades, caution signs, lights and other means to prevent accidents to persons and damage to property. Provide bridges and other crossings for accommodating travel by pedestrians and workmen.

1. The length or size of open excavation will be controlled by the particular surrounding conditions, but shall always be confined to the limits prescribed by the Engineer.

3.3 SAFETY

A. Comply with requirements of the most recent version of the Occupational Safety and Health Act (OSHA.)

B. When any support system is used that requires design by an engineer, copies of the design stamped by an engineer shall be submitted to the OWNER.

C. The Contractor has full responsibility to comply with all provisions of State of Connecticut Public General Statutes, Title 31, Chapter 571 concerning Occupational Safety and Health. Any fines levied against for violations shall be the Contractor's responsibility.

END OF SECTION

SECTION 01205 – PAYMENT ITEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes measurement and payment paragraphs for

1. Base Bid payment items (lump sum and unit price).
2. Alternate payment items.

B. Related Sections include the following:

1. Division 1 through 16 Sections for detailed procedural, material, and installation requirements associated with the Work of each payment item.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that is proposed in lieu of the corresponding Base Bid item, if Owner decides to accept the alternate.

1. The cost for each alternate is the net total to incorporate all aspects of the alternate into the Work. It replaces not supplements the corresponding Base Bid item. No other adjustments are made to the Contract Price.

a. Example: If the owner chooses to use aboveground electrical wiring, the complete cost for Alternate Item No. 7A Aboveground Electrical Distribution will replace the complete cost of Payment Item No. 7 Underground Electrical Distribution.

B. Approximate Quantities: Engineer's Opinion of Quantities for Contract Lump Sum payment items provided for Contractor's information only. No guarantees are made as to the quantities of the listed elements.

1. No changes to the Contract Price will be made due to differences between the listed approximate quantities and actual quantities required to complete the Work.

C. Base Bid: The offer or proposal of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed

D. Payment Item: The Owner's distribution of the Contract Sum through listed work items.

1. Each item is specified to include a defined scope of services. However, not all materials, labor, equipment, or services of a payment item are guaranteed to be listed or specified.
2. Include costs associated with items of work required to complete the defined scope of services within the appropriately specified payment item.
3. Payment items include all necessary material, plus cost for delivery, installation, applicable taxes, overhead, and profit.
4. Include all necessary material, plus cost for delivery, installation, applicable taxes, overhead, and profit.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 LIST OF PAYMENT ITEMS

A. Payment Item No. 1 – Mobilization/Demobilization and Incidental Construction:
   1. The Work of this item shall be measured by the Contract lump sum price.
   2. Work associated with this item will be paid for at the Contract Lump Sum price for site mobilization and demobilization, insurance, bonds, administrative and general requirements, and incidentals not covered by other bid items required to complete the work including materials, equipment, tools and labor incidental to the Work.

B. Payment Item No. 2 – Field Services:
   1. The Work of this item shall be measured by the Contract lump sum price.
   2. Work associated with this item will be paid for at the Contract Lump Sum price for field office and field survey and incidentals required to complete the work including materials, equipment, tools and labor incidental to the Work.

C. Payment Item No. 3 – Temporary Erosion Control:
   1. The Work of this item shall be measured by the Contract lump sum price.
   2. Work associated with this item will be paid for at the Contract Lump Sum price for silt fence, haybales, alternative filtration barrier, construction entrance pad, catch basin inserts, temporary sediment traps, polyacrylimide erosion control blocks, dust control, and incidentals required to complete the work including materials, equipment, tools and labor incidental to the Work.
      a. Related Section includes Division 1 Section "Temporary Erosion and Sedimentation Control."
      b. Approximate Quantities
         1) Silt Fence: 8,400 LF

2) Hay Bales: 100 LF

3) Catch Basin Inserts: 20 EA

D. Payment Item No. 4 – Temporary Diversions:

1. The Work of this item shall be measured by the Contract lump sum price.

2. Work associated with this item will be paid for at the Contract Lump Sum price for sand bag/earth fill diversion, silt fence diversion, pipe slope drain with riprap apron, and incidentals required to complete the work including materials, equipment, tools and labor incidental to the Work.

a. Related Section includes Division 1 Section "Temporary Erosion and Sedimentation Control."

E. Payment Item No. 5 – Site Preparation:

1. The Work of this item shall be measured by the Contract lump sum price.

2. Work associated with this item will be paid for at the Contract Lump Sum price for removal of existing diversion berms and downchutes, stripping and stockpiling of existing vegetative support material at the designated location, rough grading of site with on-site material, relocating existing chain link fence, raising catch basin frames and grates, and incidentals required to complete the work including materials, equipment, tools and labor incidental to the Work.

a. Related Sections include Division 2 Section "Landfill Earthwork."

b. Approximate Quantities

1) Rough Grading with On-Site Materials: 5,000 CY

2) Relocate Chain Link Fence: 150 LF

3) Existing Vegetative Support Material: 19,000 SY at an approximate depth of 6 inches.

F. Payment Item No. 6 – Relocate Leachate Force Main:

1. The Work of this item shall be measured by the Contract lump sum price.

2. Work associated with this item will be paid for at the Contract Lump Sum price for relocation of existing leachate force main including pavement saw cutting, excavation, piping, backfill, bituminous concrete restoration, and incidentals required to complete the work including materials, equipment, tools and labor incidental to the Work.

a. Related Section includes Division 2 Section "Leachate Drainage."

b. Approximate Quantities

1) Relocate Leachate Force Main: 3,300 LF

G. Payment Item No. 7 - Underground Electrical Distribution:

1. The Work of this item shall be measured by the Contract lump sum price.

2. Work associated with this item will be paid for at the Contract Lump Sum price for construction of a new underground electrical distribution including variable frequency controllers, pavement saw cutting, excavation, conduit, backfill, bituminous concrete restoration, and incidentals required to complete the work including materials, equipment, tools and labor incidental to the Work.

   a. Related Sections include Division 16 Sections.

   b. Approximate Quantities

      1) Underground Electrical Distribution Distance: 4,200 LF.

H. Payment Item No. 8 – Subgrade Preparation:

1. The Work of this item shall be measured by the Contract lump sum price.

2. Work associated with this item will be paid for at the Contract Lump Sum price for subgrade preparation, grading, and incidentals required to complete the work including materials, equipment, tools and labor incidental to the Work.

   a. Related Sections include Division 2 Section "Landfill Earthwork."

   b. Approximate Quantities

      1) Subgrade Preparation: 221,000 SY.

I. Payment Item No. 9 – 6" Cap Base Material:

1. The Work of this item shall be measured by the Contract lump sum price.

2. Work associated with this item will be paid for at the Contract Lump Sum price for 6" (installed thickness) Cap Base Material including installation, compaction, material thickness testing, and incidentals required to complete the work including materials, equipment, tools and labor incidental to the Work.

   a. Related Sections include Division 2 Section "Landfill Earthwork."

   b. Approximate Quantities

      1) 6" Cap Base Material: 214,000 SY.

J. Payment Item No. 10 – 40 Mil LLDPE Geomembrane Liner:

1. The Work of this item shall be measured by the Contract lump sum price.

2. Work associated with this item will be paid for at the Contract Lump Sum price for 40 Mil LLDPE Geomembrane Liner including seaming, testing, and incidentals required to complete the work including materials, equipment, tools and labor incidental to the Work.

   a. Related Sections include Division 2 Section "LLDPE Geomembrane Liner."

   b. Approximate Quantities

1) 40 Mil LLDPE Geomembrane Liner: 1,924,000 SF.

K. Payment Item No. 11 – Penetration Sealing and Booting:

1. The Work of this item shall be measured by the Contract lump sum price.

2. Work associated with this item will be paid for at the Contract Lump Sum price for geomembrane penetration sealing and booting for existing gas wells and markers, including materials, equipment, tools and labor incidental to the Work.

a. Related Sections include Division 2 Section "LLDPE Geomembrane Liner."

b. Approximate Quantities

1) Penetration Sealing and Booting: 152 EA.

L. Payment Item No. 12 – Cap Drainage Layer:

1. The Work of this item shall be measured by the Contract lump sum price.

2. Work associated with this item will be paid for at the Contract Lump Sum price for Cap Drainage Layer including geonet, sand drainage material, and incidentals required to complete the work including materials, equipment, tools and labor incidental to the Work.

a. Related Sections include Division 2 Section "Landfill Earthwork."

b. Approximate Quantities for Side Slopes and Top Slope

1) Geonet: 1,924,000 SF.

2) Sand Drainage Material: 214,000 SY.

c. The non-woven geotextile placed between drainage sand and vegetative support material is included under Payment Item No. 13.

M. Payment Item No. 13 – Non-Woven Geotextile:

1. The Work of this item shall be measured by the Contract lump sum price.

2. Work associated with this item will be paid for at the Contract Lump Sum price for Non-Woven Geotextile including incidentals required to complete the work including materials, equipment, tools and labor incidental to the Work.

a. Related Sections include Division 2 Section "Landfill Earthwork."

b. Approximate Quantities for Side Slopes and Top Slope

1) Geotextile: 1,924,000 SF.

N. Payment Item No. 14 – Vegetative Support Material:

1. The Work of this item shall be measured by the Contract lump sum price.

2. Work associated with this item will be paid for at the Contract Lump Sum price for Vegetative Support Material. Material shall be a combination of borrow material obtained by the Contractor, and on-site material previously stockpiled by the

Contractor under Payment Item No. 5. The Work associated with this item shall also include ~~obtained off-site including~~ soil amendments, hauling, spreading, and incidentals required to complete the work including materials, equipment, tools and labor incidental to the Work.

a. Related Sections include Division 2 Section "Landfill Vegetative Support Layer."

b. Approximate Quantities

1) Vegetative Support Material: 208,000 SY. (Approximately 189,000 SY of borrow material, and 19,000 SY of on-site material stockpiled under Payment Item No. 5.)

c. Seeding, maintenance and temporary irrigation system is included under Payment Item No. 15.

O. Payment Item No. 15– Establish and Maintain Vegetation:

1. The Work of this item shall be measured by the Contract lump sum price.

2. Work associated with this item will be paid for at the Contract Lump Sum price for Establish and Maintain Vegetation including seeding, maintenance, temporary irrigation system, and incidentals required to complete the work including materials, equipment, tools and labor incidental to the Work.

a. Related Sections include Division 2 Section "Landfill Vegetative Support Layer."

b. Approximate Quantities

1) Seed and Hay: 208,000 SY

P. Payment Item No. 16 – Erosion Control Blanket:

1. The Work of this item shall be measured by the Contract lump sum price.

2. Work associated with this item will be paid for at the Contract Lump Sum price for temporary erosion control blankets and incidental items required to complete the work including materials, equipment, tools and labor incidental to the Work.

a. Related Section includes Division 1 Section "Temporary Erosion and Sedimentation Control."

b. Approximate Quantities

1) Temporary Erosion Control Blankets: 78,000 SY

Q. Payment Item No. 17 – Erosion Control Matting:

1. The Work of this item shall be measured by the Contract lump sum price.

2. Work associated with this item will be paid for at the Contract Lump Sum price for permanent erosion control matting and incidental items required to complete the work including materials, equipment, tools and labor incidental to the Work.

a. Related Section includes Division 2 Section "Permanent Erosion and Sedimentation Control."

b. Approximate Quantities

1) Erosion Control Matting: 53,000 SY

R. Payment Item No. 18 – Type "A" Cap Anchor:

1. The Work of this item shall be measured by the Contract lump sum price.

2. Work associated with this item will be paid for at the Contract Lump Sum price for Type "A" Cap Anchor which includes modified riprap, gravel base, geonet, geomembrane, cap base material, anchor trench, welding, testing and incidental items required to complete the work including materials, equipment, tools and labor incidental to the Work.

a. Related Sections include

1) Division 2 Section "Landfill Earthwork"

2) Division 2 Section "LLDPE Geomembrane Liner"

3) Division 2 Section "Permanent Erosion and Sedimentation Control"

b. Approximate Quantities

1) Type "A" Cap Anchor: 1,800 LF

S. Payment Item No. 19 – Type "B" Cap Anchor:

1. The Work of this item shall be measured by the Contract lump sum price.

2. Work associated with this item will be paid for at the Contract Lump Sum price for Type "B" Cap Anchor which includes modified riprap, non-woven geotextile, geonet, anchor trench, welding, testing and incidental items required to complete the work including materials, equipment, tools and labor incidental to the Work.

a. Related Sections include

1) Division 2 Section "Landfill Earthwork"

2) Division 2 Section "LLDPE Geomembrane Liner"

3) Division 2 Section "Permanent Erosion and Sedimentation Control"

b. Approximate Quantities

1) Type "B" Cap Anchor: 2,000 LF

T. Payment Item No. 20 – Type "C" Cap Anchor:

1. The Work of this item shall be measured by the Contract lump sum price.

2. Work associated with this item will be paid for at the Contract Lump Sum price for Type "C" Cap Anchor which includes cap base material, geomembrane, geonet, sand drainage material, anchor trench, welding, testing and incidental items required to

complete the work including materials, equipment, tools and labor incidental to the Work.

a. Related Sections include

1) Division 2 Section "Landfill Earthwork"

2) Division 2 Section "LLDPE Geomembrane Liner"

3) Division 2 Section "Permanent Erosion and Sedimentation Control"

b. Approximate Quantities

1) Type "C" Cap Anchor: 400 LF

U. Payment Item No. 21 – Type "D" Cap Anchor:

1. The Work of this item shall be measured by the Contract lump sum price.

2. Work associated with this item will be paid for at the Contract Lump Sum price for Type "D" Cap Anchor which includes geomembrane, geonet, anchor trench, welding, testing and incidental items required to complete the work including materials, equipment, tools and labor incidental to the Work.

a. Related Sections include

1) Division 2 Section "Landfill Earthwork"

2) Division 2 Section "LLDPE Geomembrane Liner"

3) Division 2 Section "Permanent Erosion and Sedimentation Control"

b. Approximate Quantities

1) Type "D" Cap Anchor: 2,850 LF

V. Payment Item No. 22 – Phase 1A/1B Connection:

1. The Work of this item shall be measured by the Contract lump sum price.

2. Work associated with this item will be paid for at the Contract Lump Sum price for Phase 1A/1B Connection which includes geomembrane, geonet, anchor trench, welding, testing and incidental items required to complete the work including materials, equipment, tools and labor incidental to the Work.

a. Related Sections include

1) Division 2 Section "Landfill Earthwork"

2) Division 2 Section "LLDPE Geomembrane Liner"

3) Division 2 Section "Permanent Erosion and Sedimentation Control"

b. Approximate Quantities

1) Phase 1A/1B Connection: 1,500 LF

W. Payment Item No. 23 – Connection to Existing Ash Liner:

1. The Work of this item shall be measured by the Contract lump sum price.

2. Work associated with this item will be paid for at the Contract Lump Sum price for Connection to Existing Ash Liner which includes geomembrane, geonet, anchor trench, welding, testing and incidental items required to complete the work including materials, equipment, tools and labor incidental to the Work.

    a. Related Sections include

        1) Division 2 Section "Landfill Earthwork"

        2) Division 2 Section "LLDPE Geomembrane Liner"

        3) Division 2 Section "Permanent Erosion and Sedimentation Control"

    b. Approximate Quantities

        1) Connection to Existing Ash Liner : 500 LF

X. Payment Item No. 24 – Half Pipe Diversion Swale:

1. The Work of this item shall be measured by the Contract lump sum price.

2. Work associated with this item will be paid for at the Contract Lump Sum price for Half Pipe Diversion Swale which includes factory-fabricated steel pipe, joints, elbows, connectors, aluminum flashing, geonet, geomembrane, general fill, Trex anchor board, underdrain, and incidental items required to complete the work including materials, equipment, tools and labor incidental to the Work.

    a. Related Sections include

        1) Division 2 Section "Landfill Earthwork"

        2) Division 2 Section "Storm Drainage"

    b. Approximate Quantities

        1) Half Pipe Diversion Swale : 6,400 LF

Y. Payment Item No. 25 – Grouted Riprap Downchute:

1. The Work of this item shall be measured by the Contract lump sum price.

2. Work associated with this item will be paid for at the Contract Lump Sum price for Grouted Riprap Downchute which includes modified riprap, grout, and incidental items required to complete the work including materials, equipment, tools and labor incidental to the Work.

    a. Related Sections include

        1) Division 2 Section "Permanent Erosion and Sedimentation Control"

    b. Approximate Quantities

        1) Grouted Riprap Downchute : 1,625 LF

Z. Payment Item No. 26 – Impact Basins:

1. The Work of this item shall be measured by the Contract lump sum price.

2. Work associated with this item will be paid for at the Contract Lump Sum price for Impact Basins which includes cast-in-place concrete, reinforcing steel, backfill, and incidental items required to complete the work including materials, equipment, tools and labor incidental to the Work.

    a. Related Sections include

        1) Division 3 Section "Cast-in-Place Concrete"

    b. Approximate Quantities

        1) Impact Basins: 6 EA

AA. Payment Item No. 27 – Riprap Lined Ditch:

1. The Work of this item shall be measured by the Contract lump sum price.

2. Work associated with this item will be paid for at the Contract Lump Sum price for Riprap Lined Ditch which includes modified riprap, gravel base, geonet, geomembrane, and incidental items required to complete the work including materials, equipment, tools and labor incidental to the Work.

    a. Related Sections include

        1) Division 2 Section "Permanent Erosion and Sedimentation Control"

    b. Approximate Quantities

        1) Riprap Lined Ditch: 860 LF

BB. Payment Item No. 28 – Landfill Markers:

1. The Work of this item shall be measured by the Contract lump sum price.

2. Work associated with this item will be paid for at the Contract Lump Sum price for Landfill Markers which includes landfill limit and phase limit signs, posts, and incidental items required to complete the work including materials, equipment, tools and labor incidental to the Work.

    a. Related Sections include

        1) Division 2 Section "Landfill Limit Marker"

    b. Approximate Quantities

        1) Landfill Limit Markers: 23 EA

        2) Phase Limit Markers: 27 EA

CC. Payment Item No. 29 – Bituminous Concrete Access Roads:

1. The Work of this item shall be measured by the Contract lump sum price.

2. Work associated with this item will be paid for at the Contract Lump Sum price for Bituminous Concrete Access Roads which includes subbase, processed aggregate, bituminous concrete, and incidental items required to complete the work including materials, equipment, tools and labor incidental to the Work.

a. Related Sections include

1) Division 2 Section "Bituminous Concrete Paving"

b. Approximate Quantities

1) Bituminous Concrete Access Roads : 38,200 SF

DD. Payment Item No. 30 – Gravel Access Road:

1. The Work of this item shall be measured by the Contract lump sum price.

2. Work associated with this item will be paid for at the Contract Lump Sum price for Gravel Access Roads which includes Geogrid and traffic bound gravel surface, and incidental items required to complete the work including materials, equipment, tools and labor incidental to the Work.

a. Related Sections include

1) Division 2 Section "Gravel Surfacing"

b. Approximate Quantities

1) Gravel Access Roads : 29,600 SF

EE. Payment Item No. 31 – Traffic Protection:

1. The Work of this item shall be measured by the Contract lump sum price.

2. Work associated with this item will be paid for at the Contract Lump Sum price for Traffic Protection which includes relocating guide rail, new posts, precast concrete barriers, site signs, and incidental items required to complete the work including materials, equipment, tools and labor incidental to the Work.

a. Related Sections include

1) Division 2 Section "Metal Beam Guide Rail"

b. Approximate Quantities

1) Relocating Guiderail: 1,550 LF

2) New Posts: 250 EA

3) Precast Concrete Barriers: 240 LF

FF. Payment Item No. 32 – Off-Cap Drainage Improvements:

1. The Work of this item shall be measured by the Contract lump sum price.

2. Work associated with this item will be paid for at the Contract Lump Sum price for Off-Cap Drainage Improvements which includes reinforced concrete pipe, HDPE pipe, precast culvert ends, precast concrete pump chamber, riprap energy dissipator, catch basins, cleaning CT DOT drainage ditch, removing sediment from drainage ditch, and incidental items required to complete the work including materials, equipment, tools and labor incidental to the Work.

a. Related Sections include

1) Division 2 Section "Storm Drainage System"

b. Approximate Quantities

1) 30" Reinforced Concrete Pipe: 120 LF

2) 48" Reinforced Concrete Pipe: 10 LF

3) 18" HDPE Pipe: 310 LF

4) Cleaning CT DOT Drainage Ditch and relocating sediment: 1,150 LF

GG. Unit Price Payment Item No. 33 – Additional General Fill:

1. The Work of this item shall be measured by the cubic yard complete in place.

2. Work associated with this item will be paid for at the Contract Unit Price per cubic yard for Additional General Fill provided from off-site sources, placed and compacted as required to complete the landfill embankment. Costs associated with this item include general fill, compaction, testing, and incidental items required to complete the work including materials, equipment, tools and labor incidental to the Work.

a. Related Sections include

1) Division 2 Section "Landfill Earthwork"

HH. Unit Price Payment Item No. 34 – Additional Fill for Access Road:

1. The Work of this item shall be measured by the cubic yard complete in place.

2. Work associated with this item will be paid for at the Contract Unit Price per cubic yard for Additional Fill for Access Roads provided from off-site sources, placed and compacted as required to complete the roadway embankment. Costs associated with this item include fill, compaction, testing, and incidental items required to complete the work including materials, equipment, tools and labor incidental to the Work.

a. Related Sections include

1) Division 2 Section "Site Earthwork"

3.2 ALTERNATES

A. Alternates

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

2. Include as part of each alternate, coordination, modification and adjustment of materials, systems, and individual components incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

C. Alternate Item No. 7A – Aboveground Electrical Distribution:

1. The Work of this item shall be measured by the Contract lump sum price.

2. Work associated with this item will be paid for at the Contract Lump Sum price for construction of a new aboveground electrical distribution including incidentals required to complete the work including materials, equipment, tools and labor incidental to the Work.

a. Related Sections include applicable Division 16 Sections.

b. Approximate Quantities

1) Aboveground Electrical Distribution Distance: 4,200 LF.

D. Payment Item No. 9A – Owner –Supplied 6" Cap Base Material:

1. The Work of this item shall be measured by the Contract lump sum price.

2. Work associated with this item will be paid for at the Contract Lump Sum price for Owner-Supplied 6" Cap Base Material provided to the site. This item also includes Contractor's installation, compaction, material thickness testing, and incidentals required to complete the work including materials, equipment, tools and labor incidental to the Work.

a. Related Sections include Division 2 Section "Landfill Earthwork."

b. Approximate Quantities

1) 6" Cap Base Material: 214,000 SY.

~~D.~~E. Alternate Item No. 12A – Alternate Cap Drainage Layer:

1. The Work of this item shall be measured by the Contract lump sum price.

2. Work associated with this item will be paid for at the Contract Lump Sum price for Cap Drainage Layer including geotextile, sand drainage material, underdrain piping, perforated underdrain pipe with sock material, and incidentals required to complete the work including materials, equipment, tools and labor incidental to the Work.

a. Related Sections include Division 2 Section "Landfill Earthwork."

b. Approximate Quantities

1) Side Slopes

a) Geonet: 1,116,000 SF

b) Sand Drainage Material: 124,000 SY.

2) Top Slope

a) Non-woven Geotextile: 810,000 SF.

b) Sand Drainage Material: 90,000 SY.

c) 4" Perforated Pipe with Sock: 17,000 LF

d) 4" Solid Pipe: 2,500 LF

c. The non-woven geotextile placed between drainage sand and vegetative support material is included under Payment Item No. 13.

~~E.~~F. Alternate Item No. 14A – Owner-Supplied Vegetative Support Material:

1. The Work of this item shall be measured by the Contract lump sum price.
2. Work associated with this item will be paid for at the Contract Lump Sum price for Owner-Supplied Vegetative Support Material obtained on-site including soil amendments, hauling, spreading, and incidentals required to complete the work including materials, equipment, tools and labor incidental to the Work.
   a. Related Sections include Division 2 Section "Landfill Vegetative Support Layer."
   b. Approximate Quantities
      1) Vegetative Support Material: 208,000 SY. (Approximately 189,000 SY of borrow material, and 19,000 SY of on-site material stockpiled under Payment Item No. 5.)
   c. Seeding, maintenance and temporary irrigation system is included under Payment Item No. 15.

~~F.~~G. Alternate Item No. 25A – Articulating Block Downchute:

1. The Work of this item shall be measured by the Contract lump sum price.
2. Work associated with this item will be paid for at the Contract Lump Sum price for Articulating Block Downchute including geotextile underlayment and incidentals required to complete the work including materials, equipment, tools and labor incidental to the Work.
   a. Related Sections include Division 2 Section "Permanent Erosion and Sedimentation Control."
   b. Approximate Quantities
      1) Articulating Block Downchutes: 1,625 LF.

END OF SECTION

SECTION 01250 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

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

B. Related Sections include the following:

1. Division 1 Section "Product Requirements" for administrative procedures for handling requests for substitutions made after Contract award.

1.3 DEFINITIONS

A. Changes in the Work: May be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work.

1. Changes in the scope will be compensated according to the following:

a. Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;

b. Unit prices stated in the Contract Documents or subsequently agreed upon; or

c. Cost to be determined in a manner agreed upon by the parties and a mutually fixed or percentage fee.

B. Changes Order: A Change Order is a written instrument prepared by the Engineer and signed by the Owner, Contractor, and Engineer, stating their agreement upon all of the following:

1. change in the Work;

2. the amount of the adjustment, if any, in the Contract Sum; and

3. the extent of the adjustment, if any, in the Contract Time.

C. Construction Change Directive: A Construction Change Directive is a written order prepared by the Engineer and signed by the Owner and Engineer, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Price or Contract Time, or both.

1. A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

2. Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Engineer of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Price or Contract Time.

3. A Construction Change Directive signed by the Contractor indicates the agreement of the Contractor therewith, including adjustment in Contract Price and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

D. Minor Changes In The Work

1. The Engineer will have authority to order minor changes in the Work not involving adjustment in the Contract Price or extension of the Contract Time and not inconsistent with the intent of the Contract Documents. Such changes shall be effected by written order and shall be binding on the Owner and Contractor. The Contractor shall carry out such written orders promptly.

1.4 MINOR CHANGES IN THE WORK

A. Engineer will issue written supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Price or the Contract Time, AIA Document G710, "Architect's Supplemental Instructions."

1.5 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Engineer will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Price or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Proposal Requests issued by Engineer are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.

2. Within time specified in Proposal Request, submit a quotation estimating cost adjustments to the Contract Price and the Contract Time necessary to execute the change.

a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.

b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

c. Include costs of labor and supervision directly attributable to the change.

d. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

B. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change to Engineer.

1. Include a statement outlining 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 Price and the Contract Time.

2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.

3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

4. Include costs of labor and supervision directly attributable to the change.

5. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

6. Comply with requirements in Division 1 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.

C. Proposal Request Form: Use AIA Document G709 for Proposal Requests.

1.6 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Engineer may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Price or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

1.7 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Proposal Request, Engineer will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01290 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment. Also included in this Section is information regarding the following:

1. Schedule of Values
2. Retainage

B. Related Sections include the following:

1. Division 1 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.

1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
    a. Application for Payment forms with Continuation Sheets.
    b. Submittals Schedule.
    c. Contractor's Construction Schedule.
2. Submit the Schedule of Values to Owner at earliest possible date but no later than ten days before the date scheduled for submittal of initial Applications for Payment.

B. Format and Content: Use the Division 1 Section "Payment Items" as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Payment Item.

1. Identification: Include the following Project identification on the Schedule of Values:
    a. Project name and location.
    b. Name of Owner.
    c. Owner's project number.
    d. Contractor's name and address.
    e. Date of submittal.
2. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
    a. Related Specification Section or Division.
    b. Description of the Work.
    c. Name of subcontractor.
    d. Name of manufacturer or fabricator.
    e. Name of supplier.
    f. Change Orders (numbers) that affect value.
    g. Dollar value.
        1) Percentage of the Contract Price to nearest one-hundredth percent, adjusted to total 100 percent.
3. Provide a breakdown of the Contract Price in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Payment Items. Provide several line items for principal subcontract amounts, where appropriate.
4. Round amounts to nearest whole dollar; total shall equal the Contract Price.
5. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
    a. Differentiate between items stored on-site and items stored off-site. If specified, include evidence of insurance or bonded warehousing.
6. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit 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 Contractor's option.

8. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders result in a change in the Contract Price.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by Owner and Construction Manager and paid for by Owner. Applications for Payment shall indicate the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment

1. Retainage

a. Retainage of 5 percent of completed work and 50 percent of materials delivered but not installed will be withheld from Applications for Payment.

b. Retainage withheld from Applications for Payment may be reduced, at the Owner's discretion, to 2 percent of the Application for Payment upon Substantial Completion of each phase.

c. Outstanding retainage will be released as part of the Final Payment at the end of the one-year correction period.

2. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times: Progress payments shall be submitted to Owner by the 10TH of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.

C. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets as form for Applications for Payment.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Owner will return incomplete applications without action.

1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.

2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

E. Transmittal: Submit 3 signed and notarized original copies of each Application for Payment to Construction Manager by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

F. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of Values.
3. Contractor's Construction Schedule (preliminary if not final).
4. Schedule of unit prices.
5. Submittals Schedule (preliminary if not final).
6. List of Contractor's staff assignments.
7. List of Contractor's principal consultants.
8. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
9. Initial progress report.
10. Report of preconstruction conference.
11. Certificates of insurance and insurance policies.
12. Performance and payment bonds.
13. Data needed to acquire Owner's insurance.
14. Initial settlement survey and damage report if required.

G. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Price.
2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

H. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Price.
4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
6. AIA Document G707, "Consent of Surety to Final Payment."

7. Evidence that claims have been settled.
8. Final, liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01310 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. General project coordination procedures.
2. Administrative and supervisory personnel.
3. Project meetings.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 1 Section "Execution Requirements" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
2. Division 1 Section "Closeout Procedures" for coordinating Contract closeout.

1.3 COORDINATION

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

1. Schedule construction operations in 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 with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. If necessary, prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

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

1. Preparation of Contractor's Construction Schedule.
2. Preparation of the Schedule of Values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Project closeout activities.

1.4 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

A. General: In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.

1.5 PROJECT MEETINGS

A. General: Engineer will schedule and conduct meetings and conferences at Project site, unless otherwise indicated.

1. Attendees: Engineer will inform participants and others involved, and individuals whose presence is required, of date and time of each meeting.
2. Agenda: Engineer will prepare the meeting agenda and distribute the agenda to all invited attendees.
3. Minutes: Engineer will record significant discussions and agreements achieved, and distribute the meeting minutes to everyone concerned, including Owner, within 3 days of the meeting.

B. Preconstruction Conference: Engineer will schedule a preconstruction conference before start of construction, at a time convenient to Owner, Contractor, and Engineer, but no later than 15 days after execution of the Agreement. Conference will be held at Project site or another convenient location. Meeting will be conducted to review responsibilities and personnel assignments.

1. Attendees: Authorized representatives of Owner, Engineer, and their consultants; and Contractor and its superintendent; shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:
    a. Tentative construction schedule.
    b. Phasing.

c. Critical work sequencing.

d. Designation of responsible personnel.

e. Procedures for processing field decisions and Change Orders.

f. Procedures for processing Applications for Payment.

g. Submittal procedures.

h. Preparation of Record Documents.

i. Working hours.

j. Other topics of concern.

3. Execution of Owner-Contractor Agreement including executed bonds and insurance certificates may be completed immediately prior to pre-construction conference.

C. Progress Meetings: Engineer will conduct bi-weekly progress meetings, or more frequent meetings if needed, throughout the progress of Work.

1. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

b. Review present and future needs of each entity present, including the following:

1) Interface requirements.

2) Sequence of operations.

3) Status of submittals.

4) Deliveries.

5) Off-site fabrication.

6) Access.

7) Site utilization.

8) Temporary facilities and controls.

9) Work hours.

10) Hazards and risks.

11) Progress cleaning.

12) Quality and work standards.

13) Change Orders.

14) Documentation of information for payment requests.

2. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report.

   a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01330 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other miscellaneous submittals.

B. Related Sections include the following:

1. Division 1 Section "Payment Procedures" for submitting Applications for Payment.
2. Division 1 Section "Closeout Procedures" for submitting warranties and Project Record Documents.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information that requires Engineer's responsive action.

B. Informational Submittals: Written information that does not require Engineer's approval. Submittals may be rejected for not complying with requirements.

1.4 SUBMITTAL PROCEDURES

A. General: Electronic copies of CAD Drawings of the Contract Drawings will not be provided by Engineer for Contractor's use in preparing submittals.

B. Method of Transmitting Submittals: Electronic transmission of submittals, including a facsimile and e-mail process, will not be allowed.

C. Clarity: Provide neat, clean and legible printed materials that can be easily reproduced by normal photocopying or blueprinting process. Illegible submittals will be returned unreviewed.

D. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

    a. Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

E. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer's receipt of submittal.

1. Allow 15 days for initial review of each submittal. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.

F. Identification: Place a permanent label or title block on each submittal for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.

2. Provide a space approximately 4 by 5 inches on label or beside title block to record Contractor's review and approval markings and action taken by Engineer.

3. Include the following information on label for processing and recording action taken:

    a. Project name.

    b. Date.

    c. Name and address of Engineer, Contractor, and subcontractor.

    d. Name and address of supplier including name and telephone number of contact.

    e. Name of manufacturer including name and telephone number of contact.

    f. Unique identifier, including revision number.

    g. Number and title of appropriate Specification Section.

    h. Drawing number and detail references, as appropriate.

    i. Other necessary identification.

G. Deviations: Highlight, encircle, or otherwise identify deviations from the Contract Documents on submittals. Provide list or narrative of deviations on Submittal Transmittal form.

H. Additional Copies: Unless additional copies are required for final submittal, and unless Engineer observes noncompliance with provisions of the Contract Documents, initial submittal may serve as final submittal.

1. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Engineer.

I. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Engineer will return submittals, without review, received from sources other than Contractor.

1. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Engineer on previous submittals, and deviations from requirements of the Contract Documents, including minor variations and limitations. Include the same label information as the related submittal.

2. Include Contractor's certification stating that information submitted complies with requirements of the Contract Documents.

3. Transmittal Form: Use sample form at end of Section.

J. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

K. Use for Construction: Use only final submittals with mark indicating action taken by Engineer in connection with construction.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

A. General: Prepare and submit Action Submittals required by individual Specification Sections.

1. Number of Copies: Submit 5 copies of each submittal, unless otherwise indicated. Engineer will return 2 copies. Mark up and retain one returned copy as a Project Record Document.

a. Submit a preliminary single copy of each submittal where selection of options is required. Engineer will return submittal with options selected.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.

2. Mark each copy of each submittal to show which products and options are applicable.

3. Include the following information, as applicable:

a. Manufacturer's written recommendations.
b. Manufacturer's product specifications.
c. Manufacturer's installation instructions.
d. Manufacturer's catalog cuts.
e. Compliance with recognized trade association standards.

f. Compliance with recognized testing agency standards.
g. Application of testing agency labels and seals.
h. Notation of coordination requirements.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Include the following information, as applicable:

a. Dimensions.
b. Identification of products.
c. Fabrication and installation drawings.
d. Roughing-in and setting diagrams.
e. Schedules.
f. Compliance with specified standards.
g. Notation of coordination requirements.
h. Notation of dimensions established by field measurement.

2. 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 30 by 40 inches.

D. Samples: Prepare physical units of materials or products, including the following:

1. Comply with requirements in Division 1 Section "Quality Requirements" for mockups.

2. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from the same material to be used for the Work, cured and finished in manner specified, and physically identical with the product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.

b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

E. Product Schedule or List: Prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product.

F. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.

2. Number and title of related Specification Section(s) covered by subcontract.

3. Drawing number and detail references, as appropriate, covered by subcontract.

2.2 INFORMATIONAL SUBMITTALS

A. General: Prepare and submit Informational Submittals required by other Specification Sections.

1. Number of Copies: Submit two copies of each submittal, unless otherwise indicated. Engineer will not return copies.

2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.

3. Test and Inspection Reports: Comply with requirements in Division 1 Section "Quality Requirements."

B. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

C. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements and, where required, is authorized for this specific Project.

D. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements. Include evidence of manufacturing experience where required.

E. Material or Product Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements. Use attached sample Material Certificate, or provide certificate that includes the following information.

1. Project to which material is consigned.

2. Name of contractor receiving material.

3. Item number and description of material.

4. Quantity of material represented by the certificate.

5. Means of identifying consignment including label, marking, or lot number.

6. Date and method of shipment.
7. Signature of Supplier's authorized agent.
8. Notarization of certificate.

F. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.

G. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

H. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements.

I. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements.

J. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements in Division 1 Section "Closeout Procedures."

K. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

L. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:

1. Preparation of substrates.
2. Required substrate tolerances.
3. Sequence of installation or erection.
4. Required installation tolerances.
5. Required adjustments.
6. Recommendations for cleaning and protection.

M. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:

1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Review each submittal and check for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer.

B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents. See attached Submittal Transmittal for sample of statement.

3.2 ENGINEER'S ACTION

A. General: Engineer will not review submittals that do not bear Contractor's approval stamp and will return them without action.

B. Action Submittals: Engineer will review each submittal, make marks to indicate corrections or modifications required, and return it. Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:

1. Furnish as Submitted: Submittal appears to conform to Contract Documents and Contractor may proceed with ordering and installation.
2. Furnish as Noted: Same as "Furnish as Submitted" except that the Contractor must comply with modifications or notes added to the submittal by the Engineer.
3. Rejected: Submittal must be revised and resubmitted.

C. Informational Submittals: Engineer will review each submittal and will not return it, or will reject and return it if it does not comply with requirements. Engineer will forward each submittal to appropriate party.

D. Submittals not required by the Contract Documents will not be reviewed and may be discarded.

END OF SECTION

SUBMITTAL TRANSMITTAL Date: _____

To: Fuss & O'Neill, Inc.
146 Hartford Road
Manchester, CT 06040
ATTN:Mr. Craig Lapinski

From:

PROJECT: _____ SUBMITTAL NO.: _____
(List Section No., Article No., Paragraph)

_____
(Revision: 1st, 2nd, 3rd, etc.)

Transmitted herewith for review and comment are the following:

Cop-ies	Dwg. No.		Description

MANUFACTURER / SUPPLIER

Name: _____

Address: _____

Telephone No.: _____ Facsimile No.: _____

For Additional Information, Contact _____

E-mail Address: _____

I hereby certify that I have carefully examined the enclosed submittal and have determined and verified all field measurements, construction criteria, materials, catalog numbers and similar data, coordinated the submittal with other submissions and the work of other trades and contractors, and that to the best of my knowledge and belief, the enclosed submittal is in full compliance with the Contract Documents, except for the following deviations:

BY:
Signature: _____

Title: _____

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- - SAMPLE - - MATERIALS CERTIFICATE - - SAMPLE - -

(Submit on Manufacturer's letterhead)

Date: _____

WE HEREBY CERTIFY THAT _____

(Description, Kind of Material, Product Name, Model No.)

FURNISHED TO _____

(Name of Contractor) (Prime or Subcontractor)

FOR USE ON _____

(Project Name)

OWNER _____

(Project Owner)

IDENTIFIED BY: _____

(Label, Marking, Seal No., Consignment, or Waybill No.)

SHIPPED VIA: _____

(Method of Shipment, Car No., Truck No.)

SHIPPED ON: _____ DELIVERED ON: _____

MEETS THE REQUIREMENTS OF THE CONTRACT DOCUMENTS FOR THE SUBJECT PROJECT IN ALL RESPECTS. PROCESSING, PRODUCT TESTING AND INSPECTION CONTROL OF RAW MATERIALS ARE IN CONFORMANCE WITH APPLICABLE SPECIFICATIONS, DRAWINGS AND STANDARDS OF ARTICLES FURNISHED. ARTICLES FURNISHED COMPLY WITH THE FOLLOWING SPECIFICATIONS:

_____

_____

_____

_____

All records and documents pertinent to this certificate and not submitted herewith will be maintained available by the undersigned for a period of not less than 3 years from the date of this certificate.

_____

(Name of Manufacturer)

_____

(Authorized Representative's Signature)

_____

(Title)

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EQUIPMENT RECORD SHEET

- - SAMPLE - -

PROJECT: _____

_____

_____

SUBMITTAL NO.: _____
(list Section No., Article No., and Paragraph)

_____
(Revision: 1st, 2nd, 3rd, etc.)

EQUIPMENT MANUFACTURER

_____

_____

_____

_____

SERVICE REPRESENTATIVE

_____

_____

_____

_____

TYPE _____

MODEL NO. _____

SERIAL NO. _____

CAPACITY _____ at _____

Motor Mfr. _____

Motor Size _____

Volts _____ Amps _____

Phase _____ Cycles _____ RPS _____

SPECIAL NOTES AND REMARKS:

_____

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SECTION 01400 – QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

B. The Project Quality Assurance Plan, reviewed and approved by the Connecticut Department of Environmental Protection, applies to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for quality assurance and quality control.

1. Cost of testing services shall be borne by the Contractor unless specifically identified as being the responsibility of the Owner. Coordinate schedule and sample taking with testing agencies and inspections required by Owner.

2. Retain the University of Connecticut Soil Testing Laboratory to analyze vegetative support material for lime and fertilizer application rates.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Requirements for Contractor to provide quality-control services required by Engineer, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

C. Related Sections include the following:

1. Divisions 2 through 16 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and ensure that proposed construction complies with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that completed construction complies with requirements. Services do not include contract enforcement activities performed by Engineer.

C. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

1.4 DELEGATED DESIGN

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Engineer.

1.5 SUBMITTALS

A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

C. Schedule of Tests and Inspections: Prepare in tabular form.

D. Reports: Prepare and submit certified written reports.

1. Name and signature of laboratory inspector.

2. Recommendations on retesting and reinspecting.

E. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.6 QUALITY ASSURANCE

A. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

C. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance.

D. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

E. Testing Agency Qualifications: An agency with the experience and capability to conduct testing and inspecting indicated, as required by ASTM E 329, and that specializes in types of tests and inspections to be performed.

1.7 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of the types of testing and inspecting they are engaged to perform.

2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.

B. Contractor Responsibilities: Unless otherwise indicated, provide quality-control services specified and required by authorities having jurisdiction.

1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.

a. Contractor shall not employ the same entity engaged by Owner, unless agreed to in writing by Owner.

2. Notify testing agencies and Engineer at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.

3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.

4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.

5. Arrange for and conduct inspections required by State or local building, fire protection, safety, health, or environmental officials.

6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing.

D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that revised or replaced Work that failed to comply with requirements established by the Contract Documents.

E. Testing Agency Responsibilities: Cooperate with Engineer and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Engineer and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
3. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
4. Do not release, revoke, alter, or increase requirements of the Contract Documents or approve or accept any portion of the Work.
5. Do not perform any duties of Contractor.

F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections, at site or at source of products, including storage and curing of test samples.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field-curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Sections of these Specifications. Restore patched areas and extend restoration into adjoining areas in a manner that eliminates evidence of patching.

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

SECTION 01572 – TEMPORARY EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes furnishing, placing, and maintaining sedimentation control measures as shown on the Drawings, as directed by the Engineer, and where necessary to reduce sediment content of runoff. Measures include the following:

1. Silt fence.
2. Erosion control bales.
3. Alternative filtration barrier.
4. Construction entrance pad.
5. Catch basin inserts.
6. Sand bag diversion berm.
7. Pipe slope drain with riprap apron.
8. Temporary erosion control blankets.
9. Temporary Sediment Traps
10. Polyacrylimide Erosion Control Blocks.
11. Dust control.
12. Connecticut DOT Drainage Channel cleaning.

B. Related Sections include the following:

1. Division 2 Section "Earthwork."
2. Division 2 Section "Permanent Erosion and Sedimentation Control" for permanent erosion control measures including permanent turf reinforcement matting.

1.3 SUBMITTALS

A. Certificates of Compliance:

1. Silt fence.
2. Erosion control bales.
3. Alternative filtration barrier

4. Riprap.
5. Stone.
6. Catch basin inserts.
7. HDPE pipe.
8. Erosion control blanket.
9. Polyacrylimide Erosion Control Blocks
10. Calcium chloride.

B. Material Test Reports
1. Compost

1.4 QUALITY ASSURANCE

A. Where "Form 816" is referenced, it shall mean "State of Connecticut Department of Transportation Standard Specifications for Roads, Bridges and Incidental Construction, Form 816," and issued supplements.

B. Connecticut Guidelines for Soil Erosion and Sediment Control by the Connecticut Council on Soil and Water Conservation.

C. Compost Chemical Analysis Reports: Obtain one composite soil sample for each source of material. Analyze for pesticides (EPA Method 8081), chlorinated herbicides (EPA Method 8151), Total Petroleum Hydrocarbons (CTETPH method), Total RCRA 8 Metals (EPA Method 6010 / 7421 / 7470).

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver calcium chloride to site in manufacturers sealed bags.

PART 2 - PRODUCTS

2.1 SILT FENCE

A. Synthetic Filter Fabric: Woven geotextile, 36 inches maximum height, conforming to the following:

Properties	Requirement	Unit
Grab Tensile Strength (ASTM D4632):	124	Lbs
Grab Tensile Elongation (ASTM D4632):	15	Percent
Puncture Strength (ASTM D4833):	65	Lbs
Flow Rate (ASTM D4491):	20	Gal/Min/Sq. Ft.

Properties	Requirement	Unit
UV Resistance(at 500 hours) (Retained strength) (ASTM D4355):	80	Percent

B. Posts

1. Hardwood Stakes: 1-inch by 1-inch by 42-inch minimum.

C. Product and Manufacturer:

1. Harris Silt Fence by Amoco Fabrics and Filters.
2. Mutual MISF 1855 by Mutual Industries, Inc.
3. Or equal.

2.2 HAY BALES

A. Bales: Hay, weighing 40 to 120 pounds per bale.

B. Stakes: Wood, 1-inch by 1-inch by 36-inch minimum.

2.3 ALTERNATIVE FILTRATION BARRIERS

A. Compost: Clean natural material, weed free and derived from a well-decomposed source of organic matter, relatively free of inert or foreign man-made materials (less than 1 percent by dry weight) and reasonably free of refuse, physical contaminants, and material toxic to plant growth.

1. Moisture Content: ASTM D2216 and ASTM D2974, Method A.
   a. Less than 60 percent by total weight.
2. Particle Size: In accordance with TMECC 02.02-B

Square Mesh Sieve	Percent Passing By Weight
2 inch	99
3/8 inch	60

3. PH Content: 5.5 to 8.0 in accordance with TMECC 04.11-A.
4. Non-composted material will not be accepted.

B. Manufacturers:

1. Filtrexx SiltSoxx®
2. Rexius Ecoberm®
3. Approved equal

2.4 CONSTRUCTION ENTRANCE

A. Stone: Article M1.01 of Form 816, size No.3 or as indicated.

2.5 DRAINAGE STRUCTURE PROTECTION

A. Catch Basin Inserts: Woven polypropylene fabric, prefabricated to a cone-shape, with loops for lifting the insert with reinforcing steel during removal, and the following.

Properties	Requirement	Unit
Grab Tensile Strength (ASTM D4632):	300	Lbs
Grab Tensile Elongation (ASTM D4632):	20	Percent
Puncture Strength (ASTM D4833):	120	Lbs
Mullen Burst (ASTM D3786):	800	PSI
Trapezoid Tear (ASTM D4533):	120	Lbs
Flow Rate (ASTM D4491):	40	Gal/Min/Sq. Ft.
Permittivity (ASTM D4491)	0.55	Sec-1
UV Resistance(at 500 hours) (Retained strength) (ASTM D4355):	80	Percent
Apparent Opening Size (ASTM D4751):	#40	US Sieve

1. Manufacturer: ACF Environmental, 1801-A Willis Road, Richmond, VA 23237 (800-844-9223), or equal.
   a. Product: Silt Sack

B. Catch Basin Fabric: Geotextile filter fabric, meeting the requirements above, wrapped around non-standard size catch basin grates.

2.6 SAND BAG DIVERSION

A. Sandbags: Close-knit fabric to prevent transmission of sand fines through the fabric.

B. Sand: Approved, clean material or substitute.

2.7 TEMPORARY SLOPE DRAIN

A. Corrugated HDPE Drainage Tubing and Fittings NPS 4 to NPS 10: AASHTO M 252, Type S, with smooth waterway for coupling joints.

B. Riprap: Broken, irregular size and shape, graded stone conforming to Form 816, Section M.12.02, size as indicated.

2.8 EROSION CONTROL BLANKET

A. Blanket: Minimum width of 6 feet.

1. Mat: Machine-produced of 100 percent coconut fiber with colored line or thread along outer edges to indicate material overlap limits.

a. Weight: 0.50 lb./sq.yd.

b. Overlap: Approximately 2 to 5 inches.

2. Top and Bottom Cover: Heavy-weight polypropylene netting with ultraviolet additives to delay breakdown.

a. Mesh Size: 0.625-inch by 0.625 inch.

b. Weight: 3 lbs/1000 sq. ft.

B. Sew blanket and covers together on 1.5 inch center at 50 stitches per roll width with UV stable polypropylene thread.

C. Blanket: North American Green S150, Bon Terra S2, or approved equal.

D. Spray-Applied Bonded Fiber Mat Alternative: Hydrograss Technologies, Inc. GeoPerm™, or approved equal.

1. Refer to the "Maintenance" section under "Part 3 - Execution" for additional maintenance requirements associated with choosing this alternative.

2.9 TEMPORARY SEDIMENT TRAP

A. Core (Riprap): Broken, irregular size and shape, graded stone conforming to Form 816, Section M.12.02, size as indicated.

B. Face (Stone): Article M1.01 of Form 816, size No.3 or as indicated.

2.10 POLYACRYLIMIDE EROSION CONTROL BLOCKS

A. APS 700 Series Floc Log, or approved equal

B. Formulation as recommended by the manufacturer.

2.11 DUST CONTROL

A. Water: Potable.

B. Calcium Chloride: ASTM D98, Type 1 or Type 2.

PART 3 - EXECUTION

3.1 GENERAL

A. Minimize environmental damage during construction. Prevent discharge of fuel, oil, lubricants, and other fluids. Mitigate effects of discharge.

B. Install erosion and sediment control measures prior to clearing, demolition or construction.

C. Construct erosion and sediment control measures in accordance with standards and specifications of the Owner, state regulations and guidelines, and the following.

1. Provide additional sedimentation and erosion controls as required by the Engineer to address field conditions at no additional cost.

2. Do not discharge turbid water from dewatering to inland wetlands or watercourses.

3. Inspect site weekly and prior to any anticipated rain event. Ensure that erosion controls are properly maintained and functioning.

4. Supply a 24-hour contact name and telephone number as part of the erosion control plan.

D. Install additional control measures, if deemed necessary by the Owner, Engineer, and authorities having jurisdiction.

E. Protect catch basins with bale filters throughout construction until disturbed areas are stabilized.

1. Remove and dispose of sediment from control structures.

F. Control dust and wind erosion. Control dust to prevent a hazard to traffic on adjacent roadways. Dust control includes sprinkling of water or calcium chloride application.

G. Do not discharge directly into wetlands or watercourses where dewatering is necessary. Utilize methods and devices as permitted by authorities having jurisdiction and appropriate regulations to minimize and retain suspended solids including pumping water into a temporary sedimentation basin, providing surge protection at inlet and outlet of pumps, floating pump intake.

1. If pumping operation results in turbidity problems, stop pumping until means of controlling turbidity are determined and implemented.

H. Where control measures are required for longer than 60 days, use silt fence instead of hay bales.

I. Cut Areas

1. Establish an erosion control line (haybale check or filter fabric) at toe of slope in cut areas and slope stabilization with mulch or grass within 30 days of start of cut operations.

J. Fill Areas

1. Establish an erosion control line (woodchip berm or filter fabric) approximately 10 feet from toe of slope of proposed fill areas prior to beginning fill installation.
2. Initiate slope stabilization with mulch or grass within 30 days of start of fill installation.

K. Within 7 days of completing slope construction, stabilize slopes with vegetation or matting to minimize exposure.

L. Stockpiles

1. Side Slopes: 2:1 maximum.
2. Surround stockpiles by a sediment barrier.
3. Stabilize stockpiles left bare for more than 15 days with temporary vegetation or mulch.

M. Final Grading

1. If final grading is delayed for more than 30 days after land disturbances cease, stabilize soils with temporary vegetation or mulch.

N. Planting Season for Temporary Vegetation

1. March 1 to June 15 and August 1 to October 1.
2. After September 15, stabilize areas with haybale check, filter fabric, or woodchip mulch.

O. Areas to Be Left Bare Prior to Finished Grading and Seeding

1. Within Planting Seasons
   a. Temporarily seed with Perennial Ryegrass
   b. Apply at a rate of 2 pounds per 1000 sq. ft. at a depth of 1/2 inch.
   c. Where grass predominates, fertilize according to a soil test at a minimum application rate of one pound per acre.
2. Outside of Planting Seasons
   a. Apply air-dried wood chip mulch, free of coarse matter.
   b. Apply at a rate of 185 to 275 pounds per 1000 sq. ft.

3.2 CONTROL SYSTEMS

A. Prevent damage to geomembrane liner resulting from control system installation. Repair damaged geomembrane liner in accordance with manufacturer's requirements, at no additional cost to Owner.

B. Construct erosion and sediment control structures prior to site clearing and grubbing operations.

C. Silt Fence.

1. Install fencing at locations indicated or where directed by the Engineer. Maintain pitch of 2 to 20 degrees, with inclination toward potential silt source.
2. Install bottom 6 inches of fabric by trenching and burying the fabric into the notched ground.
3. Drive posts into ground a minimum of 12 inches. Additional care should be taken when installing posts above the geomembrane liner.
4. Locate fabric splices at posts only. Provide 6-inch overlap and seal.

D. Sedimentation Control Hay Bales.

1. Install bales at locations indicated or where directed by the Engineer. Place bales lengthwise with ends tight, abutting one another. Install bales with bindings located on the sides.
2. Entrench bales 4 inches and backfill. Place backfill toward potential silt source.
3. Secure in place with two stakes per bale and insert straw in voids between bales. Additional care should be taken when installing stakes above the geomembrane liner.

E. Alternative Filtration Barriers.

1. Install where conventional filtration barriers (i.e., silt fence or hay bales) are impractical or infeasible to install.
2. Installation shall be performed by a manufacturer approved installer.

F. Catch Basin Insert

1. Inspect after each major precipitation event. Inspect every two weeks if no major rain events have occurred.
2. Remove, clean, and reinstall silt sack when sediment accumulates to half capacity of sack.

G. Pipe Slope Drains and Aprons

1. Install, relocate, and maintain as required to allow work to progress.

H. Temporary Sediment Trap

1. Install were indicated or as directed by the engineer
2. Remove and reinstall as required to allow installation of geomembrane liner and final cover material below trap.

I. Polyacrylimide Erosion Control Blocks

1. Install at locations, and in quantities recommended by the manufacturer.
2. Replace as needed during the duration of the project.

J. Dust Control.

1. Apply water uniformly over the surface when dust becomes a nuisance and when directed by the Engineer.
    a. Apply water from trucks capable of uniform distribution over the surface. Provide suitable devices for positive shut-off and for regulating flow of water.
2. Apply calcium chloride at locations only when directed by Engineer at no additional cost to Owner. Spread calcium chloride by approved devices and methods for uniform distribution.
    a. Engineer shall determine application rate based upon site conditions.
3. Provide sweeping equipment with provisions for water application ahead of sweeping brooms to prevent dusting.

3.3 MAINTENANCE

A. Silt Fence and Bale Control Systems

1. Inspect control system immediately after each rainfall and daily during prolonged rainfall. Make repairs immediately.
2. Remove and dispose of accumulated sediments when sediment reaches approximately one-third the height of the control system, or when directed by the Engineer.
3. Replace control system promptly if fabric decomposes or system becomes ineffective prior to the expected usable life.
4. Maintain or replace system until no longer necessary for the intended purpose.

B. Construction Entrance Pad

1. Maintain in good condition throughout construction period. Clean or replace stone when pad has accumulated sediment.

C. Erosion Control Blanket

1. Repair damages portions of erosion control blanket until the area stabilizes with new growth or as directed by the Engineer.
2. Spray-Applied Bonded Fiber Mat Alternative: Reapply product to areas damaged by erosion until the area stabilizes with new growth or as directed by the Engineer.

D. Dust Control

1. Keep paved surfaces free of tracked sediment. Sweep adjacent paved areas throughout hauling operations, and at the end of each day's construction operation. Conduct sweeping at locations and times as directed by the Engineer at no additional cost.

E. Connecticut DOT Drainage Channel cleaning. Remove debris and sediment from drainage channel after upland areas have been stabilized. Stockpile excavated material on site at a location designated by the Engineer.

3.4 REMOVAL

A. Remove and dispose of control systems off-site after area stabilizes with new growth or as directed by the Engineer.

1. After removal of system, restore disturbed areas to original condition or better.

END OF SECTION

SECTION 01660 - PRODUCT STORAGE AND HANDLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following administrative and procedural requirements:

1. product delivery, storage, and handling;

B. Related Sections include the following:

1. Division 1 Section "Closeout Procedures" for submitting warranties for contract closeout.

1.3 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products upon delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
    a. Packages, materials, and equipment showing evidence of damage shall be rejected and replaced at no additional cost to the Owner.
5. Store products to allow for inspection and measurement of quantity or counting of units.
6. Store materials in a manner that will not endanger Project structure.
7. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.

8. Products Stored for Extended Periods of Time: Perform periodic inspections to assure products are maintained under required conditions and are undamaged.

9. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.

10. Protect stored products from damage.

11. Loose Granular Materials. Store on solid-surfaces in a well-drained area. Prevent materials from mixing with foreign matter or other granular materials.

B. Materials that have become so damaged as to be unfit for the use intended or specified, as determined by the Engineer, shall be promptly removed from the site. Replace such damaged materials at no additional cost to the Owner.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01700 - EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. General installation of products.
4. Progress cleaning.
5. Protection of installed construction.
6. Correction of the Work.

B. Related Sections include the following:

1. Division 1 Section "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.
2. Division 1 Section "Submittal Procedures" for submitting surveys.
3. Division 1 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.3 SUBMITTALS

A. Land Surveyor Qualifications.

B. As-Built Survey:

1. Draft Copy. Submit at Substantial Completion.
    a. Scale: 1" = 50'.
    b. Mapping Details. Include the following.
        1) Contours at 2-foot intervals.
        2) Drainage structure invert and outlet elevations.

3) Existing and constructed features, labeled, including access roads, monitoring wells, gas riser vents, limit of landfill cap, limit of riprap ditches, underdrains, and landfill limit markers.

2. Final Copy. Address Engineer's comments and resubmit within 30 days of receipt of Engineer's comments, and before request for Site Final Inspection.

a. Deliverables:

1) Original, certified, fixed-line mylar.

2) Three blackline copies.

3) Electronic copy of survey on CD in AutoCAD Version 2000 or Version 2005 format.

1.4 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

1. Experience: Minimum of two years in construction surveying layout and preparation of as-built surveys in accordance with the specified horizontal and vertical control requirements.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of site improvements and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of construction affecting the Work.

1. Before construction, verify the location and points of connection of utility services.

B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.

2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

a. Description of the Work.

b. List of detrimental conditions, including substrates.

c. List of unacceptable installation tolerances.

d. Recommended corrections.

2. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

C. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

D. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

E. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Engineer. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Engineer prior to proceeding with the Work.

B. General: Engage a land surveyor or professional engineer to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points in addition to those indicated to set lines and grades of construction and elsewhere as needed to locate each element of Project.
2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
3. Notify Engineer when deviations from required grades, lines, and levels exceed allowable tolerances.
4. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.

D. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Engineer.

3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Owner. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Engineer before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. Coordinates

1. Establish X, Y and Z coordinates for benchmarks and survey control points.
    a. Maximum Permissible Error: 0.10 feet, plus or minus in any coordinate direction.
2. X, Y Coordinates: Refer to coordinate system (NAD27).
3. Z Coordinates: Refer to nearest USGS benchmark.
    a. Accuracy: 0.10 feet, plus or minus (NGVD 29).

E. Certified Survey: On completion of the work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

1. Mapping details shall include, but not be limited to, two foot contour intervals, cap limits, and invert and outfall elevation of drainage structures. In addition, survey work should show locations of existing and constructed features such as access roads, monitoring wells, gas riser vents, riprap ditches, underdrains, toe drains and landfill limit markers.

3.5 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.7 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.8 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged areas.

B. Restore permanent facilities used during construction to their specified condition.

C. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

END OF SECTION

SECTION 01770 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Inspection procedures.
2. Project Record Documents.
3. Warranties.
4. Final cleaning.

B. Related Sections include the following:

1. Division 1 Section "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
2. Division 1 Section "Execution Requirements" for as-built survey and progress cleaning of Project site.
3. Divisions 2 through 16 Sections for specific closeout and special cleaning requirements for products of those Sections.

1.3 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.

1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
2. Advise Owner of pending insurance changeover requirements.
3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
5. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.

6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.

7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.

8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.

9. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

10. Complete final cleaning requirements, including touchup painting.

11. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Engineer, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

2. Results of completed inspection will form the basis of requirements for Final Completion.

1.4 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit a final Application for Payment according to Division 1 Section "Payment Procedures."

2. Submit certified copy of Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Engineer. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.

3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Preparation: Submit three copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Include the following information at the top of each page:

a. Project name.

b. Date.

c. Name of Engineer.

d. Name of Contractor.

e. Page number.

1.6 PROJECT RECORD DOCUMENTS

A. General: Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Engineer's reference during normal working hours.

B. Record Drawings: Maintain and submit one set of blue- or black-line white prints of Contract Drawings.

1. Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.

a. Give particular attention to information on concealed elements that cannot be readily identified and recorded later.

b. Accurately record information in an understandable drawing technique.

c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.

d. Mark Contract Drawings completely and accurately.

2. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.

3. Mark important additional information that was either shown schematically or omitted from original Drawings.

4. Note Work Change Directive numbers, Change Order numbers, alternate numbers, and similar identification where applicable.

5. Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location. Organize into manageable sets; bind each set with durable paper cover sheets. Include identification on cover sheets.

C. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications. Mark copy to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.

3. Note related Field Orders, Work Change Directives, and Change Orders where applicable.

D. Miscellaneous Record Submittals: Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference. Include the following:

1. Field Orders, Work Change Directives, Change Orders, and other modifications to the Contract.

2. Manufacturer's certificates.

3. Quality Control Reports

a. Field test reports and documentation.

b. Photographs.

c. Laboratory test records.

d. Daily inspection records.

e. Dated truck slips.

f. Samples.

g. Other items that may be required by the Owner.

E. Deliver one set of original Record Documents to Owner before Substantial Completion.

1. Acceptance of Record Documents by Owner is a condition for issuance of final payment.

1.7 WARRANTIES

A. Submittal Time: Submit written warranties on request of Engineer for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.

1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.

2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark 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 Installer.

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

C. Submit two signed copies of warranties, bonds, and service and maintenance contracts, executed by each of the respective manufacturers, suppliers, Installers, and subcontractors.

D. Warranty Types

1. Type A: Manufacturer's Standard Warranty. Must be written for specific project and signed by manufacturer.

2. Type B: General Contractor's Warranty. Must be written on Contractor's letterhead and signed by Contractor. Also signed by Installer or Subcontractor when designated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning:

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:

a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.

1) Remove material and debris from existing and constructed water courses, ditches, gutters, drains, pipes structures located within the Contract Limit. Dispose of

b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.

c. Remove tools, construction equipment, machinery, and surplus material from Project site.

d. Remove debris from limited access spaces, including roofs, equipment vaults, manholes, and similar spaces.

e. Sweep concrete floors broom clean in unoccupied spaces.

f. Remove labels that are not permanent.

g. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.

1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.

h. Leave Project clean and ready for occupancy.

C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION

DIVISION 2
SITE CONSTRUCTION

SECTION 02141 – LANDFILL EARTHWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Preparing landfill subgrade including general fill where required.
2. Cap base material.
3. Sand Drainage layer which includes the following:
    a. Geonet.
    b. Drainage Sand.
    c. Non-woven geotextile cover.
4. Disposal of unsuitable material.
5. Disposal of surplus suitable material, if required.
6. Stripping and stockpiling of existing vegetative support material. Vegetative support material was tested by the Owner in 1998; test results are available upon request.

B. Related Sections include the following:

1. Division 1 Section "Temporary Erosion and Sedimentation Control" for temporary site measures.
2. Division 2 Section "LLDPE Geomembrane Liner."
3. Division 2 Section "Landfill Vegetative Support Material" for landfill topsoil.
4. Division 2 Section "Site Earthwork" for miscellaneous earthwork materials and procedures for utility systems and locations beyond landfill limits.
5. Division 2 Section "Underdrains" for piped subdrainage systems.
6. Division 2 Section "Permanent Erosion and Sedimentation Control" for riprap at cap anchors.

1.3 DEFINITIONS

A. ASTM: American Society for Testing and Materials.

B. ETPH: Extractable Total Petroleum Hydrocarbons.

C. HDPE: High Density Polyethylene

D. LLDPE: Linear Low Density Polyethylene

E. RCRA: Resource Conservation Recovery Act.

1.4 SUBMITTALS

A. Product Data and Material Certifications: For the following:

1. General fill.
2. Cap Base material
3. Drainage Sand material.
4. Geonet.
5. Non-woven geotextile.

B. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance with requirements indicated. Prepare separate reports for each type and application of soil material.

1. Gradation according to ASTM D 422 and classification according to ASTM D 2487, prior to delivery and at a rate of one per 5,000 cu. yd.
2. Modified Proctor Testing according to ASTM D 1557.
    a. General Fill, Cap Base and Sand Drainage Layer: prior to delivery and at a rate of one per 5,000 cu. yd.
3. Origin of material, prior to delivery.
4. Permeability Testing according to ASTM D 5084:
    a. Cap Base and Sand Drainage Layer: One prior to delivery and one per 5,000 cu. yd. delivered.
5. Interface Friction Angle Testing according to ASTM D 5341(for interface surfaces described in Part 2):
    a. Cap Base and Sand Drainage Layer: One prior to delivery and one per 5,000 cu. yd. delivered.
    b. General Fill Material proposed for Diversion Swales: One prior to delivery and one per 5,000 cu. yd. delivered.
    c. All other General Fill: None.
    d. Geonet: One per proposed geomembrane liner type prior to delivery
6. Internal Friction Angle Testing according to ASTM D 3080:
    a. General Fill, Cap Base and Sand Drainage Layer: One prior to delivery and one per 5,000 cu. yd. delivered.

7. Soil Chemical Analysis Reports:

   a. General Fill, Cap Base and Sand Drainage Layer: RCRA 8 metals (according to EPA Method 6010 / 7421 / 7470) and ETPH (according to CTETPH): prior to delivery and one report for each 10,000 cu. yd., or portion thereof, delivered. Owner reserves the right to disqualify the source based on the results of the chemical testing.

C. Field Test Reports

1. Depth Test Hole Drawing: Identify installed layer, locate field test holes on plan, and record depth of tested layer. Submit before proceeding with subsequent layer installation.

1.5 QUALITY ASSURANCE

A. Where "Form 816" is referenced, it shall mean "State of Connecticut Department of Transportation Standard Specifications for Roads, Bridges and Incidental Construction, Form 816," and issued supplements.

B. Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct soil materials testing, as documented according to ASTM D 3740 and ASTM E 548.

1. Testing Agency performing tests involving geosynthetic materials shall also be accredited by the Geosynthetics Research Institute.

1.6 PROJECT CONDITIONS

A. Stage earthwork operations to minimize travel of vehicular traffic over the cap area.

1. Damage to the LLDPE geomembrane liner resulting from construction activities shall be repaired at the Contractor's expense.

2. No vehicular traffic shall be allowed to operate directly on the geomembrane liner.

3. Additionally, heavily-loaded construction vehicles such as loaded dump trucks and front-end loaders will not be allowed to travel over areas with installed geomembrane liner with less than 18 inches of cover.

PART 2 - PRODUCTS

2.1 GENERAL FILL

A. General Fill: Free from ice, snow, roots, sod, rubbish, and other deleterious or organic matter.

1. Use for general raises in landfill grade and waste cover.

2. Meet the following gradation:

U.S. Standard Sieve Size	Percent Finer By Weight
3-inch	100
No. 10	30-90
No. 40	10-70
No. 200	0-20

3. Minimum Interface Friction Angle: Between the non-woven geotextile and general fill material proposed for diversion swales shall be 29 degrees peak and 29 degrees residual. Test shall be performed with general fill compacted to a dry density equal to a range between 85 and 90 percent of the maximum density, at a moisture content 3 percent wet of optimum moisture, obtained in accordance with ASTM D 1557 and tested in accordance with ASTM D 5321 after soaking the prepared samples for a period of at least 24 hours to obtain uniform moisture content in the materials being tested. The specimens shall be sheared via the large scale direct shear method at a rate of 0.005 in/minute at 1 and 5 psi normal stresses.

4. Minimum Internal Friction Angle: When tested in accordance with ASTM D 3080. Test shall be performed with general fill compacted to a dry density equal to a range between 85 and 90 percent of the maximum density, at a moisture content 3 percent wet of optimum moisture, obtained in accordance with ASTM D 1557 after soaking the prepared samples for a period of at least 24 hours to obtain uniform moisture content in the materials being tested. The specimens shall be sheared via the large scale direct shear method with 1 and 5 psi normal stresses.

    a. Material proposed for Diversion Swale and Road Embankment fill: Minimum internal friction angle of 35 degrees.

    b. All other General Fill applications: Minimum internal friction angle of 29 degrees.

5. Minimum Compacted Wet Unit Weight: When compacted to 90 percent of maximum dry density at a moisture content of 3 percent wet of optimum, obtained in accordance with ASTM D 1557.

    a. Material proposed for Diversion Swale fill: Minimum of 130 pounds per cubic foot

    b. All other General Fill applications: Minimum of 110 pounds per cubic foot

2.2 CAP BASE

A. Cap Base Material. Naturally or artificially graded mixture of natural or crushed gravel free of sharp edges, and natural or crushed sand.

1. Use directly beneath landfill geomembrane liner.

2. Minimum Permeability: ASTM D 5084, 1.0 x 10^{-3} cm/sec when compacted at optimum to 3 percent of optimum moisture content, and 90 percent of maximum density in accordance with ASTM D 1557.

a. Test samples at effective confining pressure of 3 psi, under hydraulic gradients ranging from 5 to 20.

3. Minimum Interface Friction Angle: Between the cap base material and geomembrane liner. Test shall be performed with cap base material compacted to a dry density equal to a range between 85 and 90 percent of the maximum density, at a moisture content 3 percent wet of optimum moisture, obtained in accordance with ASTM D 1557 and tested in accordance with ASTM D 5321 after soaking the prepared samples for a period of at least 24 hours to obtain uniform moisture content in the materials being tested. The specimens shall be sheared via the large scale direct shear method at a rate of 0.005 in/minute at 1, 5 and 12 psi normal stresses.

a. Material proposed for slopes >10%: Minimum interface friction angle of 29 degrees peak and 29 degrees residual.

b. Material proposed for slopes ≤10%: Minimum interface friction angle of 18 degrees peak and 18 degrees residual.

4. Minimum Internal Friction Angle: Shall be 29 degrees when tested in accordance with ASTM D 3080. Test shall be performed with cap base material compacted to a dry density equal to a range between 85 and 90 percent of the maximum density, at a moisture content 3 percent wet of optimum moisture, obtained in accordance with ASTM D 1557 after soaking the prepared samples for a period of at least 24 hours to obtain uniform moisture content in the materials being tested. The specimens shall be sheared via the large scale direct shear method with 1, 5 and 12 psi normal stresses.

5. Minimum Compacted Wet Unit Weight: Shall be 110 pounds per cubic foot when compacted to 90 percent of maximum dry density at a moisture content of 3 percent wet of optimum, obtained in accordance with ASTM D 1557.

6. Meet the following gradation:

U.S. Standard Sieve Size	Percent Finer By Weight
1-inch	100
No. 10	30-90
No. 40	10-70
No. 200	0-10

2.3 DRAINAGE LAYER

A. Geonet (Bi-Planar or Tri-Planar): Drainage net with non-woven geotextile fabric bonded to each side.

1. Geonet: HDPE material.

Properties	Unit	Value	Test
Carbon Black Content	Percentage	2 to 3	ASTM D1603

Transmissivity	m^2/sec	$\geq 1.4 \times 10^{-3}$	GRI GC8
Polymer Specific Gravity		0.93	ASTM D1505
Polymer melt flow index	g/10 min	≤ 1.0	ASTM D1238
Thickness	millimeters	5.3	ASTM D5199

a. Perform transmissivity test with rigid platter or substratum and Ottowa Sand on super stratum. Test at gradient of 0.04 at a temperature of 68 degrees F and normal stress of 1,000 psf.

2. Non-Woven Geotextile:

Properties	Unit	Value	Test
Unit Weight per Area	oz./yd^2	6.0	N/A
Flow	gpm/sf	150	ASTM D4491
Grab Tensile	lbs.	120	ASTM D4632

3. Ties: Strings, plastic fasteners, or polymer braid used to secure adjacent sheets of drainage composite

   a. Metallic ties will not be allowed.

   b. Color: Yellow or white to facilitate inspection.

4. Minimum Interface Friction Angle: Between each type of proposed geomembrane liner and geonet (with non-woven geotextile heat-bonded to each side). The specimens shall be sheared via the large scale direct shear method at a rate of 0.005 in/minute at 1, 5 and 12 psi normal stresses. .

   a. Material proposed for slopes >10%: Minimum interface friction angle of 29 degrees peak and 29 degrees residual.

   b. Material proposed for slopes ≤10%: Minimum interface friction angle of 8 degrees peak and 8 degrees residual.

B. Drainage Sand.

1. Minimum Permeability: ASTM D 5084, 1.0×10^{-3} cm/sec when compacted at optimum to 3 percent of optimum moisture content, and 90 percent of maximum density in accordance with ASTM D 1557.

   a. Test samples at effective confining pressure of 3 psi, under hydraulic gradients ranging from 5 to 20.

2. Minimum Interface Friction Angle: Between the geonet and drainage sand. Test shall be performed with drainage sand compacted to a dry density equal to a range between 85 and 90 percent of the maximum density, at a moisture content 3 percent

wet of optimum moisture, obtained in accordance with ASTM D 1557 and tested in accordance with ASTM D 5321 after soaking the prepared samples for a period of at least 24 hours to obtain uniform moisture content in the materials being tested. The specimens shall be sheared via the large scale direct shear method at a rate of 0.005 in/minute at 1, 5 and 12 psi normal stresses.

a. Material proposed for slopes >10%: Minimum interface friction angle of 29 degrees peak and 29 degrees residual.

b. Material proposed for slopes ≤10%: Minimum interface friction angle of 18 degrees peak and 18 degrees residual.

3. Minimum Internal Friction Angle: When tested in accordance with ASTM D 3080. Test shall be performed with drainage sand compacted to a dry density equal to a range between 85 and 90 percent of the maximum density, at a moisture content 3 percent wet of optimum moisture, obtained in accordance with ASTM D 1557 after soaking the prepared samples for a period of at least 24 hours to obtain uniform moisture content in the materials being tested. The specimens shall be sheared via the large scale direct shear method with 1, 5 and 12 psi normal stresses.

a. Material proposed for Diversion Swale and Road Embankment fill: Minimum internal friction angle of 35 degrees.

b. All other Drainage Sand Applications: Minimum internal friction angle of 29 degrees.

4. Minimum Compacted Wet Unit Weight: When compacted to 90 percent of maximum dry density at a moisture content of 3 percent wet of optimum, obtained in accordance with ASTM D 1557.

a. Material proposed for Diversion Swale fill: Minimum of 130 pounds per cubic foot

b. All other Drainage Sand Applications: Minimum of 110 pounds per cubic foot

5. In addition to the permeability requirements, all drainage sand shall be free of sharp edges and meet the following gradation requirement.

U.S. Standard Sieve Size	Percent Finer By Weight
1-inch	100
No. 10	30-90
No. 40	10-70
No. 200	0-10

C. Non-Woven Geotextile – Placed between drainage sand and vegetative support material.

1. Needle-punched fabric of polypropylene fibers, conforming with Form 816, Article M.08.01-26.

2. Geotextile shall have the following properties:

a. Minimum Mass per Unit Area of 4.0 oz/yd^2

b. Minimum Tensile strength of 90 lbs.

c. Minimum elongation of 50 percent

d. Minimum flow rate of 150 gpm/sq.ft.

e. Minimum U.V. resistance of 70 percent at 150 hrs.

2.4 DRAINAGE LAYER – (ALTERNATE)

A. Side Slopes: Same as Article 2.3.

B. Top Slope (Slopes equal to 4 percent)

1. Geonet: None. Replaced by geotextile as follows:

a. Non-Woven Geotextile – Placed in contact with geomembrane in areas without geonet.

1) Needle-punched fabric of polypropylene fibers, conforming with Form 816, Article M.08.01-26.

2) Geotextile shall have the following properties:

a) Minimum Mass per Unit Area of 8.0 oz/yd^2

b) Minimum Tensile strength of 220 lbs.

c) Minimum elongation of 50 percent

d) Minimum flow rate of 110 gpm/sq.ft.

e) Minimum U.V. resistance of 70 percent at 150 hrs.

2. Drainage Sand: Same as Paragraph 2.3 B except for the following:

a. Minimum Permeability: On slopes less than 10 percent, a sand drainage layer with a higher permeability may be used without geonet, but with 4" underdrains laid out as depicted on the drawings. If this alternative is chosen, this soil must conform to ASTM D 5084, 1.0×10^{-2} cm/sec when compacted at optimum to 3 percent of optimum moisture content, and 90 percent of maximum density in accordance with ASTM D 1557.

1) Test samples at effective confining pressure of 3 psi, under hydraulic gradients ranging from 5 to 20.

b. Gradation: On slopes less than 10 percent, a sand drainage layer with a higher permeability may be used without drainage composite. If this alternative is chosen, this soil must conform to:

U.S. Standard Sieve Size	Percent Finer By Weight
3/8-inch	100
1/4-inch	25-60
No. 10	15-45
No. 40	5-25
No. 100	0-10
No. 200	0-5

C. Non-Woven Geotextile Placed between drainage sand and vegetative support material:

1. Same as Paragraph 2.3 C.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Protect subgrades and foundation soils against freezing temperatures or frost.

3.2 LANDFILL SITE CLEARING

A. Strip existing vegetation to root depth to enable placement of cap base material directly on daily cover material. Collect and dispose of all vegetated material.

B. Site Improvements: Remove and dispose of in-place grouted riprap and concrete slurry.

1. Contractor's Option: Crush on-site removed riprap and concrete slurry for reuse as general fill material. Submit test reports for final material gradation.

3.3 APPROVAL OF SUBGRADES

A. Notify Engineer when site has reached proposed landfill subgrade and each material level subgrade.

B. If Engineer determines that unsatisfactory conditions are present, remove and replace material to the satisfaction of the Engineer at no additional cost to the Owner.

1. Reconstruct subgrade damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer.

3.4 STORAGE OF SOIL MATERIALS

A. Stockpile materials and excavated soil materials meeting project specifications. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Prevent windblown dust.

3.5 FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 10 percent so fill material will bond with existing material.

1. Refuse Area Grades: Do not exceed earth slopes indicted in Closure Plan.

a. Maximum Slope: 3H:1V (33 percent).

b. Minimum Slope: 25H:1V (4 percent).

3.6 CAP BASE MATERIAL

A. Place and compact cap base material in one layer or 6 inch maximum lifts, to the lines and grades indicated.

B. Perform depth test hole testing.

3.7 GEONET

A. Installation:

1. Install geonet on top of geomembrane liner in accordance with manufacturer's requirements.

a. A manufacturer's Technical Service Representative shall be present during all geonet installation activities.

b. The Contractor shall bear the expense of this Technical Service Representative.

2. Placement of the geonet shall be done without damaging any underlining geosynthetic. The geonet shall be placed on the prepared surface in such a manner as to assure minimum handling. Any necessary surface preparation should be completed before installation begins.

3. Geonets shall be anchored in anchor trenches with the geomembrane cap as detailed on the approved shop drawings.

a. Only those rolls of geonet material which can be anchored and tied together that same day shall be unpackaged and placed in position.

4. Adjacent rolls shall be overlapped and plastic ties pushed through the geotextiles and geonet in the overlap area. Plastic ties shall be white or other bright color to allow easy inspection and metallic ties shall not be allowed. Plastic ties shall be installed at 5 foot intervals. There shall be no slack in the geonet, but the material shall be installed in a relaxed condition.

5. In the corners of the side slopes where there is a gap between overlapping rolls of the geonet, an extra layer of material shall be installed from the top to the bottom of the slope.

B. Protection:

1. Materials, equipment, or other items shall not be dragged across the surface of the geonet and no materials shall be allowed to slide down the slopes on the geonet.
2. The Contractor shall place all cover materials in such a manner as to ensure the geonet is not damaged.

3.8 DRAINAGE SAND LAYER

A. Place sand drainage material over goenet in one continuous lift and spread using tracked equipment weighing equivalent to or less than that of a Caterpillar D-6 bulldozer, or equal. Equipment must have a ground pressure less than 10 psi.

B. Immediately track sand after fine grading has been completed. Utilize tracked bulldozers with grousers of sufficient height to leave visible depressions in the subgrade. Operate equipment parallel to the direction of water flow, leaving track depressions that are perpendicular to the direction of water flow, which will reduce erosion potential until placement of Vegetative Support Material.

C. Perform depth test hole testing.

3.9 NON-WOVEN GEOTEXTILE

A. Installation:

1. Install non-woven geotextile where shown on the drawings in accordance with manufacturer's requirements.
    a. The surface on which the geotextile is placed shall be maintained in a firm, clean, dry and smooth condition during installation.
    b. The geotextile shall be placed over the prepared surface in a manner as to assure minimum handling.
    c. The sheets shall be of such lengths and widths and shall be placed in such a manner as to minimize field seaming.
    d. Horizontal field seams on the slopes shall be kept to a minimum.
2. Geotextile material shall be anchored as shown on the approved shop drawings, as shown on the plans or as directed by the Engineer.
    a. Geotextile shall not be welded to the liner.
    b. Only those sheets of material which can be anchored and sealed together that same day shall be unpackaged and placed in position.
    c. The leading edge of the material shall be secured at all times with sandbags or other means sufficient to hold it down during high winds.
3. Adjacent rolls shall be overlapped a minimum of 12 inches to assure continuity or as specified by the manufacturer with approval of the Engineer.
    a. The overlap shall be in the direction, such that the aggregate being spread does not push the fabric apart.

4. Installation of the geotextile shall be approved by the Engineer prior to placing cover material over the geotextile.

B. Patching:

1. If the geotextile is damaged during installation, it shall be immediately repaired.

a. A patch of fabric large enough to cover the damage, plus an 18 inch overlap shall be placed on top of the damaged section or as specified by the manufacturer.

3.10 MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill layer before compaction to no more than 1 percent dryer and 3 percent wetter than optimum.

B. Do not place fill material on surfaces that are muddy, frozen, or contain frost or ice.

C. Remove and replace, or scarify and air-dry, otherwise satisfactory soil material that exceeds optimum moisture and is too wet to compact to specified dry unit weight.

3.11 COMPACTION OF FILL

A. Place and compact fill materials in the presence of the Engineer.

B. Compact soil to not less than the following percentages of maximum dry density according to ASTM D1557:

1. General Fill: 90 percent minimum.

2. Cap Base Material: 90 percent minimum.

3. Drainage Soil: Two passes of a Caterpillar D-6 bulldozer, or equal.

4. Landfill Slopes: Scarify and recompact top 6 inches below subgrade.

3.12 GRADING

A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.

2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Grading: Slope grades to prevent ponding. Finish subgrade to required elevations within the following tolerances:

1. Lawn or Unpaved Areas: Plus or minus 1 inch, however, not consistently in one direction.

3.13 FIELD QUALITY CONTROL

A. Allow testing agency to inspect and test subgrade and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

B. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:

1. General Fill: Perform six tests per acre, minimum.
2. Cap Base Material: Perform six tests per acre, minimum.
3. Drainage Soil: Perform six tests per acre, minimum.

C. When testing agency reports that subgrade or fill has not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

D. Depth Test Hole. Confirm depth of cap base material and sand drainage layer before placement of subsequent membrane or cover material.

1. Hand excavate test holes at 100 feet on-center, maximum.
2. Record depth of layer at each test hole on site plan.
3. Refill test hole and compact material as required.
4. Engineer shall review depth readings and determine extent of areas that contain an insufficient depth of material. Provide additional material as required to meet minimum layer thickness at no additional cost. Repeat test hole process until satisfactory results are obtained.

3.14 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.15 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Transport waste material, including unsatisfactory soil, trash, and debris, to designated locations on Owner's property.

1. To minimize voids within on-site disposal areas, crush rocks and pieces of concrete-site improvements 6 inches and larger in size to a maximum size of 3 inches. At the Contractor's option, items of this nature may be:

a. Crushed for recycled fill.

b. Disposed of off-site.

B. Disposal: Transport surplus satisfactory soil to designated locations on Owner's property. Stockpile or spread satisfactory soil as directed by Engineer.

END OF SECTION

SECTION 02142 - LLDPE GEOMEMBRANE LINER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes a geomembrane landfill liner with seaming and testing.

B. Related Sections include the following:

1. Division 2 Section "Landfill Earthwork" for landfill cap materials.
2. Division 2 Section "Earthwork" for general site earthwork requirements.

1.3 DEFINITIONS

A. Installer: Authorized installer of geomembrane manufacturer.

B. LLDPE: Linear Low Density Polyethylene

C. Manufacturer's Field Representative: Authorized and trained manufacturer representative.

D. Quality Assurance Consultant (QAC): Owner's representative that will review material, procedure, and testing submittals; and will observe on-site installation including seaming operations and repair work.

1.4 SUBMITTALS

A. Bidding Submittals

1. Installer name and qualifications, including Project experience descriptions.
2. Superintendent qualifications.
3. Geomembrane product data sheet.
4. Warranties regarding quality of materials, workmanship, and long-term performance of the completed geomembrane system.

B. Process submittals to the Owner's Quality Assurance Consultant (QAC.)

C. Action Submittals, as prepared by the Installer.

1. Product Data: Include manufacturer's requirements for surface preparation, technical data, and tested physical and performance properties of geomembrane.

2. Qualification Data: For Installer and geomembrane manufacturer's Field Representative.

3. Shop Drawings: Indicate extent, panel sizes, panel identification number, and details of penetrations and seams.

   a. Assign each geomembrane panel and seam a simple and logical identification number or letters. Correlate seam identification system with panel identification system.

   b. Panel layout. Indicate seam direction and roll sizes.

      1) Design layout to utilize largest panel sizes possible, minimize seams, and to minimize horizontal field seams on slopes.

   c. Details

      1) Termination of material at perimeter of membrane areas.

      2) Penetration sealing procedures.

      3) Anchoring procedures.

4. Installation Procedures: Include manufacturer's requirements and detailed quality control procedures.

D. Informational Submittals

1. Material Quality Control Certificate: Provide for each geomembrane roll delivered to the site. List specified material properties. Clearly label with distinctive code number.

2. Manufacturer's Quality Control Test Data: Provide test data collected in accordance with the requirements of GRI Test Method GM17, dated June 2003, including test frequencies and physical/chemical properties listed in Tables 1(a) and 2(a) thereof.

3. Samples: As requested by the Quality Assurance Consultant.

4. Daily Examination Report: Before proceeding with membrane installation, complete and submit to Owner "Letter of Surface Confirmation," which states observation and acceptance of surface area to receive membrane, signed by Installer and QAC.

5. Trial Seam Test Report: Submit on a weekly basis. Installer shall record date, time, weather conditions, test results, operator, and equipment number for each trial seam tested.

   a. Trial Seam Sample: Submit properly identified unused section of trial weld seam to Owner.

6. Record Drawings: Include panel layout and identification, seam type and identification, repair locations and identifications, and destructive test sample locations and identification.

   a. Record the roll number, location, and date of installation of each panel placed.

   b. Submit working copies when requested by the Quality Assurance Consultant.

   c. Submit final Record Drawings prior to demobilizing from the site.

7. Installation Certificate: The Installer shall submit a Certificate of Acceptance stating that installation procedures and required testing have been completed in accordance with the specifications.

1.5 QUALITY ASSURANCE

A. Geomembrane Manufacturer: Manufacturer that has successfully supplied a minimum of 10,000,000 s.f. of geomembrane for landfill applications.

B. Geomembrane Manufacturer's Field Representative Qualifications: Competent, field technical representative that has personally supervised and directed the installation of a minimum of 2,000,000 s.f. of the specified geomembrane product.

C. Installer: An experienced Installer that has successfully completed projects similar in size and scope but no less than 20 geomembrane landfill closures totaling a minimum of 2,000,000 s.f.

1. Seaming Personnel: Experienced in projects of similar nature, material, and installation method, with at least one seamer having a minimum of 1,000,000 s.f. installation experience.

D. Source Limitations: Obtain each type of geomembrane through one source from a single manufacturer.

E. The Installer shall promptly inform the Quality Assurance Consultant upon placing an order for materials so that arrangements may be made, if desired, for inspection before shipment from the place of manufacture.

F. The Installer shall provide the Quality Assurance Consultant and his representatives with facilities, labor, tools, and equipment as required during installation, and allow proper time for inspecting and testing materials and workmanship.

G. Preinstallation Conference: Conduct conference at Project site.

1. Review manufacturer requirements including surface condition, forecasted weather conditions, seam details, installation and repair procedures, testing and inspection procedures, and protection of installed geomembrane.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Upon delivery of geomembrane rolls to the site, assist Owner's Quality Assurance Consultant with inspection and provide labor as needed for inspection.

1. Immediately remove from the site damaged or defective material.

B. Store membrane rolls on a prepared surface approved by the QAC, no more than 3 rolls high. Protect rolls from dirt, grease, water, abrasions, excessive heat or cold, or other damage.

C. Handle geomembrane rolls with appropriate equipment, designed to handle sheet materials. Use spreader bars and cloth chokers when loading and transporting to prevent damage or stressing of the geomembrane material.

D. Any damaged membrane shall be repaired or replaced immediately, at the discretion of the Quality Assurance Consultant, and at no cost to the Owner.

1.7 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit system to be installed according to manufacturer's written instructions and warranty requirements.

1. Install material when ambient air temperature is within the temperature range as specified and as required by the manufacturer.

B. Do not allow vehicular traffic directly on geomembrane panels. Equipment shall not damage panels by handling, leakage, transporting across panels, or any other means.

C. Personnel working with geomembrane panels shall not wear shoes that will damage the panels.

1.8 WARRANTY

A. Manufacturer's Warranty: Provide written warranty as it relates to the quality of the material, for a period of not less than 20 years.

B. Installer: Provide written, standard general contractor's warranty as it relates to performance for a period of not less than 5 years.

PART 2 - PRODUCTS

2.1 LLDPE GEOMEMBRANE

A. Material: First quality LLDPE resin containing less than 2-percent clean recycled polymer.

Properties	Requirement
Melt Index ASTM D1238, Condition 190/2.16	< 1 gram/10 min.
Specific Gravity ASTM D792, Method A	> 0.90 g/cm^3
Oxidative Inductive Time ASTM D3895 (1atm/200°C)	100

B. Membrane Properties: Unreinforced LLDPE containing 3 percent by weight maximum additives, fillers or extenders including carbon black; free of striations, pinholes, blisters, bubbles, undispersed raw materials, or signs of contamination by foreign matter on the material surface.

1. Smooth LLDPE: Physical and Chemical properties meeting the requirements of the Geosynthetic Research Institute's "Test Method GM17", Table 1(a)

2. Textured LLDPE: Physical and Chemical properties meeting the requirements of the Geosynthetic Research Institute's "Test Method GM17", Table 2(a)

C. Membrane Seams

Properties	Smooth LLDPE	Textured LLDPE
Peal Adhesion ASTM D6392	48 lb/in, width, minimum and Film Tear Bond	48 lb/in width, minimum and Film Tear Bond
Bonded Seam Strength ASTM D6392	55 lb/in width, minimum and Film Tear Bond	55 lb/in width, minimum and Film Tear Bond

2.2 CAP PENETRATIONS

A. Penetrations shall be made as shown on the drawings and in accordance with liner manufacturer's instructions.

1. Geomembrane liner boots shall be specifically manufactured by the liner manufacturer for such use or field fabricated of Geomembrane Liner material in accordance with manufacturer's instructions.

2. Stainless steel banding shall be type 304, ¾" wide with adjustable screw-type clasp, or approved equal.

3. Gasket shall be neoprene, closed cell medium, ¼" thick, 2" wide with adhesive on one side as supplied by geomembrane liner manufacturer, or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Owner's Quality Assurance Consultant (QAC) will observe the complete installation of the geomembrane system including delivery to site, handling, deploying, seaming, testing, and repair work.

1. Do not install geomebrane without QAC being present.

2. No additional compensation will be provided for possible delays that may be caused due to inspection and testing of materials and workmanship.

B. Inform QAC on a daily basis of proposed work schedule, including changes.

C. Mark geomembrane panels by their identification number or letters.

D. Install geomembrane under the direct supervision of the Manufacturer's Field Representative.

1. Do not install geomembrane without Field Representative being present.

E. The Installer shall be responsible for field handling, storing, placing, seaming, plus any other processes required to assemble a continuous secure geomembrane system.

3.2 PREPARATION

A. See Division 2 Section "Landfill Earthwork" for subgrade preparation and bedding placement.

1. Surfaces shall be smooth and free of rocks, stones, sticks, roots, sharp objects, and debris, and provide a firm, unyielding foundation for the geomembrane with no sudden, sharp or abrupt changes or break in grade.

3.3 EXAMINATION

A. Installer and Quality Assurance Consultant shall inspect the prepared subgrade on a daily basis and immediately inform the Contractor of remedial work required to bring the subgrade to the specifications required for liner installation.

1. Upon satisfactory subgrade condition, the Installer and Quality Assurance Consultant will issue a joint "Letter of Surface Confirmation."

3.4 INSTALLATION

A. Install and seam membrane panels when the ambient air temperature is between 40 degrees F and 104 degrees F, as measured 6 inches above subgrade surface elevation.

1. Do not install, seam, or repair membrane panels during precipitation, excessively high winds, or in areas of ponded water or excessive moisture.

2. Do not install and seam geomembrane panels in ambient temperatures below 40 degrees F unless approved by the Quality Assurance Consultant, and only if trial seams demonstrate the ability to meet seaming specifications.

B. Before deploying geomembrane panels, Installer shall repair subgrade or other underlying surface disturbed or damaged after issuance of "Letter of Surface Confirmation."

C. Place material over prepared subgrade with minimum handling. Place rolls in accordance with approved panel layout.

1. Install only rolls of material that can be anchored and sealed by end of each day's operation.

D. Properly secure geomembrane during installation with sandbags, rubber tires or other means approved by the QAC. Do not use large or sharp rocks, or other sharp objects.

E. Install geomembrane material in relaxed condition. Provide excess material for each panel as per requirements. Do not stretch material to fit area; keep material free from stress and tension during installation.

1. Unroll geomembrane panels in a manner that will not stretch, crimp, abrade, or otherwise damage panels. Place panels in a manner that minimizes wrinkles and differential wrinkles between adjacent panels.

F. Overlap geoemembrane panels to facilitate drainage of water. All panels deployed during a single day shall be seamed or tack welded together that same day to the extent practicable.

G. Anchor perimeter of geomembrane panels in trench as indicated on the Drawings.

3.5 FIELD SEAMING

A. Lay out the geomembrane seams parallel to the line of maximum slope.

1. Minimize the use of cross or butt seams on slopes, seams located in corners, and unusual geometric panel shapes.

B. The seam identification system shall be related to and compatible with the panel identification system.

C. Equipment: Include temperature gages and readout devices that allow continuous monitoring of apparatus temperatures during seaming. Electric generators shall be capable of providing constant voltage under load and shall be underlain with a splash pad to collect spilled fuel or oil when located on the membrane.

D. Overlap geomembrane surfaces a minimum of 4 inches and clean surfaces of moisture, grease, dust, dirt, debris and foreign material.

1. Do not use solvent or adhesive for seaming without approval from the manufacturer and the Quality Assurance Consultant.

2. When needed, install beneath the seam a protective sheet of plastic beneath the geomembrane sheets to minimize moisture and dirt during seaming

3. Where moisture or dirt causes seaming difficulty, install a protective sheet of plastic below the geomembrane material being seamed. As seaming progresses, pull the protective sheet along beneath the seaming apparatus.

a. Do not leave the protective sheet beneath the geomembrane.

4. For extrusion welding, clean surfaces to be seamed of oxidation by disc grinder not more than one hour before extruding the seam. Abrasion of the seam area with the disc grinder shall not extend more than one-half inch beyond the extrusion bead area. Tack welding of the panels to be seamed shall not damage the membrane or adversely affect the seaming operation. The top membrane of the seam overlap shall be beveled and the extrusion apparatus shall be purged of heat-degraded extrudant before seaming.

E. Fish mouths shall be cut along the ridge of the wrinkle and laid flat to overlap the edges of the cut. The overlap shall be extrusion-seamed and any portion of the seam with less than 3 inches of overlap shall be patched with a circular or oval patch extending a minimum of 6 inches beyond the cut in all directions.

F. The Installer shall log the ambient air temperature 6 inches above the membrane elevation, extruded temperatures in extruder barrels and nozzles, and operating temperatures of hot wedge seamers at intervals of 2 hours or less.

3.6 CAP PENETRATIONS

A. Any penetrations in the liner required by a pipe, vent, utility pole, fence post, concrete structure or other constructed feature shall be connected to the liner as shown on the drawings and in accordance with the geomembrane Manufacturer's recommendations as approved by the Engineer.

1. The connection to the geomembrane shall be made to assure the permeability of the liner at the connection has not been increased. Any damage to the liner materials shall be repaired in accordance with the specifications. Each penetration shall be inspected and approved by the Engineer prior to being covered.

3.7 INSPECTION

A. Visually inspect seams and panels for holes, crimps, abrasions, or defects, and mark suspect locations. Clearly mark repair locations and assign an appropriate identifying label which shall be clearly marked on the panel adjacent to the repair location and shall be shown on the Record Drawing. Each marked location shall be repaired, non-destructively tested, and data recorded on the Record Drawings.

1. Do not cover repairs until passing results of non-destructive tests are achieved and accepted by the Quality Assurance Consultant.

B. Remove large wrinkles in geomembrane panels before installation of protection sand cover. Cut wrinkle, reseam and test until an acceptable seam is obtained.

3.8 GEOMEMBRANE PROTECTION

A. Direct heavily-loaded construction vehicles, such as loaded dump trucks, to travel over geomembrane panels with a cover of 18 inches minimum.

B. Use tracked-equipment for spreading of sand cover over geomembrane panels.

1. Tracked equipment shall exert a maximum contact pressure of 10 psi (equivalent to a Caterpillar D-6 bulldozer with standard track configuration), and shall operate on a minimum of 9 inches of sand cover over geomembranes

2. Tracked equipment will not make turns in such a manner as to displace underlying soil or put additional stress on the geomembrane liner.

3. Under no circumstances shall tracked equipment be permitted to pivot steer.

C. Do not place sand layer on a membrane that is under stress due to thermal contraction or other causes, or that has large wrinkles that may fold over and crimp, or when the ambient air temperature 6 inches above the membrane is greater than 104 degrees F or lower than 40 degrees F.

D. Cut and patch panels under tensile stress due to thermal contraction or any other cause, and compensate for membrane contraction prior to placement of Drainage Sand Layer Material.

3.9 REPAIRS

A. Remove or repair damaged geomembrane panels damaged during installation at no additional cost to Owner.

B. Repair geomembrane panels as follows:

1. Preparation. Abrade surface of geomembrane in the seam/repair area no more than one hour before the repair is made. Keep repair/seam areas clean and dry at the time of the repair.

2. Spot weld small tears, pinholes or over-abraded areas where thickness of the geomembrane has been reduced by more than 4 mils (0.004 inches).

3. Abrade and reweld small sections of defective extrusion welds.

4. Remove defective seam and replace with a new strip of material. Defective hot wedge seams may be abraded and extrusion welded providing the top membrane overlap is carefully cut off.

5. Patch larger holes and defects. Extend patch material a minimum of 6 inches beyond the edges of the defect. Round corners of patches with a radius of at least 3 inches.

3.10 FIELD QUALITY CONTROL TESTING

A. Seam Testing. Record locations and results of seam tests on the Record Drawing. Keep records on site for inspection by the Owner and Quality Assurance Consultant.

B. Trial Seams

1. Sample Quantity: For each seaming apparatus, for the following instances.

a. At the beginning of each shift.

b. After apparatus has been turned off or disconnected from its power source.

c. When apparatus has been idle for 30 minutes (extrusion welder) or 60 minutes (hot wedge welder).

d. Change in operator personnel.

e. When deemed necessary by the Quality Assurance Consultant.

2. Sample Size: 3 feet long and 12 inches wide (perpendicular to the seam), minimum.

a. Cut 1-inch-wide samples perpendicular to the seam for testing. Provide at a minimum, six for peel test and three for shear test.

3. Shear (Bonded Seam Strength) and Peel (Adhesion) Tests: In accordance with ASTM D6392. Installer shall provide tensiometer, calibrated within one year from start of geomembrane installation.

4. Conduct trial seams under the same physical conditions as permanent seaming.

a. For double-fusion hot wedge seams, both seams in each sample shall be tested for peel adhesion.

b. All six peel tests and all three shear tests are required to pass for the trial seam to be acceptable.

c. Each sample failure must consist of a ductile break that is film tearing bond.

5. If either test sample fails (shear or peel), repeat trial seam test procedure. If any test seams fail on the second trial seam, the seaming apparatus shall not be used until it is repaired or faulty conditions are corrected, and two trial seams pass the destructive tests.

C. Non-destructive Seam Testing

1. Acceptable Methods. Vacuum box testing, air-pressure testing of double-fusion seams, or other methods approved by the manufacturer and Quality Assurance Consultant.

2. Perform non-destructive testing over the full length of each seam. Perform testing as work progresses. Do not wait to perform testing until the completion of large segments of field seaming.

3. Vacuum Box Testing: In accordance with ASTM D5641. Utilize vacuum box approved by the Quality Assurance Consultant. Vacuum box shall include rigid housing, transparent viewing window, a soft rubber gasket on the bottom edge, and a valve assembly with a vacuum gage.

a. Mark geomembrane seamed areas when soap bubbles are visible in the viewing window.

b. Repair marked locations and retest.

4. Air Pressure Testing: In accordance with ASTM D5820. Perform air –pressure test on double-fusion seams having an air channel between the seams in accordance with ASTM D 5820. Mark results on the geomembrane adjacent to the test location.

5. If a seam is located where non-destructive testing cannot be performed, the seam shall, at the discretion of the Quality Assurance Consultant, be cap-stripped and the cap-stripping operation shall be observed by the Quality Assurance Consultant and Installation Contractor for completeness.

D. Destructive Seam Testing

1. Samples: The Installer shall cut and remove destructive test samples from the installed geomembrane material, assign the sample an identification number, and record the sample location on the Record Drawings.
    a. Perform one series of destructive seam tests per 1,000 l.f. of seam, minimum. One test must be performed per welding machine per day.
    b. Locations: As determined by the Quality Assurance Consultant.
    c. Sample Size: 12 inches wide and 40 inches long with the seam centered lengthwise.
    d. Perform destructive seam strength testing as work progresses in order to obtain test results before seams are covered.
    e. The Installer shall immediately repair the geomembrane at the destructive test sample location, and perform non-destructive test.
2. Destructive Seam Series Test: In accordance with ASTM D6392.
    a. Field Testing. Installer shall provide field tensiometer, calibrated within one year from start of geomembrane installation.
        1) Shear (Bonded Seam Strength)
            a) One 1-inch strip cut from sample.
        2) Peel (Adhesion) Tests:
            a) Laboratory Test: Five 1-inch strips cut from samples.
    b. Laboratory Testing. Coordinated by the Quality Assurance Consultant and performed by an independent geosynthetic testing laboratory paid for by the Owner.
        1) Shear (Bonded Seam Strength)
            a) Laboratory Test: Five 1-inch strips cut from samples.
        2) Peel (Adhesion) Tests:
            a) Laboratory Test: Five 1-inch strips cut from samples.
        3) Double-fusion Hot Wedge Seams. Test both seams in each sample for peel. Testing shall include, but not necessarily be limited to, thickness (ASTM D 5199/D 5594)

E. Failure of Seam Tests.
1. If either field destructive test seams or laboratory test seams do not pass, reconstruct the seam between two passing test seam locations. Intermediate tests may be performed on each side of the failed test sample location to further isolate the defective seam area.
2. If intermediate field test seams pass, laboratory test seams shall be performed on samples from the same locations.

3. If laboratory test seams also pass, then the seam shall be reconstructed between the intermediate sample locations.

4. If either of the test seams fail, then the process shall be repeated with intermediate samples further away from the original failing seam location to determine the defective seam area.

F. Acceptable Seams.

1. Each seam shall be bounded by two locations where samples passed the laboratory destructive tests.

2. Whenever a reconstructed seam exceeds 200 feet, an additional sample shall be obtained for destructive testing along the reconstructed seam.

3. At the Quality Assurance Consultant's discretion, the Installer may be directed to take additional samples from seams welded on the same day by a seaming apparatus that welded a failed seam, at no additional cost to the Owner.

3.11 CLEANING

A. The Contractor shall be responsible for cleaning the work area at the end of each work day of unnecessary scrap material, sand bags, tools and other materials used during geomembrane installation.

3.12 POST CONSTRUCTION

A. An inspection shall be performed by the Installation Contractor, Quality Assurance Consultant, and Owner prior to the Installers' capping crew moving off the site. All identified problem areas shall be repaired by the Installation Contractor and accepted by the Quality Assurance Consultant prior to the crew moving off site.

END OF SECTION

SECTION 02144 - LANDFILL VEGETATIVE SUPPORT LAYER

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Vegetative support soil
2. Soil amendments.
3. Seeding.

B. Related Sections include the following:

1. Division 2 Section "Earthwork" for excavation, filling and backfilling, and rough grading.
2. Division 2 Section "Landfill Cover Material" for cover material requirements.

1.2 DEFINITIONS

A. Finish Grade: Elevation of finished surface of vegetative support soil.

B. Manufactured Soil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce vegetative support soil.

C. Vegetative Support soil: Imported or manufactured soil or surface soil modified to become vegetative support soil; mixed with soil amendments.

D. Subgrade: Top surface of a fill immediately beneath vegetative support soil.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name and percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

C. Product Certificates: For soil amendments, fertilizers and mulch, signed by product manufacturer.

D. Material Test Reports: For vegetative support soil.

E. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of seeded areas during a calendar year. Submit before expiration of required maintenance periods.

F. Temporary Irrigation Plan: Indicating, at a minimum,

1. Proposed pipe size, material, and layout.
2. Sprinkler head type, range, flow rate and pressure requirements.
3. Method of conveying owner-supplied potable water to the system.
4. System output, in inches / hour.
5. System operation and maintenance instructions

1.4 QUALITY ASSURANCE

A. Soil-Testing Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

B. Vegetative Support Soil Analysis: Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of soil. Obtain one composite soil sample for every 5,000 cu. yds. of material with at least one sample from each borrow source location.

1. Report suitability of soil for growth. State recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce a satisfactory soil.

C. Vegetative Support Soil Chemical Analysis: Obtain one composite soil sample for every 10,000 cu. yds. of material with at least one sample from each borrow source location. Analyze each for pesticides (EPA Method 8081), chlorinated herbicides (EPA Method 8151), Total Petroleum Hydrocarbons (CTETPH method), Total RCRA 8 Metals (EPA Method 6010 / 7421 / 7470).

D. Organic Soil Amendment Chemical Analysis: Obtain one composite soil sample from each borrow source location. Analyze each for pesticides (EPA Method 8081) and chlorinated herbicides (EPA Method 8151). Owner reserves the right to disqualify the source based on the results of the chemical testing.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Seed, Lime, and Fertilizer: Deliver in original sealed, labeled, and undamaged containers.

1.6 SCHEDULING

A. Planting Restrictions: Plant during one of the following periods. Perform seeding at other times when acceptable to the Engineer.

1. Spring Seeding: April 15 to June 15.
2. Fall Seeding: August 15 to October 15.

B. Weather Limitations: Proceed with seeding only when existing and forecasted weather conditions permit.

1.7 MAINTENANCE

A. Begin maintenance immediately after each area is planted and continue until acceptable turf area is established, but for not less than the following periods:

1. Seeded Areas: 365 days from the date of Substantial Completion.

a. When full maintenance period has not elapsed before end of planting season, or if lawn is not fully established, continue maintenance during next planting season.

B. Maintain and establish seeded areas by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth lawn.

C. Mow seeded area when grass reaches a height of 10 inches. Repeat mowing to maintain specified height without cutting more than 40 percent of grass height. Remove no more than 40 percent of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:

1. Mow grass to 6 inches high.

PART 2 - PRODUCTS

2.1 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.

B. Seed Species: Seed of grass species as follows:

	Proportion by Weight (Percent)	Minimum Purity (Percent)	Minimum Germination (Percent)
Orchard Grass	30	85	75
Creeping Red Fescue	10	98	85
K.31 Tall Fescue	50	98	85
Domestic Ryegrass	10	98	90

2.2 SOIL

A. Vegetative Support Soil: ASTM D 5268, pH range of 6 to 7, a minimum of 6 percent and a maximum of 20 percent organic material content; free of stones 1-1/4 inch or larger in any dimension and other extraneous materials harmful to plant growth.

1. Minimum Internal Friction Angle: Shall be 29 degrees when tested in accordance with ASTM D 3080. Specimen shall be prepared with moderate compactive effort and moisture content as received from the source. Tests will be performed with normal stresses of 1 and 5 psi via the large scale direct shear method.

2. Minimum In-place Wet Unit Weight: Shall be 110 pounds per cubic foot when with a moisture content as received from the source.

3. Vegetative Support Soil Source: Reuse surface soil stockpiled on-site. Existing soil that does not meet the minimum internal friction angle and in-place wet unit weight requirements above can be used only on slopes less than 10% (i.e. top of the landfill). Verify suitability of stockpiled surface soil to produce vegetative support soil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.

    a. Supplement with imported or manufactured topsoil from off-site sources when quantities are insufficient. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep; do not obtain from agricultural land, bogs or marshes.

2.3 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural limestone containing a minimum 90 percent calcium carbonate equivalent and as follows:

1. Provide lime in form of dolomitic limestone, with a minimum of 95 percent passing a No. 100 sieve.

2. Liquid lime will not be allowed.

B. Perlite: Horticultural perlite, soil amendment grade.

C. Sand: Clean, washed, natural or manufactured, free of toxic materials.

2.4 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings.

1. Organic Matter Content: 50 to 60 percent of dry weight.

    a. State of Connecticut, Department of Environmental Protection approved when derived from food and agricultural residues, animal manures, and sewage sludge.

2. Approved Products: Agresource, Inc., 100 Main Street, Amesbury, MA 01913 (1-800-313-3320), or equal.

B. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

2.5 FERTILIZER

A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

2.6 MULCHES

A. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic; free of plant-growth or germination inhibitors; with maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.

1. Product and Manufacturer:

a. Mat-Fiber by Mat, Inc. (formerly Silva-Fiber Mulch by Weyerhaueser).

b. Approved equal.

B. Straw Mulch: Air-dry, clean, mildew- and seed-free, hay or threshed straw of wheat, rye, oats, or barley; free of weeds, reeds, and twigs; maximum moisture content of 15 percent. Do not use salt hay.

C. Non-Asphalitic Tackifier:

1. Model and Manufacturer:

a. Soilmaster WR, by Environmental Soil Systems, Inc.

b. Approved equal.

2.7 WATER

A. Potable water will be supplied by the owner via an existing MDC hydrant meter in the vicinity of the landfill scalehouse.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive seed for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect adjacent and adjoining areas from hydroseeding overspray.

B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 INSTALLATION

A. Place vegetative material in one continuous lift and spread using tracked equipment weighing equivalent to or less than that of a Caterpillar D-8 bulldozer, or equal. Equipment must have a ground pressure less than 15 psi.

3.4 SEEDED AREA PREPARATION

A. Limit subgrade preparation to areas to be planted.

B. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 4 inches. Remove stones larger than 2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Spread planting soil mix to a depth of 6 inches but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.

C. Finish Grading: Grade seeded areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future.

D. Moisten prepared seededareas before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

E. Restore areas if eroded or otherwise disturbed after finish grading and before planting.

3.5 SEEDING

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.

1. Do not use wet seed or seed that is moldy or otherwise damaged.

B. Sow seed at the rate of 200 lb/1 acre.

C. Rake seed lightly into top 1/8 inch of topsoil, roll lightly, and water with fine spray.

D. Protect seeded areas with slopes exceeding 1:3 with erosion-control blankets installed and stapled according to manufacturer's written instructions.

E. Protect seeded areas with slopes not exceeding 1:3 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose depth over seeded areas. Spread by hand, blower, or other suitable equipment.

1. Bond straw mulch by spraying with non-asphaltic tackifier at manufacturer's recommended rate. Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.

2. Install cellulose fiber mulch, erosion control blanket, or other stabilization measure, as directed by the Engineer, if straw mulch is does not provide adequate erosion protection to a disturbed area.

3.6 HYDROSEEDING

A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.

1. Mix slurry with tackifier.

2. Apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a minimum rate of 175-lb/acre dry weight but not less than the rate required to obtain specified seed-sowing rate.

3.7 SATISFACTORY SEEDED AREAS

A. Satisfactory Seeded Area: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 3 by 3 inches.

1. Replant areas and spots that do not show a prompt catch at 15 day intervals, or as directed by the Engineer.

B. Reestablish lawns that do not comply with requirements and continue maintenance until lawns are satisfactory.

3.8 IRRIGATION

A. Install temporary irrigation system in accordance with approved irrigation plan.

B. Provide means of conveying Owner-supplied potable water from designated MDC hydrant meter to the temporary irrigation system including storage tank, pumps, hoses, etc.

1. Coordinate use of MDC Hydrant with landfill staff

2. Record quantity of water used for temporary irrigation

C. Operate the irrigation system during the maintenance period.

D. Monitor the system during operation and discontinue operation, as necessary, to prevent excess water from running off the landform or causing erosion.

E. Remove temporary irrigation system when vegetation has been established to the satisfaction of the engineer.

3.9 FIELD QUALITY CONTROL

A. Depth Test Hole. Confirm depth of vegetative support material after final grading.

1. Hand excavate test holes at 100 feet on-center, maximum.
2. Record depth of layer at each test hole on site plan.
3. Refill test hole and compact material as required.
4. Engineer shall review depth readings and determine extent of areas that contain an insufficient depth of material. Provide additional material as required to meet minimum layer thickness at no additional cost. Repeat test hole process until satisfactory results are obtained.

3.10 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Erect barricades and warning signs as required to protect newly planted areas from traffic. Maintain barricades throughout maintenance period and remove after grass is established.

END OF SECTION

SECTION 02310 – SITE EARTHWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Preparing subgrades for slabs-on-grade, walks, and pavements.
2. Base course for drainage ditches, structures, and swales.
3. Base course for bituminous concrete paving.
4. Excavating and backfilling trenches for buried mechanical and electrical utilities and pits for buried utility structures.
5. Disposal of unsuitable material.
6. Disposal of surplus suitable material, if required.

B. Related Sections include the following:

1. Division 2 Section "Landfill Earthwork" for earthwork associated with landfill subgrade preparation, and various earth material layers for landfill cap and cover.

1.3 DEFINITIONS

A. Backfill: Soil materials used to fill trench, structure or pit excavations.

B. Base Course:

1. Layer placed between the subgrade course and bituminous concrete paving.
2. Layer placed between subgrade and surface materials including riprap.

C. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.

D. Excavation: Removal of material encountered above subgrade elevations.

1. Additional Excavation: Excavation below subgrade elevations as directed by Engineer. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated dimensions without direction by Engineer. Unauthorized excavation, as

well as remedial work directed by Engineer, shall be without additional compensation.

E. General Fill: Soil materials used to raise existing grades where indicated on the Drawings.

F. Structures: Utility appurtenances, or other man-made stationary features constructed above or below the ground surface.

G. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below base, drainage fill, or topsoil materials.

1.4 SUBMITTALS

A. Product Data:

1. Each type of warning tape listed in paragraph 2.2.B.

2. Material certifications for general fill, base material, bedding course material, and trench backfill.

B. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated. Prepare separate reports for each type and application of material.

1. General Fill

a. Refer to Division 2 Section "Landfill Earthwork" for testing requirements.

2. Base, Bedding, Backfill Material

a. Classification according to ASTM D 2487, prior to delivery to the site and one per 5,000 CY delivered.

b. Gradation and particle size analysis according to ASTM D 422, prior to delivery to the site and one per 5,000 CY delivered.

c. Laboratory compaction test results according to ASTM D 1557, prior to delivery to the site and one per 5,000 CY delivered.

d. Soil Chemical Analysis Reports according to RCRA 8 metals (according to EPA Method 6010 / 7421 / 7470) and ETPH (according to CTETPH): prior to delivery and one report for each 10,000 cu. yd., or portion thereof, delivered. Owner reserves the right to disqualify the source based on the results of the chemical testing.

3. On-Site Soil Material

a. Classification, gradation, and laboratory compaction curve in accordance with the requirements specified for General Fill material, when requested by the Engineer.

1.5 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct soil material testing, as documented according to ASTM D 3740 and ASTM E 548.

B. Where "Form 816" is referenced, it shall mean "State of Connecticut Department of Transportation Standard Specifications for Roads, Bridges and Incidental Construction, Form 816," and issued supplements.

1.6 PROJECT CONDITIONS

A. Extent of trench excavation and excavated areas will be controlled by site conditions and Owner's requirements.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. All soil shall be free of debris, waste, frozen materials, vegetation, clay and other deleterious matter; adequately graded for satisfactory compaction.

C. General Fill: Refer to Division 2 Section "Landfill Earthwork" for material requirements.

D. Base: Naturally or artificially graded mixture of natural or crushed gravel, broken or crushed stone:

1. Drainage Ditch and Swales: Form 816, Section M.02.03, Grading B.
2. Processed Aggregate Base: Form 816, Section M.05.01.

E. Bedding:

1. Sand: Form 816, Section M.03.01-2.
2. Stone: Form 816, Section M.01.01, No. 6.

F. Backfill:

1. Sand: Form 816, Section M.03.01-2.

G. Subbase: Form 816, Section M.02.02, Grading B.

2.2 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, minimum 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep.

B. Identifying Colors for Utilities:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding or damaging Project site and surrounding area.

B. Protect excavations, backfills, fills and subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches. Provide positive drainage of backfill and fill.

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavation to subgrade elevations regardless of the character of surface and subsurface conditions encountered, including rock, soil materials, and obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended for bearing surface.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades.

3.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

B. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.

1. Clearance: 12 inches on each side of pipe or conduit.

2. Clearance: As indicated.

C. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe elevation to allow for bedding course. Hand excavate for bell of pipe.

1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.8 APPROVAL OF SUBGRADE

A. Notify Engineer when excavations have reached required subgrade.

B. If Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

1. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

C. Proof roll subgrade with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof roll wet or saturated subgrades.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer.

3.9 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill may be used when approved by Engineer.

1. Fill unauthorized excavations under other construction or utility pipe as directed by Engineer.

3.10 STORAGE OF SOIL MATERIALS

A. Stockpile borrow materials and satisfactory excavated soil materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Prevent windblown dust. Provide erosion control measures.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade.
2. Inspecting and testing underground utilities.
3. Removing trash and debris.
4. Removing temporary shoring and bracing, and sheeting.

3.12 UTILITY TRENCH BACKFILL

A. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

B. Place and compact initial backfill of subbase material, free of particles larger than 1 inch, to a height of 12 inches over the utility pipe or conduit.

1. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.

C. Coordinate backfilling with utilities testing.

D. Fill voids with approved backfill materials while shoring and bracing, and as sheeting is removed.

E. Place and compact final backfill of satisfactory soil material to final subgrade.

F. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

1. Install detectable warning tape over non-ferrous piping.

3.13 FILL

A. Preparation: Remove vegetation, topsoil, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface before placing fills.

B. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 3 horizontal so fill material will bond with existing material.

C. Place and compact fill material in layers to required elevations.

3.14 MOISTURE CONTROL

A. General Application: Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

2. Remove and replace, or scarify and air-dry, otherwise satisfactory soil material that exceeds optimum moisture content and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF BACKFILLS AND FILLS

A. Place fill material in loose lifts not exceeding 12 inches in depth for material compacted by heavy compaction equipment.

B. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:

1. Under structures, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill material.

2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material at 95 percent.

3. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material at 85 percent.

3.16 GRADING

A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.

2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Lawn or Unpaved Areas: Plus or minus 1 inch, however, not consistently in one direction.

2. Walks: Plus or minus 1 inch.

3.17 SUBBASE AND BASE COURSES

A. Under pavements and walks, place and compact materials on prepared subgrade as follows:

1. Place and compact subbase and base courses at optimum moisture content to required grades, lines, cross sections, and thickness (within 3/4 inch, plus or minus) to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

2. Shape subbase and base to required crown elevations and cross-slope grades.

3. When thickness of compacted subbase or base course is 6 inches or less, place materials in a single layer.

4. When thickness of compacted subbase or base course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.

3.18 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

C. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 square feet or less of paved area or building slab, but in no case fewer than three tests.

2. Trench Backfill: At each compacted initial and final backfill layer, at least one test for each 150 feet or less of trench length, but no fewer than two tests.

D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.19 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Engineer; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.20 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Engineer.

1. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION

SECTION 02372 - PERMANENT EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Riprap for swales and protection for drain inlets and outlets including stilling basins.
2. Grouted riprap for drainage down chutes.
3. Permanent erosion control matting (turf reinforcement matting.)
4. Articulated concrete block revetment.

B. Related Sections include the following:

1. Division 1 Section "Temporary Erosion and Sedimentation Control" for temporary site measures.
2. Division 2 Section "Landfill Earthwork" and "Site Earthwork" for excavation and backfill.
3. Division 2 Section "Underdrains" for piped subdrainage systems.
4. Division 2 Section "Storm Drainage" for enclosed, piped drainage systems.

1.3 DEFINITIONS

A. CPP: Corrugated, polyethylene pipe.

B. HDPE: High-density polyethylene plastic.

C. NPS: Nominal pipe size.

1.4 SUBMITTALS

A. Product Data and Material Certifications: For the following:

1. Riprap.
2. Erosion control matting.
3. Geotextile fabric.
4. Articulated concrete block revetment.

B. Shop Drawings: For the following.

1. Articulated concrete revetment. Include details showing layout pattern in relation to feature alignment, anticipated locations of cast-in-place concrete joints, junction details, soil anchors, and installation methods for void filling materials.

C. Calcualtions: For the following.

1. Articulated concrete block revetment. Include manufacturer's performance research results and calculations for open channel flow including hydraulic performance characteristics and Factor-of Safety design methodology.

1.5 QUALITY ASSURANCE

A. Where "Form 816" is referenced, it shall mean "State of Connecticut Department of Transportation Standard Specifications for Roads, Bridges and Incidental Construction, Form 816," and issued supplements.

PART 2 - PRODUCTS

2.1 PIPE OUTLETS

A. Riprap: Broken, irregular size and shape, graded stone conforming to Form 816, Section M.12.02, size as indicated.

B. Bedding Material: Granular fill conforming to Form 816, Section M.02.01-1 or M.02.01-2.

2.2 EROSION CONTROL MATTING (TURF REINFORCEMENT MATTING)

A. Matting: Double net cover blanket; minimum width of 6-feet.

1. Available Products:

a. North American Green, SC250.

b. Enkamat 7020.

c. Or approved equal.

2.3 ARTICULATED CONCRETE BLOCK REVETMENT

A. Materials: Provide system meeting design criteria listed on the Drawings.

B. System: Provide a matrix of interconnected block units for erosion protection, connected by geometric interlock or by cables. Include geotextile underlayment for subsoil retention.

C. Available Systems and Manufacturers:

1. AmorFlex® by Armortec, Inc., West Chester, Ohio

2. Or approved equal.

2.4 MISCELLANEOUS

A. Concrete: Form 816, Section M.03.01-01, Class "C".

B. Grout: Form 816, Section M.03.01-14.

C. Geotextile: Form 816, Section M.08.01-26.

D. Precast Concrete Culvert Flared Ends: Form 816, Section 6.52.02.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 2 Section "Earthwork."

3.2 INSTALLATION, GENERAL

A. General Locations and Arrangements: Drawing plans and details indicate general location of permanent erosion and sedimentation control systems. Lengths are approximate.

3.3 RIPRAP INSTALLATION

A. Place bedding material and geotextile where indicated on accurately shaped subgrade.

B. Construct riprap of broken stone, to the lines and grades indicated. Prevent displacement of bedding material.

C. Place riprap to full course thickness in one layer. Rearrange individual stones by hand or equipment as required to produce a reasonably well-graded distribution of rock, free from pockets of small stones and clusters of larger stones.

D. Place bedding material and filter fabric where indicated on accurately shaped subgrade.

3.4 STORM DRAINAGE INLET AND OUTLET INSTALLATION

A. Construct inlet head walls, aprons, and sides of precast, or cast-in-place reinforced concrete, as indicated.

B. Construct riprap of broken stone, as indicated. Prevent displacement of base material.

C. Place riprap in one layer and rearrange individual stones by hand or equipment as required to produce a reasonably well-graded distribution of rock, free from pockets of small stones and clusters of larger stones.

D. Install outlets that spill onto grade, anchored with concrete, where indicated.

E. Install outlet flared end sections, where indicated.

3.5 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318 and ACI 350R.

3.6 EROSION CONTROL MATTING (TURF REINFORCEMENT MATTING)

A. Install matting where indicated. Staple or stake in accordance with manufacturer's recommendations.

1. Overlap seams 2 to 5 inches.

2. Extend mat beyond top and bottom of slopes 3 feet minimum

a. At top of slopes where 3 feet is not available, anchor mat in 10-inch wide by 8-inch deep trench.

3.7 ARTICULATED CONCRETE REVETMENT

A. Install revetment system in accordance with details, manufacturer's recommendations, and approved shop drawings.

END OF SECTION

SECTION 02531 – LEACHATE FORCE MAIN SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes pipe, fittings, joining methods and general construction practice for HDPE piping systems.

B. Related Sections include the following:

1. Division 2 Section "Earthwork" for trenching and backfill.

1.3 DEFINITIONS

A. HDPE: High density polyethylene plastic.

1.4 PERFORMANCE REQUIREMENTS

A. Force-Main Pressure Ratings: At least equal to system operating pressure, but not less than 150 psig.

1.5 SUBMITTALS

A. Product Certification: Pipe, fittings, and miscellaneous appurtenances.

B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic structures, pipe, and fittings in direct sunlight. Keep plastic items at ambient outdoor temperature.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

1.7 PROJECT CONDITIONS

A. Locate existing structures and piping to be closed and abandoned.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Owner not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Owner's written permission.

PART 2 - PRODUCTS

2.1 HDPE FORCE MAIN

A. Pipe: ASTM D3035 or ASTM F714.

1. Material: ASTM D3350, minimum cell classification of PE345464C.
    a. The pipe shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material.
    b. The pipe shall be homogenous throughout and free of visible cracks, holes, foreign inclusions, voids or other injurious defects.
2. Markings: Legibly marked in green to identify sewer pipe at intervals of 5 feet maximum with manufacturer's name, trademark, pipe size (nominal size and OD base IPS), PE3408, SDR-11 appropriate legend such as HDPE, ASTM D3035 or ASTM F714, date of manufacture, and point of origin.
3. Pipe not marked as specified will be rejected.

B. HDPE Fittings

1. Butt Fusion Fittings: In accordance with ASTM D3261, and shall be manufactured by injection molding, a combination of extrusion and machining, or fabricated from HDPE pipe conforming to this specification.
    a. Material and cell classification: Same as pipe.
    b. Fabricated fittings shall be manufactured using a McElroy Datalogger to record fusion pressure and temperature. A graphic representation of the temperature and pressure data for all fusion joints made producing fittings shall be maintained as part of the quality control. The fitting shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, voids, or other injurious defects.
2. Electrofusion Fittings: ASTM F1055
    a. Material and cell classification: Same as pipe.
3. Flanged and Mechanical Joint Adapters: ASTM D3216.
    a. Material and cell classification: Same as pipe.
4. All fittings and adapters shall be pressure rated to provide a working pressure rating no less than that of the pipe.

C. HDPE Pipe Mechanical Restraint

1. Mechanical restraint for HDPE may be provided by mechanical means separate from the mechanical joint gasket sealing gland. The restrainer shall provide wide, supportive contact around the full circumference of the pipe and be equal to the listed widths.

a. Means of restraint shall be machined serrations on the inside surface of the restrainer equal to or greater than the listed serrations per inch and width.

b. Loading of the restrainer shall be by a ductile iron follower that provides even circumferential loading over the entire restrainer. Design shall be such that restraint shall be increased with increases in line pressure.

c. Serrated restrainer shall be ductile iron ASTM A536 with a ductile iron follower; bolts and nuts shall be corrosive resistant, high strength alloy steel.

d. The restrainer shall have a pressure rating of, or equal to that of the pipe on which it is used or 150 PSI which ever is lesser.

1) Restrainers shall be JCM Industries, Sur-Grip or pre-approved equal.

Nominal Size	Restraint Width	Serrations per inch
4", 6"	1-1/2"	8

e. Pipe stiffeners shall be used in conjunction with restrainers. The pipe stiffeners shall be designed to support the interior wall of the HDPE. The stiffeners shall support the pipe's end and control the "necking down" reaction to the pressure applied during normal installation. The pipe stiffeners shall be formed of 304 or 316 stainless steel to the HDPE manufacturers published average inside diameter of the specific size and DR of the HDPE. Stiffeners shall be by JCM Industries or pre-approved equal.

2.2 CLEANOUTS

A. HDPE Cleanout: HDPE pipe with ductile iron flange and HDPE blind flange.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 2 Section "Earthwork."

3.2 IDENTIFICATION

A. Materials and their installation are specified in Division 2 Section "Earthwork." Arrange for installing detectable green warning tapes directly over piping.

3.3 INSTALLATION, GENERAL

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground leachate piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical.

B. Install force-main piping to existing force main leachate system.

3.4 PIPE JOINT CONSTRUCTION AND INSTALLATION

A. HDPE Pipe and Fittings:

1. Follow HDPE pipe manufacturer's installation instructions for field cutting and fusion jointing techniques for HDPE pipe. Include acceptable size and shape of fusion bead; and minimum radius of curvature of various sizes of pipes for installing curved sections of pipe.
2. Do not install flanges, fittings, or valves in curved sections.
3. Use butt fusion jointing technique for connections between sections of fittings, unless otherwise noted herein.
4. Inspect and evaluate following manufacturer's installation instructions.
5. Remove and replace damaged HDPE pipe and fittings.

3.5 CLEANOUT INSTALLATION

A. Install cleanouts and riser extension from leachate pipe to cleanout at grade. Use HDPE pipe for riser extensions to cleanouts.

3.6 CLOSING ABANDONED LEACHATE SYSTEM

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

1. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

3.7 FIELD QUALITY CONTROL

A. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed.

1. Place plug in end of incomplete piping at end of day and when work stops.

B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place; after completion of backfill and compaction; and again at completion of Project.

1. Submit separate reports for each system inspection.

2. Defects requiring correction include the following:

a. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 95 percent of piping diameter.

b. Crushed, broken, cracked, or otherwise damaged piping.

c. Infiltration: Water leakage into piping.

d. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.

4. Reinspect and repeat procedure until results are satisfactory.

C. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.

2. Test completed piping systems according to authorities having jurisdiction.

3. Submit separate reports for each test.

4. Perform tests as follows:

a. Force Main: Perform hydrostatic test after joint restraint is complete. Test at pressure not less than one and one-half times maximum system operating pressure, but not less than 150 psig.

1) PVC Piping: Test according to manufacturer's requirements.

5. Leaks and loss in test pressure constitute defects that must be repaired.

6. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

END OF SECTION

SECTION 02584 - UNDERGROUND DUCTS AND UTILITY STRUCTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Ducts in direct-buried duct banks.
2. Handholes and handhole accessories.

B. Related Sections include the following:

1. Division 16 Section "Grounding and Bonding" for grounding electrodes, counterpoise conductors, clamps and connectors for grounding metallic manhole and handhole accessories, and testing of grounds.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Handhole hardware.
2. Conduit and ducts, including elbows, bell ends, bends, fittings, and solvent cement.
3. Duct-bank materials, including spacers and miscellaneous components.
4. Warning tape.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories including ducts for communications: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with ANSI C2.

C. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

B. Store precast concrete units at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

C. Lift and support precast concrete units only at designated lifting or supporting points.

1.6 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated.

1. Notify Owner at least two days in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without Owner's written permission.

1.7 COORDINATION

A. Coordinate layout and installation of ducts and handholes with final arrangement of other utilities and site grading, as determined in the field.

B. Coordinate elevations of ducts and duct-bank entrances into handholes with final profiles of conduits as determined by coordination with other utilities and underground obstructions. Revise locations and elevations from those indicated as required to suit field conditions and to ensure duct runs drain to handholes, and as approved by Engineer.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Underground Precast Concrete Utility Structures:

a. Carder Concrete Products.

b. Christy Concrete Products, Inc.

c. Elmhurst-Chicago Stone Co.

d. Riverton Concrete Products.

e. Rotondo Precast/Old Castle.

f. Utility Vault Co.

g. Wausau Concrete Co.

h. Approved Equal

2. Frames and Covers:

a. Campbell Foundry Co.

b. East Jordan Iron Works, Inc.

c. McKinley Iron Works, Inc.

d. Neenah Foundry Co.

e. Approved Equal

3. Nonmetallic Ducts and Accessories:

a. Arnco Corp.

b. Beck Manufacturing Inc.

c. Cantex, Inc.

d. Certainteed Corp.; Pipe & Plastics Group.

e. ElecSys, Inc.

f. Electri-Flex Co.

g. Ipex, Inc.

h. Lamson & Sessions; Carlon Electrical Products.

i. Manhattan/CDT/Cole-Flex.

j. Spiraduct/AFC Cable Systems, Inc.

k. Approved Equal

2.2 CONDUIT

A. Conduit and fittings are specified in Division 16 Section "Conduits."

2.3 DUCTS

A. Rigid Nonmetallic Conduit: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by the same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

B. Rigid Nonmetallic Conduit: NEMA TC 2, Type EPC-80-PVC, UL 651, with matching fittings by the same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.4 HANDHOLES

A. Precast Handholes: Reinforced concrete, monolithically poured walls and bottom, with steel or cast-aluminum frame and access door assembly as the top of handhole. Duct entrances and windows shall be located near corners to facilitate racking. Pulling-in irons and other built-in items shall be installed before pouring concrete. Cover shall have nonskid finish and legend. Unit, when buried, shall be designed to support AASHTO H20 loading.

B. Fiberglass Handholes: Molded fiberglass, with 6-inch- square cable entrance at each side and weatherproof cover with nonskid finish and legend. Unit, when buried, shall be designed to support AASHTO H10 loading.

C. Cover Legend: "ELECTRIC" or "COMMUNICATION".

2.5 ACCESSORIES

A. Duct Spacers: Rigid PVC interlocking spacers, selected to provide minimum duct spacings and cover depths indicated while supporting ducts during concreting and backfilling; produced by the same manufacturer as the ducts.

2.6 CONSTRUCTION MATERIALS

A. Mortar: Comply with ASTM C 270, Type M, except for quantities less than 2.0 cu. ft. where packaged mix complying with ASTM C 387, Type M, may be used.

B. Brick for Manhole Chimney: Sewer and manhole brick, ASTM C 32, Grade MS.

C. Concrete: Use 3000-psi- minimum, 28-day compressive strength and 3/8-inch maximum aggregate size. Concrete and reinforcement are specified in Division 3 Section "Cast-in-Place Concrete."

PART 3 - EXECUTION

3.1 APPLICATION

A. Underground Ducts for Electrical Feeders: Type EPC-40-PVC, direct-buried duct bank, except use Type EPC-80-PVC when in roadway.

B. Underground Ducts for Communication: Type EPC-40-PVC, direct-buried duct bank, except use Type EPC-80-PVC when in roadway.

C. Handholes: Underground precast concrete utility structures.

3.2 EARTHWORK

A. Excavation and Backfill: Comply with Division 2 Section "Earthwork" but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

C. Restore all areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, and mulching. Comply with Division 2 Section "Landscaping."

D. Restore disturbed pavement. Refer to Division 2 Section "Bituminous Concrete Pavement."

3.3 CONDUIT AND DUCT INSTALLATION

A. Slope: Pitch ducts a minimum slope of 1:300 down toward handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.

B. Curves and Bends: Use manufactured elbows for stub-ups at equipment and at building entrances. Use manufactured long sweep bends with a minimum radius of 25 feet, both horizontally and vertically, at other locations.

C. Use solvent-cement joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in the same plane.

D. Duct Entrances to Handholes: Space end bells approximately 10 inches o.c. for 5-inch ducts and vary proportionately for other duct sizes. Change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line. Grout end bells into manhole walls from both sides to provide watertight entrances.

E. Building Entrances: Make a transition from underground duct to conduit at least 10 feet outside the building wall. Use fittings manufactured for this purpose. Follow the appropriate installation instructions below:

1. Direct-Buried, Nonencased Ducts at Nonwaterproofed Wall Penetrations: Install a Schedule 40, galvanized steel pipe sleeve for each duct. Calk space between conduit and sleeve with duct-sealing compound on both sides for moisture-tight seal.

F. Direct-Buried Ducts: Support ducts on duct spacers, spaced as recommended by manufacturer and coordinated with duct size, duct spacing, and outdoor temperature. Install as follows:

1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts.

2. Trench Bottom: Continuous, firm, and uniform support for duct bank. Prepare trench bottoms as specified in Division 2 Section "Earthwork" for pipes less than 6 inches in nominal diameter.

3. Backfill: Install backfill as specified in Division 2 Section "Earthwork." After installing first tier of ducts, backfill and compact. Repeat backfilling after placing each tier. After placing last tier, hand-place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, complete backfilling normally.

4. Minimum Clearances between Ducts: 2 inches between ducts for like services and 6 inches between power and signal ducts.

5. Depth: Install top of duct bank at least 24 inches below finished grade, unless otherwise indicated.

G. Warning Tape: Bury warning tape approximately 12 inches above all duct banks. Align tape parallel to and within 3 inches of the centerline of duct bank.

H. Stub-ups: Use rigid steel conduit for stub-ups to equipment. For equipment mounted on outdoor concrete bases, extend steel conduit a minimum of 5 feet from edge of base. Install insulated grounding bushings on terminations. Couple steel conduits to ducts with adapters designed for this purpose and encase coupling with 3 inches of concrete.

I. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.

J. Pulling Cord: Install 100-lbf- test nylon cord in ducts, including spares.

3.4 HANDHOLE INSTALLATION

A. Elevation: Install handholes with depth as indicated. Where indicated, cast handhole cover frame directly into roof of handhole and set roof surface 1 inch above grade.

B. Access: Install frame and cover.

1. Set frames in paved areas and trafficways flush with finished grade. Set other frames 1 inch above finished grade.

C. Grounding: Install ground rod through floor in each structure with top protruding 4 inches above floor. Ground exposed metal components and hardware with bare-copper ground conductors. Train conductors neatly around corners. Use cable clamps secured with expansion anchors to attach ground conductors.

D. Precast Concrete Handhole Installation: Unless otherwise indicated, comply with ASTM C 891.

1. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.

2. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

3.5 FIELD QUALITY CONTROL

A. Testing: Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.

B. Grounding: Test handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 16 Section "Grounding and Bonding."

C. Duct Integrity: Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of the duct. If obstructions are indicated, remove obstructions and retest.

3.6 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of handholes. Remove foreign material.

END OF SECTION

SECTION 02621 - UNDERDRAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes subdrainage systems for the following:

1. Landfills.

B. Related Sections include the following:

1. Division 2 Section "Landfill Earthwork" for sand drainage layer material.

1.3 DEFINITIONS

A. PE: Polyethylene plastic.

B. PP: Polypropylene plastic.

C. Subdrainage: Drainage system that collects and removes subsurface or seepage water.

1.4 SUBMITTALS

A. Product Data and Certification: For the following:

1. Perforated-wall pipe and fittings.
2. Geotextile filter fabric sock.

PART 2 - PRODUCTS

2.1 PERFORATED PIPES AND FITTINGS

A. Perforated and Solid Wall PE Pipe and Fittings:

1. NPS 6 and Smaller: ASTM F 405 or AASHTO M 252, Type CP; corrugated, for coupled joints.
2. NPS 8 and Larger: ASTM F 667; AASHTO M 252, Type CP; or AASHTO M 294, Type CP; corrugated; for coupled joints.
3. Couplings: Manufacturer's standard, band type.

2.2 SOIL MATERIALS

A. Drainage Sand Layer material is specified in Division 2 Section "Landfill Earthwork."

2.3 GEOTEXTILE FILTER FABRICS

A. Description: Fabric of PP or polyester fibers or combination of both, with flow rate range from 110 to 330 gpm/sq. ft. when tested according to ASTM D 4491.

1. Structure Type: Nonwoven, needle-punched continuous filament.

2. Style**:** Sock.

2.4 MISCELLANEOUS

A. Bird Screening: Galvanized steel, 1/2-inch-square mesh, 0.041-inch wire.

B. Underdrain Pipe Clamp for Bird Screening: Stainless steel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces and areas for suitable conditions where subdrainage systems are to be installed.

B. Locate and mark existing utilities, underground structures, and aboveground obstructions before beginning installation and avoid disruption and damage of services.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PIPING APPLICATIONS

A. Landfill Subdrainage Piping:

1. Perforated PE pipe and fittings wrapped in geotextile fabric.

2. Solid wall pipe and fittings.

3.3 PIPING INSTALLATION, GENERAL

A. Install piping beginning at low points of system, true to grades and alignment indicated, with unbroken continuity of invert. Install tees, sleeves, and couplings according to manufacturer's written instructions and other requirements indicated.

1. Lay perforated pipe with perforations down.

B. Use increasers, reducers, and couplings made for different sizes or materials of pipes and fittings being connected. Reduction of pipe size in direction of flow is prohibited.

C. Install PE piping according to ASTM D 2321.

3.4 LANDFILL UNDERDRAIN INSTALLATION

A. Layout underdrain piping as shown on the drawings. Provide couplings and tees where necessary.

B. Install sand drainage material over underdrain piping in accordance with Division 2 Section "Landfill Earthwork."

C. Daylighting Requirements:

1. Extend underdrain piping horizontally a minimum of 6 inches beyond final grade elevation at invert of pipe.

2. Install bird screen on daylighted pipe and secure with pipe clamp.

3.5 IDENTIFICATION

A. Arrange for installation of detectable green warning tape directly over piping.

3.6 FIELD QUALITY CONTROL

A. Testing: After installing drainage course to top of piping, test drain piping with water to ensure free flow before backfilling. Remove obstructions, replace damaged components, and repeat test until results are satisfactory.

3.7 CLEANING

A. Clear interior of installed piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of each day or when work stops.

END OF SECTION

SECTION 02630 - STORM DRAINAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies enclosed storm drainage system for landfill closure and includes the following:

1. Precast concrete structures with frames and covers, or frames and grates.
2. Enclosed, underground piping systems.
3. Metal-lined, half-pipe, drainage swales.

B. Related Sections include the following:

1. Division 2 Section "Site Earthwork" for excavation and backfill.
2. Division 2 Section "Permanent Erosion and Sedimentation Control" for exposed drainage swales and outlets.
3. Division 2 Section "Underdrains" for subdrainage systems.

1.3 DEFINITIONS

A. HDPE: High-density polyethylene.

B. PVC: Polyvinyl chloride plastic.

C. RCP: Reinforced concrete pipe.

1.4 SUBMITTALS

A. Product Data and Material Certifications.

1. Piping.
2. Precast concrete manholes and other structures.
3. Structure frames, covers, and grates.

B. Shop Drawings:

1. Corrugated Steel Pipe and Fittings
   a. Details of factory-fabricated elbows

C. Design Mix Certifications: For each class of cast-in-place concrete.

D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.5 QUALITY ASSURANCE

A. Where "Form 816" is referenced, it shall mean "State of Connecticut Department of Transportation Standard Specifications for Roads, Bridges and Incidental Construction, Form 816," and issued supplements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic structures, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle precast concrete manholes and other structures according to manufacturer's written rigging instructions.

1.7 PROJECT CONDITIONS

A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Engineer not less than 2 days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Engineer's written permission.

PART 2 - PRODUCTS

2.1 PIPES AND FITTINGS

A. HDPE: Corrugated PE Pipe and Fittings NPS 12 to NPS 48: AASHTO M 294M, Type S, with smooth waterway for coupling joints.

1. Soiltight Couplings: AASHTO M 294M, corrugated, matching pipe and fittings.

B. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76, Class IV, for gasketed joints.

1. Gaskets: ASTM C 443, rubber.

C. Corrugated Steel Pipe and Fittings: ASTM A 760/A 760M, Type I with fittings of similar form and construction as pipe.

1. Spiral pipe will not be allowed.

2. Elbows: Custom factory-fabricated units.

3. Coating: Zinc.

4. Connections: Galvanized self-tapping screws.

5. Deadman: Polymer lumber made from reclaimed post-consumer or post-industrial plastic and wood waste in approximately equal proportions.

2.2 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350R, and the following:

1. Cement: ASTM C 150, Type II.

2. Fine Aggregate: ASTM C 33, sand.

3. Coarse Aggregate: ASTM C 33, crushed gravel.

4. Water: Potable.

B. Portland Cement Design Mix: 4,000 psi minimum, with 0.45 maximum water-cementitious ratio.

1. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

C. Structure Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4,000 psi minimum, with 0.45 maximum water-cementitious ratio.

1. Include channels in catch basins.

a. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.

D. Ballast and Pipe Supports: Portland cement design mix, 3,000 psi minimum, with 0.58 maximum water-cementitious ratio.

1. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

2.3 MISCELLANEOUS

A. Grout: Form 816, Section M.03.01-14.

B. Filter Fabric: Form 816, Section M.08.01-26.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 2 Section " Site Earthwork."

3.2 IDENTIFICATION

A. Materials and their installation are specified in Division 2 Section "Site Earthwork." Arrange for installing green warning tapes directly over piping and at outside edges of underground structures.

1. Use warning tape or detectable warning tape over ferrous piping.

2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.3 INSTALLATION, GENERAL

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line, and pull past each joint as it is completed.

C. Install gravity-flow piping and terminate piping as indicated.

1. Install piping pitched down in direction of flow, at minimum slope of 1 percent, unless otherwise indicated.

3.4 PIPE JOINT CONSTRUCTION AND INSTALLATION

A. General: Join and install pipe and fittings according to installations indicated.

B. Corrugated PE Piping: Join according to CPPA 100.

C. Concrete Pipe and Fittings: Install according to ACPA's "Concrete Pipe Installation Manual." Use the following seals:

1. Round Pipe and Fittings: ASTM C 443, rubber gaskets.

D. System Piping Joints: Make joints using system manufacturer's couplings, unless otherwise indicated.

E. Join piping made of different materials or dimensions with couplings made for this application. Use couplings that are compatible with and that fit both systems' materials and dimensions.

3.5 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318 and ACI 350R.

3.6 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:
    a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    c. Crushed, broken, cracked, or otherwise damaged piping.
    d. Infiltration: Water leakage into piping.
    e. Exfiltration: Water leakage from or around piping.
3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

3.7 CLEANING

A. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed.

1. In large, accessible piping, brushes and brooms may be used for cleaning.
2. Place plug in end of incomplete piping at end of day and when work stops.
3. Flush piping between manholes and other structures to remove collected debris, if required by authorities having jurisdiction.

B. Existing Piping, Culverts, Drainage Flows, and Structures. Clean interiors of drainage systems located within the limits of the Work of accumulated sediment and debris.

END OF SECTION

SECTION 02732 –GRAVEL SURFACING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. One course gravel wearing surface (Traffic Bound Gravel Surface).
2. Restoration of existing gravel road or drive as indicated or as directed by the Engineer.
3. Geogrid.

B. Related Sections include the following:

1. Division 2 Section "Landfill Earthwork" for landfill cap material beneath roadway.

1.3 SUBMITTALS

A. For Information Only

1. Material Certification: Signed by manufacturers or suppliers certifying that the material complies with requirements.
2. Geogrid:
    a. Shop Drawings: Indicate proposed roll layout and indicate direction of geogrid. Show roll sizes. Include details showing termination of the rolls at perimeter of lined areas; and methods of connecting, overlapping, and anchoring geogrid.
        1) Lay out geogrid to minimize field connections.
    b. Sample: One per each lot of geogrid to be used. Label samples with manufacturer's name, product identification, lot number, and roll number.
    c. Inventory tickets, roll numbers or batch identifications, packing papers, and invoices.
    d. Installation Certification: By installer and manufacturer's Technical Representative, stating the geogrid was installed in an acceptable manner per manufacturer's requirements.

1.4 QUALITY ASSURANCE

A. Form 816: State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges and Incidental Construction, Form 816.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Traffic Bound Gravel Surface: Form 816, Section M.02.03, Traffic Bound Gravel Surface.

1. Single Course: Form 816, Section M.02.06, Grading C.

B. Geogrid Reinforcement: Integrally formed bi-axial grid structure manufactured from first quality virgin high-density polyethylene.

Property	Test Method	Requirement
Carbon Black Content (min. percentage)	ASTM D4218	2
Tensile Strength (5% strain)	ASTM 6637	920 lb/ft machine direction
		1,350 lb/ft cross direction

PART 3 - EXECUTION

3.1 EXAMINATION

A. Confirm subgrade is in conformance with Division 2 Section "Earthwork." Maintain subgrade or subbase true to line and grade.

B. Proof-roll subgrade or subbase using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction.

C. Proceed with surfacing only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Stabilization Geotextile: See Division 2 Section "Landfill Earthwork" for requirements.

3.3 GEOGRID

A. Keep geogrid clean before installation. Unpackage, install and join together only enough geogrid material that can be completely installed in the same day.

B. Provide manufacturer's Technical Service Representative during start of geogrid installation activities. Inspect

C. Verify that subgrade is dry and in suitable condition to begin installation of geogrid.

D. Geogrid Installation

1. Install geogrid on prepared surface and in the presence of a manufacturer's Technical Representative. Minimize handling and movement of product. Overlap layers in accordance with manufacturer's requirements.

2. Do not allow materials or equipment to be dragged or travel over installed geogrid.

3. Place overlying materials to prevent damage to geogrid. Install 9 inch minimum layer over geogrid before allowing tracked vehicles to traverse over locations containing the geogrid.

3.4 GRAVEL SURFACE INSTALLATION

A. Spread surfacing material uniformly over geogrid.

B. Spread material to the lines, depth, and shape indicated. If required, wet material and blade, drag, or scrape to conform to typical cross section.

C. Compact to a firm and uniform surface satisfactory to the Engineer. Compact and bound each course of material with equipment specifically designed for compaction.

1. Rollers:

a. Weight: 10 tons minimum.

b. Ground Pressure: Not less than 300 pounds per linear inch of contact width.

2. Vibratory Units: Static weight of not less than 4 tons.

3. Water. Water may be used during compacting and binding operations when applied from an approved watering device. Direction and intensity of water stream shall be as ordered by the Engineer.

D. Perform compacting and binding operation at outside edges, overlapping for a distance not less than 6 inches, and progressing towards the middle of the surfacing area, parallel with the centerline of the road.

E. Remove areas of segregated coarse or fine materials and replace with well-graded material.

1. Provide additional material to fill irregularities in surface course. Evenly incorporate material with in-place gravel by scarifying, harrowing, or brooming.

3.5 RESURFACING

A. Confirm existing surface is in conformance with subgrade requirements in Division 2 Section "Site Earthwork."

B. Pre-fill ruts with material before installing overlay.

C. Install overlay in conformance with installation requirements specified herein.

3.6 INSTALLATION TOLERANCES

A. Variation from Design Elevation

1. Traffic Bound Gravel Surface: 1 inch plus or minus.

3.7 FIELD QUALITY CONTROL

A. Surface Installation: Measure finished surface for compliance with Installation Tolerances.

1. Course Thickness.

a. Roads, Drives, Walks: Take measurements at intervals of 500 feet or less, along each edge of road lane.

2. If measurements indicate a deficient or excess thickness, take additional measurements to determine the longitudinal limits of the deficiency. Correct areas found to be deficient or in excess of Installation Tolerances.

3.8 REPAIRS AND PROTECTION

A. Protecting Gravel Surfacing Roads and Areas: Protect newly graded roads and areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace material to depth as directed by Engineer; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

END OF SECTION

SECTION 02741 – BITUMINOUS CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Bituminous concrete paving.
2. Bituminous concrete patching and restoration.

B. Related Sections include the following:

1. Division 2 Section "Site Earthwork" for aggregate subbase and base courses, and for reclaimation of existing bituminous concrete.

1.2 DEFINITIONS

A. Bituminous Concrete Base Course: Asphalt-aggregate layer placed over subgrade, aggregate subbase course, or aggregate base course; and beneath bituminous concrete surface course.

B. Bituminous Concrete Surface Course: The asphalt-aggregate top course of a bituminous concrete pavement, sometimes called a wearing course.

C. DOT: Department of Transportation.

1.3 SYSTEM DESCRIPTION

A. Provide bituminous concrete paving according to materials, workmanship, and other applicable requirements of standard specifications of state or local DOT.

1. Standard Specification: State of Connecticut, Standard Specifications for Roads, Bridges and Incidental Construction, Form 816
2. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.4 SUBMITTALS

A. For Information:

1. Job-Mix Designs: Certification of each job mix proposed for the Work.
2. Qualification Data: For bituminous concrete supplier.

B. Material Certificates:

1. For each batch of paving material delivered to the Site, signed by manufacturers.

1.5 QUALITY ASSURANCE

A. Supplier Qualifications: A qualified supplier, registered with and approved by CT DOT.

B. Regulatory Requirements: Comply with CT DOT Form 816 for bituminous concrete paving work.

C. Asphalt-Paving Publication: Comply with AI MS-22, "Construction of Hot Mix Asphalt Pavements," unless more stringent requirements are indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Transport bituminous concrete mixture in tight body trucks that have been previously cleaned of foreign material.

1. Tightly cover trucks with waterproof canvas or other suitable covers.

B. Deliver mixture within 25 degrees F of approved job mix formula temperature.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp or if the following conditions are not met:

1. Prime and Tack Coats: Minimum surface temperature of 60 deg F.

2. Bituminous Concrete Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.

3. Bituminous Concrete Surface Course: Minimum surface temperature of 60 deg F at time of placement.

PART 2 - PRODUCTS

2.1 BITUMINOUS CONCRETE

A. Materials: Section M.04 and M.05.02 of Form 816.

B. Tack Coat: AASHTO M 140 Grade SS-1 or SS-1H, emulsified asphalt or AASHTO M 208 Grade CSS-1 or CSS-1H, cationic emulsified asphalt, slow setting, diluted in half with water.

2.2 MIXES

A. Bituminous Concrete: Dense, hot-laid, bituminous concrete plant mixes approved by authorities having jurisdiction and complying with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.

2. Binder Course: Class 1.

3. Surface Course: Class 2.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that surface to receive paving is dry and in suitable condition to support paving and imposed loads.

B. Proof-roll subbase or aggregate base course using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction.

C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. General: Immediately before placing bituminous concrete, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

1. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.

B. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.

1. Allow tack coat to cure undisturbed before applying bituminous concrete paving.

2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.3 REPAIRS

A. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, bituminous concrete paving at a rate of 0.05 to 0.15 gal./sq. yd.

1. Allow tack coat to cure undisturbed before applying bituminous concrete paving.

2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

B. Temporary Repair: Fill excavated pavement area with bituminous concrete base mix to indicated thickness and, while still hot, compact flush with adjacent surface.

C. Permanent Repair: Partially fill excavated pavement area with bituminous concrete base mix and, while still hot, compact. Cover bituminous concrete base course with compacted, bituminous concrete surface layer finished flush with adjacent surfaces.

3.4 BITUMINOUS CONCRETE PLACING

A. Machine place hot bituminous concrete on prepared surface, spread uniformly, and strike off. Place by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place bituminous concrete base course in number of lifts and thicknesses indicated.
2. Spread mix at minimum temperature of 250 deg F.
3. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes, unless otherwise indicated.
4. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in bituminous concrete paving mat.
5. In areas inaccessible to pavers, use staked forms to maintain indicated line and grade. Prevent segregation of mix when placing mix by hand.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of bituminous concrete base course before placing bituminous concrete surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot bituminous concrete to prevent segregation of mix; use suitable hand tools to smooth surface.

3.5 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of bituminous concrete course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
3. Offset transverse joints, in successive courses, a minimum of 24 inches.
4. Construct transverse joints as described in AI MS-22, "Construction of Hot Mix Asphalt Pavements."
5. Compact joints as soon as bituminous concrete will bear roller weight without excessive displacement.
6. Compact material at joints to a density within 2 percent of specified course density.

3.6 COMPACTION

A. General: Begin compaction as soon as placed paving material will bear roller weight without excessive displacement. Compact material with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while bituminous concrete is still hot enough to achieve specified density. Continue rolling until course has been uniformly compacted to the following density:

1. Average Density: 95 percent of reference maximum theoretical density according to AASHTO T 209, but not less than 92 percent nor greater than 97 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while bituminous concrete is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while material is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh material. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.7 INSTALLATION TOLERANCES

A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch.

2. Surface Course: Plus 1/4 inch, no minus.

B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Base Course:

a. Access Roadways: 3/8-inch.

2. Surface Course: 1/4 inch.

3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.

1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from specified requirements.

B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

C. Thickness: In-place compacted thickness of bituminous concrete courses will be determined according to ASTM D 3549.

D. Surface Smoothness: Finished surface of each bituminous concrete course will be tested for compliance with smoothness tolerances.

E. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to AASHTO T 168.

1. Reference maximum theoretical density will be determined by averaging results from four samples of bituminous concrete mixture delivered daily to site, prepared according to AASHTO T 209, and compacted according to job-mix specifications.

2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.

a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.

b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

F. Remove and replace or install additional bituminous concrete where test results or measurements indicate that it does not comply with specified requirements.

3.9 DISPOSAL

A. Remove excavated and excess materials from Project site and legally dispose of them in an approved landfill.

1. Do not allow excavated and excess materials to accumulate on-site.

END OF SECTION

SECTION 02822 - CHAIN LINK FENCE

PART 1 - GENERAL

1.1 SUMMARY

A. Work under this Section shall consist of furnishing and installing woven wire fencing/gates, supported by metal posts, erected where indicated on the Drawings or as ordered, and in conformity with these Specifications.

1.2 QUALITY ASSURANCE

A. Where "Form 816" is used, it shall mean "State of Connecticut Department of Transportation Standard Specifications for Roads, Bridges and Incidental Construction, Form 816"and issued supplements.

1.3 SUBMITTALS

A. Submit manufacturer's certification demonstrating compliance with specifications for Chain Link Fence and Gates.

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials for this Work shall conform to the requirements of Form 816, Article M.10.05, and shall be aluminum coated steel fabric with galvanized posts, rails and hardware.

PART 3 - EXECUTION

3.1 GENERAL

A. Space posts as indicated.

1. Provide pull posts with two braces for changes in horizontal or vertical alignment of 10 degrees or more.

B. Fasten braces to posts by suitable connections, and truss from line post back to post requiring bracing with 3/8-inch round rod, having a turnbuckle adjustment.

C. Pass top rail through base of line post cap and form a continuous brace from end to end of fence. Provide rail with couplings approximately every 20 feet.

1. Couplings: Outside-sleeve type, 7 inches long minimum, with one in every five couplings having a heavy spring to take up expansion and contraction in top rail.

D. Fasten fabric to line posts with bands or wire clamps of No. 6 gage aluminized steel wire 4-3/4 inches long. Space bands approximately 14 inches apart.

1. Fasten fabric to top and bottom rail with tie wires, 6-1/4 inches long, spaced approximately 24 inches apart.

END OF SECTION

SECTION 02845 – METAL BEAM GUIDE RAIL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes steel rail elements fastened to posts and terminal ends as indicated.

1. Posts: Galvanized steel.
2. Rails: Galvanized steel.
3. System:
    a. Metal beam rail Type R-B 350

B. Removal and resetting of existing guard rail.

1. Provide new posts, rail or hardware as required for a complete installation.

C. Related Sections include the following:

1. Division 2 Section "Earthwork" for excavation, filling, and rough grading.

1.3 SUBMITTALS

A. Material and Product Certificates: For each type of material required for a complete rail system.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Where referenced, comply with the following.

1. Form 816: State of Connecticut Department of Transportation Standard Specifications for Roads, Bridges and Incidental Construction.

PART 2 - PRODUCTS

2.1 METAL BEAM RAIL SYSTEM

A. Steel Posts, Welded-Soil Plates, Brackets, Back-up Rails, and Channel Rubrails: Form 816, Subarticle M.10.02-1.

B. Rail Element and Terminal Sections: Form 816, Subarticle M.10.02-3.

C. Steel Plates, Steel Washer Plates and Square Steel Washers: Form 816, Subarticle M.10.02-5.

1. ASTM A36.

2. Galvanized: ASTM A153.

D. Bolts, Rods, Washers, and Nuts: Form 816, Subarticle M.10.02-6.

E. End Anchorages: Form 816, Subarticle M.10.02-7.

F. Plastic Block-Outs: Form 816, Subarticle M.10.02-9.

G. Touch-Up Material: Zinc-rich galvanized paint conforming to Form 816, Subarticle M.10.02-8.

PART 3 - EXECUTION

3.1 GENERAL

A. Install metal beam rail system in accordance with the following and Form 816 Subarticle 9.10.03.

B. Post Installation

1. Set posts plumb and in alignment with the rail or rail treatments.

2. Drive steel posts. Protect posts and galvanized surfaces from damage during driving operations.

C. End Anchor Post.

1. Where required, set end anchor post in excavated holes. Backfill and compact material.

D. Block Outs, Brackets, Rub Rails, and Rail Elements. Erect elements to produce a smooth continuous rail. Lap terminal connectors, rubrails, and rail elements in direction of traffic.

E. Anchorages, Channels, Terminal Sections and Fittings. Install as indicated.

1. Backfill anchorage excavations with suitable material and compact in 6-inch layers.

F. Furnish extra length posts at transition areas or where field conditions warrant to maintain indicated embedment depth.

3.2 WELDING

A. Weld steel plates and posts according to the applicable requirements of American Welding Society Specifications for Welded Highway and Railway Bridges as supplemented and revised by the following:

1. Engineer will perform visual inspection of welds.
2. Correct welds found unacceptable by the Engineer.

3.3 REPAIRS

A. Before final erection, clean and paint damaged galvanized surfaces with two coats of zinc-rich touch-up material.

3.4 CLEAN UP

A. Remove and dispose of surplus and unsuitable backfill material immediately after completion of installation.

END OF SECTION

SECTION 02891 – SITE SIGNS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Site signs and post.

1.3 SUBMITTALS

A. Material Certification. For each product, certifying material meets the Specification requirements.

B. Shop Drawings

1. Location and dimension of signs including details of copy, border and mounting holes.

2. Sign post and mounting bolts.

1.4 QUALITY ASSURANCE

A. Where "Form 816" is referenced, it shall mean "State of Connecticut Department of Transportation Standard Specifications for Roads, Bridges and Incidental Construction, Form 816," and issued supplements.

PART 2 - PRODUCTS

2.1 SIGNAGE

A. Sign Posts: Galvanized steel; Form 816, Article M.18.14.

B. Mounting Bolts: Form 816, Article M.18.15.

C. Sign Panel: Sheet aluminum; Form 816, Article M.18.13.

D. Reflective Sheeting: Form 816, Article M.18.09, Type I, II or III.

E. Silk Screening: According to the requirements of the reflective sheeting manufacturer.

PART 3 - EXECUTION

3.1 FABRICATION

A. Panels: Fabricate aluminum sign blanks free of buckles, warps, dents, cockles, burrs and defects. Cut to size and shape and punch mounting holes prior to metal degreasing and application of reflective sheeting. Meet requirements of Form 816 Section 12.08 for sign face.

B. Placement and dimensions of copy, border and mounting holes in signs shall conform to the approved shop drawings. Apply non-reflective copy, border and background by the silk screen process in the manner specified by the reflective sheeting manufacturer.

3.2 INSTALLATION

A. Prior to installation, mark in paint the proposed location of signs, for review and approval by the Owner.

B. Install posts and signs in accordance with Form 816 Section 12.08, Sign Face-Sheet Aluminum.

1. Drive or auger metal sign post, and tamp backfill after posts have been set level and plumb.

C. Mount signs only after support has been satisfactorily installed in its proper location.

END OF SECTION

SECTION 02899 – LANDFILL LIMIT MARKER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Concrete filled, metal posts to act as landfill limit markers delineating the lateral limits of the geomembrane liner at locations shown on the Contract Drawings.

1.3 SUBMITTALS

A. Material Certification. For each product, certifying material meets the Specification requirements. Materials include the following:

1. Steel posts.
2. Concrete components and mix.
3. Paint.

1.4 QUALITY ASSURANCE

A. Where "Form 816 is referenced, it shall mean "State of Connecticut Department of Transportation Standard Specifications for Roads, Bridges and Incidental Construction, Form 816," and issued supplements.

PART 2 - PRODUCTS

2.1 STEEL POST

A. Limit Marker Posts: Black steel; ANSI/ASME B36.10/19; Schedule 40.

1. Diameter: 6 inches or as indicated.

2.2 CONCRETE

A. General: Comply with ACI 301 for cast-in-place concrete.

B. Materials: Portland cement complying with ASTM C 150, aggregates complying with ASTM C 33, and potable water for ready-mixed concrete complying with ASTM C 94. Measure, batch, and mix Project-site-mixed concrete according to ASTM C 94.

1. Concrete Mixes: Normal-weight concrete air entrained with not less than 4000 psi compressive strength (28 days), 3-inch slump, and 1-inch maximum size aggregate.
2. Maximum Water-Cementitious Materials Ratio: 0.45.
3. Air Content: 5.5 percent plus or minus 1.5 percent.

2.3 PAINT

A. Enamel Paint System: Form 816, Article M.18.08.
   1. Color: As indicated.
   2. Coats:
      a. Primer: One Coat
      b. Finish Coat: Two coats.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Set edge of concrete footing adjacent to limit of landfill geomembrane cap.

B. Install landfill limit marker posts as indicated. Set posts plumb and fill with concrete. Rod concrete to remove air pockets.

C. Remove spilled concrete from post and adjacent surfaces and clean surface.

D. Use excess excavated material as fill or dispose of off-site.

3.2 PAINTING

A. Paint landfill limit marker post with one coat of primer and two finish coats.

END OF SECTION

DIVISION 3
CONCRETE

SECTION 03301 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies cast-in-place concrete, including reinforcement, concrete materials, mix design, placement procedures, and finishes.

B. Cast-in-place concrete applications include the following:

1. Impact basins.

C. Related Sections include the following:

1. Division 2 Section "Earthwork" for subgrade preparation, grading, and subbase course.

1.3 SUBMITTALS

A. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:

1. Design mixes.
2. Cementitious materials and aggregates.
3. Form materials and form-release agents.
4. Steel reinforcement and reinforcement accessories.
5. Admixtures.
6. Curing materials.
7. Bonding agents.
8. Joint-filler strips.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed concrete work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

C. Source Limitations: Obtain each type of cement of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.

D. Comply with ACI 301, "Specification for Structural Concrete," including the following, unless modified by the requirements of the Contract Documents.

1. General requirements, including quality assurance, acceptance of structure, and protection of in-place concrete.
2. Formwork and form accessories.
3. Steel reinforcement and supports.
4. Concrete mixtures.
5. Handling, placing, and constructing concrete.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle steel reinforcement to prevent bending and damage.

1.6 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 FORMWORK

A. Furnish formwork and form accessories according to ACI 301.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

2.3 CONCRETE MATERIALS

A. General: Use the same brand and type of cementitious material from the same manufacturer throughout the Project.

B. Portland Cement: ASTM C 150, Types I or II or Type I/II.

C. Normal-Weight Aggregate: ASTM C 33, uniformly graded, not exceeding 1-inch nominal size.

D. Water: Potable and complying with ASTM C 94.

2.4 ADMIXTURES

A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cement and to be compatible with other admixtures. Do not use admixtures containing calcium chloride.

B. Air-Entraining Admixture: ASTM C 260.

C. Water-Reducing Admixture: ASTM C 494, Type A.

2.5 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.

2.6 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

F. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

2.7 CONCRETE MIXES

A. Comply with ACI 301 requirements for concrete mixtures.

B. Prepare design mixes, proportioned according to ACI 211.1 and ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mix or field test data bases, as follows:

1. Compressive Strength (28 Days): 4000 psi.
2. Slump: 4 inches.

C. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 5.0 percent within a tolerance of plus 1.0 or minus 1.5 percent.

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Comply with ASTM C 94.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 PREPARATION

A. Proof-roll prepared subbase surface to check for unstable areas and verify need for additional compaction. Proceed with pavement only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

B. Remove loose material from compacted subbase surface immediately before placing concrete.

3.2 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Construct forms tight enough to prevent loss of concrete mortar.

D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.

1. Do not use rust-stained steel form-facing material.

E. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required lines, grades, elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

F. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

G. Chamfer exterior corners and edges of permanently exposed concrete.

H. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

I. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.3 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor bolts, accurately located, to elevations required.

3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.5 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.

B. Construction Joints: Locate and install so as not to impair strength or appearance of concrete, at locations indicated or as approved by Engineer.

C. Isolation (Expansion) Joints: Install joint-filler strips at junctions with slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint fillers full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.

3.6 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcement steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.

D. Comply with recommendations in ACI 304R for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery, at Project site, or during placement.

F. Consolidate concrete with mechanical vibrating equipment.

G. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation.

H. Deposit concrete in forms in horizontal layers no deeper than 24 inches and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.

1. Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by ACI 309R.

2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the vibrator. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix constituents to segregate.

I. Deposit and consolidate concrete for slabs in a continuous operation, until placement is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.

2. Maintain reinforcement in position on chairs during concrete placement.

3. Screed slab surfaces with a straightedge and strike off to correct elevations.

4. Slope surfaces uniformly to drains where required.

5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, free of humps or hollows, before excess moisture or bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

J. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.

2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.

K. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows, when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.

3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched, and fins and other projections exceeding 1/4 inch in height rubbed down or chipped off.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Completely remove fins and other projections.

1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.

2. Apply the following rubbed finish, defined in ACI 301, to smooth-formed finished concrete.

   a. Smooth-rubbed finish.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.8 FINISHING UNFORMED SURFACES

A. General: Comply with ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Screed surfaces with a straightedge and strike off. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane before excess moisture or bleedwater appears on the surface.

1. Do not further disturb surfaces before starting finishing operations.

C. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and the concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots, and fill low spots. Refloat surface immediately to uniform granular texture.

3.9 TOLERANCES

A. Comply with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

B. Comply with the additional requirements for pavements.

1. Elevation: 1/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-foot- long, unleveled straightedge not to exceed 1/4 inch.
4. Joint Spacing: 3 inches.
5. Contraction Joint Depth: Plus 1/4 inch, no minus.
6. Joint Width: Plus 1/8 inch, no minus.

3.10 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection, and follow recommendations in ACI 305R for hot-weather protection during curing.

B. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface.

C. Curing Methods: Cure formed and unformed concrete for at least seven days by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

a. Water.

b. Continuous water-fog spray.

c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement. Tests will be performed according to ACI 301.

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mix exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.

3.12 REPAIRS AND PROTECTION

A. Remove and replace concrete that does not comply with requirements in this Section.

B. Remove and replace concrete pavement that is broken, damaged, or defective, or does not meet requirements in this Section.

C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION

DIVISION 16
ELECTRICAL

(To Be Issued Via Addenda)

SECTION 16010 - SUMMARY OF WORK - ELECTRICAL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The work provided under Division 16 shall be as specified in Division 16 sections listed in the table of contents and as indicated on the drawings. In summary and without limiting the generality thereof, the work shall consist of the following:

1. Basic Materials and Methods
2. Demolition
3. Power Distribution
4. Final connection to existing equipment

B. The Contractor shall be responsible for coordinating the activities of power and communication work related to this project with the owner's representative. The owner shall be informed 48 hours in advance of all power and communication outages. Any outage shall not be greater than 24 hours.

C. Electrical Contractor shall provide all temporary power and lighting as required for construction activities.

1.2 RELATED WORK

A. The following work shall be performed under other Divisions. Coordinate related work with the following:

1. Sitework for site utilities

1.3 QUALITY ASSURANCES

A. Only the best of workmanship in accordance with present standards and generally accepted construction practices will be acceptable. Any work installed which the workmanship is judged by the Engineer to be below the present standards or generally accepted construction practices shall be taken out and replaced with properly done work at the Contractor's expense.

1.4 SITE CONDITIONS

A. The Drawings shall be taken in a sense as diagrammatic. Locations of mechanical and electrical equipment are not intended to show every offset and fitting, nor every structural difficulty that may be encountered during the installation of the work. Where necessary and after approval from the Engineer, the alignment of work and equipment shall be varied from that shown on Drawings without extra expense to the Owner.

B. Install work as close as possible to layouts shown on Contract Drawings. Modify work as necessary to:

1. Provide maximum possible headroom and space clearances.
2. Provide ready access to all parts of the work, for inspection, operation, safe maintenance and repair, and code conformance.
3. Coordinate and arrange work to avoid conflicts with work of other trades. Satisfactory space conditions shall be shown on coordination drawing submittals.
4. Where space appears inadequate, consult Engineer before proceeding with installation.

C. Finished work shall present a neat coordinated appearance.

1.5 PROJECT CONTROL

A. The Contractor shall ensure no debris from demolition or construction remains at the close of each workday and that work areas adjacent to the work area are maintained in a safe and useable condition.

1.6 DEFINITIONS

A. The following terms are used in this Division and are defined as follows:

1. "Provide": To furnish and install, ready for safe and regular operation the item, material or service under discussion.
2. "Furnish": To purchase, acquire and deliver to the site, complete with related accessories.
3. "Install": To erect, mount and connect completely, by acceptable methods.
4. "Work": Labor, materials, equipment, apparatus, controls and accessories required for proper and complete installation.
5. "Concealed": Embedded in masonry or other construction; or installed in furred spaces, trenches or crawl spaces; or installed within double partitions or hung ceilings; or in enclosures.
6. "Exposed": Visible to building occupants, excluding mechanical room and utility tunnel locations.
7. "Equal": Of weight, size, design, capacity and efficiency to meet requirements specified and shown, and of acceptable manufacture, as determined in the opinion of the Engineer.
8. "Acceptable": Acceptable, as determined in the opinion of the Engineer.
9. "Contractor": General Contractor.

10. "Named" Product: Manufacturer's name for product, as recorded in published documents of latest issue as of date of Contract Documents. Obtain Engineer's permission before using products of later or earlier model.

B. Standards, specifications and tests of following technical societies, organizations and governmental bodies, as referenced in Contract Documents, are hereby made part of Contract Documents.

1. IES: Illuminating Engineering Society.
2. NEC: National Electrical Code.
3. ANSI: American National Standards Institute.
4. ASTM: American Society for Testing and Materials.
5. EPA: Environmental Protection Agency.
6. FS: Federal Specification.
7. IEEE: Institute of Electrical and Electronics Engineers.
8. NEMA: National Electrical Manufacturers Association.
9. NFPA: National Fire Protection Association.
10. OSHA: Occupational Safety and Health Administration.
11. UL: Underwriters Laboratories.
12. CODE: Codes and regulations of the Federal, State and local governments and of utility companies having jurisdiction, as appropriate.

C. Use of a singular or plural reference in these Specifications shall not be construed to limit number of units required. These specifications are intended to define quality and performance characteristics; quantity of units supplied shall be as needed to meet requirements as specified and as shown on Contract Documents.

PART 2 - PRODUCTS

A. Products provided under Division 16 shall be as specified in the following Sections of Division 16 and as indicated on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation requirements for the work provided under Division 16 shall be as specified in the following Sections of Division 16 and as indicated on the Drawings.

END OF SECTION

SECTION 16050 - BASIC MATERIALS AND METHODS - ELECTRICAL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Unless otherwise indicated, provide Basic Material and Methods including raceway, wire and cable, pull and junction boxes, outlet boxes, wiring devices, motor starters, disconnect switches, overcurrent protective devices, electrical equipment not furnished as an integral part of manufactured equipment, and all incidental devices and accessories necessary for the complete installation of electrical systems indicated on the Drawings and specified in other Sections of Division 16.

1.2 PERMITS AND FEES

A. The Contractor shall give all necessary notices, obtain all permits, file all required plans, obtain all necessary approvals of governmental departments and utilities having jurisdiction over the electrical work and obtain all required certificates and inspections. If requested in writing or specified in other Division 16 Sections provide Engineer with copies of notification letters, permits, certificates, and inspection reports. The Contractor shall pay permit fees.

1.3 CODES, REGULATIONS AND STANDARDS

A. All materials, equipment, apparatus and work shall be in accordance with the latest edition of the National Electrical Code which has been adopted by the State of Connecticut, State and Local codes, and the requirements of the local utility companies.

B. All equipment and material provided under Division 16 shall be approved by the Underwriters' Laboratories, Inc. or other national, well known testing laboratory as evidenced by listing or labeling. All equipment items or parts thereof shall bear the manufacturer's nameplate, which shall give all pertinent information for the particular item. Distributor's or contractor's nameplates will not be acceptable.

C. Contract Documents shall govern whenever they are more stringent than Code requirements.

D. Where discrepancies occur between the Specifications and the Drawings, the more stringent rule shall govern. The Contractor shall bring all discrepancies to the Engineer's attention.

1.4 SUBMITTALS

A. Prepare shop drawing according to paragraphs 1.04 G and 1.04 H and submit through the Contractor to the Engineer for review.

B. The selection and intention to use a product specified by name shall NOT excuse the need for timely submission of shop drawings for that product.

C. Immediately after award of contract and prior to submitting shop drawings, Contractor shall submit for review a preliminary list of intended or proposed manufacturers for all items for which shop drawings are required.

D. Submission of shop drawings of unnamed manufacture or shop drawings at variance with the Contract Documents is NOT a proper request for substitution.

E. Samples that are submitted in lieu of shop drawings shall be clearly identified and shall be submitted in duplicate. Only one sample will be returned and the accepted sample shall be kept available at the job site office. The accepted sample retained by the Engineer will be kept available at Engineer's home office.

F. Upon completion of shop drawing review, shop drawings will be returned, marked with one of following notations: Furnish as submitted, Furnish as corrected, Revise and Resubmit, Rejected, or Submit Specified Item. Only products whose shop drawings are marked "Furnish as submitted" or "Furnish as corrected" shall be used on the project.

G. Submittals shall clearly indicate the following information:

1. Specification Section and Paragraph under which equipment is specified. (Failure to comply will result in submittal rejection.)
2. Equipment or fixture identification corresponding to that used in Contract Documents. (Failure to comply will result in submittal rejection.)
3. Descriptive data necessary to verify compliance with Contract Documents. (Failure to comply will result in submittal rejection.)
4. Manufacturer's specifications including materials of construction, metal gauge, thickness and finish.
5. Certified dimensional drawings including clearances required for maintenance or access.
6. Performance data, ratings, operating characteristics and operating limits.
7. Electrical ratings and characteristics.
8. Wiring and control diagrams, where applicable.
9. Certifications requested, including UL label or listing.

H. In addition, submittals shall include the following:

1. Accessories and special/non-standard features and materials which are being furnished.
2. List of accessories which are required for a proper installation but are NOT being provided by the product manufacturer or are NOT being furnished under this

Section. In the latter case, identify the Section(s) under which the accessories are being furnished.

1.5 PRODUCT SELECTION

A. Contractor's options for selecting products are limited by Contract Document requirements and governing regulations and are NOT controlled by industry traditions or procedures experienced by Contractor on previous construction projects. Required procedures include, but are NOT necessarily limited to, following various methods of specifying:

1. "Or Equal": Where named products are accompanied by the term "or equal" or words of similar effect, provide one of named products or propose substitute product according to paragraph 1.06, SUBSTITUTIONS.

2. Standards, Codes and Regulations: Where specification requires only compliance with a standard, code or regulation, Contractor may select any product which complies with requirements of that standard, code or regulation.

3. Performance Requirements: Provide products which comply with specific performances indicated and which are recommended by manufacturer (in published product literature or by individual certification) for application intended. Overall performance of product is implied where product is specified with only certain specific performance requirements.

B. Inclusion by name, of more than one manufacturer or fabricator, does NOT necessarily imply acceptability of standard products of those named. All manufacturers, named or proposed, shall conform, with modification as necessary, to criteria established by Contract Documents for performance, efficiency, materials and special accessories.

1.6 SUBSTITUTIONS

A. Substitution requests from vendors, suppliers and manufacturers may be submitted only during bid period. Requests for substitution will NOT be considered unless requests are received by the Engineer at least 7 days prior to Bid Due date AND all supporting data is provided such that an adequate review can be performed. If substitution is acceptable, an Addendum will be issued.

B. Substitution request from Contractors may be submitted only after the award of Contract. Requests shall be in writing on Contractor's letterhead and shall include:

1. Contractor's statement to the effect that proposed substitution will result in overall work equal to or better than, work originally intended.

2. Contractor's detailed comparison of significant qualities between specified item and proposed substitution.

3. Statement of effect on construction time, coordination with other affected work, and cost information or proposal.

C. Substitution requests from contractors will only be considered if:

1. Extensive revisions to Contract Documents are NOT required;
2. Changes are in keeping with general intent of Contract Documents;
3. Requests are submitted in a timely and proper manner, fully documented; and
4. One or more of following conditions is satisfied; all as judged by Engineer:
    a. Where request is directly related to the "or equal" clause or words of similar effect in Contract Documents.
    b. Where specified product, material or method can NOT be provided within Contract Time; but NOT as a result of Contractor's failure to pursue the work promptly to coordinate various activities properly.
    c. Where specified product, material or method can NOT be provided in manner which is compatible with other materials of the work and where Contractor certifies that proposed substitution is compatible.
    d. Where specified product, material or method can NOT be properly coordinated with other materials of the work and where Contractor certifies that proposed substitution can be properly coordinated.
    e. Where specified product, material or method can NOT be warranted as required and where Contractor certifies that proposed substitution can be so warranted.
    f. Where specified product, material or method can NOT be used without adversely affecting Owner's insurance coverage on completed work and where Contractor certifies that proposed substitution can be so used.
    g. Where specified product, material or method will encounter other substantial non-compliances which are NOT possible to otherwise overcome except by using proposed substitution.
    h. Where specified product, material or method can NOT receive required approval by governing authority and proposed substitution can be so approved.
    i. Where a substantial advantage is offered to the Owner; in terms of cost, time, energy conservation or other valuable considerations; after deducting offsetting responsibilities that this Contractor may be required to bear, including additional compensation to Engineer for any redesign or evaluation services, increased cost of other work by other contractors, and similar considerations.

D. The burden is upon the Contractor, supplier and manufacturer to satisfy to the Engineer that:

1. The proposed substitute is equal to, or superior to, the item specified.
2. The intent of the Contract Documents, including required performance, capacity, efficiency, quality, durability, safety, function, appearance, space clearances and delivery date, will be equaled or bettered.

E. Changes in work of other trades, such as structural supports, which are required as a result of substitution and the associated costs for such changes, shall be the complete responsibility of the Contractor proposing the substitution. There shall be NO additional expense to the Owner.

1.7 SAMPLES

A. Submit samples as requested by Engineer/Owner.

1.8 RECORD DRAWINGS

A. Contractor shall maintain and keep on the job at all times, one complete and separate set of blackline prints of the Electrical work. As work progresses, all changes, revisions and additions to Electrical work shall be recorded clearly, neatly, accurately and promptly.

B. Contractor shall indicate daily progress on these prints by coloring in the various lines, fixtures, apparatus and associated appurtenances as they are erected.

C. Approval of requisition for payment of work installed will NOT be given unless supported by the record prints as required above.

D. At the conclusion of work, Contractor will deliver all record drawings to Owner as required by GENERAL CONDITIONS and SUPPLEMENTARY GENERAL CONDITIONS.

1.9 OPERATING AND MAINTENANCE MANUALS

A. Contractor shall submit for review, Operating and Maintenance manuals for each system or piece of equipment, at least 4 weeks prior to request for acceptance of same. Upon acceptance, Contractor will furnish 4 copies of each manual to Engineer for transmittal to Owner. Operating and Maintenance manuals shall be arranged in the following format:

1. Description of Electrical System and Component Parts, including function, normal operating characteristics and limiting conditions, performance curves, engineering data and tests, and complete nomenclature and manufacturer's number for replaceable parts. (Tab A)

2. Operating Procedures, including start-up, break-in, routine and normal operating instructions; regulation, control, stopping, shutdown and emergency instructions; summer and winter operating instructions; and any special operating instructions. (Tab B)

3. Sequence of Operation and Control Diagrams, corrected to show as-built conditions. (Tab C)

4. Copies of approved shop drawings, charts and diagrams. (Tab D)

5. Maintenance Procedures, including routine operations, guide to trouble-shooting; disassembly, repair and reassembly; alignment, adjusting and checking; servicing and

lubrication schedule, and list of lubricants; manufacturer's installation and maintenance bulletins and related information. (Tab E)

6. Parts List, including illustrations, assembly drawings and diagrams required for maintenance, predicted life of parts subject to wear, and recommendations for stocking spare parts. (Tab F)

7. Names, addresses and telephone numbers of manufacturer's representative and Service Company. (Tab G)

8. Other data, if required under pertinent Sections of these Specifications. (Tab H)

1.10 GUARANTEE

A. Furnish standard manufacturers' guarantees for all work under this Division. Such guarantees shall be in addition to, and NOT in lieu of, other liabilities under the law or by other provisions of the Contract Documents.

B. Materials, equipment and workmanship shall carry the standard warranty against defects in material and workmanship. Failure which may develop due to defective or improper material, equipment, workmanship or design shall be made good, forthwith, by and at the expense of the Contractor, including damage done to areas, materials and other systems resulting from this failure.

C. Guarantee that all elements of the systems are of sufficient capacity to meet the specified performance requirements as set forth in Contract Documents.

D. Upon receipt of notice from Owner of a failure of system(s) or component(s) during the guarantee period, replace affected components within reasonable time period at no additional cost.

E. Guarantee period shall extend minimum of one year from Date of Acceptance of project by Owner.

F. Before final request for payment, Contractor shall furnish written guarantee covering the above requirements.

1.11 EXAMINATION OF SITE AND CONTRACT DOCUMENTS

A. Before submitting prices or beginning work, Contractor must thoroughly examine the site and the Contract Documents.

B. No claim for extra compensation will be recognized if difficulties are encountered which would have been revealed by examination of site conditions and all Contract Documents prior to executing Contract.

C. Where discrepancies occur within Contract Documents, notify Engineer in writing, of discrepancy and request a clarification. Until notified of Engineer's decision, include item or arrangement of better quality, greater quantity or higher cost in Contract price.

D. Notify Engineer, in writing, of all materials and apparatus believed to be omitted, inadequate or unsuitable, or in violation of laws, ordinances, rules or regulations of authorities having jurisdiction. In absence of such written notice, it is mutually agreed that bid price for work performed under each Section has included the cost of any and all items required for acceptable and satisfactory functioning of the entire system.

1.12 GUARANTEE AND WARRANTY

A. All materials, equipment and labor provided under Division 16 shall be guaranteed against defects for a period of one year or as specified in Division 1. Any defects that appear during the guarantee period shall be corrected at no cost to the Owner. The Electrical contractor shall provide free maintenance and emergency service including labor and materials during the guarantee period.

B. Any item provided under Division 16 that requires excessive servicing during the guarantee period will be considered defective and shall be replaced at no cost to the Owner.

C. A letter of guarantee along with any extended equipment warranty shall be delivered to the Owner before final payment is made.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Basic Materials as specified in Section 16110 through 16199.

B. Materials for systems are specified in Section 16200 through 16999.

C. Materials for work are also specified on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The wiring method shall be copper conductors with 600 volt THWN insulation installed in concealed EMT conduit unless otherwise shown on the Drawings:

B. All work shall be run concealed wherever possible unless otherwise indicated on the Drawings and/or approved by Engineer.

C. All connections shall be made with an approved type of solderless connector, shall be protected from mechanical injury and shall be rigidly supported. All contact surfaces shall be thoroughly cleaned and bright before connection is made so as to insure a good metal-to-metal contact. All ground connections shall be accessible for inspection at all times.

D. All other installation of electrical equipment shall be in accordance with that prescribed in the individual sections of Division 16 and the National Electrical Code.

E. Conduit and electrical distribution equipment shall be installed to resist the earthquake effects determined in accordance with the requirements of the Connecticut Basic Building Code.

3.2 FIELD QUALITY CONTROL

A. Upon completion of all work and tests, the Contractor shall instruct the Owner or his representative fully in the operation, adjustment, and maintenance of all electrical equipment provided under Division 16. The procedures of any instructions pertaining to the operation and/or programming of equipment shall be video taped and two copies turned over to the owner.

B. The contractor shall obtain services of manufacturer's representatives of major equipment during erection or construction of their respective equipment to insure proper installation of same. Failure to have such checks made by manufacturers shall place full responsibility for proper installation on contractor who shall make any corrections or remedy all defects at no additional cost to Owner. If required by the Engineer, a letter shall be provided from each manufacturer certifying that manufacturer's requirements are met.

C. Each contractor shall test and adjust the systems and equipment for which he is responsible during the progress of the work, as required by the Engineer, and shall thoroughly test the same under working conditions at the completion of the work.

D. The Contractor shall coordinate all activities related to the electrical work.

3.3 LABELING

A. Labeling shall be as specified in Section 16195.

3.4 UNINSPECTED WORK

A. Uninspected work shall not be covered up or enclosed until it has been inspected, tested, and approved by the Owner's representative and by the authorities with the appropriate jurisdiction.

B. Should any work be covered or enclosed before it has been completely inspected, tested and approved, the Contractor shall uncover such work as requested. After the work has been completely inspected, tested, and approved, the Contractor shall provide all materials and labor necessary and make all repairs necessary to restore the work to its original and proper condition at no additional cost to the Owner.

END OF SECTION

SECTION 16060 - ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Electrical Demolition: Remove all existing electrical equipment, hardware and system components as shown on the Drawings including:

1. Raceway
2. Wire/cable
3. Disconnect Switches
4. J-Boxes
5. Outlet Boxes

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as shown on Drawings.

B. Verify that feeders and branch circuits designated to be removed serve only equipment which will also be removed.

C. Beginning of demolition means contractor accepts existing conditions.

3.2 PREPARATION

A. Notify and coordinate electrical power shutdown with Owner, Engineer, General Contractor, and other trades. If work occurs while building is occupied, then power outages shall be limited to short time spans and confined to small areas and coordinated with occupants. All outages of electric service shall be approved by Owner and Engineer.

B. Disconnect electrical systems in all areas where equipment is scheduled for removal.

3.3 DEMOLITION OF EXISTING ELECTRICAL WORK

A. Demolish existing electrical work under provisions of this Section.

B. Remove or relocate all existing installations to accommodate new construction.

C. For circuits removed, remove wiring to last active device.

D. Disconnect all outlets and remove devices. Remove all outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.

E. Disconnect and remove all electrical devices and equipment.

F. Relocate and if necessary extend existing circuits as required to support all existing-to-remain electrical devices and/or equipment.

3.4 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment which remain or are to be reused.

B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

END OF SECTION

SECTION 16061 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment, plus the following special applications:

1. Overhead-lines grounding.
2. Underground distribution grounding.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Qualification Data: For testing agency and testing agency's field supervisor.

C. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Grounding Conductor and Conductor Protector for Wood Poles:

1. No. 4 AWG minimum, soft-drawn copper.

2. Conductor Protector: Half-round PVC or wood molding. If wood, use pressure-treated fir or cypress or cedar.

C. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 2 inches in cross section, unless otherwise indicated; with insulators.

2.2 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad, 3/4 inch in diameter by10 feet.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.

B. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.

3. Connections to Ground Rods: Bolted connectors.

4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING OVERHEAD LINES

A. Comply with IEEE C2 grounding requirements.

B. Install 2 parallel ground rods if resistance to ground by a single, ground-rod electrode exceeds 25 ohms.

C. Drive ground rods until tops are 12 inches below finished grade in undisturbed earth.

D. Ground-Rod Connections: Install bolted connectors for underground connections and connections to rods.

E. Protect grounding conductors running on surface of wood poles with molding extended from grade level up to and through communication service and transformer spaces.

3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

3.4 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.

2. Three-phase motor and appliance branch circuits.

3. Flexible raceway runs.

3.5 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.

a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

b. Perform tests by fall-of-potential method according to IEEE 81.

3. Prepare dimensioned drawings locating each ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

B. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.

2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.

3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.

4. Manhole Grounds: 10 ohms.

C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 16112 - CONDUIT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide all material and labor for the complete installation of conduit as specified in other Sections of this Specification or indicated on the Drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Rigid Nonmetallic Conduit: PVC shall be Schedule 40 or Schedule 80 PVC. PVC shall conform to ASTM Standard F 512 (latest revision) and Article 347 "Rigid Nonmetallic Conduit" of the NEC.

B. Electrical Metallic Tubing: EMT shall be hot-dip galvanized steel. EMT shall conform to Federal Specification WWC-563 (latest revision), ANSI Specification C80.3, and Article 348 "Electrical Metallic Tubing" of the NEC.

C. Flexible Metal Conduit: FLX shall be galvanized steel strip, spiral wound into interlocked flexible steel conduit. The interior shall be formed into smooth surface for easy wire pulling. FLX shall conform to Article 350 "Flexible Metallic Conduit" of the NEC. A separate internal grounding conductor shall be installed.

D. Liquidtight Flexible Conduit: LT shall be galvanized steel strip, spiral wound into interlocked flexible steel conduit with an outer liquidtight nonmetallic sunlight resistant jacket. The interior shall be formed into smooth surface for easy wire pulling. LT shall conform to Article 351 "Liquidtight Flexible Conduit" of the NEC. A separate internal grounding conductor shall be installed.

E. Rigid Steel (RMC) Conduit – RMC shall be ferrous metal steel conduit with a coating of zinc on both inner and outer surfaces. RMC shall conform to NEC articles 344 (2002 edition) or NEC articles 346 (previous editions), and shall comply with ANSI C80.1 standards, and Federal Government standards WW-C-581 Class 1 Type A with standard for Electrical Rigid Metal Conduit – Steel, UL 6. Threaded fittings shall be marked as raintight or wet locations. Threads shall be cut at 3/4-inch per foot (1 in 16) per ANSI/ASME B.1.20.1 *Standards for Pipe Threads, General Purpose (Inch)*. Field cut threads shall be cut one thread short, to allow ease of coupling

F. Conduit Fittings: Fittings for metallic conduit shall be corrosion-resistant plated steel or die cast and UL listed as indicated below. Regal, Appleton, Atlas and Bridgeport are also acceptable manufacturers.

Conduit Type	UL File No.
EMT	E-1275, E-16592, 264J
FLX	E-1275, E-17909,650B,651B,16JO
LT	583C

Fitting for Rigid Nonmetallic Conduit (PVC) shall conform to the requirements of ASTM F 512 "Smooth-wall PVC Conduit and Fitting for Underground Installation".

Fitting for rigid aluminum conduit shall be as noted below:

1. Standard threaded couplings, locknuts, bushings, and elbows: Malleable iron, steel or aluminum alloy material. Zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are prohibited.
2. Set screw fittings are prohibited with rigid aluminum conduit.

PART 3 - EXECUTION

3.1 CONDUIT SIZING, ARRANGEMENT AND SUPPORT

A. Arrange conduit to maintain headroom and present a neat appearance.

B. Exposed conduit and conduit above accessible ceilings shall be run parallel with or at right angles to the walls of the building and adjacent piping only in locations as approved by the Architect or Engineer or as indicated on the Drawings.

C. Maintain minimum 6 inch clearance between conduit and piping. Maintain 12 inch clearance between conduit and heat sources such as flues, steam pipes, and heating appliances.

D. Arrange conduit supports to prevent distortion of alignment by wire pulling operations. All conduits shall be supported by approved hangers, clamps or clips fastened to the building structure. Do not fasten to other systems. Spacing of supports for conduits and raceways shall be in accordance with the National Electric Code.

E. Group conduit in parallel runs where practical and use conduit rack constructed of steel channel with conduit straps or clamps. Provide space for 25 percent additional conduit.

F. Do not fasten conduit with wire or perforated pipe straps. Remove all wire used for temporary conduit support during construction, before conductors are pulled.

G. Support conduit per NEC.

3.2 INSTALLATION

A. Conduit for power, lighting circuits and low voltage control circuits shall be a minimum of 3/4 inches.

B. All metal conduit, enclosures and raceways for conductors shall be mechanically joined together to form a continuous electrical continuity and bond. Provide grounding bushings on all conduits 1-1/4 inches and larger.

C. All conduits shall be concealed in finished areas unless otherwise noted and so installed so as not to damage structural members.

D. Conduits shall be in full lengths wherever possible and all ends shall be cut square, reamed and burred.

E. Bring conduit to the shoulder of fittings and couplings and fasten securely.

F. Use conduit hubs or sealing locknuts for fastening conduit to cast boxes, and for fastening conduit to sheet metal boxes in damp or wet locations.

G. Install no more than the equivalent of four 90 degree bends in between boxes.

H. Use conduit bodies to make sharp changes in direction.

I. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2 inches in size.

J. Electric metallic tubing shall be assembled with approved concrete tight die cast fittings with 2 set screws per pipe end, standard radius bends. When tubing is exposed, "L" fittings may be used.

K. Follow connector manufacturers' instructions and NEC requirements when connecting FLX, and LT conduit to junction and outlet boxes. A separate internal grounding conductor shall be installed.

L. The use of wooden plugs inserted in concrete or masonry units as base for fastenings conduits, tubing, boxes, cabinets, or other equipment shall be prohibited.

M. The installation of conduit or tubing which has been crushed or deformed shall be prohibited.

N. All conduits shall be plugged with approved discs during construction and be dry and clean before pulling wires.

O. Install conduit to prevent low spots which might accumulate water during or after installation. Where unavoidable, provide junction box with drain fitting at conduit low point.

P. Where conduit penetrates fire-rated walls and floors, provide pipe sleeve two sizes larger than conduit; pack void around conduit with fire rated flexible sealer and fill ends of sleeve with fire-resistive compound.

3.3 LABELING

A. Labeling shall be as specified in Section 16195.

END OF SECTION

SECTION 16120 - WIRE AND CABLE

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide all material and labor for the complete installation of wire and cable required for electrical work specified in other Sections of this Specification or as indicated on the Drawings.

1.2 PROJECT CONDITIONS

A. Verify that field measurements are as shown on Drawings.

B. Conductor sizes are based on copper.

C. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required meeting Project Conditions.

D. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All wire sizes indicated on Drawings and this Specification are based on copper conductors. All conductors provided shall be copper.

B. Provide copper conductors installed in conduit for power and lighting. (NEC Type THWN) Conductors shall be 98% conductivity solid or class B concentric strand copper with 600 volt thermoplastic insulation manufactured in accordance with UL 83.

C. Minimum size of conductor shall be No. 12. Conductors of size greater than No. 8 shall be stranded.

D. Copper conductor installed in conduit for low voltage control. (NEC Class 2 cable) Minimum size of conductor shall be No. 16.

E. Conductor shall be marked in accordance with the requirements of the NEC Article 310-11. Conductors shall be identified in accordance with the requirements of the NEC Article 310-12 and as indicated below:

1. Circuit with:

    a. two conductors White, Black

b. three conductors White, Black, Red

c. four conductors White, Black, Red, Blue

d. five conductors White, Black, Red, Blue, Yellow

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that mechanical work likely to damage wire has been completed.

3.2 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.3 INSTALLATION

A. Install all wire in accordance with Section 16050, manufacturer's instructions and the NEC requirements.

B. All connections and pigtail splices for wires #14-#10 shall be made with insulated type "Y", "R", or "B" spring connectors or compression splices. Conductor sizes #8 and larger shall be made with compression connectors.

C. Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.

D. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

E. Use conductor not smaller than 12 AWG for power and lighting circuits.

F. Use solid conductors for feeders and branch circuits 10 AWG and smaller.

G. Use stranded conductors not smaller than 14 AWG for control circuits.

H. There shall be no splices in any conductors except where circuits are branched and located in accessible junction or outlet box.

I. Unless otherwise noted, each conduit raceway shall contain only those conductors constituting a single feeder circuit.

J. Branch circuit home runs shall not share a common neutral. Neutral conductors shall be of same size as phase conductors unless specifically noted otherwise.

K. Pull all conductors into raceway at same time.

L. Protect cable from damage.

M. Clean conductor surfaces before installing lugs and connectors.

N. Neatly train and lace wiring inside boxes, equipment and panelboards.

O. Run conductors of same circuit in same conduit. Run conductors of different voltage systems in separate conduits.

P. All feeder and branch circuits shall have a full size separate grounding conductor installed in the conduit.

3.4 INTERFACE WITH OTHER PRODUCTS

A. Identify each conductor with its circuit number or other designation indicated on Drawings.

3.5 FIELD QUALITY CONTROL

A. Do not pull conductors into conduit until raceway system is complete and cabinets and outlet boxes are free of foreign matter and moisture.

B. Only UL approved wire pulling lubricant shall be used.

C. Insulation integrity shall be tested before energizing any circuits.

D. Verify continuity of each branch circuit conductor.

E. Inspect wire for physical damage and proper connection.

F. Perform field inspection and testing under provisions of Division 1.

END OF SECTION

SECTION 16195 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Nameplates and labels.

B. Wire and cable markers.

C. Conduit markers.

D. As indicated in other sections or on the Drawings.

1.2 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code.

1.3 SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data: Provide catalog data for nameplates, labels, and markers.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

1.4 REGULATORY REQUIREMENTS

A. Furnish products listed and classified by Underwriters Laboratories, Inc.

B. Installation shall conform to all requirements of NFPA 70, National Electric Code.

PART 2 - PRODUCTS

2.1 NAMEPLATES AND LABELS

A. Nameplates: Engraved three-layer laminated plastic, white letters on black background not less than 3/4" x 2 1/2" in size.

B. Locations:

1. Each electrical distribution and control equipment enclosure including but not limited to the following:

a. All switchgear

b. Panelboards

c. Motor switches & contactors, other motor controls

2. J-boxes larger than 12" x 12".

3. Pull boxes larger than 12" x 12".

C. Letter Size:

1. Use 1/2 inch letters for identifying individual equipment and loads.

D. Labels: Embossed adhesive tape, with 3/16 inch white letters on black background. Use for identification of individual wall switches and receptacles. Indicate circuit numbers.

2.2 WIRE MARKERS

A. Description: Tape or tubing type wire markers.

B. Locations: Each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection.

C. Legend:

1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.

2.3 UNDERGROUND WARNING TAPE

A. Description: 6 inch wide plastic tape, magnetic detectable type, colored red with suitable warning legend describing buried electrical lines; Style 57360 as manufactured by Seton Name Plate Co.

PART 3 - EXECUTION

3.1 PREPARATION

A. Submit list of proposed wording to Engineer for approval.

B. Degrease and clean surfaces to receive nameplates and labels.

3.2 APPLICATION

A. Install nameplate and label parallel to equipment lines.

B. Secure nameplate to equipment front using screws or rivets.

C. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.

D. Identify underground conduits using underground warning tape. Install one tape per trench at depth indicated on Drawings.

END OF SECTION

SECTION 16269 - VARIABLE FREQUENCY CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes solid-state, PWM, VFCs for speed control of three-phase, squirrel-cage induction motors.

1.3 DEFINITIONS

A. BMS: Building management system.

B. IGBT: Integrated gate bipolar transistor.

C. LAN: Local area network.

D. PID: Control action, proportional plus integral plus derivative.

E. PWM: Pulse-width modulated.

F. VFC: Variable frequency controller.

1.4 SUBMITTALS

A. Product Data: For each type of VFC. Include dimensions, mounting arrangements, location for conduit entries, shipping and operating weights, and manufacturer's technical data on features, performance, electrical ratings, characteristics, and finishes.

B. Shop Drawings: For each VFC.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

    a. Each installed unit's type and details.

    b. Nameplate legends.

    c. Short-circuit current rating of integrated unit.

    d. Listed and labeled for series rating of overcurrent protective devices in combination controllers by an NRTL acceptable to authorities having jurisdiction.

e. Features, characteristics, ratings, and factory settings of each motor-control center unit.

2. Wiring Diagrams: Power, signal, and control wiring for VFCs. Provide schematic wiring diagram for each type of VFC.

C. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around VFCs where pipe and ducts are prohibited. Show VFC layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

D. Manufacturer Seismic Qualification Certification: Submit certification that VFCs, accessories, and components will withstand seismic forces defined in Division 16 Section "Electrical Supports and Seismic Restraints." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For VFCs, all installed devices, and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for VFCs and all installed components.

2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

G. As-Built Wiring Diagrams (upon completion of project): Power, signal, and control wiring for VFCs. For each type of VFC, provide schematic wiring diagram, electrical enclosure layout, and interconnection diagram.

H. Provide VFC programmed parameters / configuration in hand-written format.

I. Load-Current and Overload-Relay Heater List: Compile and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

J. Load-Current and List of Settings of Adjustable Overload Relays: Compile arrange to demonstrate that dip switch settings for motor running overload protection suit actual motor to be protected.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

B. Source Limitations: Obtain VFCs of a single type through one source from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Compliance with:

1. NFPA 70.
2. ANSI/NEMA ICS 3 – Industrial Systems
3. NEMA ICS 3.1: Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems.

E. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, minimum clearances between VFCs, and adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances.

F. The Drive manufacturing facility will be ISO 9001 and 14001 certified.

G. The VFD will be UL listed, or Canadian UL listed, and complies with EMC Directive 89/336 EEC, Low Voltage Directive 73/23 EEC and Machinery Directive 98/37 EC in accordance with the European Union's CE directive.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver VFCs in shipping splits of lengths that can be moved past obstructions in delivery path as indicated.

B. Store VFCs indoors in clean, dry space with uniform temperature to prevent condensation. Protect VFCs from exposure to dirt, fumes, water, corrosive substances, and physical damage.

C. If stored in areas subject to weather, cover VFCs to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following outdoor conditions, unless otherwise indicated:

1. Ambient Temperature: -10 to 110 deg F.

2. Humidity: Less than 90 percent (noncondensing).

3. Altitude: Not exceeding 3300 feet.

B. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Owner no fewer than **two** (2) days in advance of proposed interruption of electrical service.

2. Indicate method of providing temporary electrical service.

3. Do not proceed with interruption of electrical service without Owner's written permission.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, including clearances between VFCs, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.8 COORDINATION

A. Coordinate layout and installation of VFCs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."

C. Coordinate features of VFCs, installed units, and accessory devices with pilot devices and control circuits to which they connect.

D. Coordinate features, accessories, and functions of each VFC and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Spare Fuses: Furnish one spare for every five (5) installed, but no fewer than one set of three (3) of each type and rating.

2. Indicating Lights: Two (2) of each type installed.

3. Control Relays: Two (2) of each type installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AC Tech Sub-Micro Drive, SM4100.

2. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary.

3. Danfoss Inc.; Danfoss Electronic Drives Div.

4. Eaton Corporation; Cutler-Hammer Products.

5. General Electric Company; GE Industrial Systems.

6. Rockwell Automation; Allen-Bradley Co.; Industrial Control Group.

7. Siemens Energy and Automation; Industrial Products Division.

8. Square D.

9. Toshiba International Corporation.

2.2 VARIABLE FREQUENCY CONTROLLERS

A. Description: NEMA ICS 2, IGBT, PWM, VFC; listed and labeled as a complete unit and arranged to provide variable speed of an NEMA MG 1, Design B, 3-phase induction motor by adjusting output voltage and frequency.

1. Provide unit suitable for operation of standard-efficiency motor as defined by NEMA MG 1.

B. Provide VFC for each pump.

C. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

D. Output Rating: 3-phase; 6 to 60 Hz, with voltage proportional to frequency throughout voltage range.

E. Unit Operating Requirements:

1. Input ac voltage tolerance of 380 to 500 V, plus or minus 10 percent.
2. Input frequency tolerance of 50/60 Hz, plus or minus 6 percent.
3. Minimum Efficiency: 96 percent at 60 Hz, full load.
4. Minimum Displacement Primary-Side Power Factor: 96 percent.
5. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.
6. Starting Torque: 100 percent of rated torque or as indicated.
7. Speed Regulation: Plus or minus 1 percent.

F. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.

1. Electrical Signal: 4 to 20 mA at 24 V.
2. Electrical Signal: 0 to 10 volts.

G. Internal Adjustability Capabilities:

1. Minimum Speed: 5 to 25 percent of maximum rpm.
2. Maximum Speed: 80 to 100 percent of maximum rpm.
3. Acceleration: 2 to a minimum of 22 seconds.
4. Deceleration: 2 to a minimum of 22 seconds.
5. Current Limit: 50 to a minimum of 110 percent of maximum rating.

H. Self-Protection and Reliability Features:

1. Input transient protection by means of surge suppressors.
2. Under- and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.
3. Motor Overload Relay: Adjustable and capable of NEMA ICS 2, Class 10, 20, 30 performance.
4. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
5. Instantaneous line-to-line and line-to-ground overcurrent trips.

6. Loss-of-phase protection.
7. Reverse-phase protection.
8. Short-circuit protection.
9. Motor over-temperature fault.

I. Multiple-Motor Capability: Controller suitable for service to multiple motors and having a separate overload relay and protection for each controlled motor. Overload relay shall shut off controller and motors served by it when overload relay is tripped.

J. Automatic Reset/Restart: Capable of Attempting three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional autospeed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.

K. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped.

L. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

M. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

N. VFD Output Filtering: Provide dv/dt load filters in lines of excess of 150 feet to reduce line reflectance.

O. Parameter Indication: Integral LCD display to indicate the following controller parameters:

1. Output frequency (Hz).
2. Motor speed (rpm).
3. Motor status (running, stop, fault).
4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (VDC).
9. Set-point frequency (Hz).
10. Motor output voltage (V).

P. Control Signal Interface:

1. Electric Input Signal Interface: A minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) and 6 programmable digital inputs.
2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:
    a. 0 to 10-V dc.
    b. 0-20 or 4-20 mA.
    c. Potentiometer using up/down digital inputs.
    d. Fixed frequencies using digital inputs.
    e. Keypad display for local hand operation.
3. Remote Indication Interface: A minimum of 1 dry circuit relay outputs (120-V ac, 1 A) for remote indication of any the following:
    a. Motor running.
    b. Fault and warning indication (overtemperature or overcurrent).
    c. PID high- or low-speed limits reached.

Q. Integral Disconnecting Means: NEMA AB 1, instantaneous-trip circuit breaker with lockable handle.

R. Remote Indicating Circuit Terminals: Mode selection and start/stop operation, controller status, and controller fault.

2.3 ENCLOSURES

A. Provide NEMA 3R Steel Enclosure:

1. Provide integral fan heating unit with thermostat.
2. Provide cooling fan with thermostat.
3. Provide locking mechanism.
4. Provide schematic pocket.
5. Provide drip shield.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFCs for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. The General Contractor shall install VFDs in accordance with Contract Drawings as an initial guide. The General Contractor shall install VFDs in accordance with VFD manufacturers recommended separation distances for ventilation purposes.

C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Select features of each VFC to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; and duty cycle of motor, controller, and load.

B. Select horsepower rating of controllers to suit motor controlled: Provide 10 HP Variable Torque VFC.

3.3 INSTALLATION

A. Anchor each VFC enclosure assembly to stainless-steel uni-strut and sized according to manufacturer's written instructions. Attach by bolting using stainless-steel mounting hardware. Install level and flush with mounting surface.

B. Comply with mounting and anchoring requirements specified in Division 16 Section "Electrical Supports and Seismic Restraints."

C. Install on existing uni-strut stanchion as indicated on Electrical Details.

3.4 IDENTIFICATION

A. Identify VFCs, components, and control wiring according to Division 16 Section "Electrical Identification."

B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Provide and place both in O&M and enclosure print pocket.

3.5 CONTROL WIRING INSTALLATION

A. Install wiring between VFCs and remote devices according to Division 16 Section "Conductors and Cables."

B. Bundle, train, and support wiring in enclosures.

C. Modify existing duplex pump control system and provide dry "run" contacts to Variable Frequency Controller's Run Circuit on Drive's Control Terminal Block for each pump.

D. Provide programming of "pre-selected" speed with associated wiring on Drive's Control Terminal Block for each pump. Pre-selected speed shall be as appropriate for pump's new duty point.

E. Modify existing duplex pump control system and provide a "VFD Fault" pilot light wired to the VFC's programmable output contact on the Drive's Control Terminal Block for each pump.

3.6 CONNECTIONS

A. Conduit installation requirements are specified in other Division 16 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.

B. Ground equipment according to Division 16 "Grounding and Bonding."

3.7 FIELD QUALITY CONTROL

A. The Contractor Shall provide the acceptance tests as follows:

1. Test insulation resistance for each enclosed controller element, bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

3. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection, except optional tests, stated in NETA ATS. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.8 PROGRAMMING AND ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

B. Program VFC to operate at pump's new duty point of 30ft of head, 200 gpm, 8 horsepower, at approximately 1090 RPM.

3.9 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain variable frequency controllers. Refer to Division 1 Section "Demonstration and Training."

1. Provide no less than two (2) hours of training, video taped and submitted to Owner along with O&M.

2. Provide operator training sign-off sheet with name, title, entity, date, time, signature columns to be signed by operators and maintenance staff who receive training. Furnish completed copies to Owner and Engineer.

END OF SECTION

SECTION 16315 - OVERHEAD ELECTRICAL DISTRIBUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes secondary-voltage, overhead electrical power distribution and the following:

1. Conductors, connectors, and splices.
2. Wood poles and crossarms.
3. Hardware and accessories.
4. Surge arresters.

1.3 DEFINITIONS

A. ACSR: Aluminum conductor, steel reinforced.

B. BIL: Basic impulse level, stated in kilovolts.

C. HDPE: High-density polyethylene.

D. RUS: Department of Agriculture, Rural Utilities Service.

E. Sag: The distance measured vertically from a conductor to the straight line joining its two points of support, measured at the midpoint of the span, unless otherwise indicated.

1. Final Sag: The sag of a conductor under specified conditions of loading and temperature applied after it has been subjected, for an appreciable period, to the loading prescribed for the loading district in which it is situated, or equivalent loading, and the loading removed. Final sag includes the effect of inelastic deformation (creep).
2. Initial Unloaded Sag: The sag of a conductor before the application of an external load.

F. Secondary: Conductors and components for circuits operating at the utilization voltage of 600 V or less.

G. Service: Set of insulated conductors extending from a pole to the metering point or service entrance connection at the location of utilization of electricity.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Conductors.
2. Poles.
3. Crossarms.
4. Insulators.
5. Surge arresters.
6. Guy assemblies.

B. Material Inspection Reports: From a qualified independent inspection agency indicating compliance of wood poles and crossarms with requirements indicated. RUS quality mark "WQC" on each item is acceptable in place of inspection as evidence of compliance.

C. Listing Documentation: Indicate products comply with RUS listing requirements specified in "Quality Assurance" Article.

D. Field quality-control test reports.

E. Source Quality-Control Test Reports: Factory inspection reports of wood poles.

1.5 QUALITY ASSURANCE

A. Inspection Agency Qualifications for Pole and Crossarm Inspection: An independent agency, acceptable to authorities having jurisdiction, qualified to conduct inspections indicated.

B. Treatment Technician Qualifications for Field Treatment of Wood Poles and Crossarms: Certified by authorities having jurisdiction over environmental protection at the location of Project for field application of chemicals required.

C. Electrical Components Normally Covered by Listing and Labeling Services: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Overhead-Line Components, Devices, and Accessories: Currently listed in RUS Informational Publication 202-1 without restriction for the intended application.

E. Comply with IEEE C2, except where stricter requirements are indicated or where local requirements that are stricter apply.

F. Strength of Line and Line Components Selected by Contractor: Provide grades of construction and strength required by IEEE C2 for conditions encountered at Project site for medium line loading, unless otherwise indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Wood Pole Storage and Handling: Comply with ANSI O5.1. Do not use pointed handling tools capable of producing indentations greater than 1 inch.

1.7 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Owner not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Owner's written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 CONDUCTORS, CONNECTORS, AND SPLICES

A. Acceptable Manufacturers - Conductors:

1. AFC Cable Systems.
2. Alcan Cable Co.
3. BICC Cables Company.
4. Brugg Telecom Inc.
5. Florida Wire & Cable, Inc.
6. General Wire & Cable Co.
7. Hendrix Wire and Cable Inc.
8. Kerite Company (The); Innovation Systems Inc.
9. King Wire Inc.
10. Nokia Cables USA Inc.
11. Northern Lights Cable, Inc.

12. Okonite Company (The).
13. Rome Cable Corp.
14. Southwire Company.
15. Approved Equal

B. Acceptable Manufacturers - Connectors and Splices:

1. AB Chance Co.; Hubbell, Inc.
2. Connector Manufacturing Co.
3. Cooper Power Systems.
4. Hubbell, Inc.; Anderson Electrical Products, Inc.
5. Hubbell, Inc.; Fargo Manufacturing Company.
6. Approved Equal

C. Secondary-Voltage Line Conductors: Covered hard-drawn copper, complying with ICEA S-70-547, with HDPE covering

D. Connectors, Splices, and Conductor Securing and Protecting Components: Items include wire clamps, ties, conductor armor, fittings, connectors, and terminals. Listed for the specific applications and conductor types and combinations of materials used. Descriptions as follows for various applications:

1. Copper to Copper: Copper alloy, complying with UL 486A.
2. Aluminum Composition to Aluminum Composition: Aluminum alloy, complying with UL 486B.
3. Copper to Aluminum Composition: Type suitable for this purpose, complying with UL 486B.
4. Connectors and Splices for Secondary Conductors: Listed and labeled for the conditions and materials involved in each application.
5. Splices under Tension: Compression type with strength exceeding the conductors spliced.
6. Splices and Terminations for Covered Conductors: As recommended by conductor manufacturer for conductor and covering combination and for specific materials and physical arrangement of each splice.

2.3 WOOD POLES

A. Approved Manufacturers:

1. Bell Lumber & Pole Co.
2. B. J. Carney & Co., Ltd.

3. Brown Wood Preserving Co.
4. GRA Services International, Inc.
5. J. H. Baxter & Co.
6. Koppers Industries, Inc.
7. McFarland Cascade.
8. Okonite Company (The).
9. Taylor Lumber & Treating.
10. Western Red Cedar Lumber Association.
11. Approved Equal

B. Description: Wood poles comply with ANSI O5.1 and treated according to AWPA C4 with oil-borne preservatives and petroleum complying with AWPA P8 and AWPA P9.

C. Pole Marking Location: 10 feet from the pole butt for poles 50 feet long or less.

D. Factory Operations: Machine trim poles by turning smooth, full length. Roof, gain, and bore poles before pressure treatment.

2.4 CROSSARMS

A. Description: Solid-wood distribution type, complying with RUS REA Bulletin 1728H-701 for specified construction grade and IEEE C2 for required climbing space and wire clearances.

B. Braces: Galvanized, flat, ferrous-metal units; 1/4 inch thick by 1-/4 inches wide, minimum, with length to suit crossarm dimensions.

2.5 HARDWARE AND ACCESSORIES

A. Description: Ferrous-metal items include, but are not limited to, bolts, nuts, washers, crossarm gains and braces, insulator pins, anchor rods, anchors, eyebolts, staples, and transformer brackets.

1. Comply with ANSI C135.1, ANSI C135.2, ANSI C135.4, ANSI C135.14, ANSI C135.22, ANSI C135.33, and RUS Informational Publication 202-1 listings with the exception that base material shall be malleable iron or ductile iron, and finish shall be hot-dip galvanized.

B. Guy Strand Assemblies: Cable and attachments. Include strain insulators where indicated and if required by IEEE C2. Assemblies shall have uniform minimum breaking strength for components of each assembly.

1. Cable: Seven strand. Zinc-coated steel, complying with ASTM A 475
2. Cable Termination: Thimble eye.

C. Anchor and Anchor-Rod Assemblies: Hot-dip galvanized steel.

1. Anchors: Expanding or power-installed screw type.

2. Anchor Rods for Power-Installed Screw Anchors: ASTM A 53/A 53M, Schedule 80 pipe, with coupling, and [**twin**] [**triple**] thimble eye.

D. Guy Markers: Round vinyl or PVC material, yellow color, 96 inches long. Shatter resistant at temperatures below 0 deg F.

E. Grounding Materials: Comply with NEC using materials listed by RUS for the intended purpose without restriction.

1. Conductors: No. 4 AWG, minimum; bare, solid, annealed copper, complying with ASTM B 8, unless otherwise indicated.

2. Ground Conductor Protectors: PVC or half-round wood molding, fir, pressure treated according to AWPA C25.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Verify dimensions by field measurement, and identify locations of poles, guy anchors, and other features. Also identify locations of connection to new and existing supply lines and to secondary services. Notify Engineer of discrepancies and field conditions that are not indicated and that will affect installation.

B. Ground equipment according to NEC.

C. Apply warning signs and equipment labels according to Division 16 Section "Electrical Identification."

3.2 CONDUCTOR INSTALLATION, GENERAL

A. Handle and string conductors to prevent cuts, gouges, scratches, kinks, flattening, or deformation. Remove damaged sections and splice conductors.

1. String new conductors to "initial" sag table values recommended by manufacturer for type and size of conductor.

B. Connections, Splices, and Terminations: Use kits listed for the specific type of connection and combination of materials used in the connection, or recommended for the specific use by manufacturer of material on which applied.

1. Splice Location: Do not install within 10 feet of a support.

2. Line Conductors: Install so strength exceeds ultimate rated strength of conductor.

3. Splices and Terminations of Covered Conductors: Comply with manufacturer's written instructions.

3.3 POLE AND CROSSARM INSTALLATION

A. Pole Orientation: Align curve of curved wood poles with straight-line runs of three or more poles. Align gained surfaces perpendicular to runs.

B. Elevation of Line above Grade: Install poles with top at same elevation, unless grade changes dictate elevation change in poles, and according to the following:

1. On level ground, set poles so tops of consecutive poles vary not more than 60 inches in elevation.

2. Shorten wood poles by cutting off the top and make cuts to shed water. Apply preservative to cuts.

C. Set poles according to the following:

1. Make pole holes vertical, uniform in diameter, and large enough to permit effective use of tamping bars all around. Bore or excavate holes with an average diameter at grade less than twice the diameter of the pole at the same grade.

2. Use minimum depths indicated, except at locations where hole is partly or entirely in rock and if hole is not vertical or has a diameter at grade larger than two times the pole diameter at the same level; in these conditions, increase the depth of the hole by the following increments before setting the pole:

a. Poles up to 35 Feet Long: 24 inches.

b. Poles 36 to 60 Feet Long: 30 inches.

c. Poles 61 to 75 Feet Long: 36 inches.

3. For poles on slopes, indicated hole depth is from finished grade at lowest side of hole.

4. Set poles in alignment and plumb except at dead ends, angles, and points of extra strain; rake poles against conductor strain 1 inch minimum, 2 inches maximum, (after conductors are installed at required tension) for each 10 feet of pole length. Rake poles so they will not lean or bend in direction of strain when loaded.

5. Backfill holes in 6-inch maximum lifts, and thoroughly tamp each layer before starting the next.

6. Place surplus earth around pole in a conical shape, and tamp thoroughly to provide drainage away from pole.

7. Set poles so alternate crossarm gains face in alternate directions, except at terminals and dead ends; place gains on last two poles on side facing terminal or dead end.

D. Field treat factory-treated poles and crossarms as follows:

1. Poles Treated More Than One Year before Installation: Treat portion from 24 inches above ground line to butt.

2. Field-Bored Holes and Field-Cut Gains and Pole Tops: Treat cut portions.

3. Unused Holes: Treat and plug with treated-wood-dowel drive pins.

4. Engage the services of a technician certified according to Part 1 of this Section to apply treatment. Comply with requirements in AWPA standards that govern original factory treatment for field-applied treatment chemicals and application.

E. Crossarm Installation: Set line crossarms at right angle to line for straight runs and for angles 45 degrees and more. Bisect angles less than 45 degrees.

1. Buck Arms: Install at corners and junction poles, unless otherwise indicated.

2. Double Crossarms: Install at dead ends, corners, angles, and line crossings.

3. Equipment Arms: Locate below lines and set parallel or at right angles to them, whichever provides best climbing space.

4. Gains: Install factory-cut or metal pole gains only. Do not cut gains in field without specific written approval.

3.4 HARDWARE AND ACCESSORIES INSTALLATION

A. Install washers against wood and under nuts, including eyenuts and locknuts.

B. Install nuts and locknuts wrench-tight on threaded connections.

C. Install guys to resist unbalanced loads, including those developed at angles, corners, and dead ends. Install two or more guys if a single guy will not provide adequate strength. Install separate guys if unbalanced loads are separated by 36 inches or more.

D. Protect guy strands from damage. Replace damaged guy strands. Install guy insulators where required to comply with IEEE C2 clearance requirements and elsewhere, where indicated.

E. Select guy anchors having adequate strength and holding area to suit anchor load and soil conditions at location of that anchor.

1. Soil Anchors: Align anchors in soil with guy. Set with anchor rod pointing at guy attachment on pole and rod projecting 6 to 9 inches from ground.

F. Guy Markers: Install at anchor end of guys. Clamp to guy strand or anchor at top and bottom of marker.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections. Report results in writing.

B. Testing Agency: Perform the following tests and inspections and prepare test reports:

1. Furnish instruments and equipment required for tests that comply with NETA ATS.

2. Ground Resistance: Measure resistance of each separate grounding electrode, including pole grounds. Also measure resistance of separate grounding electrode systems before bonding together.

    a. Perform tests and obtain acceptable results before energizing any portion of overhead electrical distribution system.

    b. Results and Follow-up: If ground resistance for a single ground electrode or pole ground, tested individually, exceeds 25 ohms, add a ground electrode not less than 10 feet away and interconnect with No. 2 AWG minimum bare conductor buried at least 12 inches below furnished grade.

3. Aerial Conductor Sag and Tension: Observe procedures used by Contractor to verify that initial stringing sags and tensions comply with IEEE C2 and conductor manufacturer's Product Data and written recommendations.

END OF SECTION

SECTION 16470 - PANELBOARDS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. See Drawings for panelboard schedule and equipment requirements.

B. Molded case bolt-on circuit breakers.

1.2 SYSTEM DESCRIPTION

A. See Drawings for panelboard schedule.

1.3 REFERENCES

A. FS W-C-375 - Circuit Breakers, Molded Case, Branch Circuit and Service.

B. NEMA AB 1 - Molded Case Circuit Breakers.

C. FS W-P-115 - Power Distribution Panel.

D. NEMA PB 1 - Panelboards.

E. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

F. NEMA PB 1.2 - Application Guide for Ground-fault Protective Devices for Equipment.

1.4 SUBMITTALS

A. Include circuit breaker and current limiter ratings, trip current and let-through current curves, outline dimensions, and terminal lug sizes.

1.5 REGULATORY REQUIREMENTS

A. Use circuit breakers listed by Underwriter's Laboratories, Inc., and suitable for specific application.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURES

A. General Electric

B. Square D

C. Cutler Hammer

D. Siemens

2.2 PANELBOARDS

A. Dead front construction top feed arranged for surfaced or recessed mounting.

B. Panelboard shall have copper bus and grounding bars.

C. Copper bus bar shall have voltage and current carrying ratings as specified in Article 1.02 "Systems Description" or indicated on the Drawings. Minimum asymmetrical short circuit rating for all panelboards shall be as shown on drawings.

D. The cabinets shall be galvanized 12 gauge sheet steel, rigidly formed. There shall be metal barriers forming a dead front construction. The trim shall be smooth 12 gauge sheet steel and be attached to the cabinet with screws or clamps and the trim shall be for either flush or surface mounting as shown on the Drawings. The doors shall be 12 gauge sheet steel, with 2 swing hinges, projection chrome plated lock with all locks keyed alike, and with typewritten circuit directory under protective plastic cover. Each lock shall have three keys. All exposed surfaces shall be finished in baked enamel.

E. Panelboards 400 amps and smaller: Fronts shall be hinged 1-piece with door. Front assembly shall be hinged front cover to box to permit full access to wiring gutter without removal of cover.

F. Panelboards and switchboards over 400 amps: Fronts shall be hinged 1-piece with door. Front assembly shall be hinged front cover to box by a continuous piano hinge to permit full access to wiring gutter without removal of cover.

2.3 CIRCUIT BREAKERS

A. Molded plastic case circuit breaker with bolted connection to bus bar, shall be quick make quick break, and have a toggle handle. The trip elements shall be thermal magnetic type; multi-pole circuit breakers shall have internally common trip without handle ties; and shall have positive indication of tripped condition. Single pole circuit breakers shall be full module size. Provide circuit breaker type as indicated on Drawings.

1. At submittal time, provide time/current coordination curves for all unique circuit breakers provided.

B. Configuration: Inverse time automatic tripping.

C. Ratings: NEMA AB 1; as scheduled.

D. Size: NEMA AB 1. As scheduled

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install according to all applicable provisions of NEC.

B. Connect motors, and equipment as shown on Drawings. Install wiring substantially as shown on Drawings.

C. Connect branch circuits to panelboards in such a manner that the load among all phases of the feeder is balanced within 10% with full load on panel.

D. Install typewritten directory in door frame clearly indicating each branch circuit.

E. Install enclosed circuit breakers where shown on Drawings, in accordance with manufacturer's instructions.

3.2 FIELD QUALITY CONTROL

A. Measure ampacity of all branch circuits. Adjust circuiting configuration to ensure current is below circuit breaker and conductor rating.

3.3 LABELING

A. Labeling shall be as specified in Section 16195.

END OF SECTION

APPENDIX A
STORMWATER POLLUTION CONTROL PLAN

Stormwater Pollution Control Plan

Connecticut Resources Recovery Authority
Hartford Landfill

Hartford, Connecticut

July 2006

Revised January 2007

FUSS & O'NEILL
Disciplines to Deliver

146 Hartford Road
Manchester, CT 06040

STORMWATER POLLUTION CONTROL PLAN
Connecticut Resources Recovery Authority
Hartford Landfill - Hartford, Connecticut
July 2006

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1.0 INTRODUCTION

The Connecticut Resources Recovery Authority (CRRA) is performing landfill closure activities for the Municipal Solid Waste/Interim Ash Disposal Area (the "MSW Area") of the Hartford Landfill located at 185 Liebert Road in Hartford, Connecticut. This project is a "construction activity" in accordance with the "General Permit for the Discharge of Stormwater and Dewatering Wastewaters Associated with Construction Activities," dated October 1, 2002 (modified on April 8, 2004). A copy of this general permit and registration is included in Attachment A. This stormwater pollution control plan was prepared as required by the general permit. The purpose of this plan is to specify the erosion and sedimentation control requirements, both during and after construction. Erosion and sedimentation control requirements are also shown on the Drawings for this project.

During construction, the contractor shall be responsible for implementing all elements of the erosion and sedimentation control measures as defined on the Drawings and in this stormwater pollution control plan. After construction, the Owner shall be responsible for maintaining these erosion and sedimentation control measures. Throughout the construction process, the Owner or Owner's agent shall periodically inspect all erosion control measures. A copy of the inspection form to be used is provided in Attachment B. This project will not be considered complete until all disturbed areas have been satisfactorily stabilized, all erosion has been repaired, and all temporary erosion control measures have been removed.

The general contractor and subcontractor will be required to sign the certification statement provided in Attachment C of this plan.

2.0 SITE DESCRIPTION

2.1 Project Description

The MSW Area of the Hartford Landfill occupies approximately 80 acres of an approximately 124 acre parcel in the north meadows section of Hartford, Connecticut (Figure 1). Sixteen acres of the parcel, located immediately north of the 80-acre MSW Area, was developed as a lined ash landfill in 1998 (Phase I Ash Disposal Area). The remaining area is occupied by site facilities (e.g., Scale House, Maintenance Garage, etc.) on the southerly portion of the parcel and undisturbed land to the north of the Phase I Ash Disposal Area.

Access to the landfill is off of Jennings Road (Exit 33 off of Interstate 91) with a turn onto Leibert Road, heading north, into the south end of the landfill. The landfill parcel is bounded on the south by the City of Hartford Department of Public Works facility; on the west by Interstate 91; on the north by Weston Street and the Army Corps of Engineers (USACE) Flood Control Dike (herein referred to as the "USACE Dike"); and on the east by the USACE Dike.

Buildings and structures located on the site include the scale house, vehicle maintenance facility, leachate pre-treatment facility, vehicle wheel wash facility, groundwater pumping system control building, leachate storage tank and landfill gas blower/flare station. Site utilities include:

- Storm sewers along the southern boundary of the landfill
- Water lines servicing the onsite buildings and fire hydrants

- Overhead and underground electric lines servicing the onsite buildings and the landfill gas-to-energy plant, the ash leachate collection and treatment system and the groundwater flow control system

- A 36-inch water main that enters the site from the south near the vehicle maintenance facility and then heads west across the south side of the site and crossing Interstate 91.

- A sanitary sewer line servicing the on-site buildings at the south end of the site that also crosses Interstate 91

- Leachate force main piping from the ash disposal area to the leachate storage tank at the southeast corner of the site and from the tank to the leachate pre-treatment facility

- Wastewater conveyance piping from the vehicle wheel wash facility to the leachate storage tank

- Sanitary sewer piping from the leachate pre-treatment facility to the sanitary sewer in the cul-de-sac of Leibert Road

- Two below grade sediment settling tanks, two oil water separators, and three condensate storage tanks

- Above ground fuel tanks near the leachate pre-treatment facility and the vehicle wheel wash facility

- A condensate force main and air line from the landfill gas flare running along the southerly slope of the landfill to a condensate pump station near the Leibert Road cul-de-sac

CRRA is currently finalizing a Closure Plan for the landfill that assumes closure will occur in three phases. A tentative closure construction schedule has been estimated assuming CTDEP authorization is received and construction documents can be prepared during 2006. In the spring of 2007, Phase I construction is expected to begin and to be completed before winter 2007-2008. While Phase I construction is taking place, waste will continue to be received on the east slopes of the landfill. The Phase II area is expected to be ready for closure for the 2008 construction season and should be completed during the 2008 construction season. Waste will no longer be received at the landfill after December 31, 2008. Therefore, closure construction of Phase III is expected to take place during the 2009 construction season.

This construction schedule is tentative. There are many factors, such as weather conditions, which may affect the proposed schedule. CTDEP will be kept apprised of changes in schedule as they become necessary.

Erosion control measures were designed in accordance with the 2002 edition of the "Connecticut Guidelines for Soil Erosion and Sediment Control" (CT DEP bulletin 34) as published by The Connecticut Council on Soil and Water Conservation in cooperation with the Connecticut Department of Environmental Protection. We have provided installation details

and detailed erosion and sediment control notes in the plans. These notes are in accordance with DEP Bulletin 34.

2.2 Area of Disturbance

The general intent of the landfill closure grading plan is to promote rapid runoff of stormwater while simultaneously preventing erosion. On the top of the landform, stormwater is allowed to run off as sheet flow. This sheet flow is intercepted and channelized on the steeper side slopes in order to minimize erosion. The end result is the creation of a stable, mounded landform that will maximize surface water run-off and minimize infiltration, which, in turn, reduces the potential for leachate generation.

The total disturbed area within the project site will be approximately 80 acres. The following table summarizes the disturbed areas and their drainage characteristics:

Description	Drainage Characteristics	Area
Western Side of Landform	Sheet flow until intercepted by swales, then conveyed by channels and culverts to ConnDOT drainage channel.	41 Acres
Eastern Side of Landform	Sheet flow until intercepted by swales, then conveyed by channels and culverts to USACE Dike drainage ditch.	46 Acres
Northern End of Landform	Sheet flow until intercepted by swales, then conveyed by channels to the wetlands area North of the landform.	1.5 Acres

2.3 Landfill Cap Underdrain

The landfill final cover has been designed pursuant to State of Connecticut Solid Waste Regulations. The cap structure consists of a cap base material layer, a barrier layer, and a drainage /barrier protection layer. The structure is discussed in detail in the Closure Plan, and details of the drainage layer are reproduced herein.

The composite drainage layer, consisting of a bi-planar high-density polyethylene (HDPE) drainage net with a non-woven polyester or polypropylene geotextile bonded to both sides of the net, will be placed over geomembrane on 3H:1V slopes to serve as the drainage medium for water that infiltrates through the overlying layers of the landfill cap. At the cross-slope diversion swales, spaced at approximately 100-foot intervals on the 3H:1V side slopes, four-inch slotted polyethylene tubing will be installed directly below the centerline of the swales to intercept subsurface water flowing on top of the geomembrane. This pipe system will further protect against destabilizing head build-up on top of the geomembrane. Due to the importance of maintaining the stability of the 3H:1V slopes, both the Hydrologic Evaluation of Landfill Performance (HELP) model and additional subsurface drainage composite flow calculations were performed to assess whether or not unconfined flow conditions will be maintained on the steep side slopes.

2.4 Stormwater Discharge Information

Currently, precipitation that falls on the landfill property flows in three general directions as described below:

- Stormwater falling on the western half of the landfill flows west to the western toe of slope. It is then conveyed south and discharges to a rectangular concrete channel owned by the Connecticut Department of Transportation (ConnDOT). Flow within the channel continues generally south, eventually reaching North Meadows Pond. The total upland area discharging to the ConnDOT channel is approximately 41 acres.

- Precipitation falling on the Eastern half of the landfill flows east until it is intercepted by one of several existing riprap and concrete channels. These various channels convey the stormwater toward the southeast corner of the property where it discharges to a vegetated drainage ditch that ultimately enters North Meadows Pond. The total upland area discharging to the vegetated ditch is approximately 46 acres.

- A very small area in the northwestern portion of the landfill drains to the north and into a heavily vegetated wetlands area. Flow from this wetlands area outlets to Weston Brook where it is conveyed to North Meadows Pond via MDC storm piping. The total upland area discharging to the wetlands is approximately 1.5 acres.

The proposed final landform will not substantially alter the drainage patterns described above. Only slight adjustments to the relative drainage areas will result from closure. However, due to the improved drainage characteristics of the proposed cap, total runoff volume and peak flow rates are expected to increase. Several existing drainage features will be replaced or upgraded during closure in order to accommodate these increased flows and several new permanent drainage features such as underdrains, swales, and storm piping will be added. All proposed drainage features have been engineered to safely convey a 25-year/24-hour storm event.

Because closure of the landfill will affect the volume of stormwater discharged to off-site drainage systems, Fuss & O'Neill analyzed the capacity of these systems to receive the additional flow. Both the ConnDOT drainage channel and the vegetated ditch are designed with significant storm storage capacity. Hydraulic analysis of these structures indicates that they would fully contain the total run-off volume from a 25-year/24-hour storm event from the landfill even if the outfalls were completely blocked. Therefore, the increased flow from the landfill will not adversely affect off-site drainage.

Drainage calculations used to size permanent stormwater drainage features are provided in Appendix D.

2.5 Receiving Waters

All stormwater runoff from the Landfill eventually flows into North Meadows Pond. The North Meadows Pond and Pump Station is part of the Greater Hartford Flood Control System. Under normal conditions, the pond drains by gravity to the Connecticut River. During flood events, the pump station pumps water from the pond into the Connecticut River to prevent flooding inside the USACE Dike.

The Connecticut River located to the east of the subject site is classified as SC/SB. Decker's Brook and Meadow Brook are both located north and upgradient of the landfill. Decker's Brook classification status is not shown on the maps likely because it is too small to classify. It is therefore assumed to be SA. Meadow Brook is classified as SC/SB.

The North Meadows Pond that is located south of the landfill, is a tributary to a much larger watershed than just the landfill, and is classified as B/A.

3.0 CONSTRUCTION SEQUENCE

While the majority of the landfill has reached final elevations and is ready for capping, the southeast corner and east side of the landfill will continue to receive waste until final grades are achieved. Therefore, the closure will be phased to allow closure of portions of the landfill while other portions continue to receive waste. The west and south sides of the landfill will be closed first as Phase I. Because the access road to the top of the landfill must remain open through construction, the new proposed access road will be constructed on the Phase I area prior to completing closure construction. This will allow construction and landfill traffic to continue with minimal interruption. A road construction detail is included in the project Drawings. Phase II will then be closed and tied into the completed Phase I cap system. The Ash Disposal Area is not a part of the closure plan for the MSW Area and will be closed under a separate closure plan. An estimated construction timeline is presented below:

Description	Estimated Start Date	Estimated Completion Date
Receive CTDEP Permits	4/1/07	4/1/07
Phase I Construction	7/1/07	6/30/08
Phase II Construction	7/1/08	6/30/09

Within each phase of construction, three main activities will occur in a sequential fashion:

- rough grading and cap base preparation
- geomembrane liner installation
- and cover soil placement and stabilization

Area of disturbance associated with rough grading and base preparation will be limited to no more than 10 acres prior to placement of geomembrane liner. Similarly, area of installed cover soil will be limited to no more than 10 acres prior to installation of stabilization measures (e.g. erosion control blanket or straw mulch).

4.0 CONTROLS

The following paragraphs address the controls and measures to be implemented on this site both during and after construction to minimize stormwater pollution to the waters of the State of Connecticut.

4.1 Erosion and Sediment Controls

The goal of this plan is to control erosion on the site and to control movement of sediment into adjacent wetlands, watercourses or storm sewer systems. Note that erosion and sediment

controls shall conform to the requirements of the "Connecticut Guidelines for Soil Erosion and Sediment Control," dated May 2002, which will hereafter be referred to as the "Guidelines."

Permanent on-site retention/detention of stormwater is not proposed for this landfill for two primary reasons. First, upland areas are almost exclusively vegetated. Only the paved access road and existing parking areas will be impermeable. Once vegetation has been established, down-gradient sediment migration will be minimal. Second, site constraints limit the available space to locate a basin. Construction of a basin on the property would require either taking of wetlands, relocation of substantial quantities of waste, or altering the drainage of the adjacent USACE Dike. None of these alternatives are deemed to be prudent or practicable.

Stormwater flows from impervious surfaces will be treated with "best management practices" during construction (e.g., silt sacks, hay bales, etc.). When construction is complete, sediment from impervious areas is expected to be negligible and additional treatment should not be required. CRRA will continue to monitor stormwater discharges as required by the "General Permit for the Discharge of Stormwater from Industrial Activities". If monitoring results indicate additional treatment is required to meet applicable stormwater quality standards, appropriate measures will be taken.

To meet the goals of stabilization, structural and maintenance practices shall be implemented by the Contractor as outlined below.

4.1.1 Stabilization Practices

Both temporary and permanent stabilization practices shall be implemented throughout the project to minimize erosion of soil from the disturbed site. Temporary and permanent stabilization measures are proposed to provide protection against erosion both during and after construction. When construction activities have permanently ceased or have been temporarily suspended for more than thirty days, or when final grades are reached in any portion of the site, stabilization practices shall be implemented within seven days.

The stabilization practices to be implemented during the construction of the proposed development are as follows:

- Grading sequence - Construction activities will generally commence from a point on the landfill furthest from the final stormwater discharge. This process will allow sediment to be transported downgradient by stormwater to be controlled within the existing drainage features. In addition, newly installed features will not be subject to heavy siltation because up-gradient surfaces will have been stabilized.

- Limitation of Disturbance – Disturbed earth surfaces will be limited to no more than ~~10~~ 5 acres before liner installation and no more than ~~10~~ 5 acres of un-stabilized final cover soil.

- Temporary Vegetative Cover – All exposed areas that will be inactive for more than 30 days, or 15 days for stockpiles, and have not yet reached finished grades shall receive a temporary vegetative cover during the planting season of March 15 to October 1. Note that planting between June 15 and August 1 will require watering as necessary to

promote growth. This temporary vegetative cover shall consist of perennial rye grass. The rye grass shall be planted at a rate of 1 pound per 1,000 square feet. Also, fertilizer shall be applied at a rate of 7.5 pounds per 1,000 square feet of 10-10-10 or equivalent and limestone shall be applied at a rate of 45 pounds per 1,000 square feet. Seed bed preparation and seeding shall be conducted as outlined in the "Guidelines."

- Temporary Mulching – Temporary mulching shall be used to temporarily stabilize areas that will be inactive for 30 days or more, or 15 days for stockpiles, and cannot be seeded within the recommended planting dates. In addition, temporary mulching shall be conducted immediately following temporary or permanent seeding in order to aid the growth of vegetation. Temporary mulch shall consist of straw or hay overlay applied at a rate of 70 to 90 pounds per 1,000 square feet (two tons per acre). This mulch shall be spread uniformly by hand or mulch blower and shall be bonded with a non-asphalitic tackifier or other approved method immediately after spreading.

- Permanent Vegetative Cover – Once the planting season begins, temporary stabilization measures shall be removed and slopes shall be prepared and seeded. Seeding shall only occur between April 1 and June 1 and August 15 and October 15.

- Vegetative Cover Irrigation – A temporary irrigation system shall be installed on side slopes to allow watering without operating equipment on steep areas. The contractor will be responsible for designing, installing, and maintaining the temporary irrigation system throughout the duration of the project. The contractor must also monitor the system and shut it down, as necessary, to prevent excess water from running off the landform or causing erosion.

4.1.2 Structural Practices

Structural practices shall be implemented to control the movement of sediment and minimize any discharge of pollutants from the site. The structural practices to be implemented during construction are as follows:

- Filtration barriers - Silt fence or hay bales will be installed at the base of incomplete or disturbed slopes. Silt fence is generally recommended for this application, but hay bales may be used in lieu of silt fence when areas are to be disturbed for less than sixty days. The silt fence and hay bales will reduce down gradient siltation by acting as sediment filters. These filters will remove sediment transported by sheet flow from stormwater runoff.

- Alternative Filtration Barrier – If conventional filtration barriers discussed above and depicted on the project drawings prove impractical or infeasible to install, alternative filtration barriers may be installed. These alternative systems may include Ecoberm™, SiltSoxx®, or other products.

- Anti-Tracking Aprons: To prevent soil or sediment from being carried off site by construction equipment, anti-tracking aprons will be installed before construction traffic into and out of the project area begins. The width of the anti-tracking apron shall not

be less than the width of any ingress or egress. Adjacent roadways shall be swept daily to remove any material that may be tracked onto pavement.

- Diversion Swales - Earthen swales will be constructed on the side slopes of the landfill to intercept sheet flow. These channels are graded with a slope of four percent to allow rapid drainage without developing erosive velocities. The swales have been sized to maintain freeboard in accordance with the "Guidelines" while conveying the peak discharge from the design storm.

- Permanent Erosion Control Matting - This non-biodegradable, flexible channel lining will be installed in diversion swales to reinforce vegetative cover and minimize the potential for erosion.

- Erosion control blankets - Erosion control blankets, or equivalent protection, will be installed on all landfill side slopes exceeding 10%, after placement of final cover, to minimize erosion and allow growth of permanent vegetative cover. These controls also retain soil moisture and modify soil temperature to further enhance growth.

- Mulch for Seed – Straw mulch will be installed on all disturbed surfaces with slopes not exceeding 10%, after placement of final cover, to minimize erosion and allow growth of permanent vegetative cover.

- Grouted Riprap Downchutes - Downchutes will collect the flow from diversion swales and underdrains and convey it down the side slopes of the landfill.

- Impact Basins - Cast-in-place concrete impact basins will be constructed at the bottom of each downchute to safely dissipate the energy of the rapidly flowing water. The impact basins serve the same function as the more commonly used energy dissipater, but will fit within the restricted space available on-site.

- Temporary Diversions and Slope Drain - In order to minimize the volume of runoff flowing over the steeper side slopes of the landfill, a temporary diversion and slope drain system will be placed at the top-of-slope to minimize surface run-on to disturbed areas. The temporary diversions will include silt fence backed by haybales and sandbag diversion berms for installation directly on top of the liner. These diversions will be relocated and replaced as necessary during various stages of construction to permit installation of the proposed cap. Diverted stormwater will be conveyed to the toe of the slope through temporary slope drains.

- Temporary Sediment Traps – Temporary Sediment Traps (TST) shall be installed at the downstream ends within the toe-of-slope drainage ditches located on both the east and west sides of the landfill.

- Flocculation Enhancing Polyacrylimide Blocks – Floc-Logs® or similar products will be installed in toe of slope drainage ditches to assist in the treatment of suspended solids and pollutants. Block formulation will be specified based on site specific stormwater chemistry.

4.1.3 Maintenance

The erosion and sediment controls must be maintained in a condition that will protect the resource areas from pollution during site construction. The Contractor shall conduct the following maintenance to ensure the proper performance of erosion and sediment control measures.

- Temporary and Permanent Vegetation: At any eroded areas, repair by filling to finished grades, replace vegetative support material and seed, fertilize and lime, as specified for temporary and permanent stabilization. Add additional mulch as required.

- Temporary Mulching: Where erosion is observed additional mulch should be applied. If it is determined that straw mulch is not providing adequate erosion protection to a disturbed area, the Engineer will direct the contractor to install cellulose fiber mulch, erosion control blanket, or other stabilization measure.

- Filtration Barriers: Inspect silt fence and haybales immediately after each rainfall and at least daily during prolonged rainfall. Any required repairs shall be made immediately. Should the barrier decompose or become ineffective while it is still needed, the barrier shall be replaced promptly.

  Sediment deposits should be removed when they reach approximately one-half the height of the barrier. Sediment shall be disposed of on-site as non-structural fill. Any sediment deposits remaining in place after the barrier is no longer required shall be removed and placed in a stockpile surrounded by silt fence in a location suitable to the Owner.

- Swales, Downchutes, and Impact Basins: Remove accumulated sediment from the affected area when sediment reaches a depth of 6 inches. Use removed sediment to complete non-structural fill areas during project. Once the site has been stabilized, sediment removed at the end of construction shall be stockpiled on-site, surrounded by silt fence, in a location approved by the Owner.

4.2 Dewatering Wastewaters

Should excavation dewatering become necessary for this project, there shall be no discharge directly into wetlands, watercourse, or storm sewer structures. Proper methods and devices shall be utilized to the extent permitted by law, such as pumping water into a temporary pumping settling basin, providing surge protection at the inlet and outlet of pumps, floating the intake of the pump, or other methods to minimize and retain the suspended solids. If a pumping operation causes turbidity problems, the operation shall cease until feasible means of controlling turbidity (e.g. discharge to the sanitary sewer) are determined and implemented.

4.3 Post-Construction Stormwater Management

At the end of construction, all areas disturbed by construction activities shall be stabilized. As a result, the potential for erosion at this site after construction is minimal. Grassed areas will also

serve as a filter to remove any sediment from runoff if permanently stabilized areas are properly maintained.

The goal of the post-construction stormwater management is to remove 80% of the total suspended solids from the stormwater runoff.

After all areas are stabilized, catch basin inserts will be cleaned and reinstalled. Periodic inspection of the inserts will be done in conjunction with the inspections performed in accordance with the existing General Permit for the Discharge of Stormwater Associated with Industrial Activities (No . GSI000500).

4.4 Other Controls

4.4.1 Vehicle Tracking and Dust Control

As shown on the plans, two temporary anti-tracking aprons shall be installed and maintained to prevent vehicles from tracking sediments onto city roads. The Contractor shall provide water or calcium chloride as necessary to control dust from construction activities.

5.0 INSPECTION

The Owner or the Owner's agent shall inspect disturbed areas of the construction activity that have not been permanently stabilized, structural control measures, drainage control facilities including diversion and perimeter drainage ditches, and locations where vehicles enter or exit the site at least once every seven calendar days and within 24 hours of the end of a storm that generated 0.1 inches during a twenty-four hour period. Where sites have been temporarily or finally stabilized, inspection shall be conducted at least once every month for three months.

Disturbed areas and areas used for storage of materials that are exposed to precipitation shall be inspected for evidence of, or the potential for, pollutants entering the drainage system. Erosion and sediment control measures identified in the plan shall be observed to ensure that they are operating correctly. Where discharge locations or points are accessible, they shall be visually inspected to ascertain whether erosion control measures are effective in preventing significant impacts, such as turbidity to receiving waters. Locations where vehicles enter or exit the site shall be inspected for evidence of off-site sediment tracking.

Based on the results of the inspection, the description of potential sources and pollution prevention measures identified in the plan shall be revised as appropriate by the Owner or his agent as soon as practicable after such inspection.

A report summarizing the scope of the inspection, name(s) and qualifications of personnel making the inspection, the date(s) of the inspection, major observations relating to the implementation of the storm water pollution control plan, and actions taken shall be made and retained as part of the storm water pollution control plan for at least three years after the date of inspection. A blank copy of the inspection report is provided in Attachment B.

In addition to the inspections required by this plan, the Closure Plan requires periodic inspection to assess the integrity of the access roads, slopes, and cover material. Qualified personnel will conduct inspections at a minimum of once per quarter. Roadway and access

gates will be maintained to control access to the landfill for maintenance and emergency vehicles. Although it is not anticipated that leachate seeps will be found once the geomembrane cap is in place, the site walkovers will look for and identify any problems of this nature. If erosion of slopes is noted, the affected areas will be re-graded and re-vegetated as soon as possible to prevent additional erosion.

6.0 CONTRACTORS

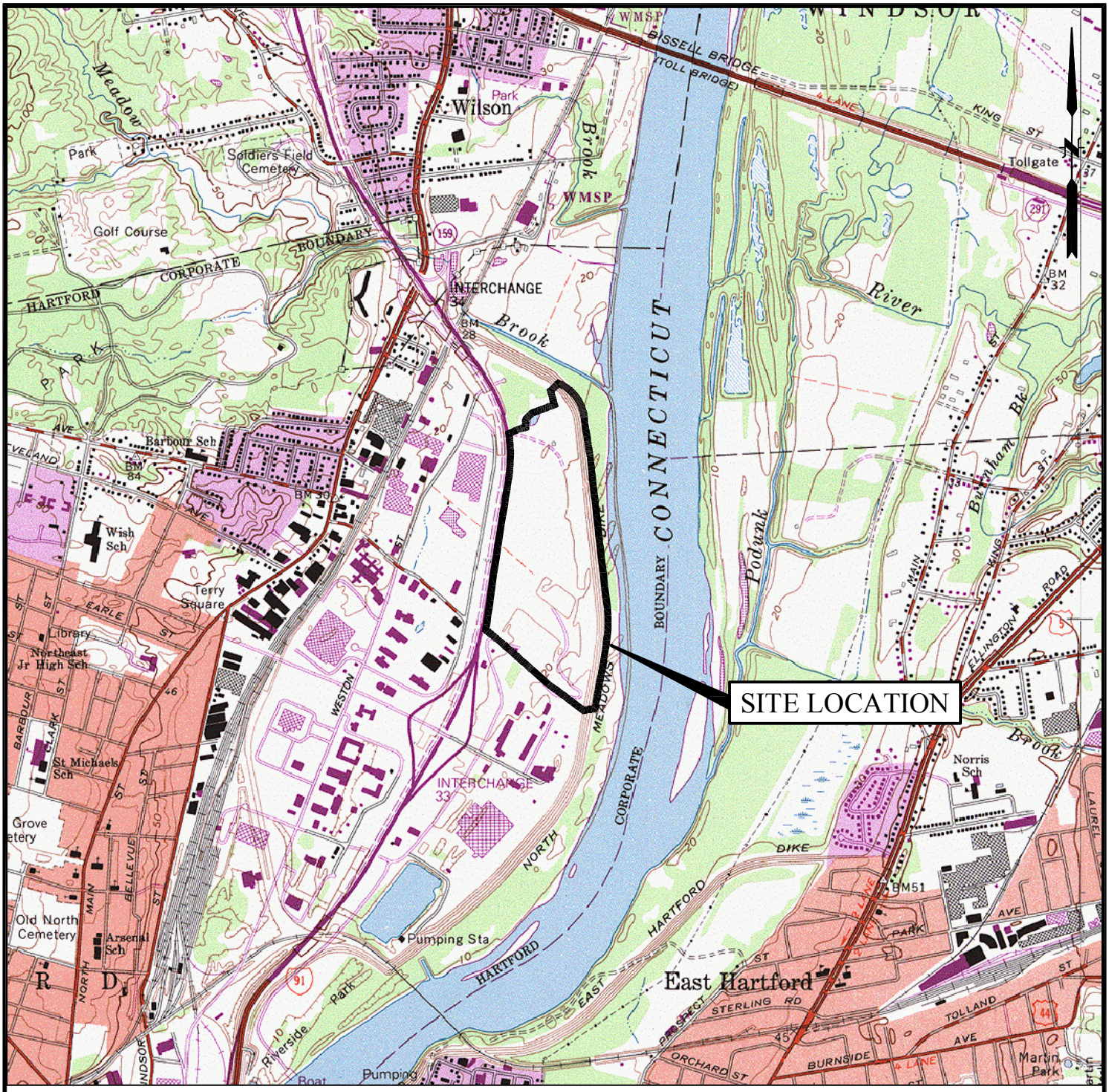
6.1 General

All contractors and subcontractors who will perform actions on site that may reasonably be expected to cause or have the potential to cause pollution of the waters of the State are identified in Attachment C.

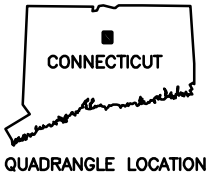
6.2 Certification Statement

All contractors and subcontractors must sign the certification included in Attachment C. All certifications will be included in this Stormwater Pollution Control Plan.

FIGURES



MAP REFERENCE:
THIS MAP WAS PREPARED FROM THE FOLLOWING 7.5 MINUTE SERIES TOPOGRAPHIC MAP:
HARTFORD NORTH, CONN. 1964, PHOTOREVISED 1992.



QUADRANGLE LOCATION

SCALE:	
HORZ.:	1" = 2,000'
VERT.:	
DATUM:	
HORZ.:	
VERT.:	
0 1000 2000	
GRAPHIC SCALE	

FUSS & O'NEILL
Disciplines to Deliver
146 HARTFORD ROAD, MANCHESTER, CONNECTICUT 06040
860.646.2469 www.FandO.com

CONNECTICUT RESOURCES RECOVERY AUTHORITY
SITE LOCATION MAP
HARTFORD LANDFILL
HARTFORD CONNECTICUT

PROJ. No.:	2004 0174.H10
DATE:	2006/06/15

FIG.1

ATTACHMENT A

General Permit

General Permit Registration Form for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities

Please complete this form in accordance with the general permit (DEP-PERD-GP-015) in order to ensure the proper handling of your registration. Print or type unless otherwise noted. You must submit the *Permit Application Transmittal Form* (DEP-APP-001) and the registration fee along with this form.

DEP USE ONLY
Application No.
Permit No.
Facility I.D.

Part I: Registration Type

Enter a check mark in the appropriate box identifying the registration type.

This registration is for (check one):	Please identify any existing permit number in the space provided:
☒ A *new* general permit registration	Existing permit number:
☐ A *modification* of an existing general permit	***GSN*** **N/A**

Part II: Fee Information

☐	***Registration only***	A registration fee of $500.00 is to be submitted with *each* registration that you are submitting at least 30 days before the initiation of construction activities.
☒	***Registration and Plan Review***	All construction projects that result in the disturbance of ten or more acres require the submittal of a Stormwater Pollution Control Plan and a $500.00 plan review fee. The plan and the fee must be submitted 30 days prior to initiation of the construction activity. $500.00 registration fee + $500.00 review fee = $1,000.00 total fee

For municipalities, a 50% discount applies. The registration will not be processed without the fee. The fee shall be non-refundable and shall be paid by certified check or money order payable to the Department of Environmental Protection.

Part III: Registrant Information

1. Fill in the name of the registrant(s) as indicated on the *Permit Application Transmittal Form* (DEP-APP-001):

   Registrant: **Connecticut Resources Recovey Authority**

   Phone: **860-775-7721** ext. Fax:

   ☐ Enter a check mark if there are co-registrants. If so, label and attach additional sheet(s) with the required information as supplied above.

Part III: Registrant Information (cont.)

2. List primary contact for departmental correspondence and inquiries, if different than the registrant.

   Name: **Connecticut Resources Recovery Authority**

   Mailing Address: **100 Constitution Plaza, 6th Floor**

   City/Town: **Hartford** State: **CT** Zip Code: **06103**

   Business Phone: **860-757-7721** ext. Fax:

   Site Phone: **860-548-1468** Emergency Phone:

   Contact Person: **Mr. David Bodendorf** Title: **Sr Environmental Engineer**

   Association (e.g. developer, general or site contractor, etc.):

3. List owner of the property on which the activity will take place, if different from registrant:

   Name: **City of Hartford**

   Mailing Address: **550 Main Street**

   City/Town: **Hartford** State: **CT** Zip Code: **06103**

   Business Phone: **860-522-4888** ext. **6535** Fax:

   Contact Person: **Bhupen Patel** Title: **Director of Public Works**

4. List developer, if different from registrant or primary contact:

   Name: **Same as Registrant**

   Mailing Address:

   City/Town: State: Zip Code:

   Business Phone: ext. Fax:

   Contact Person: Title:

5. Name and address of general contractor:

   Name: **To be determined**

   Mailing Address:

   City/Town: State: Zip Code:

   Business Phone: ext. Fax:

   Site Phone: Off-hours Phone:

   Contact Person: Title:

6. List any engineer(s) or other consultant(s) employed or retained to assist in preparing the registration and Stormwater Pollution Plan.

   ☐ Please enter a check mark if additional sheets are necessary, and label and attach them to this sheet.

   Name: **Fuss & O'Neill, Inc.**

   Mailing Address: **146 Hartford Road**

   City/Town: **Manchester** State: **CT** Zip Code: **06040**

   Business Phone: **860-646-2469** ext. **5258** Fax: **860-533-5133**

   Contact Person: **Craig M. Lapinski, P.E.** Title: **Senior Project Manager**

   Service Provided: **Landfill Closure Plan, Drainage Calculations, SWPCP**

Part IV: Site Information

1. Site or Project Name (if any): **Hartford Landfill**

   Street Address or Description of Location: **185 Liebert Road**

   City/Town: **Hartford** State: **CT** Zip Code: **06120**

2. Brief description of construction activity: **Landfill Closure**

3. Start Date: **2007** Anticipated Completion Date: **2009**

4. Estimated total number of acres to be disturbed: **80**

Part V: Stormwater Discharge Information

1. Where does stormwater discharge to:

   ☐ Municipal Separate Storm System? ☐ Yes ☒ No (Name):

   ☒ Surface water body or wetlands? ☒ Yes ☐ No (Name): **North Meadows Pond**

2. Is the discharge located less than 500 feet from a tidal wetland, which is not a fresh-tidal wetland?

   ☐ Yes ☒ No

3. Name of the watershed where the site is located OR nearest waterbody to which it discharges:

   North Meadows Pond

4. Is construction in accordance with the Guidelines established under Section 22a-329 of the Soil Erosion and Sedimentation Act? ☒ Yes ☐ No

5. Is construction in accordance with local soil erosion and sediment ordinances? ☒ Yes ☐ No

   Note: A copy of this registration and the Stormwater Pollution Control Plan must be available to the town wetlands enforcement officials, wetlands commission, or their equivalent.

6. Will the construction project disturb over ten acres? ☒ Yes ☐ No

   If yes, enclose a copy of the Stormwater Pollution Control Plan and plan review fee.

7. Has the construction project been reviewed for compliance with the following DEP programs?

   a. Coastal Management Act (Section 22a-92 of the Connecticut General Statutes) ☐ Yes ☒ No

   b. Endangered and Threatened Species (Section 26-306 of the Connecticut General Statutes) ☐ Yes ☒ No

   c. State and Federal Historic Preservation statutes? ☐ Yes ☒ No

Part VI: Supporting Documents

Please enter a check mark by the attachments as verification that *all* applicable attachments have been submitted with this registration form. When submitting any supporting documents, please label the documents as indicated in this part (e.g., Attachment A, etc.) and be sure to include the registrant's name as indicated on the *Permit Application Transmittal Form*.

☒	Attachment A:	An 8 1/2" x 11" copy of the relevant portion or a full-sized original of a USGS Quadrangle Map indicating the exact location of the facility or site. Indicate the quadrangle name on the map. (To obtain a copy of the relevant USGS Quadrangle Map, call your town hall or DEP Maps and Publications Sales at 860-424-3555.)
☒	Attachment B:	A copy of the Stormwater Pollution Control Plan and plan review fee of $500.00, if the construction project disturbs over 10 acres

Part VII: Environmental Professional Certification

The following certification must be signed by a professional engineer, licensed to practice in Connecticut.

"I certify that I have thoroughly and completely reviewed the Stormwater Pollution Control Plan for the site. I further certify, based on such review and in my professional judgment, that the Stormwater Pollution Control Plan has been prepared in accordance with the Connecticut Guidelines for Soil Erosion and Sediment Control, as amended, and the conditions for the General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities and the controls required for such Plan are appropriate for the site. I am aware that there are significant penalties for false statements in this certification, including the possibility of fine and imprisonment for knowingly making false statements."

Richard D. Jones

Signature of Professional Engineer

6/20/06

Date

Richard D. Jones, P.E.

Name of Professional Engineer (print or type)

19393

P. E. Number (if applicable)

Affix P. E. Stamp Here

Part VIII: Registrant Certification

The registrant *and* the individual(s) responsible for actually preparing the registration must sign this part. A registration will be considered incomplete unless all required signatures are provided.

"I have personally examined and am familiar with the information submitted in this document and all attachments thereto, and I certify that, based on reasonable investigation, including my inquiry of those individuals responsible for obtaining the information, the submitted information is true, accurate and complete to the best of my knowledge and belief. I certify that this general permit registration is on complete and accurate forms as prescribed by the commissioner without alteration of the text. I understand that a false statement made in the submitted information may be punishable as a criminal offense, in accordance with Section 22a-6 of the Connecticut General Statutes, pursuant to Section 53a-157b of the Connecticut General Statutes, and in accordance with any other applicable statute.

I also certify under penalty of law that I have read and understand all conditions of the General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities, that all conditions for eligibility for authorization under the general permit are met, all terms and conditions of the general permit are being met for all discharges which have been initiated and are the subject of this registration, and that a system is in place to ensure that all terms and conditions of this general permit will continue to be met for all discharges authorized by this general permit at the site. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowingly making false statements."

Signature of Registrant	Date
Peter W. Egan Name of Registrant (print or type)	**Dir. of Environmental Affairs** Title (if applicable)
Signature of Preparer (if different than above)	6/20/06 Date
Richard D. Jones, P.E. Name of Preparer (print or type)	**Senior Vice President** Title (if applicable)

☐ Please enter a check mark if additional signatures are necessary.
If so, please reproduce this sheet and attach signed copies to this sheet.

Note: Please submit the *Permit Application Transmittal Form*, the Registration Form, Fee(s), and all Supporting Documents to:

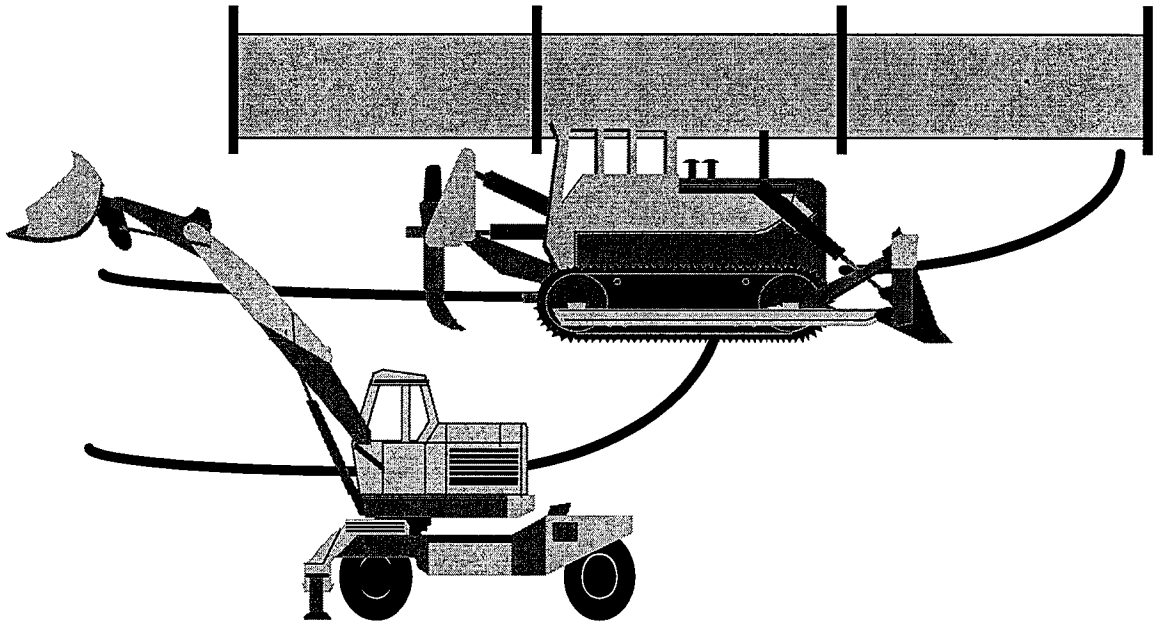
CENTRAL PERMIT PROCESSING UNIT
DEPARTMENT OF ENVIRONMENTAL PROTECTION
79 ELM STREET
HARTFORD, CT 06106-5127

Note: If discharging to municipal separate storm sewer, send a copy of this completed registration form to the owner or operator of that system.

If discharging to a public drinking water supply watershed or aquifer area, send a copy of this completed registration form to the appropriate water company.

STATE OF CONNECTICUT
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF WATER MANAGEMENT
PERMITTING, ENFORCEMENT AND REMEDIATION DIVISION
860-424-3018

General Permit for the Discharge of Stormwater and Dewatering Wastewaters Associated with Construction Activities



Issuance Date: October 1, 2002
Modified: April 8, 2004

Printed on recycled paper

General Permit for Discharge of Stormwater and Dewatering Wastewaters from Construction Activities

Table of Contents

General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities

Section 1. Authority

This general permit is issued under the authority of Section 22a-430b of the Connecticut General Statutes.

Section 2. Definitions

The definitions of terms used in this general permit shall be the same as the definitions contained in Section 22a-423 of the Connecticut General Statutes and Section 22a-430-3(a) of the Regulations of Connecticut State Agencies. As used in this general permit, the following definitions shall apply:

"*Authorized activity*" means any activity authorized under this general permit.

"*Coastal area*" means coastal area as defined in Section 22a-93(5) of the Connecticut General Statutes.

"*Coastal waters*" means coastal waters as defined in Section 22a-29 of the Connecticut General Statutes.

"*Commissioner*" means commissioner as defined in Section 22a-2(b) of the Connecticut General Statutes.

"*Construction activities*" means activities including but not limited to clearing and grubbing, grading, excavation, and dewatering.

"*Department*" means the department of environmental protection.

"*Developer*" means a person who or municipality which is responsible, either solely or through contract, for the design and construction of a project site.

"*Dewatering wastewater*" means wastewater generated from the lowering of the groundwater table, the pumping of accumulated stormwater from an excavation, or the pumping of surface water from a cofferdam, or pumping of other surface water that has been diverted into a construction site.

"*Disturbance*" means the execution of any of the construction activities defined above.

"*Erosion*" means the detachment and movement of soil or rock fragments by water, wind, ice and gravity.

"*Fresh-tidal wetland*" means a tidal wetland with an average salinity level of less than 0.5 parts per thousand.

"Guidelines" means the Connecticut Guidelines for Soil Erosion and Sediment Control, as amended, or as may be amended, established pursuant to Section 22a-328 of the Connecticut General Statutes.

"High tide line" means high tide line as defined in Section 22a-359(c) of the Connecticut General Statutes.

"Individual permit" means a permit issued to a named permittee under Section 22a-430 of the Connecticut General Statutes.

"Inland wetland" means wetlands as defined in Section 22a-38 of the Connecticut General Statutes.

"Municipal separate storm sewer" means conveyances for stormwater (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels or storm drains) owned or operated by any municipality and discharging directly to surface waters of the state.

"Municipality" means municipality as defined in Section 22a-423 of the Connecticut General Statutes.

"Permittee" means any person who or municipality which initiates, creates or maintains a discharge in accordance with Section 3 of this general permit.

"Person" means person as defined in Section 22a-423 of the Connecticut General Statutes.

"Point Source" means any discernible, confined and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel or other floating craft from which pollutants are or may be discharged.

"Registrant" means a person who or municipality which files a registration.

"Registration" means a registration form filed with the commissioner pursuant to Section 4 of this general permit.

"Retain" means to permanently hold on-site with no subsequent point-source release as in a detention system where there is a temporary holding or delaying of the delivery of stormwater downstream.

"Sediment" means solid material, either mineral or organic, that is in suspension, is transported, or has been moved from its site of origin by erosion.

"Site" means geographically contiguous land or water on which an authorized activity takes place or on which an activity for which authorization is sought under this general permit is proposed to take place. Non-contiguous land or water owned by the same person and connected by a right-of-way, which such person controls, and to which the public does not have access shall be deemed the same site.

"Soil" means any unconsolidated mineral and organic material of any origin.

"Stabilize" means the use of pavement, establishment of vegetation, use of geotextile materials, use of organic or inorganic mulching materials, or retention of existing vegetation to prevent erosion.

"Stormwater" means waters consisting of precipitation runoff.

"Tidal wetland" means a wetland as defined in Section 22a-29(2) of the Connecticut General Statutes.

"Total disturbance" means the total area on a site that will be exposed or susceptible to erosion during the course of a project.

"Total sediment load" means the total amount of sediment carried by stormwater runoff on an annualized basis.

"Upland soils" means soils which are not designated as poorly drained, very poorly drained, alluvial, or flood plain by the National Cooperative Soils Survey, as may be amended from time to time, of the Soil Conservation Service of the United States, Department of Agriculture, and/or the Inland Wetlands Commission of the community in which the project will take place.

"Water company" means water company as defined in Section 25-32a of the Connecticut General Statutes.

Section 3. Authorization Under This General Permit

(a) Eligible Activities

The following activity is authorized by this general permit, provided the requirements of subsection (b) of this section are satisfied:

The discharge of stormwater and dewatering wastewater from construction activities which result in the disturbance of one or more total acres of land area on a site regardless of project phasing. In the case of a larger plan of development (such as a subdivision), the estimate of total acres of site disturbance shall include, but is not limited to, road and utility construction, individual lot construction (i.e., house, driveway, septic system, etc.), and all other construction associated with the overall plan, regardless of the individual parties responsible for construction of these various elements.

(b) Requirements for Authorization

This general permit authorizes the activity listed in subsection (a) of this section provided:

(1) Coastal Management Act

Such activity must be consistent with all applicable goals and policies in Section 22a-92 of the Connecticut General Statutes, and must not cause adverse impacts to coastal resources as defined in Section 22a-93(15) of the Connecticut General Statutes.

(2) Endangered and Threatened Species

Such activity must not threaten the continued existence of any species listed pursuant to Section 26-306 of the Connecticut General Statutes as endangered or threatened and must not result in the destruction or adverse modification of habitat designated as essential to such species.

(3) Historic Places

Such activity must at all times be in compliance with State and Federal Historic Preservation statutes, regulations and policies including identification of any potential impacts on property listed or eligible for listing on the State and/or National Registers of Historic Places and a description of measures necessary to avoid or minimize those impacts.

(4) The stormwater is *not* discharged to a Publicly Owned Treatment Works or to ground water;

(5) The discharge shall *not* cause pollution due to acute or chronic toxicity to aquatic and marine life, impair the biological integrity of aquatic or marine ecosystems, or result in an unacceptable risk to human health.

(6) Any construction site that is registered under the General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities renewed on October 1, 1997, modified on December 20, 2000, and renewed on October 1, 2002, is authorized by this general permit provided that the site continues to meet the conditions listed in Section 6 of this general permit.

(c) Registration

Pursuant to Section 4 of this general permit, a completed registration with respect to the construction activity shall be filed with the commissioner thirty (30) days prior to the commencement of the activity unless exempted by Section 3(d) of this general permit.

(d) Small Construction

For construction projects with a total disturbed area (regardless of phasing) of between one and five acres, the permittee shall agree to adhere to the erosion and sediment control land use regulations of the town in which the construction activity is conducted. No registration pursuant to Section 4 of this general permit shall be required for such construction activity as long as it receives town review and written approval of its erosion and sediment control measures and follows the Guidelines. If no review is conducted by the town, the permittee must register and comply with Section 6 of this general permit.

(e) Geographic Area

This general permit applies throughout the State of Connecticut.

(f) Effective Date and Expiration Date of this General Permit

The modification of this general permit is effective on April 8, 2004, and expires on October 1, 2007.

(g) Effective Date of Authorization

Any activity is authorized by this general permit on the date the general permit becomes effective or on the date the activity is initiated, whichever is later.

(h) Revocation of an Individual Permit

If an activity is eligible for authorization under this general permit and such activity is presently authorized by an individual permit, the existing individual permit may be revoked by the commissioner upon a written request by the permittee. If the commissioner revokes such individual permit in writing, such revocation shall take effect on the effective date of authorization of such activity under this general permit.

(i) Issuance of an Individual Permit

If the commissioner issues an individual permit under Section 22a-430 of the Connecticut General Statutes, authorizing an activity authorized by this general permit, this general permit shall cease to authorize that activity beginning on the date such individual permit is issued.

Section 4. Registration Requirements

(a) Who Must File a Registration

With the exception noted below or in Section 3(d) of this general permit, any person who or municipality which initiates, creates, originates or maintains a discharge described in Section 3(a) of this general permit shall file with the commissioner a registration form that meets the requirements of Section 4 of this general permit, along with the applicable fee, at least thirty (30) days before the initiation of construction activities.

If a site has been previously registered under the General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities renewed on October 1, 1997, modified on December 20, 2000, and renewed on October 1, 2002, the permittee does *not* need to submit a new registration under this general permit, unless the ownership of the site has been transferred.

If the site for which a registration is submitted under this general permit is owned by one person or municipality but is leased or, in some other way, the legal responsibility of another person or municipality (the developer), the developer is responsible for submitting the registration required by this general permit. The registrant is responsible for compliance with all conditions of this general permit.

(b) Scope of Registration

A registrant shall register on one registration form every activity at a single site for which activity the registrant seeks authorization under this general permit. Activities at more than a single site may not be registered on one registration form.

(c) Contents of Registration

(1) Fees

(A) The registration fee of $500.00 shall be submitted with a registration form, provided that the registration fee for a municipality shall be $250.00. A registration shall not be deemed complete and no activity shall be authorized by this general permit (with the exception of activities previously registered under the general permit renewed on October 1, 1997, modified on December 20, 2000, and renewed on October 1, 2002), unless the registration fee has been paid in full.

(B) Registrants required to submit a stormwater pollution control plan (Plan) in accordance with Section 6(b)(3)(C) of this general permit shall pay an additional plan review fee of $500.00 with the submittal of the Plan, the registration form and registration fee, provided that the plan review fee for a municipality shall be $250.00.

(C) The registration fee and plan review fee shall be paid by check or money order payable to the **Department of Environmental Protection**.

(D) The registration fee and plan review fee are non-refundable.

(2) Registration Form

A registration shall be filed on forms prescribed and provided by the commissioner and shall include the following:

(A) Legal name, address, and telephone number of the registrant. If the registrant is a person transacting business in Connecticut and is registered with the Connecticut Secretary of the State, provide the exact name as registered with the Connecticut Secretary of the State.

(B) Legal name, address and telephone number of the owner of the property on which the activity will take place.

(C) Legal name, address and telephone number of the primary contact for departmental correspondence and inquiries, if different from the registrant.

(D) Legal name, address and telephone number of the developer of the property on which the subject activity is to take place.

(E) Legal name, address and daytime and off-hours telephone numbers of the general contractor or other representative, if different from the developer.

(F) Legal name, address and telephone number of any consultant(s) or engineer(s) retained by the permittee to prepare the registration and Stormwater Pollution Control Plan.

(G) Location address or description of the site with respect to which the registration is submitted.

(H) The estimated duration of the construction activity.

(I) A brief description of the construction activity, including, but not limited to:

(i) Number of acres disturbed.

(ii) Assurance that construction is in accordance with the Guidelines and local erosion and sediment control ordinances.

(iii) A determination of whether or not a coastal consistency review is necessary for the activity.

(iv) Assurance that there are no endangered or threatened species suspected or known to be impacted by the activity.

(J) A brief description of the stormwater discharge, including:

(i) The name of the municipal separate storm sewer system or immediate surface water body or wetland to which the stormwater runoff discharges, and whether or not the site discharges within 500 feet of a tidal wetland.

(ii) The name of the watershed or nearest waterbody to which the site discharges.

(K) An 8 ½" by 11" copy of the relevant portion or a full-sized original of a United States Geological Survey (USGS) quadrangle map, with a scale of 1:24,000, showing the exact location of the site and the area within a one mile radius of the site. Identify the quadrangle name on such copy.

(L) For all sites that will disturb 10 acres or more (regardless of phasing), a copy of the Stormwater Pollution Control Plan shall be submitted (with the $500 plan review fee) in accordance with Section 6(b)(3)(C) of this general permit.

(M) The signature of the registrant and of the individual or individuals responsible for actually preparing the registration, each of whom shall certify in writing as follows:

"I have personally examined and am familiar with the information submitted in this document and all attachments thereto, and I certify that, based on reasonable investigation, including my inquiry of those individuals responsible for obtaining the information, the submitted information is true, accurate and complete to the best of my knowledge and belief. I certify that this general permit registration is on complete and accurate forms as prescribed by the commissioner without alteration of the text. I understand that a false statement made in the submitted information may be punishable as a criminal offense, in accordance with Section 22a-6 of the Connecticut General Statutes, pursuant to Section 53a-157b of the Connecticut General Statutes, and in accordance with any other applicable statute.

I also certify under penalty of law that I have read and understand all conditions of the General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities, that all conditions for eligibility for authorization under the general permit are met, all terms and conditions of the general permit are being met for all discharges which have been initiated and are the subject of this registration, and that a system is in place to ensure that all terms and conditions of this general permit will continue to be met for all discharges authorized by this general permit at the site. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowingly making false statements."

(N) The following certification must be signed by a professional engineer, licensed to practice in Connecticut:

"I certify that I have thoroughly and completely reviewed the Stormwater Pollution Control Plan for the site. I further certify, based on such review and in my professional judgment, that the Stormwater Pollution Control Plan has been prepared in accordance with the Connecticut Guidelines for Soil Erosion and Sediment Control, as amended, and the conditions for the General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities and the controls required for such Plan are appropriate for the site. I am aware that there are significant penalties for false statements in this certification, including the possibility of fine and imprisonment for knowingly making false statements."

(d) Where to File a Registration

A registration shall be filed with the commissioner at the following address:

CENTRAL PERMIT PROCESSING UNIT
DEPARTMENT OF ENVIRONMENTAL PROTECTION
79 ELM STREET
HARTFORD, CT 06106-5127

(e) Additional Information

The commissioner may require a registrant to submit additional information that the commissioner reasonably deems necessary to evaluate the consistency of the subject activity with the requirements for authorization under this general permit.

(f) Additional Notification

For discharges through a municipal separate storm sewer system authorized by this general permit, a copy of the registration shall also be submitted to the owner and operator of that system.

For discharges within a public drinking water supply watershed or aquifer area, a copy of the registration and the Plan described in Section 6(b) of this general permit shall be submitted to the water company.

In addition, a copy of this registration and the Plan shall be available upon request to the local wetlands agency or its equivalent, or its duly authorized agent.

(g) Action by Commissioner

(1) The commissioner may reject without prejudice a registration if he determines that it does not satisfy the requirements of Section 4(c) of this general permit or more than thirty (30) days have elapsed since the commissioner requested that the registrant submit additional information or the required fee and the registrant has not submitted such information or fee. Any registration refiled after such a rejection shall be accompanied by the fee specified in Section 4(c)(1) of this general permit.

(2) The commissioner may disapprove a registration if he finds that the subject activity is inconsistent with the requirements for authorization under Section 3(b) of this general permit, or for any other reason provided by law.

(3) Disapproval of a registration under this subsection shall constitute notice to the registrant that the subject activity must be authorized under an individual permit.

(4) Rejection or disapproval of a registration shall be in writing.

Section 5. Termination Requirements

(a) Notice of Termination

At the completion of a construction project registered pursuant to Section 4 of this general permit, a Notice of Termination must be filed with the commissioner. A project shall be considered complete after the site has been stabilized for at least three months following the cessation of construction activities. A site is not considered stabilized until there is no active erosion or sedimentation present and no disturbed areas remain exposed.

(b) Termination Form

A termination notice shall be filed on forms prescribed and provided by the commissioner and shall include the following:

(1) The general permit number as provided to the permittee on the general permit certificate.

(2) The name of the registrant as reported on the General Permit Registration Form for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities (DEP-PED-REG-015).

(3) The address of the completed construction site.

(4) The date all storm drainage structures were cleaned of construction debris pursuant to Section 6(b)(6)(C)(iv) of this general permit, the date of completion of construction, and the date of the final inspections pursuant to Section 6(b)(6)(D) of this general permit.

(5) A description of the post-construction activities at the site.

(6) Signature of the permittee.

(c) Where to File a Termination Form

A termination form shall be filed with the commissioner at the following address:

PERMIT COORDINATOR
BUREAU OF WATER MANAGEMENT
DEPARTMENT OF ENVIRONMENTAL PROTECTION
79 ELM STREET
HARTFORD, CT 06106-5127

Section 6. Conditions of this General Permit

The permittee shall at all times continue to meet the requirements for authorization set forth in Section 3 of this general permit. In addition, a permittee shall assure that authorized activities are conducted in accordance with the following conditions:

(a) Conditions Applicable to Certain Discharges

(1) Any person who or municipality which discharges stormwater into coastal tidal waters for which a permit is required under either the Structures and Dredging Act in accordance with Section 22a-361 of the Connecticut General Statutes or the Tidal Wetlands Act in accordance with Section 22a-32 of the Connecticut General Statutes, shall obtain such permit(s) from the commissioner. A tidal wetland permit is required for the placement of any sediment upon tidal wetland, whether it is deposited directly or indirectly.

(2) Any site which has a post-construction stormwater discharge that is located less than 500 feet from a tidal wetlands which is not a fresh-tidal wetland, shall discharge such stormwater through a system designed to retain the volume of stormwater runoff generated by 1 inch of rainfall on the site.

(b) Stormwater Pollution Control Plan

A registrant shall develop a Stormwater Pollution Control Plan ("Plan") for each site authorized by this general permit. Once the construction activity begins, the permittee shall perform all actions required by such Plan and shall maintain compliance with the Plan thereafter. The Plan shall be designed to address two components of stormwater pollution: (1) pollution caused by soil erosion and sedimentation during and after construction; and (2) stormwater pollution caused by use of the site after construction is completed, including, but not limited to, parking lots, roadways and the maintenance of grassed areas.

(1) Development of Plan

(A) The registrant shall develop a Plan for the site. Plans shall be prepared in accordance with sound engineering practices. The Plan shall ensure and demonstrate compliance with the Guidelines.

(B) For any stormwater discharges that were permitted under the General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities renewed on October 1, 1997, modified on December 20, 2000, and renewed on October 1, 2002, the existing Plan shall be updated in accordance with subsection (b)(6) of this section. The permittee shall maintain compliance with such Plan thereafter.

(2) Deadlines for Plan Preparation and Compliance

For construction activities authorized by this general permit that are initiated after the date of issuance of this general permit, the registrant shall prepare the Plan no later than thirty days before the date of initiation of the construction activity.

(3) Signature and Plan Review

(A) The Plan shall be signed by the registrant in accordance with Section 6(h) of this general permit. The Plan shall be certified by all contractors and subcontractors in accordance with subsection (b)(6)(E) of this section.

(B) The registrant shall provide a copy of the Plan, and the registration form required in Section 4 of this general permit to the following persons immediately upon request:

(i) the commissioner;

(ii) the local agency approving sediment and erosion plans, grading plans, or stormwater management plans, and the local official responsible for enforcement of such plans;

(iii) in the case of a stormwater discharge through a municipal separate storm sewer system, the municipal operator of the system;

(iv) in the case of a stormwater discharge located within a public drinking water supply watershed or aquifer area, the water company.

The registrant shall also provide a copy of the Plan to all contractors or developers conducting construction activities on individual lots or buildings within the overall plan of development, regardless of ownership. These additional contractors or developers shall sign the certification in Section 6(b)(6)(E)(iii).

For all registrants or permittees submitting a Plan in accordance with subsection (b)(3)(B)(i) of this section, a plan review fee of $500.00 shall be submitted with the Plan.

(C) For construction activities that result in the disturbance of ten or more total acres of land area on a site (regardless of phasing), the Plan shall be submitted to the commissioner no later than thirty days before the initiation of construction activities. Plans shall be submitted in conjunction

with the registration submitted in compliance with Section 4 of this general permit.

(D) The commissioner may notify the registrant at any time that the Plan and/or the site do not meet one or more of the minimum requirements of this general permit. Within seven (7) days of such notice, or such other time as the commissioner may allow, the registrant shall make the required changes to the Plan and perform all actions required by such revised Plan. Within fifteen (15) days of such notice, or such other time as the commissioner may allow, the registrant shall submit to the commissioner a written certification that the requested changes have been made and implemented and such other information as the commissioner requires, in accordance with Sections 6(g) and 6(h) of this general permit.

(4) Keeping Plans Current

The permittee shall amend the Plan whenever there is a change in contractors or subcontractors at the site, or a change in design, construction, operation, or maintenance at the site which has the potential for the discharge of pollutants to the waters of the state and which has not otherwise been addressed in the Plan or if the actions required by the Plan fail to prevent pollution.

(5) Failure to Prepare, Maintain or Amend Plan

In no event shall failure to complete, maintain or update a Plan in accordance with subsections (b)(1) and (b)(4) of this section relieve a permittee of responsibility to implement any actions required to protect the waters of the state and to comply with all conditions of the general permit, including but not limited to installation and maintenance of all controls and management measures described in subsection (b)(6)(C) of this section and in the Guidelines.

(6) Contents of the Plan

The Plan shall include, at a minimum the following items:

(A) Site Description

(i) A description of the nature of the construction activity;

(ii) Estimates of the total area of the site and the total area of the site that is expected to be disturbed by construction activities;

(iii) An estimate, including calculations if any, of the average runoff coefficient of the site after construction activities are completed and existing data describing the soil or the quality of any discharge from the site;

(iv) A site map indicating drainage patterns and approximate slopes anticipated after major grading activities, areas of soil disturbance, the location of major structural and non-structural controls identified in the Plan, the location of areas where stabilization practices are expected to occur, areas which will be vegetated following construction, surface waters (including inland wetlands, tidal

wetlands, and fresh-tidal wetlands), and locations where stormwater is discharged to a surface water (both during and post-construction); and

(v) The name of the immediate receiving water(s) and the ultimate receiving water(s) of the discharges authorized by this general permit and areal extent of wetland acreage on the site.

(B) Construction Sequencing

Each Plan shall clearly identify the expected sequence of major construction activities on the site, including but not limited to installation of erosion and sediment control measures, clearing, grubbing, grading, cut and fill operations, drainage and utility installation, and paving and stabilization operations. This section shall include an estimated timetable for all activities which shall be revised in accordance with subdivision (4) of this section as necessary. Wherever possible, the site shall be phased to avoid the disturbance of over five acres at one time. The Plan shall clearly show the limits of disturbance for the entire activity and for each phase. Any Plan that shows a site disturbance of over ten acres total (regardless of phasing) requires submittal of the Plan to the department, in accordance with subsection (b)(3)(C) of this section.

(C) Controls

Each Plan shall include a description of appropriate controls and measures that will be performed at the site to prevent pollution of the waters of the state. The Plan shall clearly describe for each major activity identified in subsection (b)(6)(B) of this section, the appropriate control measures and the timing during the construction process that the measures would be implemented. (For example, perimeter controls for one portion of the site will be installed after the clearing and grubbing necessary for installation of the measure, but before the clearing and grubbing for the remaining portions of the site. Perimeter controls will be actively maintained until final stabilization of those portions of the site upgradient of the perimeter control. Temporary perimeter controls will be removed after final stabilization.) Controls shall be designed in accordance with the Guidelines. Use of controls to comply with subsection (b)(6)(C)(i) of this section that are not included in the Guidelines must be approved by the commissioner or his designated agent. The description of controls shall address the following minimum components:

(i) Erosion and Sediment Controls

1) Stabilization Practices

The Plan shall include a description of interim and permanent stabilization practices, including a schedule for implementing the practices. Site plans shall ensure that existing vegetation is preserved where attainable and that disturbed portions of the site are stabilized. Stabilization practices may include but not be limited to: silt fences, temporary seeding, permanent seeding, mulching, geotextiles, sod stabilization, vegetative

buffer strips, protection of trees, preservation of mature vegetation, and other vegetative and non-structural measures as may be identified by the Guidelines. Where construction activities have permanently ceased or have temporarily been suspended for more than seven days, or when final grades are reached in any portion of the site, stabilization practices shall be implemented within three days. Areas that will remain disturbed but inactive for at least thirty days shall receive temporary seeding in accordance with the Guidelines. Areas that will remain disturbed beyond the planting season, shall receive long-term, non-vegetative stabilization sufficient to protect the site through the winter. In all cases, stabilization measures shall be implemented as soon as possible in accordance with the Guidelines. Areas to be graded with slopes steeper than 3:1 (horizontal:vertical) and higher than fifteen (15) feet shall be graded with appropriate slope benches in accordance with the Guidelines.

2) Structural Practices

The Plan shall include a description of structural practices to divert flows away from exposed soils, store flows or otherwise limit runoff and the discharge of pollutants from the site. Such practices include but may not be limited to earth dikes (diversions), drainage swales, sediment traps, check dams, subsurface drains, pipe slope drains, level spreaders, storm drain inlet protection, outlet protection, reinforced soil retained systems, gabions, and temporary or permanent sediment basins and chambers. Unless otherwise specifically approved in writing, structural measures shall be installed on upland soils.

At a minimum, for discharge points that serve an area with between two (2) and five (5) disturbed acres at one time, a sediment basin, sediment trap, or other control as may be defined in the Guidelines for such drainage area, designed in accordance with the Guidelines, shall be designed and installed. All sediment traps or basins shall provide a minimum of 134 cubic yards of water storage per acre drained and shall be maintained until final stabilization of the contributing area. This requirement shall not apply to flows from off-site areas and flows from the site that are either undisturbed or have undergone final stabilization where such flows are diverted around the sediment trap or basin. Any exceptions must be approved in writing by the commissioner.

For discharge points that serve an area with more than five (5) disturbed acres at one time, a sediment basin designed in accordance with the Guidelines, shall be designed and installed, which basin shall provide a minimum of 134 cubic yards of water storage per acre drained and which basin shall

be maintained until final stabilization of the contributing area. This requirement shall not apply to flows from off-site areas and flows from the site that are either undisturbed or have undergone final stabilization where such flows are diverted around the sediment basin. Outlet structures from sedimentation basins shall not encroach upon a wetland. Any exceptions must be approved in writing by the commissioner.

3) Maintenance

Maintenance shall be performed in accordance with the Guidelines, provided that, if additional maintenance is required to protect the waters of the state from pollution, the Plan shall include a description of the procedures to maintain in good and effective operating conditions all erosion and sediment control measures, including vegetation, and all other protective measures identified in the site plan.

(ii) Dewatering Wastewaters

Where feasible and appropriate, dewatering wastewaters shall be infiltrated into the ground. Dewatering wastewaters discharged to surface waters shall be discharged in a manner that minimizes the discoloration of the receiving waters. Each plan shall include a description of the operational and structural practices that will be used to ensure that all dewatering wastewaters will not cause scouring or erosion or contain suspended solids in amounts that could reasonably be expected to cause pollution of waters of the State.

(iii) Post Construction Stormwater Management

Each plan must include a description of measures that will be installed during the construction process to control pollutants in stormwater discharges that will occur after construction operations have been completed. Unless otherwise specifically provided by the commissioner in writing, structural measures shall be placed on upland soils. This general permit only addresses the installation of stormwater management measures, and not the ultimate operation and maintenance of such structures included in such measures after the construction activities have been completed and the site has undergone final stabilization. The following measures must be implemented:

1) For construction activities initiated after October 1, 1992, the permittee shall install post-construction stormwater management measures designed to remove suspended solids and floatables (i.e., oil and grease, other floatable liquids, floatable solids, trash, etc.) from stormwater. A goal of 80 percent removal of total sediment load from the stormwater discharge shall be used in designing and installing stormwater management measures. Such measures may include but are not

limited to: stormwater detention structures (including wet ponds); stormwater retention structures; flow attenuation by use of open vegetated swales and natural depressions; infiltration of runoff on-site; vegetated buffer strips; sediment removal chambers or structures; and sequential systems (which combine several practices). Provisions shall be included to address the maintenance of any system installed.

2) Velocity dissipation devices shall be placed at discharge locations and along the length of any outfall channel as necessary to provide a non-erosive velocity flow from the structure to a water course so that the natural physical and biological characteristics and functions are maintained and protected (e.g., maintenance of hydrologic conditions, such as the hydrodynamics present prior to the initiation of construction activities).

3) Any site which has a post-construction stormwater discharge located less than 500 feet from a tidal wetlands which is not a fresh-tidal wetland, shall discharge such stormwater through a system designed to retain the volume of stormwater runoff generated by 1 inch of rainfall on the site.

(iv) Other Controls

A description of other controls used at the site. The following controls must be implemented:

1) Waste Disposal

A description of best management practices to be performed at the site, which practices shall ensure that no litter, debris, building materials, or similar materials are discharged to waters of the State.

2) Off-site vehicle tracking of sediments and the generation of dust shall be minimized.

3) All post-construction stormwater structures shall be cleaned of construction sediment and any remaining silt fence shall be removed prior to filing of a termination notice pursuant to Section 5 of this general permit.

(D) Inspection

A description of the inspection procedures that must be addressed and implemented in the following manner:

Qualified personnel (provided by the permittee) shall inspect disturbed areas of the construction activity that have not been finally stabilized, structural control measures, and locations where vehicles enter or exit the site at least once every seven calendar days and within twenty-four (24)

hours of the end of a storm that is 0.1 inches or greater. Where sites have been temporarily or finally stabilized, such inspection shall be conducted at least once every month for three months.

(i) Disturbed areas and areas used for storage of materials that are exposed to precipitation shall be inspected for evidence of, or the potential for, pollutants entering the drainage system. Erosion and sediment control measures shall be observed to ensure that they are operating correctly. Where discharge locations or points are assessable, they shall be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters. Locations where vehicles enter or exit the site shall be inspected for evidence of off-site sediment tracking.

(ii) Based on the results of the inspection, the description of potential sources and pollution prevention measures identified in the Plan shall be revised as appropriate as soon as practicable after such inspection. Such modifications shall provide for timely implementation of any changes to the site within twenty-four (24) hours and implementation of any changes to the Plan within three (3) calendar days following the inspection. The Plan shall be revised and the site controls updated in accordance with sound engineering practices, the Guidelines, and subdivisions (4) and (6)(C)(i) 3) of this section.

(iii) A report summarizing the scope of the inspection, name(s) and qualifications of personnel making the inspection, the date(s) of the inspection, major observations relating to the implementation of the Plan, and actions taken shall be made and retained as part of the Plan for at least three years after the date of inspection. The report shall be signed by the permittee or his/her authorized representative in accordance with the requirements of Section 6(h) of this general permit.

(E) Contractors

(i) The Plan shall clearly identify each contractor and subcontractor that will perform actions on the site which may reasonably be expected to cause or have the potential to cause pollution of the waters of the State, and shall include a copy of the certification statement shown below signed by each such contractor and subcontractor. All certifications shall be included in the Plan.

(ii) Subdivisions

Where individual lots in a subdivision or other common plan of development are conveyed or otherwise the responsibility of another contractor, those individual lot contractors shall be required to comply with the provisions of this general permit and shall sign the certification statement below regardless of lot size or disturbed area.

The permittee shall provide a copy of the Plan to each of these contractors.

(iii) Certification Statement

The Plan shall include the following certification signed by each contractor and subcontractor identified in the Plan as described above:

"I certify under penalty of the law that I have read and understand the terms and conditions of the General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities. I understand that as a contractor or subcontractor at the site, I am authorized by this general permit, and must comply with the terms and conditions of this general permit, including but not limited to the requirements of the Stormwater Pollution Control Plan prepared for the site."

The certification shall include the name and title of the person providing the signature; the name, address and telephone number of the contracting firm; the address (or other identifying description) of the site; and the date the certification is made.

(c) Reporting and Record Keeping Requirements

(1) The permittee shall retain copies of the Plan and all reports required by this general permit, and records of all data used to complete the registration to be authorized by this general permit, for a period of at least three years from the date that construction at the site is completed unless the commissioner specifies another time period in writing.

(2) The permittee shall retain an updated copy of the Plan required by this general permit at the construction site from the date construction is initiated at the site until the date construction at the site is completed.

(3) Upon completion of construction for sites authorized by the General Permit for the Discharge of Stormwater Associated with Commercial Activity or the General Permit for the Discharge of Stormwater Associated with Industrial Activity, the Plan shall be kept as an appendix to the Stormwater Management Plan or Stormwater Pollution Prevention Plan (as applicable) for a period of at least three years from the date of completion of construction.

(d) Regulations of Connecticut State Agencies Incorporated into this General Permit

The permittee shall comply with the following Regulations of Connecticut State Agencies which are hereby incorporated into this general permit, as if fully set forth herein:

(1) Section 22a-430-3:

Subsection (b) General - subparagraph (1)(D) and subdivisions (2),(3),(4) and (5)
Subsection (c) Inspection and Entry
Subsection (d) Effect of a Permit - subdivisions (1) and (4)

Subsection (e) Duty to Comply
Subsection (f) Proper Operation and Maintenance
Subsection (g) Sludge Disposal
Subsection (h) Duty to Mitigate
Subsection (I) Facility Modifications, Notification - subdivisions (1) and (4)
Subsection (j) Monitoring, Records and Report Requirements - subdivisions (1), (6), (7), (8), (9) and (11) (except subparagraphs (9) (A) (2) and (9) (c)
Subsection (k) Bypass
Subsection (m) Effluent Limitation Violations
Subsection (n) Enforcement
Subsection (p) Spill Prevention and Control
Subsection (q) Instrumentation, Alarms, Flow Recorders
Subsection (r) Equalization

(2) Section 22a-430-4

Subsection (t) Prohibitions
Subsection (p) Revocation, Denial, Modification
Appendices

(e) Reliance on Registration

In evaluating the registrant's registration, the commissioner has relied on information provided by the registrant. If such information proves to be false or incomplete, the registrant's authorization may be suspended or revoked in accordance with law, and the commissioner may take any other legal action provided by law.

(f) Duty to Correct and Report Violations

Upon learning of a violation of a condition of this general permit, a permittee shall immediately take all reasonable action to determine the cause of such violation, correct and mitigate the results of such violation, prevent further such violation, and report in writing such violation and such corrective action to the commissioner within five (5) days of the permittee's learning of such violation. Such information shall be filed in accordance with the certification requirements prescribed in Section 6(h) of this general permit.

(g) Duty to Provide Information

If the commissioner requests any information pertinent to the authorized activity or to compliance with this general permit or with the permittee's authorization under this general permit, the permittee shall provide such information within fifteen (15) days of such request. Such information shall be filed in accordance with the certification requirements prescribed in Section 6(h) of this general permit.

(h) Certification of Documents

Any document, including but not limited to any notice, information or report, which is submitted to the commissioner under this general permit shall be signed by the permittee, or a duly authorized representative of the permittee, and by the individual or individuals responsible for actually preparing such document, each of whom shall certify in writing as follows:

"I have personally examined and am familiar with the information submitted in this document and all attachments thereto, and I certify that, based on reasonable investigation, including my inquiry of those individuals responsible for obtaining the information, the submitted information is true, accurate and complete to the best of my knowledge and belief. I understand that a false statement made in this document or its attachments may be punishable as a criminal offense, in accordance with Section 22a-6 of the Connecticut General Statutes, pursuant to Section 53a-157b of the Connecticut General Statutes, and in accordance with any other applicable statute."

(i) Date of Filing

For purposes of this general permit, the date of filing with the commissioner of any document is the date such document is received by the commissioner. The word "day" as used in this general permit means the calendar day; if any date specified in the general permit falls on a Saturday, Sunday, or legal holiday, such deadline shall be the next business day thereafter.

(j) False Statements

Any false statement in any information submitted pursuant to this general permit may be punishable as a criminal offense, in accordance with Section 22a-6 of the Connecticut General Statutes, pursuant to Section 53a-157b of the Connecticut General Statutes.

(k) Correction of Inaccuracies

Within fifteen (15) days after the date a permittee becomes aware of a change in any information in any material submitted pursuant to this general permit, or becomes aware that any such information is inaccurate or misleading or that any relevant information has been omitted, such permittee shall correct the inaccurate or misleading information or supply the omitted information in writing to the commissioner. Such information shall be filed in accordance with the certification requirements prescribed in Section 6(h) of this general permit.

(l) Transfer of Authorization

Authorizations under this general permit are non-transferable. However, any person or municipality registering a discharge that has previously been registered under this general permit may adopt by reference the Plan developed by the previous permittee. The new permittee shall amend the Plan as required pursuant to Section 6(b)(4) prior to submitting a new registration.

(m) Other Applicable Law

Nothing in this general permit shall relieve the permittee of the obligation to comply with any other applicable federal, state and local law, including but not limited to the obligation to obtain any other authorizations required by such law.

(n) Other Rights

This general permit is subject to and does not derogate any present or future rights or powers of the State of Connecticut and conveys no rights in real or personal property nor any exclusive privileges, and is subject to all public and private rights and to any federal, state, and local laws pertinent to the property or activity affected by such general permit. In conducting any activity authorized hereunder, the permittee may not cause pollution, impairment, or destruction of the air, water, or other natural resources of this state. The issuance of this general permit shall not create any presumption that this general permit should or will be renewed.

Section 7. Commissioner's Powers

(a) Abatement of Violations

The commissioner may take any action provided by law to abate a violation of this general permit, including but not limited to penalties of up to $25,000 per violation per day under Chapter 446k of the Connecticut General Statutes, for such violation. The commissioner may, by summary proceedings or otherwise and for any reason provided by law, including violation of this general permit, revoke a permittee's authorization hereunder in accordance with Sections 22a-3a-2 through 22a-3a-6, inclusive, of the Regulations of Connecticut State Agencies. Nothing herein shall be construed to affect any remedy available to the commissioner by law.

(b) General Permit Revocation, Suspension, or Modification

The commissioner may, for any reason provided by law, by summary proceedings or otherwise, revoke or suspend this general permit or modify to establish any appropriate conditions, schedules of compliance, or other provisions which may be necessary to protect human health or the environment.

(c) Filing of an Individual Application

If the commissioner notifies a permittee in writing that such permittee must obtain an individual permit if he wishes to continue lawfully conducting the authorized activity, the permittee must file an application for an individual permit within thirty (30) days of receiving the commissioner's notice. While such application is pending before the commissioner, the permittee shall comply with the terms and conditions of this general permit and the subject approval of registration. Nothing herein shall affect the commissioner's power to revoke a permittee's authorization under this general permit at any time.

Issued Date: April 8, 2004

ARTHUR J. ROCQUE, JR.
Commissioner

This is a true and accurate copy of the general permit modified on April 8, 2004 by the Commissioner of the Department of Environmental Protection.

ATTACHMENT B

Inspection Report Form

INSPECTION REPORT FORM

CONNECTICUT RESOURCES RECOVERY AUTHORITY
HARTFORD LANDFILL
HARTFORD, CONNECTICUT

Date of Inspection _____

Inspector's Name _____

Employed By _____

Circle Type of Inspection: Monthly / Weekly / Within 24 hrs of Storm

Major Observations or Deficiencies	Actions Taken	Date Completed

_____ _____

Signature of Inspector Date

_____ _____

Signature of Owner Date

ATTACHMENT C

Identification of Contractors And Certification Statements

CONNECTICUT RESOURCES RECOVERY AUTHORITY
HARTFORD LANDFILL
HARTFORD, CONNECTICUT

General Contractor	Point of Contact	Phone

Sub-Contractors	Point of Contact	Phone

CONNECTICUT RESOURCES RECOVERY AUTHORITY
HARTFORD LANDFILL
HARTFORD, CONNECTICUT

GENERAL CONTRACTOR

"I certify under penalty of law that I have read and understand the terms and conditions of the general permit for the discharge of stormwater associated with construction activity. I understand that as a contractor on the project, I am covered by this general permit, and must comply with the terms and conditions of this permit, including, but not limited to, the requirements of the stormwater pollution control plan prepared for this project."

Signed:_____ Date:_____

Printed Name: _____ Telephone:_____

Title: _____

Firm:_____

Address:_____

_____

_____

_____

CONNECTICUT RESOURCES RECOVERY AUTHORITY
HARTFORD LANDFILL
HARTFORD, CONNECTICUT

SUBCONTRACTOR

"I certify under penalty of law that I have read and understand the terms and conditions of the general permit for the discharge of stormwater associated with construction activity. I understand that as a contractor on the project, I am covered by this general permit, and must comply with the terms and conditions of this permit, including, but not limited to, the requirements of the stormwater pollution control plan prepared for this project."

Signed:_____ Date:_____

Printed Name: _____ Telephone:_____

Title: _____

Firm:_____

Address:_____

_____

_____

_____

ATTACHMENT D

Drainage Design Calculations

Hartford Landfill Closure Plan

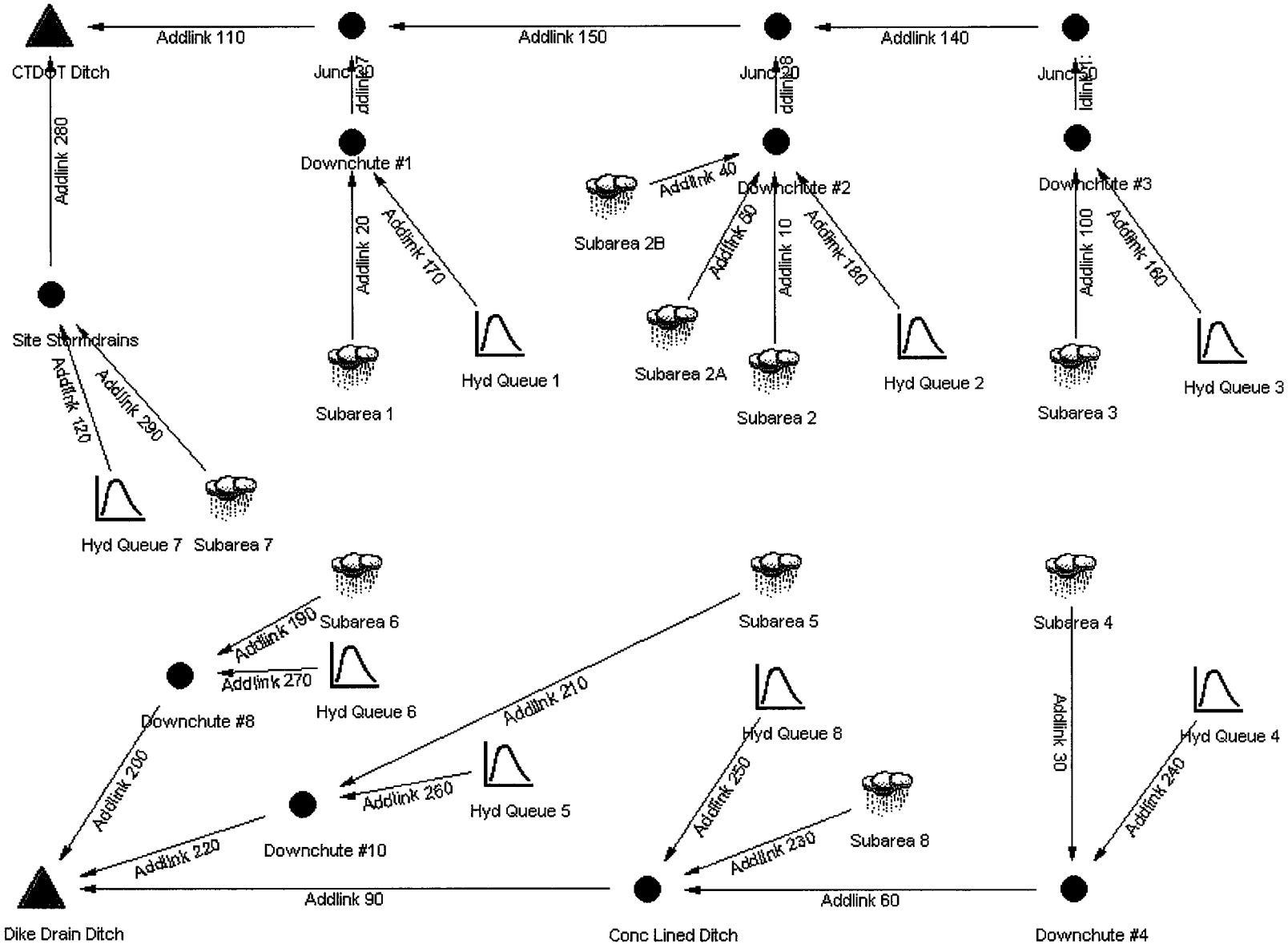
Drainage Design Backup Calculations

Prepared By: Donald R. Lussier Date: 19 May 06

Reviewed By: Richard A. Gagnon Date: 6/7/06

PondPack® Output

(including Network Diagram)


CTDOT Ditch
Addlink 110
Junction 37
Addlink 150
Junction 28
Addlink 140
Junction 50
Addlink 280
Addlink 37
Addlink 28
Addlink 51
Downchute #1
Downchute #2
Downchute #3
Addlink 20
Addlink 170
Addlink 40
Addlink 50
Addlink 10
Addlink 180
Addlink 100
Addlink 160
Subarea 2B
Site Stormdrains
Subarea 1
Hyd Queue 1
Subarea 2A
Subarea 2
Hyd Queue 2
Subarea 3
Hyd Queue 3
Addlink 120
Addlink 290
Hyd Queue 7
Subarea 7
Subarea 6
Addlink 190
Addlink 270
Hyd Queue 6
Subarea 5
Subarea 4
Downchute #8
Addlink 210
Hyd Queue 8
Addlink 30
Hyd Queue 4
Addlink 200
Addlink 260
Hyd Queue 5
Addlink 250
Addlink 240
Addlink 220
Downchute #10
Subarea 8
Addlink 230
Dike Drain Ditch
Addlink 90
Conc Lined Ditch
Addlink 60
Downchute #4

JOB TITLE
==========

Project Date: 3/20/2006
Project Engineer: Don Lussier
Project Title: Hartford Landfill
Project Comments:

Table of Contents (continued)

Table of Contents (continued)

Table of Contents (continued)

Add Hyd ADDLINK 280	Jct	SITE STORMDRAINS	Jct	CTDOT DITCH
Add Hyd ADDLINK 110	Jct	JUNC 30	Jct	CTDOT DITCH

MASTER DESIGN STORM SUMMARY

Network Storm Collection: CT - Hartford Co

Return Event	Total Depth in	Rainfall Type	RNF ID
25	5.5000	Synthetic Curve	TypeIII 24hr

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method
Hydrograph File Import Option Used For 8 node(s)

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
CONC LINED DITCH	JCT	25	6.691		12.1000	48.91		
*CTDOT DITCH	JCT	25	14.246		12.1000	115.86		
*DIKE DRAIN DITCH	JCT	25	15.496		12.1000	118.90		
DOWNCHUTE #1	JCT	25	3.488		12.1000	27.51		
DOWNCHUTE #10	JCT	25	6.387		12.1000	49.45		
DOWNCHUTE #2	JCT	25	4.217		12.1000	39.07		
DOWNCHUTE #3	JCT	25	3.065		12.1000	24.54		
DOWNCHUTE #4	JCT	25	3.510		12.1000	29.81		
DOWNCHUTE #8	JCT	25	2.419		12.1000	20.54		
HYD QUEUE 1	HYG	25	1.296		3.0000	.65		

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method
Hydrograph File Import Option Used For 8 node(s)

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
HYD QUEUE 2	HYG	25	1.083		3.0000	.55		
HYD QUEUE 3	HYG	25	1.102		3.0000	.56		
HYD QUEUE 4	HYG	25	1.157		3.0000	.58		
HYD QUEUE 5	HYG	25	2.106		3.0000	1.06		
HYD QUEUE 6	HYG	25	.797		3.0000	.40		
HYD QUEUE 7	HYG	25	1.512		3.0000	.76		
HYD QUEUE 8	HYG	25	1.048		3.0000	.53		
JUNC 20	JCT	25	7.282		12.1000	63.61		
JUNC 30	JCT	25	10.770		12.1000	91.11		
JUNC 50	JCT	25	3.065		12.1000	24.54		
SITE STORMDRAINS	JCT	25	3.476		12.1000	24.74		
SUBAREA 1	AREA	25	2.189		12.1000	26.85		
SUBAREA 2	AREA	25	1.926		12.1000	23.68		
SUBAREA 2A	AREA	25	.995		12.1000	12.23		
SUBAREA 2B	AREA	25	.211		12.1000	2.62		
SUBAREA 3	AREA	25	1.961		12.1000	23.98		
SUBAREA 4	AREA	25	2.351		12.1000	29.23		
SUBAREA 5	AREA	25	4.277		12.1000	48.39		

PondPack Ver: Compute Time: Date:

Type.... Synthetic Cumulative Depth Page 4.01
Name.... TypeIII 24hr Tag: 25 Event: 25 yr
File.... G:\P2004\0174\H10\Drainage Design\
Storm... TypeIII 24hr Tag: 25

CUMULATIVE RAINFALL DEPTHS (in)
Output Time increment = .1000 hrs
Time on left represents time for first value in each row.

Time hrs					
.0000	.0000	.0055	.0110	.0165	.0220
.5000	.0275	.0330	.0385	.0440	.0495
1.0000	.0550	.0605	.0660	.0715	.0770
1.5000	.0825	.0880	.0935	.0990	.1045
2.0000	.1100	.1156	.1212	.1269	.1327
2.5000	.1385	.1445	.1505	.1566	.1629
3.0000	.1691	.1755	.1819	.1885	.1951
3.5000	.2018	.2086	.2154	.2224	.2294
4.0000	.2365	.2437	.2510	.2583	.2658
4.5000	.2733	.2809	.2886	.2963	.3042
5.0000	.3121	.3202	.3282	.3364	.3447
5.5000	.3530	.3615	.3700	.3786	.3873
6.0000	.3960	.4050	.4142	.4237	.4334
6.5000	.4435	.4538	.4644	.4752	.4864
7.0000	.4978	.5095	.5214	.5337	.5462
7.5000	.5590	.5720	.5854	.5990	.6129
8.0000	.6270	.6416	.6569	.6728	.6893
8.5000	.7064	.7242	.7426	.7616	.7813
9.0000	.8016	.8226	.8441	.8664	.8892
9.5000	.9127	.9368	.9615	.9869	1.0129
10.0000	1.0395	1.0671	1.0960	1.1263	1.1579
10.5000	1.1908	1.2250	1.2605	1.2973	1.3355
11.0000	1.3750	1.4177	1.4654	1.5182	1.5761
11.5000	1.6390	1.7287	1.8667	2.0532	2.2880
12.0000	2.7500	3.2120	3.4469	3.6333	3.7714
12.5000	3.8610	3.9239	3.9818	4.0346	4.0823
13.0000	4.1250	4.1645	4.2027	4.2395	4.2750
13.5000	4.3093	4.3421	4.3737	4.4040	4.4329
14.0000	4.4605	4.4871	4.5131	4.5385	4.5632
14.5000	4.5873	4.6108	4.6336	4.6559	4.6774
15.0000	4.6984	4.7187	4.7384	4.7574	4.7758
15.5000	4.7936	4.8107	4.8272	4.8431	4.8584
16.0000	4.8730	4.8872	4.9011	4.9147	4.9280
16.5000	4.9411	4.9539	4.9664	4.9786	4.9906
17.0000	5.0023	5.0137	5.0248	5.0357	5.0463
17.5000	5.0566	5.0666	5.0764	5.0859	5.0951
18.0000	5.1040	5.1127	5.1214	5.1300	5.1385
18.5000	5.1470	5.1553	5.1636	5.1718	5.1798
19.0000	5.1879	5.1958	5.2037	5.2114	5.2191
19.5000	5.2267	5.2342	5.2417	5.2490	5.2563
20.0000	5.2635	5.2706	5.2777	5.2847	5.2916
20.5000	5.2985	5.3053	5.3120	5.3187	5.3253
21.0000	5.3319	5.3384	5.3448	5.3512	5.3576
21.5000	5.3638	5.3700	5.3761	5.3822	5.3882

CUMULATIVE RAINFALL DEPTHS (in)
Output Time increment = .1000 hrs
Time on left represents time for first value in each row.

Time hrs					
22.0000	5.3941	5.4000	5.4058	5.4116	5.4173
22.5000	5.4229	5.4285	5.4340	5.4394	5.4448
23.0000	5.4502	5.4554	5.4606	5.4657	5.4709
23.5000	5.4759	5.4808	5.4857	5.4905	5.4953
24.0000	5.5000				

::
TIME OF CONCENTRATION CALCULATOR
::

Segment #1: Tc: TR-55 Sheet

Mannings n	.0250
Hydraulic Length	300.00 ft
2yr, 24hr P	3.2000 in
Slope	.040000 ft/ft

Avg.Velocity 1.17 ft/sec

Segment #1 Time: .0711 hrs

Segment #2: Tc: TR-55 Shallow

Hydraulic Length	125.00 ft
Slope	.040000 ft/ft

Unpaved

Avg.Velocity 3.23 ft/sec

Segment #2 Time: .0108 hrs

Segment #3: Tc: TR-55 Channel

Flow Area	2.7600 sq.ft
Wetted Perimeter	5.91 ft
Hydraulic Radius	.47 ft
Slope	.040000 ft/ft
Mannings n	.0250
Hydraulic Length	400.00 ft

Avg.Velocity 7.18 ft/sec

Segment #3 Time: .0155 hrs

==========
Total Tc: .0973 hrs
==========

Tc Equations used...

==== SCS TR-55 Sheet Flow ==========

Tc = (.007 * ((n * Lf)**0.8)) / ((P**.5) * (Sf**.4))

Where: Tc = Time of concentration, hrs
n = Mannings n
Lf = Flow length, ft
P = 2yr, 24hr Rain depth, inches
Sf = Slope, %

==== SCS TR-55 Shallow Concentrated Flow ==========

Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved surface:
V = 20.3282 * (Sf**0.5)

Tc = (Lf / V) / (3600sec/hr)

Where: V = Velocity, ft/sec
Sf = Slope, ft/ft
Tc = Time of concentration, hrs
Lf = Flow length, ft

==== SCS Channel Flow ==

R = Aq / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

Tc = (Lf / V) / (3600sec/hr)

Where: R = Hydraulic radius
Aq = Flow area, sq.ft.
Wp = Wetted perimeter, ft
V = Velocity, ft/sec
Sf = Slope, ft/ft
n = Mannings n
Tc = Time of concentration, hrs
Lf = Flow length, ft

::
TIME OF CONCENTRATION CALCULATOR
::

Segment #1: Tc: TR-55 Sheet

Mannings n	.0250	
Hydraulic Length	300.00	ft
2yr, 24hr P	3.2000	in
Slope	.040000	ft/ft
Avg.Velocity	1.17	ft/sec

Segment #1 Time: .0711 hrs

Segment #2: Tc: TR-55 Shallow

Hydraulic Length	110.00	ft
Slope	.040000	ft/ft
Unpaved		
Avg.Velocity	3.23	ft/sec

Segment #2 Time: .0095 hrs

Segment #3: Tc: TR-55 Channel

Flow Area	2.7600	sq.ft
Wetted Perimeter	5.91	ft
Hydraulic Radius	.47	ft
Slope	.040000	ft/ft
Mannings n	.0250	
Hydraulic Length	375.00	ft
Avg.Velocity	7.18	ft/sec

Segment #3 Time: .0145 hrs

==========
Total Tc: .0951 hrs
==========

Tc Equations used...

==== SCS TR-55 Sheet Flow ==========

Tc = (.007 * ((n * Lf)**0.8)) / ((P**.5) * (Sf**.4))

Where: Tc = Time of concentration, hrs
n = Mannings n
Lf = Flow length, ft
P = 2yr, 24hr Rain depth, inches
Sf = Slope, %

==== SCS TR-55 Shallow Concentrated Flow ==========

Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved surface:
V = 20.3282 * (Sf**0.5)

Tc = (Lf / V) / (3600sec/hr)

Where: V = Velocity, ft/sec
Sf = Slope, ft/ft
Tc = Time of concentration, hrs
Lf = Flow length, ft

==== SCS Channel Flow ==

R = Aq / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

Tc = (Lf / V) / (3600sec/hr)

Where: R = Hydraulic radius
Aq = Flow area, sq.ft.
Wp = Wetted perimeter, ft
V = Velocity, ft/sec
Sf = Slope, ft/ft
n = Mannings n
Tc = Time of concentration, hrs
Lf = Flow length, ft

::
TIME OF CONCENTRATION CALCULATOR
::

Segment #1: Tc: TR-55 Sheet

Mannings n	.0250
Hydraulic Length	300.00 ft
2yr, 24hr P	3.2000 in
Slope	.040000 ft/ft
Avg.Velocity	1.17 ft/sec

Segment #1 Time: .0711 hrs

Segment #2: Tc: TR-55 Shallow

Hydraulic Length	110.00 ft
Slope	.040000 ft/ft
Unpaved	
Avg.Velocity	3.23 ft/sec

Segment #2 Time: .0095 hrs

Segment #3: Tc: TR-55 Channel

Flow Area	2.7600 sq.ft
Wetted Perimeter	5.91 ft
Hydraulic Radius	.47 ft
Slope	.040000 ft/ft
Mannings n	.0250
Hydraulic Length	375.00 ft
Avg.Velocity	7.18 ft/sec

Segment #3 Time: .0145 hrs

==========
Total Tc: .0951 hrs
==========

Tc Equations used...

==== SCS TR-55 Sheet Flow ==========

Tc = (.007 * ((n * Lf)**0.8)) / ((P**.5) * (Sf**.4))

Where: Tc = Time of concentration, hrs
n = Mannings n
Lf = Flow length, ft
P = 2yr, 24hr Rain depth, inches
Sf = Slope, %

==== SCS TR-55 Shallow Concentrated Flow ==========

Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved surface:
V = 20.3282 * (Sf**0.5)

Tc = (Lf / V) / (3600sec/hr)

Where: V = Velocity, ft/sec
Sf = Slope, ft/ft
Tc = Time of concentration, hrs
Lf = Flow length, ft

==== SCS Channel Flow ==========

R = Aq / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

Tc = (Lf / V) / (3600sec/hr)

Where: R = Hydraulic radius
Aq = Flow area, sq.ft.
Wp = Wetted perimeter, ft
V = Velocity, ft/sec
Sf = Slope, ft/ft
n = Mannings n
Tc = Time of concentration, hrs
Lf = Flow length, ft

::
TIME OF CONCENTRATION CALCULATOR
::

Segment #1: Tc: TR-55 Sheet

Mannings n	.0250	
Hydraulic Length	90.00	ft
2yr, 24hr P	3.2000	in
Slope	.040000	ft/ft
Avg.Velocity	.92	ft/sec

Segment #1 Time: .0271 hrs

Segment #2: Tc: TR-55 Channel

Flow Area	2.7600	sq.ft
Wetted Perimeter	5.91	ft
Hydraulic Radius	.47	ft
Slope	.040000	ft/ft
Mannings n	.0250	
Hydraulic Length	400.00	ft
Avg.Velocity	7.18	ft/sec

Segment #2 Time: .0155 hrs

==========
Total Tc: .0426 hrs

Calculated Tc < Min.Tc:
Use Minimum Tc...
Use Tc = .0833 hrs
==========

Tc Equations used...

==== SCS TR-55 Sheet Flow ==========

Tc = (.007 * ((n * Lf)**0.8)) / ((P**.5) * (Sf**.4))

Where: Tc = Time of concentration, hrs
n = Mannings n
Lf = Flow length, ft
P = 2yr, 24hr Rain depth, inches
Sf = Slope, %

==== SCS Channel Flow ==========

R = Aq / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

Tc = (Lf / V) / (3600sec/hr)

Where: R = Hydraulic radius
Aq = Flow area, sq.ft.
Wp = Wetted perimeter, ft
V = Velocity, ft/sec
Sf = Slope, ft/ft
n = Mannings n
Tc = Time of concentration, hrs
Lf = Flow length, ft

::
TIME OF CONCENTRATION CALCULATOR
::

Segment #1: Tc: TR-55 Sheet

Mannings n	.0250
Hydraulic Length	300.00 ft
2yr, 24hr P	3.2000 in
Slope	.040000 ft/ft
Avg.Velocity	1.17 ft/sec

Segment #1 Time: .0711 hrs

Segment #2: Tc: TR-55 Shallow

Hydraulic Length	110.00 ft
Slope	.040000 ft/ft
Unpaved	
Avg.Velocity	3.23 ft/sec

Segment #2 Time: .0095 hrs

Segment #3: Tc: TR-55 Channel

Flow Area	2.7600 sq.ft
Wetted Perimeter	5.91 ft
Hydraulic Radius	.47 ft
Slope	.040000 ft/ft
Mannings n	.0250
Hydraulic Length	530.00 ft
Avg.Velocity	7.18 ft/sec

Segment #3 Time: .0205 hrs

==========
Total Tc: .1011 hrs
==========

Tc Equations used...

==== SCS TR-55 Sheet Flow ==========

Tc = (.007 * ((n * Lf)**0.8)) / ((P**.5) * (Sf**.4))

Where: Tc = Time of concentration, hrs
n = Mannings n
Lf = Flow length, ft
P = 2yr, 24hr Rain depth, inches
Sf = Slope, %

==== SCS TR-55 Shallow Concentrated Flow ==========

Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved surface:
V = 20.3282 * (Sf**0.5)

Tc = (Lf / V) / (3600sec/hr)

Where: V = Velocity, ft/sec
Sf = Slope, ft/ft
Tc = Time of concentration, hrs
Lf = Flow length, ft

==== SCS Channel Flow ==

R = Aq / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

Tc = (Lf / V) / (3600sec/hr)

Where: R = Hydraulic radius
Aq = Flow area, sq.ft.
Wp = Wetted perimeter, ft
V = Velocity, ft/sec
Sf = Slope, ft/ft
n = Mannings n
Tc = Time of concentration, hrs
Lf = Flow length, ft

::
TIME OF CONCENTRATION CALCULATOR
::

Segment #1: Tc: TR-55 Sheet

Mannings n	.0250	
Hydraulic Length	230.00	ft
2yr, 24hr P	3.2000	in
Slope	.040000	ft/ft
Avg.Velocity	1.11	ft/sec

Segment #1 Time: .0575 hrs

Segment #2: Tc: TR-55 Channel

Flow Area	2.7600	sq.ft
Wetted Perimeter	5.91	ft
Hydraulic Radius	.47	ft
Slope	.040000	ft/ft
Mannings n	.0250	
Hydraulic Length	420.00	ft
Avg.Velocity	7.18	ft/sec

Segment #2 Time: .0163 hrs

==========
Total Tc: .0737 hrs

Calculated Tc < Min.Tc:
Use Minimum Tc...
Use Tc = .0833 hrs
==========

Tc Equations used...

==== SCS TR-55 Sheet Flow ==========

Tc = (.007 * ((n * Lf)**0.8)) / ((P**.5) * (Sf**.4))

Where: Tc = Time of concentration, hrs
n = Mannings n
Lf = Flow length, ft
P = 2yr, 24hr Rain depth, inches
Sf = Slope, %

==== SCS Channel Flow ==========

R = Aq / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

Tc = (Lf / V) / (3600sec/hr)

Where: R = Hydraulic radius
Aq = Flow area, sq.ft.
Wp = Wetted perimeter, ft
V = Velocity, ft/sec
Sf = Slope, ft/ft
n = Mannings n
Tc = Time of concentration, hrs
Lf = Flow length, ft

==== SCS Channel Flow ==========

```
R  = Aq / Wp
V  = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

Tc = (Lf / V) / (3600sec/hr)

Where:  R  = Hydraulic radius
        Aq = Flow area, sq.ft.
        Wp = Wetted perimeter, ft
        V  = Velocity, ft/sec
        Sf = Slope, ft/ft
        n  = Mannings n
        Tc = Time of concentration, hrs
        Lf = Flow length, ft
```

::
TIME OF CONCENTRATION CALCULATOR
::

Segment #1: Tc: TR-55 Channel

Flow Area	19.0000	sq.ft
Wetted Perimeter	15.00	ft
Hydraulic Radius	1.27	ft
Slope	.000800	ft/ft
Mannings n	.0150	
Hydraulic Length	3000.00	ft

Avg.Velocity 3.29 ft/sec

Segment #1 Time: .2534 hrs

==========
Total Tc: .2534 hrs
==========

Tc Equations used...

==== SCS Channel Flow ==

R = Aq / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

Tc = (Lf / V) / (3600sec/hr)

Where: R = Hydraulic radius
Aq = Flow area, sq.ft.
Wp = Wetted perimeter, ft
V = Velocity, ft/sec
Sf = Slope, ft/ft
n = Mannings n
Tc = Time of concentration, hrs
Lf = Flow length, ft

::
TIME OF CONCENTRATION CALCULATOR
::

Segment #1: Tc: TR-55 Sheet

Mannings n	.0250
Hydraulic Length	300.00 ft
2yr, 24hr P	3.2000 in
Slope	.040000 ft/ft
Avg.Velocity	1.17 ft/sec

Segment #1 Time: .0711 hrs

Segment #2: Tc: TR-55 Shallow

Hydraulic Length	110.00 ft
Slope	.040000 ft/ft
Unpaved	
Avg.Velocity	3.23 ft/sec

Segment #2 Time: .0095 hrs

Segment #3: Tc: TR-55 Channel

Flow Area	2.7600 sq.ft
Wetted Perimeter	5.91 ft
Hydraulic Radius	.47 ft
Slope	.040000 ft/ft
Mannings n	.0250
Hydraulic Length	530.00 ft
Avg.Velocity	7.18 ft/sec

Segment #3 Time: .0205 hrs

==========
Total Tc: .1011 hrs
==========

Slope	.040000	ft/ft
Unpaved		
Avg.Velocity	3.23	ft/sec

Segment #2 Time: .0043 hrs

Segment #3: Tc: TR-55 Channel

Flow Area	2.7600	sq.ft
Wetted Perimeter	5.91	ft
Hydraulic Radius	.47	ft
Slope	.040000	ft/ft
Mannings n	.0250	
Hydraulic Length	420.00	ft
Avg.Velocity	7.18	ft/sec

Segment #3 Time: .0163 hrs

Segment #4: Tc: TR-55 Channel

Flow Area	2.7600	sq.ft
Wetted Perimeter	5.91	ft
Hydraulic Radius	.47	ft
Slope	.080000	ft/ft
Mannings n	.0350	
Hydraulic Length	1500.00	ft

Avg.Velocity 7.25 ft/sec

Segment #4 Time: .0575 hrs

Total Tc: .1491 hrs

::
TIME OF CONCENTRATION CALCULATOR
::

Segment #1: Tc: TR-55 Sheet

Mannings n	.0250	
Hydraulic Length	50.00	ft
2yr, 24hr P	3.2000	in
Slope	.040000	ft/ft
Avg.Velocity	.82	ft/sec

Segment #1 Time: .0170 hrs

Segment #2: Tc: TR-55 Channel

Flow Area	2.7600	sq.ft
Wetted Perimeter	5.91	ft
Hydraulic Radius	.47	ft
Slope	.040000	ft/ft
Mannings n	.0250	
Hydraulic Length	750.00	ft
Avg.Velocity	7.18	ft/sec

Segment #2 Time: .0290 hrs

==========
Total Tc: .0460 hrs

Calculated Tc < Min.Tc:
Use Minimum Tc...
Use Tc = .0833 hrs
==========

Tc Equations used...

==== SCS TR-55 Sheet Flow ==========

Tc = (.007 * ((n * Lf)**0.8)) / ((P**.5) * (Sf**.4))

Where: Tc = Time of concentration, hrs
n = Mannings n
Lf = Flow length, ft
P = 2yr, 24hr Rain depth, inches
Sf = Slope, %

==== SCS Channel Flow ==========

R = Aq / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

Tc = (Lf / V) / (3600sec/hr)

Where: R = Hydraulic radius
Aq = Flow area, sq.ft.
Wp = Wetted perimeter, ft
V = Velocity, ft/sec
Sf = Slope, ft/ft
n = Mannings n
Tc = Time of concentration, hrs
Lf = Flow length, ft

::
TIME OF CONCENTRATION CALCULATOR
::

Segment #1: Tc: TR-55 Sheet

Mannings n	.0250
Hydraulic Length	300.00 ft
2yr, 24hr P	3.2000 in
Slope	.040000 ft/ft
Avg.Velocity	1.17 ft/sec

Segment #1 Time: .0711 hrs

Segment #2: Tc: TR-55 Shallow

Hydraulic Length	50.00 ft
Slope	.040000 ft/ft
Unpaved	
Avg.Velocity	3.23 ft/sec

Segment #2 Time: .0043 hrs

Segment #3: Tc: TR-55 Channel

Flow Area	2.7600 sq.ft
Wetted Perimeter	5.91 ft
Hydraulic Radius	.47 ft
Slope	.040000 ft/ft
Mannings n	.0250
Hydraulic Length	420.00 ft
Avg.Velocity	7.18 ft/sec

Segment #3 Time: .0163 hrs

Tc Equations used...

==== SCS TR-55 Sheet Flow ==========

Tc = (.007 * ((n * Lf)**0.8)) / ((P**.5) * (Sf**.4))

Where: Tc = Time of concentration, hrs
n = Mannings n
Lf = Flow length, ft
P = 2yr, 24hr Rain depth, inches
Sf = Slope, %

==== SCS TR-55 Shallow Concentrated Flow ==========

Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved surface:
V = 20.3282 * (Sf**0.5)

Tc = (Lf / V) / (3600sec/hr)

Where: V = Velocity, ft/sec
Sf = Slope, ft/ft
Tc = Time of concentration, hrs
Lf = Flow length, ft

RUNOFF CURVE NUMBER DATA

Soil/Surface Description	CN	Area acres	Impervious Adjustment %C	%UC	Adjusted CN
Brush - brush, weed, grass mix - po	77	8.630			77.00
COMPOSITE AREA & WEIGHTED CN --->		8.630			77.00 (77)

SCS UNIT HYDROGRAPH METHOD
(Computational Notes)

DEFINITION OF TERMS: ----------

At = Total area (acres): At = Ai+Ap
Ai = Impervious area (acres)
Ap = Pervious area (acres)
CNi = Runoff curve number for impervious area
CNp = Runoff curve number for pervious area
fLoss = f loss constant infiltration (depth/time)
gKs = Saturated Hydraulic Conductivity (depth/time)
Md = Volumetric Moisture Deficit
Psi = Capillary Suction (length)
hK = Horton Infiltration Decay Rate (time^-1)
fo = Initial Infiltration Rate (depth/time)
fc = Ultimate(capacity)Infiltration Rate (depth/time)
Ia = Initial Abstraction (length)
dt = Computational increment (duration of unit excess rainfall)
Default dt is smallest value of 0.1333Tc, rtm, and th
(Smallest dt is then adjusted to match up with Tp)
UDdt = User specified override computational main time increment
(only used if UDdt is => .1333Tc)
D(t) = Point on distribution curve (fraction of P) for time step t

K = 2 / (1 + (Tr/Tp)): default K = 0.75: (for Tr/Tp = 1.67)
Ks = Hydrograph shape factor
= Unit Conversions * K:
= ((1hr/3600sec) * (1ft/12in) * ((5280ft)**2/sq.mi)) * K
Default Ks = 645.333 * 0.75 = 484

Lag = Lag time from center of excess runoff (dt) to Tp: Lag = 0.6Tc
P = Total precipitation depth, inches
Pa(t) = Accumulated rainfall at time step t
Pi(t) = Incremental rainfall at time step t
qp = Peak discharge (cfs) for 1in. runoff, for 1hr, for 1 sq.mi.
= (Ks * A * Q) / Tp (where Q = 1in. runoff, A=sq.mi.)
Qu(t) = Unit hydrograph ordinate (cfs) at time step t
Q(t) = Final hydrograph ordinate (cfs) at time step t
Rai(t)= Accumulated runoff (inches) at time step t for impervious area
Rap(t)= Accumulated runoff (inches) at time step t for pervious area
Rii(t)= Incremental runoff (inches) at time step t for impervious area
Rip(t)= Incremental runoff (inches) at time step t for pervious area
R(t) = Incremental weighted total runoff (inches)
Rtm = Time increment for rainfall table
Si = S for impervious area: Si = (1000/CNi) - 10
Sp = S for pervious area: Sp = (1000/CNp) - 10
t = Time step (row) number
Tc = Time of concentration
Tb = Time (hrs) of entire unit hydrograph: Tb = Tp + Tr
Tp = Time (hrs) to peak of a unit hydrograph: Tp = (dt/2) + Lag
Tr = Time (hrs) of receding limb of unit hydrograph: Tr = ratio of Tp

SCS UNIT HYDROGRAPH METHOD
(Computational Notes)

PRECIPITATION: ----------
Column (1): Time for time step t
Column (2): D(t) = Point on distribution curve for time step t
Column (3): Pi(t) = Pa(t) - Pa(t-1): Col.(4) - Preceding Col.(4)
Column (4): Pa(t) = D(t) x P: Col.(2) x P

PERVIOUS AREA RUNOFF (using SCS Runoff CN Method) ----------
Column (5): Rap(t) = Accumulated pervious runoff for time step t
If (Pa(t) is <= 0.2Sp) then use: Rap(t) = 0.0
If (Pa(t) is > 0.2Sp) then use:

Rap(t) = (Col.(4)-0.2Sp)**2 / (Col.(4)+0.8Sp)

Column (6): Rip(t) = Incremental pervious runoff for time step t
Rip(t) = Rap(t) - Rap(t-1)
Rip(t) = Col.(5) for current row - Col.(5) for preceding row.

IMPERVIOUS AREA RUNOFF ----------
Column (7 & 8)... Did not specify to use impervious areas.

INCREMENTAL WEIGHTED RUNOFF: ----------
Column (9): R(t) = (Ap/At) x Rip(t) + (Ai/At) x Rii(t)
R(t) = (Ap/At) x Col.(6) + (Ai/At) x Col.(8)

SCS UNIT HYDROGRAPH METHOD: ----------
Column (10): Q(t) is computed with the SCS unit hydrograph method
using R() and Qu().

HYG file =
HYG ID = Drain Weep 1
HYG Tag = 25

Peak Discharge = .65 cfs
Time to Peak = 3.0000 hrs
HYG Volume = 1.296 ac-ft

HYDROGRAPH ORDINATES (cfs)
Output Time increment = 3.0000 hrs
Time on left represents time for first value in each row.

Time hrs					
.0000	.65	.65	.65	.65	.65
15.0000	.65	.65	.65	.65	

HYG file =
HYG ID = Drain Weep 2
HYG Tag = 25

Peak Discharge =	.55 cfs
Time to Peak =	3.0000 hrs
HYG Volume =	1.083 ac-ft

HYDROGRAPH ORDINATES (cfs)
Output Time increment = 3.0000 hrs
Time on left represents time for first value in each row.

Time hrs					
.0000	.55	.55	.55	.55	.55
15.0000	.55	.55	.55	.55	

HYG file =
HYG ID = Drain Weep 3
HYG Tag = 25

Peak Discharge = .56 cfs
Time to Peak = 3.0000 hrs
HYG Volume = 1.102 ac-ft

HYDROGRAPH ORDINATES (cfs)
Output Time increment = 3.0000 hrs
Time on left represents time for first value in each row.

Time hrs					
.0000	.56	.56	.56	.56	.56
15.0000	.56	.56	.56	.56	

```
                    Area =       7.730 acres
                    S    =   2.9870 in
                    0.2S =    .5974 in

                     Cumulative Runoff
                    -------------------
                           3.0465 in
                            1.962 ac-ft

HYG Volume...           1.961 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =    .10107 hrs (ID: SUBAREA 7)
Computational Incr, Tm =    .01348 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =     .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =    .7491)

Unit peak,          qp =    86.66 cfs
Unit peak time      Tp =   .06738 hrs
Unit receding limb, Tr =   .26951 hrs
Total unit time,    Tb =   .33689 hrs
```

SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration = 24.0000 hrs Rain Depth = 5.5000 in
Rain Dir = G:\P2004\0174\H10\Drainage Design\
Rain File -ID = - TypeIII 24hr
Unit Hyd Type = Default Curvilinear
HYG Dir = G:\P2004\0174\H10\Drainage Design\
HYG File - ID = work_pad.hyg - SUBAREA 1 25
Tc = .0973 hrs
Drainage Area = 8.630 acres Runoff CN= 77

==========
Computational Time Increment = .01298 hrs
Computed Peak Time = 12.1074 hrs
Computed Peak Flow = 26.99 cfs

Time Increment for HYG File = .1000 hrs
Peak Time, Interpolated Output = 12.1000 hrs
Peak Flow, Interpolated Output = 26.85 cfs
==========

DRAINAGE AREA

ID:SUBAREA 1
CN = 77
Area = 8.630 acres
S = 2.9870 in
0.2S = .5974 in

Cumulative Runoff

3.0465 in
2.191 ac-ft

HYG Volume... 2.189 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc = .09733 hrs (ID: SUBAREA 1)
Computational Incr, Tm = .01298 hrs = 0.20000 Tp

Unit Hyd. Shape Factor = 483.432 (37.46% under rising limb)
K = 483.43/645.333, K = .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp = 1.6698 (solved from K = .7491)

Unit peak, qp = 100.47 cfs
Unit peak time Tp = .06488 hrs
Unit receding limb, Tr = .25954 hrs
Total unit time, Tb = .32442 hrs

SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration = 24.0000 hrs Rain Depth = 5.5000 in
Rain Dir = G:\P2004\0174\H10\Drainage Design\
Rain File -ID = - TypeIII 24hr
Unit Hyd Type = Default Curvilinear
HYG Dir = G:\P2004\0174\H10\Drainage Design\
HYG File - ID = work_pad.hyg - SUBAREA 2 25
Tc = .0951 hrs
Drainage Area = 7.590 acres Runoff CN= 77

==========
Computational Time Increment = .01268 hrs
Computed Peak Time = 12.1052 hrs
Computed Peak Flow = 23.77 cfs

Time Increment for HYG File = .1000 hrs
Peak Time, Interpolated Output = 12.1000 hrs
Peak Flow, Interpolated Output = 23.68 cfs
==========

DRAINAGE AREA

ID:SUBAREA 2
CN = 77
Area = 7.590 acres
S = 2.9870 in
0.2S = .5974 in

Cumulative Runoff

3.0465 in
1.927 ac-ft

HYG Volume... 1.926 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc = .09507 hrs (ID: SUBAREA 2)
Computational Incr, Tm = .01268 hrs = 0.20000 Tp

Unit Hyd. Shape Factor = 483.432 (37.46% under rising limb)
K = 483.43/645.333, K = .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp = 1.6698 (solved from K = .7491)

Unit peak, qp = 90.46 cfs
Unit peak time Tp = .06338 hrs
Unit receding limb, Tr = .25351 hrs
Total unit time, Tb = .31689 hrs

SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration = 24.0000 hrs Rain Depth = 5.5000 in
Rain Dir = G:\P2004\0174\H10\Drainage Design\
Rain File -ID = - TypeIII 24hr
Unit Hyd Type = Default Curvilinear
HYG Dir = G:\P2004\0174\H10\Drainage Design\
HYG File - ID = work_pad.hyg - SUBAREA 2A 25
Tc = .0951 hrs
Drainage Area = 3.920 acres Runoff CN= 77

==========
Computational Time Increment = .01268 hrs
Computed Peak Time = 12.1052 hrs
Computed Peak Flow = 12.28 cfs

Time Increment for HYG File = .1000 hrs
Peak Time, Interpolated Output = 12.1000 hrs
Peak Flow, Interpolated Output = 12.23 cfs
==========

DRAINAGE AREA

ID:SUBAREA 2A
CN = 77
Area = 3.920 acres
S = 2.9870 in
0.2S = .5974 in

Cumulative Runoff

3.0465 in
.995 ac-ft

HYG Volume... .995 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc = .09507 hrs (ID: SUBAREA 2A)
Computational Incr, Tm = .01268 hrs = 0.20000 Tp

Unit Hyd. Shape Factor = 483.432 (37.46% under rising limb)
K = 483.43/645.333, K = .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp = 1.6698 (solved from K = .7491)

Unit peak, qp = 46.72 cfs
Unit peak time Tp = .06338 hrs
Unit receding limb, Tr = .25351 hrs
Total unit time, Tb = .31689 hrs

SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration = 24.0000 hrs Rain Depth = 5.5000 in
Rain Dir = G:\P2004\0174\H10\Drainage Design\
Rain File -ID = - TypeIII 24hr
Unit Hyd Type = Default Curvilinear
HYG Dir = G:\P2004\0174\H10\Drainage Design\
HYG File - ID = work_pad.hyg - SUBAREA 2B 25
Tc (Min. Tc) = .0833 hrs
Drainage Area = .830 acres Runoff CN= 77

==========
Computational Time Increment = .01111 hrs
Computed Peak Time = 12.1063 hrs
Computed Peak Flow = 2.63 cfs

Time Increment for HYG File = .1000 hrs
Peak Time, Interpolated Output = 12.1000 hrs
Peak Flow, Interpolated Output = 2.62 cfs
==========

DRAINAGE AREA

ID:SUBAREA 2B
CN = 77
Area = .830 acres
S = 2.9870 in
0.2S = .5974 in

Cumulative Runoff

3.0465 in
.211 ac-ft

HYG Volume... .211 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc = .08330 hrs (ID: SUBAREA 2B)
Computational Incr, Tm = .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor = 483.432 (37.46% under rising limb)
K = 483.43/645.333, K = .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp = 1.6698 (solved from K = .7491)

Unit peak, qp = 11.29 cfs
Unit peak time Tp = .05553 hrs
Unit receding limb, Tr = .22213 hrs
Total unit time, Tb = .27767 hrs

SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration = 24.0000 hrs Rain Depth = 5.5000 in
Rain Dir = G:\P2004\0174\H10\Drainage Design\
Rain File -ID = - TypeIII 24hr
Unit Hyd Type = Default Curvilinear
HYG Dir = G:\P2004\0174\H10\Drainage Design\
HYG File - ID = work_pad.hyg - SUBAREA 3 25
Tc = .1011 hrs
Drainage Area = 7.730 acres Runoff CN= 77

==========
Computational Time Increment = .01348 hrs
Computed Peak Time = 12.1147 hrs
Computed Peak Flow = 24.12 cfs

Time Increment for HYG File = .1000 hrs
Peak Time, Interpolated Output = 12.1000 hrs
Peak Flow, Interpolated Output = 23.98 cfs
==========

DRAINAGE AREA

ID:SUBAREA 3
CN = 77
Area = 7.730 acres
S = 2.9870 in
0.2S = .5974 in

Cumulative Runoff

3.0465 in
1.962 ac-ft

HYG Volume... 1.961 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc = .10107 hrs (ID: SUBAREA 3)
Computational Incr, Tm = .01348 hrs = 0.20000 Tp

Unit Hyd. Shape Factor = 483.432 (37.46% under rising limb)
K = 483.43/645.333, K = .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp = 1.6698 (solved from K = .7491)

Unit peak, qp = 86.66 cfs
Unit peak time Tp = .06738 hrs
Unit receding limb, Tr = .26951 hrs
Total unit time, Tb = .33689 hrs

SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration = 24.0000 hrs Rain Depth = 5.5000 in
Rain Dir = G:\P2004\0174\H10\Drainage Design\
Rain File -ID = - TypeIII 24hr
Unit Hyd Type = Default Curvilinear
HYG Dir = G:\P2004\0174\H10\Drainage Design\
HYG File - ID = work_pad.hyg - SUBAREA 4 25
Tc (Min. Tc) = .0833 hrs
Drainage Area = 9.260 acres Runoff CN= 77

==========
Computational Time Increment = .01111 hrs
Computed Peak Time = 12.1063 hrs
Computed Peak Flow = 29.32 cfs

Time Increment for HYG File = .1000 hrs
Peak Time, Interpolated Output = 12.1000 hrs
Peak Flow, Interpolated Output = 29.23 cfs
==========

DRAINAGE AREA

ID:SUBAREA 4
CN = 77
Area = 9.260 acres
S = 2.9870 in
0.2S = .5974 in

Cumulative Runoff

3.0465 in
2.351 ac-ft

HYG Volume... 2.351 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc = .08330 hrs (ID: SUBAREA 4)
Computational Incr, Tm = .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor = 483.432 (37.46% under rising limb)
K = 483.43/645.333, K = .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp = 1.6698 (solved from K = .7491)

Unit peak, qp = 125.95 cfs
Unit peak time Tp = .05553 hrs
Unit receding limb, Tr = .22213 hrs
Total unit time, Tb = .27767 hrs

SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration = 24.0000 hrs Rain Depth = 5.5000 in
Rain Dir = G:\P2004\0174\H10\Drainage Design\
Rain File -ID = - TypeIII 24hr
Unit Hyd Type = Default Curvilinear
HYG Dir = G:\P2004\0174\H10\Drainage Design\
HYG File - ID = work_pad.hyg - SUBAREA 5 25
Tc = .1491 hrs
Drainage Area = 16.850 acres Runoff CN= 77

==========
Computational Time Increment = .01988 hrs
Computed Peak Time = 12.1294 hrs
Computed Peak Flow = 49.79 cfs

Time Increment for HYG File = .1000 hrs
Peak Time, Interpolated Output = 12.1000 hrs
Peak Flow, Interpolated Output = 48.39 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
==========

DRAINAGE AREA

ID:SUBAREA 5
CN = 77
Area = 16.850 acres
S = 2.9870 in
0.2S = .5974 in

Cumulative Runoff

3.0465 in
4.278 ac-ft

HYG Volume... 4.277 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc = .14913 hrs (ID: SUBAREA 5)
Computational Incr, Tm = .01988 hrs = 0.20000 Tp

Unit Hyd. Shape Factor = 483.432 (37.46% under rising limb)
K = 483.43/645.333, K = .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp = 1.6698 (solved from K = .7491)

Unit peak, qp = 128.02 cfs
Unit peak time Tp = .09942 hrs
Unit receding limb, Tr = .39769 hrs
Total unit time, Tb = .49711 hrs

SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration = 24.0000 hrs Rain Depth = 5.5000 in
Rain Dir = G:\P2004\0174\H10\Drainage Design\
Rain File -ID = - TypeIII 24hr
Unit Hyd Type = Default Curvilinear
HYG Dir = G:\P2004\0174\H10\Drainage Design\
HYG File - ID = work_pad.hyg - SUBAREA 6 25
Tc (Min. Tc) = .0833 hrs
Drainage Area = 6.380 acres Runoff CN= 77

==========
Computational Time Increment = .01111 hrs
Computed Peak Time = 12.1063 hrs
Computed Peak Flow = 20.20 cfs

Time Increment for HYG File = .1000 hrs
Peak Time, Interpolated Output = 12.1000 hrs
Peak Flow, Interpolated Output = 20.14 cfs
==========

DRAINAGE AREA

ID:SUBAREA 6
CN = 77
Area = 6.380 acres
S = 2.9870 in
0.2S = .5974 in

Cumulative Runoff

3.0465 in
1.620 ac-ft

HYG Volume... 1.620 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc = .08330 hrs (ID: SUBAREA 6)
Computational Incr, Tm = .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor = 483.432 (37.46% under rising limb)
K = 483.43/645.333, K = .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp = 1.6698 (solved from K = .7491)

Unit peak, qp = 86.78 cfs
Unit peak time Tp = .05553 hrs
Unit receding limb, Tr = .22213 hrs
Total unit time, Tb = .27767 hrs

SUMMARY FOR HYDROGRAPH ADDITION
at Node: DOWNCHUTE #8

HYG Directory: G:\P2004\0174\H10\Drainage Design\

Upstream Link ID	Upstream Node ID	HYG file	HYG ID	HYG tag
ADDLINK 190	SUBAREA 6	work_pad.hyg	SUBAREA 6	25
ADDLINK 270	HYD QUEUE 6	work_pad.hyg	Drain Weep 6	25

INFLOWS TO: DOWNCHUTE #8

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
work_pad.hyg	SUBAREA 6	25	1.620	12.1000	20.14
work_pad.hyg	Drain Weep 6	25	.797	3.0000	.40

TOTAL FLOW INTO: DOWNCHUTE #8

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
work_pad.hyg	DOWNCHUTE #8	25	2.419	12.1000	20.54

SUMMARY FOR HYDROGRAPH ADDITION
at Node: CTDOT DITCH

HYG Directory: G:\P2004\0174\H10\Drainage Design\

Upstream Link ID	Upstream Node ID	HYG file	HYG ID	HYG tag
ADDLINK 280	SITE STORMDRAINS	work_pad.hyg	SITE STORMDRAINS	25
ADDLINK 110	JUNC 30	work_pad.hyg	JUNC 30	25

INFLOWS TO: CTDOT DITCH

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
work_pad.hyg	SITE STORMDRAINS	25	3.476	12.1000	24.74
work_pad.hyg	JUNC 30	25	10.770	12.1000	91.11

TOTAL FLOW INTO: CTDOT DITCH

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
work_pad.hyg	CTDOT DITCH	25	14.246	12.1000	115.86

SUMMARY FOR HYDROGRAPH ADDITION
at Node: SITE STORMDRAINS

HYG Directory: G:\P2004\0174\H10\Drainage Design\

Upstream Link ID	Upstream Node ID	HYG file	HYG ID	HYG tag
ADDLINK 120	HYD QUEUE 7	work_pad.hyg	Drain Weep 7	25
ADDLINK 290	SUBAREA 7	work_pad.hyg	SUBAREA 7	25

INFLOWS TO: SITE STORMDRAINS

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
work_pad.hyg	Drain Weep 7	25	1.512	3.0000	.76
work_pad.hyg	SUBAREA 7	25	1.961	12.1000	23.98

TOTAL FLOW INTO: SITE STORMDRAINS

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
work_pad.hyg	SITE STORMDRAINS	25	3.476	12.1000	24.74

SUMMARY FOR HYDROGRAPH ADDITION
at Node: JUNC 20

HYG Directory: G:\P2004\0174\H10\Drainage Design\

Upstream Link ID	Upstream Node ID	HYG file	HYG ID	HYG tag
ADDLINK 140	JUNC 50	work_pad.hyg	JUNC 50	25
ADDLINK 80	DOWNCHUTE #2	work_pad.hyg	DOWNCHUTE #2	25

INFLOWS TO: JUNC 20

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
work_pad.hyg	JUNC 50	25	3.065	12.1000	24.54
work_pad.hyg	DOWNCHUTE #2	25	4.217	12.1000	39.07

TOTAL FLOW INTO: JUNC 20

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
work_pad.hyg	JUNC 20	25	7.282	12.1000	63.61

SUMMARY FOR HYDROGRAPH ADDITION
at Node: CONC LINED DITCH

HYG Directory: G:\P2004\0174\H10\Drainage Design\

Upstream Link ID	Upstream Node ID	HYG file	HYG ID	HYG tag
ADDLINK 250	HYD QUEUE 8	work_pad.hyg	Drain Weep 8	25
ADDLINK 230	SUBAREA 8	work_pad.hyg	SUBAREA 8	25
ADDLINK 60	DOWNCHUTE #4	work_pad.hyg	DOWNCHUTE #4	25

INFLOWS TO: CONC LINED DITCH

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
work_pad.hyg	Drain Weep 8	25	1.048	3.0000	.53
work_pad.hyg	SUBAREA 8	25	2.130	12.2000	21.60
work_pad.hyg	DOWNCHUTE #4	25	3.510	12.1000	29.81

TOTAL FLOW INTO: CONC LINED DITCH

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
work_pad.hyg	CONC LINED DITCH	25	6.691	12.1000	48.91

SUMMARY FOR HYDROGRAPH ADDITION
at Node: DOWNCHUTE #2

HYG Directory: G:\P2004\0174\H10\Drainage Design\

Upstream Link ID	Upstream Node ID	HYG file	HYG ID	HYG tag
ADDLINK 180	HYD QUEUE 2	work_pad.hyg	Drain Weep 2	25
ADDLINK 10	SUBAREA 2	work_pad.hyg	SUBAREA 2	25
ADDLINK 50	SUBAREA 2A	work_pad.hyg	SUBAREA 2A	25
ADDLINK 40	SUBAREA 2B	work_pad.hyg	SUBAREA 2B	25

INFLOWS TO: DOWNCHUTE #2

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
work_pad.hyg	Drain Weep 2	25	1.083	3.0000	.55
work_pad.hyg	SUBAREA 2	25	1.926	12.1000	23.68
work_pad.hyg	SUBAREA 2A	25	.995	12.1000	12.23
work_pad.hyg	SUBAREA 2B	25	.211	12.1000	2.62

TOTAL FLOW INTO: DOWNCHUTE #2

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
work_pad.hyg	DOWNCHUTE #2	25	4.217	12.1000	39.07

SUMMARY FOR HYDROGRAPH ADDITION
at Node: DOWNCHUTE #3

HYG Directory: G:\P2004\0174\H10\Drainage Design\

Upstream Link ID	Upstream Node ID	HYG file	HYG ID	HYG tag
ADDLINK 160	HYD QUEUE 3	work_pad.hyg	Drain Weep 3	25
ADDLINK 100	SUBAREA 3	work_pad.hyg	SUBAREA 3	25

INFLOWS TO: DOWNCHUTE #3

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
work_pad.hyg	Drain Weep 3	25	1.102	3.0000	.56
work_pad.hyg	SUBAREA 3	25	1.961	12.1000	23.98

TOTAL FLOW INTO: DOWNCHUTE #3

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
work_pad.hyg	DOWNCHUTE #3	25	3.065	12.1000	24.54

SUMMARY FOR HYDROGRAPH ADDITION
at Node: DOWNCHUTE #4

HYG Directory: G:\P2004\0174\H10\Drainage Design\

Upstream Link ID	Upstream Node ID	HYG file	HYG ID	HYG tag
ADDLINK 240	HYD QUEUE 4	work_pad.hyg	Drain Weep 4	25
ADDLINK 30	SUBAREA 4	work_pad.hyg	SUBAREA 4	25

INFLOWS TO: DOWNCHUTE #4

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
work_pad.hyg	Drain Weep 4	25	1.157	3.0000	.58
work_pad.hyg	SUBAREA 4	25	2.351	12.1000	29.23

TOTAL FLOW INTO: DOWNCHUTE #4

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
work_pad.hyg	DOWNCHUTE #4	25	3.510	12.1000	29.81

PondPack Ver: Compute Time: Date:

SUMMARY FOR HYDROGRAPH ADDITION
at Node: DOWNCHUTE #10

HYG Directory: G:\P2004\0174\H10\Drainage Design\

Upstream Link ID	Upstream Node ID	HYG file	HYG ID	HYG tag
ADDLINK 260	HYD QUEUE 5	work_pad.hyg	Drain Weep 5	25
ADDLINK 210	SUBAREA 5	work_pad.hyg	SUBAREA 5	25

INFLOWS TO: DOWNCHUTE #10

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
work_pad.hyg	Drain Weep 5	25	2.106	3.0000	1.06
work_pad.hyg	SUBAREA 5	25	4.277	12.1000	48.39

TOTAL FLOW INTO: DOWNCHUTE #10

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
work_pad.hyg	DOWNCHUTE #10	25	6.387	12.1000	49.45

SUMMARY FOR HYDROGRAPH ADDITION
at Node: DOWNCHUTE #1

HYG Directory: G:\P2004\0174\H10\Drainage Design\

Upstream Link ID	Upstream Node ID	HYG file	HYG ID	HYG tag
ADDLINK 20	SUBAREA 1	work_pad.hyg	SUBAREA 1	25
ADDLINK 170	HYD QUEUE 1	work_pad.hyg	Drain Weep 1	25

INFLOWS TO: DOWNCHUTE #1

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
work_pad.hyg	SUBAREA 1	25	2.189	12.1000	26.85
work_pad.hyg	Drain Weep 1	25	1.296	3.0000	.65

TOTAL FLOW INTO: DOWNCHUTE #1

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
work_pad.hyg	DOWNCHUTE #1	25	3.488	12.1000	27.51

SUMMARY FOR HYDROGRAPH ADDITION
at Node: JUNC 30

HYG Directory: G:\P2004\0174\H10\Drainage Design\

Upstream Link ID	Upstream Node ID	HYG file	HYG ID	HYG tag
ADDLINK 70	DOWNCHUTE #1	work_pad.hyg	DOWNCHUTE #1	25
ADDLINK 150	JUNC 20	work_pad.hyg	JUNC 20	25

INFLOWS TO: JUNC 30

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
work_pad.hyg	DOWNCHUTE #1	25	3.488	12.1000	27.51
work_pad.hyg	JUNC 20	25	7.282	12.1000	63.61

TOTAL FLOW INTO: JUNC 30

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
work_pad.hyg	JUNC 30	25	10.770	12.1000	91.11

SUMMARY FOR HYDROGRAPH ADDITION
at Node: JUNC 50

HYG Directory: G:\P2004\0174\H10\Drainage Design\

Upstream Link ID	Upstream Node ID	HYG file	HYG ID	HYG tag
ADDLINK 130	DOWNCHUTE #3	work_pad.hyg	DOWNCHUTE #3	25

INFLOWS TO: JUNC 50

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
work_pad.hyg	DOWNCHUTE #3	25	3.065	12.1000	24.54

TOTAL FLOW INTO: JUNC 50

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
work_pad.hyg	JUNC 50	25	3.065	12.1000	24.54

SUMMARY FOR HYDROGRAPH ADDITION

HYG Directory: G:\P2004\0174\H10\Drainage Design\

Upstream Link ID	Upstream Node ID	HYG file	HYG ID	HYG tag
ADDLINK 200	DOWNCHUTE #8	work_pad.hyg	DOWNCHUTE #8	25
ADDLINK 220	DOWNCHUTE #10	work_pad.hyg	DOWNCHUTE #10	25
ADDLINK 90	CONC LINED DITCH	work_pad.hyg	CONC LINED DITCH	25

INFLOWS TO: DIKE DRAIN DITCH

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
work_pad.hyg	DOWNCHUTE #8	25	2.419	12.1000	20.54
work_pad.hyg	DOWNCHUTE #10	25	6.387	12.1000	49.45
work_pad.hyg	CONC LINED DITCH	25	6.691	12.1000	48.91

TOTAL FLOW INTO: DIKE DRAIN DITCH

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
work_pad.hyg	DIKE DRAIN DITCH	25	15.496	12.1000	118.90

Index of Starting Page Numbers for ID Names

FlowMaster® Output

- Sub-Area 2A – Representative Top-of-Landform area diverted by diversion swale
- Sub Area 2B – Representative Side-Slope area
- Downchutes – Flow characteristics for largest drainage area
- West Side Riprap Ditch – Analyzed at the point of outfall into 30" RCP pipe
- East Side Riprap Ditch – Analyzed at the point of outfall into 24" HDPE pipe
- Existing Concrete Dike Swale – Analyzed at the point of outfall into Vegetated Ditch
- CTDOT Drainage Channel – Analyzed for capacity to handle flow from final landform
- Various existing and proposed pipes

Worksheet for Sub-Area 2A

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.025	
Channel Slope	0.04000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	12.23	ft³/s

Diversion Swale Slope (TYP)

From Pondpack

Results

Normal Depth	0.57	ft
Flow Area	1.95	ft²
Wetted Perimeter	5.07	ft
Top Width	4.85	ft
Critical Depth	0.77	ft
Critical Slope	0.01216	ft/ft
Velocity	6.28	ft/s
Velocity Head	0.61	ft
Specific Energy	1.18	ft
Froude Number	1.75	
Flow Type	Supercritical	

< design depth of 3'

V > 4 fps, ∴ need perm turf reinforcement mat

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.57	ft
Critical Depth	0.77	ft
Channel Slope	0.04000	ft/ft
Critical Slope	0.01216	ft/ft

Cross Section for Sub-Area 2A

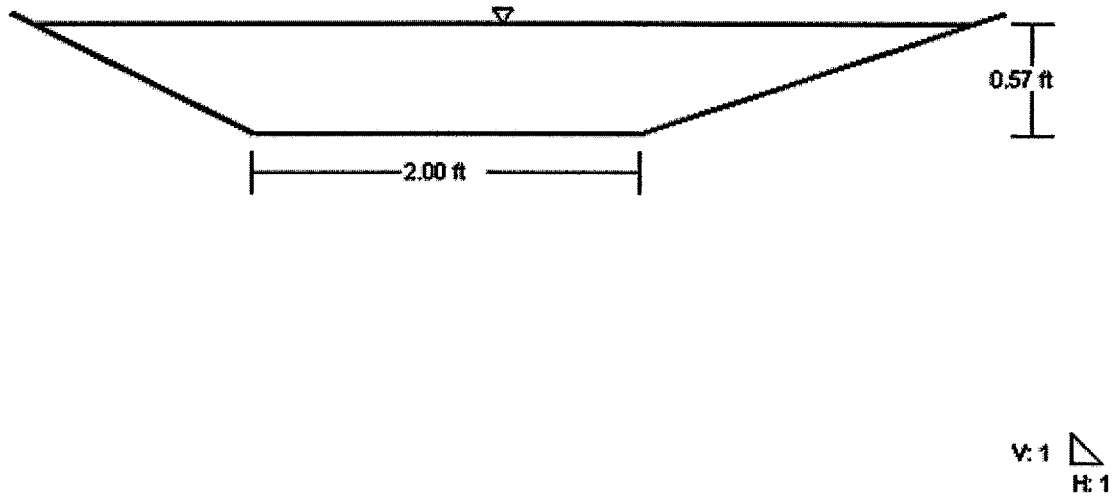
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.025	
Channel Slope	0.04000	ft/ft
Normal Depth	0.57	ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	12.23	ft^3/s

Cross Section Image



Worksheet for Sub-Area 2B

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.025	
Channel Slope	0.04000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	2.62	ft^3/s

Results

Normal Depth	0.25	ft
Flow Area	0.65	ft^2
Wetted Perimeter	3.35	ft
Top Width	3.25	ft
Critical Depth	0.33	ft
Critical Slope	0.01509	ft/ft
Velocity	4.01	ft/s
Velocity Head	0.25	ft
Specific Energy	0.50	ft
Froude Number	1.57	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.25	ft
Critical Depth	0.33	ft
Channel Slope	0.04000	ft/ft
Critical Slope	0.01509	ft/ft

Cross Section for Sub-Area 2B

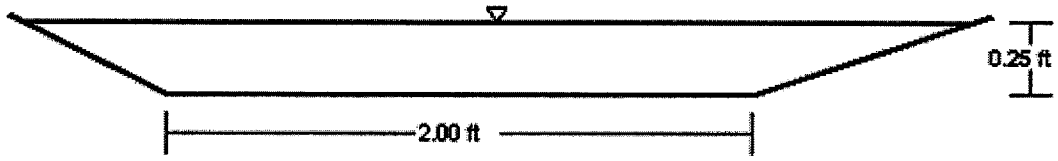
Project Description

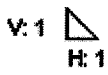
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.025	
Channel Slope	0.04000	ft/ft
Normal Depth	0.25	ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	2.62	ft^3/s

Cross Section Image





Worksheet for Downchutes

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.33333	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	6.00	ft
Discharge	49.45	ft³/s

Flow in Downchute #10. Highest peak flow in any of the downchutes

Results

Normal Depth	0.46	ft
Flow Area	3.20	ft²
Wetted Perimeter	8.07	ft
Top Width	7.85	ft
Critical Depth	1.12	ft
Critical Slope	0.01460	ft/ft
Velocity	15.44	ft/s
Velocity Head	3.70	ft
Specific Energy	4.17	ft
Froude Number	4.26	
Flow Type	Supercritical	

< design depth of 18"

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.46	ft
Critical Depth	1.12	ft
Channel Slope	0.33333	ft/ft
Critical Slope	0.01460	ft/ft

Cross Section for Downchutes

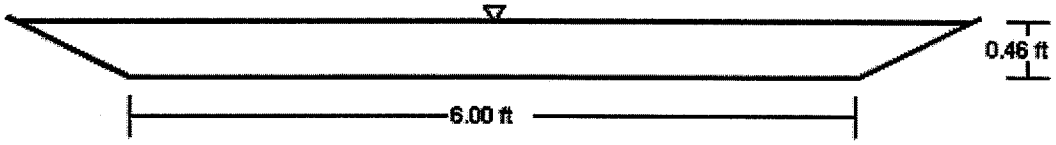
Project Description

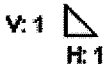
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.33333	ft/ft
Normal Depth	0.46	ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	6.00	ft
Discharge	49.45	ft³/s

Cross Section Image





Worksheet for West Side Riprap Ditch

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.025	
Channel Slope	0.00360	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	91.11	ft³/s

Slope based on 2006 Survey

Peak Flow @ End (10yr 30') from Pond Pack

Results

Normal Depth	2.22	ft
Flow Area	21.18	ft²
Wetted Perimeter	15.98	ft
Top Width	15.09	ft
Critical Depth	1.77	ft
Critical Slope	0.00931	ft/ft
Velocity	4.30	ft/s
Velocity Head	0.29	ft
Specific Energy	2.51	ft
Froude Number	0.64	
Flow Type	Subcritical	

< design depth = 3.9' (at end of ditch)

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.22	ft
Critical Depth	1.77	ft
Channel Slope	0.00360	ft/ft
Critical Slope	0.00931	ft/ft

Cross Section for West Side Riprap Ditch

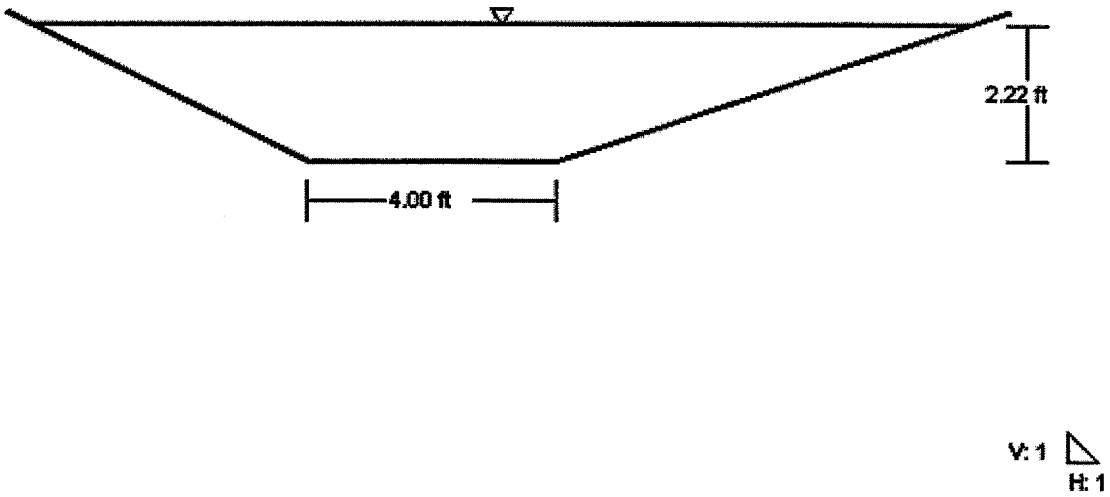
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.025	
Channel Slope	0.00360	ft/ft
Normal Depth	2.22	ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	91.11	ft³/s

Cross Section Image



Worksheet for East Side Riprap Ditch

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.025	
Channel Slope	0.08000	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	49.45	ft³/s

Approx slope of Road

Peak flow at end (D.C. #10)

Results

Normal Depth	0.75	ft
Flow Area	4.40	ft²
Wetted Perimeter	8.04	ft
Top Width	7.74	ft
Critical Depth	1.28	ft
Critical Slope	0.01010	ft/ft
Velocity	11.24	ft/s
Velocity Head	1.96	ft
Specific Energy	2.71	ft
Froude Number	2.63	
Flow Type	Supercritical	

< design depth of 2'

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.75	ft
Critical Depth	1.28	ft
Channel Slope	0.08000	ft/ft
Critical Slope	0.01010	ft/ft

Cross Section for East Side Riprap Ditch

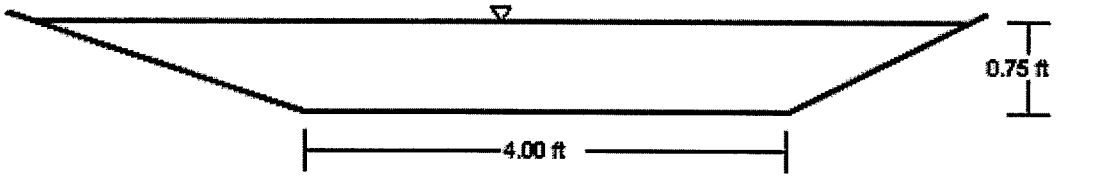
Project Description

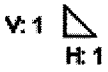
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.025	
Channel Slope	0.08000	ft/ft
Normal Depth	0.75	ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	49.45	ft^3/s

Cross Section Image





Worksheet for Existing Dike Swale

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00080	ft/ft
Constructed Depth	2.50	ft
Constructed Top Width	16.00	ft
Discharge	48.91	ft³/s

Average slope for length

dimensions based on F&O Field survey data

From Pondpack Model

Results

Normal Depth	1.67	ft
Flow Area	14.50	ft²
Wetted Perimeter	13.61	ft
Top Width	13.06	ft
Critical Depth	1.25	ft
Critical Slope	0.00251	ft/ft
Velocity	3.37	ft/s
Velocity Head	0.18	ft
Specific Energy	1.84	ft
Froude Number	0.56	
Flow Type	Subcritical	

< constructed depth

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.67	ft
Critical Depth	1.25	ft
Channel Slope	0.00080	ft/ft
Critical Slope	0.00251	ft/ft

Cross Section for Existing Dike Swale

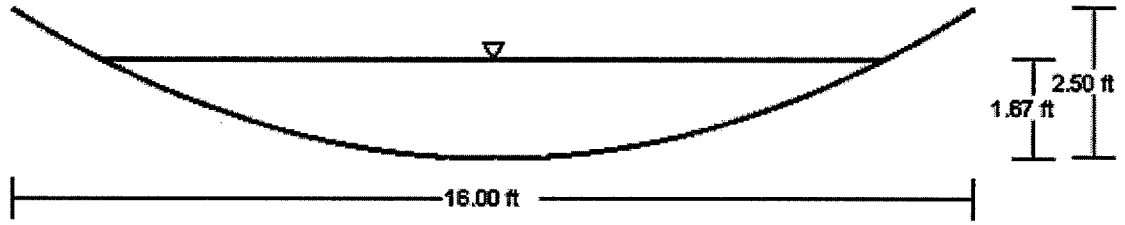
Project Description

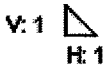
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00080	ft/ft
Constructed Depth	2.50	ft
Normal Depth	1.67	ft
Constructed Top Width	16.00	ft
Discharge	48.91	ft³/s

Cross Section Image





Worksheet for CTDOT Drainage Channel

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	Based on F&O field survey
Channel Slope	0.00380	ft/ft
Bottom Width	4.00	ft – Based on As-Built CTDOT drawings
Discharge	115.86	ft³/s – From Pond Pack

Results

Normal Depth	3.50	ft < constructed depth
Flow Area	14.00	ft²
Wetted Perimeter	11.00	ft
Top Width	4.00	ft
Critical Depth	2.97	ft
Critical Slope	0.00576	ft/ft
Velocity	8.28	ft/s
Velocity Head	1.06	ft
Specific Energy	4.56	ft
Froude Number	0.78	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.50	ft
Critical Depth	2.97	ft
Channel Slope	0.00380	ft/ft
Critical Slope	0.00576	ft/ft

Cross Section for CTDOT Drainage Channel

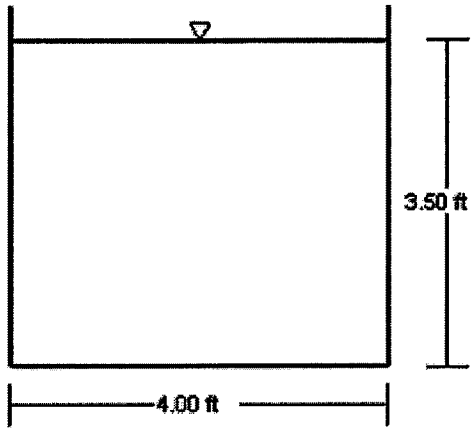
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00380	ft/ft
Normal Depth	3.50	ft
Bottom Width	4.00	ft
Discharge	115.86	ft^3/s

Cross Section Image



V: 1
H: 1

Check for full flow ~~depth~~ discharge

Worksheet for 30" RCP Pipe

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01680	ft/ft
Normal Depth	2.50	ft
Diameter	2.50	ft
Discharge	53.16	ft³/s

3 full flow capacity

Results

Discharge	53.16	ft³/s
Normal Depth	2.50	ft
Flow Area	4.91	ft²
Wetted Perimeter	7.85	ft
Top Width	0.00	ft
Critical Depth	2.34	ft
Percent Full	100.0	%
Critical Slope	0.01452	ft/ft
Velocity	10.83	ft/s
Velocity Head	1.82	ft
Specific Energy	4.32	ft
Froude Number	0.00	
Maximum Discharge	57.19	ft³/s
Discharge Full	53.16	ft³/s
Slope Full	0.01680	ft/ft
Flow Type	SubCritical	

< design inflow ∴ need to add barrell !

design inflow = 91.11 cfs

2 × 53.16 > 91.11 cfs

∴ Add 30" RCP

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

Cross Section for 30" RCP Pipe

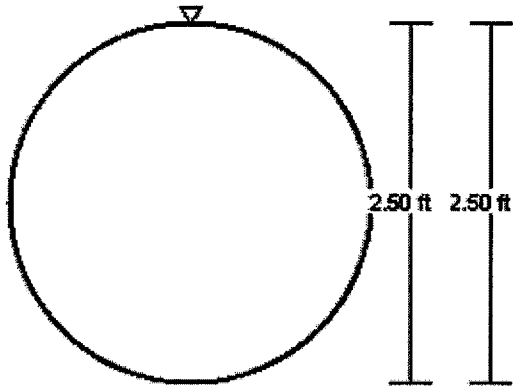
Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01680	ft/ft
Normal Depth	2.50	ft
Diameter	2.50	ft
Discharge	53.16	ft^3/s

Cross Section Image



V: 1
H: 1

Check for full flow discharge

Worksheet for 48" RCP Pipe

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Normal Depth	4.00	ft
Diameter	4.00	ft
Discharge	143.64	ft³/s

design pitch = 1%

} full flow condition

Results

Discharge	143.64	ft³/s
Normal Depth	4.00	ft
Flow Area	12.57	ft²
Wetted Perimeter	12.57	ft
Top Width	0.00	ft
Critical Depth	3.54	ft
Percent Full	100.0	%
Critical Slope	0.00893	ft/ft
Velocity	11.43	ft/s
Velocity Head	2.03	ft
Specific Energy	6.03	ft
Froude Number	0.00	
Maximum Discharge	154.51	ft³/s
Discharge Full	143.64	ft³/s
Slope Full	0.01000	ft/ft
Flow Type	SubCritical	

> design flow = 91.11

∴ OK!

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

Cross Section for 48" RCP Pipe

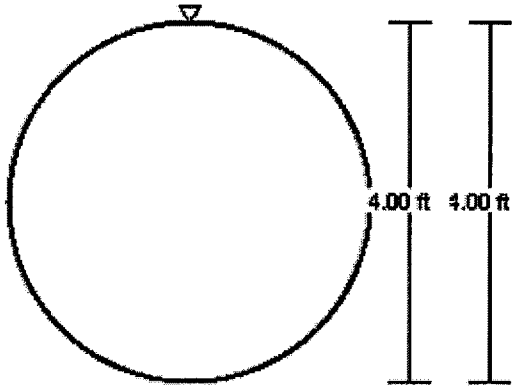
Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Normal Depth	4.00	ft
Diameter	4.00	ft
Discharge	143.64	ft^3/s

Cross Section Image



V: 1
H: 1

Worksheet for 24" HDPE Pipe

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.010		
Channel Slope	0.04000	ft/ft	← design pipe slope
Diameter	2.00	ft	
Discharge	49.45	ft³/s	Peak flow from Pondpack

Results

Normal Depth	1.40	ft	< pipe diameter ∴ ok!
Flow Area	2.36	ft²	
Wetted Perimeter	3.97	ft	
Top Width	1.83	ft	
Critical Depth	1.98	ft	
Percent Full	70.2	%	
Critical Slope	0.02601	ft/ft	
Velocity	20.98	ft/s	
Velocity Head	6.84	ft	
Specific Energy	8.24	ft	
Froude Number	3.26		
Maximum Discharge	63.27	ft³/s	
Discharge Full	58.82	ft³/s	
Slope Full	0.02828	ft/ft	
Flow Type	SuperCritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	70.23	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s

Cross Section for 24" HDPE Pipe

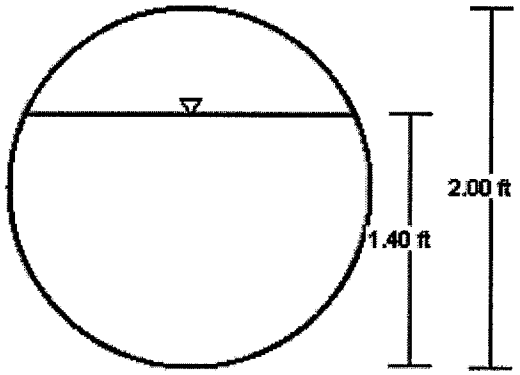
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.010	
Channel Slope	0.04000	ft/ft
Normal Depth	1.40	ft
Diameter	2.00	ft
Discharge	49.45	ft^3/s

Cross Section Image



V: 1
H: 1

For Replacing 2 - 12" RCP with 2- 18" HDPE in NE corner

Worksheet for 18" HDPE Pipe

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.010	
Channel Slope	0.01500	ft/ft
Normal Depth	1.50	ft
Diameter	1.50	ft
Discharge	16.72	ft³/s

design slope

} full flow condition

Results

Discharge	16.72	ft³/s
Normal Depth	1.50	ft
Flow Area	1.77	ft²
Wetted Perimeter	4.71	ft
Top Width	0.00	ft
Critical Depth	1.44	ft
Percent Full	100.0	%
Critical Slope	0.01304	ft/ft
Velocity	9.46	ft/s
Velocity Head	1.39	ft
Specific Energy	2.89	ft
Froude Number	0.00	
Maximum Discharge	17.99	ft³/s
Discharge Full	16.72	ft³/s
Slope Full	0.01500	ft/ft
Flow Type	SubCritical	

→ single pipe capacity

× 2 pipes > design peak flow = 29.81 cfs.

∴ 2 pipes OK!

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

Cross Section for 18" HDPE Pipe

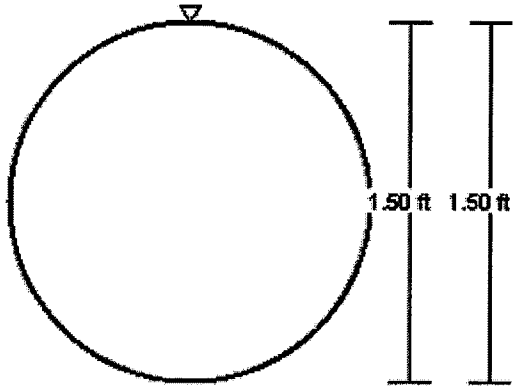
Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.010	
Channel Slope	0.01500	ft/ft
Normal Depth	1.50	ft
Diameter	1.50	ft
Discharge	16.72	ft^3/s

Cross Section Image



V: 1
H: 1

For Replacing 12" RCP w/ 18" HDPE in SE Corner

Worksheet for 18" HDPE Pipe

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.010	
Channel Slope	0.02000	ft/ft
Diameter	1.50	ft
Discharge	20.14	ft³/s

Design Slope based on field survey data

Peak flow from area 6 From

Results

Normal Depth	1.30	ft
Flow Area	1.62	ft²
Wetted Perimeter	3.58	ft
Top Width	1.03	ft
Critical Depth	1.47	ft
Percent Full	86.5	%
Critical Slope	0.01943	ft/ft
Velocity	12.40	ft/s
Velocity Head	2.39	ft
Specific Energy	3.69	ft
Froude Number	1.74	
Maximum Discharge	20.77	ft³/s
Discharge Full	19.31	ft³/s
Slope Full	0.02175	ft/ft
Flow Type	SuperCritical	

< pipe diameter ∴ OK!

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	86.46	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s

Cross Section for 18" HDPE Pipe

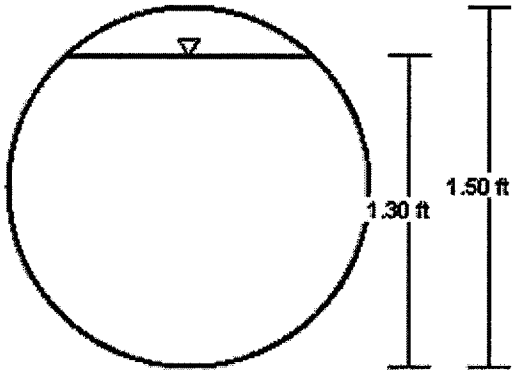
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.010	
Channel Slope	0.02000	ft/ft
Normal Depth	1.30	ft
Diameter	1.50	ft
Discharge	20.14	ft^3/s

Cross Section Image



V: 1
H: 1

Check for full-flow capacity vs. expected volume

Worksheet for 4" Underdrain

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.010	
Channel Slope	0.02000	ft/ft
Normal Depth	0.33	ft
Diameter	0.33	ft
Discharge	0.35	ft³/s

Smooth interior (ADS N-12 or equal)

Results

Discharge	0.35	ft³/s
Normal Depth	0.33	ft
Flow Area	0.09	ft²
Wetted Perimeter	1.05	ft
Top Width	0.00	ft
Critical Depth	0.31	ft
Percent Full	100.0	%
Critical Slope	0.01728	ft/ft
Velocity	4.01	ft/s
Velocity Head	0.25	ft
Specific Energy	0.58	ft
Froude Number	0.00	
Maximum Discharge	0.38	ft³/s
Discharge Full	0.35	ft³/s
Slope Full	0.02000	ft/ft
Flow Type	SubCritical	

Compare to expected flow in drain recieving highest volume

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

FUSS & O'NEILL
Disciplines to Deliver

PREPARED BY	DATE	CHECKED BY	DATE	PROJECT NO.
DRL	19 Jun 06	JPD	6/27/06	04-0174.H10

SHEET NO. of

4" Under Drain Capacity

Drainage Layer Peak output (From HELP model)
= 140,000 CF / day

Area = 80 Acres

∴ Peak output = 140,000/80 = $\frac{1750 \text{ CF}}{\text{Acre}}$ / day

= $\frac{.02 \text{ CFS}}{\text{Acre}}$

Largest Area Serviced by Single 4" Pipe
≅ 3.5 Acre

∴ Peak flow in Pipe =

3.5 Acre × .02 $\frac{\text{CFS}}{\text{Acre}}$ = .07 CFS

.07 CFS << .35 CFS

↳ Full flow capacity from Flow Master™

Various Calculations

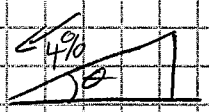
- Drainage Layer Weeping Rate
- Permissible Shear in vegetated Diversion Swales

FUSS & O'NEILL
Disciplines to Deliver

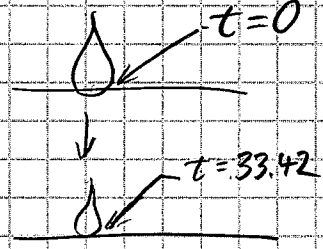
PREPARED BY	DATE	CHECKED BY	DATE	PROJECT NO.
DRL	30Mar06	JPD	6/27/06	04-0174.H10

SHEET NO. of

Drainage Layer Weeping Rate



$\theta = 2.29°$



$9'' \times \frac{2.54\ cm}{in} = 22.86\ cm \div 1.9\times10^{-4}\ cm/s \div \frac{3600\ s}{hr} = 33.42\ hr$

$22.86\ cm \div 10^{-3}\ cm/s \div 3600\ s/hr = 6.35\ hr$

$5.5\times10^{-3}\ m^2/s \div .007\ m = .786\ m/s$ (particle permeability) (Values for Tenax TD-5)

$.786\ m/s \times \sin 2.29° = .0314\ m/s$ (permeability in 4% plane)

$50' \times \frac{m}{3.28'} \div .0314\ m/s = 485\ s = .13\ hr$

Total Time = 33.42 hr + 6.35 hr + .13 hr = **39.9 hr**

$2.5'' \times \frac{1\ ft}{12\ in} \times \frac{43560\ ft^2}{Acre} = \frac{9075\ CF}{Acre}$

$\frac{9075\ CF}{Acre} \div \left(39.9\ hr \times \frac{3600\ s}{hr}\right) = .063\ cfs/Acre$

∴ Add .06 cfs/Acre to flow in all areas (shown as "Hyd Qadd" on Network Diagram)

FOL #110

Subarea 2A - Check for permissible velocity & need for channel lining

Velocity in channel = 6.28 ft/s (using Manning eq. in Flowmaster assuming 25yr event)

6.28 > 4.0 ∴ Need Channel lining

Shear stress in Channel:

$\tau_d = \gamma d S$ (Eq 7.12 from Conn DOT drainage Manual)

$\tau_d = 62.4 \frac{lbs}{ft^3} \times .59\ ft \times .02$

$= .74\ lbs/ft^2$

Permissible Shear Stress for Synthetic Mat Per Drainage Manual

$.74\ lbs/ft^2 < 2.0\ lbs/ft^2$ ∴ OK

$<< 10.0\ lbs/ft^2$

Permissible Shear for SC250

Table 7-4 Permissible Shear Stresses for Lining Materials*

Lining Category	ConnDOT Designations	Lining Type	Permissible Unit Shear Stress Pa	Permissible Unit Shear Stress lb/ft^2
Erosion Control Matting**	Type E	Woven Paper Net	7.2	0.15
		Jute Net	21.5	0.45
	Type F	Fiberglass Roving:		
		Single	28.7	0.60
		Double	40.7	0.85
	Type G	Straw with Net	69.4	1.45
		Curled Wood Mat	74.2	1.55
	Type H	Synthetic Mat	95.8	2.00
Vegetative Turf Establishment		Class A	177.2	3.70
		Class B	100.6	2.10
		Class C-Use for DOT projects	47.9	1.00
		Class D	28.7	0.60
		Class E	16.8	0.35
Gravel Riprap	Special	25 mm (1 in)	15.8	0.33
		50 mm (2 in)	31.6	0.67
Rock Riprap	Modified	125 mm (5 in)	79.8	1.68
		150 mm (6 in)	95.8	2.00
	Intermediate	200 mm (8 in)	127.7	2.68
		300 mm (12 in)	191.5	4.00
	Standard	380 mm (15 in)	239.3	5.00
Bare Soil		Non-cohesive	Figure 7-13	
		Cohesive	Figure 7-14	

* Reproduced from HEC-15
** See Section 7.6.8

7.6.8 Erosion Control Matting

Erosion control matting is evaluated by the Department for use in eight Types (A-H), grouped into two Classes. Types A through D are included in Class 1 and are designated as Slope Protection. This classification is based upon steepness of the slope and soil type. The purpose of Class 1 matting is to protect the seedbed from loss of soil, and promote the establishment of a warm-season, perennial vegetative cover.

Composite Turf Reinforcement

SC250®

DESCRIPTION

Permanent 3-D TRM Structure:
Three UV Stable Nets
-High Strength Top Net
-3-D Corrugated Center Net
-High Strength Bottom Net

Matrix Material:
70% Straw/30% Coconut

Stitching:
UV Stable Polypropylene
Thread on 1.5 inch centers

TYPICAL APPLICATIONS

Medium to High Flow Channels
1:1 & Greater Slopes
Veg. Grow In Period: Up To 24 Months
> 10 yr. Permanent Veg. Reinforcement

DESIGN VALUES

Unveg. - 3.0 lbs/ft² (144 Pa)
Veg. – up to 10.0 lbs/ft² (478 Pa)
Meets FHWA FP – 03
Categories, Type 5. A, B & C
Permanent TRM

C350®

DESCRIPTION

Permanent 3-D TRM Structure:
Three UV Stable Nets
-Super-High Strength Top Net
-3-D Corrugated Center Net
-Super-High Strength Bottom Net

Matrix Material:
100% Coconut Fiber

Stitching:
UV Stable Polypropylene
Thread on 1.5 inch centers

TYPICAL APPLICATIONS

High Flow Channels
1:1 & Greater Slopes
Veg. Grow In Period: Up To 36 Months
> 10 yr. Permanent Veg. Reinforcement

DESIGN VALUES

Unveg. - 3.2 lbs/ft² (153 Pa)
Veg. – up to 12.0 lbs/ft² (574 Pa)
Meets FHWA FP – 03
Categories, Type 5. A, B & C
Permanent TRM

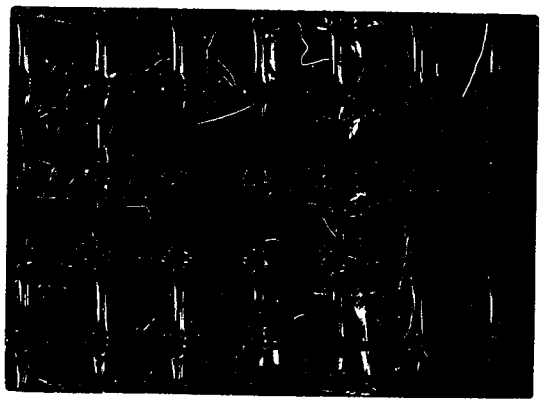
P550®

DESCRIPTION

Permanent 3-D TRM Structure:
Three UV Stable Nets
-Ultra-High Strength Top Net
-3-D Corrugated Center Net
-Ultra-High Strength Bottom Net

Matrix Material:
100% Polypropylene Fiber

Stitching:
UV Stable Polypropylene
Thread on 1.5 inch centers



TYPICAL APPLICATIONS

Extreme High Flow Channels
1:1 & Greater Slopes
Veg. Grow In Period: Greater Than 36 Months
> 10 yr. Permanent Veg. Reinforcement

DESIGN VALUES

Unveg. – 4.0 lbs/ft² (191 Pa)
Veg. – up to 14.0 lbs/ft² (672 Pa)
Meets FHWA FP – 03
Categories, Type 5. A, B & C
Permanent TRM

All Vmax³ products have been tested by AASHTO's National Transportation Product Evaluation Program for RECPs.

Culvert Analysis Report
Hartford Landfill

Analysis Component			
Storm Event	Design	Discharge	115.86 cfs

From PondPack

Peak Discharge Method: User-Specified			
Design Discharge	115.86 cfs	Check Discharge	200.00 cfs

Tailwater properties: Rectangular Channel

Tailwater conditions for Design Storm.

Discharge	115.86 cfs	Bottom Elevation	7.70 ft
Depth	4.55 ft	Velocity	6.36 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-54 inch Circular	115.86 cfs	14.16 ft	7.28 ft/s
Weir	Not Considered	N/A	N/A	N/A

HW Elev (14.16) < Top of Channel (≈ 19)

∴ OK!

Culvert Analysis Report
Hartford Landfill

Component:Culvert-1

Culvert Summary			
Computed Headwater Elevation	14.16 ft	Discharge	115.86 cfs
Inlet Control HW Elev.	13.01 ft	Tailwater Elevation	12.25 ft
Outlet Control HW Elev.	14.16 ft	Control Type	Outlet Control
Headwater Depth/Height	1.40		

Grades			
Upstream Invert	7.86 ft	Downstream Invert	7.70 ft
Length	147.00 ft	Constructed Slope	0.000000 ft/ft

Hydraulic Profile			
Profile	PressureProfile	Depth, Downstream	4.55 ft
Slope Type	N/A	Normal Depth	N/A ft
Flow Regime	N/A	Critical Depth	3.17 ft
Velocity Downstream	7.28 ft/s	Critical Slope	0.004878 ft/ft

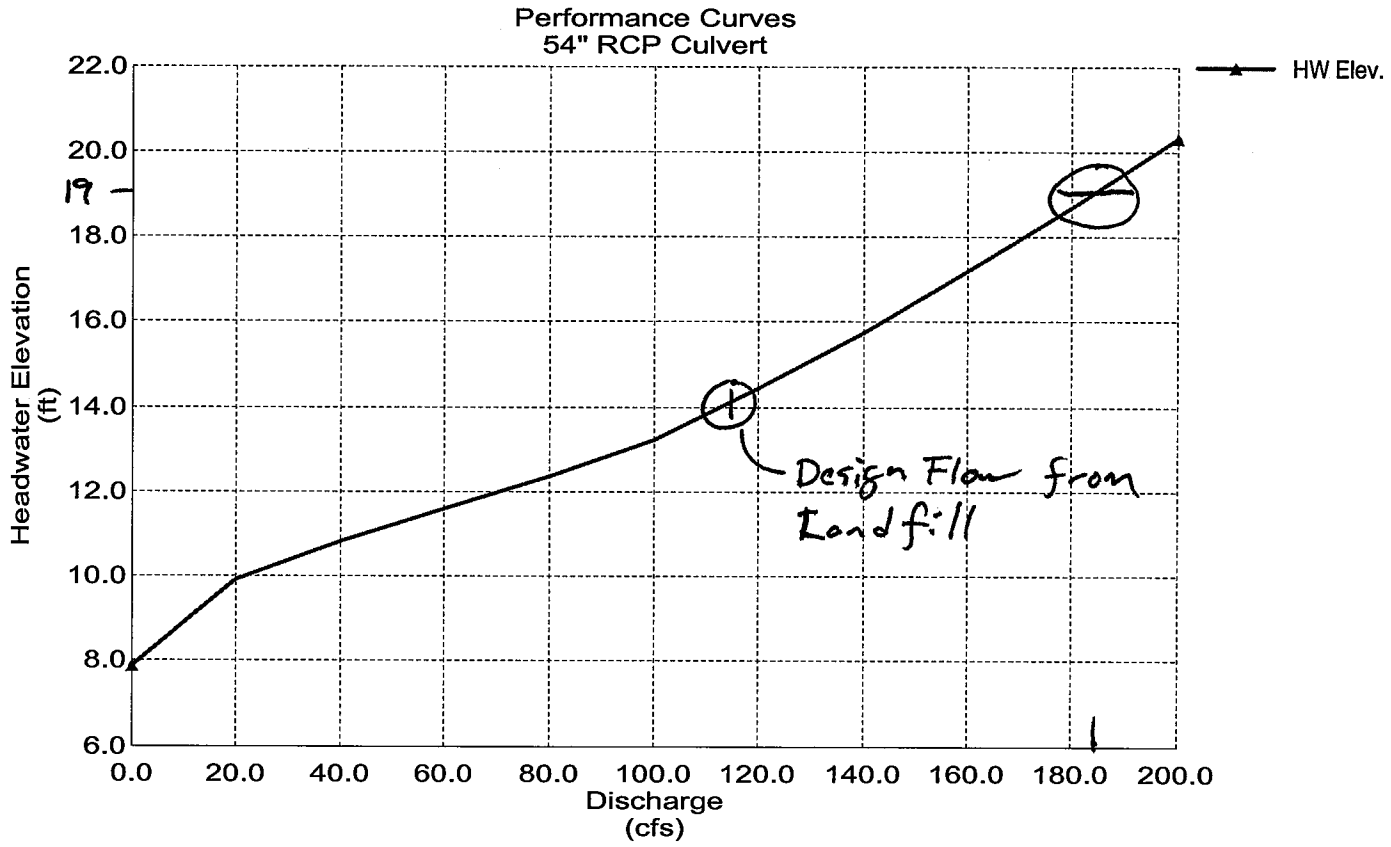
Section			
Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	4.50 ft
Section Size	54 inch	Rise	4.50 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	14.16 ft	Upstream Velocity Head	0.82 ft
Ke	0.50	Entrance Loss	0.41 ft

Inlet Control Properties			
Inlet Control HW Elev.	13.01 ft	Flow Control	Unsubmerged
Inlet Type	Square edge w/headwall	Area Full	15.9 ft²
K	0.00980	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	1
C	0.03980	Equation Form	1
Y	0.67000		

Performance Curves Report
Culvert-1

Range Data:			
	Minimum	Maximum	Increment
Discharge	0.00	200.00	20.00 cfs



Channel & Culvert will safely convey ≈ 185 cfs without local flooding.

∴ OK!

Drainage Design Calculation Sketch

LEGEND

- DRAINAGE SUB-AREA BOUNDRY
- SHEET FLOW TIME OF CONCENTRATION LINE
- SHALLOW CONCENTRATED FLOW TIME OF CONCENTRATION LINE
- CHANNEL FLOW TIME OF CONCENTRATION LINE

Replace Pre-cast chamber w/ new chamber
Install 48" RCP Outfall

Add 30" RCP Barrel

EXISTING 30" RCP CULVERT W/SC VALVE

EXISTING CULVERT INADEQUATE TO HANDLE PEAK FLOW

EXISTING 30" CMP CULVERT (TO BE REMOVED)

EXISTING 72" CMP CULVERT (TO BE REMOVED)

EXISTING 72" CMP CULVERT (TO BE REMOVED)

CULVERT WITH SEDIMENT TO REMAIN AREA

Conn DOT Drainage Ditch

CITY OF HARTFORD DPW YARD

D.C. #1

Tc (SHEET) 90' – 33%

Tc (CHANNEL) 400' – 4%

SUBAREA 2B AREA = .83 ACRES

D.C. #2

Tc (CHANNEL) 400' – 4%

Tc (SHALLOW) 125' – 4%

SUBAREA 1 AREA = 8.63 ACRES

SUBAREA 2 AREA = 12.34 ACRES

Tc (CHANNEL) 375' – 2%

D.C. #3

Tc (SHALLOW) 110' – 4%

Tc (CHANNEL) 530' – 4%

SUBAREA 2A AREA = 3.92 ACRES

SUBAREA 3 AREA = 7.73 ACRES

Tc (SHALLOW) 200' – 4%

Tc (CHANNEL) 470' – 4%

Tc (SHEET) 300' – 4%

Tc (SHEET) 300' – 4%

Tc (SHEET) 300' – 4%

Replace 12" RCP w 18" HDPE

12" RCP STORM DISCHARGE INTO DRAINAGE DITCH

IMPACT BASIN EXCAVATION IN WATER EXISTING CATCH BASIN

D.C. #9

SUBAREA 7 AREA = 12.10 ACRES

Tc (SHEET) 300' – 4%

Tc (SHEET) 230' – 4%

SUBAREA 4 AREA = 9.26 ACRES

D.C. #8

SUBAREA 5 AREA = 16.85 ACRES

Tc (SHALLOW) 50' – 4%

Tc (CHANNEL) 420' – 4%

GRADE RIPRAP DITCH TO DRAIN TO EXISTING CATCH BASIN INLET

SUBAREA 6 AREA = 6.38 ACRES

D.C. #7

D.C. #6

D.C. #5

D.C. #10

Tc (CHANNEL) 750' – 4%

Tc (CHANNEL) 420' – 4%

D.C. #4

Tc (SHEET) 50' – 4%

Replace 12" RCP w 24" HDPE

SUBAREA 4 AREA = 8.39 ACRES

Tc (CHANNEL) 3000' – 4%

12" RCP DISCHARGE TO DRAINAGE DITCH

Replace 2-12" RCP w 2-18" HDPE

Dike Drainage Ditch

EXISTING CONCRETE LINED DRAINAGE DITCH

EXISTING DIKE MAINTENANCE ROAD

No.	DATE	DESCRIPTION	BY
1.			

REVISIONS

PROJ. MANAGER:	CML
CHIEF DESIGNER:	DRL
REVIEWED BY:	DATE

SEAL

SEAL

DRAFT

SCALE:
HORZ.: 1" = 100'
VERT.:
DATUM:
HORZ.: NAD 27
VERT.: NGVD29
100 50 0 100
GRAPHIC SCALE

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146 HARTFORD ROAD, MANCHESTER, CONNECTICUT 06040
860.646.2469 www.FandO.com

CONNECTICUT RESOURCES RECOVERY AUTHORITY
DRAINGE CALCULATION BACKUP SKETCH
HARTFORD LANDFILL CLOSURE PLAN
HARTFORD CONNECTICUT

PROJ. No.: 04-0174.H10
DATE: MAY 2006

FIG.1

APPENDIX B
QUALITY ASSURANCE PLAN

Quality Assurance Plan
Landfill Closure Construction

Hartford Landfill
Hartford, Connecticut

July 2006

Revised January 2007

FUSS & O'NEILL
Disciplines to Deliver

Fuss & O'Neill
146 Hartford Road
Manchester, CT 06040

QUALITY ASSURANCE PLAN
LANDFILL CLOSURE CONSTRUCTION
Hartford Landfill
Hartford, Connecticut

TABLE OF CONTENTS

QUALITY ASSURANCE PLAN
LANDFILL CLOSURE CONSTRUCTION
Hartford Landfill
Hartford, Connecticut

TABLE OF CONTENTS

1.0 INTRODUCTION

The Connecticut Resources Recovery Authority (CRRA) intends on closing the Mixed Waste/Interim Ash Disposal Area of the Hartford Landfill located at 180 Leibert Road in Hartford, Connecticut. This document serves as a Quality Assurance Plan (QAP) specifically developed for the proposed closure construction activities at the landfill. In general, closure construction activities will consist of constructing an impermeable barrier and soil cover over approximately 80 acres of landfill area with associated access roads and storm water control features. The closure will be performed in three phases. The east side of the landfill will continue to receive waste to reach final elevations, while the west side, which is currently at final elevations, will be closed. This document accompanies and is consistent with the Closure Plan for this landfill dated April 2006.

This QAP is intended to provide guidance for control of construction quality aspects of the proposed landfill closure activities. This document outlines specific duties of the Quality Assurance Consultant (QAC) and construction contractor, and procedures for documenting and reporting that the closure activities have been conducted in general conformance with the CTDEP-approved plans, specifications, and applicable regulations. Specific details of proposed construction quality assurance/quality control activities will be presented in the Standard General Conditions of the Construction Contract, supplementary conditions, technical specifications and final design drawings that will be made part of the project's contract documents. These documents should be consulted should questions arise or omissions be discovered in this QAP. Table 1 summarizes the reporting and testing requirements for the major tasks and materials for this project.

2.0 RESPOSIBILITY AND AUTHORITY

2.1 General

Quality assurance consists of implementing a planned system of activities to assure closure construction occurs as specified in the contract documents. Implementing quality assurance activities for this project involves applying standards and procedures outlined in the contract documents to assure the closure construction meets or exceeds the performance criteria. The following paragraphs outline the organization of the project participants and their responsibilities, meetings, and testing/submittal requirements.

2.2 Project Organization and Responsibilities

The construction phase of the project involves coordination between five participants:

- CTDEP
- CRRA
- Engineer
- Quality Assurance Consultant
- Construction Contractor

Each participant has a responsible role in implementing the proposed closure activities. A project organization chart has been provided as Figure 1 and shows the general lines of communication between the parties as described below:

2.2.1 Connecticut Department of Environmental Protection

The role of the CTDEP in this project is to review and approve, as appropriate, documents submitted in connection with the closure contract, and assess whether or not the closure is being constructed in conformance with the Connecticut General Statutes (CGS) Section 22a-208 and RSCA Section 22a-209.

The closure of the landfill is to be completed in accordance with the terms and conditions established in the Authorization for Closure (Authorization). It is anticipated that the terms and conditions of the Authorization will reference the CTDEP-approved landfill closure plan and engineering drawings, and require the CRRA to submit this QAP for CTDEP approval on or before sixty days prior to commencing the construction activities. No closure construction activities will be undertaken until the CTDEP issues approval of the QAP.

2.2.2 CRRA

CRRA will be the Authorization Holder. Therefore, CRRA is responsible for completing construction activities in accordance with the terms and conditions of the Authorization. Closure activities will be substantially completed by the date specified in the Authorization. CRRA will solicit bids and ultimately hire a qualified contractor who will complete the construction work. Alternatively, CRRA may act as the Contractor for all or part of the closure activities. CRRA will also retain the services of a Quality Assurance Consultant who will oversee the implementation of the Quality Assurance Plan.

2.2.3 Engineer

The Engineer for the project will be an experienced civil engineer, licensed by the State of Connecticut. The responsibilities of the Engineer during construction will be detailed in the contract documents. Generally, the Engineer will make visits to the site at intervals appropriate to the various stages of construction in order to observe the progress and quality of the work completed by the Contractor. The Engineer will provide clarifications and interpretations of the contract documents, have the responsibility to authorize minor variations in the work that are compatible with the CTDEP-approved closure plans, and have the authority to reject defective work. The Engineer may, at his discretion, test materials at random or observe quality control testing as it is being performed.

CRRA retained Fuss & O Neill as Engineer to prepare the closure plan including draft technical specifications, engineering drawings and the QAP. After receiving the Authorization, Fuss & O Neill will finalize the technical specifications, construction drawings and assemble the Contract Documents. Fuss & O Neill will function as the Engineer and report to CRRA at least during the bidding phase of the construction.

2.2.4 Quality Assurance Consultant

The Quality Assurance Consultant (QAC) for the project will be an experienced civil engineer, licensed by the State of Connecticut. The individual or firm serving as the QAC will have a track record of successful landfill closures within the state. The QAC is responsible for coordinating the activities as presented in this QAP and will report to CRRA. The responsibilities of the QAC include:

- Providing written certification to the CTDEP that sedimentation and erosion controls have been installed (provided prior to initiating construction)

- Reviewing and approving submittals made by the construction contractor

- Documenting construction and QAC activities

- Coordinating independent testing services where applicable

- Preparing a final closure certification report upon completion of the landfill closure activities

The QAC and the Engineer may be filled by one and the same entity.

2.2.5 Construction Contractor

The Construction Contractor is the individual or entity who will complete the proposed closure construction work. Pursuant to the contract documents, the Construction Contractor is referred to as the "Contractor" who will enter into an agreement with the Owner to successfully complete the work.

The Contractor is responsible for supervising and directing the work and solely responsible for the means, methods, techniques, sequences and procedures of construction in accordance with the contract documents. The Contractor is responsible for maintaining and supervising all safety precautions and programs and compliance with all applicable laws. The Contractor also maintains the record documentation, including those annotations made to the construction documents that reflect minor changes to the proposed work.

The Contractor is responsible for providing material submittals to the QAC in a timely manner for review prior to installation. He or she is also responsible for performing soil and geomembrane testing on capping materials as required to determine compliance with the project specifications. A soil testing laboratory and a geomembrane testing laboratory approved by the QAC will be retained by the Contractor to provide the Contractor testing and reporting services. These documents will be submitted to the QAC to review for conformance with the requirements of the Contract Documents.

2.2.6 Land Surveyor

The Land Surveyor retained by the Construction Contractor will be a professional land surveyor who is legally qualified to practice in the State of Connecticut and who is experienced in providing land-surveying services of the kind required. The selected Land Surveyor will have a minimum of two years experience in construction surveying layout and preparation of as-built surveys in accordance with the specified horizontal and vertical control requirements.

2.3 Project Meetings

Project meetings are proposed throughout the course of the project. Meetings may or may not involve all the parties listed in the QAP. The intent of the meetings will be to establish lines of

communication to report, control and resolve problems that could affect the quality of the work. The following meetings are proposed as part of this project.

2.3.1 Pre-Construction Meeting

Prior to any work being undertaken at the site, a meeting with the Owner, Contractor, Engineer, QAC, and CTDEP will be held to establish a working understanding among the parties and to discuss the schedules listed in the contract documents (e.g., progress schedule and schedule of shop drawings). Other topics that will be discussed include the procedures for handling shop drawings, processing of applications for payment, and maintaining project record documents.

2.3.2 Project Progress Meetings

Progress meetings will be held bi-weekly (or more frequently as needed) at the site with the Owner, Contractor, Engineer, QAC and CTDEP, as necessary, for the purposes of understanding the project's construction and administration progress. Meeting notes will be prepared and distributed to the attendees within five days.

2.3.3 Daily Meetings

Contractor will conduct daily "tailgate meetings" with the crew leaders, subcontractors, QAC, and owner, as required, for the purpose of reviewing daily construction schedule and resolving outstanding construction issues.

2.3.4 Corrective Action Meetings

Significant conditions adverse to quality may be identified during the course of the construction work by one or more of the parties involved with the project. The condition reported to be adverse will be analyzed by the reporting party to determine if it represents a significant condition adverse to quality. If determined to be significant, the Owner will then perform an analysis to determine if corrective action is required, and if necessary, hold a meeting with the QAC, Contractor and others, as appropriate, to discuss the proper course of action.

3.0 OBSERVATION AND TESTING

3.1 General

Quality control includes testing and final observation of materials and workmanship before and during construction to assess compliance of the materials and workmanship with the final engineering design plans and specifications.
Detailed descriptions of the character and quality of material submittals, workmanship, and observation of the work will be presented in the contract documents. Technical specifications presented in the contract documents detail submittals, specific testing requirements and laboratory testing protocols in accordance with the American Society of Testing Materials (ASTM), the Connecticut Department of Transportation (ConnDOT) Standard Specifications for Roads, Bridges and Incidental Construction (Form 816), and other recognized standards. The Contractor's, QAC's and Owner's responsibilities concerning tests and observations, as well as correction, removal or acceptance of defective work will be presented in the Standard General Conditions of the Construction Contract presented in the contract documents.

3.1.1 Project Submittals

The Contractor will provide the QAC project submittals for review and approval in accordance with the contract documents. Before providing the project submittals, the Contractor will have determined and verified that the items contained in the submittal are acceptable for its intended use. The QAC will perform a timely review of the material submittal. Submittals determined to be deficient will be returned to the Contractor for corrections. Approved submittals will be returned to the Contractor for his use in maintaining the project record documents. Project record documents, which include a compilation of approved submittals and marked-up (i.e. red-lined) copies of the construction drawings and specifications, will be furnished to the QAC and Owner in connection with final payment at the time of contract closeout.

3.1.2 Testing and Reporting Requirements

There are testing and reporting requirements to verify the chemical and physical characteristics of materials and statements supporting the quality control of workmanship. Refer to the technical specifications for more detailed descriptions of the work to be performed and the testing/submittals required.

3.2 Disruption and Grading of Landfill Materials

This work will consist of the excavation, deposition, and compaction of existing on-site materials within the limits of the landfill necessary to prepare a suitable base for constructing the cap. The Contractor will provide odor control measures as needed including limiting areas of disturbance, covering exposed waste in a timely fashion, and/or applying odor control agents.

The Contractor will notify the QAC in writing one week prior to any excavation, disruption, or removal of deposited material, and submit an Odor Control Plan which will describe in narrative form proposed procedures in the event that odor control is required.

3.3 Cap Base Material

The following submittals, required for cap base material imported by the Contractor, will be made part of the quality control program prior to placing the cap base material layer:

- A materials certificate stating that cap base material meets the technical specification prior to delivery of soil to the site. If material is obtained from more than one source, then a materials certificate will be submitted from each source.

- A grain size analysis, modified proctor test report, permeability test report, interface friction angle test report (for cap base/liner interface) and internal friction angle.

The following testing, required of the Contractor, will be made part of the quality control program during placement of the cap base material layer:

- Compaction test reports immediately following field testing of material. Field testing will be measured with a Nuclear Density Gauge at a frequency of six tests per acre.

- Measurements of the cap base material thickness taken following compaction every 100 feet on center.

- Grain size, modified proctor, permeability, interface friction angle(for cap base/liner interface), and internal friction angle test reports at a rate of at least once per 5,000 cubic yards of material delivered.

3.4 Geomembrane

The following submittals, required for geomembrane supplied by the Contractor, will be made part of the quality control program prior to placing the geomembrane:

- Brand information and Manufacturer Literature, including manufacturer's quality control test results for the batch and lot numbers of material supplied to the project.

- Warranties for geomembrane material and installation workmanship.

- Installation contractor's name, qualifications, and project descriptions.

- Installation construction contractor superintendent's name and qualifications.

- Proposed panel layout drawing.

- Quality Control Plan

The following submittals shall be provided on a daily basis during the course of geomembrane installation:

- Cap base material layer surface conformation form signed by the installation contractor and the QAC representative.

- Trial seam test results.

- Destructive seam testing results.

- Vacuum testing results.

- Air testing results.

The following submittal shall be provided at the completion of the project.

- As-built panel layout drawing indicating panel locations, numbers and repair locations.

3.5 Bi-Planar Geonet

The following submittals, required for bi-planar geonet supplied by the Contractor, will be made part of the quality control program at least 10 days prior to delivery of materials to the site:

- A sample of the proposed bi-planar geonet
- Certification that the material meets the required specifications
- Interface friction angle test reports (for geonet/liner interfaces)

3.6 Underdrains

The Contractor shall submit to the Engineer product data sheet and certification that the material meets the required specifications at least 10 days prior to delivery of materials to the site.

3.7 Geotextiles

The Contractor shall submit to the Engineer samples of the proposed geotextiles, and certification that the material meets the required specifications, at least 10 days prior to delivery of materials to the site.

3.8 Drainage Sand Layer

The following submittals, required for Barrier Protection Soil supplied by the Contractor, will be made part of the quality control program prior to and during placement of the Barrier Protection Soil:

- A materials certificate stating that cover material meets the technical specification as well as a grain size, permeability, modified proctor, interface friction(for sand/geonet interface) and internal friction angle test analysis prior to delivery of soil to the site. If material is obtained from more than one source, then the items will be submitted from each source.
- Grain size analysis, permeability analysis, modified proctor, interface friction angle and internal friction angle test reports at a rate of at least once per 5,000 cubic yards of material delivered.
- Submit RCRA 8 metals and ETPH analytical testing reports for Geomembrane Protection Soil obtained at the source prior to delivery of the material to the landfill, and at a rate of at least once per 10,000 cubic yards delivered.
- Measurements of the barrier protection sand thickness taken following compaction (Two passes with a Caterpillar D-6 bulldozer) every 100 feet on center.
- Compaction test reports immediately following field testing of material. Field testing will be measured with a Nuclear Density Gauge at a frequency of six tests per acre. (Note: this testing is for record purposes only)

3.9 Vegetative Support Material

The following submittals, required of the Contractor, will be made part of the quality control program prior to and during placement of the vegetative support soil:

- For each source prior to delivery of the material to the site, a certified test report and certificate of conformance with the technical specification for vegetative support material, including grain size, organic content, cation exchange capacity, pH, nutrient content, internal friction angle, pesticide analysis, herbicide analysis, RCRA 8 metals analysis, and ETPH analysis.

- Submit certified test reports with grain size and organic content analyses cation exchange capacity, nutrient content, internal friction angle, and pH at a rate of at least one per 5,000 cubic yards of material delivered.

- Submit pesticide, herbicide, RCRA 8 and ETPH analytical testing reports for vegetative support material at a rate of at least one per 10,000 cubic yards delivered or one per source if less than 10,000 cubic yards is obtained from any one source.

- Submit a certificate of conformance and product information for the fertilizer prior to delivery to the site.

- Submit a certificate of conformance and product information for the mulch prior to delivery to the site.

- Measurements of the vegetative support material thickness taken following final grading every 100 feet on center.

3.10 Turf Establishment

The following submittals, required of the Contractor, will be made part of the quality control program prior to commencement of turf establishment activities:

- A materials certification and copies of catalog cut sheets for review and acceptance for fertilizer, lime, seed, erosion control blanket and matting products reflecting that they comply with the specifications.

- A hydroseed procedure and application rates for approval that includes the number of pounds of wood fiber mulch and tackifier to be used per one hundred (100) gallons water. This statement will also specify the number of square feet of seeding that can be covered with the quantity of solution in the hydroseeder.

- Full and complete written maintenance instructions for proper care and development of seeded areas.

3.11 Riprap

Prior to delivery of the riprap to the site, material certification of conformance with the specifications and one riprap sample per source meeting the requirements in the specification will be submitted.

3.12 Grout

The Contractor shall submit to the Engineer product data sheet and certification that the material meets the required specifications at least 10 days prior to delivery of materials to the site.

3.13 Crushed Stone

A material certification of conformance with the specifications and a grain size analysis, one per source, will be submitted prior to delivery of the material to the site.

3.14 Gravel Surfacing, Bituminous Concrete Base and Subbase Materials

The following submittals, required for gravel surfacing, road base and subbase materials imported by the Contractor, will be made part of the quality control program prior to placing the material:

- A materials certificate stating that material meets the technical specification prior to delivery of soil to the site. If material is obtained from more than one source, then a materials certificate will be submitted from each source.

- A soil classification, grain size analysis, and modified proctor test results.

The following testing, required of the Contractor, will be made part of the quality control program during placement of the gravel surfacing, road base and subbase material layers:

- Compaction test reports immediately following field testing of material. Field testing will be measured with a Nuclear Density Gauge at a frequency of one per 2,000 square feet of roadway per layer.

- Soil classification, grain size analysis, and modified proctor test reports at a rate of at least once per 5,000 cubic yards of material delivered.

3.15 Bituminous Concrete

The Contractor shall submit job-mix design and material certification for each type of bituminous concrete indicated to the Engineer at least 10 days prior to delivery of materials to the site.

3.16 General Fill

The following submittals, required of the Contractor, will be made part of the quality control program prior to delivery of the material to the site:

- A material certification of conformance with the specifications, a grain size analysis, and a modified proctor analysis, one per source.

- RCRA 8 metals analysis and ETPH analysis, one per source.

The following testing, required of the Contractor, will be made part of the quality control program during placement of General Fill:

- Grain size analysis and modified proctor analysis, one per 5,000 CY delivered to the site.

- RCRA 8 metals analysis and ETPH analysis, one per 10,000 CY delivered to the site.

- Compaction test results at a frequency of six per acre per lift, reported daily as placed and compacted.

4.0 REPORTING AND DOCUMENTATION

4.1 General

Documentation consists of the design drawings, approved submittals, addenda, change orders, written clarifications, and all other data required by the contract documents. In addition, documentation prepared by the QAC will include daily field reports, independent laboratory test results (where applicable), and photographs of pertinent phases of the construction.

4.2 Project Record Documents

As specified in the contract documents, record documents will be maintained by the Contractor in a safe place at the site and will be annotated to show changes made during construction. The documents will be made available to the Owner and QAC for reference during construction. Upon final completion of the work, the project record documents will be delivered to the QAC for the Owner in connection with final payment.

4.3 Final Certification Report

The QAC will prepare a report that documents the closure was conducted in general conformance with the approved plans and specifications. The report will include copies of daily field reports, testing results and as-built plans. The report will be submitted to the CTDEP upon completion of the landfill closure activities.

4.4 As-Built Drawings

In accordance with RCSA 22a-209-13(f), the CRRA will submit to the CTDEP as-built site drawings certified by a professional engineer licensed in the State of Connecticut that grading and closure have been completed as specified in the approved closure plan. The as-built drawings will be submitted to the CTDEP within ninety (90) days of completing the landfill closure. The drawings and a detailed description of the landfill will be recorded in the land records of the City of Hartford and a certified copy of the recording will be forwarded to the CTDEP.

This QAP Prepared By:	Chris T. Cullen, P.E., Project Manager
This QAP Reviewed By:	Craig M. Lapinski, P.E., Senior Project Manager Richard D. Jones, P.E., Senior Vice President

TABLES

TABLE 1
TESTING/REPORTING SUMMARY

Construction Task/Product	Test/Submittal	Frequency
Landfill Disruption/ Regrading	Odor Control Plan	Once: one week prior to disruption
Cap Base Material	Materials certification	One per source: prior to delivery
	Grain Size, permeability, modified proctor interface friction angle and internal friction angle reports	One per 5,000 CY delivered
	Compaction test results	6 per acre
	Cap base material thickness	100 'on center
Geomembrane	Manufacturer's factory QC results	Per delivery: Prior to installation
	Warranties: Material and Workmanship	Prior to installation
	Installation contractor qualifications	Prior to installation
	Installation superintendent qualifications	Prior to installation
	Proposed panel layout drawing	Prior to installation
	Cap base surface conformation form	Daily prior to work
	Trial seam test results	Daily
	Destructive seam test results	One per 1,000 linear feet
	Vacuum test results	Daily
	Air test results	Daily
Bi-Planar Geonet	Material sample, certification	Prior to delivery
	Interface friction angle test reports	One per proposed geomembrane type: prior to delivery
Underdrains	Product data sheet and material certification	Prior to installation
Geotextiles	Material certification and sample	One per geotextile specified: Prior to installation
Drainage Sand	Materials certification	One per source: prior to delivery
	Grain Size, permeability, modified proctor interface friction angle and internal friction angle reports	One per 5,000 CY delivered
	Compaction test results	6 per acre
	RCRA 8 metals & ETPH analyses	One per source prior to delivery & one per 10,000 CY delivered
	Drainage Sand thickness	100 'on center
Vegetative Support Material	Material Certification	One per source: prior to delivery
	RCRA 8 metals, ETPH, pesticide and herbicide analyses	One per source prior to delivery and one per 10,000 CY delivered
	Grain size analysis, organic content, pH, cation exchange cap., nutrient content and internal friction angle test report	One per source prior to delivery, and one per 5,000 CY delivered
	Fertilizer Certification	Prior to delivery
	Mulch Certification	Prior to delivery
	Vegetative Support Material thickness	100 'on center
Turf Establishment	Material certification and catalog cuts for fertilizer, lime, seed, erosion control blankets	Prior to installation
	Hydroseed procedure, application rates	Prior to application
	Maintenance instructions	Prior to installation
Riprap	Material certification and sample	Prior to installation
Crushed Stone	Material certification & grain size results	One per source: prior to Delivery
Gravel Surfaceing, Bituminous Concrete Base, and Subbase Material	Material certification, grain size analysis, modified proctor analysis	For each type of material, one per source: prior to delivery, and one per 5,000 CY delivered

Construction Task / Product	Test / Submittal	Frequency
	Compaction test results	One per 2,000 square feet per layer
Bituminous Concrete Base	Job Mix Design and material certification	Prior to installation
	In-place density test results	One per 1,000 square yards
General Fill	Material certification, grain size analysis, modified proctor analysis	One per source: prior to delivery, and one per 5,000 CY delivered
	RCRA 8 metal & ETPH analyses	One per source prior to delivery & one per 10,000 CY delivered
	Compaction test results	6 per acre

FIGURE

Project Organization Chart

Quality Assurance Plan
Landfill Closure Construction
Hartford Landfill
Hartford, Connecticut
July 2006

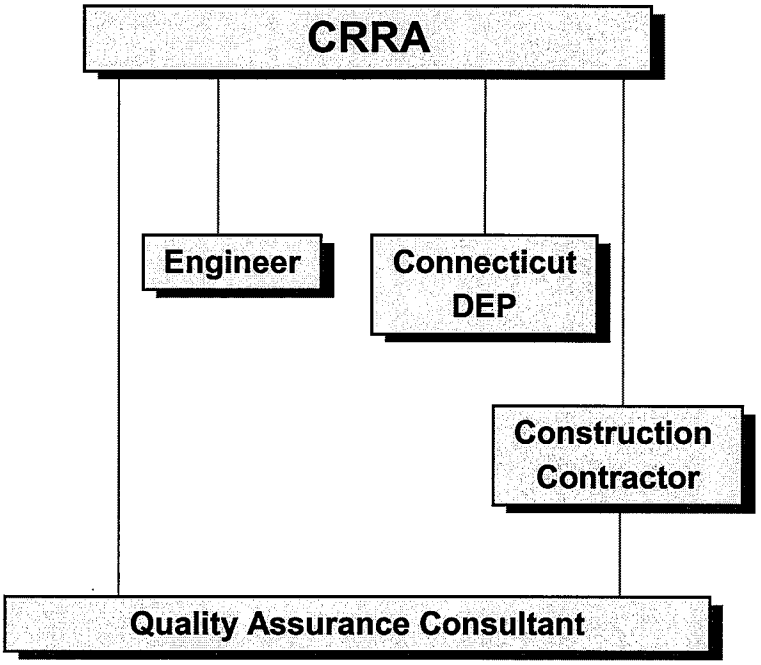

Figure 1

FUSS & O'NEILL
Disciplines to Deliver

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