

SECTION 31 00 00

EARTHWORK

PART 1 - GENERAL

1.1 Description

- A. Provide facilities, labor, materials, tools, equipment, appliances, transportation, supervision, and related work necessary to complete the work specified in this section.
- B. Work performed under this Section of the Specifications shall be subject to the Contract Documents.
- C. The work of this section includes but is not necessarily limited to:
  - 1. Excavation, fill, and backfill, as indicated or required, including compaction.
  - 2. Excavation, as required, to the lines and grades indicated on the Drawings and accepted the Engineer.
  - 3. Excavation and offsite legal disposal of unsuitable or excess materials unless on-site locations are designated. Excavation shall include removal and satisfactory disposal of all unclassified material encountered throughout the site.
  - 4. Rough grading, including placement, moisture conditioning, and compaction of fills and backfill.
  - 5. Placement of base and subbase course materials under structures, pavements, slabs, and footings, including compaction.
  - 6. Trench excavation, bedding, and backfill for structures, foundations, and utilities, including compaction.
  - 7. The removal, hauling and stockpiling of suitable excavated materials for subsequent use in the work. Stockpiling shall include protection to maintain materials in a workable condition.
  - 8. Rehandling, hauling, and placing of stockpiled materials for use in refilling, filling, backfilling, grading, and such other operations.
  - 9. Protect and preserve all existing buildings, pavements, and utilities to remain.
  - 10. Implementing dust mitigation measures.
  - 11. Environmental controls.
  - 12. Providing products in sufficient quantities to meet the project requirements.
  - 13. Providing adequate pumping and drainage facilities to keep the work area sufficiently dry.
  - 14. Obtain all required permits, licenses, and approvals of appropriate municipal and utility authorities, prior to

commencing the work of this Section, and pay costs incurred therefrom.

- D. Provide facilities, labor, materials, tools, equipment, appliances, and related work necessary to provide and maintain erosion and dewatering controls during construction operations. All measures shall be installed and maintained according to plans and other sections of the specifications.
- E. Contractor shall be responsible for notifying all affected utility companies before starting work. Comply with the requirements of the Commonwealth of Massachusetts "Dig Safe" Utilities Underground Plant Damage Prevention System; telephone 1-888-344-7233.

**1.2 Measurement and Payment**

- A. Measurement and payment requirements per Contract Documents.

**1.3 Reference Materials**

- A. NHDOT Standard Specifications for Road and Bridge Construction.
- B. NHDOT Standard Plans for Roadway Construction.

**1.4 Submittals**

- A. The Contractor shall submit written documentation showing conformance of the materials and constructed work with the Specifications.
- B. Submit the name of each material supplier and specific type and source of each material. Any change in source throughout the project requires approval of the Owner or Engineer.
- C. The Engineer will be responsible for the approval or rejection of the suitability of all materials.

**1.5 Laws and Regulations**

- A. Work shall be accomplished in accordance with regulations of local, county, state and federal agencies or utility company standards as they apply.

**1.6 Quality Assurance**

- A. The Engineer will periodically observe and document the earthwork activities to determine that the work is completed in general accordance with the Project Specifications.
- B. The Contractor shall provide a minimum forty-eight (48) hour notice to the Engineer prior to commencing earthwork operations.
- C. Approvals given by the Engineer shall not relieve the Contractor of his responsibility for performing the work in accordance with the Contract Documents.
- D. Testing (by Contractor's QC Firm) of on-site backfill, common fill, clean granular fill, structural fill, and aggregate subbase from off-site borrow sources, shall include:
  - 1. Soil Classification (ASTM D2487) - Minimum of one test for each visible change in material, at least one test for every borrow source, and at least one test for every 5,000 tons of clean fill,

re-compacted subgrade, and aggregate subbase material placed. One test for the on-site backfill material placed. Testing shall be incidental to the work.

2. Standard Proctor Moisture - Density Curve (ASTM D698) - Minimum of one test for each visible change in material, at least one test for every borrow source, and at least one test for every 5,000 tons of clean fill, re-compacted subgrade, and aggregate subbase material (if less than 30% by weight is retained on the  $\frac{3}{4}$ -inch sieve) placed. One test for the on-site backfill material placed. Testing shall be incidental to the work.
- E. During performance of the Work, the Contractor shall employ all equipment and services necessary for control of depths, lines, and grades within required tolerances.
- F. The Owner may retain and pay for the services of an independent testing and inspection firm and/or a Geotechnical Consultant to perform on-site observation and testing during the various phases of the construction operations. The scope of services will be determined by the Owner and the independent testing and inspection firm and/or the Geotechnical Consultant and will be provided to the Contractor. The Owner reserves the right to modify or waive the services of the independent testing and inspection firm and/or the Geotechnical Consultant. The services of an independent testing firm and/or Geotechnical Consultant may include, but not necessarily be limited to, the following:
1. Observation during excavation and dewatering of controlled fill areas.
  2. Laboratory testing and analysis of fill materials as specified herein, and proposed by the Contractor for incorporation into the Work.
  3. Observation of construction and performance of water content, gradation and compaction tests at a frequency and locations that the independent testing and inspection firm and/or the Geotechnical Consultant may require. The results of these tests will be submitted to the Owner, Engineer, and Contractor on a timely basis so that action can be taken to remedy indicated deficiencies. During the course of construction, the independent testing and inspection firm and/or the Geotechnical Consultant will advise the Owner in writing, if at any time in their opinion, the Work hereunder is of unacceptable quality. Failure of independent testing and inspection firm and/or the Geotechnical Consultant to give notice, shall not excuse the Contractor from latent defects discovered in his work.
- G. The Contractor shall make provisions for allowing observations and testing of Contractor's work by the independent testing and inspection firm and/or the Geotechnical Consultant.
1. The presence of the independent testing and inspection firm and/or the Geotechnical Consultant does not include supervision or direction of the actual work of the Contractor, and his employees or agents. Neither the presence of the independent

testing and inspection firm and /or the Geotechnical Consultant, nor any observations and testing performed by them, nor failure to give notice of defects shall excuse the Contractor from defects discovered in his work.

- H. Costs related to retesting due to unacceptable qualities of work and failures discovered by testing shall be paid for by the Contractor at no additional expense to Owner, and the costs thereof will be deducted by the Owner from the Contract Sum.

#### **1.7 Coordination**

- A. The work of this Section shall be coordinated with that of other trades affecting, or affected by, this work, as necessary to assure the steady progress of all work of the Contract.
- B. It is hereby understood that the Contractor has carefully examined the site and all conditions affecting work under this Section. No claim for additional costs will be allowed because of lack of full knowledge of existing conditions.
- C. Plans, surveys, measurements and dimensions under which the work is to be performed are believed to be correct to the best of the Engineer's knowledge, but the Contractor shall have examined them for himself during the bidding period. The Contractor shall verify dimensions and elevations on the ground and report any discrepancies immediately to the Engineer. Any discrepancies not reported prior to construction shall not be the basis for claims for extra compensation.
- D. As construction proceeds, the Contractor shall be responsible for notifying the Owner and Engineer prior to the start of earthwork operations requiring observation and/or testing.

#### **1.8 Subsurface Soil Data**

- A. The Contractor shall review pertinent data for the site. After obtaining Owner's permission, take whatever additional subsurface explorations deemed necessary at no expense to the Owner.
- B. The above data are for general information and are accurate only at the particular locations and times the subsurface explorations were made. It is the Contractor's responsibility to make interpretations and to draw conclusions based on the character of materials to be encountered and the impact on his work based on his expert knowledge of the area and of earthwork techniques.
- C. The Drawings in the geotechnical report showing existing ground elevations are only for whatever use the Contractor may make of them. The engineers, surveyors, the Owner, the Engineer, and/or their representatives take no responsibility for the accuracy and/or the reliability of the information given.
- D. If a potential conflict exists between the Geotechnical Report and these technical Specifications, the Contractor shall, immediately upon its discovery, request clarification from the Owner's Representative or the Engineer.

#### **1.9 Permits, Codes And Safety Requirements**

- A. All work shall conform to the Drawings and Specifications and shall comply with applicable codes and regulations.
- B. All work shall comply with the provisions of the Manual of Accident Prevention in Construction of the Associated General Contractors of America, Inc., and the requirements of the Occupational Safety and Health Administration, United States Department of Labor.
- C. The Contractor shall procure and pay for all permits and licenses required to complete the work specified herein and shown on the Drawings.
- D. The Contractor shall properly maintain all excavations, sheeting, bracing, trench shields or other facilities in a safe condition throughout the project. Sufficient suitable barricades, warning lights, floodlights and signs to protect life and property shall be installed and maintained at all times.

#### **1.10 Layout and Grades**

- A. All lines and grade work not presently established at the site shall be laid out in accordance with Drawings and Specifications by a Registered Land Surveyor or Professional Engineer employed by the Contractor. The Contractor shall establish permanent benchmarks and replace as directed by the Engineer any which are destroyed or disturbed.
- B. The words "finished grade" as used herein shall mean final grade elevations indicated on the Drawings. Spot elevations shall govern over proposed contours. Where not otherwise indicated, project site areas shall be given uniform slopes between such points and existing established grades.
- C. The word "subgrade" as used herein, means the required surface of subsoil or compacted fill. This surface is immediately beneath the site improvements, specially dimensioned fill, or other surface material.

#### **1.11 Disposition of Existing Utilities**

- A. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, the Contractor shall notify the Engineer and Utility Owner immediately for directions. The Contractor shall provide sketches of existing conditions if there are variances, as well as any modifications, on "as-built" drawings.
- B. Existing utilities serving facilities occupied and used by the Owner shall not be interrupted except when approved in writing, and then only after temporary utility services have been approved and provided.
- C. Active utilities existing on the site shall be carefully protected from damage and relocated or removed as required by the work. When an active utility line is exposed during excavation its location and elevation shall be plotted on the record drawings and the Contractor shall notify in writing both the Engineer and the Utility Owner.
- D. The Contractor shall cooperate with the Owner and Utility Owner in

keeping utility services and facilities in operation. All utilities shall be protected from damage during construction, unless otherwise indicated to be removed or abandoned. If damaged, the utilities shall be repaired as required by the Utility's Owner at the Contractor's expense. The Contractor shall contact the affected Utility as soon as any damage is uncovered.

- E. Inactive or abandoned utilities encountered beneath the footprint of the proposed building shall be removed and replaced/backfilled with properly placed and compacted structural fill. Inactive or abandoned utilities encountered in the proposed pavement areas shall be removed, plugged or capped as approved by the Engineer. The location of such utilities shall be noted on the record drawings and reported in writing to the Engineer.

#### **1.12 Drainage**

- A. The Contractor shall control the grading in areas under construction on the site so that the surface of the ground will properly slope to prevent accumulation of water in excavated areas and onto adjacent properties.
- B. Should surface, rain or groundwater be encountered during the operations, the Contractor shall furnish and operate dewatering measures and equipment to control water levels as required to perform the work. The Contractor shall be responsible for any damage to work or adjacent properties from such water. All piping exposed above surface for this use shall be properly covered to allow foot traffic and vehicles to pass without obstructions.
- C. The presence of groundwater, to any degree, will not constitute a condition for which an increase in the contract price may be made.
- D. The Contractor shall dispose of accumulated water in accordance with applicable regulations, ordinances, and instructions of the authorities having jurisdiction. The Contractor shall obtain all necessary permits.

### **PART 2 - PRODUCTS**

#### **2.1 Materials**

- A. Subgrade is the material in excavation (cuts) and fills located below subbase.
- B. On-Site Materials
  - 1. Material on the site is the property of the Owner and shall be incorporated in the work if possible.
  - 2. Topsoil/subsoil is not suitable for reuse as Structural Fill, Clean Granular Fill, or Common Fill unless otherwise directed by the Engineer.
  - 3. When approved for use by the Engineer, existing on-site materials shall be segregated from the former forest mat layer prior to reuse.
  - 4. Material not incorporated in the work either because it is

unsuitable or the quantity exceeds the project's needs shall be hauled away and disposed of at the Contractor's expense.

5. Material designated to be wasted by the Engineer shall be disposed of by the Contractor.
  - a. Contractor shall dispose of contaminated materials in accordance with the Contract Documents and all regulations.
  - b. Material designated to be saved by the Engineer shall be stockpiled at a location designated by the Engineer.
  - c. Unsuitable material shall consist of grubbings or other materials of a deleterious nature as deemed by the Engineer and in accordance with the Contract Documents.

C. Clean Granular Fill shall meet the approval of the Engineer. Clean fill shall be of such a nature that it will form a stable dense fill. The material shall be essentially free of trash, ice snow, tree stumps, wood, roots, topsoil, organic materials, and other objectionable materials which may be compressible or which cannot be properly compacted. Snow, ice, and frozen soils are not suitable fill materials and shall not be permitted.

1. Material shall be friable soil containing no stone greater than two-thirds (2/3) the loose lift thickness with a maximum stone size of two (2) inches in diameter.
2. Sediments resulting from dredging are not suitable materials for clean fill.
3. All on-site materials proposed to be used as clean fill are subject to Engineer approval.

Contractor should provide documentation (i.e., analytical sample results at a minimum frequency of 1 sample/1,500 tons) that all clean fill material is suitable for use on the Project, is free of Oil and/or Hazardous Materials (OHM), or Site criteria such as MCP RCS-1 criteria as established by the Engineer, and is free from debris or other materials which could render this material unsuitable. Clean Granular Fill shall meet the following gradation requirements:

Sieve Size	Percent Passing by Weight
3-inch	100
¾-inch	60 - 90
No. 4	20 - 70
No. 200	2 - 8

D. Common Fill shall be granular material consisting of hard sand and gravel. Common backfill shall be free of organic matter, trash,

roots or other deleterious material and shall contain no stone measuring greater in any dimension than two-thirds of the loose lift thickness, or 8 inches (200 mm), whichever is smaller. Common backfill material shall be capable of forming a firm, stable base when spread and compacted in accordance with this specification. In addition, common backfill shall be non-plastic (plasticity index zero, defined as liquid limit minus plastic limit). Common backfill materials may be obtained from either on-site excavations or from off-site sources. Any materials excavated from the trench and not conforming to this specification shall be properly disposed of as specified and replaced with approved material, as required, at no additional cost to the Owner. Common fill shall meet the following gradation requirements:

Sieve Size	Percent Passing by Weight
6-inch	100
¾-inch	60 - 100
No. 4	20 - 85
No. 200	0 - 25

- E. Gravel Fill shall consist of hard, durable gravel free from trash, organic matter, clay, surface coatings, and other deleterious materials. Gravel fill shall have a maximum stone size of two-thirds of the loose lift thickness, or 6 inches, whichever is smaller. That portion passing the 4 inch (100 mm) sieve shall meet the following gradation requirements, as determined by ASTM C 136 and ASTM C 117:

Sieve Size	Percent Passing by Weight
6-inch	100
No. 4	25 - 75
No. 200	0 - 10

- F. When approved by the Engineer, gravel fill for pipe bedding shall have a maximum stone size of 1.5 inches.
- G. Crushed Stone shall be composed of durable crushed rock consisting of angular fragments, free from a detrimental quantity of thin, flat, elongated pieces or shall be durable crushed gravel stone



obtained by artificial crushing of gravel boulders or fieldstone.

1. The crushed stone shall be free from clay, loam, or deleterious material.
2. Crushed stone shall conform to the following gradation:

<u>Percent Passing by Weight</u>			
<u>Sieve Size</u>	<u>3/8-inch Stone</u>	<u>1/2-inch Stone</u>	<u>3/4-inch Stone</u>
1 inch		-	100
3/4 inch		-	90 - 100
5/8 inch		100	-
1/2 inch	100	85 - 100	10 - 50
3/8 inch	85-100	15 - 45	0 - 20
No. 4	10-30	-	0 - 5
No. 8	10 (max)	0 - 5	-

<u>Percent Passing by Weight</u>		
<u>Sieve Size</u>	<u>1-1/2-inch Stone</u>	<u>2-inch Stone</u>
2 inch	100	90 - 100
1-1/2 inch	95 - 100	-
1-1/4 inch	-	25 - 50
1 inch	35 - 70	-
3/4 inch	0 - 25	0 - 15
1/2 inch	-	-

- H. Riprap. Riprap shall consist of a protective covering of angular shaped stones laid on slopes in front of structures, retaining walls, wingwalls, piers, and elsewhere as required, to insure protection of structures and embankments.
1. Stone used for riprap shall be hard, durable, angular in shape, resistant to weathering and to water action, free from overburden, spoil, shale and organic material, and shall meet the gradation requirements specified.
  2. Neither breadth nor thickness of a single stone should be less than one-third its length. Each load of riprap shall be reasonably well-graded from the smallest to the maximum size specified.

3. Rounded stone or boulders will not be accepted.
4. Shale and stone with shale seams are not acceptable.
5. Stone shall be gray or natural in color, no pink rock will be accepted in the Project.
6. Stones smaller than the specified 10 percent size and spalls will not be permitted in an amount exceeding 10 percent by weight of each load.
7. The minimum unit weight of the stone shall be 155 lb/ft<sup>3</sup> (2,482 kg/m<sup>3</sup>) as computed by multiplying the specific gravity (bulk-saturated-surface-dry basis, AASHTO Test T85) times 62.4 lb/ft<sup>3</sup>.
8. Quality requirements:
  - a. The stone shall have a loss of not more than 40 percent after 500 revolutions when tested by AASHTO Test T96.
  - b. Stones shall have a loss not exceeding 10 percent with the sulfate test after 5 cycles when tested by AASHTO Test T104.
  - c. The stone shall have a loss not exceeding 10 percent after 12 cycles of freezing and thawing when tested by AASHTO Test T103.
  - d. The Contractor shall provide documentation that riprap meets all quality and gradation requirements for Engineer approval prior to importing material to the Project Site.
- I. Structural Fill shall consist of crushed gravel unless bank-run gravel, clean stone fill is specified on the plans or permitted by the Engineer.  $\frac{3}{4}$  crushed stone may be used in wet conditions as approved by the Engineer. Material shall be free of construction and demolition debris, frozen soil, organic soil, peat, stumps, brush, trash, and refuse and meet the following gradation:

Sieve Size	Percent Passing by Weight
5-inch	100
$\frac{3}{4}$ inch	60-100
No. 4	20 - 80
No. 200	0 - 10

- J. Topsoil (stripped from site) or Loam (supplied from off-site) shall be a sandy loam or loam soil classification as defined by the USDA Soil Conservation Service, Soil Classification System consisting of a fertile, friable, natural topsoil/loam typical of locality, without admixture of subsoil, refuse or other foreign materials, shall be obtained from a well-drained arable site, and shall meet

ASTM D5268. Material shall be such a mixture of sand, silt and clay particles as to exhibit sandy and clayey properties in about equal proportions. Material shall be free of stumps, roots, heavy or stiff clay, stones larger than 3/4-inch in diameter, lumps, coarse sand, noxious weeds, sticks, brush or other litter, and shall have the following mechanical analysis:

Textural Class	Percent of Total Weight	Average Percent
Sand 0.05 - 2.0 mm dia. range	45 to 75	60
Silt 0.002 - 0.05mm dia. range	15 to 35	25
Clay less than 0.002 mm dia. range	5 to 25	15

1. 95 percent of Topsoil shall pass a 2.0 mm sieve.
2. Topsoil/Loam shall have a pH value in the range of 6.0 to 7.0. If Topsoil/Loam material does not fall within the required pH range, limestone or aluminum sulfate shall be added to bring the pH within the specified limit.
  - a. Prior to stripping, the topsoil shall demonstrate, by the occurrence upon it of healthy crops, grass or other vegetative growth, that it is reasonably well drained and that it does not contain toxic amounts of either acid or alkaline elements.
  - b. Loam and topsoil shall contain not less than 4 percent nor more than 20 percent organic matter as determined by the loss on ignition of oven-dried samples. Test sample shall be oven-dried to a constant weight at a temperature of 230°F.

In other portions of these specifications, the words 'loam' and 'topsoil' are used interchangeably.

## 2.2 Use of Materials

- A. Use of materials shall be as described below and as shown on the plans. Further details can be found in the project plans. Combinations or layering of materials may be necessary in certain instances such as for detention embankments, subsurface disposal areas, and riprap walls as examples.
  1. On-Site Materials: On-site materials shall be incorporated in the work if possible.
  2. Common Fill: Use common fill as common/subgrade fill in parking areas and roadway embankments; foundation wall backfill if used in conjunction with a bond break and sized/screened to 3-inch minus.
  3. Clean Granular Fill: Use clean fill for general grading as backfill, below floor slabs-on-grade; for exterior concrete

slabs exposed to frost, at exterior ramps, aprons, and loading bays adjacent to entrances/exits; as footing and foundation wall backfill; backfill behind unbalanced foundation/retaining walls. Stones larger than two inches (2") shall be removed prior to compaction.

4. Gravel Fill: Use for pipe bedding backfill. Use for material placed "in the wet". Use for backfill behind retaining walls and retaining structures. Use for pipe and utility bedding.
5. Crushed Stone: Use crushed stone as bedding for manholes and catch basin structures (3/4") and as bedding for piping under wet subgrade conditions. Use for material for stabilized construction entrances (2.0").
6. Structural Fill: Use structural fill under the culvert and retaining wall footings and in other soil bearing situations; below the foundations and within the building pad.
7. Riprap: Use riprap for slope stabilization and for erosion control in channel bottoms, overflow areas, level spreaders, and where indicated.
8. Topsoil/Loam: Use as fill in designated landscape and lawn areas; if off-site material is required, Loam shall be furnished and installed. Topsoil maybe used as fill in landscape and lawn areas if an excess of topsoil exists on-site.

### **PART 3 - EXECUTION**

#### **3.1 General**

- A. Excavations, filling, backfilling, and grading shall be to subgrade elevations specified.
- B. Excavated materials suitable for backfill shall be stockpiled in an orderly manner sufficiently distant from excavations to prevent overloading, slides, and cave-ins.
- C. Excavations shall be done in ways that will prevent surface water and subsurface water from causing flooding or other damage to the site and surrounding area.
- D. Locate existing underground utilities in areas of work. If utilities are to remain in place, provide adequate means of protection during earthwork operations.
- E. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork activities.

#### **3.2 Examination**

- A. The Contractor shall examine the areas and conditions under which excavating, filling, and grading are to be performed and notify the Engineer in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in an acceptable manner.

### **3.3 Clearing and Grubbing**

- A. Cut and remove trees, remove stumps and brush. Legally dispose of off-site.
- B. Strip all topsoil, subsoil and other unsuitable materials to its full depth within the Contract limits.
- C. Other Specification Sections shall apply to clearing and grubbing under demolition and shall include air quality, erosion control, and hazardous waste.
- D. Remove all topsoil, subsoil, vegetative matter, and non-soil materials and, after screening out the roots, rocks greater than 3/4 inch in size, and deleterious debris, separately stockpile the topsoil and subsoil materials.

### **3.4 Dewatering**

- A. Dewatering shall be performed in accordance with Section 31 23 19 Dewatering.

### **3.5 Excavations**

- A. Site General Requirements
  - 1. Site excavation shall conform to elevations and dimensions shown within a vertical tolerance of 0.10 feet except as otherwise stipulated in the field by the Engineer or Owner. The Contractor shall excavate to a depth to provide for any subsequent loam, sod, or other specified surface material.
  - 2. Sides and slopes of excavations shall be maintained in a safe condition by sloping, scaling, benching, shelving, or shoring and bracing until completion of backfill placement as applicable, or completion of finished slopes, as shown on the drawings.
  - 3. Provide shoring, sheeting, and bracing of excavations as required to assure complete safety against collapse of the earth at the site of excavations. Alternatively, lay back excavations to suitable slope.
  - 4. Control the grading so that ground is pitched to prevent water from running to excavated areas, damaging other structures, or adjacent properties.
  - 5. Where soil has been softened or eroded by flooding, equipment, traffic, or placement during unfavorable weather, or such other conditions, it shall be removed and replaced by the Contractor with suitable material, and at no cost to the Owner.
  - 6. Exercise care to preserve the material below and beyond the lines of excavation. Where excavation is carried out below indicated grade or beyond the lines of excavation, Contractor shall backfill and compact the over excavation with structural fill to the indicated grade, at no additional cost to the Owner and at the direction of the Engineer.
  - 7. Provide sheeting, shoring and bracing to complete and protect all excavated areas, as required for safety and compliance with OSHA.

The Contractor shall adhere to and enforce precautions as outlined in OSHA Regulations, CFR 29, Part 1926.650. Costs for sheeting, shoring, and bracing shall be included as a part of the Contract Price for completing the work and Owner shall make no separate payment for this work.

8. Excavated materials unsuitable for reuse, surplus excavated rock, and surplus excavated soil not used to fulfill requirements of the Contract, shall become the property of the Contractor and shall be removed from the site in accordance with the regulations and requirements of all municipalities or agencies having jurisdiction over the disposal sites and the route between the project and the disposal sites.
9. Unsuitable materials which are classified as organics such as peat, trash, fill, stumps, debris, material determined to be hazardous, and topsoil and subsoil when determined by Engineer to be unacceptable for incorporation into the work.
10. Do not over excavate below proposed design grades for the purpose of obtaining borrow for use off-site.

### **3.6 Trench Excavation**

#### **A. General**

1. Before any trenching operation begins, the line of work shall be cleared and all existing underground utilities and structures located.
  2. All utilities encountered during the trenching operation shall be properly protected in accordance with the requirements of the Utility Owner. The Contractor shall bear the costs for any damages to existing utilities caused by the Contractor's trenching operations.
  3. Excavate as necessary for all drainage pipes, utilities, and related structures and appurtenances, and for any other trenching necessary to complete the work.
- B.** In general, machine excavation of trenches will be permitted with the exception of preparation of pipe beds which will be hand work. Excavate by hand or machine methods to at least six inches (6") below the bottom of pipe or as shown on the Drawings. Excavation to final grade shall be made in such a manner as to maintain the undisturbed bearing character of the soils exposed at the excavation level.
- C.** Utilities or piping shall not be laid directly on boulders, cobbles, or other hard material. This material shall be removed to a minimum of six inches (6") below the bottom of pipe at all points and backfilled or compacted as specified.
- D.** Remove unsuitable material encountered at subgrade elevations, backfill with material specified herein and as otherwise indicated on the Drawings, specified, or directed. Compact as specified with approved compactors.
- E.** In general, the width of trenches shall be kept to a minimum and in

the case of piping shall not exceed the sum of the pipe's outside diameter plus 2'-0" to at least twelve inches (12") above the pipe.

- F. Excavated material suitable for backfill shall be placed in spoil banks where it will not interfere with work. Spoil banks shall be located sufficiently back from the edge of trench to prevent excessive loading on the trench wall. Spoil banks shall be confined so that areas reserved for use of vehicles are kept free and material stays within property or easements provided. Where there is insufficient space for material in spoil banks adjacent to excavation, excess material shall be removed to another approved site and brought back when needed.
- G. Trench walls shall be sloped, sheathed, shored or suitably braced to conform to all applicable laws, regulations and codes to protect the work being constructed and to provide safe working conditions. Unless otherwise directed, bracing and sheathing shall be removed as trenches and pits are refilled.
- H. Trenches shall be kept dry during the placement of all utilities by pumping or other appropriate dewatering procedures as needed.

### **3.7 Material Storage**

- A. The Contractor shall stockpile satisfactory excavated material where directed, until required for backfill or fill. The Contractor shall place, grade and shape stockpiles for proper drainage.
- B. Materials required in the work shall be located and retained a sufficient distance from the edge of excavations to prevent such materials from falling or sliding back into the excavations and to prevent cave-ins.
- C. The Contractor shall dispose of excess soil material and waste materials as herein specified.

### **3.8 Preparation of Excavation Bottoms**

#### **A. General**

- 1. The Contractor shall complete the excavations to the specified or indicated limits and required subgrades.
- 2. The Contractor shall remove any additional materials below subgrade levels which were not naturally deposited, are disturbed or are unsuitable, as directed by the Engineer.
- 3. The Contractor shall grade all holes, swales and low points which will not otherwise be removed in the course of the work to the indicated subgrade level.

#### **B. Trenches**

- 1. Compaction equipment used in open areas where space permits shall consist of vibratory rollers, fully loaded ten-wheel dump trucks, pneumatic compactors, or other similar equipment.
- 2. Compaction equipment for fill against foundation walls and in other confined areas shall be accomplished by means of drum-type, power-driven, hand-guided vibratory compactors operating at 2,000 cycles per minute, or by hand-guided vibratory plate tampers.

### 3.9 Backfilling and Placement

#### A. General

1. Areas where excavation has been completed, as determined by Engineer, shall be backfilled as specified and as shown on the Drawings.
2. Fill materials of the various types specified shall generally be placed and compacted within the limits and to the thickness indicated on the Drawings unless otherwise specified.
3. Prior to placing fill materials, the Contractor shall complete the specified ground surface and subgrade preparation for materials encountered at ground surface and at subgrade levels.
4. Contractor shall keep Record Drawings on the site at all times and neatly and accurately record the exact location of their work as actually installed. This shall include the location and dimensions of underground and concealed Work including vegetated soil cap subgrade elevations.
5. Dewater subgrade areas prior to filling.
6. Control groundwater and surface runoff to minimize disturbance of exposed natural ground surface, previously placed and compacted fill and material being placed.
7. Soil fill moisture shall be maintained at an acceptable working range to allow for proper compaction. The amount of moisture required shall be determined by the Engineer for the material and compaction methods being used. Moisture shall be added to the material during compaction only when it is necessary to increase the percentage of moisture to obtain satisfactory compaction.
8. Do not place fill on frozen ground.
9. Do not place frozen fill.
10. Place fill in uniform horizontal layers and compact immediately after placement. Where the horizontal layer meets a rising slope, the layer shall be keyed into the slope by cutting a bench during spreading of preceding lift.
11. To the extent that is practical, each layer of fill shall be compacted to the specific density the same day it is placed.
12. The Contractor shall minimize voids during placement.
13. Backfill shall be placed within a tolerance of plus or minus 0.10 feet from the locations, elevations, and grades shown on the Drawings.
14. Protect structures and pipes from damage during backfilling operations. Repair damage at no cost to Owner.
15. Placement of fill shall not begin prior to observation and approval of subgrade conditions by Engineer.
16. Protect foundations, footings, and waterproofing during backfilling. Repair damage at no cost to Owner.



17. Prior to backfilling between structures and sheeting, remove unsuitable material, including rubbish, organic materials, or other debris. Do not commence filling operations until conditions have been observed by Engineer.
18. Backfill shall not be placed against walls until they are braced or have cured sufficiently to develop strength necessary to withstand, without damage, pressure from backfilling and compacting operations.
19. In compacting and other operations, the Contractor shall conduct his operations in a manner to prevent damage to structures due to passage of heavy equipment over and adjacent to structures. Repair damage made by the Contractor, at no additional cost to the Owner.
20. Upon completion of the work, the final ground surface shall be left in a firm, unyielding, true, uniform condition free from ruts. Repair disturbed areas caused equipment traffic at no cost to Owner.
21. The Structural Fill shall be placed and compacted at least three (3) days prior to the placement of the concrete structures. Each layer shall be compacted immediately after placing.
22. Structural fill shall be used as backfill beneath all structure foundations to replace unsuitable material or as backfill beneath structure foundations to meet the depth of the bottom of footings and shall be at least six (6) inches deep.

**B. Equipment**

1. Compaction equipment used in open areas where space permits shall consist of vibratory rollers, fully loaded ten-wheel dump trucks, pneumatic compactors, or other similar equipment.
2. Compaction equipment for fill against walls and in other confined areas shall be accomplished by means of drum-type, power-driven, hand-guided vibratory compactors operating at 2,000 cycles per minute, or by hand-guided vibratory plate tampers.

**C. Riprap**

1. The stones shall be placed upon an approved subgrade to the lines and grades shown on the plans and as directed.
2. Each stone shall be carefully placed, by hand or machine as required, on a prepared bed, normal to the slope and firmly bedded thereon.
3. The larger stone shall be placed closely together and the intervening spaces filled with smaller stones in such a manner that the entire surface will form a compact mass.

**3.10 Trench backfilling**

**A. General**

1. Trenches shall be backfilled as soon as practicable with

suitable approved materials. All trench backfilling shall be done with special care, in the following manner and as the Engineer may direct from time to time.

2. Backfill material for pipe bedding shall be deposited in the trench, uniformly on both sides of the pipe, for the entire width of the trench to the spring-line of the pipe. The backfill material shall be placed by hand shovels in layers not more than 6 inches (6") thick in loose depth and each layer shall be thoroughly and evenly compacted by tamping on each side of the pipe to provide uniform support around the pipe.
3. Trench backfilling shall be placed so as not to disturb the previously installed pipes, utilities, concrete, and other work within and near the trench. The moisture content of the backfill material shall be such that proper compaction will be obtained. Backfill of trenches within areas of pavement construction shall be made in controlled compacted lifts extending to grades required to establish the proper pavement base courses.
4. Any trenches or excavations improperly backfilled, or where settlement occurs, shall be reopened to the depth required for proper compaction, then refilled and compacted with the surface restored to the required grade and condition, at no additional cost to the Owner.
5. During filling and backfilling operations, pipelines will be checked to determine whether any displacement of the pipe has occurred. If the inspection of the pipelines shows poor alignment, displacement of pipe, or any other defects, the condition shall be remedied by removal, realignment, and backfill of the pipe, in a manner satisfactory to the Engineer at no additional cost to the Owner.

### **3.11 Compaction**

#### **A. General**

1. Compaction densities for the backfilling operations shall be the percentage of the maximum density obtainable at optimum moisture content, as determined and controlled in accordance with ASTM Standard 1557 Method D. Laboratory maximum density tests shall be made for each material proposed for use in backfilling for trenches. Field density tests shall be made in accordance with ASTM Standard D1556. All laboratory and field density tests shall be conducted by an approved laboratory.
2. Locations for field density tests shall be as directed by the Engineer. Field density tests may be ordered by the Engineer as the situation warrants.

#### **B. Compaction Requirements**

1. The degree of compaction is expressed as a percentage of the maximum dry density at optimum moisture content as determined by ASTM D1557, Method C. The compaction requirements are as follows:

<u>Area</u>	<u>Degree of Compaction</u>
Below footings	95%
Below culvert	95%
Storm Drain Structures	92%
Pipe bedding	85%
Trench backfill	92%
Lawn areas	90%

2. Compaction percentages are based on the laboratory derived Maximum Density Values.
3. If any test fails, it shall be the responsibility of the Contractor to adjust the moisture and recompact the area. The area will be retested.

#### C. Moisture Control

1. Fill that is too wet for proper compaction shall be harrowed or otherwise dried to a proper moisture content to allow compaction to the required density. If fill cannot be dried within 24 hours of placement, it shall be removed and replaced with drier fill.
2. Fill that is too dry for proper compaction shall receive water uniformly applied over the surface of the loose layer. Sufficient water shall be added to allow compaction to the required density.
3. In no case shall fill be placed over material that is frozen. No fill material shall be placed, spread, or rolled during unfavorable weather conditions. When work is interrupted by heavy rains, fill operations shall not be resumed until the moisture content and the density of the previously placed fill are as specified.

#### D. Lift Thickness of Material

1. Structural Fill. The Structural Fill shall be placed in layers not to exceed 12 inches (12") in thickness when utilizing heavy compaction equipment, and 8 inches (8") when utilizing light hand-operated compaction equipment and compacted to 95% maximum relative density as determined by AASHTO T99, Method C. The granular material shall be placed in the full width of the excavation with equipment as approved by the Engineer and in such a manner which will not cause segregation and which will require minimum blading or manipulation. The equipment and the method used shall be approved by the Engineer.
2. On-Site Materials and Clean Granular Fill. On-site Materials and Clean Fill to be used as backfill shall be placed in uniform layers not exceeding 12 inches when utilizing heavy compaction equipment, and 8 inches (8") when utilizing light hand-operated

compaction equipment, and compacted to the minimum degree of compaction as listed above, as determined by ASTM D698 with a minimum of three passes of a vibratory compactor or other approved equivalent.

3. Crushed Stone and Gravel Fill. Crushed Stone and Gravel Fill to be used as backfill shall be placed in uniform layers not to exceed 12 inches (9") in thickness when utilizing heavy compaction equipment, and 8 inches (8") when utilizing light hand-operated compacted equipment. Compact with a minimum of four (4) coverages of acceptable compaction equipment. Compact to the minimum degree of compaction as listed above, as determined by ASTM D698.

E. Protection of Fill

1. Protection of compacted fill shall be the responsibility of the Contractor. Newly graded areas shall be protected from the actions of the elements and traffic. Any settlement or washing that occurs prior to acceptance of the work shall be repaired and grades shall be established to the required elevations and slopes. Damage to any compacted lift (including those lifts previously tested and approved by the Engineer) occurring at any time during the course of construction, which is caused by equipment, moisture entering the embankment, or from any other cause, shall be fully repaired by the Contractor prior to placement of overlying materials, at no additional cost to Owner and to the complete satisfaction of the Engineer.
2. In the event of and prior to the commencement of heavy rains, the Contractor shall suspend fill operations immediately and shall take all necessary steps to keep the site as well drained as possible. Fill operations shall not be resumed until the moisture content of the fill is such as to permit compliance with the Specifications.
3. All corrective work or operations necessary to maintain proper moisture control of the fill material shall be at the expense of the Contractor.

F. Grading Tolerances

1. Grading shall be completed to meet or exceed the following tolerances of uniformity\*

Location	Tolerance
Final Grade	1 inch
Top of Subgrade Beneath Structures	1 inch

\* Uniformity is defined as no variations in the surface materials at the grades and slopes indicated on the Drawings that exceed the listed tolerance over a length of ten feet (10') horizontally in any direction.

2. The bottom of earth and rock excavations shall be formed to provide a smooth, uniform slope and grade. The bottom of the excavated grade shall be free of pockets, depressions or ridges

that would collect or concentrate water, silts, or other such objectionable material prior to the placement of backfill or other finish materials.

G. Finish

1. Upon completion of the work, ground surface shall be left in a firm, unyielding, true, uniform condition, free of ruts.

**3.12 Sheeting and Bracing**

A. General

1. Whenever sheeting and bracing will be required, it shall be furnished and installed by the Contractor in accordance with the recommendations of the structural engineer and/or geotechnical engineer engaged by the Contractor.
2. Submit the sheeting and bracing designs to the Owner and the Engineer for the project record. The sheeting and bracing plans and calculations shall bear the professional seals and signatures of the Contractor's engineers. These plans and calculations shall be submitted prior to the start of work.
3. The Contractor shall furnish and install the required sheeting and bracing in accord with the submitted designs. The Contractor shall include the costs for this work in his bid price for the project. No additional or separate compensation will be allowed.

**3.13 Closing Abandoned Underground Utilities**

- A. The Contractor shall close open ends of abandoned underground utilities, indicated to remain, permanently with closures sufficiently strong to withstand pressures which may result after closing.
- B. The Contractor shall close open ends of metallic conduit and pipe with threaded galvanized metal caps or plastic plugs, or other suitable method for the type of material and size of pipe. Do not use wood plugs.
- C. The Contractor shall close open ends of concrete and masonry utilities with not less than 8 inch thick brick masonry bulkheads, constructed to completely fill the opening.

**3.14 Maintenance**

- A. Protection of Graded Areas: The Contractor shall protect newly graded areas from traffic and erosion and shall repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances. The Contractor shall keep newly graded areas free of trash and debris.
- B. The Work shall be sequenced to minimize disturbance of completed areas.
- C. Where completed areas are disturbed by subsequent project operations or adverse weather, the Contractor shall fill and reshape eroded areas until acceptance of the Work.

**3.15 Disposal of Excess and Waste Materials**

- A. The Contractor shall remove waste materials, including excess and unacceptable excavated material, trash and debris, and legally dispose of it off the Owner's property.

(END OF SECTION 31 00 00)

## SECTION 31 05 19

### GEOTEXTILES

#### PART 1 - GENERAL

##### 1.1 Summary

A. Work specified in this Section includes, but is not necessarily limited to, furnishing all labor, materials, and equipment for the installation of geotextile, as specified herein and as shown on the Drawings.

##### 1.2 Price and Payment Procedures

A. Measurement and payment requirements per Contract Documents.

##### 1.3 Quality Control

A. The Geotextile Manufacturer shall be responsible for the production of geotextile rolls and shall be a well-established firm with more than two years of experience in the manufacture of geotextile filters and cushions. The Geotextile Manufacturer shall submit a statement to the Engineer listing:

1. Certified minimum average roll property values of the proposed geotextiles and the tests used to determine those properties.

##### 1.4 Submittals

A. Submit in accordance with Contract Documents:

1. Woven Geotextile for Silt Fence; and
2. Non-Woven Filter Fabric for Separation Layers.

#### PART 2 - PRODUCTS

##### 2.1 Geotextile Properties

A. Unless otherwise noted, the Geotextile Supplier shall furnish materials whose "Minimum Average Roll Values", as defined by the Federal Highway Administration (FHWA), meet or exceed the criteria specified in Part 2 of this Section. The Geotextile Supplier shall provide test results for these procedures, as well as a certification that the material properties meet or exceed the specified values. The geotextiles provided by the Geotextile Supplier shall be stock products. The Geotextile Supplier shall not furnish products specifically manufactured to meet the specifications of this project unless authorized by the Engineer.

B. The woven products (as specified) shall be manufactured from continuous filaments or staple fibers.

C. The Geotextile Supplier shall submit documentation that the geotextiles meet the property values listed the NHDOT Standard Specifications for Road and Bridge Construction and that the geotextiles will:

1. Retain their structure during handling, placement, and long-term service; and
2. Be capable of withstanding direct exposure to sunlight for a maximum of exposure period of 14 days between lay down and cover

with no measurable deterioration.

- D. The minimum test values identified in this Section are based on current manufacturers specifications, and may change based on future manufacturer's guaranteed minimum test values.

## **2.2 Woven Geotextile for Silt Fence**

- A. Woven geotextile filter material shall be used on the silt fences.
- B. Filter material shall be Mirafi 100X or equal.
- C. The geotextile filter material shall conform to the NHDOT Standard Specifications for Road and Bridge Construction Section 593.

## **2.3 Non-Woven Filter Fabric for Separation Layers**

- A. Non-woven filter fabric material shall be used for all separation layer applications (i.e. construction stabilized entrance and under rip rap). Non-woven filter fabric material shall be used assist in stabilizing soil subgrades to be laid on approved soil subgrades prior to placement of fill materials
- B. The non-woven filter fabric shall be Mirafi 140N or equivalent filter fabric. The Non-woven filter fabric shall meet the requirements of NHDOT Standard Specifications for Road and Bridge Construction Section 593

## **2.4 Packing and Labeling**

- A. Geotextiles shall be supplied in rolls wrapped in relatively impermeable and opaque protective covers.
- B. The Manufacturer shall identify all rolls of geotextiles with the following information:
  - 3. Manufacturer's name
  - 4. Product Identification
  - 5. Lot number
  - 6. Roll number
  - 7. Roll dimensions.

## **2.5 Transportation**

- A. Transportation of the geotextiles is the responsibility of the Contractor. The Contractor shall be liable for all damages to the materials incurred prior to and during transportation to the site.

## **2.6 Handling and Storage**

- A. Handling, unloading, storage, and care of the geotextiles prior to, during and following installation are the responsibility of the Contractor. The Contractor shall be liable for all damages to the materials incurred prior to final acceptance of the Contractor's work by the Engineer.
- B. The geotextile shall be protected from moisture, direct exposure to sunlight, puncture, or other damaging or deleterious conditions. The geotextile shall be protected from mud, dirt and dust. Any additional storage procedures required by the Geotextile Supplier shall be the Contractor's responsibility.



## **PART 3 - EXECUTION**

### **3.1 Handling and Placement**

- A. All geotextile shall be handled in a manner intended to prevent damage to the geotextile.
- B. Precautions shall be taken to prevent damage to underlying layers during placement of the geotextile.
- C. After unwrapping the geotextile from its opaque cover, the geotextile shall not be left exposed for a period in excess of 30 days unless a longer exposure period is approved by the Engineer, based on a formal demonstration from the Geotextile Supplier that the geotextile is stabilized against U.V. degradation for a period in excess of 30 days. Any material not accepted under this paragraph shall be replaced by the responsible party at no cost to the Owner.
- D. Care shall be taken not to entrap stones, excessive dust, or moisture in the geotextile during placement.
- E. All geotextiles shall be anchored with ballast during windy conditions. Such ballasts shall be installed during placement and shall remain until the geotextiles are weighted with permanent backfill, as shown on the Drawings.
- F. Surfaces to be covered with geotextile shall be examined before deployment by the Contractor and shall examine the deployed geotextile surface after installation to ensure that no potentially harmful foreign objects are present either above or below the geotextile. Foreign objects shall be removed and damaged geotextile shall be replaced at no additional cost to Owner.
- G. Adjacent sections of geotextile shall be overlapped a minimum of six (6) inches unless noted otherwise or as directed by the Engineer

### **3.2 Repair**

- A. Any holes or tears in the geotextile shall be repaired by the Contractor as follows:
  - 1. On slopes steeper than 10 horizontal to 1 vertical, a patch made from the same geotextile shall be double seamed into place (with each seam 0.5 in. (12 mm) apart and no closer than 1 in. (25 mm) from any edge). Should any tear exceed 10 percent of the width of the roll, that roll shall be removed from the slope and replaced with new material.
  - 2. On slopes flatter than 10 horizontal to 1 vertical, a patch made from the same geotextile shall be continuously sewn in place with a minimum of 2 ft (600 mm) overlap in all directions.
- B. Care shall be taken by the Contractor to remove any soil or other material which may have penetrated the torn geotextile.

### **3.3 Placement of Soil Materials**

- A. The Contractor shall place all soil materials on top of a geotextile in a manner such:
  - 1. The geotextile and underlying materials are not damaged;
  - 2. Minimum slippage occurs between the geotextile and underlying layers during placement; and
  - 3. Excess stresses are not induced in the geotextile.

B. Equipment shall not be driven directly on the geotextiles.

**3.4 Product Protection**

A. The Contractor shall use all means necessary to protect all prior work and materials and completed work of other Sections.

B. In the event of damage, the Contractor shall immediately make all repairs and replacements necessary, to the approval of the Engineer and at no additional cost to the Owner.

**3.5 Safety**

A. All geotextile installation shall be performed in accordance with all applicable OSHA regulations.

(END OF SECTION 31 05 19)

## SECTION 31 23 19

### DEWATERING

#### PART 1 - GENERAL

##### 1.1 Description

A. Work specified in this Section includes, but is not necessarily limited to, furnishing all labor, materials and equipment for dewatering activities necessary to control of surface and subsurface water within the site.

##### 1.2 Price and Payment Procedures

A. Measurement and payment requirements per Contract Documents.

##### 1.3 Dewatering System Requirements

A. The Contractor shall design the water management systems to:

1. Effectively reduce the hydrostatic pressure and lower the groundwater levels to a minimum of 2 feet below the bottom of excavations;
2. Develop a substantially dry and stable subgrade for the proposed work;
3. Prevent damage to adjacent properties, buildings, structures, utilities and other facilities;
4. Retain all sediments on-site within the work area.

B. Pumps and Piping or Hose:

1. The Contractor shall provide pumps and piping or hose capable of removing water from within the Limits of Excavation.
2. The Contractor shall notify the Engineer whenever pumps are added or removed.
3. The Contractor shall provide sufficient pumps and piping or hose to dewater all areas where site clearing, excavation, backfill, and other operations are taking place at any time.

C. The Contractor shall design, provide, install, and operate the Dewatering System. The Engineer shall approve the design prior to procurement or installation of same.

D. Locate dewatering facilities where they will not interfere with utilities and construction work to be done by others.

E. Modify dewatering equipment and procedures when operations are insufficient to maintain a dry excavation or threaten to cause damage to new or existing facilities or adjacent areas.

F. The Dewatering System may include pumps and piping or hose, instrumentation and controls, sumps, wells, well points and temporary diversion devices.

G. The Contractor shall design the collection system for excavation dewatering to minimize collection of suspended solids.

- H. The presence of groundwater, to any degree, will not constitute a condition for which an increase in the contract price may be made.
- I. Temporary Diversion Devices - The Contractor shall provide sand bags, coffer dams or other effective temporary diversion devices required to divert water away from excavation areas and to locations where dewatering pumps are installed.

**1.4 Submittals**

- A. None Required.

**PART 2 - PRODCUTS**

**2.1 General**

- A. The Contractor shall provide, operate, and maintain a dewatering system consisting of pumps, drains, piping instrumentation and controls, sumps, deep wells, well points, temporary diversion devices and any other facilities necessary to control water levels in areas of work, including spare units available for immediate use in the event of equipment breakdowns.

**PART 3 - EXECUTION**

**3.1 General**

- A. The Contractor shall design, install, operate, and remove the dewatering systems in accordance with applicable federal, state, county and local Laws and Regulations, and generally accepted industry practices.
- B. The Contractor shall perform dewatering work when necessary at no additional cost to the Owner.
- C. Pumping of large volumes of water from sumps in trenches or excavations, resulting in movement of foundation soil material, will not be permitted.
- D. Groundwater shall be continuously maintained at least 2-feet below the working construction grade until earthworks and/or backfilling are complete.

**3.2 Surface Water Control**

- A. Intercept and divert surface water runoff away from excavations through the use of dikes, curbing, walls, ditches, pipes, sumps or other approved means.
- B. The Contractor shall collect and prevent surface and subsurface water seepage from entering the excavations. Divert the water to settling basins or other approved equipment required to reduce the amount of fine particles before discharge into drainage pipes and natural water courses. If a drainage system or water course is silted or becomes blocked due to dewatering operation, it shall be cleaned by the Contractor at no additional cost to the Owner.

**3.3 Dewatering Excavations**

- A. The Contractor shall furnish and install the components of the

Dewatering System as required to perform the work and keep the site free of standing water or excessively muddy conditions as needed for proper execution of the construction work.

- B. Perform dewatering operations to lower the groundwater level in excavations as required to provide a stable, dry subgrade for the prosecution of the proposed work.
- C. Maintain dewatering operations in a manner that prevents buildup of excessive hydrostatic pressure and damage to structures and the subgrade.
- D. Do not allow water to accumulate in excavations. Contractor shall provide and maintain ample means and devices to remove promptly, and to dispose of properly, all water entering excavations and to keep them dry until the proposed work is completed.
- E. The Contractor, in consultation with the Engineer, shall modify the operation procedures on design based on field conditions, if necessary to meet performance requirements of the system.
- F. The dewatering areas shall be limited to areas where Work is being conducted and areas where Work is planned for that day.
- G. The Contractor shall grade the excavation area using slopes, berms and sumps in conjunction with the dewatering systems to channel water away from the immediate Work areas to minimize dewatering.
- H. Do not discharge water to protected environmental resources without treatment to remove suspended solids and sediments.
- I. No pipe shall be laid in water. Contractor shall constantly guard against the possibility of flotation of pipe or structures after installation. Backfill or other means shall be placed promptly to prevent this occurrence.

#### **3.4 Disposal of Water**

- A. The Contractor shall dispose of water pumped or drained from the construction site in a suitable manner to avoid public nuisance, injury to public health, damage to public and private property, and damage to the work completed or in progress.
- B. Water discharged from construction and dredging operations shall be directed to sediment settling facilities, sediment filtration devices, or other treatment system or device accepted by the Engineer, prior to discharge to adjacent water courses.
- C. The Contractor shall provide suitable temporary channels for water that may flow along or across the construction site.
- D. The Contractor shall not allow ground or surface water to enter piped utilities, except where the Owner specifically allows the use of storm drains for receiving such discharges.
- E. Effluent from dewatering operations shall not be discharged directly to wetlands or waterways and shall not be discharged to storm drain systems prior to being filtered through a siltation

basin.

F. Discharge shall be such that no erosion occurs.

**3.5 Damage**

- A. The Contractor shall discharge water pumped from excavations in a manner which will not result in damage to adjacent properties.
- B. All damage resulting from the dewatering operations, or the failure of the Contractor to maintain the work in a suitably dry condition shall be repaired by the Contractor at no additional cost to the Owner.
- C. The Contractor shall take all necessary precautions to protect new work from flooding and flood damage during storms or from other causes.
- D. The Contractor shall thoroughly brace or otherwise protect all pipelines and structures which are not stable, against flotation, when necessary.

**3.6 Removal of Temporary Works**

- A. After the temporary works have served their purposes, the Contractor shall remove them or level and grade them to the extent required by the plans and to prevent any obstruction of the flow of water or any other interference with the operation of or access to the permanent work.

(END OF SECTION 31 23 19)

SECTION 31 25 00

**EROSION AND SEDIMENTATION CONTROLS**

**PART 1 - GENERAL**

**1.1 Summary**

- A. This Section specifies requirements for temporary and permanent erosion and sedimentation control provisions as they relate to the construction process.
- B. The work includes:
- C. Providing and maintaining all temporary erosion and sedimentation control measures shown on the Drawings and required by the Engineer during the life of the Contract to control soil erosion and water pollution.
- D. The installation and maintenance of additional silt fence, berms, ditches, sedimentation basins, construction exits, fiber mats, catch basin filters, straw, netting, gravel, trenches, mulches, grasses, slope drains, and other approved erosion control devices or methods, needed to protect any areas on or off site.
- E. Dust suppression.
- F. When the use of siltation fence is ordered, the Contractor shall furnish and place siltation fence as a temporary erosion and pollution control device at locations shown on the plans or ordered by the Engineer. The Contractor shall not use hay bales for siltation barriers unless specifically shown on the Drawings or authorized by the Engineer.
- G. When seeding is ordered, the Contractor shall sow seed of the type ordered on the areas as directed by the Engineer.

**1.2 Price and Payment Procedures**

- A. Measurement and payment requirements per Contract Documents.

**1.3 References**

- A. NHDOT Standard Specifications for Road and Bridge Construction
- B. Applicable portions of the Town of Plaistow Ordinances and Bylaws

**1.4 Definition and Coordination of Erosion and Sedimentation Control Provisions**

- A. Permanent erosion and sedimentation control measures are defined as those elements that are to be incorporated into the final project product, including but not necessarily limited to such items as: finish paving and landscape, detention basin forebays, sedimentation control structures (Voctechinics, Stormceptor, catch basins, etc.), swales and ditches, berms, and other such items.
- B. Temporary erosion and sedimentation control measures are defined as those elements that are required by permit approvals and necessary to be installed by the Contractor to meet federal, state and local regulations for the construction program,

including, but not necessarily limited to, such items as: silt fences, berms, portable sedimentation basins, straw bales, check dams, and other such items, all of which shall be removed by the Contractor after installation of permanent erosion and sedimentation control measures, stabilization of the site, and prior to final completion of the project.

- C. The temporary control provisions shall be coordinated with the permanent erosion and sedimentation control features to the extent practical to ensure economical, effective, and continuous erosion and sedimentation controls throughout the construction and post-construction periods.

#### **1.5 Laws and Regulations**

- A. Copies of these publications are available for inspection at the office of the Engineer.

#### **1.6 Review and/or Inspection of Erosion and Sedimentation Control Measures**

- A. All construction under this project shall be subject to review and/or inspection by the appropriate local, State and Federal agencies responsible for ensuring the adequacy of erosion and sedimentation control measures.
- B. Erosion and sediment controls must be reviewed by a qualified person employed by the Contractor at least once every 7 calendar days or once every 14 calendar days and within 24 hours of the occurrence of a storm event greater than 0.25 inches of rain. The Contractor will be responsible for completing these inspections and documenting the inspections.

#### **1.7 Design Criteria**

- A. The Contractor shall conduct all construction in a manner and sequence that causes the least practical disturbance of the physical environment.
- B. The Contractor shall stabilize disturbed earth surfaces in the shortest practical time and employ any and all such temporary erosion control devices as may be necessary until such time as adequate soil stabilization has been achieved or permanent erosion control devices are operational.
- C. The erosion control devices specified herein and indicated on the Drawings represent the minimum required Work for erosion control. The Contractor shall add to these minimum devices any and all measures to effectively prevent migration of sediment from the work area at no additional cost to the Owner.

#### **1.8 Construction Operations**

- A. When in the opinion of the Engineer it becomes necessary, the Engineer will inform the Contractor of construction procedures and operations that jeopardize erosion and sedimentation control provisions. If these construction procedures and operations are not corrected promptly, the Owner may suspend the performance of any or all construction until corrections have been made, and such suspension shall not be the basis of any claim by the Contractor for additional compensation from the Owner nor for an



extension of time to complete the Work.

### **1.9 Submittals**

- A. The Contractor shall submit product data sheets for the following products:
  - 1. Seed Mix for clean stockpiles;
  - 2. 6 millimeter (mm) thick polyethylene for contaminated stockpiles;
  - 3. Straw Bales;
  - 4. Silt Fence; and
  - 5. Catch Basin Inlet Filters

## **PART 2 - PRODUCTS**

### **2.1 Materials**

- A. Straw bales.
  - 1. Bales shall be made of straw with forty pounds minimum weight and one hundred and twenty pounds maximum weight. They should be either wire bound or string tied.
  - 2. Wood stakes shall be a minimum of 2-inches by 2-inches nominal size and a minimum of 3-feet long.
- B. Silt Fence.
  - 1. The silt fence shall consist of a 3-foot wide continuous length sediment control fabric, stitched to 2 1/2-foot wide, continuous length support netting, and stapled to pre- weathered oak posts installed as shown on the drawings. The oak posts shall be 2-inches by 2-inches by 4.5 feet and shall be tapered. The support netting shall be a woven industrial strength polypropylene geotextile in accordance with Geotextiles - Section 31 05 19.
- C. Construction Entrance
  - 1. Crushed stone shall be in accordance with Earthwork - Section 31 00 00.
  - 2. Geotextile shall be a nonwoven geotextile in accordance with Geotextiles - Section 31 05 19.
  - 3. The construction entrance shall be installed prior to starting site grading and maintained throughout construction.
- D. Catch Basin Inlet Filter
  - 1. Catch basin inlet filters shall be installed as indicated on the plans and at any additional catch basins which may accumulate sediment due to the construction.
  - 2. Filter shall be a nonwoven geotextile in accordance with Geotextiles - Section 31 05 19.

## **PART 3 - EXECUTION**

### **3.1 General Erosion Control Requirements**

- A. Prior to commencement of the work, the Contractor shall meet with the Engineer to develop a mutual understanding relative to compliance with the provisions of this Section and administration of the erosion and sediment control program.
- B. The Contractor shall construct all permanent erosion and sedimentation control features at the earliest practical time as outlined in the accepted schedule. Temporary erosion and sedimentation control measures shall be used to correct conditions that develop during construction which were unforeseen, but are needed prior to installation of permanent erosion and sedimentation control features, or that are needed temporarily to control erosion or sedimentation which develops during construction operations.
- C. The Engineer/ Owner has the authority to control the surface area of each material exposed by construction operations and to direct the Contractor to immediately provide permanent or temporary erosion control measures to prevent contamination of adjacent streams, watercourses, lakes, ponds, storm drainage systems or other areas of water impoundment. Every effort shall be made by the Contractor to prevent erosion on the site and abutting properties and roads.
- D. Where erosion is likely to be a problem, clearing and grubbing operations shall be scheduled and performed so that grading operations and permanent erosion and sedimentation control features can follow immediately thereafter, if conditions permit; otherwise, temporary erosion and sedimentation control measures will be required between successive construction stages.
- E. The Contractor shall operate all equipment and perform all construction operations so as to minimize pollution. The Contractor shall cease any operations that will increase pollution during rainstorms.
- F. The Contractor shall place additional erosion and sedimentation controls as required by laws and regulations.
- G. The Contractor shall use erosion controls to contain discharge from pumping operations during dewatering operations to prevent silt from entering the storm drains or receiving watercourse.
- H. Contractor shall be responsible for controlling erosion within the project area and retaining sediment on-site away from sensitive environmental resources. Any fines, construction delays, remedial actions, or incarceration resulting from the Contractor's failure to comply with these provisions shall be the responsibility of the Contractor and not the Owner. The Contractor shall remove the erosion control installations upon completion of the Work or if ordered by the Engineer.
- I. Failure by the Contractor to control erosion, pollution, and siltation shall be cause for the Owner to employ outside assistance to provide the necessary corrective measures. The cost of such assistance, including engineering costs, will be charged to the Contractor and appropriate deductions made from the Contractor's monthly progress payment.
- J. The Contractor shall remove and properly dispose of sediment from

control facilities as required by the Engineer. The Contractor shall modify and improve erosion and sedimentation control facilities and replace deteriorated straw bales and other devices as required by the Engineer.

- K. Prior to removal of all siltation fencing and/or sediment control devices, the Contractor shall remove and dispose of all retained silt or other materials at no additional cost to the Owner.
- L. Minimum temporary and permanent erosion and sedimentation control measures are shown on the Drawings. The Contractor shall strictly adhere to the minimum provisions shown. Additionally, temporary measures shall be selected and constructed by the Contractor in consultation with the Engineer to accommodate changing field conditions that develop during construction.
- M. All disturbed areas shall be re-vegetated by loaming and seeding unless otherwise noted on the approved plan.
- N. Slopes with exposed soils shall be stabilized by mulching, seeding or otherwise protected as the work progresses to comply with the intent of this specification. All damaged slopes shall be repaired as soon as possible. The Engineer will limit the surface area of earth material exposed if the Contractor fails to sufficiently protect the slopes to prevent pollution.
- O. The Contractor shall at all times have on hand the necessary materials and equipment to provide for early slope stabilization and corrective measures to damaged slopes.

### **3.2 Dust Suppression**

- A. The Contractor will be responsible for implementing dust mitigation measures at the direction of the Engineer. Dust mitigation may involve wetting the work area with water/amended water to reduce dust levels or other means as required to achieve acceptable dust thresholds during earthwork. Sprinkling shall be repeated at such intervals as to keep the disturbed area damp at all times. Should dust exceed permissible levels for extended periods of time (i.e., one work day), it may be necessary to halt work until dust mitigation is effective and this work stoppage will not be cause for a delay or claim by the Contractor.

### **3.3 Erosion and Sedimentation Control - Straw Bales**

- A. Straw bales shall be installed at the locations, shown on the Drawings and in general as follows:
  - 1. Toe of slope of embankment construction to filter all runoff flowing to off-site discharges.
  - 2. Toe of temporary earthwork stockpile slopes.
  - 3. Across construction ditches prior to entry into drainage system or waterway, and at 50 foot intervals along the remainder of the ditch.
  - 4. Surrounding completed drainage inlets.
  - 5. Other locations shown on the Contract Drawings and required by

laws, regulations, and permits.

- B. Straw bales shall be installed in line with each bale installed tight against the previous bale to form a continuous barrier. The bales shall be set in a trench approximately 4 inches into the ground. Secure bales in place with two (2) stakes per bale. Stakes shall be driven a minimum of 18-24 inches into the ground. The bales shall be set in a trench approximately 4 inches into the ground.
- C. After the bale lines are staked, the end joints shall be chinked with loose hay to close any gaps. Excavated soil shall then be backfilled against the uphill side of the barrier to a depth of 4-inches above the downhill grade.
- D. Following compaction of the backfill, loose hay shall be scattered over the surface directly behind the barrier.
- E. Soil shall be placed on the upside slope of the bales. Deteriorated, destroyed, or rotted bales shall be replaced immediately. Sediment shall be removed and disposed of periodically from behind the straw bales. Sediment shall be removed from behind the straw bales when it has accumulated to one-half the original height of the bale measured at the low point or if ordered by the Engineer. The accumulated sediment shall not be allowed to rise above the mid-height of the bale. All sediment, straw bales, and appurtenances shall be removed and disposed of at the completion of the Contract.

#### **3.4 Silt Fence**

- A. Silt fence shall be installed at locations as shown on the Drawings.
- B. Silt fence posts shall be spaced eight (8) feet center-to-center or closer. They shall extend at least two (2) feet into the ground. They shall extend at least two (2) feet above ground. Supporting posts shall be spaced 4 feet on center, and driven at least 1 foot into the ground. Posts shall be 1-1/2 inch square or heavier wood posts or standard steel posts.
- C. Fabric shall be anchored in a 46-inch deep trench dug on the upslope side of the posts. The trench shall be at least 4 inches wide. The fabric shall be laid in the trench, backfilled, and compacted.
- D. Fabric rolls shall be spliced at posts. The fabric shall be overlapped 6 inches, folded over, and then securely fastened to posts by nailing or stapling.
- E. Silt fences shall be inspected immediately after each storm event and at least daily during prolonged rainfall.

#### **3.5 Construction Entrance**

- A. The Contractor shall excavate the area of the entrance to a minimum of 3 inches and clear existing vegetation, roots, and other objectable material.
- B. Filter fabric shall then be placed the full widths and length of the entrance followed by stone to the specified dimensions.
- C. The Contractor shall maintain the entrance in a condition which will

prevent the tracking or flow of dirt or mud onto public right of ways.

### **3.6 Maintenance of Erosion and Sedimentation Control Measures**

- A. The Contractor shall check the condition of erosion and sedimentation control devices daily and maintain them in good operating condition. Straw bales shall be replaced when deteriorated.
- B. The Contractor shall inspect the condition of diversion dikes and ditches, filter berms, interceptor dikes, sediment basins, and other erosion and sedimentation control devices after each rainstorm and during major storm events. Repairs shall be made as necessary.
- C. During construction, temporary outlets of the drainage systems shall direct the flow to temporary or permanent sedimentation basins.
- D. Temporary soil erosion and sedimentation control devices shall be removed and adjacent areas outside the limits of grading restored upon completion of the work or when required by the Engineer.

### **3.7 Removal and Cleanup**

- A. All temporary erosion control facilities and accumulated sediments shall be removed in a neat and workmanlike manner when all disturbed areas have been satisfactorily stabilized as determined by the Engineer.
- B. Straw bales should be broken up and dispersed on the adjacent ground once the Engineer has determined that all disturbed areas are satisfactorily stabilized.
- C. Sediments and other earth materials resulting from the installation/operation of the soil erosion and sediment control structures shall not leave the project site unless so directed by the Engineer, but shall be consolidated below the proposed cover soil layer as practicable. Management of sediment shall be performed by the Contractor at no additional expense to the Owner. The Contractor shall perform all sediment management activities in close coordination with the Engineer.
- D. The Contractor shall remove or level and grade to the extent required by the plans and to prevent any obstruction of the flow of water or any other interference with the operation of or access to the completed work.

(END OF SECTION 31 25 00)

## SECTION 32 12 16

### ASPHALT PAVING

#### PART 1 - GENERAL

##### 1.1 Summary

A. This work shall cover the composition, mixing, construction upon the prepared subgrade, and the protection of hot asphalt concrete pavement. The hot asphalt concrete pavement shall consist of an aggregate or asphalt base course and asphalt surface course constructed in conformity with the lines, grades, thickness, and cross sections as shown. Each course shall be constructed to the depth, section, or elevation required by the drawings and shall be rolled, finished, and approved before the placement of the next course. Work shall be performed as shown on the Drawings.

##### 1.2 Price and Payment Procedures

A. Measurement and payment requirements per Contract Documents.

##### 1.3 References

A. Reference Standards

1. NHDOT Standard Specifications for Road and Bridge Construction
2. NHDOT Standard Plans for Road Construction
3. Applicable portions of the Town of Plaistow Ordinances and Regulations

##### 1.4 Alignment and Grade Control

A. The Contractor's Registered Professional Land Surveyor shall establish and control the pavement (aggregate or asphalt base course and asphalt surface course) alignments, grades, elevations, and cross sections as shown on the Drawings.

##### 1.5 Submittals

- A. Submit in accordance per Contract Documents.
1. Product Data
  2. Manufacturer Instructions

##### 1.6 Quality Assurance

A. Provide in accordance with Contract Documents.

#### PART 2 - PRODUCTS

##### 2.1 Bitumen for Tack Prime Coat

A. Provide in accordance with NHDOT Standard Specifications for Road and Bridge Construction Section 401, 410, and 702.

##### 2.2 Hot Bituminous Pavement (Top and Base)

A. Provide in accordance with NHDOT Standard Specifications for Road and Bridge Construction Section 401, 410, and 702.

## **PART 3 - EXECUTION**

### **3.1 General**

- A. The Asphalt Concrete Paving equipment, weather limitations, job-mix formula, mixing, construction methods, compaction, finishing, tolerance, and protection shall conform to the requirements of the appropriate sections of the NHDOT Standard Specifications for Road and Bridge Construction for the type of material specified.

### **3.2 Subgrade**

- A. Shape to line and grade and compact with self-propelled rollers.
- B. All depressions that develop under rolling shall be filled with acceptable material and the area re-rolled.
- C. Soft areas shall be removed and filled with acceptable materials and the area re-rolled.
- D. Should the subgrade become rutted or displaced prior to the placing of the subbase, it shall be reworked to bring to line and grade.
- E. Proof-roll the subgrade with maximum 45 tonne (50 ton) gross weight dump truck as directed by VA Resident Engineer or VA Contracting Officer. If pumping, pushing, or other movement is observed, rework the area to provide a stable and compacted subgrade.

### **3.3 Base Courses**

- A. Base
  - 1. Spread and compact to the thickness shown on the drawings.
  - 2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.
  - 3. After completion of the base rolling there shall be no hauling over the base other than the delivery of material for the top course.
- B. Thickness tolerance: Provide the compacted thicknesses shown on the Drawings within a tolerance of minus 0.0" to plus 0.5".
- C. Smoothness tolerance: Provide the lines and grades shown on the Drawings within a tolerance of 3/16 inch in ten feet.
- D. Moisture content: Use only the amount of moisture needed to achieve the specified compaction.

### **3.4 Top Courses**

- A. Remove all loose materials from the compacted base.
- B. Apply the specified prime coat, and tack coat where required, and allow to dry in accordance with the manufacturer's recommendations as approved by the Engineer.
- C. Spreading:
  - 1. Spread material in a manner that requires the least handling.

2. Where thickness of finished paving will be 76mm (3") or less, spread in one layer.

D. Rolling:

1. After the material has been spread to the proper depth, roll until the surface is hard, smooth, unyielding, and true to the thickness and elevations shown on the drawings.
2. Roll in at least two directions until no roller marks are visible.
3. Finished paving smoothness tolerance:
  - a. No depressions which will retain standing water.
  - b. No deviation greater than 1/8" in six feet.

**3.5 Final Clean Up**

- A. Remove all debris, rubbish, and excess material from the work area.

**3.6 Closeout Activities**

- A. Provide in accordance per Contract Documents.

(END OF SECTION 32 12 16)



**SECTION 32 15 40**

**Crushed Stone Surfacing**

**PART 1 - GENERAL**

**1.1 Summary**

A. This work shall cover the composition, mixing, construction upon the prepared base and subgrade. The gravel drive and walkway consist of an aggregate or asphalt base course subgrade constructed in conformity with the lines, grades, thickness, and cross sections as shown. Each course shall be constructed to the depth, section, or elevation required by the drawings and shall be approved before the placement of the next course.

**1.2 Price and Payment Procedures**

A. Measurement and payment requirements per Contract Documents.

**1.3 References**

A. Reference Standards

1. NHDOT Standard Specifications for Road and Bridge Construction
2. NHDOT Standard Plans for Road Construction
3. Applicable portions of the Town of Plaistow Ordinances and Regulations

**1.4 Alignment and Grade Control**

A. The Contractor's Registered Professional Land Surveyor shall establish and control the gravel (crushed gravel base course and crushed gravel subbase) alignments, grades, elevations, and cross sections as shown on the Drawings.

**1.5 Submittals**

A. Submit in accordance with the Contract Documents.

1. Product Data
2. Manufacturer Instructions

**1.6 Quality Assurance**

A. Provide in accordance with the Contract Documents.

**PART 2 - PRODUCTS**

**2.1 Crushed Gravel Base Course and Subbase**

A. Provide in accordance with NHDOT Standard Specifications -2010 Section 304.2 and 304.4

**PART 3 - EXECUTION**

**3.1 General**

A. The gravel equipment, weather limitations, job-mix formula, mixing, construction methods, compaction, finishing, tolerance, and protection shall conform to the requirements of the appropriate

sections of the NHDOT Standard Specifications for Road and Bridge Construction for the type of material specified.

### **3.2 Subgrade**

- A. Shape to line and grade and compact with self-propelled rollers.
- B. All depressions that develop under rolling shall be filled with acceptable material and the area re-rolled.
- C. Soft areas shall be removed and filled with acceptable materials and the area re-rolled.
- D. Should the subgrade become rutted or displaced prior to the placing of the subbase, it shall be reworked to bring to line and grade.
- E. Proof-roll the subgrade with maximum 45 tonne (50 ton) gross weight dump truck as directed by VA Resident Engineer or VA Contracting Officer. If pumping, pushing, or other movement is observed, rework the area to provide a stable and compacted subgrade.

### **3.3 Base Courses**

- A. Base
  - 1. Spread and compact to the thickness shown on the drawings.
  - 2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.
  - 3. After completion of the base rolling there shall be no hauling over the base other than the delivery of material for the top course.
- B. Thickness tolerance: Provide the compacted thicknesses shown on the Drawings within a tolerance of minus 0.0" to plus 0.5".
- C. Smoothness tolerance: Provide the lines and grades shown on the Drawings within a tolerance of 3/16 inch in ten feet.
- D. Moisture content: Use only the amount of moisture needed to achieve the specified compaction.

### **3.5 Final Clean Up**

- A. Remove all debris, rubbish, and excess material from the work area.

### **3.6 Closeout Activities**

- A. Provide in accordance with the Contract Documents.

(END OF SECTION 32 15 40)

## SECTION 32 18 23.13

### INFIELD MIX

#### PART 1 - GENERAL

##### 1.1 Description

- A. The work of this Section consists of all surfacing work and related items as indicated on the drawings and or as specified herein and includes, but is not limited to, the following items:

1. Infield Mix for softball field surfacing

- B. Related Sections:

1. Section 31 00 00 - Earthwork
2. Section 32 15 40 - Crushed Stone Surfacing

##### 1.2 Measurement and Payment

- A. Measurement and payment requirements per Contract Documents.

##### 1.3 Performance Requirement

- A. The following standards and definitions are applicable to the work of this Section to the extent referenced herein:

1. ASTM: American Society for Testing and Materials.

##### 1.4 Submittals

- A. Shop Drawings and Product Data: Show details of installation, including plans and sections.

##### 1.5 Project/Site Conditions

- A. Environmental Conditions: Proper drainage is required as Infield Mix drains water laterally off the surface.

- B. Environmental Limitations: Store in a moderate temperature. Warning Track Mix can form clods in cold weather. It is recommended to install above 60 degrees F.

- C. Field Measurements: Each proposer is required to visit the site of the work to verify the existing conditions. No adjustments will be made to the Contract Sum for variations in the existing conditions.

1. Where surfacing is indicated to fit with other construction, verify dimensions of other construction by field measurements before proceeding with the work.

##### 1.6 Quality Assurance

- A. Installer Qualifications: Installer to provide evidence to indicate successful experience in installation of Infield Mix or approval by manufacturer.

## **PART 2 - Products**

### **2.1 General**

- A. Infield Mix shall meet manufacturer requirements and those specified in the Contract Documents.

## **PART 3 - Execution**

### **3.1 Preparation**

- A. Proper base preparation is essential in the performance of the Infield Mix. Base material should be leveled or laser graded to same grade as Infield Mix. Base material has to be level to ensure Infield Mix is at a uniform depth of 3" to 4" across entire field.
- B. Pre-soak base material with water prior to installing Infield Mix and allow time for drying until base can accept compaction without deformation. Compact base to 95% compaction.

### **3.2 Placement/Compaction**

- A. Place Infield Mix at a 3" to 4" compacted depth.
- B. Grade Mix with box blade, laser grader or equal. It is recommended to grade or laser grade Infield Mix at .5% slope towards drainage area.
- C. Compact Infield Mix as needed. Installation methods may achieve desired hardness without compacting material. If Infield Mix is too soft or surface contains excessive loose material, compaction is needed.
  - 1. Compaction can be achieved by a 1-ton double-drum roller.
  - 2. Compact material making 1 to 2 passes.
  - 3. Use plate compactor, water roller, or hand tamp on edges and hard to get areas.
- D. Do not use calcined clay or other soil amendments.

### **3.3 Inspection**

- A. Finished surface shall be uniform, solid under foot, with desired amount of loose surface material. Compacted Infield Mix shall be firm to full depth with no soft areas.

### **3.4 Maintenance**

- A. Do not contaminate Infield Mix with any outside soils as this will compromise its performance.
- B. Remove debris, such as paper, grass clippings, leaves or other organic material by mechanically blowing or hand raking the surface as needed.

### 3.5 Repairs

- A. Excavate damaged area to the depth of the Infield Mix and square-off sidewalls.
- B. Apply Infield Mix to excavated area to finish grade.
- C. Compact with an 8" to 10" hand tamp or 1000 lb. Roller.

END OF SECTION (32 18 23.13)

## SECTION 32 31 13

### CHAIN LINK FENCE

#### PART 1 - GENERAL

##### 1.1 Summary

- A. Work specified in this Section includes, but is not necessarily limited to, furnishing all labor, materials, and equipment necessary for the installation of PVC coated chain link fence, PVC coated galvanized framework, foul poles, and all required appurtenances.

##### 1.2 Price and Payment Procedures

- A. Measurement and payment requirements per Contract Documents.

##### 1.3 References

- A. ASTM A36 Standard Specification for Carbon Structural Steel
- B. ASTM A780 Standard Practice for Repair of Damaged and Uncoated Areas of Hot-dip Galvanized Coatings
- C. ASTM B221 Standard Specification for Aluminum and Aluminum Alloy Bars, Rods, Wire Profiles and Tubes
- D. ASTM F552 Standard Terminology Relating to Chain Link Fencing
- E. ASTM F567 Standard Practice for Installation of Chain Link Fence
- F. ASTM F626 Standard Specification for Fence Fittings
- G. ASTM F668 Standard Specification for Polyvinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain Link Fence Fabric
- H. ASTM F934 Standard Specification for Standard Colors for Polymer-Coated Chain Link Fence Materials
- I. ASTM F1043 Standard Specification for Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework
- J. ASTM F1083 Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
- K. ASTM F1664 Standard Specification for Polyvinyl Chloride (PVC) and Other Conforming Organic Polymer-Coated Steel Tension Wire Used With Chain Link Fence
- L. ASTM F1665 Standard Specification for Polyvinyl Chloride (PVC) and Other Conforming Organic Polymer-Coated Steel Barbed Wire Used With Chain Link Fence
- M. WLG2445 Chain Link Fence Manufacturers Institute, Chain Link Fence Wind Load Guide for the Selection of Line Posts and Line Post Spacing

##### 1.4 Submittals

- A. Shop drawings: Layout of fences, backstop fencing, foul poles, details, and finishes of components, accessories, and post foundations.

- B. Product data: Manufacturer's catalog cuts indicating material compliance and specified options.
- C. Samples: If requested, samples of materials (e.g., fabric, wires, color, and accessories).

### **1.5 Quality Assurance**

- A. Manufacturer: Company having manufacturing facilities in the United States with 5 years experience specializing in manufacturing of chain link fence products.
- B. Tolerances: ASTM current specification and tolerances apply and supersede any conflicting tolerance.
- C. Substitutions: Alternate chain link products may be acceptable by the architect as equal if approved in writing ten days prior to bidding provided that the items submitted meet the specifications contained in this document.
- D. Single source: To ensure system integrity obtain the chain link system, framework, fabric, fittings, gates and accessories from a single source.

## **PART 2 - PRODUCTS**

### **2.1 Chain Link Fence Fabric**

- A. Poly Vinyl Chloride (PVC) color coated steel chain link fabric per ASTM F668 Class 1.
- B. Chain link fabric shall be woven into a two-inch mesh; 9-gauge galvanized wire with a minimum breaking strength of 1290 lbs. in accordance with ASTM F668, Class 1.
- C. Polyvinyl chloride coating shall be a dense and impervious covering free of voids, having a smooth lustrous surface without pinholes, voids, or rough or blistered surface.
- D. Vinyl coating shall have a maximum specific gravity of 1.30 and a minimum hardness Durometer reading of A 95.
- E. Color of chain link fabric per ASTM F934 and shall be black.

### **2.2 Fence Posts and Hardware**

- A. Steel pipe Type I: ASTM F1043 Group IA, ASTM F1083 standard weight schedule 40 hot-dip galvanized pipe having a zinc coating of 1.8 oz/ft<sup>2</sup> (550 g/m<sup>2</sup>) on the outside and 1.8 oz/ft<sup>2</sup> (550 g/m<sup>2</sup>) on the inside surface. Exterior of pipe to have F1043 PVC thermally fused color coating, minimum thickness 10 mils (0.254 mm). Regular Grade: Minimum steel yield strength of 30,000 psi (205 MPa)
- B. Pipe End, Corner, and Line Post 1.9-inch OD; 2.28lbs/ft
- C. Pipe Rail and Braces, 1.660 in. OD; 2.27lbs/ft

### **2.3 Fittings**

- A. All fittings to be PVC thermally fused color coated having a minimum thickness of 0.006" (0.152 mm) per ASTM F626. PVC color to match fabric and framework. Moveable parts, nuts and bolts to be field coated with PVC liquid touch up after installation.

- B. Post caps: ASTM F626 galvanized pressed steel, malleable iron, or aluminum alloy weather tight closure cap for tubular posts. Provide one cap for each post. "C" shaped line post without top rail do not require post caps. When top rail is specified provide line post loop tops to secure top rail.
- C. Rail ends: Galvanized pressed steel per ASTM F626, for connection of rails to post using a brace band.
- D. Top rail sleeves: 7" (178 mm) galvanized steel sleeve per ASTM F626.
- E. Wire ties: 9 gauge (0.148") (3.76 mm) galvanized steel wire for attachment of fabric to line posts and rails. Pre-formed hog ring ties to be 9 gauge (0.148") (3.76 mm) galvanized steel or aluminum for attachment of fabric to tension wire. Tie wire and hog rings PVC coated and in compliance with ASTM F626. Color to match fabric color.
- F. Brace and tension (stretcher bar) bands: ASTM F626 galvanized 12 gauge (0.105") (2.67mm) pressed steel by 3/4" (19mm) formed to a minimum 300-degree profile curvature for post attachment. Secure bands using minimum 5/16" (7.94 mm) galvanized carriage bolt and nut.
- G. Tension (stretcher) galvanized steel bars: One-piece lengths equal to 2 inches (50 mm) less than full height of fabric with a minimum cross-section of 3/16" x 3/4" (4.76 mm x 19 mm) per ASTM F626. Provide tension (stretcher) bars where chain link fabric is secured to the terminal post.
- H. Truss rod assembly: Galvanized steel minimum 5/16" (7.9mm) diameter truss rod with pressed steel tightener, in accordance with ASTM F626
- I. Barbed wire supporting arms: Galvanized pressed steel barb arm per ASTM F626 with provisions for attaching barbed wire. Provide arms with loop hole for applications using top rail. Arms shall withstand 250 lb. (113.5 kg) downward pull at outermost end of arm without failure. Arms add an additional 13 in. (330 mm) in height.
- J. Carriage bolts and nuts: Galvanized of commercial quality

#### **2.4 Chain Link Swing Gates**

- A. Fabricate chain link swing gates in accordance with ASTM F900. Gate frame to be of welded construction. Weld areas to be protected with zinc-rich paint per ASTM A780 then over coated with liquid PVC to match frame. The gate frame members are to be spaced no greater than 8' 0" (2.44 m) apart horizontally or vertically. Exterior members to be 1.900" (48.3 mm) OD pipe, interior members when required shall be 1.660" (42.2 mm) OD pipe. PVC coated pipe to be Grade 2 ASTM F1043 Group IC per section 2.03. Chain link fabric to match specification of fence system. Fabric to be stretched tightly and secured to vertical outer frame members using tension bar and tension bands spaced 12" (304.8 mm) on center and tied to the horizontal and interior members 12" (304.8 mm) on center using 9-gauge galvanized steel ties per section 2.04.
- B. Hinges, hot dip galvanized pressed steel or malleable iron, structurally capable of supporting gate leaf and allow opening and



closing without binding. Non-lift-off type hinge design shall permit gate to swing 180° (3.14 rad)

- C. Latch: Galvanized forked type capable of retaining gate in closed position and have provision for padlock. Latch shall permit operation from either side of gate.
- D. Double gates: Provide galvanized drop rod with center gate stop pipe or receiver to secure inactive leaf in the closed position. Provide galvanized pressed steel locking latch, requiring one padlock for locking both gate leaves, accessible from either side.
- E. Keeper to secure open leaves: Provide galvanized gate hold back keeper for each gate leaf over 5' (1524 mm) wide. Gate keeper shall consist of mechanical device for securing free end of gate when in full open position.
- F. Latch, hinges, moveable parts may be field coated with liquid PVC.
- G. Gate posts: PVC color coated Grade 2 pipe ASTM F1043 Group IC.

Gate fabric height up to and including 6 ft. (1.2m)	
Gate leaf width	Outside Diameter
up to 4 ft. (1.2 m)	2.375 in. (60.3 mm)
over 4 ft. to 10 ft.	2.875 in. (73.0 mm)
over 10 ft. to 18 ft.	4.000 in. (101.6 mm)
Gate fabric height over 6 ft. to 12 ft.	
Gate leaf width	
up to 6 ft. (1.8 m)	2.875 in. (73.0 mm)
over 6 ft. to 12 ft.	4.000 in. (101.6 mm)
over 12 ft. to 18 ft.	6.625 in. (168.3 mm)
over 18 ft. to 24 ft.	8.625 in. (219.1 mm)

## 2.5 Tension Wire

- A. Tension wire: Poly Vinyl Chloride (PVC) coated metallic coated steel tension wire per ASTM F 1664 PVC coating class and color to match chain link fabric

## 2.5 Post Setting Materials

- A. Concrete: Minimum 28-day compressive strength of 3,000 psi (20 MPa).
- B. Drive Anchors: Galvanized ASTM A36 steel drive anchor angle blades, 1" x 1" x 30" long secured to post with a pressed steel galvanized shoe clamp.

## PART 3 - EXECUTION

### **3.1 Chain Link Framework Installation**

- A. Install chain link fence system in accordance with ASTM F567 and manufacturer's instructions.
- B. Locate terminal post at each fence termination and change in horizontal or vertical direction of 30° or more.
- C. Concrete set posts: Dig holes in firm, undisturbed or compacted soil. Holes shall have diameter 4 times greater than outside dimension of post, and depths approximately 6" (152 mm) deeper than post bottom. Excavate deeper as required for adequate support in soft and loose soils, and for posts with heavy lateral loads. Set post bottom 36" (914 mm) below surface when in firm, undisturbed soil. Place concrete around posts in a continuous pour. Trowel finish around post and slope to direct water away from posts.  
  
Drive Anchor set line posts: With protective cap, drive post 36" (914 mm) into ground. Excavate a 6" (152.4 mm) diameter by 6" (152.4 mm) deep section around post to accommodate the drive anchor shoe clamp. Drive the 2 diagonal drive anchor angle blades into the soil and securely tighten the angle blades to the post using the shoe clamp, bury the shoe clamp.
- D. Check each post for vertical and top alignment, and maintain in position during placement and finishing operations.
- E. Bracing: Install horizontal brace and truss assembly at mid-height or above for fences 6' (1829 mm) and over at each fabric connection to the terminal post. The diagonal truss rod is installed at the point where the brace rail is attached to the terminal post and diagonally down to the bottom of the adjacent line post. Place the truss rod in tension by adjusting the turnbuckle.
- F. Tension wire: Install tension wires so that it will be located 4" (101.6 mm) up from bottom the fabric. If top rail is not specified, install the tension wire so that it will be located 4" (101.6 mm) down from the top of the fabric. Stretch and Install tension wire before installing the chain link fabric and attach it to each post using wire ties.
- G. Top rail: Install in lengths of 21' (6.400 m). Connect ends with sleeves forming a rigid connection, allow for expansion and contraction.
- H. Center Rails: Install mid rails between line posts and attach to post using rail end or line rail clamps.
- I. Bottom Rails: Install bottom rails between posts and attach to post using rail end or line rail clamps.
- J. Touch up any nicks or scratches of the PVC color coating with liquid PVC paint.

### **3.2 Chain Link Gate Installation**

- A. Swing gates: Installation of swing gates and gate posts shall be per ASTM F567. Direction of swing shall be as shown on drawings. Gates shall be hung plumb in the closed position with minimal space from grade to bottom of gate leaf. Double gate drop bar receiver shall be

set in a minimum concrete footing 6" (152 mm) diameter by 24" (610 mm) deep. Gate leaf holdbacks shall be installed on all double gates and all gate leafs greater than 5' (1524 mm) in width.

- B. Horizontal slide gates: Install cantilever and overhead horizontal slide gates and gate posts in accordance with ASTM F567. Horizontal sliding gates shall be plumb in the closed position with minimal ground clearance and slide with an initial force of 40 lbs. (18.14 kg). Double gate drop bar receiver shall be set in a minimum concrete footing 6" (152 mm) diameter by 24" (610 mm) deep. Install top and bottom safety roller covers and adjacent safety guide posts on ASTM F1184 Type II Class 2 external roller cantilever.

### **3.1 Chain Link Fabric Installation**

- A. Fabric: Install fabric on security side, pull fabric taut; thread the tension bar through fabric and attach to terminal posts with tension bands spaced maximum of 15" (381 mm) on center and attach so that fabric remains in tension after pulling force is released. Install fabric so that it is 2" (50 mm) +/- 1" (25 mm) above finish grade.
- B. Secure fabric using wire ties to line posts at 15" (381 mm) on center and to rails and braces 24" (610 mm) on center, and to the tension wire using hog rings 24" (610 mm) on center. Tie wire shall be secured to the fabric by wrapping it two 360 degree turns around the chain link wire pickets. Cut off any excess wire and bend back so as not to protrude so as to avoid injury if a pedestrian may come in contact with the fence.

### **3.2 Electrical Grounding**

- A. Grounding when required shall be the responsibility of a licensed electrical contractor.

### **3.3 Site Clean Up**

- A. Clean up area adjacent to fence line from debris and unused material created by fence installation.

(END OF SECTION 32 31 13)

## SECTION 32 80 00

### IRRIGATION

#### PART 1 - GENERAL

##### 1.1 Description

- A. Work performed under this Section of the Specifications shall be subject to the Contract Documents. Include labor and materials associated with excavating for and installing irrigation systems.
- B. Replace existing irrigation lines and sprinkler heads in-kind as shown on the Drawings.
- C. Essential Design and Performance Requirements:
  - 1. Demonstrate a clear, experience-based understanding of local rules and regulations governing water use for field landscapes. Meet all applicable state and local codes including plumbing and electrical codes.
  - 2. Obtain direct knowledge of site conditions by field inspection, review of soils and planting specifications and design, discussions with the Engineer.
  - 3. Specify manufacturer, model, type, and size of all components to facilitate ongoing maintenance and management of the system.
  - 4. Design the irrigation system so that it can be installed efficiently on an active construction site, in cooperation with other construction trades with minimal coordination and installation difficulties.
  - 5. Design, select and place irrigation components, including overhead sprinkler and drip/micro-irrigation components in accordance with the Engineer's design intent.
  - 6. Design and install an irrigation system that will provide for a minimum establishment period of three years for turf areas.
  - 7. Design and implement a zone system that will allow for progressive reduction in supplemental water as landscape elements become fully established. Recognize that the system will need to be operational even after landscape establishment to respond to periods of unforeseen heat and drought.
  - 8. Verify the water source meets peak demand for landscape water with an irrigation duration limited to night-time use.
  - 9. Protect the water source in accordance with all state and local requirements. Protect potable water sources above all other criteria. In the absence of suitable state or local requirements, assess the degree of hazard and specify the necessary and appropriate backflow

protection, metering and application rates. Recommend changes in planting design to protect potable water.

10. For zones with drip irrigation:

- a. Specify filtration at the control valve to remove particulate matter.
  - b. Separate drip-irrigation zones from overhead irrigated zones since drip-irrigation systems to protect against water losses due to evaporation, wind, or surface runoff.
  - c. Design and implement a system that allows watering rates to be adjusted to respond to differing site conditions.
  - d. Consider differing plant water requirements and root zone depths and use separate drip-irrigation zones where practical.
  - e. Specify pressure-compensated devices to improve overall uniformity.
  - f. Specify pressure regulation upstream from the drip-irrigation to avoid damage to systems that have no pressure regulation. Forego and omit only when absolute maximum possible pressure is verified to be lower than the maximum allowable pressure of all drip-irrigation components.
  - g. Utilize BMPs to improve uniformity and limit contamination of lines.
- D. This specification is intended as an outline to irrigation requirements. Submit a complete design and working plan, outlining all irrigation requirements, for review and acceptance by the Engineer. The Contractor shall be required to furnish install all materials necessary to complete the irrigation systems in accordance the best practice and to the full intent of the Contract Documents and the requirements described in this Section. Determine available water pressure and GMP and size irrigation system accordingly.
- E. Trench excavation, backfilling and bedding materials, together with the testing of the completed installation shall be included in this work.
- F. The work shall be constructed and finished in every respect in a good, workmanlike and substantial manner, to the full intent and meaning of the Drawings and Specifications. All parts necessary for the proper and complete execution of the work, whether the same may have been specifically mentioned or not, or indicated on the Drawings, shall be done or furnished in a manner corresponding with the rest of the work as if the same were specifically herein described.
- G. Install a below grade irrigation pump system that will provide a mechanical point of connection for the irrigation system. Connection between pump system and the irrigation system shall be a new 3-inch pipe.
- H. The electrical point of connection for the irrigation system shall be to a 120-volt, 20-amp building electrical circuit provided and installed by others. Contractor shall provide controllers equipped with an indoor

electrical box. If Owner decides to locate the controllers outside, supply a suitable outdoor rated enclosure.

- I. Develop design drawings for the irrigation system that are integral and Complementary of these Specifications. Furnish and install all parts, which may be required by the approved Design Drawings and omitted by the Specifications, or vice versa, just as though required by both. Should there appear to be discrepancies or question of intent, refer the matter to the Owner for decision, and his interpretation shall be final, conclusive and binding.
  
- J. In every respect construct and furnish all irrigation work in a good, workmanlike and substantial manner, to the full intent and meaning of the Drawings and Specifications. All parts necessary for the proper and complete execution of the work, whether they may have been specifically mentioned or not, or indicated on the approved design drawings, shall be done or furnished in a manner corresponding with the rest of the work as if the same were specifically herein described.

## **1.2 Measurement and Payment**

- A. Measurement and payment requirements per Contract Documents.
- B. Backfill material shall be placed in accordance with the Contract documents. Payment for backfill material shall be provided per the applicable material specification.

## **1.3 Related Work**

- A. Carefully examine all of the Contract Documents for requirements that affect the Work of this Section.
  - 1. 31 3300 EARTHWORK
  - 2. 32 1823.13 INFIELD MIX
  - 2. 32 9220 SEEDING

## **1.4 Laws and Regulations**

- A. Work shall be accomplished in accordance with regulations of local, county, state and federal agencies or utility company standards as they apply.

## **1.5 Examination of Conditions**

- A. Fully inform yourself of existing conditions on the site before submitting his bid, and shall be fully responsible for carrying out all work required to fully and properly execute the work of the Contract, regardless of the conditions encountered in the actual Work. No claim for extra compensation or extension of time will be allowed on account of actual conditions inconsistent with those assumed.

## **1.6 Quality Assurance**

- A. Installer: A firm, which has at least 5 years' experience in work of the type and size required by this Section and which is acceptable to the

Owner.

- B. References: The Contractor must supply three references for work of this type and size with their bid including names and phone numbers of contact person(s).
- C. Applicable requirements of accepted Standards and Codes shall apply to the Work of this Section and shall be so labeled or listed:
  - 1. American Society for Testing & Materials (ASTM)
  - 2. National Plumbing Code (NPC)
  - 3. National Electric Code (NEC)
  - 4. National Sanitary Foundation (NSF)
  - 5. American Society of Agricultural Biological Engineers (ASABE)
  - 6. Underwriters Laboratories, Inc. (UL)
  - 7. Occupational Safety and Health Regulations (OSHA)
  - 8. American Society of Irrigation Consultants (ASIC)
- D. Obtain Engineer's acceptance of installed and tested irrigation system prior to installing backfill materials.
- E. Commission a 3rd-Party audit of the irrigation system to verify design, materials and installation conforms to the requirements of Design and Performance Criteria. Any deficiencies and shortcomings shall be repaired or offending systems corrected or replaced as directed by the Engineer based on 3rd-Party evaluation.
- F. Submit a scope and fee for services to provide full and complete inspection, management and maintenance of the installed irrigation system during its time of seasonal operation. Anticipate that the entire system will be designed and installed to exacting standards and maintenance of the top-quality, state-of-the-art automatic irrigation system will be performed by you. Make all corrections to the automatic irrigation system that you installed. No compensation will be provided for any component of the automatic irrigation system that was installed in error or in design.

#### **1.7 Tests**

- A. Observation: The Engineer will be on site at various times to insure the system is being installed according to the Specifications and Drawings.
- B. Coverage Test: After completion of the system, test the operation of entire system and adjust sprinklers as directed by the Owner. Demonstrate to the Owner that all irrigated areas are being adequately covered. Furnish and install materials required to correct inadequacies of coverage due to deviations from the Drawings or where the system has been willfully installed when it is obviously inadequate or inappropriate without bringing it to the attention of the Owner. See Part 3 - Execution).
- C. The Owner shall be notified 7 days in advance for observations.
- D. During punch listing, the contractor shall be responsible for having two-way communication and sufficient personnel to provide instantaneous

communication between the observation area and the controller for the system.

### 1.8 Shop and Design Drawings

- A. Submit to the Engineer in electronic PDF format Samples, Certifications, Shop Drawings and Catalog Cuts, Manufacturer's product data and certified test results for all materials required.
- B. Provide copies of product specification sheets on all proposed equipment to be installed to the Engineer for approval prior to the start of work. Work on the irrigation system may not commence until product sheets are submitted and approved. Submittals shall be marked up to show proper nozzles, sizes, flows, etc. Equipment to be included:
  - 1. Sprinkler Heads and Nozzles
  - 2. Drip Tubing and Fittings
  - 3. MP Rotator Nozzles
  - 4. Bubblers
  - 5. Valves: Manual and Automatic
  - 6. Controllers and Enclosures
  - 7. Decoders
  - 8. Surge Arrestors
  - 9. Flow Sensors
  - 10. Plug-In Class 2 Transformer
  - 11. Electrical Mounting Box
  - 12. Valve Boxes
  - 13. Pipe and Fittings
  - 14. Wire and Connectors
  - 15. Quick Coupling Valves
  - 16. Sprinkler Supports
  - 17. Rain Sensors
  - 18. Grounding Equipment
  - 19. Air/Vacuum Relief Valves (Mainline)
  - 20. Air/Vacuum Relief Valves (Drip)
  - 21. Automatic Flushing Valves (Drip)
  - 22. Deep Drip Stakes (Drip)
  - 23. Disk Filters (Drip)
  - 24. Pressure Regulators (Drip)
  - 25. Miscellaneous Materials
- C. Project Record Documents:
- D. Provide and keep up-to-date a complete redlined Record Set of Drawings of the system as the project proceeds. Correct drawings daily, showing every change from the original Drawings and Specifications. Record Drawings shall specify and exactly locate sprinkler type; pop up height and nozzle for each sprinkler installed. Each valve box location to be referenced by distance from a minimum of two permanent locations. Controllers, rain sensors, air vacuum relief valves, automatic flushing valves, quick coupling valves, well and all other equipment shall be indicated on the drawings. All wire routing, wire size and splices shall be indicated. Main line pipe and wire route shall have two (2) distinctly



different graphic symbols (line types). The redlined record set of drawings shall be kept at job site and shall be used only as a record set.

- E. On or before the date of final field observation, deliver corrected and Completed AutoCAD computer plots of "as-built record drawings on vellum and AutoCAD electronic files on disk to Owner as part of contract closeout. Delivery of plots will not relieve Contractor of the responsibility of furnishing required information that may have been omitted from the prints.

#### **1.9 Delivery, Storage and Handling**

- A. Store and handle all materials in compliance with manufacturer instructions and recommendations. Protect from all possible damage. Minimize on-site storage.

#### **1.10 Guarantee**

- A. Obtain in the Owner's name the standard written manufacturer's guarantee of all materials furnished under this Section where such guarantees are offered in the manufacturer's published product data. All these guarantees shall be in addition to, and not in lieu of, other liabilities that the Contractor may have by law.
- B. In addition to the manufacturers guarantees warrant the entire irrigation system, both parts and labor for a period of one year from the date of acceptance by the Owner.
- C. As part of the one-year warranty perform the first year-end winterization and spring startup for the irrigation system.
- D. Should any problems develop within the warranty period because of inferior or faulty materials or workmanship, they shall be corrected to the satisfaction of the Owner at no additional expense to the Owner.

#### **1.11 Coordination**

- A. The Contractor shall at all times coordinate his work closely with the Engineer and Owner to avoid misunderstandings and to efficiently bring the project to completion. The Engineer shall be notified as to the start of work, progression and completion, as well as any changes to the drawings before the change is made. The Contractor shall also coordinate his work with that of his sub-contractors.
- B. The Contractor shall be held responsible for and shall pay for all damage to other work caused by his work, workmen or sub-contractors. Repair such damage, as directed by the Engineer at no additional cost to the Owner.

#### **1.12 Maintenance and Operating Instructions**

- A. Include in your Bid an allowance for four (4) hours of instruction of Owner and/or Owner's personnel upon completion of check/test/start-

up/adjust operations by a competent operator (Notify the Engineer's office at least one week in advance of check/-test/start-up/adjust operations).

- B. Upon completion of work and prior to application for acceptance and final payment, submit a minimum of 3 three ring, hard cover binders titled MAINTENANCE AND OPERATING INSTRUCTIONS FOR THE P.A.R.C. SOFTBALL FIELD IRRIGATION SYSTEM, to the Engineer. After review and approval, the copies will be forwarded to the Owner. Included in the Maintenance and Operating binders shall be:
1. Table of Contents
  2. Written description of Irrigation System.
  3. System drawings:
    - a. One (1) copy of the original irrigation plan;
    - b. One (1) copy of the Record Drawing;
    - c. One (1) reproducible of the Record Drawing;
    - d. One (1) copy of the controller valve system wiring diagram
  4. Listing of Manufacturers.
  5. Manufacturers' data where multiple model, type and size listings are included; clearly and conspicuously indicating those that are pertinent to this installation.
    - a. "APPROVED" submittals of all irrigation equipment;
    - b. Operation:
    - c. Maintenance: including complete troubleshooting charts.

### **1.13 Parts List**

- A. Names, addresses and telephone numbers of recommended repair and service companies. A copy of the suggested "System Operating Schedule" which shall call out the required zone run time in minutes per day and days per week in order to provide the desired amount of water to each area under "no-rain" conditions.
- B. Winterization and spring start-up procedures.
- C. Guarantee data.

### **1.14 Procedure**

- A. Provide and install temporary support, adequate protection and maintenance of all structures, drains, sewers, and other obstructions encountered. Where grade or alignment is obstructed, the obstruction shall be permanently supported, relocated, removed or reconstructed as directed by the Engineer or Owner.

## **PART 2 - PRODUCTS**

### **2.1 General**

- A. All materials to be incorporated in this system shall be new and without flaws or defects and of quality and performance as specified and meeting the requirements of the system. All material overages at the completion of the installation are the property of the Contractor and shall be removed from the site.

- B. No material substitutions from the irrigation products described in these specifications and shown on the drawings shall be made without prior approval and acceptance from the Engineer.

## **2.2 PVC Irrigation Pipe**

- A. Pipe 2-1/2 inches and smaller shall be Class 200, Type 1120, SDR 21, Solvent-Weld PVC, conforming to ASTM No. D2241 as manufactured by IpeX, JM Eagle, Silverline or approved equal.
- C. Pipe 3 inches and larger shall be Class 200, Type 1120, SDR 21, Gasket-Joint PVC, conforming to ASTM No. D1784 as manufactured by IpeX, JM Eagle, Silverline or approved equal.
- D. Pipe sleeves beneath non-soil areas shall be PVC, ASTM D1784, Class 160 water pipe as manufactured by IpeX, JM Eagle, National or approved equal.
- E. All pipe shall bear the following markings: Manufacturer's name, nominal pipe size, schedule or class, pressure rating in psi, and date of extrusion.
- F. The pipe insertion mark shall be visible to show the proper depth into spigot.

## **2.3 PVC Irrigation Fittings**

- A. Fittings for solvent weld PVC pipe shall be Schedule 40 or 80 solvent weld PVC fittings as manufactured by Dura, Lasco, Spears or approved equal. Fittings shall bear manufacturer's name or trademark, material designation, size, and applicable I.P.S. schedule.
- C. Fittings at directional changes, pipe reductions and plugs, 3- inch and larger shall be deep bell push-on gasket joint ductile iron fittings. Fittings shall be manufactured of ductile iron, grade 70-55-05 in accord with ASTM A536 and gaskets shall meet ASTM F477. Fittings shall be as manufactured by Harrington Corporation or approved equal.
- D. Mainline pipe to zone valve / lateral pipe connections 3 inches and above shall be manufactured by the Harrington Corporation or approved equal push-on gasket joint ductile iron service tees.
- E. PVC threaded connections in and out of valves shall be made using Schedule 80 tee nipples and Schedule 40 couplers or socket fittings. Schedule 40 threads shall not be specified.
- F. PVC solvent shall be NSF approved, for Type I and Type II PVC pipe, and Schedule 40 and 80 fittings. Cement shall meet ASTM D2564 and FF493 for potable water pipes. PVC solvent cement shall be medium set, not fast (no wet and dry, or hot) Rectorseal Gold, IPS Weld-On 711, Oatey Heavy Duty Cement or approved equal, and shall be used in conjunction with the appropriate primer.
- G. Primer shall be NSF approved, and formulated for PVC and CPVC pipe

- applications. Primer is to meet ASTM F 656. Primer shall be Rectorseal Jim PR-2, IPS Weld-On P-68, Oatey Primer for PVC and CPVC, or approved equal. Clear primers shall not be specified.
- H. Nipples to be schedule 80 molded PVC as manufactured by Dura, Lasco, Spears or approved equal.
  - I. Sleeving shall be installed wherever piping is going under hardscape areas. Minimum cover over sleeving pipe shall be 24 inches. Sleeving shall extend 18 inches beyond edges of walls and pavement. Sleeving shall be field marked with a vertical wooden stake extending above grade or other means to require field location at the time of irrigation installation.
  - J. Pipe shall be laid on undisturbed trench bottom required suitable base is available - no rock; if not, excavate to 2-inch below pipe invert and require and install sand base or crushed stone upon which to lay pipe.
  - K. Backfill material shall contain no foreign matter and no rock. Backfill shall be laid-up in 6-inch (maximum) lifts and tamped to compaction with mechanical equipment. Compact backfill in trenches to dry density equal to the adjacent undisturbed soil, and conform to adjacent grades without dips, sunken area, humps, or other irregularities. Frozen material shall not be used for backfill.
  - L. Require welded joints have at least 15 minutes' set-up/curing time before moving or handling. When the temperature is above 80° F, require connections to set minimum 24 hours before pulling or pressure is applied to the system. When temperature is below 80° F, require following manufacturer's recommendations.
  - M. Mainline pipe shall have minimum 22 inches of cover and lateral pipe shall have minimum 16 inches of cover for PVC and 12 inches of cover for polyethylene unless otherwise dictated by project conditions.
  - N. Open end(s) of the pipe shall be closed by a watertight plug or other means at all times. Pipe not to be installed that day shall not be laid out. Should water enter the trench during or after installation of the piping, no additional piping may be installed or backfilled until water is removed from the trench. Pipe shall not be installed when water is in the trench, when precipitation is occurring, or when the ambient temperature is at 40° F or below.
  - O. Route pipe on drawings to prevent damage to tree roots.
  - P. Require 3-inch minimum clearance between sprinkler lines and lines of other trades. Irrigation lines shall not be installed directly above another line of any kind.
  - Q. Prior to installation of sprinkler internals or tree stake emitters require flushing of the pipe system under a full head of water.
  - R. Bell and gasket mainline pipe and fittings shall have thrust blocks sized and placed in accordance with pipe manufacturer's

recommendations. Thrust blocks shall be installed at tees, elbows, crosses, reducers, plugs, caps and valves.

- S. Size of thrust block shall be determined by working pressure, size and type of fitting, and soil conditions as per ASABE Standard S376.2 and pipe and fitting manufacturer's recommendations. Thrust blocks shall be installed against undisturbed soil. Bricks, stones, boulders, etc. shall not be approved as thrust blocks or thrust block material.
- T. Thrust blocks shall utilize standard concrete mix shall be in accordance with ASTM C150, ASTM C-33, and ASTM C-94 with a compressive strength (28 days) of 3,000 psi.
- U. Prefabricated concrete blocks shall not be allowed for thrust blocks.

#### **2.4 Brass Pipe and Fittings**

- A. Brass pipe shall be 125lb., cast bronze, ground joint pattern, threaded, ASTM B43-98.
- B. Brass fittings shall be cast bronze, screwed, 125lb. Class.

#### **2.5 PVC Pipe Sleeves**

- A. All pipe sleeves beneath non-soil areas shall be PVC minimum, Class 160 water pipe as manufactured by Cresline, Carlon, JMM or equal. Minimum sleeve size to be 3-inch.

#### **2.6 Wire Conduit**

- A. Conduit for wiring beneath non-soil areas shall be PVC, SCH-40 conduit with solventweld joints, as manufactured by Cresline, Carlon, JMM or approved equal.
- B. Sweep ells shall be standard electrical type PVC schedule 40 long sweep elbows. Cap sweep ell with tri-plug with the ring for securing nylon pull rope.
- C. Conduits shall extend 18 inches beyond edges of walls and pavement.
- C. Conduit for above ground wiring to rain sensors or controllers shall be rigid metallic conduit or as approved by the Engineer or Owner.

#### **2.7 Polyethylene Irrigation Pipe**

- A. Lateral piping 1-1/4 inch and smaller may be installed with polyethylene (PE3408) pipe, SDR 15, Class 100, Type III, Grade 3, Class C conforming to ASTM D2239, with a minimum pressure rating of 100 psi as manufactured by Cresline, Oil Creek, Polystar or approved equal.

#### **2.8 Polyethylene Fittings**

- A. Fittings shall be insert PVC or Nylon type fittings. Fittings shall conform to NSF standards and be attached with two (2) offset dog-eared stainless steel clamps.
- B. Clamps shall be as manufactured by Murray, Oetiker or approved equal.
- C. Fittings shall be marked by the manufacturer with the appropriate ASTM designations and pressure ratings. Fittings shall be per ASTM D2609 as manufactured by Dura, Lasco, Spears or approved equal.

## **2.9 Spray Sprinklers**

- A. Pop up spray sprinklers shall be pressure regulating (30-psi), plastic construction with ratcheting riser, removable nozzle and check valve. Nozzle sizes shall be match precipitated, fixed arcs and indicated on the drawing legend. Pop-up heights shall be 4 inches for turf and 12 inches for groundcover and shrubs. Variable arc nozzles (van) shall only be allowed where a fixed arc is not available.

Sprinklers shall carry a minimum 3-year exchange warranty against defects. Sprinklers shall be manufactured by Hunter Industries Model PROS-04/12-PRS30-CV, Rain Bird Model 1804/1812-SAM-PRS or approved equal.

## **2.10 Rotary Sprinklers**

- A. Full and part circle pop up sprinklers with multi-stream, multi-trajectory rotary nozzles shall be pressure regulating (40/45-psi), plastic construction with ratcheting riser, removable nozzle and check valve. Nozzle size shall be as indicated on the drawing and on the legend. Pop-up height shall be 4 inches for turf and 12 inches for groundcover and shrubs.
- B. Multi-stream adjustable rotary nozzles shall be manufactured by Hunter Industries, model MP2000, MP 3000 or approved equal for 11-19-foot spacing and 20-30-foot spacing's respectively. Variable arc rotator nozzles shall not be allowed.
- C. Sprinkler shall carry a minimum 3-year exchange warranty against defects. Sprinklers shall be manufactured by Hunter Industries model PROS-04/12-PRS40-CV, Rain Bird model 1804/12-SAM-PRS-P45 or approved equal.

## **2.11 Small/Medium Rotary Sprinklers**

- A. Small/medium rotary sprinklers shall be gear-driven, rotary type sprinklers, designed for in-ground installation with integral check valves and in-riser flow shut-off capability. Sprinkler shall be capable of covering a 25-44-foot radius and flow range of 0.9-7.0 gpm at 50-55 pounds per square inch of pressure.
- B. Sprinklers shall have a one hundred percent warranty for two years'

minimum against defects in workmanship.

- C. Nozzle assembly shall elevate minimum four inches when in operation and retraction shall be achieved by a stainless-steel spring. Riser assembly shall be plastic. A nozzle wiper seal shall be included in the sprinkler for continuous operation under the presence of sand and other foreign material.
- D. Sprinkler parts shall be removable through the top of the unit through the removal of a heavy-duty threaded cap. Sprinkler shall have a three quarter-inch (3/4") IPS water connection on the bottom of the sprinkler.
- E. Nozzles (quarter, half, full, etc.) shall be matched precipitated.
- G. Sprinklers shall be manufactured by Hunter Industries model I20-04, Rain Bird model 5004-PL-SAM or approved equal.
- H. Sprinklers shall not exceed maximum spacing indicated on the drawings.
- I. Require sprinkler zone operation adjustment after installation using flow control device on valve.
- J. Two (2) wrenches or keys for disassembling and adjusting sprinkler shall be required.

## **2.11 Large Rotary Sprinklers**

- A. Large rotary sprinklers shall be gear-driven, rotary type with drain check valve and stainless steel riser designed for in-ground installation. The nozzle assembly shall elevate three inches when in operation and retraction shall be achieved by a stainless steel spring. Check valve shall be capable of holding up to 10 feet of elevation. Sprinkler shall be capable of covering a 49-61-foot radius and flow range of 7.5 to 15.7 gpm at 60 pounds per square inch of pressure.
- B. Sprinkler parts shall be removable through the top of the unit by removing a heavy duty threaded cap. The sprinkler shall have a one-inch (1") IPS water connection on the bottom of the sprinkler.
- C. Nozzles (quarter, half, full, etc.) shall be matched precipitated or zoned accordingly.
- E. Sprinklers shall be manufactured by Hunter Industries model I25-04-SS, Rain Bird model 8005-SS or approved equal.
- F. Sprinklers shall not exceed maximum spacing indicated on the drawings.
- G. Require sprinkler zone operation adjustment after installation using flow control device on valve.

- H. Two (2) wrenches or keys for disassembling and adjusting sprinkler shall be required.

#### **2.12 Flood and Stream Bubblers**

- A. Bubblers shall be pressure compensating stream or flood type, have a non-adjustable flow rate, 1/2 inch female threads and a 1/2-inch filter screen. Bubblers shall be match precipitated.
- C. Bubblers assemblies shall be manufactured by Hunter Industries, model MSBN or PCB series, Rain Bird, model 1300 or 1400 series or approved equal.
- D. Install bubblers on 1/2 inch Schedule 80 PVC TBE nipple riser, length as required.

#### **2.13 Electric Control Valves**

- A. Electric control valves shall be one (0-25 gpm), one and one half (26-40 gpm) and two(41 gpm and larger) inch remote control, diaphragm type, fiberglass or reinforced nylon body plastic valves with manual flow control, manual bleed screw and 200 psi pressure rating.
- B. Where necessary to require proper pressure to the sprinklers, valve shall include a pressure regulating accessory to be install on the solenoid assembly as manufactured by Hunter Industries model Accusync, Rain Bird model PRS or approved equal.
- C. Valves shall be manufactured by Hunter Industries model ICV, Rain Bird model PEB or approved equal.
- D. Control valves shall be installed on a level crushed stone base. Valves shall be set plumb with adjusting handle and bolts, screws and wiring accessible through the valve box opening. Valves shall be set in a plumb position with 24-inch minimum maintenance clearance from other equipment.

#### **2.14 Valve Boxes**

- A. Valve boxes shall be manufactured from unformed resin with a tensile strength of 3,100-5,500 psi conforming to ASTM D638. Boxes shall be green or black in color.
- B. Valve box for mainline ringtite isolation gate valves, 3 inches and larger, shall be 5-1/4-inch round valve boxes with poly-iron (detectable) sleeves. Top piece shall be 15-1/2 inches long and bottom piece 24 inches. Top shall turn on bottom section for adjustment to grade.
- C. Valve boxes for small isolation valves, wire splices and quick coupling valves shall be 10-inch round valve boxes with metal detection, T-top lids and bolt down covers.
- D. Valve boxes for single electric valves with isolation and dual 1 inch and 1-1/2 inch electric valves with isolation shall be 12-inch standard



valve boxes with metal detection, T-top lids and bolt down covers. When multiple 1 inch and 1-1/2 inch electric valves are installed in the same area, they are to be installed no more than two (2) valves per box in a 12-inch standard box.

E. Valve boxes for air release valves, single and dual 2 inch valves with isolation and deep drip stake tree zones shall be 18-inch jumbo valve boxes with metal detection, T-top lids and bolt down covers. When multiple 2 inch electric valves are installed in the same area, they are to be installed no more than two (2) valves per box in an 18-inch standard box.

E. Splice boxes shall have gray lids.

F. Valve boxes shall be manufactured by Highline Products, Olde Castle Specification Grade, NDS Pro Series or approved equal. Valve box extensions shall be made by the same manufacturer as the box.

G. Require a valve access box for each electric valve, quick coupling valve, isolation valve, flushing valve and wire splice.

H. Valve boxes shall be set on a minimum 4-inch crushed stone base.

I. Valve boxes shall be parallel or perpendicular to hardscape edges and equidistance to other valve boxes installed in the same location. A sufficient amount of turf or planting shall remain in place between each valve box and between valve boxes and hardscapes.

J. Valve box extensions shall be required on valve boxes in order to install valve box covers at grade.

K. Valve box locations shall be in mulched areas where possible. Engineer shall approve location of valve box locations before installation.

M. Bricks, stones, etc. shall not be used to support valve boxes.

## **2.15 Automatic controller**

A. Irrigation system controller shall be electronic in construction with capability of up to 10 hour run times per zone in increments of 1 or 10 minutes. Controllers to have minimum four independent programs, auto/off switch and be capable of manual, semi-automatic and automatic operation. Controller shall have water budgeting feature, cycle and soak feature, sensor input terminal, locking, weather resistant metal cabinet and internal transformer. Terminal strip connection shall be easily accessible. The controller shall be U.L. listed, 120 volt, 60 Hertz, A.C. type.

B. Controller shall have flow monitoring capability with compatible flow sensor connection. Controller shall be capable of automatic flow learning per station and have station level flow diagnostics and alarm shutdown.

C. Controller station operation shall be of automatic sequential stacking to avoid overlapping operation unless programmed to overlap and 0 to 300% water budgeting feature in 1% increments by program.

D. Controller shall have dual master valve/remote pump start circuit for use with a master valve to pressurize the system when the irrigation cycle starts. Master valve/pump start circuit shall be programmable by station.

E. Controller shall be capable of being operated manually at any time. A single station, a group of stations, or a program can be selected to run for the programmed time without affecting the normal program. This controller shall be capable of running a variable system test program without affecting the normal program.

F. Controller shall be compatible with the UMass Lowell's Rain Bird IQ irrigation central control system.

G. Controller shall have an internal non-volatile memory, which will retain the irrigation program and the programmed date and time for a minimum of 100 years without power. A 9 VDC rechargeable battery and recharging circuit shall also be included for counting down the program-in-progress during a power outage and shall allow programming of the controller when it is disconnected from the main power supply.

H. Controller shall be UL Listed as a manufactured product.

I. Controller shall be as manufactured by Rain Bird, model LXME-F, or LXD-F with Rain Bird IQ3G-USA SIM card and IQNCC-Communication Cartridge or approved equal.

J. Station quantity shall be number of zones on the design plus spare wires indicated on the drawings plus two empty stations.

K. Include external antenna on outside of enclosure, Rain Bird IQEXTANTGP or approved equal. Connect antenna with NCX connectors, male and female.

L. Controller shall be mounted in the specified stainless steel enclosure. Zone wires shall be labeled as to zone/station served at controller.

M. Controller shall be installed on new concrete base, poured-in-place. Expansion shield shall not be used. Contractor to use template to install poured-in-place stainless steel "J" bolts to fasten enclosure base. Prefabricated controller base shall not be specified or allowed for installation.

N. Controller shall be installed on the pad to allow the operator to stand on the pad in front of the controller during programming and maintenance. A minimum of 6 inches of concrete shall remain on the left and right sides of the controller. No part of the controller shall hang over the pad.

O. Install minimum one (1), 3 inch PVC conduit sweep ell and spool piece through controller pad as required for 24-volt valve wiring. Install minimum one (1), 1-1/2 inch PVC conduit sweep ell and spool piece through controller pad for #6 AWG bare copper wire. Install minimum two (2), 1 inch PVC conduit sweep ell and spool piece through controller pads for power and flow meter wires. Maintain required depth of bury in/out of pad.

P. Controller power wire, communication and #6 AWG bare copper wire shall be brought to the exterior through separate sleeves in the support pad. Grounding wire shall be installed through the controller concrete pad through a separate 1-1/2-inch sweep in accordance with NEC.

Q. Require sealing of enclosure sweep holes with expandable foam insulation.

R. Controller shall be installed level on pad and tight to the base (no gaps).

S. Keys shall be turned over to Owner.

## **2.16 Decoders**

A. Decoders shall be installed between the controller and the electric control valves to provide the 24-volt power supply for individual valves. Each decoder shall be available in 1, 2 or 4-station devices. Decoder shall have a unique serial number and controller assigned address to identify it in the network.

B. Decoders shall be 1, 2 or 4 stations, Rain Bird FS Series, models FD-101, FD-102, FD-202 and FD-401 or approved equal. Six station decoders shall not be allowed.

C. Flow sensor decoder shall communicate pulses from the flow meter to irrigation controller for the two-wire system.

D. Flow sensor decoder shall be manufactured Rain Bird, model SD-210 or approved equal.

## **2.17 Surge Arrestor (Controller)**

A. Modular surge arrester shall be a single phase, two pole arrester designed to protect single or split phase 120 volt or 120/240 volt electrical systems. Electrical connections shall be embedded in a UL recognized epoxy to seal and protect them from moisture and corrosion.

B. Surge arrester shall be molded from weather and UV resistant polycarbonate, complying with the UL Standard for flame and strength resistance.

C. Ground wire from arrester, together with the power supply ground wire shall be grounded to the grounding grid.

D. Arrestor shall include green (okay) and red (replace) LED indicator lights.

E. Surge Arrestor shall be manufactured by Intermatic, Paige Electric, model, AG2401C250090LED with mounting bracket, or approved equal.

#### **2.18 Surge Arrestor (Two Wire Path)**

A. Surge arrestor shall directly connect to the two-wire path and requires no power from the two-wire path.

B. Surge arrestor shall be fully sealed and capable of direct burial. It shall have three wires. The red and black wire 12-inches in length connect to the two-wire path, and the green ground wire connects to the grounding system.

C. Arrestor shall be manufactured by Rain Bird, Model LSP1-Turf, or approved equal.

#### **2.19 Flow Sensor**

A. Flow sensor shall have ability to track flow through the Rain Bird or approved equal controller. Flow sensor must be accurate to within plus or minus 1% of full scale and display repeatability of plus or minus 0.5% of full scale. Flow sensor shall be installed according to Manufacturer recommendations for the appropriate pipe size. Flow sensors shall be Rain Bird FS Series sensors or approved equal.

B. Flow sensor shall be installed on a level crushed stone base with required upstream and downstream pipe lengths.

C. Install flow sensor in minimum 10-inch round valve box separated from other equipment per the flow sensor instruction requirements.

D. Communication cable shall be installed from controller to flow sensor. Connect flow sensor using one pair of the 18-6, three pair cable and waterproof connections.

#### **2.20 Identification Tags**

A. Valves shall have ID tags attached. ID tags shall be manufactured from Polyurethane Behr Desopan. Provide one tag for each electric valve. Use one maxi size tag for electric control valve. Each tag shall provide valve and station number information, controller designation if applicable for multiple controller sites or decoder identification code.

B. Tags shall be manufactured by T. Christy Enterprises, Paige Electric or approved equal.

#### **2.21 Master Valve**

A. Electric master valve shall be remote control, diaphragm type, fiberglass or reinforced nylon body plastic valve with manual flow

control, manual bleed screw and 200 psi pressure rating sized for the project water supply flow.

B. Master valve shall be manufactured by Hunter Industries model ICV, Rain Bird model EB or approved equal.

C. Master valve shall be installed on a level crushed stone base. Valve shall be set plumb with bolts, screws and wiring accessible through the valve box opening. Valve shall have a maintenance clearance from other equipment.

D. Install master valve in minimum 10-inch round valve box.

E. Master valve requires dedicated control wire from controller #14 AWG UF solid copper control wire and #12 AWG UF solid copper common wire. Common shall be white and control shall be red in color for master valve operation.

## **2.22 Stainless Steel Enclosures**

A. Enclosure shall be vandal and weather resistant in nature manufactured entirely of 304-grade stainless steel. The main housing door shall be louvered at the bottom and equipped with a hollow center thermoplastic door seal. The entry lip shall be louvered on the backside. Filter screens shall cover all louvers. The top entry lid shall have two gas springs, for easy access, a continuous stainless steel piano hinge, and a threepoint locking mechanism with provisions for padlock. Enclosure shall include a mounting plate for the controller face plate. Removable stainless steel tray shall be provided and installed for the mounting of electronics and other equipment.

B. Enclosure shall be a NEMA 3R Rainproof Enclosure as listed by Underwriters Laboratories, Inc.

C. Controller enclosure shall be 16 inches wide x 15.5 inches deep x 38 inches tall, as manufactured by Strong Box, model SB-16SS with Tray16RBLX or approved equal.

D. Install enclosure on concrete pad, where indicated on the drawings. Standard concrete mix shall be in accordance with ASTM C150, ASTM C-33, and ASTM C-94 with a compressive strength (28 days) of 3,000 psi. Final location of enclosures shall be coordinated with the UMass Lowell Project Manager as to best screen the enclosure and deter vandalism.

E. Concrete pad for controller enclosure shall be minimum 28 inches wide by 28 inches deep by 6 inches thick. Base shall be installed on a minimum 6-inch crushed stone base. Require one (1) 1-inch sweep elbow (power), one (1) 1-1/2-inch sweep elbow (ground), and one (1) 3-inch sweep elbow (field wiring) through concrete pad into controller enclosure.

## **2.23 Quick Coupling Valves**

A. Valve body shall be of cast brass construction with a working pressure of 125 psi. The valve seat disc plunger body shall be spring loaded so that the valve is normally closed under conditions when the key is not inserted.

B. Top of the valve body receiving the key shall be equipped with ACME threads and smooth face to require the key to open and close the valve slowly. The quick coupling valve shall be equipped with a vinyl cover.

C. Valve body construction shall be such that the coupler seal washer may be removed from the top for cleaning or replacement without disassembling any other parts of the valve.

D. Keys shall be ACME with 1-inch male thread and 3/4-inch female thread at the top.

E. Require one (1) key for every four quick couplers with 1-inch x 3/4-inch swivel hose ends.

F. Quick coupling valves, keys and swivels shall be manufactured by Hunter Industries, model HQ-44RC-AW, HK-44A and HS-1 or approved equal.

G. Quick coupling valves to be installed on 1-inch prefabricated PVC unitized swing joint assemblies with double O-ring seals, minimum 315 psi rating and minimum length of 12 inches with brass insert and stabilizer (unless stabilizer is an integral part of the quick coupling valve). Prefabricated PVC swing joints shall be as manufactured by Dura, Lasco, Spears or approved equal.

## **2.24 Combination Air Vacuum Release Valve**

A. Combination air vacuum release valve shall be Crispin, Model IC10 with 1 inch NPT inlet and a 1 inch air and vacuum outlet with a 3/32-inch pressure air release orifice. The valve body shall be cast iron body with stainless steel internals and float and Buna-N seating material. The valve shall exhaust large quantities of air on system start-up and allow air to re-enter the pipeline when the line is being emptied or drained. The valve shall also automatically vent air that accumulates while the system is under pressure.

B. A 1 inch ball valve and bronze wye strainer shall be installed below the air/vacuum relief valve. Wye strainer shall utilize a 3/4-inch boiler drain for cleaning.

C. Release valve outlet shall be piped with brass elbows and nipples to direct the air out of the valve.

D. Ball valve shut-off shall be easily accessible through the valve box. Install boiler drains on discharge of wye strainers.

E. Require thirty-two (32), 3/8 inch holes be drilled in air vacuum release valve box cover for air passage.

F. Air vacuum release valve shall be installed straight up from mainline and not on the side.

## 2.25 Wire

A. Conventional valve control wire shall be minimum #14-awg, common #12-awg, single strand, solid copper, UL- approved direct burial AWG-U.F., 600V and shall meet state and local codes for this service. Individual wires must be used for each zone valve.

Common wire shall be white in color, control wire for spray and rotor zones shall be red in color, landscape zone(s) control wire shall be orange and spare wires shall be blue.

B. Two-wire system wiring shall be polyethylene double-jacketed or UF-B UL PVC doublejacketed two-conductor solid copper designed for direct burial systems. Wire shall be manufactured by Paige Electric (maxi wire) or approved equal. Wire gauge shall be AWG #14/14.

C. Communication cable for the hardwire path from the controller to the flow sensor shall be jacketed, six conductor, three pair cable. Cable shall be suitable for direct burial in the earth and also may be installed in ducts or conduits. Conductors shall be high density insulated tin coated copper conductors. Conductors shall have a 0.008-inch corrugated aluminum shield longitudinally applied with an overlap. The cable shall conform to REA PE-39, PE-54 or PE-89 standards. The six conductors shall be #19 AWG with polyethylene insulation wall. Wire shall be as manufactured by Paige Electric, P7315DRev-3 or approved equal.

D. Tracer wire shall be minimum #14, single strand, solid copper; UL-approved direct burial AWG-U.F., 600V and shall meet all state and local codes for this service. Mainline tracer wire shall be yellow in color, lateral tracer wire purple in color unless there is a previous existing system.

E. Where an existing irrigation was in place, no red or white wire shall be used. Turf zones shall be purple in color and common wire yellow. Tracer wires shall then be brown and gray respectively.

F. In ground wire connections shall be UL listed (486D), manufactured by 3M, model DBR/Y-6 splice kits or approved equal.

G. Wire type and method of installation shall be in accordance with local codes for NEC Class II circuits of 30-volt A.C. or less.

H. Wiring shall be installed along with the mainline at pipe invert. Multiple wire bundles shall be cinched together at maximum 12-foot centers using plastic cable cinches and shall be laid beside the irrigation lines. Sufficient slack for expansion and contraction shall be provided and wiring shall not be installed tightly. Require an additional 8 inches to 12 inches' slack at changes of direction. An expansion curl shall be required and installed within 6 inches of each wire connection to a solenoid.

I. Wiring in valve boxes shall have sufficient length to require the valve solenoid, splice, and connections to be brought above grade for servicing. Slack shall be coiled for neatness in the valve box. Each valve shall homerun back to the controller. No tying

together of zones in the field shall be allowed.

J. Wire shall be laid in trenches and shall be carefully backfilled to avoid any damage to the wire insulation or wire conductors themselves. In areas of unsuitable material, the trench shall have a 2-inch layer of sand or stone dust on the bottom before the wires are laid into the trench and backfilled. Wire not to be installed that day shall not be laid out to prevent UV degradation. Wires exposed shall be neatly coiled and placed in black plastic bags to prevent exposure.

K. Each controller shall have a separate common in accordance with NEC.

L. Splices shall be made in valve boxes, at controllers, or at valve boxes (wire runs requiring splices between valve locations shall be required and installed in splice box-valve box shall be used). Require splice locations to be shown on the record drawings.

M. Require a complete wiring diagram showing wire routing for the connections between the controller, decoders and valves.

## **2.26 Isolation Valves**

A. Isolation valves 2-1/2 inches and smaller shall be gate type, of bronze construction, US Manufacture, 200 WOG with bronze cross handle and 200 psi rating. Gate valves to be as manufactured by Nibco, model T-113-K, Apollo model 102T or approved equal.

B. Isolation valves 3 inches and larger shall be cast iron epoxy coated inside and outside, ringtite valves, 200 psi rated, ductile iron gland flange, bronze stem-seal replaceable under pressure, stainless steel stem, US Manufacturer, 2-inch operating nut and resilient wedge replaceable disc conforming to AWWA C-509 as manufactured by Waterous 500 Series, Clow 2630 Series, Kennedy Ken-Seal Series or approved equal.

C. Install isolation valves on a level, minimum 4-inch crushed stone base.

D. Tighten valve bonnet packing before valve box and backfill installation.

E. Require installation of thrust blocks for ringtite valves.

## **2.27 Sprinkler Supports**

A. 1/2 and 3/4 inch sprinklers shall be installed on swing pipe assemblies, minimum length 6 inches, maximum 18 inches as manufactured by Hunter, Irritrol, Rain Bird or approved equal.

B. Swing pipe operating pressure shall be up to 80 psi with an inside diameter of 0.49 inches, manufactured of low-density polyethylene material meeting ASTM D2104, D2239 and D2737. Swing joint swing pipe and fittings shall be manufactured by Hunter



Industries, model FLEXsg, with HSBE-050 and HSBE-075 fittings or approved equal.

C. Large rotary sprinklers shall be installed on 1-inch prefabricated PVC unitized swing joint assemblies with double O-ring seals, minimum 315 psi rating and minimum length of 12 inches. Prefabricated PVC swing joints shall be as manufactured by Dura, Lasco, Spears or approved equal.

## **2.28 Rain Sensor (Wired or Wireless)**

A. Rain sensor shall be plastic in construction with adjustable interruption point, 1/2 inch IPS threads and stainless steel vandal resistant guard. Rain sensor shall be manufactured by Hunter Industries, model Rain-Clik, Rain Bird, model RSD-BEx or approved equal VIT or approved equal with stainless steel sensor guard.

B. Wireless rain sensors shall operate up to 200 feet from receiver unit and have built-in bypass switch on receiver panel.

C. Input power shall be 24 VAC from controller.

D. Install rain sensor wiring within 1/2-inch inch conduit where above ground and in building.

E. Mount rain sensor on exterior controller enclosure or on building where indicated on the drawings. Rain sensor shall be in direct contact with the weather and not in contact with the irrigation spray.

## **2.29 In-Line Drip Tubing**

A. In-line emitters in drip tubing to be .92 gallon per hour on pre-installed 12-inch spacing within tube for all planting beds. In-line drip tubing to be as manufactured by Netafim Irrigation, Model TLDL-9-12 or approved equal. Start pressure shall be a minimum of 45PSI.

## **2.30 In-Line Drip Tubing Fittings**

A. Fittings for in-line drip tubing shall be constructed of molded brown plastic having a (I.D)of .57 inches. Female and male threaded ends shall be capable of mating to standard pipe threads with tapered threads. In-line drip tubing fittings shall be as manufactured by Netafim, TL Series or approved equal.

B. Stainless steel clamps shall be used to secure in-line drip tubing to insert barbed fittings. Nominal size shall be 13/16 inches, Part No. 210. Clamps shall be constructed of 304-grade stainless steel. Interior clamp wall shall be smooth to prevent crimping or pinching of tubing. Wall thickness of clamps shall be 0.236 inches with an overall bandwidth of 1/4-inch. Properly secured clamps shall be capable of withstanding a maximum operating pressure of 441 psi. Clamps shall be one "ear" type. Clamps shall be as manufactured by Oetiker or approved equal.

C. Tubing stakes shall be plastic coated steel, or other non-corrosive strong material to secure tubing.

### **2.31 Drip Stake Assemblies**

A. Deep drip stake shall be 24 inch constructed of PVC material. Tube shall have an outside diameter of 1¼ inches. Cap material shall be made of ABS and the combination of stake tube and cap shall be able to withstand multiple strikes from a 3-lb. sledge hammer for the purpose of installing.

B. Deep drip stakes shall incorporate a screen filter within the unit to eliminate debris from entering the internal area of the stake. Deep drip stakes shall be designed so as to permit twisting of stakes after installation to dislodge root intrusion.

C. Stake cap shall have an opening to accommodate ¼ inch diameter drip or low volume distribution tubing. The internal stake tube dimensions shall be able to house a fixed or variable low volume emitter.

D. ¼ inch diameter drip distribution tubing shall be black EDTUBE as manufactured by Netafim or approved equal. Fittings shall be UV resistant and be 0.160 inch fittings compatible with solid drip tubing and distribution tubing ring.

E. Stakes shall have a 2 gph emitter installed in the stake. Emitter shall be as manufactured by Rain Bird, model XB-20PC (Red) or approved equal.

F. Drip stake assemblies shall be manufactured by Green King, model A-DD24 or approved equal.

G. Drip stakes to be installed three or four per tree depending on size off a blank drip tubing ring.

### **2.32 Disk Filter (Drip)**

A. The filters at each drip zone valve shall be a plastic filter consisting of a two piece threaded housing with o-ring seal. The filter screen shall be 140-mesh size. Filters shall be sized to mid-range flow and not exceed 2.5-PSI pressure loss.

B. Filter shall be as manufactured by Netafim, Model DF-xxx-140 or approved equal.

### **2.33 Pressure Regulators (Drip)**

A. Pressure regulators shall assure an incoming pressure of 45-PSI into drip tubing. Discharge pressure shall not be less than 45-PSI. Manifold regulators to match flow rate to mid-range flow.

B. The pressure regulator shall be as manufactured by Netafim, Model PRV-XXX-XX-45 or approved equal.

### **2.34 Automatic Flushing Valve (Drip)**

A. Flush valves shall produce 1-gallon flush and be constructed of black molded plastic with insert barbed fitting end configuration. The top of the flush valves shall have six openings from which debris or sediment can pass through from the system to the atmosphere or valve box.

B. Flush valve shall be as manufactured by Netafim, Model TLFV or approved equal.

### **2.35 Air Vacuum/Relief Valves (Drip)**

A. The air vacuum / relief valves shall be constructed of black plastic with 1/2-inch male pipe thread capable of mating with a threaded PVC reduction bushing.

B. Air vacuum relief valves shall be as manufactured by Netafim, Model TLAVRV or approved equal.

### **2.36 Grounding Equipment**

A. Ground rods for controllers shall be 5/8 inch x 10-foot-long copper clad, UL Listed.

B. Ground rods for decoder surge arrestors shall be 5/8 inch x 8-foot-long copper clad, UL Listed.

C. Ground plates for controllers shall be 4 inch x 96-inch-long copper x 0.06 inch, UL Listed with 25 feet of #6 insulated, solid copper wire already attached.

D. Ground plates for decoder surge arrestors shall be 4 inch x 36-inch-long x 0.06-inch copper, UL Listed with 15 feet of #10 insulated, solid copper wire already attached.

E. Bare copper wire for controllers shall be #6 AWG.

F. Bare copper wire for decoder surge arrestors shall be #10 AWG.

G. Exothermic connectors shall be as manufactured by Cadweld or approved equal.

H. Ground enhancement material shall be Loresco PowerSet or approved equal.

I. Grounding rod shall be driven into the ground its full length within 8-feet of the controller and connected via a Cadweld or approved equal connection to #6 solid, bare copper wire. The copper wire is to be installed in as straight a line as possible, and if it is necessary to make a turn or bend, it shall be done in a sweeping curve with a minimum radius of 8 inches and a minimum included angle of 90 degrees. There shall be no splices in the bare copper wire. The top of the ground rod shall be driven below the ground surface. A 4-inch plastic grated cover, set a minimum of 1-inch below grade, shall be placed over the ground rod and Cadweld or approved equal connection for periodic maintenance. Cover

shall be installed on a minimum of 6 inches of 4-inch ADS or approved equal corrugated polyethylene, perforated drainage pipe. Plate shall be installed 24 inches below grade with 50 lbs. of PowerSet or approved equal ground enhancement material spread evenly below the plate and 50 lbs. of PowerSet or approved equal ground enhancement material spread evenly above the plate in accordance with the manufacturer's requirements. Plates shall also be covered with a 4-inch grated cover as specified, set a minimum of 1-inch below grade, to facilitate drainage onto the plate. Cover shall be installed on a minimum of 24 inches of 4-inch ADS or approved equal corrugated polyethylene, perforated drainage pipe.

J. Grounding grid shall have an earth resistance no greater than 10 ohms. If earth resistance is greater than 10 ohms, additional grounding rods and/or plates and enhancement material shall be added to system until desired test results have been met.

K. Two-wire decoder communication path shall be grounded at 600 foot maximum intervals and at every termination of a part of the wire path to a surge arrester decoder. Any branch exceeding 50 feet requires a lightning surge arrester and grounding.

L. Grounding rod shall be driven into the ground its full length within 8-feet of the surge arrester and connected via a Cadweld or approved equal connection to #10 solid, bare copper wire. The copper wire is to be installed in as straight a line as possible, and if it is necessary to make a turn or bend, it shall be done in a sweeping curve with a minimum radius of 8 inches and a minimum included angle of 90 degrees. There shall be no splices in the bare copper wire. The top of the ground rod shall be driven below the ground surface. A 4-inch plastic grated cover, set a minimum of 1-inch below grade, shall be placed over the ground rod and Cadweld or approved equal connection for periodic maintenance. Cover shall be installed on a minimum of 6 inches of 4-inch ADS or approved equal corrugated polyethylene, perforated drainage pipe. Grounding plate, 4-inch x 36-inch x 0.0625-inch copper grounding plate, shall be installed at various soil depths based on soil profile depth with 25 lbs. of ground enhancement material spread evenly below the plate and 25 lbs. evenly above the plate, one (1) 50-pound bag. The grounding electrode shall be installed at least 8 feet from wires connected to the surge arrester and 20ft. from the grounding plate. Ground plate shall be installed 10 feet from other wires.

M. Each controller and surge arrester shall have a separate ground grid.

### **2.37 Core Hole Pipe Seals**

A. Water supply copper pipe and irrigation electrical conduit will require 3-core holes through building concrete walls. Pipes shall be sealed within core holes with modular seals. Coordinate design with respective members of the design team.

B. Modular seals shall be rated at 20 psig (40 feet of head). Seals shall be designed for use as a permanent seal. Seal elements shall be specially compounded to resist aging and attack from ozone, sunlight,

water and a wide range of chemicals. Modular seals shall have an operating range of -40 to +250F and a composite pressure plate.

C. Standard fasteners shall have a two-part zinc dichromate and proprietary corrosion inhibiting coating. Seals shall have Factory Mutual Fire Approvals. Modular seals shall be manufactured in an ISO 9001:2000 certified facility.

D. Modular seals shall be as manufactured by Flexicraft Thunderline Modular Seals, model Link-Seal "C" or approved equal.

E. Seals shall be installed per manufacturer's requirements.

### **2.38 Spare Parts**

A. Contractor shall supply the following tools and equipment to the Engineer or Owner before final inspection:

1. Two (2) wrenches for disassembling and adjusting each type of sprinkler head provided.
2. One (1) of each type of gate valve used in the project.
3. Two (2) of each type sprinkler used in the project.
4. Two (2) of each type nozzle used in the project.

B. Before final punch listing can occur, written evidence that the Engineer has received the tools and equipment must be shown to the Owner.

## **PART 3 - EXECUTION**

### **3.1 General**

A. Before work is commenced, hold a conference with the Engineer to discuss general details of the work.

B. Examine all contract documents applying to this Section noting any discrepancies and bringing the same to the attention of the Engineer for timely resolution.

C. All work indicated on approved Shop Drawings shall be provided whether or not specifically mentioned in the Specifications.

D. Make all field measurements necessary for the work noting the relationship of the irrigation work to the other trades. Coordinate with other trades (landscaping and other site work trades). Project shall be laid out essentially as indicated on the Irrigation Plans, making minor adjustments for variations in the planting arrangement. Major changes shall be reviewed with the Engineer prior to proceeding.

E. Location of sprinkler equipment shall be contingent upon and subject to integration with all other underground utilities. Employ all data contained in the Contract Documents and shall verify this information at the construction site to confirm the manner by which it relates to the installation.

F. Coordinate installation of all sprinkler materials, including pipe, to avoid conflict with the trees, shrubs, or other plantings.

G. During progress of work, a competent superintendent and all assistants necessary shall be on site. All shall be satisfactory to the Engineer. The superintendent shall not be changed, except with the consent of the Engineer, unless that person proves unsatisfactory and ceases to be employed. The superintendent shall represent the Contractor in his absence and all directions given to the superintendent shall be as binding as if given to the Contractor.

H. At all times, protect existing irrigation, landscaping, paving, structures, walls, footings, etc. from damage. Any inadvertent damage to the work of another trade shall be reported at once.

### **3.2 Pipe and Fittings Installation**

A. Using proper width trencher chain, excavate a straight (vertical) and true trench to a depth of 2-inch of pipe invert elevation.

B. Planting soil encountered within the limits of trench excavation for irrigation mains and branch lines shall be carefully removed to the lines and depths as shown on the Drawings and stockpiled for subsequent replacement in the upper 6 inches of the trench from which it is excavated. Such removal and replacement of the quantities of loam shall be considered incidental to the irrigation system and no additional compensation will be allowed therefore.

C. Pipe shall be laid on undisturbed trench bottom provided suitable base is available - no rock larger than 1 inch or sharp edges; if not, excavate to 2 inch below pipe invert and provide and install sand base or crushed stone upon which to lay pipe.

D. Back filling shall be accomplished as follows: the first 10-inch of backfill material shall contain no foreign matter and no rock larger than 1 inch in diameter. Carefully place material around pipe and wire and tamp in place. Remainder of backfill shall be laid-up in 6-inch (maximum) lifts and tamped to compaction with mechanical equipment. Compact backfill in trenches to dry density equal to the adjacent undisturbed soil, and conform to adjacent grades without dips, sunken area, humps, or other irregularities. Frozen material shall not be used for backfill.

E. Do backfilling when pipe is cool. During hot weather cool pipe by operating the system for a short period, or by backfilling in the early part of the morning before the heat of the day.

F. Make all solvent-weld joints in strict accordance with manufacturer's recommendations, making certain not to apply an excess of primer or solvent, and wiping off excess solvent from each connection. Allow welded joints at least 15 minutes set-up/curing time before moving or handling. When the temperature is above 80° F, allow connections to set minimum 24 hours before pulling or pressure is applied to the system. When temperature is below 80° F, follow

manufacturer's recommendations. Provide and install for expansion and contraction as recommended. Wire shall be laid in same trench as mainline and at pipe invert (see Wire Installation).

G. Mainline pipe shall have minimum 22 inches of COVER (excavate to invert as required by pipe size). Lateral pipe shall have minimum 16 inches of COVER for PVC excavate to invert as required by pipe size.

H. Cut plastic pipe with handsaw or pipe-cutting tool, removing all burrs at cut ends. All pipe cuts are to be square and true. Bevel cut end as required to conform to Manufacturer's Specifications.

I. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the trench. At times, when installation of the piping is not in progress, the open end(s) of the pipe shall be closed by a watertight plug or other means. All piping, which cannot temporarily be joined, shall be sealed to make as watertight as possible. This provision shall apply during the lunch hour as well as overnight. Pipe not to be installed that day shall not be laid out. Should water enter the trench during or after installation of the piping, no additional piping may be installed or back filled until all water is removed from the trench. Pipe shall not be installed when water is in the trench, when precipitation is occurring, or when the ambient temperature is at 40° F or below. Pipe installed at temperatures below 40° F shall be removed and replaced at no cost to the Owner. PVC pipe shall be snaked in the trench to accommodate for expansion and contraction due to changes in temperature.

J. In installing irrigation pipe the Contractor shall route the pipe as necessary to prevent damage to tree roots. Where trenching must occur near trees, the Contractor shall provide proper root pruning and sealing methods to all roots 1 inch and larger.

K. Maintain 6 inch minimum clearance between sprinkler lines and lines of other trades. Do not install sprinkler lines directly above another line of any kind.

L. Maintain 1-inch minimum between lines that cross at angles of 45 to 90 degrees.

M. Throughout the guarantee period it will be the responsibility of the Contractor to refill any trenches that have settled due to incomplete compaction.

### **3.3 Electrical Wire Conduit Installation**

A. Install electrical conduit in all non-soil areas, as well as for all above ground wiring where wire passes under or through walls, walks and paving to controllers and rain sensor.

B. Extend conduit 18 inches beyond edges of walls and pavement.

### **3.4 Pipe Sleeving Installation**

A. Install sleeving wherever piping is going under a non-soil area or through the well, generally where indicated on the Drawings. Install all sleeving pipe at the same depth as the corresponding pipe.

### **3.5 Isolation Valve Installation**

A. Install isolation valves per detail where indicated on the Approved Drawings. Install all isolation valves on a level crushed stone base so that they can be easily opened or closed with the appropriate valve wrench. Install specified valve box over each isolation valve.

B. Check and tighten valve bonnet packing before valve box and backfill installation.

### **3.6 Valve Box Installation**

A. Furnish and install a valve access box for each electric valve, quick coupling valve isolation valve, air relief valve, flushing valve and wire splice.

B. Install all valve access boxes on a minimum 4-inch crushed stone base. Finish elevation of all boxes shall be at grade. Supply all crushed stone and install before valve boxes. Crushed stone shall not be poured into previously installed valve boxes.

### **3.7 24 Volt Control Valve Installation**

A. Install control valves on a level crushed stone base. Grade of bases shall be consistent throughout the project so that finish grades fall within the limits of work. Valves shall be set plumb with adjusting handle and all bolts, screws and wiring accessible through the valve box opening. Set valves in a plumb position with 24-inch minimum maintenance clearance from other equipment.

B. Install at sufficient depth to provide more than 6 inch, nor less than 4 inch cover from top of valve to finish grade.

C. Adjust zone valve operation after installation using flow control device on valve.

### **3.8 Wiring Installation**

A. Install wiring along with the main line. Multiple wire bundles shall be cinched together at maximum 12-foot centers using plastic cable cinches and shall be laid beside, and at the same invert as, the irrigation lines. Sufficient slack for expansion and contraction shall be maintained and wiring shall at no point be installed tightly. Provide and install an additional 8 inches to 12 inches slack at all changes of direction. Wiring in valve boxes shall be a sufficient length to allow the valve solenoid, splice, and all connections to be brought above grade for servicing. This additional slack shall be coiled for neatness in the valve box. Each valve shall have a separate wire back to the controller.

B. Lay all wire in trenches and shall be carefully back-filled to avoid any damage to the wire insulation or wire conductors themselves. In areas of



unsuitable material, the trench shall have a 2 inches layer of sand or stone dust on the bottom before the wires are laid into the trench and back-filled. The wires shall have a minimum of 12 inches of cover and 18 inches under the driveway to meet code. Wire not to be installed that day shall not be laid out.

C. Provide an expansion curl and install within 6 inches of each wire connection to a solenoid. Expansion curls can be formed by wrapping five (5) turns of wire around a 1-inch diameter or larger pipe and then withdrawing the pipe.

D. Provide and install a common ground wire of white for location (A) and yellow color for location (B). Control wire shall be red for location (A) and orange for location (B), and spare wiring shall be blue for location (A) and purple in color for location (B).

E. Service wiring in connection with Drawings and local codes for 24-volt service. All inground wire connections shall be waterproofed with 3M DBY-6 splice kits. All splices shall be made in valve boxes (wire runs requiring splices between valve locations shall be provided and installed in splice box - valve box with black cover shall be used). Splice locations shall be shown on the Record Drawings.

F. Provide a complete wiring diagram showing wire routing for the connections between the controller and valves. See Section 1 for the inclusion of wiring diagram in operation and maintenance manuals.

### **3.9 Controller Installation**

A. Install site irrigation controllers in location(s) determined during the design and review process. Contractor to wire valves and rain sensor into each controller and set proper program.

B. Wire controller to 120-volt electrical supply provided and installed to the controller locations by OTHERS.

C. Keys shall be turned over to Engineer.

### **3.10 Grounding Installation**

A. Each grounding rod shall be driven into the ground its full length within 8 feet of the control location and connected via a Cadweld connection to #6 solid, bare copper wire. The copper wire is to be installed in as straight a line as possible, and if it is necessary to make a turn or bend, it shall be done in a sweeping curve with a minimum radius of 8 inches and a minimum included angle of 90 degrees. There shall be no splices in the bare copper wire. The top of the ground rod shall be driven below the ground surface. A 4 inch grated cover as specified, set a minimum of 1 inch below grade, shall be placed over the ground rod and Cadweld connection for periodic maintenance. Cover shall be installed on a minimum of 6 inches of 4 inch ADS corrugated polyethylene, perforated drainage pipe. Plates shall be installed 36 inches below grade with 50 lbs of Power Set ground enhancement material spread evenly below the plate and 50 lbs of Power Set ground enhancement material spread evenly above the plate in accordance with the manufacturer's requirements. Plates shall also be covered with a 4 inch grated cover as specified, set a minimum of 1 inch below grade, to facilitate drainage onto the plate.

Cover shall be installed on a minimum of 36 inches of 4 inch ADS corrugated polyethylene, perforated drainage pipe.

B. When tested, grounding grid shall have an earth resistance no greater than 5 ohms. If earth resistance is greater than 5 ohms, additional grounding plates and enhancement material shall be added to system until desired test results have been met.

### **3.11 Rain Sensor Installation**

A. Install rain sensor in location(s) determined during the design and review process. Coordinate final location of rain sensor with Engineer. Rain sensor shall be in direct contact with the weather and not in contact with the irrigation spray.

B. Install rain sensor wiring within ½ inch conduit where exposed. Use #12 common wire for rain sensor circuit. All above ground wires shall be installed in conduits.

### **3.12 Sprinkler Installation**

A. Install spray and rotary sprinklers flush (perpendicular) to grade on swing pipe assemblies, minimum length 6 inches, maximum 18 inches.

B. Sprinklers shall not exceed maximum spacing indicated

C. Adjust sprinkler zone pressure with flow control on valve.

D. When pipe sizing, no nozzle shall be considered less than 0.5 gpm because of sprinkler seal flushing during valve opening. Valve opening and closing delays should be programmed to aid with flushing and to assure pump does not lose required pressure during zone transitions.

### **3.13 Quick Coupling Valve Installation**

A. Provide and install quick coupling valves where indicated on the Drawings.

B. Quick coupling valves to be mounted on 1-inch prefabricated swing joint with brass insert per details.

### **3.14 Air Relief Valve Installation (Mainline)**

A. Install air vacuum/relief valves as per detail at locations shown on the drawings.

B. Provide ball valve shut-off, and wye strainer under all air vacuum/relief valves as per detail. Ball valve shut-off shall be easily accessible through the valve box.

C. Drill thirty two (18), 3/8 inch holes in air vacuum/relief valve box covers for air passage.

D. Install air vacuum/relief valve straight up from mainline and not on the side. This may require additional mainline depth at air vacuum/relief valve locations.

E. Install the air vacuum/relief valve at the highest point of the mainline in the vicinity of where shown on the drawings.

### **3.15 In-Line emitter Tube Installation**

A. Install in-line emitter tubing in areas designated by hand under the mulch, and shall have an average depth of 4 inches unless otherwise indicated on the drawings. Tubing should not be visible through the mulch. All in-line emitter tubing shall be installed on the high side of the plant material being watered to help insure dispersion of the water.

B. In-line emitter tubing is to be installed 4 inches from all planter edges, curbs and walls. Spacing of in-line emitter tube is to be 18 inches center-to-center in all irrigated areas.

C. All in-line tubing shall have a minimum incoming pressure of not less than 5-PSI of the pressure regulator, 45-PSI, to assure a maximum linear length of 280 feet at zero elevation lift.

### **3.16 Drip Pressure Regulator**

A. Pressure regulator shall assure a 45-PSI downstream pressure entering drip supply header. Pressure shall be verified by contractor to assure proper operating pressure for the in-line emitter tubing at maximum linear run of 280 feet. Contractor may need to manifold pressure regulators to reach the mid-range flow of the regulator.

### **3.17 Tubing Stake Installation (Drip)**

A. Secure in-line drip tubing with stakes. Stakes shall be spaced to ensure that tubing does not shift location in presence of foot traffic, operations, gravity on slope installations, or environmental effects. Stake in-line drip tubing at minimum 5-foot intervals to prevent movement.

### **3.18 Air Relief Valve Installation (Drip)**

A. Install air relief valves in the emitter tubing, at high elevation points as indicated on the drawing.

### **3.19 Flush Valve Installation (Drip)**

A. Install flush lines on end of PVC exhaust header where indicated on the drawings.

### **3.20 Check/Test/Start-Up/Adjust**

A. Flushing:

1. After all piping, valves, sprinkler bodies, pipe lines and risers are in place and connected, but prior to installation of sprinkler internals, open the control valves and flush out the system under a full head of water.

2. Sprinkler internals, flush caps and riser nozzles shall be installed only after flushing of the system has been accomplished to the full satisfaction of the Engineer or Owner.

3. Contractor shall be responsible for flushing the entire system after installation is complete and will be responsible for any clogged nozzles for thirty (30) days after substantial completion of this portion of the landscape irrigation system.

**B. Testing:**

1. Leakage test: test all lines for leaks under operating pressure. Repair all leaks and re-test.

2. Coverage test: perform a coverage test in the presence of the Engineer (notify Engineer at least seven (7) days in advance of scheduled coverage test). Representative will determine if the water coverage is complete and adequate. Readjust heads and/or head locations as necessary or directed to achieve proper coverage.

3. All testing shall be at the expense of the Contractor.

**3.21 Cleaning and Adjusting**

A. At the completion of the work, clean all parts of the installation thoroughly. Clean all equipment, pipe, valves and fittings of grease, metal cuttings and sludge which may have accumulated by the operation of the system for testing.

B. Adjust sprinkler heads, valve boxes, and quick coupling valves to grade as required, so that they will not be damaged by mowing operations.

C. Continue sprinkler coverage adjustment as required by settlement, etc., throughout the guarantee period.

D. Operate each control zone for a minimum of 5 minutes and all heads checked for consistency of delivering water. Adjustments shall be made to sprinklers that are not consistent to the point that they match the manufacturer's standards. All sprinklers, valves, timing devices or other mechanical or electrical components, which fail to meet these standards, shall be rejected, replaced and tested until they meet the manufacturer's standards.

**3.22 Acceptance and operation By Owner**

A. Upon completion of the work and acceptance by the Owner, take responsibility for the training of the Owner and the Owner's Landscape Maintenance Contractor in the operation of the system (provide minimum 48 hours written notice in advance of test). The Contractor shall furnish, in addition to the Record Drawings and operational manuals, copies of all available specification sheets and catalog sheets to the Owner's personnel responsible for the operation of the irrigation system. The Contractor shall guarantee all parts and labor for a minimum period of one (1) year from date of acceptance.

B. Conditions for acceptability of work for start of maintenance by Owner issued by Engineer shall include but not be limited to:

1. Punch list items complete and approved by Engineer.
2. Landscape irrigation system complete and in place.
3. As-built drawings complete.
4. Maintain installation and watering schedules until all conditions noted above have been completed.

### **3.23 Clean Up**

A. Upon completion of all installation work, remove all leftover materials and equipment from the site in a safe and legal manner.

B. Remove all debris resulting from work of this section.

C. Regrade, lightly compact, and replant around sprinkler heads where necessary to maintain proper vertical positioning in relation to established grade.

D. Fill all depressions and eroded channels with sufficient soil mix to adjust grade to ensure proper drainage. Compact lightly, and replant filled areas in accord with Drawings requirements.

(END OF SECTION 32 80 00)

**SECTION 32 92 19**

**SEEDING**

**PART 1 - GENERAL**

**1.1 Description**

- A. Work specified in this Section includes, but is not necessarily limited to, furnishing all labor, materials, and equipment for site seeding and landscaping.
- B. The work includes:
  - 1. Furnishing, spreading, and fine grading of topsoil and loam borrow
  - 2. Application of lime and fertilizers.
  - 3. Seeding and mulching
  - 4. Maintenance of seeded areas.
- C. All areas disturbed during construction shall be seeded and/or planted to a condition equal to that prior to the start of construction. All areas to be seeded and/or planted shall have a minimum of 6 inches of approved topsoil.
- D. No topsoil shall be placed prior to acceptance of test result submittals by the Engineer.

**1.2 Price and Payment Procedures**

- A. Measurement and payment requirements per Contract Documents.

**1.3 Reference Materials**

- A. Reference Standards
  - 1. NHDOT Standard Specifications for Road and Bridge Construction.
  - 2. NHDOT Standard Plans for Road Construction.

**1.4 Submittals**

- A. Manufacturers Product Data
  - 1. Submit material specifications and installation instructions where applicable attesting that the following materials meet the requirements specified:
    - a. Fertilizer.
    - b. Seed.
    - c. Lime.
- B. Soil Test Reports
  - 1. Prior to ordering the topsoil, submit soil test report to the Engineer for review and approval. Do not order materials until approval has been obtained. Delivered materials shall closely match the approved samples.
- C. Certificates
  - 1. A manufacturer's Certificate of Compliance to the specifications

shall be submitted by the manufacturers with each shipment of each type of seed. These certificates shall include the guaranteed percentages of purity, weed content, and germination of the seed; the net weight of seed; and date of shipment. No seed shall be sown until the Contractor has submitted these certificates.

D. Maintenance Manual

1. The Contractor shall submit a written manual prepared for the Owner that outlines a schedule for proper maintenance of the seeded lawns. This maintenance schedule should include timing and methods for mowing, watering, aeration, fertilization, liming, and other lawn maintenance operations.

E. Submittal Schedule

1. Before installation:
  - a. Manufacturer's product data for seed.
  - b. Soil test reports.
  - c. Seed certification.
  - d. Hydroseed mix.
2. After installation and before acceptance
  - a. Maintenance Manual.

**1.5 Quality Assurance**

- A. All work shall be performed by personnel experienced in lawn installation under the full-time supervision of a qualified foreman.
- B. Work shall be coordinated with all other trades on site.

**1.6 Delivery, Storage, and Handling**

- A. Deliver material to the site in original unopened packages, showing weight, manufacturer's name, and guaranteed analysis.
- B. Store materials in a manner that their effectiveness and usability will not be diminished or destroyed. Materials shall be uniform in composition, dry, unfrozen, and free flowing. Any material which has become caked or otherwise damaged or which does not meet specified requirements will be rejected.

**1.7 Inspection for Acceptance**

- A. Conditions of Acceptance
  1. Acceptance shall be given for the entire portion of the lawn areas. No partial acceptance will be given.
  2. Lawns shall exhibit a uniform, thick, well-developed stand of grass. Lawn areas shall have not bare spots in excess of four inches in diameter and bare spots shall comprise no more than 2% of the total area of the lawn.
  3. Lawn areas shall not exhibit signs of damage from erosion,

washouts, gullies, or other causes.

4. Pavement surfaces and site improvements adjacent to lawn areas shall be clean and shall be free of spills or overspray from placing or handling of topsoil and seeding operations.

B. Inspection and Acceptance

1. Upon written request of the Contractor, the Engineer will inspect all lawn areas to determine completion of work. This request must be submitted at least five days prior to the anticipated inspection date.
2. If the lawn areas are not acceptable, the Engineer will indicate corrective measures to be taken, and shall extend the maintenance period as necessary for the completion of the work. The Contractor shall request a second inspection of the lawns after corrective measures have been accomplished. This process shall be repeated until the total lawn area being inspected is acceptable.
3. When the lawn areas are acceptable, a meeting of the Contractor and Owner's Representative will be arranged to accept the lawn work. A final inspection will be a part of this meeting. At this meeting, the Contractor shall be furnished with a written acceptance of the lawn section being approved. The Contractor shall turn over maintenance of the lawn areas to the Owner at this meeting.
4. Following the acceptance of lawns, the Contractor shall provide the Owner with access to all lawn areas as required for the Owner's maintenance work.

C. Site Cleanup

1. The Contractor shall leave the site in a clean and neat condition. Final acceptance will not be granted until this condition is met.

**PART 2 - PRODUCTS**

**2.1 Soils**

- A. Topsoil shall conform to the requirements of Section 310000 - Earthwork.
- B. Testing shall confirm that the topsoil, obtained from the site or loam from off-site, contains not less than 4% nor more than 20% organic matter as determined by the loss on ignition of oven-dried samples. Test samples shall be oven-dried to a constant weight at a temperature of 230 degrees F. (+5 degrees F.) and certified test results shall be sent to the Engineer by the laboratory for approval.

**2.2 Soil Conditioning Materials**

- A. Lime: Lime shall be an approved agricultural limestone containing no less than 50% total carbonates, and 25% total magnesium with a neutralizing value of at least 100%. The material shall be ground to such a fineness that 40% will pass through a No. 100 U.S. Standard Sieve, and 98% will pass through a No. 20 U.S. Standard



Sieve. The lime shall be uniform in composition, dry and free flowing, and shall be delivered to the site in the original, unopened containers, each bearing the manufacturer's guaranteed analysis. Any lime that becomes caked or otherwise damaged (making it unsuitable for use) will be rejected.

- B. Fertilizer: Fertilizer shall be a complete, standard product complying with state and federal fertilizer laws. The fertilizer shall be uniform in composition, dry and free flowing, and shall be delivered to the site in the original, unopened containers, each bearing the manufacturer's guaranteed analysis, and submitted to the Engineer for approval.
1. Fertilizer shall contain the following minimum percentage of available plant food by weight: 10% nitrogen, 10% phosphorus, 10% potash, in which 75% of the nitrogenous elements shall be derived from organic sources or ureaform.
  2. Exact percentages of fertilizer may vary in accordance with the soil test report.
  3. Any fertilizer that becomes caked or otherwise damaged (making it unsuitable for use) will be rejected.
- C. Superphosphate: Superphosphate shall be composed of finely ground phosphate rock, as commonly used for agricultural purposes, and containing not less than 20% available phosphoric acid. Superphosphate shall be delivered to the site in the original, unopened containers, each bearing the manufacturer's guaranteed analysis and submitted to the Engineer for approval. Any superphosphate that becomes caked or otherwise damaged (making it unsuitable for use) will be rejected.

### **2.3 Water**

- A. Water shall be furnished by the Contractor, suitable for irrigation, and free from ingredients harmful to plant life. Hoses and other watering equipment required for the work shall be furnished by the Contractor.

### **2.4 Seed**

- A. Seed shall be: fresh, clean, and selected from the previous year's crop; shall have a maximum weed seed content of 1%; shall comply with applicable federal and state seed laws; and shall be furnished and delivered premixed in unopened containers in proportions consistent with the NHDOT Standard Specifications for Road and Bridge Construction Section 644.

### **2.5 Mulch**

#### **A. Wood Cellulose Fiber Mulch**

1. Mulch to cover hydroseeded areas shall be fiber-processed from whole wood chips manufactured specifically for standard hydraulic mulching equipment. Fiber shall not be produced from recycled material such as sawdust, paper, or cardboard.
2. Moisture content shall not exceed 10%, plus or minus 3%, as

defined by the pulp and paper industry standards. Fiber shall have a water holding capacity of not less than 900 grams of water per 100 grams fiber.

3. Mulch shall disperse into a uniform slurry when mixed with water. Mulch shall be nontoxic to plant life or animal life.
4. Mulch shall contain a non-petroleum based tackifier and a green dye for visual monitoring during application, but non-injurious to plant growth.

## **2.6 Erosion Control Matting for Sloped Areas**

- A. Matting for erosion control shall be provided on all slopes of 1-foot rise to 2 feet and steeper and shall consist of undyed and unbleached smolder resistant jute yarn woven into a uniform, open, plain weave mesh. Jute matting shall be furnished in rolled strips and shall conform to the following:
  1. Width: 48 inches, plus or minus one inch.
  2. 78 warp ends per width of cloth.
  3. 41 weft ends per yard.
  4. Weight: To average between 1.22 lbs. and 1.80 lbs. per linear yard.
  5. Tolerance: plus or minus 5%
- B. Stakes for pegging erosion control matting shall be sound hardwood approximately 1 inch by 3 inches. Stakes shall be free from insects and fungi and capable of remaining intact in the ground for at least two years.

## **2.7 Hydroseed Mix**

- A. The Contractor shall submit a certified statement as to number of lbs. of fertilizer, amounts and types of grass seed, and processed fiber, per 100 gallons of water.

## **PART 3 - EXECUTION**

### **3.1 Seed Bed Preparation**

- A. Grade all lawn areas to finish grades as indicated on the Drawings. When no grades are shown, areas shall have a smooth and continual grade between existing or fixed controls and elevations shown on Drawings. Roll, scarify, and rake as required to obtain uniform, even lawn surfaces. All lawn areas shall slope to drain. Finish grades shall be approved by the Engineer.
- B. If no new topsoil is required, thoroughly loosen soil in areas to be seeded to a minimum depth of 6 inches with approved power or hand equipment. Remove rocks, debris, clods and other undesirable substances, and maintain grading and drainage patterns.
- C. When topsoil is required, place topsoil on previously scarified subsoil to a minimum depth of 6 inches. Subsoil shall be cleaned of debris and stones larger than 2 inches prior to topsoil spreading.

- D. Apply fertilizer, superphosphate, and lime, at rates recommended by the testing agency and approved by the Engineer. Thoroughly and evenly incorporate fertilizer and lime into the soil to a depth of 3 inches by discing or other approved methods. In areas inaccessible to power equipment, fertilizer and lime shall be incorporated into the soil by manual methods. At existing trees, the depth shall be adjusted to avoid disturbance of the tree roots.
- E. Seeding shall be done immediately after final grading, provided the bed has remained in a good, friable condition, and has not become muddy or compacted. Any undulations or irregularities in the surface resulting from fertilizing, liming, tilling, or other causes, shall be regraded prior to seeding. The surface shall be free of stones, cleared of all trash, debris, roots, brush, wire, grade stakes, and other objects that would interfere with establishment of lawn and lawn maintenance operations.

### **3.2 Hydroseed Bed Preparation**

- A. Prepare seed bed for hydroseeding the same as for seeding, but do not incorporate fertilizer into the top 3 inches of topsoil.
- B. Hydroseeding shall be applied with a spray machine designed for this purpose and approved by the Engineer.

### **3.3 Seeding**

- A. Seeding shall be done between April 1 to June 1, or between August 15 to October 15, except as otherwise authorized in writing by the Engineer.
- B. All disturbed areas not otherwise developed shall be seeded.
- C. Seeding shall not be done during windy or inclement weather.

### **3.4 Manual Seeding**

- A. Sow lawn seed uniformly with an approved mechanical seeder at the rate of 5 lbs. per 1,000 square feet. Culti-packer or approved similar equipment may be used to cover the seed and to form the seed bed in one operation. In areas inaccessible to the Culti-packer, the seeded ground shall be lightly raked with flexible rakes and rolled with a water ballast roller. Seeding shall be done in two directions at right angles to each other.
- B. In areas having slopes 3:1 or steeper, and in drainage swales, the Contractor shall carry out a separate overseeding operation immediately after sowing the specified seed mix. The overseeding shall be sown at the rate of 3 lbs. per 1,000 square feet. Seeded areas requiring additional erosion control, shall be covered with an approved, biodegradable erosion control fabric and the fabric firmly anchored in place.

### **3.5 Hydroseeding**

- A. Designated areas shall be hydroseeded only after written approval of the finished grading by the Engineer.
- B. Fertilizer shall be added to the hydroseeding slurry at the rate of 5 lbs. per 1,000 square feet.

- C. Seed shall be added to the hydroseeding slurry at the rate of 75 lbs. per acre.
- D. Wood cellulose fiber mulch shall be added to the hydroseeding slurry at the rate of 2 tons per acre.
- E. A mobile tank with a capacity of at least 500 gallons shall be filled with water, and the required amounts of seed, wood cellulose mulch, and fertilizer. The slurry shall be thoroughly mixed by means of positive agitation in the tank. The slurry shall be applied by means of a centrifugal pump using the turret or hose application technique from the mobile tank. The hose or turret shall be equipped with a seeding nozzle of a proper design to ensure even distribution of the solution over the area to be seeded and shall be operated by a person thoroughly familiar with this type of seeding operation.

### **3.6 Maintenance and Protection**

- A. Maintenance of seeded areas shall begin immediately after installation. Maintenance includes watering, weeding, mowing and edging, reseeding, disease and insect pest control, repair of all erosion damage, and any other procedures consistent with good horticultural practice, required to ensure normal, vigorous, and healthy growth. Maintenance shall continue until final acceptance of the work.
- B. Maintenance shall also include all temporary protection fences, barriers, signs, and all other work incidental to proper maintenance.
- C. Scattered bare spots will be allowed up to a maximum of 2% of any lawn area, provided none are larger than 72 square inches. After the grass has sprouted, all bare areas shall be re-seeded repeatedly until all areas are covered with a satisfactory growth of grass. At the time of the first cutting, lawn should be mowed not less than 2-1/2 inches high. Do not remove more than one-third of the grass blade. All lawns shall receive at least three mowings before acceptance.
- D. The seeded areas shall be maintained in a continuous moist condition, satisfactory for good germination and growth of grass until acceptance.
- E. Six weeks after the seeded areas have become established, fertilizer shall be applied over the entire area.

(END OF SECTION 32 92 20)

SECTION 33 40 00

STORMWATER UTILITIES

**PART 1 - GENERAL**

**1.1 Summary**

- A. This Section specifies requirements for furnishing and installing the site storm drainage utilities system, as indicated on the Drawings, as specified herein.

**1.2 Price and Payment Procedures**

- A. Measurement and payment requirements per Contract Documents.

**1.3 References**

- A. Reference Standards
  - 1. NHDOT Standard Specifications for Road and Bridge Construction
  - 2. NHDOT Standard Plans for Road Construction
  - 3. Applicable portions of the Town of Plaistow Ordinances and Regulations

**1.4 Submittals**

- A. Shop Drawings
  - 1. Materials list of items proposed for the work.
  - 2. Product Data
  - 3. Certificates
    - a. Manufacturer's notarized certificate certifying conformance with the Specifications to accompany shipments.
  - 4. Manufacturer Instructions
- B. Closeout and Maintenance Material Submittals per Contract Documents.

**1.5 Quality Assurance**

- A. Provide in accordance with Contract Documents.
  - 1. Record depth and take ties to the locations of the following:
    - a. Pipe stub capped ends
    - b. Locations of plugged pipes
    - c. Manholes

**1.6 Coordination and Verification**

- A. The Contractor shall field verify and survey the size, location and elevations of all existing pipe and utility lines prior to ordering of materials for this utility system. A report of the findings of the verification survey shall be submitted to the Engineer for information and comment.

### **1.7 Delivery, Storage, and Handling**

- A. All materials shall be adequately protected from damage during transit. Pipes shall not be dropped.
- B. All pipe and other appurtenances shall be inspected before placement in the work and any found to be defective from any cause, including damage caused by handling, and determined by the Engineer to be unrepairable, shall be replaced at no cost to the Owner.
- C. Storage and handling of pipes and other system appurtenances shall be in accordance with the manufacturer's recommendations.

### **1.8 Inspection**

- A. The manufacturer/supplier is responsible for the provision of all test requirements specified for each type of pipe. In addition, any pipe may be inspected at the plant for compliance with these specifications by an independent testing laboratory selected and paid by the Owner. The Contractor shall require the manufacturer's cooperation in these inspections.
- B. Inspection of the pipe may also be made after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the specification requirements, even though pipe samples may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall be removed from the site at once.

## **PART 2 - PRODUCTS**

### **2.1 General**

- A. All materials for storm drainage utilities system shall be new and unused.

### **2.2 Pipe**

- A. High Density Corrugated Polyethylene Pipe and Fittings, Smooth Interior: Shall meet the requirements of ASTM D3350. Four-inch through 10-inch diameter pipe corrugated polyethylene drainage pipe shall meet the requirements of AASHTO M 252. Twelve-inch through 60-inch diameter corrugated polyethylene pipe shall meet the requirements of AASHTO M 294, Types S. Standard Fitting connections shall be fabricated to sizes shown on the Drawings.
  - 1. Pipe joints and fittings shall conform to the requirements of AASHTO M 252 or AASHTO M294. Pipe joints shall be Bell and Spigot soil tight joints and gaskets shall meet the requirements of ASTM F477. Fittings shall also be soil tight and gasketed.
  - 2. Where called for on the Drawings, corrugated pipe shall be slotted or perforated by the manufacturer prior to delivery to the job site. Coupling bands shall conform to the manufacturer's specifications. Couplers shall cover not less than one corrugation on each section of pipe.

## **2.3 Storm Drain Manholes**

### **A. Precast Concrete Construction:**

1. Provide in accordance with NHDOT Standard Specifications for Road and Bridge Construction Section 604 and related sections.
2. Manhole shall be constructed of pre-cast reinforced concrete sections unless otherwise directed by the Engineer.
3. Precast Unit Joint Seals: Preformed butyl rubber O-ring type seals meeting the requirements of ASTM C990.
4. Openings for pipe and materials to be embedded in the walls of the manholes sections for joint seals shall be cast in the sections at the required locations during manufacture. Sections with incorrectly cast and patched pipe openings will be rejected.
5. Openings shall be cast into the manhole sections to receive entering pipes during manufacture. The openings shall be sized to provide a uniform 2 inch maximum annular space between the outside of the pipe wall and the opening in the riser. After the pipe is in position, the annular space shall be solidly filled with nonshrink mortar. Care shall be taken to assure that the openings are located to permit setting of the entering pipe at its correct elevation.

### **B. Steps:**

1. Steps for manholes shall be steel reinforced copolymer polypropylene plastic step with at least a 14-inch wide stepping surface conforming to ASTM C478 and ASTM A615.

### **C. Manhole Frame and Cover: Grey iron casting conforming to ASTM A48, heavy duty, with word "DRAIN" embossed on cover. Letter size shall be three inches (3 in.). Frame and cover shall have a minimum clear opening of 24 inches and have a minimum weight of 475 pounds.**

### **D. Frames and covers shall be manufactured in the USA.**

## **PART 3 - EXECUTION**

### **3.1 General**

- A. Install storm drain system in accordance with Sections 603 and 604 of the NHDOT Standard Specifications for Road and Bridge Construction.
- B. Contractor shall verify the location, size invert and type of existing pipes at all points of connection prior to ordering new utility materials.
- C. All materials shall be stored and handled in accordance with the manufacturer's recommendations.
- D. Pipe Grade Defined
  1. All grades shown shall refer to the invert of the pipe unless otherwise noted. The invert is defined as the inside bottom of the pipe.

- E. All pipe shall be laid accurately to the lines and grades shown on the Drawings and in conformance with the pipe manufacturer's recommendations.
- F. As soon as the trench is excavated to the normal grade of the bottom of the trench, the Contractor shall immediately place the bedding material in the trench. The pipe shall be firmly bedded in the compacted bedding material accurately to the lines and grades shown on the Drawings.
- G. Laying Pipe: Each length of pipe shall be laid with firm, full and even bearing throughout its entire length, in a prepared trench. Pipe shall be laid with bells upgrade unless otherwise approved by the Engineer.
  - 1. Every length of pipe shall be inspected and cleaned of all dirt and debris before being laid. The interior of the pipe and the jointing seal shall be free from sand, dirt and trash. Extreme care shall be taken to keep the bells of the pipe free from dirt and rocks so that joints may be properly lubricated and assembled. No pipe shall be trimmed or chipped to fit.
  - 2. No length of pipe shall be laid until the proceeding lengths of pipe have been thoroughly embedded in place, to prevent movement or disturbance of the pipe alignment.
  - 3. Take necessary precautions to prevent flotation of the pipe as a result of water in the trench.
- H. Notch under pipe bells and joints where required to provide for uniform bearing under entire length of pipe.
- I. Excavation, backfilling and compaction shall be as specified in Section 313000 - EARTHWORK.
- J. Maintain optimum moisture content of bedding material to attain required compaction density.
- K. Pipe Extension: Where an existing pipe is to be extended, the same type of pipe shall be used, unless otherwise approved by the Engineer.
- L. Pipe Jointing: All joints shall be made in a dry trench and in accordance with the manufacturer's recommendations and the best practices for type of pipe installed. The ends of the pipe shall be wiped clean with a dry cloth before making the joint.
- M. Full Lengths of Pipe: Only full lengths of pipe shall be used in the installation except that partial lengths of pipe may be used at the entrance to structures, and to accommodate the required locations of service connection fittings.
- N. Pipe Entrances to Drainage Structures: All pipe entering drainage structures shall be cut flush with the inside face of the structure, and the cut ends of the pipe surface within the structure shall be properly rounded and finished so that there will be no protrusion, ragged edges or imperfections that will impede or affect the hydraulic characteristics of the stormwater flow. The method of cutting and finishing shall be subject to the



approval of the Engineer.

- O. Protection during Construction: The Contractor shall protect the installation at all times during construction, and movement of construction equipment, vehicles and loads over and adjacent to any pipe shall be performed at the Contractor's risk.
  1. At all times when pipe laying is not in progress, all open ends of pipes shall be closed by approved temporary watertight plugs. If water is in the trench when work is resumed, the plug shall not be removed until the trench has been dewatered and all danger of water entering the pipe eliminated.

### **3.2 Excavation and Backfilling for Pipes**

- A. The type of materials to be used in bedding and backfilling and the method of placement shall conform to the requirements of Section 313000 - EARTHWORK, the details shown on the Drawings and the following.
- B. Embedment materials are those used for bedding, haunching and initial backfill around pipes as illustrated on the Drawings.
  1. All embedment materials should be free from lumps of frozen soil or ice when placed. Embedment materials should be placed and compacted at optimum moisture content.
- C. Trench Bedding: Material must be provided to insure proper line and grade is maintained. Unsuitable or unstable materials shall be undercut and replaced with a suitable bedding material, placed in 6 inch lifts. Other methods of stabilization, such as geotextiles may be appropriate and their use must be approved by the Engineer or Owner's Representative.
  1. Provide a stable and uniform bedding for the pipe and any protruding features of its joints and/or fittings. The middle of the bedding equal to 1/3 of the pipe outside diameter should be loosely placed, with the remainder compacted to a minimum of 95 percent Modified Proctor Density.
- D. Haunching: Proper haunching provides a major portion of the pipe's strength and stability. Exercise care to insure placement and compaction of the embedment material in the haunches. For larger diameter pipes (pipes greater than 30 inch diameter), embedment materials should be worked under the haunches by hand. Haunching materials shall be placed and compacted in 6 inch maximum lifts, compacted to 95 percent Modified Proctor Density.
- E. Initial Backfill: The initial backfill shall be from the springline to 24 inches above the pipe to provide protection for the pipe from construction operations during placement of the final backfill and protect the pipe from stones or cobbles in the final backfill. Compact initial backfill per Section 313000 - EARTHWORK.
  1. Flooding or jetting as a procedure for compaction are not allowed.
- F. Final Backfill: The final backfill should be the same material as the proposed embankment or surface finishes. Generally, the excavated material may be used as final backfill. Placement should

be as specified for the embankment. In lieu of a specification, the final backfill should be placed in 12 inch maximum lifts and compacted to a minimum 95 percent modified proctor density to prevent excessive settlement at the surface. Compaction should be performed at optimum moisture content.

- G. Vehicular and Construction Loads: During construction, avoid heavy equipment loads (greater than 40,000 lbs. per axle) over the pipe. Additional temporary cover should be placed over the pipe for heavy construction load crossings. Hydrohammers or hoe-pak compactors may not be used over the pipe until at least 48 inches of cover have been provided.

### 3.3 Manholes- Precast

- A. Provide in accordance with Section 604 of the NHDOT Standard Specifications for Road and Bridge Construction.
- B. Manholes, Catch Basins, and Drop Inlets: Shall be constructed at the locations and to the lines, grades, dimensions and design shown on Drawings or as required by the Engineer.
- C. Precast Concrete Units: Shall be installed in a manner that ensures watertight construction and all leaks in precast concrete structures shall be sealed. If required, precast concrete structures shall be repaired or replaced to obtain watertight construction.
- D. Stubs shall be short pieces of pipe cut from the bell ends of the pipe. Stubs shall be plugged with brick masonry unless otherwise directed by the Engineer.
- E. Manhole Inverts shall conform accurately to the size of the adjoining pipes.
  - 1. Manhole inverts shall be constructed of 3,500 psi concrete as shown the Drawings.
  - 2. Inverts shall be laid out in smooth diameter curves of the longest possible radius to provide uniform flow channels.
  - 3. Invert shelves shall be graded with a 1 inch drop per one foot length sloped from the manhole walls.
- F. Manhole steps shall be accurately positioned and embedded in the concrete when the section is cast. Precast reinforced concrete manhole sections shall be set vertical and with sections and steps in true alignment.
- G. All holes in sections used for their handling shall be thoroughly plugged with rubber plugs made specifically for this purpose, or with mortar. The mortar shall be one part cement to 1-1/2 parts sand, mixed slightly damp to the touch, hammered into the holes until it is dense and an excess of paste appears on the surface, and finished smooth and flush with the adjoining surfaces.
- H. Precast sections shall be level and plumb with approved joint seals. Water shall not be permitted to rise over newly made joints until after inspection and acceptance. All joints shall be watertight.

- I. Openings which have to be cut in the sections in the field shall be carefully made to prevent damage to the riser. Damaged risers will be rejected and shall be replaced at no additional cost to the Owner.

### **3.4 Manhole Steps**

- A. Steps shall be cast into the precast walls during manufacture.
- B. Steps in brick masonry and concrete units shall be installed as the masonry courses are laid.

### **3.5 Castings**

- A. Cast-iron frames for grates and covers shall be well bedded in cement mortar and accurately set to the proposed grades.
- B. All voids between the bottom flange and the structure shall be completely filled to make a watertight fit. A ring of mortar, at least one-inch (1 in.) thick and pitched to shed water away from the frame shall be placed over and around the outside of the bottom flange. The mortar shall extend to the outer edge of the masonry all around its circumference and shall be finished smooth. No visible leakage will be permitted.
- C. Structures within the limits of bituminous concrete pavement shall be temporarily set at the elevation of the bottom of the binder course. After the binder course has been compacted, the structures shall be set at their final grade. Backfill necessary around such structures after the binder course has been completed shall be made with 3,500 psi concrete.

### **3.6 Connections to Existing Facilities**

- A. General Requirements: The Contractor shall make all required connections of the proposed drainage system into existing drainage system, where and as shown on the Drawings.
- B. Compliance with requirements of Owner of Facility: Connections into existing drainage system facilities shall be performed in accordance with the requirements of the Owner of the facility. The Contractor shall comply with all such requirements, including securing of all required permits, and paying the costs thereof.

### **3.7 Manhole Connections**

- A. Manhole pipe connections for precast manhole bases may be accomplished by any method described below. The Contractor shall make sure that the outside diameter of the pipe is compatible with the particular pipe connection used.
  - 1. A tapered hole filled with non-shrink waterproof grout after the pipe is inserted. This connection method will not be allowed when connecting PVC pipe to manholes.
  - 2. The LOCK JOINT Flexible Manhole Sleeve cast in the wall of the manhole base. The stainless steel strap and exposed sleeve shall be protected from corrosion with a bitumastic coating.
  - 3. PRESS WEDGE II gasket cast into the wall on the manhole base. The rubber wedge shall only be driven into the V slot from the

outside of the manhole.

4. The RES-SEAL, a cast iron compression ring which compresses a rubber "O" ring gasket into a tapered hole in the wall of the manhole base. Exposed metal shall be protected from corrosion with a bitumastic coating.
5. KOR-N-SEAL neoprene boot cast into the manhole wall. The stainless steel clamp shall be protected from corrosion with a bitumastic coating.

### **3.8 Cleaning, Testing, and Repair**

- A. The Contractor shall clean the entire drainage system of all debris and obstructions. Cleaning shall include, removal of all formwork from structures, concrete and mortar droppings, construction debris and dirt. The system shall be thoroughly flushed clean and the Contractor shall furnish all necessary hose, pumps, pipe and other equipment that may be required for this purpose. No debris shall be flushed into existing drains, storm recharge chambers, storm drains and/or streams.
- B. Testing and Correction of Defective Work: If a mandrel with a minimum length that is greater than the pipe diameter and a minimum diameter of 90 percent of the pipe diameter cannot be pulled through the pipe after seven (7) days of completed trench backfill, the pipe line shall be deemed unacceptable and the pipe lines shall be removed and replaced. The Contractor shall make the necessary repairs or replacements required to permanently provide an open and structurally sound drainage system capable of supporting the anticipated loading from all sources throughout the year.

### **3.9 Final Inspection**

- A. Upon completion of the work, and before final acceptance by the Engineer, the entire drainage system shall be subjected to a final inspection in the presence of the Engineer. The work shall not be considered as complete until all requirements for line, grade, cleanliness, mandrel tests, and other requirements have been met.

### **3.10 Acceptance**

- A. The Owner reserves the right to accept piped utilities in sections after the satisfactory tests have been made and approved, and to make full use of any part or parts of the system after acceptance of those parts.
- B. Until such time as the entire contract has been accepted by the Owner, the Contractor shall be held responsible to rectify any leaks, errors, or other poor workmanship which may be discovered and shall make any necessary repairs, alterations, or adjustments as may be required to properly complete the work.
- C. All piping shall be thoroughly cleaned of all silt, debris, and foreign material of any kind prior to final inspection.

(END OF SECTION 33 40 00)