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TECHINCAL SPECIFICATIONS

Re-Grading & Re-Conditioning
of Black River Athletic Fields
Chester Township, Morris County
Block 33, Lot 17.01

233 North Road
Chester, NJ 07930



March 19, 2021
FPA No. 15502.003

BLACK RIVER ATHLETIC FIELDS

Chester Township, Morris County, NJ

TECHNICAL SPECIFICATIONS

3/19/2021

Section Description	Section No.
Site Clearing	31 10 00
Earthwork	31 20 00
Dewatering	31 23 19
Excavation Support and Protection	31 50 00
Turf and Grasses	32 93 00
Soil Erosion and Sediment Control	32 96 00
Irrigation Components and or Systems	32 98 00
Storm Utility Drainage Piping	22 13 13

SECTION 31 10 00 – SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Protecting existing trees and vegetation to remain.
2. Removing trees and other vegetation.
3. Clearing and grubbing.
4. Topsoil stripping.
5. Removing above-grade site improvements.
6. Removing below- grade utility improvements
7. Disconnecting, capping or sealing, and abandoning site utilities in place.
8. Disconnecting, capping or sealing, and removing site utilities.

- B. Related Sections include the following:

1. Division 31 Section 31 20 00 "Earthwork" for soil materials, excavating, backfilling, and site grading.

1.3 DEFINITIONS

- A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches (50 mm) in diameter; and free of weeds, roots, and other deleterious materials.

1.4 MATERIALS OWNERSHIP

- A. Except for materials indicated to be stockpiled or to remain Owner's property, cleared and waste materials shall become Contractor's property and shall be removed from the site.

1.5 SUBMITTALS

- A. The contractor shall be responsible to provide photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing. The photographs or videotape must be submitted prior to any site clearing activity.
- B. Record drawings according to contract requirements.

1. Identify and accurately locate capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 QUALITY ASSURANCE

- A. Preinstallation Conference: Conduct conference at Project site to comply with requirements of the Specifications.

1.7 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
- C. Notify utility locator service for area where Project is located before site clearing.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Division 31 Section 31 20 00 "Earthwork."
 1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Provide erosion-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Locate and clearly flag trees and vegetation to remain or to be relocated.
- D. Protect existing site improvements to remain from damage during construction.
 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 UTILITIES

- A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
 - 1. The Contractor shall coordinate with the Owner and the respective utility companies to arrange for the shut off of indicated utilities.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Owner and Engineer not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Owner's written permission.
- C. Excavate for and remove underground utilities indicated to be removed.

3.3 CLEARING AND GRUBBING

- A. The contractor shall be responsible to remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction. Removal includes digging out stumps and obstructions and grubbing roots.
 - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 - 2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
 - 3. Completely remove stumps, roots, obstructions, and debris extending to a depth of 18 inches (450 mm) below exposed subgrade.
 - 4. Use only hand methods for grubbing within drip line of remaining trees.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.
 - 1. Place fill material in horizontal layers not exceeding 8-inch (200-mm) loose depth, and compact each layer to a density equal to adjacent original ground.

3.4 TOPSOIL STRIPPING

- A. Remove vegetation, sod and grass before stripping topsoil.
- B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
 - 1. Strip surface soil of unsuitable topsoil, including trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and provide temporary seeding as per the soil erosion and sediment control standards.

1. Limit height of topsoil stockpiles to 72 inches (1800 mm).
2. Do not stockpile topsoil within drip line of remaining trees.
3. Dispose of excess topsoil as specified for waste material disposal.
4. Stockpile surplus topsoil and allow for resspreading deeper topsoil.

3.5 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, aggregate base and all other items as indicated on the plans.
 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.

3.6 DISPOSAL

- A. The Contractor to remove surplus soil material, unsuitable topsoil, unsuitable soils, obstructions, demolished materials, and waste materials, including trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 31 10 00

SECTION 31 20 00 - EARTHWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Preparing subgrades for slabs-on-grade, walks, pavements, landscaping, lawns and plantings.
 - 2. Drainage course for slabs-on-grade.
 - 3. Subbase course for concrete walks and pavements.
 - 4. Subbase and base course for asphalt paving.
 - 5. Subsurface drainage backfill for walls and trenches.
 - 6. Excavating and backfilling for utility trenches.
 - 7. Excavating and backfilling trenches for buried mechanical and electrical utilities and pits for buried utility structures.
- B. Related Sections include the following:
 - 1. Section 31 10 00 "Site Clearing" for temporary erosion and sedimentation control measures, site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
 - 2. Section 31 23 19 "Dewatering" for lowering and disposing of ground water during construction.

1.3 UNIT PRICES

- A. Rock Measurement: No separate payment will be made for the removal of rock and replacement with approved material.

1.4 DEFINITIONS

- A. Backfill: Soil material used to fill an excavation.
 - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Course placed between the subbase course and hot-mix asphalt paving.
- C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.

- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. Excavation: Removal of material encountered above subgrade elevations.
 - 1. This work shall include the removal of the existing rock and fill material as required to construct the proposed improvements, including the building, walls, utilities, foundations, roadways, sidewalk and all other structures that are constructed below existing grade.
- G. Fill: Soil materials used to raise existing grades.
- H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. for bulk excavation or 3/4 cu. Yd. for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
 - 1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch- wide, maximum, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,090 lbf and stick-crowd force of not less than 18,650 lbf; measured according to SAE J-1179.
 - 2. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 210-hp flywheel power and developing a minimum of 48,510-lbf breakout force with a general-purpose bare bucket; measured according to SAE J-732.
- I. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. or more in volume that when tested by an independent geotechnical testing agency, according to ASTM D 1586, exceeds a standard penetration resistance of 100 blows / 2 inches.
- J. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- K. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- L. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- M. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.5 SUBMITTALS

- A. Product Data: For the following:

1. Each type of plastic warning tape.
2. Drainage and separation fabric.

B. Samples: For the following:

1. Forty (40) pound bag samples of each material to be used as backfill and bedding shall be submitted to the Soils Engineer two (2) weeks minimum prior to commencing fill operations. This material shall not be used as a compacted fill until approved by the Engineer. By submitting samples of this material, the Contractor agrees and guarantees that the fill material used for construction will conform with the samples (s) supplied. Final acceptance of fill material rests with the Engineer, whose decision shall be final and binding upon the Contractor. However, the acceptance of any material by the Engineer shall not relieve the Contractor of his responsibility to have the fill material used conform to the sample(s) approved by the Engineer.
2. The Contractor shall supply data on the compaction equipment to the Engineer not less than two (2) weeks prior to the intended use of the equipment and the equipment shall be approved by the Engineer prior to commencing compaction operations.
3. 12-by-12-inch sample of drainage fabric.
4. 12-by-12-inch sample of separation fabric

C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:

1. Classification and grain size analysis according to ASTM D 2487 and ASTM D 422 of each on-site or borrow soil material proposed for fill and backfill.

Select subparagraph above or below.

2. Laboratory compaction curve according to ASTM D 1557 for each on-site or borrow soil material proposed for fill and backfill.

D. Blasting will not be permitted.

1.6 QUALITY ASSURANCE

- A. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548 and responsible to provide the necessary testing and approval determinations as the soils engineer.
- B. Preexcavation Conference: Conduct conference at Project site to comply with requirements in specifications.

1.7 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by the owner and then only after arranging to provide temporary utility services according to requirements indicated.
 - 1. Notify owner not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Owner's written permission.
 - 3. Contact utility-locator service for area where Project is located before excavating.
- B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils:
 - 1. Fill Classification:
 - a. Type "S" Fill – shall be structural fill consisting of clean sand and gravel to be used in general, for the support of foundations and new structures. This fill shall be imported from off the site and shall meet the following gradation requirement.

U.S. Standard Sieve Size Percent Finer By Weight

1 inch	100
3/8 inch	65-100
No. 10	40-85
No. 30	20-65
No. 60	10-45
No. 200	5-12

- b. Type "G" Fill – shall be a granular fill consisting of a clean sand and gravel to be used, in general, for backfilling around and between structures and underneath paved areas, pipelines and utilities. This fill shall be imported from off the site and shall meet the gradation requirements as listed below. If suitable Type "G" materials are found on the site and is accepted by the Engineer, it shall be stored for use.

U.S. Standard Sieve Size Percent Finer By Weight

2 inch	100
1 inch	80-100
3/8 inch	70-100
No. 10	50-100
No. 30	30-85

No. 60	15-65
No. 200	5-15

- c. Type "W" Fill – shall be a structural fill consisting of clean stone conforming to New Jersey Department of Transportation coarse aggregate size No. 57, used to facilitate dewatering while providing a firm workmat subgrade onto which foundations may be constructed as well as providing a drainage blanket and pipe bedding. The fill material shall be imported from off-site and shall meet the following gradation requirements.

<u>U.S. Standard Sieve Size</u>	<u>Percent Finer By Weight</u>
1 1/2 inch	100
1 inch	95-100
1/2 inch	25-60
No. 4	0-10
No. 8	0-5

2. Unsatisfactory soils include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

2.2 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility; colored as follows:
- B. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as per authority having jurisdiction, or as follows:
1. Red: Electric.
 2. Yellow: Gas, oil, steam, and dangerous materials.
 3. Orange: Telephone and other communications.
 4. Blue: Water systems.
 5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

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

- B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Section 31 10 00 "Site Clearing."
- C. Protect and maintain erosion and sedimentation controls, which are specified in Section 32 96 00 "Soil Erosion and Sediment Control", during earthwork operations.
- D. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
 - 2. Install a dewatering system, specified in Division 2 Section "Dewatering", to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.3 EXPLOSIVES

- A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
 - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 - 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

- A. All excavations shall be in accordance with OSHA requirements.
- B. Excavate trenches to indicated gradients, lines, depths, and elevations.
 1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- C. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.
 1. Clearance: 12 inches each side of pipe or conduit.
- D. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
 1. For pipes and conduit less than 6 inches in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
 2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
 3. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
- E. Trench Bottoms: Excavate trenches 6 inches deeper than bottom of pipe elevation to allow for bedding course. Hand excavate for bell of pipe.
 1. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.8 SUBGRADE INSPECTION

- A. Notify Engineer when excavations have reached required subgrade.
- B. If Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

- C. Proof-roll subgrade below the building slabs and pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 - 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 5 mph.
 - 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Engineer, and replace with compacted backfill or fill as directed, without additional compensation.
- D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill may be used when approved by Owner.
 - 1. Fill unauthorized excavations under other construction or utility pipe as directed by Engineer.

3.10 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
 - 2. Surveying locations of underground utilities for Record Documents.
 - 3. Testing and inspecting underground utilities.
 - 4. Removing concrete formwork.
 - 5. Removing trash and debris.
 - 6. Removing temporary shoring and bracing, and sheeting.
 - 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings.
- D. Place and compact initial backfill of subbase material, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit.
 - 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- E. Backfill voids with satisfactory soil while installing and removing shoring and bracing, and as sheeting is removed.
- F. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- G. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs or as directed by the utility company or authority having jurisdiction.

3.13 FILL

- A. Preparation: Remove vegetation, topsoil, debris, unsatisfactory soil materials, obstructions and deleterious materials from ground surface before placing fills.
- B. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- C. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use satisfactory soil material.
 - 2. Under walks and pavements, use satisfactory soil material.
 - 3. Under steps and ramps, use engineered fill.
 - 4. Under building slabs, use engineered fill.
 - 5. Under footings and foundations, use engineered fill.

3.14 MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
 - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Compacting of prepared subgrade under Type "S", Type "G", and Type "W" Fills – after excavation to the required subgrade, the subgrade shall be compacted by approved equipment and methods to develop to a depth of at least twelve (12) inches below ground surface at least 95% of maximum dry density as determined by the Engineer in conformance with ASTM Standard D1557. Any soft or weak spots detected during the compaction operation or proof-rolling of subgrade must be removed and replaced with controlled fill as directed by the Engineer. The compaction shall be checked by the Engineer and lean concrete or fill shall not be placed until compaction of the existing subgrade is approved by the Engineer
- B. Placement of Type "S", "G", and "W" Fills – No backfill shall be placed until the excavation and subgrade has been approved by the Engineer and until backfill materials to be used are approved by the Engineer, and no backfill shall be placed on frozen or thawing ground. Fill shall be placed in uniform horizontal layers not more than twelve (12) inches in thickness and shall be compacted with a high energy self-propelled vibratory roller. Lift thickness may be adjusted in the field by the Engineer if required soil density is not being achieved.
- C. Compaction of Types "S", "G", and "W" Fills – the backfill shall be compacted near optimum moisture content by means of vibratory compactors to not less than 95% of the maximum density determined in accordance with ASTM Standard D1557. The Engineer shall check the obtained in-place density of the compacted fill using the method of ASTM Standards D 1556 or D 2922 for in place density tests. Should the obtained density of the compacted fill be less than specified, the Contractor shall recompact the area until the required maximum density is reached. Only hand held compaction equipment shall be used within four (4) feet of foundation walls and structures.
- D. Moisture Control – the moisture-density curve for the fill used shall be used as a guide in controlling moisture to achieve the required degree of compaction. If, in the opinion of the Engineer, fill material becomes too wet for the required compaction, the fill shall be dried by a method approved by the Engineer prior to commencing or continuing compaction operations. Likewise, if the opinion of the Engineer, the fill material becomes too dry for the required compaction, the fill shall be moistened by a method approved by the Engineer prior to commencing or continuing compaction operations
- E. Drainage of the Site – at all times, Contractor shall maintain and operate proper and adequate surface and subsurface drainage in order to keep the construction site dry and in such condition that placement and compaction of fill may proceed unhindered by saturation of the area.
- F. Backfill of Excavations – any excavation (e.g., utilities, walls, footings, etc.) made within the compacted fill areas shall be backfilled with the same type of fill as removed and in accordance with Specifications herein. Where compacted fill is placed adjacent to walls, if the difference in elevation of the top of the fill on either side of the wall is more than one (1) foot, the wall is to be

adequately braced. Any excavation made in virgin material shall be backfilled with Type "G" fill as herein specified unless otherwise shown on the Contract Drawings or directed by the Engineer.

- G. Final Approval – immediately before the Contractor shall place foundations or floor slabs on compacted fills or virgin soil, the Engineer will inspect the foundation and floor slab subgrade. The Contractor shall remove any soft fill and replace with properly compacted material. The pouring of foundations or floor slab shall commence within twenty-four (24) hours of approval. Rain, frost and other factors (which in the opinion of the Engineer are potentially damaging to the fill or virgin material), occurring after the final approval, but before or during pouring, shall require an additional inspection of the compacted fill or virgin material for approval by the Engineer. The Contractor shall correct any deficiencies found at this time, at his own expense.
- H. Maintenance of Fills – all vehicles passing over the fill areas shall use diverse routes to insure uniform compaction of the fill.

Before shutdown of the work for any cause, and at the conclusion of work for the day, fill shall be bladed to a grade which will insure drainage away from the unfinished surface of the fill.

Excess materials shall be stored as directed by the Owner, and following completion of the work shall be removed from the site.

3.16 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 - 1. Lawn or Unpaved Areas: Plus or minus 1 inch.
 - 2. Walks: Plus or minus 1 inch.
 - 3. Pavements: Plus or minus 1/2 inch.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.17 SUBBASE AND BASE COURSES

- A. Place subbase and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase and base course under pavements and walks as follows:
 - 1. Place base course material over subbase course under.
 - 2. Shape subbase and base course to required crown elevations and cross-slope grades.
 - 3. Place subbase and base course 6 inches or less in compacted thickness in a single layer, unless otherwise directed.
 - 4. Place subbase and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.

5. Compact subbase and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

- C. Pavement Shoulders: Place shoulders along edges of subbase and base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.18 DRAINAGE COURSE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
 1. Place drainage course 6 inches or less in compacted thickness in a single layer, unless otherwise noted.
 2. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 3. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.19 FIELD QUALITY CONTROL

- A. Testing Agency: The contractor is responsible to engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing and approval determinations as the soils engineer. The contractor is to cooperate with the soils consultant in all respects and shall provide samples of each type of fill material used so that various tests may be performed to ascertain compliance with the specifications.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect/Engineer.
- D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
 1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least 1 test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than 3 tests.
 2. Foundation Wall Backfill: At each compacted backfill layer, at least 1 test for each 100 feet or less of wall length, but no fewer than 2 tests.
 3. Trench Backfill: At each compacted initial and final backfill layer, at least 1 test for each 150 feet or less of trench length, but no fewer than 2 tests.
- E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth

required; recompact and retest until specified compaction is obtained with no additional compensation from the owner.

3.20 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by Engineer; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.
 - 1. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 31 20 00

SECTION 31 23 19 - DEWATERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, to this Section.

1.2 SUMMARY

- A. This Section includes construction dewatering.
- B. Related Sections include the following:
 - 1. Division 31 Section 31 20 00 "Earthwork" for excavating, backfilling, and site grading.

1.3 PERFORMANCE REQUIREMENTS

- A. Dewatering Performance: Design, provide, test, operate, monitor, and maintain a dewatering system of sufficient scope, size, and capacity to control ground-water flow into excavations and permit construction to proceed on dry, stable subgrades.
 - 1. Work includes removing dewatering system when no longer needed.
 - 2. Contractor to maintain dewatering operations to ensure erosion is controlled, stability of excavations and constructed slopes is maintained, and flooding of excavation and damage to structures are prevented.
 - 3. Prevent surface water from entering excavations by grading, dikes, or other means.
 - 4. Accomplish dewatering without damaging existing buildings and site improvements adjacent to excavation.

1.4 SUBMITTALS

- A. Shop Drawings: For dewatering system, where applicable show arrangement, locations, and details of wells and well points; locations of headers and discharge lines; and means of discharge and disposal of water.
 - 1. Include Shop Drawings signed and sealed by the qualified professional engineer responsible for their preparation.
- B. Photographs or videotape, sufficiently detailed, of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by dewatering operations.
- C. Record drawings at Project closeout identifying and locating capped utilities and other subsurface structural, electrical, or mechanical conditions.

- D. Field Test Reports: Before starting excavation, submit test results and computations demonstrating that dewatering system is capable of meeting performance requirements.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer to assume engineering responsibility and perform dewatering who has specialized in installing dewatering systems similar to those required for this Project and with a record of successful in-service performance.
- B. Regulatory Requirements: Comply with water disposal requirements of authorities having jurisdiction.

1.6 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by the Owner or others unless permitted in writing by the Owner and/or Engineer and then only after arranging to provide temporary utility services according to requirements indicated.
- B. The contractor shall make test borings and/or conduct other exploratory operations as required to design the dewatering system, if necessary.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
 - 1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site and surrounding area.
 - 2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
- B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

3.2 DEWATERING

- A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.
- B. Before excavation below ground-water level, place system into operation to lower water to specified levels and then operate it continuously until drains, sewers, and structures have been constructed and fill materials have been placed, or until dewatering is no longer required.
- C. Provide an adequate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.
 - 1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
- D. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
 - 1. Maintain piezometric water level a minimum of 24 inches (600 mm) below surface of excavation.
- E. Dispose of water removed from excavations in a manner to avoid endangering public health, property, and portions of work under construction or completed. Dispose of water in a manner to avoid inconvenience to others. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.
- F. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on a continuous basis if any part of system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged structures and foundation soils at no additional expense.
 - 1. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches (900 mm) below overlying construction.
- G. Damages: Promptly repair damages to adjacent facilities caused by dewatering operations.

END OF SECTION 31 23 19

SECTION 31 50 00 – EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, to this Section.

1.2 SUMMARY

- A. This Section includes excavation support and protection systems.
- B. Related Sections include the following:
 - 1. Section 31 20 00 "Earthwork" for excavating and backfilling.

1.3 PERFORMANCE REQUIREMENTS

- A. Design, provide, monitor, and maintain an anchored and braced excavation support and protection system capable of resisting soil and hydrostatic pressure and supporting sidewalls of excavations.
 - 1. Work includes removing excavation support and protection systems when no longer needed.
 - 2. Prevent surface water from entering excavations by grading, dikes, or other means.
 - 3. Install excavation support and protection systems without damaging existing buildings, pavements, and other improvements adjacent to excavation.

1.4 SUBMITTALS

- A. Shop Drawings: Prepared by or under the supervision of a qualified professional engineer for excavation support and protection systems. System design and calculations must be acceptable to authorities having jurisdiction.
 - 1. Include Shop Drawings signed and sealed by the qualified professional engineer responsible for their preparation.
- B. Photographs or videotape, sufficiently detailed, of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by excavation support and protection systems.

1.5 PROJECT CONDITIONS

- C. Existing Utilities: Do not interrupt utilities serving facilities occupied by the Owner or others unless permitted in writing by the Owner and/or Engineer and then only after arranging to provide temporary utility services according to requirements indicated.
- D. Make test borings and/or conduct other exploratory operations as necessary.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials need not be new but must be in serviceable condition.
- B. Structural Steel: ASTM A 36 (ASTM A 36M).
- C. Steel Sheet Piling: ASTM A 328 (ASTM A 328M) or ASTM A 572 (ASTM A 572M).
- D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of 3 inches (75 mm).

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.
 - 1. Shore, support, and protect utilities encountered.
- B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
- C. Locate excavation support and protection systems clear of permanent construction and to permit forming and finishing of concrete surfaces.
- D. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure excavation support and protection systems remain stable.
- E. Promptly repair damages to adjacent facilities caused by the use of excavation support and protection systems.

END OF SECTION 31 50 00

SECTION 32 93 00 – TURF AND GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Lawns.
 - 2. Topsoil and soil amendments.
 - 3. Fertilizers and mulches.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Section 31 10 00 "Site Clearing" for protection of existing trees and planting, topsoil stripping and stockpiling, and site clearing.
 - 2. Section 31 20 00 "Earthwork" for excavation, filling, rough grading, and subsurface aggregate drainage and drainage backfill.

1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract.
- B. Product certificates signed by manufacturers certifying that their products comply with specified requirements.
 - 1. Manufacturer's certified analysis for standard products.
 - 2. Analysis for other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
 - 3. Label data substantiating that plants, trees, shrubs, and planting materials comply with specified requirements.
- C. Certification of grass seed from seed vendor for each grass-seed mixture stating the botanical and common name and percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
- D. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and address of architects and owners, and other information specified.
- E. Material test reports from qualified independent testing agency indicating and interpreting test results relative to compliance of the following materials with requirements indicated.

1. Analysis of existing surface soil.
2. Analysis of imported topsoil.

F. Planting schedule indicating anticipated dates and locations for each type of planting.

G. Maintenance instructions recommending procedures to be established by Owner for maintenance of landscaping during an entire year. Submit before expiration of required maintenance periods.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed landscaping work similar in material, design, and extent to that indicated for this Project and with a record of successful landscape establishment.

1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on the Project site during times that landscaping is in progress.

B. Testing Agency Qualifications: To qualify for acceptance, an independent testing agency must demonstrate to Architect's satisfaction, based on evaluation of agency-submitted criteria conforming to ASTM E 699, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.

C. Provide quality, size, genus, species, and variety of trees and shrubs indicated, complying with applicable requirements of ANSI Z60.1 "American Standard for Nursery Stock."

D. Topsoil Analysis: Furnish a soil analysis made by a qualified independent soil-testing agency stating percentages of organic matter, inorganic matter (silt, clay, and sand), deleterious material, pH, and mineral and plant-nutrient content of topsoil.

1. Report suitability of topsoil for growth of applicable planting material. State recommended quantities of nitrogen, phosphorus, and potash nutrients and any limestone, aluminum sulfate, or other soil amendments to be added to produce a satisfactory topsoil.

E. Measurements: Measure trees and shrubs according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches (150 mm) above ground for trees up to 4-inch (100-mm) caliper size, and 12 inches (300 mm) above ground for larger sizes. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip-to-tip.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements of the Contract for "Project Meetings."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery and while stored at site.

- B. Seed: Deliver seed in original sealed, labeled, and undamaged containers.
- C. Trees and Shrubs: Deliver freshly dug trees and shrubs. Do not prune before delivery, except as approved by Engineer. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy natural shape. Provide protective covering during delivery. Do not drop trees and shrubs during delivery.
 - 1. Immediately after digging bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.
- D. Handle balled and burlapped stock by the root ball.
- E. Deliver trees, shrubs, ground covers, and plants after preparations for planting have been completed and install immediately. If planting is delayed more than 6 hours after delivery, set planting materials in shade, protect from weather and mechanical damage, and keep roots moist.
 - 1. Heel-in bare-root stock. Soak roots in water for 2 hours if dried out.
 - 2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
 - 3. Do not remove container-grown stock from containers before time of planting.
 - 4. Water root systems of trees and shrubs stored on site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.

1.6 PROJECT CONDITIONS

- A. Utilities: Determine location of above grade and underground utilities and perform work in a manner which will avoid damage. Hand excavate, as required. Maintain grade stakes until removal is mutually agreed upon by parties concerned.
- B. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Architect before planting.

1.7 COORDINATION AND SCHEDULING

- A. Coordinate installation of planting materials during normal planting seasons for each type of plant material required.

1.8 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: Warrant the following living planting materials for a period of one year after date of Substantial Completion, against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, or abuse by Owner,

abnormal weather conditions unusual for warranty period, or incidents that are beyond Contractor's control.

1. Trees.
2. Shrubs.
3. Ground covers.
4. Plants.

- C. Remove and replace dead planting materials immediately unless required to plant in the succeeding planting season.
- D. Replace planting materials that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
- E. A limit of one replacement of each plant material will be required, except for losses or replacements due to failure to comply with requirements.

1.9 TREE AND SHRUB MAINTENANCE

- A. Maintain trees and shrubs by pruning, cultivating, watering, weeding, fertilizing, restoring planting saucers, tightening and repairing stakes and guy supports, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray as required to keep trees and shrubs free of insects and disease. Restore or replace damaged tree wrappings. Maintain trees and shrubs for the following period:
 1. Maintenance Period: 3 months following Substantial Completion.

1.10 GROUND COVER AND PLANT MAINTENANCE

- A. Maintain ground cover and plants by watering, weeding, fertilizing, and other operations as required to establish healthy, viable plantings for the following period:
 1. Maintenance Period: 3 months following Substantial Completion.

1.11 LAWN MAINTENANCE

- A. Begin maintenance of lawns immediately after each area is planted and continue until acceptable lawn is established, but for not less than the following periods:
 1. Seeded Lawns: 60 days after date of Substantial Completion.
 - a. When full maintenance period has not elapsed before end of planting season, or if lawn is not fully established at that time, continue maintenance during next planting season.
 2. Sodded Lawns: 30 days after date of Substantial Completion.
 3. Plug-Sodded Lawns: 30 days after date of Substantial Completion.

4. Sprigged Lawns: 30 days after date of Substantial Completion.
- B. Maintain and establish lawns by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth lawn.
- C. Watering: Provide and maintain temporary piping, hoses, and lawn-watering equipment to convey water from sources and to keep lawns uniformly moist to a depth of 4 inches (100 mm).
 1. Water lawn at the minimum rate of 1 inch (25 mm) per week.
- D. Mow lawns as soon as there is enough top growth to cut with mower set at specified height for principal species planted. Repeat mowing as required to maintain specified height without cutting more than 40 percent of the grass height. Remove no more than 40 percent of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet.
- E. Postfertilization: Apply fertilizer to lawn after first mowing and when grass is dry.
 1. Use fertilizer that will provide actual nitrogen of at least 1 lb per 1000 sq. ft. (0.5 kg per 100 sq. m) of lawn area.

PART 2 - PRODUCTS

2.1 GRASS MATERIALS

- A. Grass Seed: Fresh, clean, dry, new-crop seed complying with the Association of Official Seed Analysts' "Rules for Testing Seeds" for purity and germination tolerances.
 1. Seed Mixture: Provide seed of grass species and varieties, proportions by weight, and minimum percentages of purity, germination, and maximum percentage of weed seed as indicated on the Contract Documents.

2.2 TOPSOIL

- A. Topsoil: ASTM D 5268, pH range of 5.5 to 7, 5 percent organic material minimum, free of stones 1 inch (25 mm) or larger in any dimension, and other extraneous materials harmful to plant growth.
 1. Topsoil Source: Reuse surface soil stockpiled on the site. Verify suitability of surface soil to produce topsoil meeting requirements and amend when necessary. Supplement with imported topsoil when quantities are insufficient. Clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful to plant growth.
 2. Topsoil Source: Import topsoil from off-site sources. Obtain topsoil from naturally well-drained sites where topsoil occurs at least 4 inches (100 mm) deep; do not obtain from bogs or marshes.

2.3 SOIL AMENDMENTS

- A. Lime: ASTM C 602, Class T, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent, with a minimum 99 percent passing a No. 8 (2.36 mm) sieve and a minimum 75 percent passing a No. 60 (250 micrometer) sieve.
 - 1. Provide lime in the form of dolomitic limestone.
- B. Aluminum Sulfate: Commercial grade, unadulterated.
- C. Sand: Clean, washed, natural or manufactured sand, free of toxic materials.
- D. Perlite: Horticultural perlite, soil amendment grade.
- E. Peat Humus: Finely divided or granular texture, with a pH range of 6 to 7.5, composed of partially decomposed moss peat (other than sphagnum), peat humus, or reed-sedge peat.
- F. Peat Humus: For acid-tolerant trees and shrubs, provide moss peat, with a pH range of 3.2 to 4.5, coarse fibrous texture, medium-divided sphagnum moss peat or reed-sedge peat.
- G. Sawdust or Ground-Bark Humus: Decomposed, nitrogen-treated, of uniform texture, free of chips, stones, sticks, soil, or toxic materials.
 - 1. When site treated, mix with at least 0.15 lb (2.4 kg) of ammonium nitrate or 0.25 lb (4 kg) of ammonium sulfate per cu. ft. (cu. m) of loose sawdust or ground bark.
- G. Manure: Well-rotted, unbleached stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.
- H. Compost: All-grow or mushroom compost.
- I. Conditioner: Turface MVP or approved equal.
- J. Herbicides: EPA registered and approved, of type recommended by manufacturer.
- K. Water: Potable.

2.4 FERTILIZER

- A. Bonemeal: Commercial, raw, finely ground; minimum of 4 percent nitrogen and 20 percent phosphoric acid.
- B. Superphosphate: Commercial, phosphate mixture, soluble; minimum of 20 percent available phosphoric acid.
- C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea-form, phosphorous, and potassium in the following composition:

- D. Slow-Release Fertilizer: Granular fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

2.5 WEED-CONTROL BARRIERS

- A. Sheet Polyethylene: Black, 0.006-inch (0.15-mm) minimum thickness.
- B. Nonwoven Fabric: Polypropylene or polyester fabric, 3 oz. per sq. yd. (100 g per sq. m) minimum.
- C. Composite Fabric: Woven, needle-punched polypropylene substrate bonded to a nonwoven polypropylene fabric, 4.8 oz. per sq. yd. (160 g per sq. m).

2.6 EROSION-CONTROL MATERIALS

- A. Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches (150 mm) long.
- B. Fiber Mesh: Biodegradable twisted jute or spun-coir mesh, 0.92 lb per sq. yd. (0.5 kg per sq. m) minimum, with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches (150 mm) long.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive landscaping for compliance with requirements and for conditions affecting performance of work of this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 LAWN PLANTING PREPARATION

- A. Limit subgrade preparation to areas that will be planted in the immediate future.
- B. Loosen subgrade to a minimum depth of 4 inches (100 mm). Remove stones larger than 1-1/2 inches (38 mm) in any dimension and sticks, roots, rubbish, and other extraneous materials.
- C. Spread planting soil mixture to depth required to meet thickness, grades, and elevations shown, after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen.
 - 1. Place approximately 1/2 the thickness of planting soil mixture required. Work into top of loosened subgrade to create a transition layer and then place remainder of planting soil mixture.
 - 2. Allow for sod thickness in areas to be sodded.
- D. Preparation of Unchanged Grades: Where lawns are to be planted in areas unaltered or undisturbed by excavating, grading, or surface soil stripping operations, prepare soil as follows:

1. Remove and dispose of existing grass, vegetation, and turf. Do not turn over into soil being prepared for lawns.
 2. Till surface soil to a depth of at least 6 inches (150 mm). Apply required soil amendments and initial fertilizers and mix thoroughly into top 4 inches (100 mm) of soil. Trim high areas and fill in depressions. Till soil to a homogenous mixture of fine texture.
 3. Clean surface soil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful to plant growth.
 4. Remove waste material, including grass, vegetation, and turf, and legally dispose of it off the Owner's property.
- E. Grade lawn and grass areas to a smooth, even surface with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future. Remove trash, debris, stones larger than 1-1/2 inches (38 mm) in any dimension, and other objects that may interfere with planting or maintenance operations.
- F. Moisten prepared lawn areas before planting when soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- G. Restore prepared areas if eroded or otherwise disturbed after fine grading and before planting.

3.3 RECONDITIONING LAWNS

- A. Recondition existing lawn areas damaged by Contractor's operations, including storage of materials or equipment and movement of vehicles. Also recondition lawn areas where settlement or washouts occur or where minor regrading is required.
1. Recondition other existing lawn areas.
- B. Remove sod and vegetation from diseased or unsatisfactory lawn areas; do not bury into soil. Remove topsoil containing foreign materials resulting from Contractor's operations, including oil drippings, fuel spills, stone, gravel, and other construction materials, and replace with new topsoil.
- C. Where substantial lawn remains, mow, dethatch, core aerate, and rake. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.
- D. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of it off the Owner's property.
- E. Till stripped, bare, and compacted areas thoroughly to a depth of 6 inches (150 mm).
- F. Apply required soil amendments and initial fertilizers and mix thoroughly into top 4 inches (100 mm) of soil. Provide new planting soil as required to fill low spots and meet new finish grades.
- G. Apply seed and protect with mulch as required for new lawns.
- H. Apply sod as required for new lawns.
- I. Water newly planted areas and keep moist until new grass is established.

3.16 CLEANUP AND PROTECTION

- A. During landscaping, keep pavements clean and work area in an orderly condition.
- B. Protect landscaping from damage due to landscape operations, operations by other contractors and trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.

3.17 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of it off the Owner's property.

END OF SECTION 32 93 00

SECTION 32 96 00 – SOIL EROSION AND SEDIMENT CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, to this Section.

1.2 SUMMARY

Soil Erosion and Sediment Control shall include implementation and maintenance of soil erosion and sediment control devices and construction procedures, as shown on the plans or as directed by the Engineer, which will reduce and prevent soil losses and associated damages from sedimentation during construction of this project.

All work will be in conformance with the contract documents and Standards for Soil Erosion and Sediment Control in New Jersey revised and adopted April, 1987, and the latest revisions thereof.

PART 2 - PRODUCTS

2.1 MATERIALS

Hay bales shall consist of timothy, redtop or native grasses bound together with nylon or wire.

Stabilize hay bales with two rebar, steel pickets or two 2"x2" wood stake anchors (length = 1.5' to 2.0') as may be required or as directed by the Owner. Contractor shall embed anchors a depth of 4" or as applicable with site conditions to stabilize hay bales. Stone aggregate shall be 1½ - 2" in diameter.

All other materials shall be as shown and called for on the plans as "Soil Erosion and Sediment Control Notes & Details".

PART 3 - EXECUTION

3.1 CONSTRUCTION

The work of soil erosion and sediment controls shall include, but not be limited to the following:

All soil erosion and sediment control practices on this project shall be constructed in accordance with the "Standards for Soil Erosion and Sediment Control in New Jersey" or as approved for this project.

1. The smallest practicable area of land shall be exposed at any one time during the project and, whenever feasible, natural vegetation shall be retained and protected. Stripping of vegetation, grading or other soil disturbance shall be completed in a manner which will minimize soil erosion.
2. A schedule of construction operations shall be submitted to the Engineer for his approval including staging areas, stockpile areas and disturbance outside the limits of work. All erosion control devices shall be inspected and maintained periodically.
3. Written notification must be provided to the Engineer and the Soil Conservation District or municipal agency having jurisdiction 72 hours prior to the start of any land disturbing activity.

4. The Applicant must obtain a district issued report of compliance prior to applying for the municipal certificate of occupancy. Please give the district one-week notice to schedule this inspection.
5. All soil erosion and sediment control devices shall be in place prior to any major soil disturbances or installed and removed in their proper sequence to allow for further operations on the site.
6. All sediment control structures shall be checked and maintained on a regular basis and basins shall be cleaned periodically when storage capacity is affected by siltation.
7. During construction, any additional control measures as deemed necessary to prevent erosion or control sediment beyond those measures shown on the approved plans shall be installed or employed at the direction of the Engineer.
8. After completion of construction, soil and sediment controls shall be left in place until all disturbed areas are stabilized.
9. Disturbed areas shall be maintained in a rough graded condition and temporarily seeded and/or mulched until proper weather conditions exist for the establishment or permanent vegetative cover.
10. All areas disturbed by grading on which permanent or semi-permanent seeding or temporary seeding have not been made and all slopes with a grade steeper than 2:1 shall be treated by mulching. The mulch shall be applied at a rate of 2 TO 2 1/2 tons per acre of equivalent measure, according to State standards.
11. All areas disturbed by grading including soil stockpiles which will not be used or constructed upon for a period greater than 30 days shall be temporarily seeded and protected as required.
12. All areas disturbed by grading which will not be constructed upon within six months are to be stabilized with a permanent type seeding and fertilizing.
13. All disturbed areas shall be treated with 6" of topsoiled, limed and fertilized prior to both temporary and permanent seeding as indicated on plans and in conformance with charts and tables as set forth in the "Standards for Soil Erosion and Sediment Control in New Jersey".
14. A crushed stone wheel cleaning "Tracking Pad" is to be installed at all site exits using 2-1/2 inch stone to a length of at least 50 feet. All driveways must exhibit this item in the drive during construction.
15. All paved roadways must be kept clean at all times. Do not use a fire or garden hose to clean roads unless runoff is directed to a proper sediment basin.
16. All Storm drainage inlets are to be protected by temporary filter devices, as indicated on the plans, to prevent the entry of sediment carried by run-off water until vegetation and/or paving is established as planned.
17. Whenever well points, pumps or other dewatering methods are used, care shall be taken to provide for the elimination of erosion and entrapment of sediment at the outfall of said dewatering.
18. All drainage swales shall be parabolic in shape unless otherwise noted and shall conform to SCS design standards.
19. Drainage swales and other structures shall be located in the field so as to retain as much of the original vegetation as possible, especially large trees.

20. The Contractor shall be responsible to contact and obtain approval from the Soil Conservation District for staging/stockpiling areas over 5,000 square feet.
21. The Contractor must confine all phases of construction work within the permanent and temporary construction easements.
22. The Contractor shall be responsible to secure his own ingress and egress to the construction site. If construction driveways are required, they shall be provided in accordance with the detail. They shall be the width of opening shown on the plans or as required by the Soil Conservation District, a minimum of 50 feet in length and a minimum of one foot deep.
23. The Contractor will strictly adhere to all plans, specifications and details approved by the Soil Conservation District.
24. All erosion and sediment control practices shall be in place prior to any grading operations and installation of proposed structure or utilities.
25. To provide suitable conditions for growth and vegetation and to prevent the acidifying of drainage water in those areas underlain with acid formation having a pH below 4.0 the following requirements shall be met:
 - a. Grading shall be such that a minimum of acid formation shall be exposed.
 - b. All exposed material shall be covered with a minimum of one foot on non-acid (pH minimum 5.0) soil suitable for plant growth plus 6" of topsoil.
26. Seeded Dates: The following seeding dates are recommended to establish permanent vegetative cover:

Spring: March 15-May 30
Fall: August 15-October 15
27. Mulch material shall be unrotted salt hay or small grain straw applied at a rate of at least 2.0 Tons per acre, 90 pounds per 1000 square feet. In no case shall more than five days elapse between seeding and mulching, or by hydroseeding as per the manufacturers specifications.
28. All damage incurred by erosion shall be rectified immediately by the contractor.
29. All plan revisions must be submitted to the district for proper review.
30. Maximum side slopes shall not exceed 2:1 unless approved by the district.
31. All dewatering operations shall discharge into an approved sediment basin.
32. The district must be notified, in writing, for the sale of any portion of the project or for the sale of any building lots. New Owner's name(s), addresses, and phone numbers shall be provided to the district.

All soil erosion and sediment control devices shall be installed prior to any major soil disturbance, or in their proper sequence, and maintained until permanent protection is established. During the length of the entire project, the Contractor shall be responsible for maintaining all soil erosion and sediment control devices in an efficient workable condition.

Hay bales shall be replaced as they become filled with silt. Stone at the construction entrances shall be respread as existing stone becomes dirty and covered with silt.

END OF SECTION 32 96 00

SECTION 32 98 00- IRRIGATION COMPONENTS AND/OR SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, to this Section.

1.2 SUMMARY

- A. This Section includes the following:

Work to be performed under this Section shall consist of furnishing all labor and materials necessary to construct a complete working and tested sprinkler irrigation system as per all drawings and specifications

1.2 REFERENCES

- A. ANSI – American National Standards Institute
- B. ASIC – American Society of Irrigation Consultants: ASIC Grounding Guideline.
- C. ASSE – American Society of Sanitary Engineering: ASSE 1013, 1015: Backflow Preventers, Pressure Reducers.
- D. ASTM – American Society of Testing and Materials
- E. IA – The Irrigation Association: Main BMP Document.
- F. NFPA – National Fire Protection Association: NFPA 70 National Electrical Code.
- G. UL – Underwriters Laboratories: UL Wires and Cables.

1.3 DEFINITIONS

- A. Water Supply: On site well.
- B. Point of Connection: Location where Contractor shall tie into water supply to provide irrigation water to the Project.
- C. Mainline: Pressurized piping downstream of the Point of Connection to provide water to remote control valves and quick couplers. Normally under constant pressure.
- D. Lateral Pipe: The system of pipes that provide water from the valves to the sprinkler heads or emitters.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data and installation instructions prior to ordering of any materials. Delivered material shall match approved submittals.
- B. Certifications: All general laborers and workers shall be previously trained and familiar with sprinkler installation, and have a minimum of one-year experience.
- C. As-Built Drawings: Submit red-lined plan layout and details illustrating field installed points of connection, controllers, mainline and lateral line locations, size, and assembly. Include type and coverage of heads, type of valves, controllers, fittings, emitters, and accessories.
- D. Operation and Maintenance Data:
 - 1. Submit instructions covering full operation, care, and maintenance of system (and controls) and manufacturer's parts catalog.

2. Include year-to-year schedule showing length of time each valve is to be open to provide determined amount of water, drain procedures, cleanout features, etc.
 3. Instruct Owner's maintenance personnel on how to operate controller, adjust sprinkler heads and other equipment, and use special tools for adjustments.
- E. Keys:
1. Manual Valve Key: Furnish two 3 foot long valve keys to fit each type of valve assembly.
 2. Controller: Furnish two keys for each automatic controller.
- F. Tools: Furnish two sets of special tools required for removing, disassembling, and adjusting each type of valve supplied on the Project.

1.5 PERFORMANCE REQUIREMENTS

- A. All work to be performed to current standards of local governing municipality.
- B. Location of Equipment: Design locations shown on plans are approximate.
 1. Adjust as necessary to avoid obstructions.
 2. The number of heads or valves cannot be less than that indicated on plans without approval by Owner.
- C. PVC Pipe: Must be stamped with certified NFS.
- D. Verify and mark locations of all utilities and underground obstructions. Contractor shall contact local utility location services a minimum of 48 hours prior to the commencement of any construction.
- E. Contractor shall be responsible to obtain all necessary permits and to comply with electrical company requirements.
- F. No substitutions of materials are allowed unless approved by Owner.
- G. Record Copy: Maintain at project site one copy of plans marked "Project Record Copy". Mark any deviation in material installation or design on this copy. Maintain and update at least weekly. Use this copy to produce As-Built Drawings upon project completion.

1.6 QUALITY ASSURANCE

- A. Contractor shall have considerable experience and demonstrate ability in the installation of irrigation system(s) of specified type(s) in a neat, orderly, and responsible manner in accordance with recognized standards of workmanship.
 1. Contractor must be a current Certified Irrigation Contractor in good standing as set forth by the Irrigation Association.
 2. Contractor must be licensed to perform landscape construction in the state of this project.
- B. All work shall be performed in accordance with the best standards of practice relating to the trade.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, unload, store, and handle materials, packaging, bundling, and products in dry, weatherproof, waterproof condition in a manner to prevent damage, breakage, deterioration, intrusion, ignition, and vandalism.
- B. Deliver in original unopened packaging containers prominently displaying manufacturer's name, volume, quantity, contents, instructions, and conformance to local, state, and federal law.

- C. Remove and replace cracked, broken, or contaminated items or elements prematurely exposed to moisture, inclement weather, temperature extremes, fire, and/or jobsite damage.
- D. Damaged materials attributed to Contractor shall be replaced with new materials at Contractor's expense.

1.8 JOB SITE CONDITIONS

- A. Protection of Property: Preserve and protect all monuments, structures, existing improvements, and paved areas from damage due to work of this section. In the event damage does occur, completely repair or replace all damage to satisfaction of Owner at no additional cost to the Project or Owner.
- B. Protection and Repair of Underground Lines: Request proper utility company to stake exact location (including depth) of all underground utilities. Take whatever precautions are necessary to protect these underground lines from damage, and, in the event damage does occur, repair all damages at no additional cost to the Project or Owner.
- C. Replacement of Paving and Curbs: Where trenches and lines cross existing roadways, paths, curbing, etc., keep damage to a minimum and restore to original condition.

1.9 WARRANTY

- A. Contractor shall provide a one year warranty that covers all material, workmanship, and labor.
 - 1. Shall include filling and/or repairing depressions or replacing turf or other plantings due to settlement of irrigation trenches or irrigation system elements.
 - 2. Shall include replacing turf or other plantings due to malfunctioning irrigation system.
 - 3. Valve boxes, sprinklers, or other components settled from original finish grade shall be restored to proper grade. Irrigation system shall be adjusted to provide proper, adequate coverage of irrigated areas.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS:

- A. Material: PVC
- B. Pressure Pipe: Schedule 40.
- C. Lateral Pipe: Schedule 40.
- D. Fittings: Schedule 40, solvent welded or threaded.
- E. Risers: Schedule 80, threaded.
- F. Sleeves: Schedule 40, minimum 2".

2.2 AUTOMATIC CONTROLLER

- A. Description: The Rain Bird™ ESP-LXD irrigation controller Irrigation controller or approved equal.
- B. Irrigation controller specifications include but are not limited to:
 - 1. The controller shall be of a hybrid type that is microelectronic circuitry capable of fully automatic or manual operation.

2. The controller shall be housed in a wall-mountable, weather resistant plastic cabinet with a key-locking cabinet door suitable for indoor or outdoor installation.
 3. The controller shall be a two-wire path decoder based control system.
 4. The controller shall have incorporated a base station ESPLXD-M50 Module or approved equal with capacity of 50 stations as well as two additional expansion slots capable of receiving ESPLXD-SM75 Modules or approved equal to create a controller capacity of 200 stations.
 5. The weather sensors shall include but are not limited to the Rain Bird™ WR2 Rain/Freeze Sensor, the Rain Bird™ RSD Rain Sensor, and the Rain Bird™ Anemometer with Rain Bird™ PT3002 pulse monitor or approved equals. The equipment shall be compatible with all equipment.
 6. The controller shall have 4 separate and independent programs which can have different start time, start day cycles and station run times with each program having up to 8 start times per day.
 7. The controller shall have a water management software.
 8. The controller shall incorporate a shall provide real-time flow, power, and station management; Controller shall have the ability to learn the normal flow rate of each station.
 9. Shall be manufactured by Rain Bird® Corporation, Azusa, California or an approved equal.
- C. Provide a lockable powder-coated steel case suitable for mounting in a control cabinet.
- D. Provide a lockable weather proof pedestal for controller. Pedestal shall be Rain Bird™ LXMMPED powder-coated steel pedestal or an approved equal.

2.3 CONTROL VALVES

- A. Description: Rain Bird® 100-PESB-PRS-D electric remote control valve or an approved equal:
1. Rain Bird® 100-PESB- PRS-D electric remote control valve or an approved equal.
- B. Electric remote control valve specifications include but are not limited to:
1. The valve body shall be constructed of heavy-duty glass-filled ultra-violet resistant nylon.
 2. Diaphragm shall be of nylon reinforced nitrile rubber.
 3. Shall be compatible with decoders.
 4. Shall contain a nylon scrubber which prevents debris build-up and clogging.
 5. Valve can accommodate a field-installed pressure regulating module.
 6. Operating pressure range of 20 to 200 psi (1.4 to 13.8 bar).
 7. Operating flow rate of 5 to 200 gpm (1.14 to 45.4 m³/h; 19.2 to 757 l/m).
 8. Shall include a 5-year trade warranty.

2.4 QUICK COUPLING VALVE

- A. Description: Quick-coupling valve as follows:
1. Rain Bird® 44-NP-LRC quick-coupling valve or approved equal.

- B. Quick-coupling valve specifications include but are not limited to:
 1. Shall be constructed of rugged, red brass construction for long life and reliable performance.
 2. Shall include a purple locking thermoplastic cover for durability and vandal resistance.
 3. Operating pressure range of 5 to 125 psi (0.3 to 8.6 bar).
 4. Operating flow rate of 10 to 125 gpm (2.27 to 28.38 m³/h; 37.8 to 265 l/m).
 5. Shall include a 3-year trade warranty.

2.5 BACKFLOW PREVENTER


- A. Manufacturer's standard, to suit sprinkler system as follows:
 1. Reduced Pressure Principle Device (RP) or as required by local governing municipality.
 2. Capability of being tested and serviced without removing from line.
- B. Comply with local water district and State requirements for such.

2.9 ROTOR HEADS

- A. Rotor sprinkler head specifications include but are not limited to:
 1. Shall be Rain Bird® 8005 rotor sprinkler or an approved equal.
 2. Full and part circle arc rotation in one unit to reduce inventory requirements with part circle adjustable arc rotation of 50 to 330 degrees (0.9 to 5.8 rad).
 3. Shall have vandal resistant features including a non-strippable drive mechanism, and a brass reinforcing shaft.
 4. Shall have a pressure-activated, multi-function wiper seal that protects internals from debris and assures positive pop-up and retraction.
 5. Operating precipitation rate of .66 to 1.23 inches per hour (17 to 31 mm/h).
 6. Operating pressure range of 50 to 100 psi (3.4 to 6.9 bar).
 7. Operating flow rate of 11.1 to 36.3 gpm (2.5 to 8.2 m³/h).
 8. The body, stem, nozzle, and screen shall be constructed of heavy-duty and ultra-violet resistant plastic.
 9. Shall include an internal check valve to prevent low head drainage of up to 10 feet (3.1 m) to prevent puddling, run-off and erosion.
 10. Shall include a set of eight interchangeable color-coded Rain Curtain™ nozzles with 25 degree (0.4 rad) trajectory.
 11. Shall have standard green rubber cover or optional purple rubber cover for non-potable water.
 12. Shall include a five-year trade warranty.

2.15 VALVE BOX

- A. Description: Valve boxes or other devices as necessary.
- B. Valve boxes specifications include but are not limited to:
 1. Shall be made of structural foam HPDE resin that is resistant to ultra-violet light, weather, moisture and chemical action of soils.
 2. Lids shall be clearly marked with the words "IRRIGATION CONTROL VALVE" molded onto the top.
 3. Lid colors are available in black, green and purple designating non-potable water use. Color to be selected by Township.
 4. Purple colored lids designate non-potable water use.

- a. Easy-to-read purple wording in English "DO NOT DRINK", Spanish "NO BEBA" warnings.
 - b. International do not drink symbol as illustrated: 
5. Shall include a 5-year trade warranty.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Stake pipe and equipment layout as follows:
 1. Mark routing of pressure supply line and flag heads for first few zones for Owner's review and approval. Owner will review staking and direct changes if required. Review does not relieve installer from coverage problems due to improper placement after staking.
- B. Excavate trenches for irrigation system pipe to provide minimum cover per plans and details. Before excavating, establish the location of all underground utilities and obstructions. Dig trenches straight and support pipe continuously on bottom of trench. Clean trench bottom and smooth by removing all rock and organic debris.
- C. Barricade trenches that are left open overnight.

3.2 INSTALLATION

- A. General: Plans are diagrammatic. Contractor is responsible for preparing layout and design of system. Proceed with installation in accordance with the following:
 1. Install stop and waste valves, backflow preventers, and other equipment required by local authorities according to laws and regulations in order to make system complete.
 2. Install main line, control valves, lateral lines, fittings, and heads/drip line as specified. Avoid conflict with tree locations. Where trenching is required in proximity to trees which are to remain, do not damage roots.
 3. Thoroughly flush main lines before installing automatic control valves, and laterals before installing sprinklers. Flush supply lines thoroughly before installing backflow preventers or other regulating devices.
 4. Adjust heads to be plumb and flush with finished grades, even with top of soil level or top of material level after completion of grading, seeding or sodding, and rolling of grass areas.
 5. Any discrepancies between existing site conditions and those indicated on the plans shall be called to the attention of Owner prior to continuance of the project.
- B. Piping: Assemble all mainline and lateral lines in accordance with manufacturer's recommendations with no cul-de-sacs. Assure positive drainage.
 1. Pack the opening around the pipe with non-shrink grout at wall penetrations. Fill perimeter slot with backer rod and sealant at exterior face. Repair below grade waterproofing and make penetration watertight.

2. Install PVC pipe in dry weather above 40 degrees F as specified by manufacturer's recommendations. Allow joints to cure a minimum of 8 hours before testing.
 3. Lay pipe and make all plastic to plastic joints in accordance with manufacturer's recommendations.
- C. Sleeves: Install sleeves before concrete/paving work.
- D. Control Valves:
1. Install control valves at plan locations, according to details, and in accordance with manufacturer's recommendations.
 2. Install one valve per valve box and provide 12 inches of expansion loop slack wire at all connections inside valve box.
- E. Manual Drains:
1. Install per manufacturer's recommendations on upstream and downstream side of backflow preventers and at lowest point along main pressure pipe.
 2. Install by teeing down to $\frac{3}{4}$ inch drain valve. Provide a drainage sump sized to receive volume of drain water.
 3. Make manual drain valves accessible by installing an adjustable pipe sleeve to meet finished grade with locking valve marker lid flush with finish grade.
- F. Quick-Coupling Valves: Install using 1 inch PVC nipples and schedule 40 ells as detailed. Location as indicated on plans.
- G. Backflow Preventer:
1. Install assembly complete for irrigation system with 2 drain valves and 2 shut off valves per detail, local laws and regulations, and per manufacturer's specifications.
 2. Install assemblies with drain valves in below grade installations. Provide open box floor with gravel drain sump.
- H. Valve Boxes
1. Install over all remote control valves, manual control valves, zone shutoff valves, gate valves, or globe valves. Size to provide adequate room for maintenance.
 2. Install boxes on level subgrade with proper drainage. Place parallel or perpendicular to adjacent curbs, sidewalks, or driveways.
 3. Imprint a valve control number on each box cover that corresponds to the valve controller in a permanent and legible manner.
 4. Place washed gravel aggregate in sump as shown on details.
- I. Automatic Controller
1. Stake controller location for approval.
 2. Install according to manufacturer's instructions.
 3. Mount the panel enclosure so adjustments can be conveniently made by operator.

4. Properly ground controller per local laws and regulations. Make all control wire connections to automatic controller. Coordinate controller installation with other electrical work.
5. Connect remote control valves to controller in numerical sequence as shown on Plans.
6. Pour concrete pedestal base with inserted conduits and bolts if pedestal controller is used. Concrete base to be not less than 6 inches (150 mm) greater in each direction than overall dimensions of controller.
7. Program controller to provide appropriate amount of water for each station.

J. Wire and Electrical Work

1. Use electrical control and ground wire suitable for sprinkler control cable of size indicated on Plans.
2. Tape control wires to underside of pipe at 15 ft intervals.
3. Provide 120-volt power connection to automatic controller to conform to local codes, ordinances and authorities having jurisdiction.
4. Low Voltage Wiring:
 - a. Bury control wiring between controller and electric valves in pressure supply line trenches, strung as close as possible to main pipe lines with such wires to be consistently located below and to one side of the pipe, or in separate trenches.
 - b. Bundle all 24-volt wires at 10-foot intervals and lay with pressure supply line pipe to one side of trench.
 - c. Provide an expansion loop at every pressure pipe angle and fitting and at every electric control valve location (in valve box). Form expansion loop by wrapping wire at least 8 times around a $\frac{3}{4}$ -inch pipe and withdrawing pipe.
 - d. Make all splices and E.V.C. connections using dry splice method.
 - e. Install all control wire splices not occurring at control valve in a separate splice valve box.
 - f. Install control wire for each control valve.
 - g. Run 2 spare #14-1 wires from controller pedestal or electric control valve on each and every leg of mainline. Label spare wires at controller and wire stub box.

K. Sprinkler Heads, Emitters, Rotators, and Rotors

1. Install per plans, details, and manufacturer's recommendations.
2. Flush circuit piping with full head of water and install sprinklers after hydrostatic test is completed.
3. Adjust nozzles to allow for adequate coverage and to minimize overspray onto walks, roads, driveways, and buildings.
4. Locate part-circle sprinklers a minimum distance of 4 inches (100 mm) from walls and 2 inches (50 mm) from other boundaries, unless otherwise indicated.
5. Stake emitter tubing with tubing stakes.
6. Adjust heads to be plumb and flush with finish grades, even with top of soil level or top of material level after completion of grading, seeding, sodding, and rolling of grass.

L. Drip Tubing

1. Install all surface drip tubing per plans before installation of mulch and as indicated on details.
2. Install subsurface drip tubing per plans and as indicated on details.
3. Install all point-source drip per plans and as indicated on details.
4. Install flush caps as indicated on details.

M. Thrust Blocks

1. Install on pipe sized 2" or larger wherever the line:
 - a. Changes any direction at tees, angles, and crosses vertical and horizontal.
 - b. Changes at reducers.
 - c. Stops at a dead-end.
 - d. Valves at which thrust develops when closed.
2. Size of thrust block depends on pressure, pipe size, soil type, and fitting type. As a general rule, one cubic foot (minimum) of concrete is required for each thrust block.
3. Thrust blocks shall rest against undisturbed original soil in direction of thrust.

3.3 BACKFILLING

- A. Do not begin backfilling operations until system tests and approvals have been completed.
- B. Bed all pipe a minimum of 2 inches. Backfill to 6 inches above pipe with soil free of rocks over 1-inch diameter, debris, or organic matter. Backfill remainder of trench with soil of like quality to adjacent areas. Haul away all material not suitable for backfill.
- C. Compact backfill in 6-inch lifts thoroughly to prevent settling damage to grades or plant material. Leave trenches slightly mounded to allow for settlement after backfilling is completed. Low areas and damage caused by settling will be repaired by Contractor at no additional cost to the Project or Owner.
- D. Prevent soil, rocks, or debris from entering pipes or sleeves.

3.4 FLUSHING AND TESTING

- A. Flushing: After piping, risers, and valves are in place and connected, but prior to installation of sprinkler heads, thoroughly flush piping system under full head of water pressure from dead end fittings. Maintain flushing for 5 minutes through furthest valves. Cap risers after flushing.
- B. Testing: Notify Owner 48 hours in advance of all testing. Conduct tests in presence of Owner's Representative.
 1. After backfilling and installation of control valves, fill pressure supply line with water and pressurize to 40 PSI over the designated static pressure or 120 PSI, whichever is greater, for a period of 2 hours.
 2. Leakage, Pressure Loss – Test is acceptable if no leakage or pressure loss is evident during test period.
 3. Leaks – Detect and repair all leaks.
 4. Retest system until test pressure can be maintained for duration of test.
 5. Before final acceptance, test supply line under pressure for a period of 48 hours.

3.5 INSPECTION

- A. Arrange for Owner's presence 48 hours in advance of inspection walk-through.
- B. Examine areas and conditions under which work of this section is to be performed and ensure a complete and operating installation prior to scheduling a walk-through.
- C. Operate each zone in its entirety for Owner at time of walk-through and open all valve boxes as directed.
- D. Expose all drip emitters under operations for observation by Owner to demonstrate they are performing and installed as designed prior to placing of mulch material. Schedule separate walk-through as necessary.
- E. As necessary Owner will generate a list of items to be corrected prior to Final Acceptance.
- F. Furnish all materials and perform all work required to correct inadequacies of installed system.

3.6 RESTORATION AND CLEANING

- A. Flush dirt and debris from piping before installing sprinklers and other devices.
- B. Adjust automatic control valves to provide flow rate of rated operating pressure required for each sprinkler circuit.
- C. Restore all damaged areas to original condition unless otherwise shown on plans at no additional cost to the Project or Owner.
- D. Maintain continuous cleaning operation throughout duration of work. Dispose of, off-site, at no additional cost to Project or Owner, all trash or debris generated by installation of irrigation system.

END OF SECTION 32 98 00

SECTION 33 41 00 – STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, to this Section.

1.2 SUMMARY

- A. This Section includes storm drainage outside the building.

1.3 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Nonpressure-Piping Pressure Ratings: At least equal to system test pressure.

1.4 SUBMITTALS

- A. Shop Drawings: Include plans, elevations, details, and attachments for the following:
 - 1. Precast concrete manholes and other structures, including frames, covers, and grates.
 - 2. Cast-in-place concrete manholes and other structures, including frames, covers, and grates.
 - 3. Storm drainage piping materials, cleanouts and bedding.
 - 4. Connections to existing structures.
 - 5. Bolted frames, covers and grates.
- B. Coordination Drawings: Show manholes and other structures, pipe sizes, locations, and elevations. Include details of underground structures and connections. Show other piping in same trench and clearances from sewerage system piping. Indicate interface and spatial relationship between piping and proximate structures.
- C. Design Mix Reports and Calculations: For each class of cast-in-place concrete.
- D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect pipe, pipe fittings, and seals from dirt and damage.
- B. Handle precast concrete manholes and other structures according to manufacturer's written rigging instructions.
- C. Do not store plastic structures, pipe and fittings in direct sunlight.

1.6 PROJECT CONDITIONS

- A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.
- B. Locate existing structures and piping to be closed and abandoned.
- C. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Owner not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe and fitting materials.

2.2 PIPES AND FITTINGS

- A. PVC Sewer Pipe and Fittings, NPS 15 and smaller ASTM D3034, SDR 35 for solvent cemented or gasketed joints.
- B. High Density Polyethylene Pipe- smooth interior, AASHTO M 294-94, Type S, O-Ring rubber gasket joints meeting ASTM F477 as specified on the plans or approved equal.
- C. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76 (ASTM C 76M), Class III or V, Wall B, for gasketed joints.
 - 1. Gaskets: ASTM C 443 (ASTM C 443m), rubber.

2.3 MANHOLES

- A. Normal-Traffic Precast Concrete Manholes: ASTM C 478 (ASTM C 478M), precast, reinforced concrete, of depth indicated, with provision for rubber gasketed joints.
 - 1. Diameter: 48 inches minimum, unless otherwise indicated.
 - 2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
 - 3. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
 - 4. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.
 - 5. Top Section: Eccentric-cone type, unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
 - 6. Gaskets: ASTM C 443 (ASTM C 443M), rubber.

7. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch- diameter frame and cover.
 8. Steps: Fiberglass, individual steps or ladder. Include width that allows worker to place both feet on one step and is designed to prevent lateral slippage off step. Cast or anchor into base, riser, and top section sidewalls with steps at 12- to 16-inch intervals. Omit steps for manholes less than 60 inches deep.
 9. Steps: ASTM C 478 (ASTM C 478M), individual steps or ladder. Omit steps for manholes less than 60 inches deep.
 10. Pipe Connectors: ASTM C 923 (ASTM C 923M), resilient, of size required, for each pipe connecting to base section.
- B. Cast-in-Place Concrete Manholes: Construct of reinforced-concrete bottom, walls, and top; designed according to ASTM C 890 for A-16, heavy-traffic, structural loading; of depth, shape, dimensions, and appurtenances indicated.
1. Ballast: Increase thickness of concrete, as required to prevent flotation.
 2. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch- diameter frame and cover.
 3. Steps: Fiberglass, individual steps or ladder. Include width that allows worker to place both feet on one step and is designed to prevent lateral slippage off step. Cast or anchor into sidewalls with steps at 12- to 16-inch intervals. Omit steps for manholes less than 60 inches deep.
 4. Steps: Manufactured from deformed, 1/2-inch steel reinforcement rod or as indicated on the plans and details complying with ASTM A 615/A 615M and encased in polypropylene complying with ASTM D 4101. Include pattern designed to prevent lateral slippage off step. Cast or anchor into sidewalls with steps at 12- to 16-inch intervals. Omit steps for manholes less than 60 inches deep.
- C. Manhole Frames and Covers: ASTM A 536, Grade 60-40-18, ductile-iron castings designed for heavy-duty service. Include 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch- diameter cover. Include indented top design with lettering "STORM SEWER" cast into cover.

2.4 CATCH BASINS

- A. Normal-Traffic, Precast Concrete Catch Basins: ASTM C 478 (ASTM C 478M), precast, reinforced concrete, of depth indicated, with provision for rubber gasketed joints.
1. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
 2. Riser Sections: 4-inch minimum thickness, 48-inch diameter, and lengths to provide depth indicated.
 3. Top Section: Eccentric-cone type, unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
 4. Gaskets: ASTM C 443 (ASTM C 443M), rubber.
 5. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch diameter frame and grate.

6. Steps: Fiberglass, individual steps or ladder. Include width that allows worker to place both feet on one step and is designed to prevent lateral slippage off step. Cast steps or anchor ladder into base, riser, and top section sidewalls at 12- to 16-inch intervals. Omit steps for catch basins less than 60 inches deep.
 7. Steps: ASTM C 478 (ASTM C 478M), individual steps or ladder. Omit steps for catch basins less than 60 inches deep.
 8. Pipe Connectors: ASTM C 923 (ASTM C 923M), resilient, of size required, for each pipe connecting to base section.
- B. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for heavy-duty service. Include bolted frame and grates as indicated on the plans.
1. Size: 24 by 24 inches minimum, unless otherwise indicated.
 2. Grate Free Area: Approximately 50 percent, unless otherwise indicated.
- C. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for heavy-duty service. Include 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch-diameter flat grate with small square or short-slotted drainage openings.
1. Grate Free Area: Approximately 50 percent, unless otherwise indicated.

2.5 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318, ACI 350R, and the following:
1. Cement: ASTM C 150, Type II.
 2. Fine Aggregate: ASTM C 33, sand.
 3. Coarse Aggregate: ASTM C 33, crushed gravel.
 4. Water: Potable.
- B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water-cementitious ratio.
1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
 2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed steel.
- C. Structure Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water-cementitious ratio.
1. Include channels and benches in manholes.
 - a. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
 - b. Benches: Concrete, sloped to drain into channel.
 2. Include channels in catch basins.
 - a. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.

- D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water-cementitious ratio.
 - 1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
 - 2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed steel.

2.6 PROTECTIVE COATINGS

- A. Description: One- or two-coat, coal-tar epoxy; 15-mil minimum thickness, unless otherwise indicated; factory or field applied to the following surfaces:
 - 1. Concrete Manholes: On exterior surface.
 - 2. Manhole Frames and Covers: On entire surfaces.
 - 3. Catch Basins: On exterior surface.
 - 4. Catch Basin Frames and Grates: On entire surfaces.
 - 5. Stormwater Inlets: On exterior surface.
 - 6. Stormwater Inlet Frames and Grates: On entire surfaces.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earthwork."

3.2 PIPING APPLICATIONS

- A. Refer to Part 2 of this Section for detailed specifications for pipe and fitting products listed below. Use pipe, fittings, and joining methods according to applications indicated.

3.3 SPECIAL PIPE COUPLING AND FITTING APPLICATIONS

- A. Special Pipe Couplings: Use where required to join piping and no other appropriate method is specified. Do not use instead of specified joining methods.

3.4 INSTALLATION, GENERAL

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line, and pull past each joint as it is completed.
- C. Use manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.
- D. Use proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

- E. Install gravity-flow piping and connect to building's storm drains, of sizes and in locations indicated. Terminate piping as indicated.
 - 1. Install piping pitched down in direction of flow, at minimum slope of 1 percent, unless otherwise indicated.

3.5 PIPE JOINT CONSTRUCTION AND INSTALLATION

- A. General: Join and install pipe and fittings according to installations indicated and manufacturer's specifications.
- B. Concrete Pipe and Fittings: Install according to ACPA's "Concrete Pipe Installation Manual." Use the following seals:
 - 1. Round Pipe and Fittings: ASTM C 443 (ASTM C 443M), rubber gaskets.
- C. High density Polyethylene pipe and fittings as follows:
 - 1. Join pipe and gasketed fittings with gaskets according to ASTM D 2321.
 - 2. Install in accordance with ASTM D 2321 and the manufacturers specifications. .
- D. Join piping made of different materials or dimensions with couplings made for this application. Use couplings that are compatible with and that fit both systems' materials and dimensions.

3.6 CATCH-BASIN INSTALLATION

- A. Construct catch basins to sizes and shapes indicated.
- B. Set frames and grates to elevations indicated.

3.7 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318 and ACI 350R.

3.8 FIELD QUALITY CONTROL

- A. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed.
 - 1. In large, accessible piping, brushes and brooms may be used for cleaning.
 - 2. Place plug in end of incomplete piping at end of day and when work stops.
 - 3. Flush piping between manholes and other structures to remove collected debris, if required by authorities having jurisdiction.
- B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
 - 1. Submit separate reports for each system inspection.
 - 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.

- b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 4. Reinspect and repeat procedure until results are satisfactory.

END OF SECTION 33 41 00