

SECTION 31 20 00 - EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Preparing subgrades for walks, pavements, turf and grasses, and plants.
2. General excavating and backfilling.
3. Drainage course for concrete slabs-on-grade.
4. Subbase course for concrete walks and pavements.
5. Subbase course and base course for asphalt paving.
6. Subsurface drainage backfill for walls and trenches.
7. Excavating and backfilling trenches for utilities.
8. Testing requirements for testing agency.

B. Related Sections:

1. Division 01 Section "Temporary Facilities and Controls" for temporary controls, utilities, and support facilities; also for temporary site fencing if not in another Section.
2. Division 03 Section "Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
3. Division 21, 22, 23, 26, 27, and 28 Sections for installing underground mechanical and electrical utilities and buried mechanical and electrical structures.
4. Division 32 Section "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.
5. Division 33 Section "Storm Utility Drainage Piping" for drainage of slabs-on-grade and play areas.

C. Unless noted otherwise, the Contractor shall excavate, backfill, grade, and replace site surface materials as required for the complete and proper execution and installation of all work. Work shall include, but is not necessarily limited to: excavation, backfilling, rough grading, and finish grading as required to allow for new construction including retaining walls, curbs, sidewalks, paving, landscaping, site utilities, mechanical services, electrical utilities, and all other miscellaneous items required.

D. For the basis of bidding, all excavation shall be assumed to be earth. In the event rock is encountered in the excavation, the contractor will be additionally compensated for the rock excavation as set forth in Division 01 Section "Contract Modification Procedures."

E. Use of explosives will not be permitted without the consent of the Owner.

1.3 UNIT PRICES

A. Specific work of this section is itemized as Unit Prices on the Bid Form to add or deduct specific units of work to the project. Unit Price descriptions, requirements and units of work are enumerated in Division 01 Section "Unit Prices." Unit Prices are inclusive of all labor, materials, overhead, and profit per unit of work indicated.

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

1.4 ALLOWANCES

A. Work Included in the Base Bid: The Contractor shall include in the space provided on the Bid Form, the allowances for work of this section itemized on the Bid Form. The cost of these quantities shall be computed using the Unit Prices stated on the Bid Form. The work listed is in addition to that required to complete the work of the Contract and, consequently, the sum therefore may be deducted from the Contract amount if the corresponding work is not required by actual conditions encountered.

1.5 DEFINITIONS

A. Backfill: Soil material or controlled low-strength 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: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer 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: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.

2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be provided by Contractor without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. PADOT or PennDOT: Pennsylvania Department of Transportation.

I. 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. Rock Excavation by Hand: Removal of rock type materials by a worker using pneumatic vibrating chipper or air spade.
2. Rock Excavation by Ram Hammer: Removal of rock type materials using equipment equivalent to Caterpillar Model No. 320 GC track-mounted hydraulic excavator, equipped with a 42-inch-wide short-tip radius rock bucket, rated at not less than 145-hp flywheel power (150 9249) with bucket force of not less than 28,000 lbs and stick force of not less than 22,000 lbs. This type of excavation shall be employed when other rock removal methods are ruled out as too dangerous to existing building and its stability.
3. Rock Excavation by Ripping: Removal of rock type materials using equipment equivalent to Caterpillar Model No. D8T, heavy-duty, track-type tractor rated at not less than 345-hp flywheel power and developing minimum of 50,000-lb pry-out force. Rock ripping method shall be attempted for all bulk rock excavation as it is encountered at the site; however, this method shall be limited to bulk rock excavation work only. Existing site rock which cannot be ripped with ripper tractors, as determined by trial ripping, and verified by the Architect, shall be excavated by rock excavation methods employing drilling and blasting and only when agreed to by the Owner.

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: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

L. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

M. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

1. Controlled low-strength material, including design mixture.
2. Warning tapes.
3. Geofoam.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D 2487.
2. Laboratory compaction curve according to ASTM D 1557.

- C. Topsoil Analysis Report: Contractor is responsible to have on-site topsoil tested and new (import) topsoil tested by qualified agronomist. Prior to seeding, verify necessary soil amendments. Copies of test results to be submitted for review and approval.
- D. Preexcavation Photographs or Video: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins. Failure by the Contractor to do so shall prevent Contractor from submitting claims for additional cost required to correct any damage identified after earth moving activities commence.

1.8 QUALITY ASSURANCE

- A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

1.9 REGULATORY REQUIREMENTS

- A. Comply with all applicable federal, state, and local codes, ordinances, and regulations, in addition to the following:
 1. International Building Code, Chapter 18 "Soils and Foundations."
 2. The Commonwealth of Pennsylvania Department of Transportation Specifications, Publication 408, latest edition.
 3. Department of Environmental Protection publications relative to work required.
- B. These regulatory requirements shall form a part of these specifications as if physically attached hereto. In case of conflict, the provisions ensuring the greater public safety shall govern.

1.10 PREINSTALLATION MEETINGS

- A. Preexcavation Conference: Conduct conference at Project site.
 1. Review specification requirements.
 2. Review regulatory requirements
 3. Review installation procedures.
 4. Review all site and foundation drawings.
 5. Inspect project conditions.
 6. Coordination of work with utility location service.
 7. Field quality control.

1.11 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving 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 Owner or authorities having jurisdiction.

B. Notify utility locator service "PA One Call" for area where Project is located a minimum of one week before beginning earth moving operations. Where utilities are indicated to remain, provide adequate means of support and protection during earthwork operations.

1. In addition to the PA One Call, Contractor shall utilize ground-penetrating radar as indicated in Division 01 Section "Execution" to confirm and locate all underground utilities.
2. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult utility owner immediately for direction. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Any damaged utilities shall be repaired at the Contractor's expense and to the satisfaction of the utility Owner and Architect.
3. Do not interrupt existing utilities serving facilities occupied by Owner or others, during occupied hours, except when permitted in writing by Architect and then only after acceptable temporary utility services have been provided.
 - a. Provide minimum of 48-hour notice to Architect and Owner's Representative and receive written notice to proceed before interrupting any utility.
4. Demolish and completely remove from the site existing underground utilities indicated to be removed. Coordinate with utility companies for shutoff of services if lines are active.

C. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures, specified in Division 01 Section "Temporary Facilities and Controls," Division 01 Section "Erosion and Sediment Control", Division 31 Section "Site Clearing," are in place.

D. Do not commence earth moving operations until plant-protection measures are in place.

E. Do not commence earth moving operations until utility location work required by Division 01 Section "Execution" is complete.

F. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.

1. Operate warning lights as recommended by authorities having jurisdiction.
2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
3. Perform excavation by hand within dripline of large trees to remain. Protect root systems from damage or dryout to the greatest extent possible. Maintain moist condition for root system and cover exposed roots with moistened burlap.

G. Provide traffic control for excavation within and adjacent to state roads and their right-of-way.

1. Comply with authorities having jurisdiction for traffic control.
2. Refer to PADOT Publication 213, Temporary Traffic Control Guidelines for short or long term operations as applicable.

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: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- E. Backfill and fill: Satisfactory soil materials, unless otherwise indicated.
- F. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.
- G. Structural (Engineered) Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve (common name of "2A Modified" Stone).
- H. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
- I. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.
- J. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 4 sieve.
- K. Sand: ASTM C 33; fine aggregate.
- L. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.
- M. Non-Structural Backfill and Fill Materials (for Lawn Areas): Excavated soil materials free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

2.2 TOPSOIL

- A. Acceptable topsoil shall be stockpiled for re-use in landscape work. If quantity of stockpiled topsoil is insufficient, provide (at no additional cost) additional topsoil as required to complete landscape work.
- B. Provide new topsoil that is fertile, friable, natural loam, surface soil, reasonably free of subsoil, clay lumps, brush, weeds and other litter, and free of roots, stumps, stones larger than 2 inches in any dimension, and other extraneous or toxic matter harmful to plant growth.

1. Obtain topsoil from local sources or from areas having similar soil characteristics to that found at project site. Obtain topsoil only from naturally, well-drained sites where topsoil occurs in a depth of not less than 4 inches. Do not obtain from bogs or marshes.
2. Topsoil shall be a loam or sandy loam. The particle gradation of the topsoil shall be within the following range as a percentage of the total mix:
 - a. Sand (0.500 MM to 0.050 MM) up to 80%.
 - b. Silt (0.050 MM to 0.005 MM) up to 25%.
 - c. Clay (0.003 MM and smaller) up to 10%.
3. Ideal Topsoil Nutrients: All topsoil for lawns (both on-site and new) to receive proper amendments so nutrients fall within the following guidelines:

<u>Element</u>	<u>Ideal Range</u>
pH	6.8
P O	300.00 lbs.
K O	3.5%
Ca	65.0%
Mg	10.0%

<u>Element</u>	<u>Ideal Range</u>
B	1.2 ppm
Fe	200.0 ppm
Mn	20-85 ppm
Cu	0.5-3.0 ppm
Zn	3-10.0 ppm

- C. New Topsoil: Before delivery of topsoil, furnish Architect with written statement giving location of properties from which topsoil is to be obtained, names and addresses of owners, depth to be stripped, and crops grown during past 2 years. Submit a sample for review and approval. Contractor will be responsible to test new topsoil to determine the soil amendments necessary for lawns or planting areas. Copies of test results to be submitted for review and approval.

2.3 ACCESSORIES

- A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils 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 deep; colored 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.

2.4 GEOFOAM

- A. Extruded-Polystyrene Board Insulation: ASTM C578, Type VI, 1.80-lb/cu. ft. density, 40-psi compressive strength per ASTM D1621, minimum compressive modulus of 1400 psi per ASTM D1621, and a minimum foundation modulus "K" of 300 pci.
- B. Connectors: Geofoam manufacturer's multibarded, galvanized-steel sheet connectors or deformed steel reinforcing bars, 3/4 inch in diameter.

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 earth moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

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. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting or runoff areas. Do not use trench excavations as temporary drainage ditches.
 - 3. Maintain dewatering until dewatering is no longer required.
- C. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.

3.3 EXCAVATION, GENERAL

- A. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth. Do not excavate rock until it has been classified and cross sectioned by Architect or Owner's Representative. The Contract Sum will be adjusted for rock excavation according to unit prices included in the Contract Documents.
 - 1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.

- a. Intermittent drilling; blasting, if permitted; ram hammering; or ripping of material not classified as rock excavation is earth excavation.
2. Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the following dimensions:
 - a. 24 inches outside of concrete forms other than at footings.
 - b. 12 inches outside of concrete forms at footings.
 - c. 6 inches outside of minimum required dimensions of concrete cast against grade.
 - d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
 - e. 6 inches beneath bottom of concrete slabs-on-grade.
 - f. 6 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide.
 - g. Depth required for minimum scheduled aggregate base and paving under bituminous paving.
 - h. 6" below bottom of topsoil under lawn and planting areas.
3. Contractor shall keep a running account of all rock excavation completed and shall have the Owner's Representative sign off on quantities daily. A specifically designated set of plans shall be kept noting location, quantity, type of excavation and date of removal for all rock excavation, and each quantity shall be initialed by Architect directly on this plan signifying agreement to its removal. When all excavation work is completed, this rock excavation report shall be submitted to the Architect to serve as a permanent record of rock excavation work completed. Cost for rock removal shall be based on the following payment System for Classified Rock Excavation:
 - a. Condition A: Owner shall be given a credit for the unperformed earth excavation replaced by rock excavation. Contractor will be paid an extra to cover the additional rock excavation. The credit for unperformed earth excavation and the extra for rock excavation shall be computed by multiplying the quantity by the applicable Unit Price stated in the Bid Form.
 - b. Condition B: Extra excavation is ordered over and above contract requirements. Contractor will be compensated for this excavation by multiplying the additional quantity by the applicable Unit Price stated in the Bid Form.
 - c. Condition C: Unit Prices submitted for rock excavation are determined to be unbalanced or unreasonable and hence rejected. Rock excavation shall proceed on a time and material cost basis acceptable to all parties, following Architect's written instructions. Owner shall be given credit for the unperformed earth excavation replaced by rock excavation.

3.4 STABILITY OF EXCAVATIONS

- A. General: Comply with local codes, ordinances, and requirements of agencies having jurisdiction.
- B. Slope or bench sides of excavations to comply with local codes, ordinances, and requirements of agencies having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in safe condition until completion of backfilling.
- C. Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers, and cross braces, in good serviceable condition. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Extend shoring and bracing as excavation progresses. Remove shoring and bracing when no longer required.

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.
- B. Excavations at Edges of Tree- and Plant-Protection Zones:
 - 1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

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. 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.
- B. 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: 6-9 inches each side of pipe or conduit or as indicated, whichever is greater.
- C. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.
 - 1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
- D. Trenches in Tree- and Plant-Protection Zones:
 - 1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
 - 2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.

3.8 COLD WEATHER PROTECTION

- A. Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F.

B. Cold Weather Protection of Interior Column Footings: During cold weather, the General Contractor shall take whatever measures are necessary to protect the interior column footings from heaving due to frost. The Contractor, at its option, may pour the interior footings lower than the elevations noted on the foundation plans, at no additional cost to the Owner. Any change to the Contract Drawings shall first be reviewed and accepted by the Architect and/or Engineer.

3.9 SUBGRADE INSPECTION

A. Notify Architect when excavations have reached required subgrade.

B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons 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 3 mph.
2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.10 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, with 28-day compressive strength of 2500 psi, may be used when approved by Architect.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.11 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.
2. Legally dispose of excess excavated soil material and materials not acceptable for use as backfill or fill at an acceptable off-site location.

3.12 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.

3.13 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. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of columns or bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Division 03 Section "Cast-in-Place Concrete"
- D. Trenches under Roadways: Provide 4-inch- thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase course. Concrete is specified in Division 03 Section "Cast-in-Place Concrete"
- E. Backfill voids with satisfactory soil while removing shoring and bracing.
- F. 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 pipe or conduit.
 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- G. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.14 PLACEMENT PREPARATION

- A. Preparation: Remove vegetation, debris, unsatisfactory soil materials, obstructing and deleterious materials from ground surface prior to placement of fill.

3.15 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
 1. Under grass and planted areas, use clean, approved satisfactory soil material.
 2. Under walks and pavements, use satisfactory soil material or imported structural fill.

3. Under steps and ramps, use structural fill.
4. Under building slabs, use structural fill up to the 4 inch of crushed stone base.
5. Under footings and foundations, use structural fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

D. Import fill included in the Base Bid and at no additional cost to Owner.

1. Under Sidewalks, Steps, Foundations, and Ramps (Structural Fill): Number 2A crushed aggregate in accordance with PADOT-408, Section 703, for use to bring subgrade up to required elevation.
2. Site Filling (Non-Structural): Clean, excavated subsoil, as approved by the Architect, for use when supply of approved on-site excavated material has been exhausted.

3.16 GEOFOAM FILL

- A. Install geofoam blocks in layers with abutting edges and ends and with the long dimension of each block at right angles to blocks in each subsequent layer. Offset joints of blocks in successive layers.
- B. Install geofoam connectors at each layer of geofoam to resist horizontal displacement according to geofoam manufacturer's written instructions.

3.17 SOIL 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.

3.18 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry density according to ASTM D 1557:
 1. Under structures, building slabs, steps, and pavements, compact each layer of backfill or fill soil material at 98 percent.
 - a. Floor slabs shall be supported on crushed stone base, following removal of topsoil, rock, and any soft or disturbed soils within the building area, and installation of structural fill up to an elevation of 4 inches below proposed bottom of slab elevation.

- b. Prior to placing crushed stone base, existing subgrade shall be proofrolled with a loaded tandem axle dump truck or fifteen ton roller under the observation of the Testing Laboratory's Soils Engineer, and built-up with new structural fill to reach scheduled subgrade elevation. All unsuitable subgrade materials shall be removed and replaced with compacted structural fill. The extent of undercutting, if any, shall be determined in the field by the Testing Laboratory's Soils Engineer. No structural fill or crushed stone for floor slab support shall be placed until the subgrade has been approved.
- 2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.
- 3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 90 percent.
- 4. For utility trenches, compact each layer of initial and final backfill soil material at 90 percent.

D. Footings, structural fill and stone bases shall not be placed until subgrade is approved by the Testing Laboratory's Soils Engineer.

3.19 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 Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 - 1. Turf or Unpaved Areas: Plus or minus 1 inch.
 - 2. Walks: Plus or minus 1 inch.
 - 3. Pavements: Plus or minus 1/2 inch.
 - 4. Swales: Finish swales to ensure proper flow and drainage. Conduct final rolling operations to produce hard, uniform and smooth cross-section.
- C. Compaction: After grading, compact subgrade surfaces to the depth and indicated percentage of maximum or relative density for each area classification.

3.20 TOPSOILING

- A. After the areas required to be topsoiled have been brought to the subgrades shown on the Drawings, and immediately prior to dumping and spreading the topsoil, loosen the subgrade, wherever excessively compacted by traffic or other causes, by discing or by scarifying to a depth of at least 3 inches, to permit bonding of the topsoil to the subgrade.
- B. Spread topsoil uniformly on all areas not covered by paving or other construction and evenly spread to a thickness of 6 inches. The spreading shall be performed in such a manner that seeding can proceed with little additional soil preparation or tillage. Correct irregularities in the surface resulting from topsoiling or other operations in order to prevent the formation of depressions where water will stand. Do not place when subgrade is excessively wet, extremely dry or in a condition otherwise detrimental to proper grading.

- C. After the topsoil has been spread and graded as required, clear surface of all stones, stumps, or other objects larger than 1 inch in thickness or diameter and of all roots, brush, wire, grade stakes, or other objects. Keep paved areas, over which hauling operations are conducted, clean.
- D. Where any portion of the surface becomes gullied or otherwise damaged, repair the affected area to establish the condition and grade prior to topsoiling and then re-topsoil.

3.21 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:
 - 1. Shape subbase course and base course to required crown elevations and cross-slope grades.
 - 2. Place subbase course and base course 6 inches or less in compacted thickness in a single layer.
 - 3. Place subbase course 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.
 - 4. Compact subbase course 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.

3.22 FIELD QUALITY CONTROL

- A. Special Inspections: Contractor shall engage a qualified special inspector to perform the following special inspections:
 - 1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
 - 2. Determine that fill material and maximum lift thickness comply with requirements.
 - 3. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.
- B. Testing Agency: Contractor shall engage a qualified geotechnical engineering testing agency to perform tests and inspections.
- C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- D. Testing agency will test compaction of soils in place according to ASTM D 1556, (sandcone method) and ASTM D 2167 (rubber balloon method), ASTM D 2922 (nuclear method), as applicable. Tests will be performed at the following locations and frequencies:
 - 1. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities.
 - 2. Test bottom of excavation using drop penetration bar consisting of 1 inch diameter rod, 8 foot long, with collar securely welded at center. Raise 25 pound sliding weight to top of rod and allow to drop, striking collar and driving rod into soil. Record number of blows for each foot of penetration and determine the soil bearing pressure.
 - 3. Test at all columns and at 20 foot maximum intervals for wall footings, average test approximately 4 foot in depth.

4. Paved Areas Subgrade: Soil, fill, structural fill, and backfilling in all areas throughout the project shall be tested, including plumbing, electrical and HVAC trenches. The Contractor's selected Testing Laboratory shall perform, as a minimum, the following tests:
 - a. Field test of compacted fill for moisture content and dry weight of compacted soils. One test per 50 lineal feet per 16" of backfill depth for trenches, and parallel to backfilled foundation walls. One test for each 2000 sq.ft. of each 16" loose layer of fill under bituminous paved areas.
 - b. Field density compaction test for density of soil in place. One test per 50 lineal feet per 16" of backfill depth for trenches, and parallel to backfilled foundation walls. One test for each 2000 sq.ft. of each 16" loose layer of fill under bituminous paved areas.
 - c. Approve the subgrade and fill material as suitable for percentage compaction specified, identify soil type by ASTM D 2487 classification, and give moisture content by ASTM D 1557 – Modified Proctor Test. Soils Engineer from testing laboratory shall recommend compaction equipment and work methods required to achieve compaction specified. Submit copy of all test data and recommendations to Architect, all field compaction work shall follow these recommendations.
 - d. If in opinion of Architect, based on testing laboratory reports and inspection, subgrade or fills that have been placed are below specified density, perform additional compaction and testing until specified density is obtained.
5. Lawn Areas: Soil, fill, and backfilling in all areas throughout the project shall be tested, including plumbing, electrical and HVAC trenches. The Contractor's selected Testing Laboratory shall perform as a minimum, the following tests:
 - a. Field test of compacted fill for moisture content and dry weight of compacted soils. One test per 50 lineal feet per 16" of backfill depth for trenches, and parallel to backfilled foundation walls. One test for each 5,000 sq.ft. of each loose layer of fill under lawns.
 - b. Field density compaction test for density of soil in place. One test per 50 lineal feet per 16" of backfill depth for trenches, and parallel to backfilled foundation walls. One test for each 5,000 sq.ft. of each 16" loose layer of fill under lawns.

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 materials to depth required; recompact and retest until specified compaction is obtained.

3.23 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 Architect; 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.

3.24 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.
- B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.
 - 1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 31 20 00

SECTION 32 12 16 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cold milling of existing asphalt pavement.
2. Hot-mix asphalt patching.
3. Hot-mix asphalt paving.
4. Hot-mix asphalt overlay.

B. Related Requirements:

1. Division 02 Section "Structure Demolition" and Division 02 Section "Selective Demolition" for demolition and removal of existing asphalt pavement.
2. Division 31 Section "Earth Moving" for subgrade preparation, fill material, unbound-aggregate subbase and base courses, and aggregate pavement shoulders.
3. Division 32 Section "Pavement Markings and Traffic Signage."

1.3 UNIT PRICES

A. Specific work of this section is itemized as Unit Prices on the Bid Form to add or deduct specific units of work to the project. Unit Price descriptions, requirements and units of work are enumerated in Division 01 Section "Unit Prices." Unit Prices are inclusive of all labor, materials, overhead and profit per unit of work indicated.

1.4 DEFINITIONS

A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

B. PADOT or PennDOT: Pennsylvania Department of Transportation.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:

- a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.

- b. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
2. Review project conditions and ADA accessibility requirements.
3. Review specification requirements.
4. Review project schedule.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 1. Include technical data and tested physical and performance properties.
 2. Paving Schedule: For each paving type indicated, provide a paving schedule that correlates with the job mix designs and the paving types.
 3. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
 - a. Demonstrate compliance with PADOT criteria and standards.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer, installer and testing agency.
- B. Material Certificates: For each paving material. Include statement that mixes containing recycled materials will perform equal to mixes produced from all new materials.
- C. Material Test Reports: For each paving material, by a qualified testing agency.
- D. Field quality-control reports.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A paving-mix manufacturer and installer who are thoroughly familiar with the paving system specified and whose paving work conforms to all requirements set forth by PA-DOT (PDT 408).
- B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.
- C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the Municipality and PADOT for asphalt paving work.
- D. Asphalt-Paving Publication: Comply with PennDOT Publication 408 Specifications, unless more stringent requirements are indicated.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
 1. Prime Coat: Minimum surface temperature of 60 deg F.
 2. Tack Coat: Minimum surface temperature of 60 deg F.

3. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
4. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

B. When the air temperature falls below 50 deg F, extra precautions shall be taken in drying the aggregate, controlling the temperature of the delivered material, and compacting the mixture.

PART 2 - PRODUCTS

2.1 AGGREGATES

- A. General: Use materials and gradations that have performed satisfactorily in previous installations.
- B. Coarse Aggregate: Sound, angular crushed stone or crushed gravel complying with ASTM D 692-88 and PennDOT Publication 408, Section 703.2.
- C. Fine Aggregate: Sharp-edged natural sand or sand prepared from stone, gravel, or combinations thereof, complying with ASTM D 1073 and PennDOT Publication 408, Section 703.1.
 1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

2.2 ASPHALT MATERIALS

- A. Asphalt Binder: AASHTO M 320 or AASHTO MP 1a, PG 64-22 or PG 58-28 where permitted in PennDot Publication 408, Section 420.
- B. Asphalt Cement: ASTM D 3381 for viscosity-graded material, ASTM D 946 for penetration-graded material and PennDOT Publication 408, Section 702.
- C. Prime Coat: Asphalt emulsion prime coat complying with PennDOT Publication 408, Section 461.
- D. Tack Coat: Emulsified asphalt; ASTM D 977 complying with PennDOT Publication 408, Section 460.
- E. Water: Potable.
- F. Undersealing Asphalt: ASTM D 3141, pumping consistency.

2.3 AUXILIARY MATERIALS

- A. Joint Sealant: ASTM D 6690 or AASHTO M 324, Type II or III, hot-applied, single-component, polymer-modified bituminous sealant.
- B. Paving Geotextile: AASHTO M 288 paving fabric; nonwoven polypropylene; resistant to chemical attack, rot, and mildew; and specifically designed for paving applications.

2.4 MIXES

- A. General: Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by PADOT and complying with the following requirements:

B. HEAVY-DUTY PAVING:

1. Superpave HMA Wearing Course – 1-1/2-inch minimum thickness after compaction.
2. Superpave HMA Binder Course – 2-inch minimum thickness after compaction.
3. Superpave HMA Base Course – 5-inch minimum thickness after compaction.
4. Aggregate Base – 8-inch minimum thickness after compaction, installed over compacted subgrade.

C. STANDARD-DUTY PAVING:

1. Superpave HMA Wearing Course – 1-1/2-inch minimum thickness after compaction.
2. Superpave HMA Base Course – 2-1/2-inch minimum thickness after compaction.
3. Aggregate Base – 6-inch minimum thickness after compaction, installed over compacted subgrade.

D. PAVING OVERLAY:

1. Superpave HMA Wearing Course – 1-1/2-inch minimum thickness after compaction.

2.5 ASPHALT MATERIAL ESCALATION CLAUSE

- A. General: This clause is applicable only to the asphalt material required for the scope of work defined on this Project and shall apply to the Base Bid, Alternates, and Unit Prices. This provision shall not apply to any other portion of the Work of this Project. The Pennsylvania Asphalt Pavement Association (PAPA) index for Zone 1 on the day Bids are received shall establish the benchmark for any cost adjustment of asphalt materials required for this Project.
- B. Asphalt Material Escalation: Should the cost of asphalt materials required on this Project increase or decrease by more than 5% of the posted PAPA asphalt index per ton of asphalt material, the Contractor or Owner shall be entitled to an adjustment for the cost of asphalt material only. The adjustment shall be calculated using the net increase or decrease (i.e. the value in excess of 5%) at the time the material was provided versus the index at the time Bids were received. Adjustment shall be made by Change Order and shall be based upon the asphalt batch plant's material delivery tickets identifying the actual quantity of material delivered to and incorporated into the Project. No adjustment will be provided for any material for which no ticket is provided. In the case of a credit to the Owner where material tickets are not provided by the Contractor, the quantity shall be measured and verified by the Owner and Architect, and the subsequent credit shall be for the actual total difference in the index without regard to the 5% escalator.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to begin paving.
- B. Proof-roll subgrade below 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 3 mph.
 2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
 3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 COLD MILLING

A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.

1. Mill to a depth of 1-1/2 inches.
2. Mill to a uniform finished surface free of excessive gouges, grooves, and ridges.
3. Control rate of milling to prevent tearing of existing asphalt course.
4. Repair or replace curbs, manholes, and other construction damaged during cold milling.
5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
6. Patch surface depressions deeper than 1 inch after milling, before wearing course is laid.
7. Keep milled pavement surface free of loose material and dust.

3.3 PATCHING

A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompack existing unbound-aggregate base course to form new subgrade.

B. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate of 0.05 to 0.15 gal./sq. yd.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

C. Placing Patch Material: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.4 REPAIRS

A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.

1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.

B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch.

1. Clean cracks and joints in existing hot-mix asphalt pavement.
2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.
3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

3.5 BASE COURSE PLACEMENT

- A. Crushed aggregate base course shall be compacted to the lines, grade, and thickness as shown on the Drawings. Base course shall be placed in uniform horizontal layers then rolled thoroughly to a hard, even, unyielding surface, compacted to not less than 98 percent of maximum density at optimum moisture. Base course shall not be applied over soft, wet or frozen subgrade.
 - 1. When the aggregate base course is indicated to be 6 inches thick or less, place material in a single layer. When indicated to be more than 6 inches thick, place material in equal layers, except no single layer more than 6 inches or less than 3 inches in thickness when compacted.
- B. Base course thickness after compacting shall be as shown on the Drawings. Base course shall be placed in uniform horizontal layers then rolled thoroughly to a hard, even, unyielding surface, compacted to not less than 88 percent of theoretical density. Base course shall not be applied over wet or frozen subgrade.
- C. The subgrade shall be prepared in accordance with PDT-408, Section 210, and shall be shaped to true lines and elevations as shown on the Drawings, thoroughly compacted to not less than 95 percent of maximum dry density at optimum moisture. Remove any boulders to a depth of 6" below subgrade. Remove all spongy material, replace with crushed stone fill material and compact solidly. The finished surface shall be uniformly shaped to permit drainage, and any irregularities, dented or depressed areas shall be corrected prior to placing the aggregate base course.
- D. The prepared subgrade shall be protected by the Contractor using all means necessary to prevent rutting and tracking from vehicles and equipment. Where completed subgrade areas are disturbed or damaged by subsequent construction operations or adverse weather, make all repairs or replacements necessary, including re-grading and re-compacting, to the approval of the Architect and at no additional cost to the Owner.
- E. Joining New Pavements to Existing: Saw cut contact area between existing and new pavements so they are smooth and straight before starting paving.
 - 1. Provide a contact area of the surface layer not less than 18 inches wider than the base, unless otherwise indicated.
 - 2. Provide horizontal distance between concrete curbs, slant curbs, playground edging, and similar construction to allow room for compaction equipment to be used on all layers.
- F. Joint Sealer: Apply to surfaces at cracks and joints of previously constructed asphalt pavement.
 - 1. Apply to surface that is clean, dry, free of grease, dust and loose particles; and when air and surface temperatures are above 40 deg F.
 - 2. Remove all loose stones and chips from the crack/joint before filling.
 - 3. Do not apply if rain threatens or is predicted within 12 to 14 hours.
 - 4. Apply two 3/8-inch to 1/2-inch layers of filler, and allow to dry thoroughly between applications; comply with manufacturer's directions.
- G. Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd. Apply enough material to penetrate and seal but not flood surface. Allow prime coat to cure.
 - 1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
 - 2. Protect primed substrate from damage until ready to receive paving.

H. Tack Coat: Apply uniformly to contact surfaces of previously constructed asphalt or Portland cement concrete and surfaces abutting or projecting into hot-mixed asphalt pavement, including the vertical surfaces of concrete to be in contact with the hot-mixed asphalt. Distribute at a rate of 0.05 to 0.15 gal./sq. yd.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

I. Asphalt Sealer: Apply to surfaces at joints of previously constructed asphalt or Portland cement concrete and at surfaces abutting or projecting into hot-mixed asphalt pavement.

1. Apply asphalt sealer to top surfaces of new hot-mixed asphalt abutting existing asphalt pavement. Apply uniform coat 6 inches wide centered over joint extending 3 inches parallel either side of joint, with neat edges.
2. Apply asphalt sealer to top surfaces of joints formed by hot-mixed asphalt paving and rims of manholes, catch basins, water valves, etc.
3. Apply uniform coat of sand or stone dust to exposed asphalt sealer upon completion.
4. Exercise care in application of asphalt sealer to avoid smearing or staining of adjoining concrete and other surface and appurtenances. Remove and clean damaged surfaces.
5. Allow to dry until at proper condition to receive paving.

3.6 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

3.7 INSTALLATION OF PAVING GEOTEXTILE

A. Apply tack coat uniformly to pavement surfaces to receive paving geotextile at a rate of 0.20 to 0.30 gal./sq. yd.

B. Place paving geotextile promptly in accordance with manufacturer's written instructions. Broom or roll geotextile smooth and free of wrinkles and folds. Overlap longitudinal joints 4 inches and transverse joints 6 inches.

C. Protect paving geotextile from traffic and other damage, and place hot-mix asphalt overlay the same day.

3.8 PLACING HOT-MIX ASPHALT

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted in accordance with PDT-408 Sections 309 and 409.

1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
2. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
3. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches from strip to strip to ensure proper compaction of mix along longitudinal joints.
2. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.9 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
3. Offset transverse joints, in successive courses, a minimum of 24 inches.
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.10 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent or greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.11 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
 - 1. Base Course: Plus or minus 1/2 inch.
 - 2. Surface Course: Plus 1/4 inch, no minus.
- B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
 - 1. Base Course: 1/4 inch.
 - 2. Surface Course: 1/8 inch.
 - 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.
 - 4. ADA accessible areas and building access paths shall be constructed in accordance with ADAAG and ANSI-117.1 requirements.
- C. Drainage: Surfaces shall drain to drains or drainage areas as indicated without the formation of puddles. All areas where drainage does not occur properly or puddles form shall be corrected.

3.12 PROTECTION AND CLEANING

- A. Protect adjacent work from splashing of paving materials. Protect paving against traffic until surface has properly cured. Provide temporary barriers, warning lights and other protection as necessary. Remove when no longer required.
- B. All adjacent materials soiled from paving installation shall be cleaned to the satisfaction of the Architect.

3.13 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor shall engage a qualified testing agency to perform tests and inspections.
- B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
- C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- D. In-Place Density: Testing agency shall take samples of uncompacted paving mixtures and compacted pavement in accordance with ASTM D979 or AASHTO T 168 and shall confirm compliance with PADOT specifications.
 - 1. Reference maximum theoretical density shall be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared in accordance with ASTM D2041, and compacted in accordance with job-mix specifications.

2. In-place density of compacted pavement shall be determined by testing core samples in accordance with ASTM D1188 or ASTM D2726.
 - a. One core sample will be taken for every 250 sq. yd. or less of installed pavement, with no fewer than three cores taken.
 - b. Field density of in-place compacted pavement may also be determined by nuclear method in accordance with ASTM D2950 and coordinated with ASTM D1188 or ASTM D2726.
- E. Replace and compact hot-mix asphalt where core tests were taken.
- F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

END OF SECTION 32 12 16

SECTION 32 12 36 – COAL TAR SEALCOATING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Oil spot primer.
2. Crack sealant.
3. Line black-out paint.
4. Coal tar seal coat.

B. Related Requirements:

1. Division 32 Section "Asphalt Paving."
2. Division 32 Section "Pavement Markings and Traffic Signage."

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review project conditions.
2. Review specification requirements.
3. Review project schedule.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each sealcoating material.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the Municipality and PADOT for sealcoating paving work.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not apply sealcoating materials if existing asphalt is dirty, wet or excessively damp, if rain is imminent or expected before time required for adequate cure. Comply with manufacturer's requirements.

1. Ambient Conditions: Minimum surface temperature and ambient temperature of 50 deg F and rising at time of placement.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Basis of Design: Subject to compliance with requirements, Coal Tar Sealcoating products incorporated into the project shall be based on products manufactured by:

1. SealMaster Pavement Products & Equipment.

B. Acceptable Manufacturers: Subject to compliance with requirements, in lieu of the Basis of Design manufacturer, Contractor may provide products from the following manufacturers that meet or exceed the published data of the specified Basis of Design products.

1. Western Colloid.

2.2 MATERIALS

A. Primer: Acrylic co-polymer latex emulsion.

1. Basis of Design Product: SealMaster; "Petro-Seal Oil Spot Primer."

B. Crack Sealant: Rubberized asphalt hot pour crack sealant.

1. Basis of Design Product: SealMaster; "CrackMaster Parking Lot Grade (Hot Pour Rubberized Crack Sealant)."

C. Line Black-Out Paint: Acrylic traffic marking paint.

1. Basis of Design Product: SealMaster; "Line Black-Out Paint (Black)."

D. Seal Coat: Clay-stabilized, mineral-filled coal tar emulsion sealcoat.

1. Basis of Design Product: SealMaster; "Coal Tar Concentrate Pavement Sealer."

E. Pave Gel: Polymer latex resin emulsion.

1. Basis of Design Product: SealMaster "Pave Gel Polymer Additive."

F. Sand: 40 to 70 mesh AFS fineness gradation as recommended by sealcoat manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine pavement surface prior to performing work.
- B. Notify Architect and Owner of any adverse or unacceptable conditions that would affect successful repair efforts or application of materials.
- C. Do not commence work until unacceptable conditions are corrected.

3.2 SURFACE PREPARATION AND INSTALLATION

- A. Surface shall be clean and free from all loose material and dirt. Blow, sweep or broom existing asphalt as required to remove base material and dirt. Remove grass along edge of pavement to find true edge of pavement.
- B. Repair cracks and prime oil spots.
- C. All work shall be performed in accordance with manufacturer's recommendations.

3.3 CRACK REPAIR

- A. Fill and seal cracks in existing asphalt paving as follows:
 1. Cracks shall be free from dust, dirt, vegetation and moisture. Clean cracks with mechanical wire brush followed by a compressed air heat lance to remove loose debris and moisture.
 2. Melt crack sealant using equipment recommended by manufacturer.
 3. Apply heated crack sealant using a pump and wand system, a crack banding unit or a pour pot as appropriate for conditions.
 4. Seal edges of all existing joints between curbs and asphalt paving.

3.4 OIL SPOT PRIMING

- A. Prime oil spots as follows:
 1. Wipe or scrape excessive build-up of oil, grease, and gasoline spots.
 2. Apply oil spot primer with brush, roller or sprayer.
 3. Allow adequate time to dry prior to sealcoating.

3.5 LINE BLACK-OUT PAINT

- A. Apply line black-out paint at locations where existing traffic markings are not indicated to remain in the same location.
 1. Remove all loose material and dirt from existing traffic markings.
 2. Apply line black-out paint with pressurized spray equipment, brush or roller.
 3. Allow adequate time to dry prior to sealcoating.

3.6 SEALCOAT APPLICATION

A. Applying Coal Tar Sealer Concentrate.

1. Prepare surfaces as indicated in Surface Preparation article and as required by manufacturer.
2. Use equipment with continuous agitation or mixing capabilities to maintain homogeneous consistency of pavement sealer mixture throughout the application process. Spray equipment shall be capable of mixing and spraying pavement sealer with sand added. Self-propelled squeegee equipment with mixing capability shall have at least 2 squeegee or brush devices (one behind the other) to assure adequate distribution and penetration of sealer into pavement surface. Hand squeegees and brushes shall be acceptable in areas where practicality prohibits the use of mechanized equipment.
3. Mix sealcoat concentrate with water, pave gel and sand in accordance with manufacturer's recommended proportions.
4. Apply two coats of mixed sealcoat at a rate of .11 to .13 gallon per square yard per coat to entire pavement area. Allow first coat to dry thoroughly prior to applying second coat.
5. Apply a third coat of mixed SealMaster Coal Tar Sealer at a rate of .11 to .13 gallon per square yard to high traffic areas including parking area entrances, exits and drive lanes (or as specified in additional diagrams or drawings). Allow second coat to dry thoroughly before applying a third coat to these areas.
6. Allow final coat of pavement sealer to dry 24 hours prior to applying pavement markings.

3.7 PROTECTION AND CLEANING

- A. Protect adjacent work from splashing of sealcoat materials. Protect parking lots and driveways from traffic until surface has properly cured. Provide temporary barriers, warning lights and other protection as necessary. Remove when no longer required.
- B. All adjacent materials soiled from sealcoat installation shall be cleaned to the satisfaction of the Architect.

END OF SECTION 32 12 16

SECTION 32 17 13 - PARKING BUMPERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes wheel stops.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PARKING BUMPERS

- A. Concrete Wheel Stops: Precast, steel-reinforced, air-entrained concrete, 4000-psi minimum compressive strength, 4-1/2 inches high by 9 inches wide by 72 inches long. Provide chamfered corners, transverse drainage slots on underside, and a minimum of three factory-formed or -drilled vertical holes through wheel stop for anchoring to substrate.
 - 1. Surface Appearance: Free of pockets, sand streaks, honeycombs, and other obvious defects. Corners shall be uniform, straight, and sharp.
 - 2. Mounting Hardware: Galvanized-steel spike or dowel, 1/2-inch diameter, 10-inch minimum length.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that pavement is in suitable condition to begin installation according to manufacturer's written instructions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install wheel stops according to manufacturer's written instructions unless otherwise indicated.
- B. Securely anchor wheel stops to pavement with hardware in each preformed vertical hole in wheel stop as recommended in writing by manufacturer. Recess head of hardware beneath top of wheel stop.

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END OF SECTION 32 17 13

SECTION 32 17 23 - PAVEMENT MARKINGS AND TRAFFIC SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes painted markings applied to seal coated asphalt, asphalt, concrete pavement and traffic signage.
- B. Related Requirements:
 - 1. Division 03 Section "Cast-in-Place Concrete."
 - 2. Division 32 Section "Asphalt Paving."
 - 3. Division 32 Section "Coal Tar Sealcoating."

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to marking pavement and traffic signage including, but not limited to, the following:
 - a. Pavement aging period before application of pavement markings.
 - b. Review requirements for protecting pavement markings, including restriction of traffic during installation period.
 - 2. Review project conditions.
 - 3. Review project schedule.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include technical data and tested physical and performance properties.
- B. Shop Drawings: For pavement markings.
 - 1. Indicate pavement markings, colors, lane separations, defined parking spaces, and dimensions to adjacent work.
 - 2. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.
- C. Samples: For each exposed product and for each color and texture specified; on rigid backing, 8 inches square.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of PADOT for pavement-marking and traffic signage work.
 - 1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 55 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide pavement marking paint by one of the following:
 - 1. INSL-X Products; Benjamin Moore & Co.
 - 2. PPG Paints; PPG Industries, Inc.
 - 3. Rust-Oleum Corporation; a subsidiary of RPM International, Inc.
 - 4. Sherwin-Williams Company (The).
 - 5. Products of manufacturers listed in Division 32 Section "Coal Tar Sealcoating".

2.2 PAVEMENT-MARKING PAINT

- A. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M 248, Type N and PADOT Publication 408, Section 962; colors complying with FS TT-P-1952.
 - 1. Color: White, Yellow, Blue and as indicated.

2.3 TRAFFIC SIGNAGE

- A. Parking Signs: Mounted on posts of standard steel channels with galvanized coating and shop-applied painted finish.
 - 1. Sign Panels: Provide smooth, even, level sign panel surfaces constructed to remain flat under installed conditions. Provide standard parking signs as indicated, of metal panels with edges mechanically and smoothly finished.
 - 2. Sign Panel Finish: Baked enamel, factory-applied
 - 3. Copy, Graphic Content, Size and Style: As indicated on Drawings.
- B. Concrete for Sign Posts: Provide concrete consisting of portland cement per ASTM C 150, aggregates per ASTM C 33, and potable water. Mix materials to obtain concrete with a minimum 28-day compressive strength of 3000 psi. Use at least four sacks of cement per cu. yd., 1-inch maximum size aggregate, 3-inch maximum slump.

1. Packaged Concrete Mix: Mix dry-packaged normal-weight concrete conforming to ASTM C 387 with clean water to obtain a 2- to 3-inch slump.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that pavement is dry and in suitable condition to begin pavement marking according to manufacturer's written instructions.
- B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

3.2 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.
- B. Allow paving to age for a minimum of 30 days before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.
 1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to pavement. Mask an extended area beyond edges of each stencil to prevent paint application beyond the stencil. Apply paint so that it cannot run beneath the stencil.

3.3 TRAFFIC SIGNAGE

- A. Mount with sign at height complying with applicable standards.
 1. Provide concrete footings at least 3 feet deep, with sloped tops finished to drain water away from post.
 2. Stop footings 2 inches below grade, unless otherwise indicated, to allow covering with surface material.

3.4 PROTECTING AND CLEANING

- A. Protect pavement markings and traffic signage from damage and wear during remainder of construction period.
- B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 32 17 23

SECTION 32 31 13 – GALVANIZED CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.
- B. Work in this Section applies only to Reading Crest Avenue Facility.

1.2 SUMMARY

- A. Section Includes:

- 1. Galvanized Chain-link fences.
 - 2. Swing gates.

- B. Related Requirements:

- 1. Division 03 Section "Cast-in-Place Concrete" for cast-in-place concrete post footings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Fence and gate posts, rails, and fittings.
 - b. Chain-link fabric, reinforcements, and attachments.
 - c. Gates and hardware.

- B. Shop Drawings: For each type of fence and gate assembly.

- 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Include accessories, hardware, gate operation, and operational clearances.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample Warranty: For special warranty.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1. Review specification requirements.
2. Review installation procedures.
3. Inspect project conditions.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.7 WARRANTY

A. Special Warranty: Installer agrees to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Failure to comply with performance requirements.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CHAIN-LINK FENCE FABRIC

A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist according to "CLFMI Product Manual" and requirements indicated below:

1. Fabric Height: As indicated on Drawings.
2. Steel Wire for Fabric: Wire diameter of 0.148 inch.
 - a. Mesh Size: 2 inches.
 - b. Zinc-Coated Fabric: ASTM A392, Type II, Class 2, 2.0 oz./sq. ft. with zinc coating applied before weaving.
 - c. Coat selvage ends of metallic-coated fabric before the weaving process with manufacturer's standard clear protective coating.

2.2 FENCE FRAMEWORK

A. Posts and Rails: ASTM F1043 for framework, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F1043 or ASTM F1083 based on the following:

1. Fence Height: As indicated on Drawings.
2. Heavy-Industrial-Strength Material: Group IC, round steel pipe, electric-resistance-welded pipe.
 - a. Line Post: As indicated on drawings.
 - b. End, Corner, and Pull Posts: As indicated on drawings.

3. Horizontal Framework Members: Intermediate and top and bottom rails according to ASTM F1043.
4. Brace Rails: ASTM F1043.
5. Metallic Coating for Steel Framework:
 - a. External, Type B: Zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. of zinc after welding, a chromate conversion coating, and a clear, verifiable polymer film. Internal, Type D, consisting of 81 percent, not less than 0.3-mil-thick, zinc-pigmented coating.

2.3 SWING GATES

- A. General: ASTM F900 for gate posts and swing gate types.
 1. Gate Leaf Width: As indicated.
- B. Pipe and Tubing:
 1. Zinc-Coated Steel: ASTM F1043 and ASTM F1083; protective coating and finish to match fence framework.
 2. Gate Posts: Round tubular steel.
 3. Gate Frames and Bracing: Round tubular steel.
- C. Frame Corner Construction: Welded.
- D. Hardware:
 1. Hinges: 360-degree inward and outward swing.
 2. Latch: Permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.
 3. Cane Bolts: Galvanized or stainless steel minimum 18 inches long to anchor bottom of gate in closed or fully open position.

2.4 FITTINGS

- A. Provide fittings according to ASTM F626.
- B. Post Caps: Provide for each post.
 1. Provide line post caps with loop to receive tension wire or top rail.
- C. Rail and Brace Ends: For each gate, corner, pull, and end post.
- D. Rail Fittings: Provide the following:
 1. Top Rail Sleeves: Pressed-steel or round-steel tubing not less than 6 inches long.
 2. Rail Clamps: Line and corner boulevard clamps for connecting intermediate and bottom rails to posts.
- E. Tension Bars: Steel, length not less than 2 inches shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.

F. Truss Rod Assemblies: Steel, hot-dip galvanized after threading rod and turnbuckle or other means of adjustment.

G. Tie Wires, Clips, and Fasteners: According to ASTM F626.

1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, according to the following:

a. Hot-Dip Galvanized Steel: 0.148-inch- diameter wire; galvanized coating thickness matching coating thickness of chain-link fence fabric.

H. Finish:

1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz./sq. ft. of zinc.

2.5 GROUT AND ANCHORING CEMENT

A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout, recommended in writing by manufacturer, for exterior applications.

B. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating, and that is recommended in writing by manufacturer for exterior applications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.

1. Do not begin installation before final grading is completed unless otherwise permitted by Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 CHAIN-LINK FENCE INSTALLATION

A. Install chain-link fencing according to ASTM F567 and more stringent requirements specified.

1. Install fencing on established boundary lines inside property line.

- B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.
- C. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
 - 1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
 - 2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
 - a. Exposed Concrete: Extend 2 inches above grade; shape and smooth to shed water.
- D. Terminal Posts: Install terminal end, corner, and gate posts according to ASTM F567 and terminal pull posts at changes in horizontal or vertical alignment of 30 degrees or more. For runs exceeding 500 feet, space pull posts an equal distance between corner or end posts.
- E. Line Posts: Space line posts uniformly at 96 inches o.c.
- F. Post Bracing and Intermediate Rails: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.
 - 1. Locate horizontal braces at midheight of fabric 72 inches or higher, on fences with top rail, and at two-third fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.
- G. Top Rail: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.
- H. Intermediate and Bottom Rails: Secure to posts with fittings.
- I. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 2-inch bottom clearance between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.
- J. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts, with tension bands spaced not more than 15 inches o.c.
- K. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric according to ASTM F626. Bend ends of wire to minimize hazard to individuals and clothing.
 - 1. Maximum Spacing: Tie fabric to line posts at 12 inches o.c. and to braces at 24 inches o.c.
- L. Fasteners: Install nuts for tension bands and carriage bolts on the side of fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

3.4 GATE INSTALLATION

- A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation.

3.5 ADJUSTING

- A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Lubricate hardware and other moving parts.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain chain-link fences and gates.

END OF SECTION 32 31 13

SECTION 32 31 14 – POLYMER-COATED CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.
- B. Work in this Section applies only to work at Main Office facility.

1.2 SUMMARY

A. Section Includes:

- 1. Polymer Chain-link fences.
- 2. Swing gates.
- 3. Privacy fence screening.

B. Related Requirements:

- 1. Division 03 Section "Cast-in-Place Concrete" for cast-in-place concrete post footings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Fence and gate posts, rails, and fittings.
 - b. Chain-link fabric, reinforcements, and attachments.
 - c. Privacy screening.
 - d. Gates and hardware.

B. Shop Drawings: For each type of fence and gate assembly.

- 1. Include plans, elevations, sections, details, and attachments to other work.
- 2. Include accessories, hardware, gate operation, and operational clearances.

C. Samples for Initial Selection: For each type of factory-applied finish.

D. Samples for Verification: For each type of component with factory-applied finish, prepared on Samples of size indicated below:

- 1. Polymer-Coated Components: In 6-inch lengths for components and on full-sized units for accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample Warranty: For special warranty.

1.5 PREINSTALLATION MEETINGSS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review specification requirements.
 - 2. Review installation procedures.
 - 3. Inspect project conditions.

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.7 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure to comply with performance requirements.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Warranty Period: Five years from date of Substantial Completion.
- B. Special Warranty:
 - 1. Failures include, but are not limited to, the following:
 - a. Weathering, discoloration, or fading within the warranty period.
 - b. Shrinkage or damage from temperature extremes (hot or cold).
 - c. Wind damage from winds not in excess of 90 MPH.
 - 2. Warranty Period: Seven years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CHAIN-LINK FENCE FABRIC

- A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist according to "CLFMI Product Manual" and requirements indicated below:
 - 1. Fabric Height: As indicated on Drawings.
 - 2. Steel Wire for Fabric: Wire diameter of 0.148 inch.

- a. Mesh Size: 2 inches.
- b. Polymer-Coated Fabric: ASTM F668, Class 2a or Class 2b over zinc-coated steel wire.
 - 1) Color: As selected by Architect from manufacturer's full range, according to ASTM F934.

2.2 FENCE FRAMEWORK

- A. Posts and Rails: ASTM F1043 for framework, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F1043 or ASTM F1083 based on the following:
 - 1. Fence Height: As indicated on Drawings.
 - 2. Heavy-Industrial-Strength Material: Group IC, round steel pipe, electric-resistance-welded pipe.
 - a. Line Post: As indicated on drawings.
 - b. End, Corner, and Pull Posts: As indicated on drawings.
 - 3. Horizontal Framework Members: Intermediate and top and bottom rails according to ASTM F1043.
 - 4. Brace Rails: ASTM F1043.
 - 5. Metallic Coating for Steel Framework:
 - a. Type B: Zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. of zinc after welding, a chromate conversion coating, and a clear, verifiable polymer film.
 - 6. Polymer coating over metallic coating.
 - a. Color: Match chain-link fabric, according to ASTM F934.

2.3 SWING GATES

- A. General: ASTM F900 for gate posts and swing gate types.
 - 1. Gate Leaf Width: As indicated.
- B. Pipe and Tubing:
 - 1. Zinc-Coated Steel: ASTM F1043 and ASTM F1083; protective coating and finish to match fence framework.
 - 2. Gate Posts: Round tubular steel.
 - 3. Gate Frames and Bracing: Round tubular steel.
- C. Frame Corner Construction: Welded.
- D. Hardware:
 - 1. Hinges: 360-degree inward and outward swing.
 - 2. Latch: Permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.
 - 3. Cane Bolts: Galvanized or stainless steel minimum 18 inches long to anchor bottom of gate in closed or fully open position.

2.4 FITTINGS

- A. Provide fittings according to ASTM F626.
- B. Post Caps: Provide for each post.
 - 1. Provide line post caps with loop to receive tension wire or top rail.
- C. Rail and Brace Ends: For each gate, corner, pull, and end post.
- D. Rail Fittings: Provide the following:
 - 1. Top Rail Sleeves: Pressed-steel or round-steel tubing not less than 6 inches long.
 - 2. Rail Clamps: Line and corner boulevard clamps for connecting intermediate and bottom rails to posts.
- E. Tension and Brace Bands: Pressed steel.
- F. Tension Bars: Steel, length not less than 2 inches shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.
- G. Truss Rod Assemblies: Steel, hot-dip galvanized after threading rod and turnbuckle or other means of adjustment.
- H. Tie Wires, Clips, and Fasteners: According to ASTM F626.
 - 1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, according to the following:
 - a. Hot-Dip Galvanized Steel: 0.148-inch- diameter wire; galvanized coating thickness matching coating thickness of chain-link fence fabric.
- I. Finish:
 - 1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz./sq. ft. of zinc.
 - a. Polymer coating over metallic coating.

2.5 PRIVACY SCREENING

- A. Privacy Screening: Screening material shall be a PVC mesh fence windscreens that maintains airflow and 90% visual privacy. Mesh shall be provided with a premium UV-coating for long-term use in any weather environment.
- B. Basis of Design: Systems and materials shall meet or exceed all specified requirements for Fence Screen LLC "Commercial PVC Mesh Plus 350 Series screening and system and shall have the following minimum properties.
 - 1. Commercial PVC Mesh Plus with no fillers.
 - 2. 90% privacy with UV inhibitors for extreme conditions.
 - 3. Denier: 9x18 1000.
 - 4. Tensile grab strength: 230/200 lbs.
 - 5. Tensile tear strength: 200/140 lbs.

6. Weight: 330 g/m².
7. Grommets: Stainless steel or brass
8. Colors: As selected by Architect from manufacturer's full range.

C. Features:

1. Maximum grommet spacing is 12 inches.
2. Wind vents shall be provided at a maximum of 10'-0" on center.
3. A reinforced center binding strip with grommets shall be provided at the mid-rail fence height and shall be secured at maximum 12 inches on center.
4. UV Stable fasteners/ties with minimum 100 1b. tensile strength.

2.6 GROUT AND ANCHORING CEMENT

- A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout, recommended in writing by manufacturer, for exterior applications.
- B. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating, and that is recommended in writing by manufacturer for exterior applications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.
 1. Do not begin installation before final grading is completed unless otherwise permitted by Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 CHAIN-LINK FENCE INSTALLATION

- A. Install chain-link fencing according to ASTM F567 and more stringent requirements specified.
 1. Install fencing on established boundary lines inside property line.
- B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.

- C. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
 - 1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
 - 2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
- D. Terminal Posts: Install terminal end, corner, and gate posts according to ASTM F567 and terminal pull posts at changes in horizontal or vertical alignment of 30 degrees or more. For runs exceeding 500 feet, space pull posts an equal distance between corner or end posts.
- E. Line Posts: Space line posts uniformly at 96 inches o.c.
- F. Post Bracing and Intermediate Rails: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.
 - 1. Locate horizontal braces at midheight of fabric 72 inches or higher, on fences with top rail, and at two-third fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.
- G. Top Rail: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.
- H. Intermediate and Bottom Rails: Secure to posts with fittings.
- I. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 2-inch bottom clearance between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.
- J. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts, with tension bands spaced not more than 15 inches o.c.
- K. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric according to ASTM F626. Bend ends of wire to minimize hazard to individuals and clothing.
 - 1. Maximum Spacing: Tie fabric to line posts at 12 inches o.c. and to braces at 24 inches o.c.
- L. Fasteners: Install nuts for tension bands and carriage bolts on the side of fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.
- M. Privacy Screening: Install slats in accordance with manufacturer's written requirements to comply with Site conditions, warranty, and specified requirements.

3.4 GATE INSTALLATION

- A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation.

3.5 ADJUSTING

- A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Lubricate hardware and other moving parts.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain chain-link fences and gates.

END OF SECTION 32 31 14

SECTION 32 92 00 - TURF AND GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Seeding.
2. Hydroseeding.
3. Turf renovation.
4. Erosion-control material(s).
5. Maintenance of turfs and grasses.

B. Related Requirements:

1. Division 31 Section "Earth Moving" for excavating, filling and rough grading.
2. Division 32 Section "Plants" for trees, shrubs, ground covers, and other plants as well as border edgings and mow strips.

1.3 STIPULATIONS

A. The Landscape Installer is responsible for the success of the turf and grass installation and is required to be onsite daily to perform turf and grass maintenance including watering and reseeding as required to achieve Satisfactory Turf as defined in this Section. The Landscape Installer shall also remove all rocks in the turf and grasses.

B. The General Contractor is responsible for all of the Architect's costs associated with the Landscape Installers failure to water and maintain the turf and grass installation daily and is responsible for all costs for the Owner to supplement the Landscape Installer's maintenance requirements.

1.4 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

C. Maintenance: Fostering and maintaining the health and growth of turfs and grasses by the Installer daily for a minimum of 45 days after installation and weekly after turfs and grasses are established during the maintenance period to achieve Satisfactory Turf.

- D. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- E. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- F. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. Refer to Division 31 Section "Earth Moving" for planting soils.
- G. Soil Amendments: Organic and inorganic materials added to planting soil to increase soil fertility prior to planting or seeding.
- H. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- I. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- J. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review specification stipulations.
 - 2. Review specification requirements.
 - 3. Review installation procedures.
 - 4. Review project Stipulations and maintenance requirements pre-and post occupancy.
 - 5. Inspect project conditions.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Planting and Maintenance Service Schedule: Provide anticipated planting dates for turfs and grasses and a matrix of tasks and procedures to be performed by the Installer during the warranty maintenance period indicated in Part 3. Include watering, fertilization, grub control, weed control, aeration, rolling, mowing, reseeding, testing, and other activities.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For landscape Installer.
- B. Stipulation Acceptance: On the General Contractor's and Landscape Installer's letterhead, provide document accepting Stipulations noted in this Section.

- C. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, 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. Product Certificates: For fertilizers, from manufacturer.
- E. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.
- F. Material Test Reports: For existing native surface topsoil, existing in-place surface soil, and imported or manufactured topsoil, as required and at no additional cost to the Owner. All costs shall be included in the base bid.

1.8 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf during a calendar year. Submit before expiration of required maintenance periods.

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.
 - 1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
 - 2. Experience: Five years' experience in turf installation in addition to requirements in Division 01 Section "Quality Requirements."
 - 3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 - 4. Pesticide Applicator: State licensed, commercial.
 - 5. Proximity: Not more than one hour normal travel time from Installer's place of business to Project site.
 - 6. Maintenance: Performing maintenance as indicated in Part 3.
- B. Soil-Testing Laboratory Qualifications: An independent laboratory or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
- C. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of the soil.
 - 1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.
 - 2. The soil-testing laboratory shall oversee soil sampling, with depth, location, and number of samples to be taken per instructions from Architect. A minimum of three representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
 - 3. Report suitability of tested soil for turf growth.
 - a. Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. or volume per cu. yd. for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.

- b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.

D. Topsoil Analysis

1. Furnish soil analysis by a qualified soil testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of topsoil.
2. Report suitability of topsoil for lawn growth. State recommended quantities of nitrogen, phosphorous, and potash nutrients and soil amendments to be added to produce satisfactory topsoil.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.
- B. Bulk Materials:
 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 3. Accompany each delivery of bulk fertilizers, lime and soil amendments, and other materials with appropriate certificates.

1.11 FIELD CONDITIONS

- A. Planting Restrictions: Plant during one of the following periods in accordance with the Project Schedule. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of planting completion.
 1. Spring Planting: March 15 through June 1.
 2. Fall Planting: August 15 through October 15.
- B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

1.12 WARRANTY MAINTENANCE SERVICE

- A. Warranty Maintenance Service: Installer shall provide full maintenance service by skilled employees of landscape installer as per the requirements and schedule indicated in Part 3. Begin maintenance immediately after each area is planted.

1. Where maintenance is not performed in accordance with this section and the result in unsatisfactory turfs and grasses, Installer will continue to provide maintenance service beyond the schedule in Part 3 until the Architect and Owner are satisfied with the quality of the turf and grass installation. Architect reserves the right to backcharge the Contractor for additional costs incurred for failure to perform specified maintenance to establish Satisfactory Turf in accordance with the Maintenance Schedule.

1.13 WARRANTY

- A. Warranty: The installer shall rebuild, repair, replace any turf and grass installations that have proven defective due to unsatisfactory material or workmanship for a period of one year from substantial completion.

PART 2 - PRODUCTS

2.1 SEED

- A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.
- B. Seed Species: Seed of grass species as follows, with not less than 95 percent germination, not less than 98 percent pure seed, and not more than 0.5 percent weed seed.
 1. As indicated on Site/Civil Drawings.

2.2 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent with a minimum 95% passing through No. 8 sieve and a minimum 55% passing through No. 60 sieve, and as follows:
 1. Provide lime in form of ground dolomitic limestone.
- B. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, and with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.
- C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- D. Aluminum Sulfate: Commercial grade, unadulterated.
- E. Perlite: Horticultural perlite, soil amendment grade.
- F. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 sieve.
- G. Sand: Clean, washed, natural or manufactured, and free of toxic materials.
- H. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.

- I. Soil Conditioner: A soil conditioner such as "gypsum" or equivalent material shall be applied and incorporated into the soil. Guaranteed Analysis:
 1. Minimum Calcium Sulfate as CaSO₄ 64.5%
 2. Minimum Calcium (Ca) from CaSO₄ 18.9%
 3. Minimum Sulfur (S) from CaSO₄ 15.1%
 4. Rate of Application: 50 lbs/1,000 Sq. Ft.
- J. Basic H Surfactant: Basic H Surfactant containing 28% active ingredients of Linear Alcohol Alcohoxylates shall be applied at the rate of 2 oz. Per 1,000 sq. ft.
- K. Straw Mulch: Wheat or oat straw, free of viable seed, well cured to less than 20% moisture content by weight.

2.3 ORGANIC SOIL AMENDMENTS

- A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1/2-inch sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
 1. Organic Matter Content: 50 to 60 percent of dry weight.
 2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
- B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture, with a pH range of 3.4 to 4.8.
- C. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

2.4 FERTILIZERS

- A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.
- B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.5 PLANTING SOILS

- A. Planting Soil: Existing, native surface topsoil formed under natural conditions with the duff layer retained during excavation process and stockpiled on-site. Verify suitability of native surface topsoil to produce viable planting soil. Clean soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
 1. Supplement with planting soil when quantities are insufficient.
 - a. Supplement surface soil with imported or manufactured topsoil from off-site sources to provide quantities required for lawn planting. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep; do not obtain from agricultural land, bogs, or marshes. Obtain off-site topsoil from local sources or from areas having similar soil characteristics to that found at Project site.
 2. Mix existing, native surface topsoil with soil amendments in quantities outlined in soil test reports to produce planting soil.
- B. Planting Soil: Imported topsoil or manufactured topsoil from off-site sources. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep; do not obtain from agricultural land, bogs, or marshes.
 1. Additional Properties of Imported Topsoil or Manufactured Topsoil: Screened and free of stones 1/2-inch or larger in any dimension; free of roots, plants, sod, clods, clay lumps, pockets of coarse sand, paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials harmful to plant growth; free of obnoxious weeds and invasive plants including quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and bromegrass; not infested with nematodes, grubs, and other pests, pest eggs, or other undesirable organisms and disease-causing plant pathogens; friable and with sufficient structure to give good tilth and aeration. Continuous, air-filled, pore-space content on a volume/volume basis shall be at least 15 percent when moisture is present at field capacity. Soil shall have a field capacity of at least 15 percent on a dry weight basis.
 2. Mix imported topsoil or manufactured topsoil with soil amendments and fertilizers in quantities outlined in soil test reports to produce planting soil.

2.6 MULCHES

- A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.
- B. Sphagnum Peat Mulch: Partially decomposed sphagnum peat moss, finely divided or of granular texture, and with a pH range of 3.4 to 4.8.
- C. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content of 2 to 5 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
 1. Organic Matter Content: 50 to 60 percent of dry weight.
 2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.

- D. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.
- E. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.
- F. Asphalt Emulsion: ASTM D 977, Grade SS-1; nontoxic and free of plant-growth or germination inhibitors.

2.7 PESTICIDES AND HERBICIDES

- A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
 - 1. Pre-emergent Herbicide: Shall be "Tupersan" (manufactured by Dupont Chemical Co.) – active ingredients: Siduron (1-(2 methylcyclohexyl), 3-(phenylurea)).
- C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.
 - 1. Broadleaf Herbicide: Shall be Brominal ME4 as manufactured by Union Carbide.
 - a. Active Ingredients
 - 1) Octanoic acid, 3,5-dibromo-4-hydroxybenzonitrile ester 31.5%
 - 2) Butyric acid, 3,5-dibromo-4-hydroxylbenzonitrile ester 22.1%
 - 3) Inen Ingredients 46.4%

2.8 EROSION-CONTROL MATERIALS

- A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches long.
- B. Erosion-Control Fiber Mesh: Biodegradable burlap or spun-coir mesh, a minimum of 0.92 lb/sq. yd., with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches long.
- C. Erosion-Control Mats: Cellular, nonbiodegradable slope-stabilization mats designed to isolate and contain small areas of soil over steeply sloped surface, of 3-inch nominal mat thickness. Include manufacturer's recommended anchorage system for slope conditions.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Invisible Structures, Inc; "Slopetame 2."
 - b. Presto Products Company; "Geoweb."
 - c. Tenax Corporation - USA; "Tenweb."
 - d. North American Green.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.
 - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 - 2. Do not mix or place soils and soil amendments in frozen, wet or muddy conditions.
 - 3. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 - 4. Uniformly moisten excessively dry soil that is not workable or which is dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

- A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
 - 1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
 - 2. Protect grade stakes set by others until directed to remove them.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 TURF AREA PREPARATION

- A. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 6 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Apply fertilizer directly to subgrade before loosening.
 - 2. Thoroughly blend planting soil off-site before spreading.
 - a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
 - b. Mix lime with dry soil before mixing fertilizer.
 - 3. Spread planting soil to a depth of 6 inches but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
 - a. For planting soil more than 8 inches in depth, place soil mix in layers not more than 8 inches in loose depth and compact with a sheep's foot roller.
 - b. Spread approximately 1/2 the thickness of planting soil over loosened subgrade. Mix thoroughly into top 2 inches of subgrade. Spread remainder of planting soil.

4. Review subgrade with Architect.
- B. Unchanged Subgrades: If turf is to be planted in areas unaltered or undisturbed by excavating, grading, or surface-soil stripping operations, prepare surface soil as follows:
 1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
 2. Loosen surface soil to a depth of at least 6 inches. Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top 4 inches of soil. Till soil to a homogeneous mixture of fine texture.
 - a. Apply fertilizer directly to surface soil before loosening.
 3. Remove stones larger than 1-1/2 inches in any dimension and sticks, roots, trash, and other extraneous matter.
 4. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.
 5. Review subgrade with Architect.
- C. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future. Final stone pick the surface of stones larger than 1" in any dimension.
- D. Fertilization: Immediately before seeding, apply starter fertilizer at rate of 1/2 to 1 lb/1000 sq.ft. nitrogen. Repeat application at same rate two weeks after seeding.
- E. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- F. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 PREPARATION FOR EROSION-CONTROL MATERIALS

- A. Prepare area as specified in "Turf Area Preparation" Article.
- B. For erosion-control mats, install planting soil in two lifts, with second lift equal to thickness of erosion-control mats. Install erosion-control mat and fasten as recommended by material manufacturer.
- C. Fill cells of erosion-control mat with planting soil and compact before planting.
- D. For erosion-control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer.
- E. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.5 SEEDING

- A. Seeding will not be permitted until final precision grading is inspected and approved by the Architect.
 1. Where work commences without approval, Architect may require entire unapproved area to be re-prepared and re-seeded.

- B. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph.
 - 1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
 - 2. Do not use wet seed or seed that is moldy or otherwise damaged.
 - 3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.
- C. Sow seed at a total rate of 3 to 4 lb/1000 sq. ft. for new seeding and 1.25 lb/1000 sq.ft. for overseeding.
- D. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.
- E. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets and 1:6 with erosion-control fiber mesh installed and stapled according to manufacturer's written instructions.
- F. Protect seeded areas with erosion-control mats where indicated on Drawings; install and anchor according to manufacturer's written instructions.
- G. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.
 - 1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.
 - 2. Bond straw mulch by spraying with asphalt emulsion at a rate of 10 to 13 gal./1000 sq. ft. Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.
- H. Protect seeded areas from hot, dry weather or drying winds by applying compost mulch within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 1/4 inch, and roll surface smooth.

3.6 HYDROSEEDING

- A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
 - 1. Mix slurry with nonasphaltic tackifier.
 - 2. Spray-apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than 1500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate.

3.7 TURF RENOVATION

- A. Renovate all existing turf where indicated and in all areas disturbed by the work of the Project.
- B. Renovate turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.
 - 1. Reestablish turf where settlement or washouts occur or where minor regrading is required.
 - 2. Install new planting soil as required.
- C. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.

- D. Remove topsoil containing foreign materials, such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.
- E. Mow, dethatch, core aerate, and rake existing turf.
- F. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.
- G. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.
- H. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches.
- I. Apply soil amendments and initial fertilizer required for establishing new turf and mix thoroughly into top 4 inches of existing soil. Install new planting soil to fill low spots and meet finish grades.
- J. Apply seed and protect with straw mulch as required for new turf.
- K. Water newly planted areas and keep moist until new turf is established.

3.8 TURF MAINTENANCE

- A. General: Installer shall maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
 - 1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
 - 2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
 - 3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
- B. Watering: Installer shall install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.
 - 1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
 - 2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.
- C. Installer shall mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain 1-1/2"-2" grass height.
- D. Turf Postfertilization: Installer shall apply fertilizer after initial mowing and when grass is dry.
 - 1. Use fertilizer that provides actual nitrogen of at least 1 lb/1000 sq. ft. to turf area.

3.9 WARRANTY MAINTENANCE SCHEDULE

A. Warranty Maintenance: Immediately after installation, installer shall continuously water, mow and review conditions of the turfs and grasses as required to foster satisfactory growth. The installer shall perform maintenance in accordance with this Section. The dates are to be used as a guide and shall be confirmed prior to application, or modified due to climate conditions.

1. End of Warranty Maintenance Period: June 15, 2027.

a. Warranty Maintenance Period will be extended as required to achieve Satisfactory Turf at no cost to the Owner if the Turf Maintenance is not performed in accordance with this Section or Satisfactory Turf is not established at the end of the Warranty Maintenance Period.

B. Maintenance Schedule

1. March

a. Fertilizer: Apply 25-5-10, 60% WIN @ 4.4 lb./1,000 sq. ft.
b. Reseeding: Reseed thin areas showing wear, incorporate the seed with a spiker or drill seeder. Seed with match the original sod variety mix.

2. April

a. Pre-Emergent Weed Control: Apply "Tupersan" in two applications at the rate specified for the project.
b. Post-Emergent Weed Control: as recommended by the manufacturer to control broad-leaf type weeds (because this weed control may severely damage young seedlings, use depending on field conditions, we may not apply this until fall-see Sept.-Oct.).
c. Basic H Surfactant: Apply as indicated.

3. June

a. Pre-emergent Weed Control: "Tupersan" applied at a rate specified by the manufacturer.
b. Fertilizer: Apply 46-0-0 Nitrogen @ 2.5 lb/1,000 sq. ft.
c. Grub Control: Apply brand name chemical recommended by manufacturer to control identified insect at manufacturer's recommendations and procedures (may require more than one application).
d. Post-Emergent Weed Control: as recommended by manufacturer to control broad-leaf weeds (because this weed control may severely damage young seedlings, use depending on field conditions, we may not apply this until fall-see Sept-Oct).

4. November

a. Aerification: Aerate utilizing a hollow line or spoon to remove soil cores to leave a hole or cavity in the sod. The core diameter shall be between $\frac{1}{2}$ and $\frac{3}{4}$ inches, penetration shall be 3 to 4 inches and core spacing shall be 4 to 6 inch centers. If needed after aeration, sweep or drag the field with a mat to remove or break up the core materials on the surface.
b. Fertilizer: 35-5-10 6% WIN @ 4.4 lb/1,000 sq. ft. and treat with fungicide or insecticide if needed.
c. Reseeding: Reseed areas showing wear. Incorporate the seed with a spiker or drill seeder. Seed will match the original sod varietal mix.

3.10 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by Architect:
 - 1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.
- B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

3.11 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents according to requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.12 CLEANUP AND PROTECTION

- A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.
- C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.
- D. Remove nondegradable erosion-control measures after grass establishment period.

END OF SECTION 32 92 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 Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipe and fittings.
2. Nonpressure transition couplings.
3. Cleanouts.
4. Drains.
5. Manholes.
6. Catch basins.
7. Stormwater inlets.
8. Miscellaneous storm utility drainage piping accessories.

1.3 DEFINITIONS

A. HDPE: High Density Polyurethane plastic.
B. RCP: Reinforced concrete pipe.
C. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water. Pipe joints shall be at least silttight, unless otherwise indicated.
B. PDT 408 shall provide minimum requirements for materials and installations as applicable.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
B. Shop Drawings:

1. Manholes: Include plans, elevations, sections, details, frames, and covers.
2. Catch basins and stormwater inlets. Include plans, elevations, sections, details, frames, covers, and grates.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.
- B. Field quality-control reports.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle manholes according to manufacturer's written rigging instructions.
- D. Handle catch basins and stormwater inlets according to manufacturer's written rigging instructions.

1.8 PROJECT CONDITIONS

- A. Site Information: Perform site survey, research public utility records, and verify existing utility locations before starting pipe installation.
- B. Locate existing structures and piping to be closed and abandoned.
- C. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 1. Notify Architect and Owner's Representative no fewer than two days in advance of proposed interruption of service.
 2. Do not proceed with interruption of service without Architect and Owner Representative's written permission.

PART 2 - PRODUCTS

2.1 PE PIPE AND FITTINGS

- A. Corrugated PE Pipe and Fittings NPS 12 to NPS 60: AASHTO M 294M, Type S, with smooth waterway for coupling joints.
 1. Silttight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings.
 2. Soiltight Couplings: AASHTO M 294M, corrugated, matching pipe and fittings.
- B. PVC Gravity Sewer Piping:
 1. Pipe and Fittings: ASTM F 679, PVC gravity sewer pipe with bell-and-spigot ends and with integral ASTM F 477, elastomeric seals for gasketed joints.

2.2 CONCRETE PIPE AND FITTINGS

A. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76.

1. Bell-and-spigot ends and gasketed joints with ASTM C 443, rubber gaskets
2. Class IV, Wall A.

2.3 NONPRESSURE TRANSITION COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Concrete Pipes: ASTM C 443, rubber.
2. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
3. For Fiberglass Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
4. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
5. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings:

1. Description: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Ring-Type, Flexible Couplings:

1. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

2.4 CLEANOUTS

A. Plastic Cleanouts:

1. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.5 DRAINS

A. Cast-Iron Area Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe.
 - e. Watts Water Technologies, Inc.
 - f. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

2. Description: ASME A112.6.3 gray-iron round body with anchor flange and round secured grate. Include bottom outlet with inside calk or spigot connection, of sizes indicated.

2.6 MANHOLES

A. Standard Precast Concrete Manholes:

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Diameter: 48 inches minimum unless otherwise indicated.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.
4. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
5. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.
7. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
8. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
9. Steps: ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 48 inches.
10. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Manhole Frames and Covers:

1. Description: Ferrous; 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 cast into cover, using wording equivalent to "STORM SEWER."
2. Material: ASTM A 536, Grade 60-40-18 ductile iron unless otherwise indicated.

2.7 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350/350R, 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 materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

1. 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.
 - a. Invert Slope: 1 percent through manhole.
2. Benches: Concrete, sloped to drain into channel.
 - a. Slope: 8 percent.

D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

2.8 CATCH BASINS

A. Standard Precast Concrete Catch Basins:

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
3. Riser Sections: 4-inch minimum thickness, 48-inch diameter, and lengths to provide depth indicated.
4. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
5. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
6. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and shape matching catch basin frame and grate. Include sealant recommended by ring manufacturer.
7. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch- diameter frame and grate.
8. Steps: ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 48 inches.
9. Pipe Connectors: ASTM C 923, 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 A-16, structural loading. Include flat grate, bicycle safe, with small square or short-slotted drainage openings.

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 A-16, structural loading. Include 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch- diameter flat grate, bicycle safe, with small square or short-slotted drainage openings.

1. Grate Free Area: Approximately 50 percent unless otherwise indicated.

2.9 STORMWATER INLETS

- A. Curb Inlets: Made with vertical curb opening, of materials and dimensions according to utility standards.
- B. Frames and Grates: Heavy duty, according to utility standards.
- C. Lawn Inlets: Type M and Type C inlet.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in Division Section "Earth Moving."

3.2 PIPING INSTALLATION

- 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 into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- 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.
- C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- D. Install 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, nonpressure drainage piping according to the following:
 1. Install piping pitched down in direction of flow.
 2. Install piping with 36-inch minimum cover.
 3. Install PE corrugated sewer piping according to ASTM D 2321.
 4. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
 5. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

3.3 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, nonpressure drainage piping according to the following:
 1. Join corrugated PE piping according to ASTM D 3212 for push-on joints.
 2. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasketed joints.
 3. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.
 4. Join dissimilar pipe materials with nonpressure-type flexible couplings.

3.4 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
 - 1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
 - 2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
 - 3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
 - 4. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.
- B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding earth grade.
- C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.5 DRAIN INSTALLATION

- A. Install type of drains in locations indicated.
 - 1. Use Light-Duty, top-loading classification drains in earth or unpaved foot-traffic areas.
 - 2. Use Medium-Duty, top-loading classification drains in paved foot-traffic areas.
 - 3. Use Heavy-Duty, top-loading classification drains in vehicle-traffic service areas.
 - 4. Use Extra-Heavy-Duty, top-loading classification drains in roads.
- B. Embed drains in 4-inch minimum concrete around bottom and sides.
- C. Fasten grates to drains if indicated.
- D. Set drain frames and covers with tops flush with pavement surface.
- E. Assemble trench sections with flanged joints.
- F. Embed trench sections in 4-inch minimum concrete around bottom and sides.

3.6 MANHOLE INSTALLATION

- A. General: Install manholes, complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants according to ASTM C 891.
- C. Where specific manhole construction is not indicated, follow manhole manufacturer's written instructions.
- D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements.

3.7 CATCH BASIN INSTALLATION

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

3.8 STORMWATER INLET AND OUTLET INSTALLATION

- A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.
- B. Construct riprap of broken stone, as indicated.
- C. Install outlets that spill onto grade, anchored with concrete, where indicated.
- D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.
- E. Construct energy dissipaters at outlets, as indicated.

3.9 CONCRETE PLACEMENT

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

3.10 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Division 33 Section "Facility Storm Drainage Piping."
- B. Make connections to existing piping and underground manholes.
 - 1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
 - 2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
 - 3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.
 - a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
 - b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
 - 4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
- C. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
 - 1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.

3.11 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

- A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
 1. Close open ends of piping with at least 8-inch- thick, brick masonry bulkheads.
 2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
- B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:
 1. Remove manhole or structure and close open ends of remaining piping.
 2. Remove top of manhole or structure down to at least 36 inches below final grade. Fill to within 12 inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.
- C. Backfill to grade according to Division 31 Section "Earth Moving."

3.12 IDENTIFICATION

- A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.
 1. Use detectable warning tape over ferrous piping.
 2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.13 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. Damage: 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.

C. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
 - a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
 - b. Option: Test plastic piping according to ASTM F 1417.
 - c. Option: Test concrete piping according to ASTM C 924.
6. Force-Main Storm Drainage Piping: Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 150 psig.
 - a. Ductile-Iron Piping: Test according to AWWA C600, "Hydraulic Testing" Section.
 - b. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.

D. Leaks and loss in test pressure constitute defects that must be repaired.

E. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

END OF SECTION 33 41 00