

SECTION 02300 – EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Preparing subgrades for slabs-on-grade, walks, pavements, lawns and grasses, and exterior plants.
2. Excavating and backfilling for buildings, pavements and structures.
3. Drainage course for slabs-on-grade.
4. Subbase course for concrete walks and pavements.
5. Subbase and base course for asphalt paving.
6. Subsurface drainage backfill for walls and trenches.
7. Excavating and backfilling for utility trenches.
8. Excavating and backfilling trenches for buried mechanical and electrical utilities and pits for buried utility structures.
9. Special Provision: Rock Excavation and Embankment

1.2 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: Course placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe or box culvert.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

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

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Engineer.

2. Bulk Excavation: Excavations more than 20 feet in width and pits more than 30 feet in either length.
 3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.
- G. Fill: Soil materials used to raise existing grades.
- H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits and boulders of rock material exceeding 1 cu. yd. For bulk excavation or $\frac{3}{4}$ cu. yd. for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted.
1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator, equipped with a 42-inch wide, maximum, short-tip-radius rock bucket, rated at not less than 138-hp flywheel power with bucket curling force of not less than 28,090 lbf and stick-crowd force of not less than 15,650 lbf measured according to SAE J-1179
 2. Bulk Excavation: Late-model, track-mounted loader, rated at not less than 210-hp flywheel power and developing a minimum of 48,510 lbf breakout force measured with a general-purpose bare bucket; measured according to SAE J-732.
- I. 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.
- J. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- K. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- L. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.3 QUALITY ASSURANCE

- A. Pre-excavation Conference: Conduct conference at Project site to comply Project Standards
- B. Assign, engage, and schedule review of excavation operations by a Qualified Site (QA) Engineer, or designated representative.

- C. Quality Assurance personnel, programs, tests, and inspections are to be provided by the Owner and managed by the Design Engineer on the Project.
- D. The type and character of tests, inspections, and oversight is to be consistent and in accord with recognized industry practices for the type, character, means and methods of the earthwork or related operations being prosecuted on the site. The inspection and testing means and methods are to be provided by a third party testing agency and managed by the Design Engineer.

1.4 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, SM, GC, SC, CL, and ML or a combination of these group symbols; free of rock or gravel larger than 6 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter. Rock Excavation fill material can be blended with satisfactory soils in accordance with the VDOT Road and Bridge Specifications and approved by the Site (QA) Engineer.
- C. Unsatisfactory Soils: ASTM D 2487 soil classification groups MH, CH, OL, and OH, or a combination of these group symbols.
 - 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. 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.
- F. Bedding Course / Engineered Fill 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.
- H. Sand: ASTM C 33; fine aggregate, natural, or manufactured sand.
- I. Impervious Fill: Clayey gravel (GC), sandy clay (SC), or lean clay (CL) soil mixture capable of compacting to a dense state.

2.2 GEOTEXTILES AND GEOMEMBRANES

- A. Separation Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 - 1. Survivability: Class 2; AASHTO M 288.
 - 2. Grab Tensile Strength: 205 lbf; ASTM D 4632.
 - 3. Sewn Seam Strength: 205 lbf; ASTM D 4632
 - 4. Tear Strength: 525 lb; ASTM D 4533.
 - 5. Puncture Strength: 525 lbf; ASTM D6241.
 - 6. Apparent Opening Size: No. 80 sieve, maximum; ASTM D 4751.
 - 7. Permittivity: 1.4 per second, minimum; ASTM D 4491.
 - 8. UV Stability: 70 percent after 500 hours' exposure; ASTM D 4355.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Prepare of subgrades for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface.

- C. Protect and maintain erosion and sedimentation controls during earthwork operations.
- D. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

3.2 DEWATERING

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

3.3 EXPLOSIVES

- A. Explosives: Blasting is not permitted on this site.

3.4 EXCAVATION, GENERAL

- A. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock.
 - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, remove unsuitable material 24" and replace with satisfactory fill materials as specified.
 - 2. Remove rock to lines and grades indicated to permit installation of permanent construction.
 - 3. 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.

3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 2 inches. 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. Extend excavations a minimum of 24 inches from retaining wall limits in addition to the dimensions shown above in Section 3.4.A.2 for placing and removing concrete formwork, for installing services and other construction, for installation of structural fill, and for inspections.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.
- B. Shape, compact, and prepare subgrades for placement of walks and pavements, and;
- C. Prepare for and coordinate QA Inspection by the Site (QA) Engineer. Obtain approval via proof-rolling or other approved inspection method as prescribed and required by the Site (QA) Engineer.

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 as a minimum, and; to lines, depths and grades prescribed on the plans (where such is provided).
- 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 a minimum of 12 inches higher than top of pipe or conduit, unless otherwise indicated.
 - 1. Clearance: 12 inches on each side of pipe or conduit unless otherwise indicated.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
 - 1. For pipes and conduit less than 6 inches in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.

2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
3. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe elevation to allow for bedding course. Hand excavate for bell of pipe.

1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.8 SUBGRADE INSPECTION

- A. Notify Engineer for inspection if unsuitable material is encountered. Authorized excavation of unsuitable material will be paid for according to contract provisions for unit prices.
- B. Prepare for and coordinate QA Inspection by the Site (QA) Engineer. Obtain approval via proof-rolling or other approved inspection method as prescribed and required by the Site (QA) Engineer.

3.9 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom (below and through the unauthorized excavation zone), without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Site (QA) Engineer to fill voids caused or created by the excavation through the unauthorized excavation zone or layers).
 1. Fill unauthorized excavations under other construction or utility pipe as directed by Engineer.
 2. Inspection and approval of means and measures required to correct and remedy construction in and over unauthorized excavation zones must be made by the Site (QA) Engineer and approved by the Principal Design Engineer(s).

3.10 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil, surplus 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. Material not needed is to be exposed of at the contractors expense. See the Erosion and Sediment Control drawings for more information.

2. Consult Site (QA) Engineer and Owner for approval of means, methods and locations of site stockpiles.

3.11 BACKFILL

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

3.12 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow or ice.
- B. Place and compact bedding course on trench bottoms and where indicated using 6- inch depth. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Backfill trenches excavated under footings and within 18 inches of bottom of footings with VDOT #68 stone; fill with concrete to elevation of bottom of footings.
- D. Place and compact initial backfill of #68 stone in 6-inch layers from the top of the pipe bedding to a height of 12 inches over the utility pipe or conduit. Sub-base stone as proposed in the typical pavement sections shall be placed in 6-inch fills to 95% compaction until sub-base elevation is met.
 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- F. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the utility pipe or conduit.
- G. Backfill voids with satisfactory soil while installing and removing shoring and bracing.

- H. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- I. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.
- J. Install 12-gauge tracer wire taped directly to the top of the utility.

3.13 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 satisfactory soil material.
 - 2. Under walks and pavements, use satisfactory soil material.
 - 3. Under steps and ramps, use satisfactory soil material up to 24" from the bottom of footing. Use engineered/structural fill within 24" of bottom of footing.
 - 4. Under building slabs, use satisfactory soil material up to 24" from the bottom of slab. Use engineered/structural fill within 24" of bottom of slab.
 - 5. Under footings and foundations, use satisfactory soil material up to 24" from the bottom of footing. Use engineered/structural fill within 24" of bottom of footing. 24" depth of structural fill is to extend a minimum of 60" beyond the footprint of the building on all sides.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.14 SOIL MOISTURE CONTROL

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

3.15 COMPACTION OF BACKFILLS AND FILLS

- A. Place backfill and fill 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 materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
 - 1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill material at 95 percent. Excavate and backfill a minimum of 5' beyond culvert limits.
 - 2. Under walkways, scarify and recompact top 8 inches below subgrade and compact each layer of backfill or fill material at 95 percent.
 - 3. Under lawn or unpaved areas, scarify and recompact top 8 inches below subgrade and compact each layer of backfill or fill material at 90 percent.
 - 4. For utility trenches, compact each layer of initial and final backfill soil material at 95 percent.

3.16 GRADING

- A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations.

3.17 SUBSURFACE DRAINAGE

- A. Not prescribed.

3.18 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and re-establish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Engineer; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.19 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove waste material, trash, and debris, and legally dispose of it off Owner's property. Surplus soil and waste material shall be disposed of off-site at a permitted site at the expense of the Contractor.

4.0 ROCK EXCAVATION AND EMBANKMENT CONSTRUCTION

ROCK MATERIALS – SPECIAL PROVISIONS

1. When the excavated material consists predominantly of rock fragments, as proceeds from mechanical (hoe) ramming means and methods, the material (i.e. proceeds) may be of such size that it cannot be placed in layers of the thickness prescribed elsewhere herein without crushing, pulverizing, or further breaking down of the pieces resulting from the excavation methods noted herein.
 - A. Rock Material may be placed in the embankment layers that are not thicker than the approximate average size of the larger rocks.
 - B. Uniformly moisten or aerate rock fill layer before compaction to within 5 percent of optimum moisture content.
 - C. Rock not more than 4 feet in any dimension may be placed in an embankment to within 10 feet of the top of earthwork. The remainder of the embankment to within 2 feet of the top shall not contain rock of more than 2 feet in any dimension.
 - D. The final 2 feet of the embankment immediately below the subgrade shall be composed of materials placed in layers of not more than 8 inches, before compaction, and compacted in accordance with the project specifications. Maximum allowable particle sizes placed within 2 feet below top of earthwork shall not exceed 6 inches in any dimension. Finally, maximum allowable particles sizes placed within the upper 12 inches of the top of earthwork shall not exceed 3 inches in any dimension.
2. Rock Excavation (“rock fills”) is not to be for embankments for ponds and basins. Rock fills can be used to meet subgrade elevations before Structural/Engineered Fill is placed

for areas under slabs on grade, footings, and under the building. The Site (QA) Engineer must inspect and approve the fill in this area as described within Section 4.0.

3. Use of Rock Excavation (Materials) are subject to all appropriate and stated means and measures for Means, Methods, Preparations and Execution of EARTHWORK (operations) as noted herein in this and other related sections of the Specifications. Quality Assurance as provided and made by the Site (QA) Engineer will be required for use of Rock Excavation Materials in Embankments and for EARTHWORK. Certified QA Reports must be supplied to the Principal Design Engineer(s) for any operations for and relation to use of Rock Excavation Materials on the Project Site.
4. The Contractor must provide a written plan to describe and certify locations, depths and character of Rock Materials used in Embankment Construction prior to placement of rock fills. The Principal Design Engineer(s) will provide appropriate reviews and grant approvals upon receipt of an acceptable plan for execution of and placement of Rock Materials in Site Embankments. Placement of Rock Materials within existing Utility Easements along the outer edges of the property lines is prohibited.

END OF SECTION 02300

SECTION 02370 – EROSION& SEDIMENT CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. The latest edition of the Virginia Erosion & Sediment Control Handbook (“VESC, 1992.)

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Project description
 - 2. Erosion and sediment control measures
 - 3. Structural practices and details
 - 4. Management strategies
 - 5. Stabilization requirements
 - 6. Maintenance requirements
- B. Related Sections include the following:
 - 1. Division 31 Section “Earthwork”

1.3 PROJECT DESCRIPTION

The Project, in General, consists of the Construction of new maintenance facility associated site improvements. The work included in this contract. The site work also includes grading, erosions and sediment control, drainage, utilities, and subbase preparation, building, building part, construction, asphalt paving, and other miscellaneous items as noted in the Project Drawings and Specifications.

- A. Existing site conditions
 - 1. The existing site slopes to the west at approximately 7-15%. The area is currently the maintenance building and lot. The Existing surface makeup is asphalt with grass on the southeast and western slopes.
- B. Adjacent Property
 - 1. The Immediate adjacent area to the northwest is a waste water plant that is separated by a wood line and railroad tracks. To the west there is land consisting

of a sporting complex and recreation fields. To the south, across Belair Avenue there is a subdivision separated by railroad as well as tree line. Adjacent properties and roadways are to be kept in a mud-and-dust-free condition during all phases of construction.

C. Soils

1. The soils map and soils descriptions have been included on the C400 sheet. The soil data was obtained from the USDA soil survey.

D. Critical Erosion Areas

1. There are no critical areas identified on this project. However, care should be taken during construction to ensure that the perimeter erosion and sediment controls are being implemented correctly to prevent sediment from escaping the project work area and passing through or accumulating in the existing drainway. Good judgement pertaining to weather and site conditions should always be used when performing a land disturbing activity conservation easement.

PART 2 - PRODUCTS

2.1 EROSION AND SEDIMENT CONTROL MATERIALS

- A. Unless otherwise indicated, all vegetative and structural erosion and sediment control structures will be constructed and maintained according to minimum standards and specifications of the Virginia Erosion and Sediment Control Handbook.

2.2 STRUCTURAL PRACTICES

A. Topsoil Stockpile

1. There may not be an adequate amount of the existing topsoil on the site for re-application prior to seeding. The Contractor is responsible for importing topsoil to the site to meet the spreading depths specified in 2.2.C. Topsoil imported to the site can be stockpiled prior to re-spreading. Location shall be on consistent grade and not in a drainway. Stockpile erosion is to be contained by a silt fence, and any other controls specified or required by the VESCH. Protect topsoil with mulch and/or temporary vegetation.

B. Vegetative Measures

1. Permanent or temporary soil stabilization shall be applied to denuded areas within seven (7) days after final grade is reached on any portion of the site. Temporary soil stabilization shall be applied within seven (7) days to denuded areas that may

not be at final grade but will remain dormant for longer than fourteen (14) days. Permanent soil stabilization shall be applied to all areas that are to be left dormant for more than six (6) months.

C. Permanent Seeding (VESC Std. & Spec. 3.32)

1. Topsoil is to be spread at a minimum depth of 4” unless otherwise specified. The topsoil shall be tested at VPI&SU Cooperative Extension Service Soil Testing Laboratory or other reputable commercial laboratory to determine if and what rate to apply soil supplements. If soil testing is not possible the following soil amendments will be applied:
 - a. Apply Pulverized Agricultural at 2 tons/acre (90 lbs per 1000 sf)
 - b. Apply 10-20-10 or equivalent fertilizer at a rate of 1000 lbs/acre (23 lbs per 1000 sf)
2. Apply permanent seeding at a rate of 200 lbs/acre (4.6 lbs per 1000 sf) containing the following percentages of seed types:
 - a. Kentucky 31 or Turf-Type Tall Fescue – 95-100% of Seed Mixture
 - b. Improved Perennial Rye Grass – 0-5% of Seed Mixture
 - c. Kentucky Bluegrass – 0-5% of Seed Mixture.
3. Apply a seasonal nurse crop at a rate of 20 lbs/acre to match season as follows:
 - a. Annual Rye (February 16th through April or August 16th through October)
 - b. Foxtail Millet (May 1st through August 15th)
 - c. Winter Rye (November through February 15th)
4. Straw Mulch shall be applied to all seeded areas at the rate of 4000 lbs per acre and anchored with Cutback or Emulsified Asphalt applied at a rate of 200 gallons per acre.

D. Silt Fence (VESC Std. & Spec. 3.05)

1. Silt fence shall consist of a pervious synthetic fabric consisting of propylene, nylon, polyester or ethylene yarn and shall conform to VESC Standard 3.05.

PART 3 - EXECUTION

3.1 MANAGEMENT STRATEGIES

- A. Construction should be sequenced so that grading operations can begin and end as quickly as possible.
- B. All sediment trapping measures shall be installed as a first step in grading.
- C. Temporary seeding or other stabilization shall follow immediately after grading.
- D. The job superintendent shall be responsible for the installation and maintenance of all erosion and sediment control practices, and shall be appropriately trained and certified as a Responsible Land Disturber (“RLD”).

3.2 CONSTRUCTION REQUIREMENTS

- A. Underground utility lines shall be installed in accordance with the following standards in addition to other applicable criteria:
 - 1. Excavated material shall be placed on the uphill side of trenches.
 - 2. Effluent from dewatering operations shall be filtered or passed through an approved sediment trapping device, or both, and discharged in a manner that does not adversely affect flowing streams or off-site property.
 - 3. Material used for backfilling trenches shall be properly compacted in order to minimize erosion and promote stabilization.
 - 4. Restabilization shall be accomplished in accordance with the Virginia Erosion and Sediment Control Handbook.
- B. Where construction vehicle access routes intersect paved or public roads, provisions shall be made to minimize the transport of sediment by vehicular tracking onto the paved surface. Where sediment is transported onto a paved or public road surface, the road surface shall be cleaned thoroughly at the end of each day. Sediment shall be removed from the roads by shoveling or sweeping and transported to a sediment control disposal area. Street washing shall be allowed only after sediment is removed in this manner. This provision shall apply to all land-disturbing activities.
- C. All temporary erosion and sediment control measures shall be removed within 30 days after final site stabilization or after the temporary measures are no longer needed, unless otherwise authorized by the local program authority. Trapped sediment and the disturbed soil areas resulting from the disposition of temporary measures shall be permanently stabilized to prevent further erosion and sedimentation.
- D. Properties and waterways downstream from development sites shall be protected from sediment deposition.

3.3 MAINTENANCE

- A. In general, all erosion and sediment control measures will be checked by the Contractor weekly and after each significant rainfall.
- B. Permanent structures will be maintained by the Owner's maintenance force after completion, and final certified approval of the project by the Engineer.

3.4 STANDARDS AND SPECIFICATIONS

- A. Virginia Erosion and Sediment Control Standards and Specifications, (VESC Handbook, 1992) related to this project page and are part of the Contract.

END OF SECTION 02370

SECTION 02510 - WATER DISTRIBUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Town of Front Royal Standards and Specifications (Latest Edition)(i.e. the “Utility Company, Department, Utility Owner, or Owner”).

1.2 SUMMARY

- A. This Section includes water-distribution piping and related components outside the building for water service and fire-service mains.
- B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.
- C. System performance requirements for potable water service: 20 psig unless otherwise noted or specified by the locality.

1.3 DEFINITIONS

- A. PE: Polyethylene plastic.
- B. PP: Polypropylene plastic.
- C. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Detail pre-cast concrete vault assemblies and indicate dimensions, method of field assembly, and components, when specified or called for on drawings.
 - 1. Wiring Diagrams: Power, signal, and control wiring for alarms.

- C. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
 - 2. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.
- E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.
- F. NSF Compliance:
 - 1. Comply with NSF 14 for plastic potable-water-service piping. Include marking "NSF-pw" on piping.
 - 2. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
 - 1. Ensure that valves are dry and internally protected against rust and corrosion.
 - 2. Protect valves against damage to threaded ends and flange faces.
 - 3. Set valves in best position for handling. Set valves closed to prevent rattling.

- B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.
- G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.7 PROJECT CONDITIONS

- A. Interruption of Existing Water-Distribution 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 water-distribution service according to requirements indicated:
1. Notify Owner no fewer than three days in advance of proposed interruption of service.
 2. Do not proceed with interruption of water-distribution service without Owner's written permission.
 3. Verify that water service piping may be installed to comply with original design and referenced standards.
 4. Perform Site Survey and evaluate available data, contact utility-locating service for Project area.

1.8 COORDINATION

- A. Coordinate connection to water main with Town of Luray.

- B. Coordinate piping materials, sizes, entry locations, and pressure requirements with building water distribution piping.
- C. Coordinate with other utility and underground installations.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L , water tube, annealed temper.
 - 1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
 - 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
 - 3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.2 PVC PIPE AND FITTINGS

- A. PVC, AWWA Pipe: AWWA C900, Class 200, with bell end with gasket, and with spigot end.
 - 1. Comply with UL 1285 for fire-service mains if indicated.
 - 2. PVC Fabricated Fittings: AWWA C900, Class 200, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
 - 3. PVC Molded Fittings: AWWA C907, Class 200, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.

2.3 JOINING MATERIALS

- A. Brazing Filler Metals: AWS A5.8, BCuP Series.
- B. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

2.4 PIPING SPECIALTIES

- A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

B. Tubular-Sleeve Pipe Couplings:

- a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work, but are not limited to, the following:
 1. Dresser, Inc.; Dresser Piping Specialties.
 2. Ford Meter Box Company, Inc. (The); Pipe Products Div.
 3. JCM Industries.
 4. Smith-Blair, Inc

2.5 BRASS BALL VALVES**A. Two-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Hammond Valve.
 - d. NIBCO
 - e. Apollo

2.6 GATE VALVES**A. AWWA, Cast-Iron Gate Valves:**

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Stockham Div.
 - b. Mueller Co.; Water Products Div.
 - c. NIBCO INC.
 - d. U.S. Pipe and Foundry Company.

B. Bronze Gate Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Hammond Valve.
 - d. NIBCO
 - e. Apollo

2.7 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.

1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

2.8 CHECK VALVES

A. AWWA Check Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2.9 CORPORATION VALVES AND CURB VALVES

A. Manufacturers:

1. Available Manufacturers: Subject to compliance with Owner's Utility requirements, manufacturers offering products that may be incorporated into the Work:
 - A. Ford Meter Box Company, Inc. (The); Pipe Products Div.

2.10 WATER METERS

A. Water meters will be furnished as part of the contract by the winning bidder.

2.11 CONCRETE VAULTS

A. Description: Pre-cast, reinforced-concrete vault, designed for A-16 load designation according to ASTM C 857 and made according to ASTM C 858, if and where specified in the Drawings and General Provisions of the Contract.

1. Ladder: ASTM A 36/A 36M, aluminum or polyethylene-encased steel steps.
2. Aluminum access hatch lockable.
 - a. Dimension: 24-inch by 24-inch minimum, unless otherwise indicated.
3. Drain: Minimum 2" diameter pvc pipe drain to day light or other method approved by the Owner and Engineer. Pipe end to be covered with 24 mesh stainless steel screen and held in place with a stainless steel clamp.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Refer to Division 31 Section "Earthwork" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.
- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
- C. Do not use flanges or unions for underground piping.
- D. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.
- E. Underground water-service piping NPS 3/4 to NPS 2 shall be the following:
 - 1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
- F. Underground Combined Water-Service and Fire-Service-Main Piping NPS 6 to NPS 12 shall be the following:
 - 1. Mechanical-joint pipe and mechanical-joint fittings.
 - 2. C900 PVC DR 14, AWWA Class 200 C900-97, (Class 305 C900-07) pipe; push-on-joint, mechanical-joint, fittings; and gasketed joints.

3.3 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Underground Valves, NPS 4 and Larger: AWWA, cast-iron, nonrising-stem, metal seated gate valves with valve box.
 - 2. Use the following for valves in vaults and aboveground:
 - a. Gate Valves, NPS 2 and Smaller: Bronze, nonrising stem.
 - b. Gate Valves, NPS 3 and Larger: AWWA, cast iron.
 - 3. Relief Valves: Use for water-service piping in vaults and aboveground.

- a. Air-Release Valves: To release accumulated air.
- b. Air/Vacuum Valves: To release or admit large volume of air during filling of piping.
- c. Combination Air Valves: To release or admit air.

3.4 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. General Locations and Arrangements: Drawings indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, unless deviations to layout are approved on Coordination Drawings.
- B. Install piping at indicated slope (where applicable).
- C. Install components with pressure rating equal to or greater than system operating pressure.
- D. Install piping free of sags and bends.
- E. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- F. Install fittings for changes in direction and branch connections.
- G. Piping Connections: Unless otherwise indicated, make piping connections as specified below:
 1. Install unions, in piping 2-inch NPS and smaller, adjacent to each valve and at final connection to each piece of equipment with 2-inch NPS or smaller threaded pipe connection.
 2. Install flanges, in piping 2-1/2-inch NPS and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
 3. Install dielectric fittings to connect piping of dissimilar metals.

3.5 PIPING INSTALLATION

- A. Water-Main Connection: Arrange with utility company for tap of size and in location indicated in water main. Provide minimum advance notice of four days prior to scheduling water main connection operations.
- B. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.
- C. Make connections larger than NPS 2 with tapping machine according to the following:
 1. Install tapping sleeve and tapping valve according to MSS SP-60.

2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.

D. Make connections NPS 2 and smaller with drilling machine according to the following:

1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company standards.
2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
4. Install corporation valves into service-saddle assemblies.
5. Install manifold for multiple taps in water main.
6. Install curb valve in water-service piping with head pointing up and with service box.

3.7 JOINT CONSTRUCTION

A. Make pipe joints according to the following:

7. Copper-Tubing, Pressure-Sealed Joints: Use proprietary crimping tool and procedure recommended by copper, pressure-seal-fitting manufacturer.
8. PE Piping Insert-Fitting Joints: Use plastic insert fittings and fasteners according to fitting manufacturer's written instructions.
9. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.
10. Fiberglass Piping Bonded Joints: Use adhesive and procedure recommended by piping manufacturer.
11. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure. Refer to Division 2 Section "Piped Utilities - Basic Materials and Methods" for joining piping of dissimilar metals.

3.8 ANCHORAGE INSTALLATION

A. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:

1. Water-Service Piping: According to AWWA C600.

2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.

3.9 WATER METER INSTALLATION

- A. Install water meters, piping, and specialties according to public works written instructions, and as per the brand required by the local Public Works Department.

3.10 ROUGHING-IN FOR WATER METERS

- A. Rough-in piping and specialties for water meter installation according to utility company's written instructions.

3.11 VACUUM BREAKER ASSEMBLY INSTALLATION

- A. Install pressure vacuum breaker assemblies of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

3.12 WATER METER BOX INSTALLATION

- A. Install water meter boxes in paved areas flush with surface.
- B. Install water meter boxes in grass or earth areas flush with surface.

3.13 CONCRETE VAULT INSTALLATION

- A. Install precast concrete vaults according to ASTM C 891.

3.14 CONNECTIONS

- A. Piping installation requirements are specified in other Division 2 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect water-distribution piping to utility water main. Use tapping sleeve and tapping valve or service clamp and corporation valve per local Public Works Department requirements.

3.15 FIELD QUALITY CONTROL

- A. Piping Tests: See Virginia Department of Health Waterworks Regulations (see plans).

3.16 IDENTIFICATION

- A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping.

END OF SECTION 02510

SECTION 02531 - SANITARY SEWERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes sanitary sewerage outside the building up to the drainfield.
- B. Related Sections include the following:

1.3 DEFINITIONS

- A. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

- A. Product Data: For the following:
- B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic structures, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.

PART 2 - PRODUCTS

2.1 PIPES AND FITTINGS

- A. PVC Pressure Pipe: SDR 21, gasketed joint, in accordance with ASTM D 1784 and ASTM D 2241, for gasketed joints.
 - 1. PVC Pressure Fittings: schedule 40 solvent weld in accordance with ASTM D-2466.
- B. PVC Sewer Pipe and Fittings: According to the following:

1. PVC Sewer Pipe and Fittings, ASTM D 3034, SDR 35, for gasketed joints.

- a. Gaskets: ASTM F 477, elastomeric seals.

2.2 SPECIAL PIPE COUPLINGS AND FITTINGS

- A. Sleeve-Type Pipe Couplings: ASTM C 1 173, rubber or elastomeric sleeve and band assembly fabricated to mate with pipes to be joined, for non-pressure joints.

1. Sleeve Material for Plastic Pipe: ASTM F 477, elastomeric seal.

2. Bands: Stainless steel, at least one at each pipe insert.

2.3 CLEAN OUTS

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

PART 3- EXECUTION

3.1 EARTH WORK

- A. Excavating, trenching, and backfillin4 are specified in Division 32 Section "Earthwork."

3.2 IDENTIFICATION

- A. Materials and their installation are specified in Division 2 Section "Earthwork." Arrange for installing green warning tapes directly over piping and at outside edges of underground structures.

1. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.3 PIPING APPLICATIONS

- A. General: Include watertight joints.

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

- C. Gravity-Flow Piping: Use the following:
 - 1. NPS 4 to NPS 6 (DN100 and DN 150): PVC sewer pipe and fittings, gasketed joints.

3.4 SPECIAL PIPE COUPLING AND FITTING APPLICATIONS

- A. Special Pipe Couplings: Use where required to join piping and no other appropriate method is specified. Do not use instead of specified joining methods.
 - 1. Use the following pipe couplings for non-pressure applications:
 - a. Sleeve type to join piping, of same size, or with small difference in OD.
 - b. Increaser/reducer-pattern, sleeve type to join piping of different sizes.
 - c. Bushing type to join piping of different sizes Where annular space between smaller piping's OD and larger piping's ID permits installation.

3.5 INSTALLATION, GENERAL

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Request instructions from Engineer before proceeding if any conflicts exist between manufacturer's recommendations or the contract documents. Present all conflicts between piping & equipment, structures or facilities to the Engineer before proceedings.
- 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 using lubricants, cements, and other installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.
- C. Use manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- D. Use proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

- E. Install gravity-flow piping and connect to building's sanitary drains, of sizes and in locations indicated. Terminate piping as indicated.
- F. Ensure that water level in trench is 6 inches, minimum, below the invert of the piping before laying pipes. Maintain dry condition until piping installation & backfill is complete.
- G. Cut pipe where required for installation of valves, fittings, or structures. Use only tools specially designed for cutting the piping material in use. Prepare cut ends for jointing in accordance with manufacturer's requirements. Flame cutting of pipe is prohibited.
- H. Place & compact bedding as shown on the contract plans.
 - 1. Install piping pitched down in direction of flow, at minimum slope of 1/8" per foot, unless otherwise indicated.
 - 2. Install piping with minimum cover as shown on plans.
- 1. Extend sanitary sewerage piping and connect to building's sanitary drains, of sizes and in locations indicated. Terminate piping as indicated.
- J. Install PVC force-main piping according to AWWA M23.

3.6 PIPE JOINT CONSTRUCTION AND INSTALLATION

- A. General: Join and install pipe and fittings according to installations indicated.
- B. PVC Sewer Pipe and Fittings: As follows:
 - 1. Join pipe and gasketed fittings with gaskets according to ASTM D 2321.
 - 2. Join profile sewer pipe fittings with gaskets according to ASTM D 2321 and manufacturer's written instructions.
 - 3. Install according to ASTM D 2321.
 - 4. Lay pipe with bell and spigot joints with bells upstream.
 - 5. Completely clean all jointing surfaces and adjacent areas prior to making joint.
 - 6. Field cut pipe for shorter than standard pipe lengths. Cut ends square and perpendicular to the pipe axis. Remove and smoothly bevel ends. Stop mark field spigots with a felt tip mark or wax crayon for proper length of assembly insertion in accordance with manufacturer's recommendations.
 - 7. Assemble all joints in accordance with recommendations of the manufacturer. Use only manufacturer recommended joint lubricants.
 - 8. Rotate the spigot by hand or with a strap wrench to verify proper jointing. If unusual jointing resistance is encountered or if the insertion

mark does not reach the flush position, disassemble the joint, inspect for damage, reclean the joint components and repeat the assembly steps.

9. Use a bar and wood blocking to properly seat pipe joints. **DO NOT USE BACKHOE BUCKET, OR SIMILAR MACHINERY, TO FORCE JOINT ASSEMBLY.**
- C. System Piping Joints: Make joints using system manufacturer's couplings, unless otherwise indicated.
- D. Join piping made of different materials or dimensions with couplings made for this application. Use couplings that are compatible with and that fit both systems' materials and dimensions.
- E. Install with top surfaces of components, except piping, flush with finished surface.

3.7 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Install piping so cleanouts open in direction of flow in sewer pipe.

3.8 FIELD QUALITY CONTROL

- A. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed.
 1. Place plug in end of incomplete piping at end of day and when work stops.
 2. 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 (600 mm) 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 95 percent of piping diameter.
 - c. Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.

- e. Exfiltration: Water leakage from or around piping.
- 3. Replace defective piping using new materials and repeat inspections until defects are within allowances specified.
- 4. Reinspect and repeat procedure until results are satisfactory.
- C. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems according to authorities having jurisdiction.
 - 3. Schedule tests and inspections by authorities having jurisdiction with at least 48 hours' advance notice.
 - 4. Submit proposed testing method, materials & procedures for review minimum 10 days prior to testing.
 - 5. Submit separate reports for each test.
 - a. Sanitary Sewerage: Perform hydrostatic test.
 - (1) Provide all materials required for test including water for testing & flushing.
 - (2) Allowable leakage is maximum of 50 gal. per inch of nominal pipe size per mile of pipe, during 24-hour period.
 - (3) Close openings in system and fill with water.
 - (4) Purge air and refill with water.
 - (5) Disconnect water supply.
 - (6) Test and inspect joints for leaks.
 - (7) Option: Test ductile-iron piping according to AWWA C600, Section "Hydrostatic Testing." Use test pressure of at least 10 psig.
- h. The line is considered acceptable if the time for the pressure to decrease from 3.5 psig to 2.5 psig is not less than the amount determined by the following table, except that Reinforced Concrete Pipe shall be half this duration.

MINIMUM ACCEPTANCE TIMES

Pipe Diameter (in.)	Minimum Time (min:sec)	Length for Minimum Time (ft.)	Time for Longer Length (sec.)
4	3:46	597	0.380 L
6	5:40	398	0.854 L
8	7:34	298	1.520 L
10	9:26	239	2.374 L
12	11:20	194	3.418 L
15	14:10	159	5.342 L
18	17:00	133	7.692 L

21	19:50	114	10.470 I.
24	22:40	99	13.674 I.
27	25:30	88	17.306 I.
30	28:20	80	21.366 I.
33	21:10	72	25.852 L
36	34:00	66	30.768 I.

Where L is the excess test length for minimum time.

- c. If the leakage in the section tested exceeds the specified amount, repair or replace the section tested to reduce the leakage to within the specified limits and repeat the test until the leakage requirements are met.
- d. The Contractor may, at his option, infiltration/exfiltration test all sewer pipe in lieu of the air test.
 - Option: Test concrete piping according to ASTM C 924.
6. Leaks and loss in test pressure constitute defects that must be repaired.
7. Replace leaking piping using new materials and repeat testing until leakage is within allowances specified.
8. Visual Inspection: Prior to final acceptance, perform a visual inspection of all appurtenance structures, i.e. manholes, chambers, etc. Repair visual leaks, regardless of their magnitude.

END OF SECTION 02531

SECTION 02630 - STORM DRAINAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes gravity-flow, nonpressure storm drainage outside the building, with the following components:
 - 1. Cleanouts.
 - 2. Drains.
 - 3. Precast concrete and/or Cast-in-place concrete manholes.

1.2 DEFINITIONS

- A. PVC: Polyvinyl chloride plastic.
- E. HDPE: High Density Polyethylene

1.3 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water. Maintain head for a minimum 15 minutes. Pipe joints shall be at least silttight, unless otherwise indicated.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Drains.
 - 2. Storage and leaching chambers.
- B. Shop Drawings: For the following:
 - 1. Manholes: Include plans, elevations, sections, details, and frames and covers. Include design calculations, and concrete design-mix report for cast-in-place manholes.

2. Catch Basins and Stormwater Inlets. Include plans, elevations, sections, details, and frames, covers, and grates.
 3. Stormwater Detention Structures: Include plans, elevations, sections, details, frames and covers, design calculations, and concrete design-mix report.
- C. 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.
- D. Field quality-control test reports.

1.5 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.

1.6 PROJECT CONDITIONS

- A. 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 Engineer and Owner no fewer than three days in advance of proposed interruption of service.
 2. Do not proceed with interruption of service without Engineer's and Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

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

2.2 HDPE PIPE AND FITTINGS

- A. Corrugated HDPE Drainage Pipe and Fittings NPS 10 and Smaller: AASHTO M 252M, 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 tube and fittings.
 - 2. Soiltight Couplings: AASHTO M 252M, corrugated, matching tube and fittings.
 - 3. Silttight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings.
 - 4. Soiltight Couplings: AASHTO M 294M, corrugated, matching pipe and fittings.

- B. Corrugated PE Pipe and Fittings NPS 12 to NPS 60 : VDOT Spec. Sec. 232, AASHTO MP7, 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 MP7, corrugated, matching pipe and fittings.

2.3 PVC PIPE AND FITTINGS

- A. PVC Sewer Pipe and Fittings, NPS 15 and Smaller: ASTM D 3034, SDR 35, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

- B. PVC Profile Gravity Sewer Pipe and Fittings: ASTM F 794 pipe, with bell-and-spigot ends; ASTM D 3034 fittings, with bell ends; and ASTM F 477, elastomeric seals.

2.4 CONCRETE PIPE AND FITTINGS

- A. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76, with bell-and-spigot or groove and tongue ends and sealant joints with ASTM C 990 (ASTM C 990M), bitumen or butyl-rubber sealant.
 - 1. Class I, Wall A & B.
 - 2. Class II, Wall A, B, & C.
 - 3. Class III, Wall A, B & C.
 - 4. Class IV, Wall A, B & C.
 - 5. Class V, Wall B & C.

2.5 NONPRESSURE-TYPE PIPE 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 Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - 3. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- C. Unshielded Flexible Couplings: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
- D. Shielded Flexible Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
- E. Ring-Type Flexible Couplings: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.
- F. Nonpressure-Type Rigid Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

2.6 CLEANOUTS

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

2.10 MANHOLES

- A. Standard Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
 - 1. Diameter: 48 inches minimum, unless otherwise indicated.
 - 2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
 - 3. Base Section: 8-inch minimum thickness for floor slab and 5-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.

4. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.
5. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
6. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
7. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
8. Steps: Individual FRP steps, FRP ladder, or 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 1 step and designed to prevent lateral slippage off of 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 60 inches.
9. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
10. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
11. Manhole Frames and Covers: 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."
 - a. Material: ASTM A 536, Grade 60-40-18 ductile or gray iron equivalent, or unless otherwise indicated by Town Codes and Standards.

- B. Cast-in-Place Concrete Manholes: Construct of reinforced-concrete bottom, walls, and top; designed according to ASTM C 890 for A-16 (ASSHTO HS20-44), heavy-traffic, structural loading; of depth, shape, dimensions, and appurtenances indicated.

1. Ballast: Increase thickness of concrete, as required to prevent flotation.
2. All castings specifications are to be equivalent or in excess to those shown in Section 2.10 A above, or cast-in-place structures will not be allowed by the Owner.

2.11 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:
1. Cement: ASTM C 150, Type II.
 2. Fine Aggregate: ASTM C 33, sand.
 3. Coarse Aggregate: ASTM C 33, crushed gravel.
 4. Water: Potable.

- B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water-cementitious materials ratio.
 - 1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
 - 2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

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

2.12 CATCH BASINS

- A. Standard Precast Concrete Catch Basins: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
 - 1. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
 - 2. Riser Sections: 4-inch minimum thickness, 48-inch diameter, and lengths to provide depth indicated.
 - 3. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
 - 4. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
 - 5. 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.
 - 6. Grade Rings: Include 2 or 3 reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch-diameter frame and grate.
 - 7. Steps: Individual FRP steps, FRP ladder, or 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 1 step and designed to prevent lateral slippage off of 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 60 inches.
 - 8. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.

- B. Cast-in-Place Concrete, Catch Basins: Construct of reinforced concrete; designed according to ASTM C 890 for structural loading; of depth, shape, dimensions, and appurtenances indicated.

1. Bottom, Walls, and Top: Reinforced concrete.
 2. Channels and Benches: Concrete.
 3. Steps: Individual FRP steps, FRP ladder, or 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 1 step and designed to prevent lateral slippage off of 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 60 inches.
- C. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include flat grate 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.
- D. 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 with small square or short-slotted drainage openings.
1. Grate Free Area: Approximately 50 percent, unless otherwise indicated.

2.13 STORMWATER INLETS

- A. Curb Inlets: Made with vertical curb opening, of materials and dimensions according to utility standards.
- B. Curb Inlets: Vertical curb opening, of materials and dimensions indicated.
- C. Provide Manufacturers recommended outlet screens, and structure filters for all storm water- storm drainage inlets that are immediately upstream of the proposed "Rain Tank Structures" Inlets.

2.14 STORMWATER DETENTION STRUCTURES

- A. Reference is hereby made to the Stormwater Management Narrative attached to the Plan Set, and the details located in the project drawings.
- B. Manhole Frames and Covers: ASTM A 536, Grade 60-40-18, ductile-iron castings designed for heavy-duty service. Include 24-inch ID by 7- to 9-inch

riser with 4-inch minimum width flange, and 26-inch- diameter cover. Include indented top design with lettering "STORM SEWER" cast into cover.

- C. Temporary Sediment Basin Riser Structures are subject to compliance with all applicable VESC Handbook Standards and Specifications, and must be approved by the Project Engineer as a Shop Drawing Submittal prior to ordering of products or assemblies by the Contractor.

2.15 PIPE OUTLETS

- A. Head Walls: Cast-in-place reinforced concrete, with apron and tapered sides.
- B. Filter Stone: According to NSSGA's "Quarried Stone for Erosion and Sediment Control," No. FS-2, No. 4 screen opening, average-size, graded stone.

PART 3 - EXECUTION

3.1 EARTHWORK

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

3.2 PIPING APPLICATIONS

- A. General : Include Soiltight Joints, unless watertight or silttight joints are indicated.
- B. Gravity-Flow, Nonpressure Sewer Piping: Use the following pipe materials for each size range:
 - 1. NPS 4 and NPS 6: PVC sewer pipe and fittings, gaskets, and gasketed joints.
 - 2. NPS 8 to NPS 36 : Corrugated HDPE drainage pipe and fittings, silttight couplings, and coupled joints.
 - 3. Retain one or more of nine subparagraphs below. If more than one type of material and joining method is used, identify various materials on Drawings and show points of transition from one material to another.

4. General: The use of silttight couplings is specified to minimize infiltration and inflow that could cause damage and degradation, including trash and debris deposition, within the underground storm drainage and management systems.

3.3 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 design considerations into account. 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. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.
- F. Install gravity-flow, nonpressure drainage piping according to the following:
 1. Install piping pitched down in direction of flow, at at the minimum slope in percent indicated on the drawings, unless otherwise approved or indicated. Provide manufacturers catalog sheets and joint details as submittal for review and approval by the Project Engineer.
 2. Install piping NPS 6 and larger with approved joints at tee fittings and at changes in direction
 3. Install piping with 36-inch, or as indicated minimum cover.
 4. Install piping below frost line.
 5. Install HDPE corrugated sewer piping according to CPPA's "Recommended Installation Practices for Corrugated High-Density Polyethylene Pipe and Fittings."
 8. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
 9. Install PVC profile gravity sewer piping according to ASTM D 2321 and ASTM F 1668.

3.4 PIPE JOINT CONSTRUCTION

- A. Basic pipe joint construction is specified in Division 33 Section "Common Work Results for Utilities." Where specific joint construction is not indicated, follow piping manufacturer's written instructions.
- B. Join gravity-flow, nonpressure drainage piping according to the following:
 - 1. Join corrugated steel sewer piping according to ASTM A 798/A 798M.
 - 2. Join corrugated aluminum sewer piping according to ASTM B 788/B 788M.
 - 3. Join corrugated PE piping according to CPPA 100 and the following:
 - a. Use silttight couplings for Type 2, silttight joints.
 - b. Use soiltight couplings for Type 1, soiltight joints.
 - 4. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric gasket joints.
 - 5. Join dissimilar pipe materials with nonpressure-type flexible or rigid couplings.
- C. Join force-main pressure piping according to the following:
 - 1. Join PVC pressure piping according to AWWA M23 for gasketed joints.

3.5 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extension from sewer pipe to cleanout 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.
- 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 with tops flush with pavement surface.

3.6 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.

B. Embed drains in 4-inch minimum depth of concrete around bottom and sides.

C. Fasten grates to drains if indicated.

D. Set drain frames and covers with tops flush with pavement surface.

3.7 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections according to ASTM C 891.

C. Construct cast-in-place manholes as indicated.

D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere, unless otherwise indicated.

3.8 CATCH BASIN INSTALLATION

A. Construct catch basins to sizes and shapes indicated.

B. Set frames and grates to elevations indicated.

3.9 STORMWATER INLET AND OUTLET INSTALLATION

A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.

B. Install outlets that spill onto grade, anchored with concrete, where indicated.

C. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.

3.10 CONCRETE PLACEMENT

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

3.11 CONNECTIONS

3.12 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 "Earthwork."

3.13 IDENTIFICATION

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

3.14 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 4. Reinspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
1. Do not enclose, cover, or put into service before inspection and approval.
 2. Test completed piping systems according to authorities having jurisdiction.
 3. 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 .
- C. Leaks and loss in test pressure constitute defects that must be repaired.
- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.
- 3.15 CLEANING
- A. Clean interior of piping of dirt and superfluous materials. Flush with clean water.

END OF SECTION 02630