



State of West Virginia
Department of Administration
Purchasing Division
2019 Washington Street East
Post Office Box 50130
Charleston, WV 25305-0130

Solicitation

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| NUMBER |
| WSH13095 |

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| ADDRESS CORRESPONDENCE TO ATTENTION OF: |
| ROBERTA WAGNER 304-558-0067 |

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HEALTH AND HUMAN RESOURCES
OPERATIONS
VARIOUS LOCALES AS INDICATED
ON PURCHASE ORDER

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| DATE PRINTED |
| 01/09/2013 |

BID OPENING DATE:

02/13/2013

BID OPENING TIME 1:30PM

| LINE | QUANTITY | UOP | CAT. NO. | ITEM NUMBER | UNIT PRICE | AMOUNT |
|---|----------|-----|----------|-------------|------------|--------|
| ADDENDUM NO. 1 | | | | | | |
| 1. ADDENDUM ISSUED TO PROVIDE THE FOLLOWING OMITTED PAGES TO THE DETAILED SPECIFICATIONS AS PROVIDED BY THE ARCHITECT, IKM INCORPORATED. | | | | | | |
| DIVISION 31 | | | | | | |
| SECTION 31 10 00 - SITE CLEARING | | | | | | |
| SECTION 31 20 00 - EARTH MOVING | | | | | | |
| SECTION 31 21 19 - DEWATERING | | | | | | |
| SECTION 31 50 00 - EXCAVATION SUPPORT PROTECTION | | | | | | |
| DIVISION 32 | | | | | | |
| SECTION 32 12 16 - ASPHALT PAVING | | | | | | |
| SECTION 32 13 13 - CONCRETE PAVING | | | | | | |
| SECTION 32 13 73 - CONCRETE PAVING JOINT SEALANTS | | | | | | |
| SECTION 32 17 13 - PARKING BUMPERS | | | | | | |
| SECTION 32 18 13 - SYNTHETIC TURF | | | | | | |
| SECTION 32 18 16 - EXTERIOR RESILIENT SURFACING | | | | | | |
| SECTION 32 31 14 - NO CLIMB FENCE & SALLY PORT GATE | | | | | | |
| SECTION 32 92 00 - TURF & GRASSES | | | | | | |
| SECTION 32 93 00 - PLANTS | | | | | | |
| DIVISION 33 | | | | | | |
| SECTION 33 11 13 - FACILITY WATER DISTRIBUTION PIPING | | | | | | |
| SECTION 33 13 13 - FACILITY SANITARY SEWERS | | | | | | |
| SECTION 33 41 00 - STORM UTILITY DRAINAGE PIPING | | | | | | |
| 2. ADDENDUM ACKNOWLEDGMENT. THIS DOCUMENT SHOULD BE SIGNED AND RETURNED WITH YOUR BID. FAILURE TO SIGN AND RETURN MAY RESULT IN DISQUALIFICATION OF YOUR BID. | | | | | | |
| SIGNATURE | | | | | | |
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WHEN RESPONDING TO SOLICITATION, INSERT NAME AND ADDRESS IN SPACE ABOVE LABELED 'VENDOR'



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| END OF ADDENDUM NO. 1 | | | | | | |
| 0001 | 1 | JB | | 968-20 | | |
| 50 BED ADDITION TO WILLIAM R. SHARPE JR. HOSPITAL | | | | | | |
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| TO PROVIDE CONSTRUCTION OF A 50 BED ADDITION AND RENOVATIONS TO WILLIAM R. SHARPE JR. HOSPITAL PER THE DRAWINGS AND SPECIFICATIONS PROVIDED BY THE ARCHITECT IKM, INC. AND THE OWNER. | | | | | | |
| ***** THIS IS THE END OF RFQ WSH13095 ***** TOTAL: _____ | | | | | | |

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WHEN RESPONDING TO SOLICITATION, INSERT NAME AND ADDRESS IN SPACE ABOVE LABELED 'VENDOR'

SOLICITATION NUMBER: WSH13095

Addendum Number: 01

The purpose of this addendum is to modify the solicitation identified as ("Solicitation") to reflect the change(s) identified and described below.

Applicable Addendum Category:

- ☐ Modify bid opening date and time
- ☒ Modify specifications of product or service being sought
- ☐ Attachment of vendor questions and responses
- ☐ Attachment of pre-bid sign-in sheet
- ☒ Correction of error
- ☐ Other

Description of Modification to Solicitation:

1. To provide Division 31, 32 & 33 specifications previously omitted.
2. To provide Addendum Acknowledgment.

Additional Documentation: Documentation related to this Addendum (if any) has been included herewith as Attachment A and is specifically incorporated herein by reference.

Terms and Conditions:

1. All provisions of the Solicitation and other addenda not modified herein shall remain in full force and effect.
2. Vendor should acknowledge receipt of all addenda issued for this Solicitation by completing an Addendum Acknowledgment, a copy of which is included herewith. Failure to acknowledge addenda may result in bid disqualification. The addendum acknowledgement should be submitted with the bid to expedite document processing.

ATTACHMENT A

SECTION 31 10 00 - SITE CLEARING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawing and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Section, apply to this section.

1.2 SUMMARY

A. Section Includes:

- 1) Protecting existing vegetation to remain.
- 2) Removing existing vegetation.
- 3) Clearing and grubbing.
- 4) Stripping and stockpiling topsoil.
- 5) Removing above- and below-grade site improvements.
- 6) Disconnecting, capping or sealing, and abandoning site utilities in place.
- 7) Temporary erosion- and sedimentation-control measures.

B. Related Sections:

- 1) Division 01 Section "Temporary Facilities and Controls" for temporary utility services, construction and support facilities, security and protection facilities, and temporary erosion- and sedimentation-control measures.
- 2) Division 01 Section "Execution" for field engineering and surveying.

1.3 DEFINITIONS

- A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- B. Subsurface 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.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow.
- D. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other non-soil materials.

- E. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated of drawings.
- F. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated.
- G. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIAL OWNERSHIP

- A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become contractor's property and shall be removed from project site.

1.5 SUBMITTALS

- A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
 - 1) Use sufficiently detailed photographs or videotape.
 - 2) Include plans and notations to indicate specific wounds and damage conditions of each tree or other plans designated to remain.
- B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 QUALITY ASSURANCE

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

1.7 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1) Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Architect and authorities having jurisdiction.
 - 2) Provide alternate routes around closed or obstructed traffic ways if required by Architect or authorities having jurisdiction.
- B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
- C. Utility Locator Service: Notify utility locator service for area where project is located before site clearing.
- D. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.
- E. The following practices are prohibited within protection zones:
 - 1) Storage of construction materials, debris, or excavated material.

- 2) Parking vehicles or equipment.
- 3) Foot traffic.
- 4) Erection of sheds or structures.
- 5) Impoundment of water.
- 6) Excavation or other digging unless otherwise indicated.
- 7) Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- F. Do not direct vehicle or equipment exhaust towards protection zones.
- G. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.
- H. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Division 31 "Earth Moving."
 - 1) Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated. Flag each tree trunk at 54 inches above the ground.
- C. Protect existing improvements to remain from damage during construction.
 - 1) Restore damaged improvements to their original condition, as acceptable to Architect.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control drawings that comply with EPA 832/R-92-005 or requirements of authorities having jurisdiction, whichever is more stringent.

- B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

- A. General: Protect trees and plants remaining on-site as required to maintain tree and plant life during construction. Mark with tape, fencing, etc. as required.
- B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.

3.4 EXISTING UTILITIES

- A. Contractor will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, in coordination with Architect/Engineer.
 - 1) Verify that utilities have been disconnected and capped before proceeding with site clearing.
- B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.
 - 1) Arrange with utility companies to shut off indicated utilities.
 - 2) Contractor will arrange to shut off indicated utilities in coordination with Architect/Engineer.
- C. Locate, identify, and disconnect utilities indicated to be abandoned in place.
- D. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1) Notify Architect not less than two days in advance of proposed utility interruptions.
 - 2) Do not proceed with utility interruptions without Architect's written permission.

3.5 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
 - 1) Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 - 2) Remove stumps, roots, obstructions, and debris.
 - 3) Use only hand methods for grubbing within protection zones.

- 4) Chip removed tree branches and dispose of off-site.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
 - 1) Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to a maximum depth of 12 inches in a manner to prevent intermingling with underlying subsoil or other waste materials.
 - 1) Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects more than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
 - 1) Limit height of topsoil stockpiles to 72 inches.
 - 2) Do not stockpile topsoil within protection zones.
 - 3) Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
 - 4) Stockpile surplus topsoil to allow for resspreading deeper topsoil.

3.7 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 - 1) Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
 - 2) Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

END OF SECTION

SECTION 31 20 00 – EARTH MOVING**PART 1 GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY**A. Section Includes:**

- 1) Preparing subgrades for slabs-on-grade, walks, pavements, turf and grasses, and, plants.
- 2) Excavating and backfilling for buildings and structures.
- 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 and pit for buried utility structures.

B. Related Sections:

- 1) Division 01 Section for recording preexcavation and earth moving progress.
- 2) Division 01 Section "Temporary Facilities and Controls" for temporary controls, utilities, and support facilities; also for temporary site fencing if not in another Section.
- 3) Division 31 Section "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
- 4) Division 32 Section "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.

1.3 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 changes in the Work.
 - 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 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 that exceed 1 cu. yd. (0.76 cu. m) for bulk excavation or 3/4 cu. yd. (0.57 cu. m) 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- (1065-mm-) wide, maximum, short-tip-radius rock bucket; rated at not less than 138-hp (103-kW) flywheel power with bucket-curling force of not less than 28,700 lbf (128 kN) and stick-crowd force of not less than 18,400 lbf (82 kN) with extra-long reach boom; measured according to SAE J-1179.
- 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: 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.
- K. 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.
- L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 SUBMITTALS

- A. 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 698

1.5 QUALITY ASSURANCE

- A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.
- B. Pre-excavation Conference: Conduct conference at project site.

1.6 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 written permission from Architect and authorities having jurisdiction.
 - 2) Provide alternate routes around closed or obstructed traffic ways if required by Architect/Owner or authorities having jurisdiction.
- B. Utility Locator Service: Notify utility locator service for area where project is located before beginning earth moving operations.
- C. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures, specified in Division 01 Section "Temporary Facilities and Controls" and Division 31 Section "Site Clearing" are in place.

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 (75 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
 - 1) Plasticity Index: 15 percent.
 - 2) Liquid limit less than 40
- 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 (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.
- E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand with composition and gradation conforming to requirements of the WVDOH, "Construction and Material Specifications."
- F. 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 (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.
- G. 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 (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.
- H. Drainage Course: Narrowly graded mixture of washed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.
- I. 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 (25-mm) sieve and 0 to 5 percent passing a No. 4 (4.75-mm) sieve.
- J. Sand: ASTM C 33; fine aggregate.
- K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

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.

3.3 EXPLOSIVES

- A. Explosives: Do not use explosives.

3.4 EXCAVATION

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
 - 1) If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
 - 2) Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
 - a) 24 inches (600 mm) outside of concrete forms other than at footings.
 - b) 12 inches (300 mm) outside of concrete forms at footings.
 - c) 6 inches (150 mm) 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 (150 mm) beneath bottom of concrete slabs-on-grade.
 - f) 6 inches (150 mm) beneath pipe in trenches, and the greater of 24 inches (600 mm) wider than pipe or 42 inches (1065 mm) wide.
- B. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by Architect. The Contract Sum will be adjusted for rock excavation according to unit prices included in the Contract Documents. Changes in the Contract Time may be authorized for rock excavation.
 - 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; 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 (600 mm) outside of concrete forms other than at footings.
 - b) 12 inches (300 mm) outside of concrete forms at footings.
 - c) 6 inches (150 mm) 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 (150 mm) beneath bottom of concrete slabs-on-grade.
 - f) 6 inches (150 mm) beneath pipe in trenches, and the greater of 24 inches (600 mm) wider than pipe or 42 inches (1065 mm) wide.

3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). 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) Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures; Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch (25 mm). Do not disturb bottom of excavations intended as bearing surfaces.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

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

3.7 EXCAVATION FOR UTILITY TRENCHES

- A. 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 (300 mm) higher than top of pipe or conduit unless otherwise indicated.
 - 1) Clearance: 12 inches (300 mm) each side of pipe or conduit.
- 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 (150 mm) in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
 - 2) For pipes and conduit 6 inches (150 mm) or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
 - 3) For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.
 - 4) Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
- D. Trench Bottoms: Excavate trenches 4 inches (100 mm) 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 (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.8 SUBGRADE INSPECTION

- A. Notify Architect and Soils Lab when excavations have reached required subgrade.
- B. If Architect and Soils Lab determine that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes) 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 (5 km/h).
 - 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. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the work.
- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi (17.2 MPa), may be used when approved by Architect/Engineer.
 - 1) Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect/Engineer.

3.10 STORAGE OF SOIL MATERIALS

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

3.11 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1) Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
 - 2) Surveying locations of underground utilities for Record Documents.

- 3) Testing and inspecting underground utilities.
- 4) Removing concrete formwork.
- 5) Removing trash and debris.
- 6) Removing temporary shoring and bracing, and sheeting.
- 7) Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches (450 mm) of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Division 03.
- D. Trenches under Roadways: Provide 4-inch- (100-mm-) thick, concrete-base slab support for piping or conduit less than 30 inches (750 mm) below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches (100 mm) of concrete before backfilling or placing roadway subbase course. Concrete is specified in Division 03.
- 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 (25 mm) in any dimension, to a height of 12 inches (300 mm) 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. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- H. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.
- I. Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

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 engineered fill.
 - 4) Under building slabs, use engineered fill.
 - 5) Under footings and foundations, use engineered fill.
- 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 soil layer before compaction to within -3% to +4% 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 -3% to +4% and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches (200 mm) in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches (100 mm) 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 unit weight according to ASTM D 698:
- 1) Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches (300 mm) of existing subgrade and each layer of backfill or fill soil material at 98 percent.
 - 2) Under walkways, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 98 percent.
 - 3) Under turf or unpaved areas, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 98 percent.
 - 4) For utility trenches, compact each layer of initial and final backfill soil material at 98 percent.

3.16 GRADING

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

- 1) Provide a smooth transition between adjacent existing grades and new grades.
 - 2) Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site 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 (25 mm).
 - 2) Walks: Plus or minus 1 inch (25 mm).
 - 3) Pavements: Plus or minus 1/2 inch (13 mm).
- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch (13 mm) when tested with a 10-foot (3-m) straightedge.

3.17 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) Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 - 2) Place base course material over subbase course under hot-mix asphalt pavement.
 - 3) Shape subbase course and base course to required crown elevations and cross-slope grades.
 - 4) Place subbase course and base course 6 inches (150 mm) or less in compacted thickness in a single layer.
 - 5) Place subbase course and base course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
 - 6) Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 98 percent of maximum dry unit weight according to ASTM D 698.
- C. Pavement Shoulders: Place shoulders along edges of subbase course and base course to prevent lateral movement. Construct shoulders, at least 12 inches (300 mm) wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 98 percent of maximum dry unit weight according to ASTM D 698.

3.18 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.

- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
 - 1) Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 - 2) Place drainage course 6 inches (150 mm) or less in compacted thickness in a single layer.
 - 3) Place drainage course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
 - 4) Compact each layer of drainage course to required cross sections and thicknesses to not less than 98 percent of maximum dry unit weight according to ASTM D 698.

3.19 FIELD QUALITY CONTROL

- A. Soils engineer for testing and inspection of proofrolling and compaction operations shall be provided by Owner.
- B. 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.
- C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by testing agency.
- D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
 - 1) Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. (186 sq. m) or less of paved area or building slab, but in no case fewer than three tests.
 - 2) Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet (30 m) or less of wall length, but no fewer than two tests.
 - 3) Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet (46 m) or less of trench length, but no fewer than two tests.
- E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.20 PROTECTION

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

- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1) Scarify or remove and replace soil material to depth as directed by Architect and Soils Lab; 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.

END OF SECTION

SECTION 31 23 19 – DEWATERING**PART 1 GENERAL****1.1 RELATED DOCUMENTS**

- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Bid Scope Manual, and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- B. Section includes construction dewatering.
- C. Related Sections:
 - 1. Division 01 Section "Construction Progress Documentation" for recording preexisting conditions and dewatering system progress.
 - 2. Division 31 Section "Earth Moving" for excavating, backfilling, site grading, and for site utilities.
 - 3. Division 31 Section "Excavation Support and Protection" for shoring, bracing, and sheet piling of excavations.
 - 4. Division 33 Section "Subdrainage" for permanent foundation wall, underfloor, and footing drainage.

1.3 PERFORMANCE REQUIREMENTS

- B. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.
 - 1. Delegated Design: Design dewatering system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
 - 2. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, that excavation does not flood, and that damage to subgrades and permanent structures is prevented.
 - 3. Prevent surface water from entering excavations by grading, dikes, or other means.
 - 4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
 - 5. Remove dewatering system when no longer required for construction.

1.4 SUBMITTALS

- B. Shop Drawings: For dewatering system. Show arrangement, locations, and details of wells and well points; locations of risers, headers, filters, pumps, power units, and discharge lines; and means of discharge, control of sediment, and disposal of water.
 - 1. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.
 - 2. Include a written plan for dewatering operations including control procedures to be adopted if dewatering problems arise.
- C. Delegated-Design Submittal: For dewatering system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Qualification Data: For qualified Installer.
- E. Field quality-control reports.
- F. Other Informational Submittals:
 - 1. Photographs or Videotape: Show existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by dewatering operations.

1.5 QUALITY ASSURANCE

- B. Installer Qualifications: An experienced installer that has specialized in design of dewatering systems and dewatering work.
- C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning dewatering. Comply with hauling and disposal regulations of authorities having jurisdiction.
- D. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to dewatering including, but not limited to, the following:
 - a. Inspection and discussion of condition of site to be dewatered including coordination with temporary erosion control measures and temporary controls and protections.
 - b. Geotechnical report.
 - c. Proposed site clearing and excavations.
 - d. Existing utilities and subsurface conditions.
 - e. Coordination for interruption, shutoff, capping, and continuation of utility services.
 - f. Construction schedule. Verify availability of Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - g. Testing and monitoring of dewatering system.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
 - 1. Notify Architect and Owner no fewer than two 2 days in advance of proposed interruption of utility.
 - 2. Do not proceed with interruption of utility without Owner's written permission.
- B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from this data.
 - 1. Make additional test borings and conduct other exploratory operations necessary for dewatering.
 - 2. The geotechnical report is included elsewhere in the Project Manual.
- C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements, establishing exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.
 - 1. During dewatering, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Architect if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 PRODUCTS

Not Used.

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 dewatering operations.
 - 1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site and surrounding area.
 - 2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
- B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.

Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

- C. Provide temporary grading to facilitate dewatering and control of surface water.
- D. Monitor dewatering systems continuously.
- E. Promptly repair damages to adjacent facilities caused by dewatering.
- F. Protect and maintain temporary erosion and sedimentation controls, which are specified in Division 31 Section "Site Clearing" during dewatering operations.

3.2 INSTALLATION

- A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.
 - 1. Space well points or wells at intervals required to provide sufficient dewatering.
 - 2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.
- B. Before excavating below ground-water level, place system into operation to lower water to specified levels. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.
- C. Provide an adequate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.
 - 1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
- D. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
 - 1. Maintain piezometric water level a minimum of 24 inches (600 mm) below surface of excavation.
- E. Dispose of water removed 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. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.
- F. Provide standby equipment on site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged structures and foundation soils at no additional expense to Owner.

1. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches (900 mm) below overlying construction.
- G. Damages: Promptly repair damages to adjacent facilities caused by dewatering operations.

3.3 **FIELD QUALITY CONTROL**

- A. Observation Wells: Provide, take measurements, and maintain at least the minimum number of observation wells or piezometers indicated; additional observation wells may be required by authorities having jurisdiction.
1. Observe and record daily elevation of ground water and piezometric water levels in observation wells.
 2. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. In areas where observation wells are not functioning properly, suspend construction activities until reliable observations can be made. Add or remove water from observation-well risers to demonstrate that observation wells are functioning properly.
 3. Fill observation wells, remove piezometers, and fill holes when dewatering is completed.
- B. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation.

END OF SECTION

SECTION 31 50 00 – EXCAVATION SUPPORT AND PROTECTION**PART 1 GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. This section includes temporary excavation support and protection systems.

1.3 PERFORMANCE REQUIREMENTS

- A. Design, furnish, install, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting soil and hydrostatic pressure and superimposed and construction loads.
 - 1) Provide professional engineering services needed to assume engineering responsibility, including preparation of shop drawings and a comprehensive engineering analysis by a qualified professional engineer.
 - 2) Prevent surface water from entering excavations by grading, dikes, or other means.
 - 3) Install excavation support and protection systems without damaging existing buildings, pavements, and other improvements adjacent to excavation.
 - 4) Compliance with the sustainable construction goals of the project.

1.4 SUBMITTALS

- A. Shop Drawings for Information: Prepared by or under the supervision of a qualified professional engineer for excavation support and protection systems.
 - 1) Include shop drawings signed and sealed by the qualified professional engineer responsible for their preparation.
- B. Qualification Data: For installer and professional engineer.
- C. Photographs or videotape, sufficiently detailed, of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by the absence of, the installation of, or the performance of excavation support and protection systems.

1.5 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated.
- B. Project-Site Information: A geotechnical report has been prepared for this project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from this data.
 - 1) Make additional test borings and conduct other exploratory operations necessary for excavation support and protection.
 - 2) The geotechnical report is included elsewhere in the Project Manual.
- C. Survey adjacent structures and improvements, employing a qualified professional engineer or land surveyor; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.
 - 1) During installation of excavation support and protection systems, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Architect if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 PRODUCTS

2.1 MATERIALS

- A. General: Provide materials that are either new or in serviceable condition.
- B. Structural Steel: ASTM A 36, ASTM A 690, ASTM A 992. Provide material with a minimum 90% recycled content.
- C. Steel Sheet Piling: ASTM A 572; with continuous interlocks.
- D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of 4 inches.
- E. Cast-in-Place Concrete: ACI 301, of compressive strength required for application. Provide material with a minimum fly ash content of 30% of Cementitious material by weight.
- F. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

PART 3 EXECUTION**3.1 PREPARATION**

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

3.2 SOLDIER BEAMS AND LAGGING

- A. Install steel soldier beams before starting excavation. Space soldier beams at regular intervals not to exceed allowable flexural strength of wood lagging. Accurately align exposed faces of flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.
- B. Install wood lagging within flanges of soldier beams as excavation proceeds. Trim excavation as required to install lagging. Fill voids behind lagging with soil, and compact.
- C. Install wales horizontally at centers indicated and secure to soldier beams.

3.3 SHEET PILING

- A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock to form a continuous barrier. Limit vertical offset of adjacent sheet piling to 60 inches. Accurately align exposed faces of sheet piling to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment. Cut tops of sheet piling to uniform elevation at top of excavation.

3.4 TIEBACKS

- A. Tiebacks: Drill for, install, grout, and tension tiebacks into position. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.
- 1) Test loading shall be observed by a qualified professional engineer responsible for design of excavation support and protection system.
 - 2) Maintain tiebacks in place until permanent construction is able to withstand lateral earth and hydrostatic pressures.
 - 3) Detension all tiebacks after permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.5 BRACING

- A. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.
- 1) Do not place bracing where it will be cast into or included in permanent concrete work, unless otherwise approved by Architect.
 - 2) Install internal bracing, if required, to prevent spreading or distortion of braced frames.
 - 3) Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.6 REMOVAL AND REPAIRS

- A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.
- 1) Remove excavation support and protection systems to a minimum depth of 48 inches below overlying construction and abandon remainder.
 - 2) Repair or replace, as approved by Architect, adjacent work damaged or displaced by removing excavation support and protection systems.

- B. Leave excavation support and protection systems permanently in place.

END OF SECTION

SECTION 32 12 16 – ASPHALT PAVING**PART 1 GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY**A. Section Includes:**

- 1) Aggregate base.
- 2) Hot-mix asphalt patching.
- 3) Hot-mix asphalt paving.
- 4) Hot-mix asphalt paving overlay.
- 5) Asphalt surface treatments.
- 6) Pavement-marking paint.

B. Related Sections:

- 1) Division 31 Section "Earth Moving" for aggregate subbase and base courses and for aggregate pavement shoulders.

1.3 DEFINITION

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

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
 - 1) Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the work.
 - 2) Job-Mix Designs: For each job mix proposed for the work.
- B. Samples: For each paving fabric, 12 by 12 inches (300 by 300 mm) minimum.
- C. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:
- D. Qualification Data: For qualified manufacturer and Installer.
- E. Material Certificates: For each paving material, from manufacturer.
- F. Material Test Reports: For each paving material.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction or WVDOH.
- B. Installer Qualifications: Imprinted-asphalt manufacturer's authorized installer who is trained and approved for installation of imprinted asphalt required for this project.
- C. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.
- D. Pavement markings within public right-of-ways shall be in accordance with US Manual on Uniform Traffic Control Devices.
- E. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of WVDOH for asphalt paving work.
- F. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this section.
- G. Preinstallation Conference: Conduct conference at project site.
- H. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:
 - I. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
 - J. Review condition of subgrade and preparatory work.
 - K. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
 - L. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pavement-marking materials to project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.
- B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.7 PROJECT 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:
 - B. Prime Coat: Minimum surface temperature of 60 deg F (15.6 deg C).

- C. Tack Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
- D. Asphalt Base Course: Minimum surface temperature of 40 deg F (4.4 deg C) and rising at time of placement.
- E. Asphalt Surface Course: Minimum surface temperature of 60 deg F (15.6 deg C) at time of placement.
- F. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F (4.4 deg C) for oil-based materials, 55 deg F (12.8 deg C) for water-based materials, and not exceeding 95 deg F (35 deg C).

PART 2 PRODUCTS

2.1 COMPACTED AGGREGATES

- A. Aggregate base shall consist of stone, gravel or slags with composition and gradation described conforming to requirements of the current edition of WVDOH Standard Specifications for Roads and Bridges.

2.2 AGGREGATES

- A. General: Use locally available materials and gradations that have performed satisfactorily in previous installations.
 - 1) Coarse Aggregate: ASTM D 692, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.
 - 2) Fine Aggregate: ASTM D 1073, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.

2.3 ASPHALT MATERIALS

- A. General: Use locally available materials and gradations that have performed satisfactorily in previous installations. Comply with the current edition of WVDOH Standard Specifications for Roads and Bridges.

2.4 AUXILIARY MATERIALS

- A. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.
- B. Sand: ASTM D 1073 or AASHTO M 29, Grade Nos. 2 or 3.
- C. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M 248, colors complying with FS TT-P-1952.
- D. Color: White, as per the US Manual on Uniform Traffic Control Devices.
- E. Separation Stabilization Paving Geotextile: Non-woven polypropylene. As per the current edition of WVDOH Standard Specifications for Roads and Bridges.

2.5 MIXES

- A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction; designed according to procedures in AI MS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types."

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.
- C. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph (5 km/h).
- D. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).
- E. 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.
- F. Proceed with paving only after unsatisfactory conditions have been corrected.
- G. Verify that utilities, traffic loop detectors, and other items requiring a cut and installation beneath the asphalt surface have been completed and that asphalt surface has been repaired flush with adjacent asphalt prior to beginning installation of imprinted asphalt.

3.2 PATCHING

- A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches (300 mm) into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.
- B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.
- C. Pump hot undersealing asphalt under rocking slab until slab is stabilized or, if necessary, crack slab into pieces and roll to reseat pieces firmly.
- D. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.
- E. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).

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

3.3 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 (25 mm) in existing pavements.
- B. Install leveling wedges in compacted lifts not exceeding 3 inches (75 mm) thick.
- C. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch (6 mm).
- D. Clean cracks and joints in existing hot-mix asphalt pavement.
- E. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch (6 mm) wide. Fill flush with surface of existing pavement and remove excess.
- F. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch (6 mm) wide. Fill flush with surface of existing pavement and remove excess.

3.4 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.
- B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.
 - 1) Mix herbicide with prime coat if formulated by manufacturer for that purpose.
- D. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).
 - 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.

3.5 HOT-MIX ASPHALT PLACING

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

- 1) Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
 - 2) Place hot-mix asphalt surface course in single lift.
 - 3) Spread mix at minimum temperature of 250 deg F (121 deg C).
 - 4) Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
 - 5) 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 (3 m) wide unless infill edge strips of a lesser width are required.
- 1) After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of 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.

3.6 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 (150 mm).
 - 3) Offset transverse joints, in successive courses, a minimum of 24 inches (600 mm).
 - 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.

3.7 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 (85 deg C).
- 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 nor 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.

3.8 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 (13 mm).
 - 2) Surface Course: Plus 1/4 inch (6 mm), 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 (3-m) straightedge applied transversely or longitudinally to paved areas:
 - 1) Base Course: 1/4 inch (6 mm).
 - 2) Surface Course: 1/8 inch (3 mm).
- C. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch (6 mm).
- D. Traffic-Calming Devices: Compact and form asphalt to produce the contour indicated and within a tolerance of plus or minus 1/8 inch (3 mm) of height indicated above pavement surface.

3.9 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.
- B. Allow paving to completely cure before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Outdoor ambient temperature must be 50°F or greater during pavement marking application.
- E. 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 (0.4 mm).
 - 1) Broadcast glass beads (when required) uniformly into wet pavement markings at a rate of 6 lb/gal. (0.72 kg/L).

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will 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 will take samples of uncompacted paving mixtures according to ASTM D 979.
 - 1) Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
- E. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.11 DISPOSAL

- A. Except for material indicated to be recycled, remove excavated materials from project site and legally dispose of them in an EPA-approved landfill.
- B. Do not allow milled materials to accumulate on-site.

END OF SECTION

SECTION 32 13 13 – CONCRETE PAVING**PART 1 GENERAL****1.1 RELATED DOCUMENTS**

- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Bid Scope Manual and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- B. This Section includes exterior cement concrete pavement for the following:
 - 1. Driveways.
 - 2. Curbs.
 - 3. Walkways.
- C. Related Sections include the following:
 - 1. Division 31 Section "Earth Moving" for subgrade preparation, grading, and subbase course.
 - 2. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants of joints in concrete pavement and at isolation joints of concrete pavement with adjacent construction.

1.3 DEFINITIONS

- B. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 SUBMITTALS

- B. Product Data: For each type of manufactured material and product indicated.
- C. Design Mixtures: For each concrete pavement mixture. Include alternate mixture designs when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- D. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:
- E. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:
 - 1. Cementitious materials.
 - 2. Steel reinforcement and reinforcement accessories.
 - 3. Fiber reinforcement.

4. Admixtures.
5. Curing compounds.
6. Applied finish materials.
7. Bonding agent or epoxy adhesive.
8. Joint fillers.

F. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
- C. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.
- D. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
 1. Before submitting design mixtures, review concrete pavement mixture design and examine procedures for ensuring quality of concrete materials and concrete pavement construction practices. Require representatives, including the following, of each entity directly concerned with concrete pavement, to attend conference:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete producer.
 - d. Concrete pavement subcontractor.

1.6 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 PRODUCTS**2.1 MANUFACTURERS**

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
 2. Products: Subject to compliance with requirements, provide one of the products specified.
 3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.
1. Use flexible or curved forms for curves with a radius 100 feet (30.5 m) or less.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

- A. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
- B. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.
- C. Epoxy-Coated Welded Wire Fabric: ASTM A 884/A 884M, Class A, plain steel.
- D. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420); deformed.
- E. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A 615/A 615M, Grade 60 (Grade 420) deformed bars.
- F. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M; with ASTM A 615/A 615M, Grade 60 (Grade 420) deformed bars.
- G. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60 (Grade 420), deformed bars; assembled with clips.
- H. Plain Steel Wire: ASTM A 82.
- I. Deformed-Steel Wire: ASTM A 496.

- J. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A coated, plain.
- K. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615M, Grade 60 (Grade 420). Cut bars true to length with ends square and free of burrs.
- L. Epoxy-Coated Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60 (Grade 420), plain steel bars.
- M. Tie Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- N. Hook Bolts: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), internally and externally threaded. Design hook-bolt joint assembly to hold coupling against pavement form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
- O. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete, and as follows:
 - 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
 - 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
- P. Epoxy Repair Coating: Liquid two-part epoxy repair coating, compatible with epoxy coating on reinforcement.
- Q. Zinc Repair Material: ASTM A 780.

2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source throughout the Project:
 - 1. Portland Cement: ASTM C 150, Type I or II.
 - a. Fly Ash: ASTM C 618, Class C or F.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33, coarse aggregate, uniformly graded. Provide aggregates from a single source.
 - 1. Maximum Coarse-Aggregate Size: 3/4 inch (19 mm) nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94/C 94M.
- D. Air-Entraining Admixture: ASTM C 260.
- E. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.4 FIBER REINFORCEMENT

- A. Synthetic Fiber: Fibrillated polypropylene fibers engineered and designed for use in concrete pavement, complying with ASTM C 1116, Type III, 1/2 to 1-1/2 inches (13 to 38 mm) long.
 1. Products:
 - a. Fibrillated Fibers:
 - (1) Axim Concrete Technologies; Fibrasol F.
 - (2) FORTA Corporation; Forta.
 - (3) Euclid Chemical Company (The); Fiberstrand F.
 - (4) Grace, W. R. & Co.--Conn.; Grace Fibers.
 - (5) SI Concrete Systems; Fibermesh.

2.5 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.
 1. Products:
 - a) Axim Concrete Technologies; Cimfilm.
 - b) Burke by Edeco; BurkeFilm.
 - c) ChemMasters; Spray-Film.
 - d) Conspec Marketing & Manufacturing Co., Inc.; Aquafilm.
 - e) Dayton Superior Corporation; Sure Film.
 - f) Euclid Chemical Company (The); Eucobar.
 - g) Kaufman Products, Inc.; Vapor Aid.
 - h) Lambert Corporation; Lambco Skin.
 - i) L&M Construction Chemicals, Inc.; E-Con.
 - j) MBT Protection and Repair, ChemRex Inc.; Confilm.
 - k) Meadows, W. R., Inc.; Sealtight Evapre.
 - l) Metalcrete Industries; Waterhold.
 - m) Nox-Crete Products Group, Kinsman Corporation; Monofilm.
 - n) Sika Corporation, Inc.; SikaFilm.
 - o) Symons Corporation; Finishing Aid.

- p) Vexcon Chemicals, Inc.; Certi-Vex EnvioAssist.
- E. White Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B.
 - 1. Products:
 - a) Anti-Hydro International, Inc.; AH Curing Compound #2 WP WB.
 - b) Burke by Edoco; Resin Emulsion White.
 - c) ChemMasters; Safe-Cure 2000.
 - d) Conspec Marketing & Manufacturing Co., Inc.; W.B. Resin Cure.
 - e) Dayton Superior Corporation; Day-Chem White Pigmented Cure (J-10-W).
 - f) Euclid Chemical Company (The); Kurez VOX White Pigmented.
 - g) Kaufman Products, Inc.; Thinfilm 450.
 - h) Lambert Corporation; Aqua Kure-White.
 - i) L&M Construction Chemicals, Inc.; L&M Cure R-2.
 - j) Meadows, W. R., Inc.; 1200-White.
 - k) Symons Corporation; Resi-Chem White.
 - l) Tamms Industries, Inc.; Horncure 200-W.
 - m) Unitex; Hydro White.
 - n) Vexcon Chemicals, Inc.; Certi-Vex Enviocure White 100.

2.6 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

2.7 MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.
 - 2. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs for the trial batch method.
- B. Proportion mixtures to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 4500 psi (31 MPa).
 - 2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.50.
 - 3. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).
- C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
 - 1. Air Content: 6 percent plus or minus 1.5 percent for 1-inch (25-mm) nominal maximum aggregate size.
- D. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing admixture in concrete, as required, for placement and workability.

2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
- E. Synthetic Fiber: Uniformly disperse in concrete mix at manufacturer's recommended rate, but not less than 1.5 lb/cu. yd. (0.90 kg/cu. m).

2.8 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116. Furnish batch certificates for each batch discharged and used in the Work.
 1. When air temperature is between 85 deg F (30 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
 1. For concrete mixes of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 2. For concrete mixes larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.
 1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph (5 km/h).
 2. Proof-roll with a loaded 10-wheel tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).
 3. Subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch (13 mm) require correction according to requirements in Division 31 Section "Earth Moving."

- C. Proceed with concrete pavement operations only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

3.2 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- E. Zinc-Coated Reinforcement: Use galvanized steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.
- F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.
- G. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch (50-mm) overlap of adjacent mats.

3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.
 - 1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.

- B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.
1. Continue steel reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
 2. Provide tie bars at sides of pavement strips where indicated.
 3. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
 5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
1. Locate expansion joints at intervals of 50 feet (15.25 m), unless otherwise indicated.
 2. Extend joint fillers full width and depth of joint.
 3. Terminate joint filler not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished surface if joint sealant is indicated.
 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 6. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 3/8-inch (10-mm) radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.
- E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 3/8-inch (10-mm) radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

3.5 CONCRETE PLACEMENT

- A. Inspection: Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery or at Project site.
- F. Do not add water to fresh concrete after testing.
- G. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- H. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.
- I. Place concrete in two operations; strike off initial pour for entire width of placement and to the required depth below finish surface. Lay welded wire fabric or fabricated bar mats immediately in final position. Place top layer of concrete, strike off, and screed.
 1. Remove and replace concrete that has been placed for more than 15 minutes without being covered by top layer, or use bonding agent if approved by Architect.
- J. Screed pavement surfaces with a straightedge and strike off.
- K. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

- L. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Compact subbase and prepare subgrade of sufficient width to prevent displacement of paver machine during operations.
- M. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not approved, remove and replace with formed concrete.
- N. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.
- O. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
 - 2. Do not use frozen materials or materials containing ice or snow.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mix designs.
- P. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
 - 1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 - 3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.6 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
 - 1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.

2. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch (1.6 to 3 mm) deep with a stiff-bristled broom, perpendicular to line of traffic.

3.7 CONCRETE PROTECTION AND CURING

- A. Comply with ACI 306.1 for cold-weather protection.
- B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- D. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:
 1. Moist Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.8 PAVEMENT TOLERANCES

- A. Comply with tolerances of ACI 117 and as follows:
 1. Elevation: 1/4 inch (6 mm).
 2. Thickness: Plus 3/8 inch (10 mm), minus 1/4 inch (6 mm).
 3. Surface: Gap below 10-foot- (3-m-) long, unlevelled straightedge not to exceed 1/4 inch (6 mm).
 4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch (25 mm).

5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch (6 mm).
- 6) Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch (13 mm).
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches (6 mm per 300 mm).
8. Joint Spacing: 3 inches (75 mm).
9. Contraction Joint Depth: Plus 1/4 inch (6 mm), no minus.
10. Joint Width: Plus 1/8 inch (3 mm), no minus.

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 1. Testing Frequency: Obtain at least 1 composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mix placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
 4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
 5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
 6. Compressive-Strength Tests: ASTM C 39/C 39M; test 1 specimen at 7 days and 2 specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from 2 specimens obtained from same composite sample and tested at 28 days.
- C. Strength of each concrete mix will be satisfactory if average of any 3 consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).

- D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
- G. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.10 REPAIRS AND PROTECTION

- A. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section.
- B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with Portland cement concrete bonded to pavement with epoxy adhesive.
- C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION

SECTION 32 13 73 – CONCRETE PAVING JOINT SEALANTS**PART 1 GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- B. This Section includes the following:

1. Expansion and contraction joints within cement concrete pavement.
2. Joints between cement concrete and asphalt pavement.

- C. Related Sections include the following:

1. Division 07 Section "Joint Sealants" for sealing nontraffic and traffic joints in locations not specified in this Section.
2. Division 32 Section "Asphalt Paving" for constructing joints between concrete and asphalt pavement.
3. Division 32 Section "Concrete Paving" for constructing joints in concrete pavement.

1.3 SUBMITTALS

- B. Product Data: For each joint-sealant product indicated.

- C. Samples for Verification: For each type and color of joint sealant required. Install joint-sealant samples in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

- D. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.

- E. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for sealants.

1.4 QUALITY ASSURANCE

- B. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- C. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- D. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
 - 1. Use manufacturer's standard test methods to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 - 2. Submit not fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
 - 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 - 4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
 - 5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.
- E. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency based on testing of current sealant products within a 36-month period preceding the Notice to Proceed with the Work.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 for testing indicated, as documented according to ASTM E 548.

1.5 DELIVERY, STORAGE, AND HANDLING

- B. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.
- C. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.6 PROJECT CONDITIONS

- B. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.

2. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (4.4 deg C).
3. When joint substrates are wet or covered with frost.
4. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
5. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.
- B. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.2 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.

2.3 COLD-APPLIED JOINT SEALANTS

- A. Multicomponent Jet-Fuel-Resistant Sealant for Concrete: Pourable, chemically curing elastomeric formulation complying with the following requirements for formulation and with ASTM C 920 for type, grade, class, and uses indicated:
 1. Urethane Formulation: Type M; Grade P; Class 12-1/2; Uses T, M, and, as applicable to joint substrates indicated, O.
- B. Type NS Silicone Sealant for Concrete: Single-component, low-modulus, neutral-curing, nonsag silicone sealant complying with ASTM D 5893 for Type NS.
 1. Products:
 - a. Crafcro Inc.; RoadSaver Silicone.
 - b. Dow Corning Corporation; 888.
- C. Type SL Silicone Sealant for Concrete and Asphalt: Single-component, low-modulus, neutral-curing, self-leveling silicone sealant complying with ASTM D 5893 for Type SL.
 1. Products:
 - a. Crafcro Inc.; RoadSaver Silicone SL.
 - b. Dow Corning Corporation; 890-SL.

- D. Multicomponent Low-Modulus Sealant for Concrete and Asphalt: Proprietary formulation consisting of reactive petropolymer and activator components producing a pourable, self-leveling sealant.

- 1. Products:
 - a. Meadows, W. R., Inc.; Sof-Seal.

2.4 HOT-APPLIED JOINT SEALANTS

- E. Jet-Fuel-Resistant Elastomeric Sealant for Concrete: Single-component formulation complying with ASTM D 3569.

- 1. Products:
 - a. Crafco Inc.; Superseal 444/777.
 - b. Meadows, W. R., Inc.; Poly-Jet 3569.

2.5 JOINT-SEALANT BACKER MATERIALS

- F. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.
- G. Round Backer Rods for Cold- and Hot-Applied Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.
- H. Backer Strips for Cold- and Hot-Applied Sealants: ASTM D 5249; Type 2; of thickness and width required to control sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.
- I. Round Backer Rods for Cold-Applied Sealants: ASTM D 5249, Type 3, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

2.6 PRIMERS

- J. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 3 EXECUTION

3.1 EXAMINATION

- K. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

- 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- L. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

- M. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

- N. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- O. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- P. Install backer materials of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
1. Do not leave gaps between ends of backer materials.
 2. Do not stretch, twist, puncture, or tear backer materials.
 3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.
- Q. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses provided for each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- R. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealants from surfaces adjacent to joint.
 2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.
- S. Provide joint configuration to comply with joint-sealant manufacturer's written instructions, unless otherwise indicated.
- T. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

3.4 CLEANING

- U. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

- V. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations with repaired areas are indistinguishable from the original work.

END OF SECTION

SECTION 32 17 13 – PARKING BUMPERS**1. GENERAL****1.1 SUMMARY**

- A. The extent of parking bumpers is shown on the drawings and specified herein.
- B. Types of parking bumpers include the following:
 - 1. Plastic bumper guards.

1.2 SUBMITTALS

- A. Manufacturer's product data for parking bumpers.
- B. Shop Drawings for anchorage of bumpers.

2. PRODUCTS**2.1 BUMPER GUARDS**

- A. Provide parking bumpers as indicated on drawings and as follows:
 - 1. Fabricated of plastic. Plastic may be high density polyethylene, or may have 100% recycled plastic content.
 - 2. Color: Yellow.
 - 3. Length: Minimum 6 ft.
 - 4. Size: Minimum 8 inches wide x 4 inches tall.
 - 5. Pre-drilled holes for attachment
- B. Suppliers: Subject to compliance with requirements, provide one of the following:
 - 1. Recycled Plastic Wheel Stops; Barco Products.
 - 2. Plastic Parking Stop; Parking Lot Warehouse.
 - 3. Solid Truck Block; The Traffic Safety Store.
- C. Accessories: Provide the following:
 - 1. Galvanized steel spikes for anchoring bumpers to asphalt.
 - 2. Galvanized lag bolts and anchors for anchoring bumpers to concrete.

3. EXECUTION**3.1 INSTALLATION**

- A. Install parking bumpers in accordance with manufacturer's written instructions and other recommendations. Include all accessories required for a complete installation.
- B. Install parking bumpers neatly and securely in proper locations.

END OF SECTION 32 17 13

SECTION 32 18 13 – SYNTHETIC TURF**1. GENERAL****1.1 SUMMARY**

- A. Artificial grass surface over compacted gravel base.
 - 1. Finished product seamed to provide resilient continuous surface over entirety of Project surface.
- B. Related Sections:
 - 1. Compacted gravel base is specified in Division 31 Earthwork.

1.2 REFERENCE SPECIFICATIONS AND STANDARDS:

- A. Materials and methods of construction shall comply with the latest provisions of the following standards:
 - 1. ASTM D2859: Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials (Pill Flammability).
 - 2. ASTM F1951-99: Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment.
 - 3. Toxic Characteristic Leaching Procedure (TCLP) by Method 6010B.

1.3 SUBMITTALS:

- A. Product Data: For each type of product indicated.
- B. Materials certificates, certifying each material item complies with, or exceeds, specified requirements. Certificates of compliance must be signed by materials producer and contractor.
- C. Laboratory Testing Reports: Testing reports for turf material including Flammability, Handicap Accessibility, and Lead (Pb).
- D. Samples: 12" x 12" sections of turf material.
- E. Warranties: Product and maintenance warranties must be provided to the Owner prior to installation.
- F. Product verification: Delivery slip and item list for each material shipment, including turf and infill material.
- G. Installer Qualifications
 - 1. A list of five (5) pet surfacing or similar projects completed with a similar product within the last five (5) years. List shall include names of project representatives and respective telephone numbers. List shall also contain projects which require the same level of or greater difficulty, e.g. number of cutouts, transitions and other special requirements. These five (5) projects shall have been contracted and installed by the company installing the surface.

1.4 TESTING OF MATERIALS:

- A. Provide test results from an independent testing laboratory which meet these standards:
 - 1. ASTM D2859: Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials (Pill Flammability). Test results
 - 2. ASTM F1951-99: Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment.

3. Toxic Characteristic Leaching Procedure (TCLP) by Method 6010B.

1.5 WORKMANSHIP AND QUALITY ASSURANCE:

- A. The artificial grass is to be installed per manufacturer's plans and specifications.
- B. All artificial grass and components shall be provided by a single source.

1.6 DELIVERY AND STORAGE OF MATERIALS:

- A. Artificial grass will be delivered in rolls 15' in length, wrapped in plastic. Drain/Performance pad for under the grass will be delivered on pallets or in rolls wrapped in plastic to the job site.
- B. Products will be stored in a dry, secure area.
- C. Guarantee/Warranty of the Material and Workmanship
 1. The artificial grass installed under this contract will be warranted for a period of eight (8) years from the date of manufacturing against defects in material or workmanship, resulting in premature wear, deterioration and excessive fading/UV degradation during ordinary and normal use of the product(s). Vandalism and force majeure will not be covered.
 - a. Submit written warranty, by the installer
 2. When defective material or workmanship is discovered requiring repair or replacement, all such repair work or replacement work shall be done by the CONTRACTOR at its own expense after written notification is given of such required repairs. However, if the CONTRACTOR fails to comply with the requirements of the above guarantee within reasonable time after notification is given, the owner shall proceed to have the repairs made by others at the CONTRACTOR'S expense.
 - a. Any unsafe conditions that arise shall be secured and maintained by the installer until all required repairs or replacements have been completed.
 - b. All resurfacing will conform in kind and quality to the specifications set forth in the plans and specifications, and will be free of defects in workmanship and material.

2. PRODUCTS

- A. Basis of Design: PRO PLUS-60ST as manufactured by Artificial Turf Supply, LLC.
 1. Subject to compliance with requirements, other acceptable products include:
 - a. Circuit Trainer as manufactured by Synthetic Turf International.
 - b. Field Turf Pets as manufactured by Field Turf.
 - c. K9 Grass as manufactured by Forever Lawn, Inc.
- B. Synthetic turf to have all of the following requirements independently and collectively:
 1. Blades: Polyethylene. Primary blades are dual-tone green wide bladed monofilament polyethylene, secondary blades are green texturized polyethylene. Polyethylene blades that are web or honeycomb fibrillated are not acceptable.
 2. Weight: Product face weight to be 69 ounces. With backing, total weight of product to be minimum 102 ounces.
 3. Tufting: Tufting gauge to be 3/8", pile height 1". Tufting configuration – A/B setup, dual yarn, alternating rows wide monofilament polyethylene and texturized polyethylene blades.

4. Backing: Multi-layered:
 - a. First single layer: 18 pic polyback construction, 7 ounces per square yard. (Stabilized primary backing consisting of polyester, fiberglass and polyurethane).
 - b. Second layer: 26 ounce per square yard, urethane layer.
5. Permeability: Turf Product meets or exceeds vertical drainage capacity of thirty (30) inches of water per hour.
6. Seams: Primary seaming system is comprised of geotextile fabric and urethane based glue as the bond.
7. Synthetic Nailing Strip: A synthetic, 2" x 3" or 2" x 4", TREX, Poly-Tuf HDPE or equivalent nailing strip shall be used at all points where turf system meets a sidewalk or other concrete surface.
8. Subsurface Drainage/Performance Pad: Provide AWD Excel Drain, Brock Power Base or equivalent.
9. Infill material: No infill. No crumb rubber granules allowed.

3. EXECUTION

3.1 BASE REQUIREMENTS

- A. Base to be cleared, leveled and compacted with 3-4 inches of #8 crushed and washed stone at a finished height to 2-3 inches below adjoining finished surface height.
 1. Compaction of base: Dry density after compaction to be 95% of dry density for material being tested in accordance with Modified Proctor procedure according to ASTM 1557.
 2. Permeability of entire turf system and base shall be greater than ten (10) inches/hour.

3.2 PREPARATION

- A. The perimeter of the area shall be defined with a composite nailer board. Secure nailer boards into adjacent concrete or asphalt, or hold in place with rebar or landscape spikes.
- B. Cleaning: Entire surface to receive turf shall be clean and free of any foreign material.

3.3 INSTALLATION

- A. Subsurface Drainage/Performance Pad: Thickness may vary according to type of drain/performance pad used. Install drainage/performance pad per drainage/performance pad manufacturer's specifications.
- B. Artificial Turf: Roll out in sections and seam together using a Geotextile fabric and a urethane based glue as the bond.
- C. Securing: Secure turf around the perimeter. If using nailer boards, use 1" stainless steel staples to secure turf to the boards. Place staples every 1 inch.
- D. Protection: Protect turf surface during installation process. Protect surface during curing period upon completion of installation.

END OF SECTION 32 18 13

SECTION 32 18 16 – EXTERIOR RESILIENT SURFACING**1. GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Exterior resilient surfacing.

1.2 REFERENCES**A. American Society for Testing and Materials (ASTM):**

1. ASTM D412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension.
2. ASTM D624 Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
3. ASTM D2047 Standard Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine.
4. ASTM D2859 Standard Test Method for Flammability of Finished Textile Floor Covering Materials.
5. ASTM E303 Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester.
6. ASTM F1951 Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment.

1.3 SYSTEM DESCRIPTION**A. Performance Requirements:** Provide a 1 layer rubber-urethane flooring surface which has been designed, manufactured and installed to meet the following criteria:

1. Flammability (ASTM D2859): Pass.
2. Tensile Strength (ASTM D412): 60 psi (413 kPa).
3. Tear Resistance (ASTM D624): 140%.
4. Water Permeability: 0.4 gal/yd²/second.
5. Accessibility: Comply with requirements of ASTM F1951.

1.4 SUBMITTALS**A. Product Data:** For each type of product indicated. installation instructions.**B. Verification Samples:** Submit manufacturer's standard verification samples of 9" x 9" (229 x 229 mm) minimum.**C. Quality Assurance/Control Submittals:**

1. Certificate of qualifications of the flooring surface installer.

D. Closeout Submittals:

1. Warranty documents specified herein.

1.5 QUALITY ASSURANCE

- A. Qualifications: Utilize an installer approved and trained by the manufacturer of the flooring surface, having experience with other projects of the scope and scale of the work described in this section.
- B. Certifications: Certification by manufacturer that installer is an approved applicator of the flooring surface.

1.6 DELIVERY, STORAGE & HANDLING

- A. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Storage & Protection: Store materials protected from exposure to harmful environmental conditions and at a minimum temperature of 40 degrees F and a maximum temperature of 90 degrees F.

1.7 PROJECT/SITE CONDITIONS

- A. Environmental Requirements: Install flooring surface when minimum ambient temperature is 40 degrees F and maximum ambient temperature is 90 degrees F. Do not install in steady or heavy rain.

1.8 WARRANTY

- A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under contract documents.
- B. Proper drainage is critical to the longevity of the EverTop surface. Inadequate drainage will cause premature breakdown of the poured system in affected areas; and void the warranty.
 - 1. Warranty Period: 7 years from date of completion of work when aromatic urethane is specified. 10 years from date of completion of work when aliphatic urethane is specified.

2. PRODUCTS

2.1 RECREATIONAL AND HIGH TRAFFIC FLOORING SURFACE

- A. Basis of Design: EverTop as manufactured by Surface America, Inc.
 - 1. Subject to compliance with requirements, other acceptable products include:
 - a. Play Safe Surfacing, Poured in place.
 - b. No Fault Sport, Safety Surfacing.
- B. System: Exterior Resilient Surfacing, including the following:
 - 1. EverTop Primer:
 - a. Material: Urethane.
 - 2. EverTop Flooring Surface:
 - a. Material: Blend of recycled EPDM (ethylene propylene diene monomer) rubber and aromatic or aliphatic urethane binder.
 - b. Thickness: Nominal 1/2" (12.7 mm), minimum 3/8" (9.5 mm), maximum 5/8" (15.9 mm).
 - c. Color: As selected by Architect from manufacturer's full range.

- d. Dry Static Coefficient of Friction (ASTM D2047): 1.0.
- e. Wet Static Coefficient of Friction (ASTM D2047): 0.9.
- f. Dry Skid Resistance (ASTM E303): 89.
- g. Wet Skid Resistance (ASTM E303): 57.

2.2 MIXES

- A. Required mix proportions by weight:
 - 1. 22% urethane (ratio: 18% urethane divided by 82% rubber). 18% urethane, 82% rubber (based on entire rubber & urethane mix).

3. EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- A. Comply with the instructions and recommendations of the flooring surface manufacturer.

3.2 EXAMINATION

- A. Site Verification of Conditions: Verify that substrate conditions are suitable for installation of the flooring surface. New asphalt must be fully cured - up to 30 days.
- B. Do not proceed with installation until unsuitable conditions are corrected.

3.3 PREPARATION

- A. Existing Substrate Preparation:
 - 1. Remove from substrate any loose or delaminated material that would be deleterious to application of the new flooring surfacing.
- B. Surface Preparation: Apply primer to substrate perimeter and any adjacent vertical barriers, such as curbs or slabs that will contact flooring surface, at rate of 300 ft²/gal.

3.4 INSTALLATION

- A. Do not proceed with surfacing installation until all applicable site work, including substrate preparation and other relevant work, has been completed.
- B. Primer Application: Apply primer to substrate perimeter and any adjacent vertical barriers, such as curbs or slabs that will contact flooring surface, at rate of 300 ft²/gal.
- C. Flooring Installation:
 - 1. Install flooring at consistent density of 58 pounds, 9 ounces per cubic foot to nominal thickness of 1/2" or as otherwise specified (minimum thickness 3/8").
 - 2. Allow surfacing to cure for minimum of 48 hours.
 - 3. At end of minimum curing period, verify that surface is sufficiently dry and firm to allow foot traffic and use without damage to surface.
 - 4. Do not allow foot traffic or use of surface until sufficiently cured.

3.5 PROTECTION

- A. Protect installed surface from damage resulting from subsequent construction activity on site.

END OF SECTION 32 18 16

SECTION 32 31 14 – NO-CLIMB FENCE AND SALLY PORT GATE**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Galvanized & coated steel welded-wire fence system.
 - 2. Anti-Dig Grid as part of fence system.
 - 3. Vertical pivot gate at Sally Port.
 - 4. Gate operator, including controls.
- B. Related Requirements:
 - 1. Section 281300 "Access Control" for access control devices installed at remote access point and provided as part of a security system.

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For fabrication and erection of fencing and gate. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Include shop drawings for supporting framework of fencing and gate signed and sealed by a Professional Engineer licensed in the State of West Virginia.
 - 2. Include diagrams for power, signal, and control wiring.
- C. Samples: For each fence material and for each color specified.
 - 1. Provide Samples 12 inches in length for linear materials.
 - 2. Provide Samples 12 inches square for wire mesh.
- D. Samples for Initial Selection: For components with factory-applied color finishes.
- E. Samples for Verification: 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.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data:
 - 1. For gate operators to include in maintenance manuals.

2. Polymer finishes.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. Products shall be new from recognized, reputable manufacturers.
- C. Manufacturer shall have minimum of 10 years successful experience in the manufacturer of welded wire mesh fence systems for security applications.
- D. Used, re-rolled or re-galvanized material is not acceptable.
- E. Gates shall be in compliance with ASTM F 2200, Standard Specification for Automated Vehicular Gate Construction and operators are UL 325 compliant.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Lightning-Protection System: Maximum grounding-resistance value of 25 ohms under normal dry conditions.

2.2 GALVANIZED-STEEL, WELDED-WIRE FENCES

- A. Galvanized-Steel, Welded-Wire Fences:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide welded wire mesh fence system as manufactured by Riverdale Mills Corp. or comparable product by one of the following:
 - a. A & T Iron Works, Inc.
 - b. Ametco Manufacturing Corporation.
 - c. BarnettBates Corporation.
 - d. Hill & Smith Inc.
 - e. Jerith Manufacturing Company, Inc.
 - f. Omega II Fence Systems; a division of Metaltech - Omega Inc.
- B. Fence Fabric: Welded Wire Fabric shall be fabricated from low carbon steel wire and electronically control welded.
 1. Spacing of Vertical Wires: 3 inches.
 2. Vertical Wire Size: 10.5 gauge, 0.096158 inch.
 3. Spacing of Horizontal Wires: 1/2 inch.
 4. Horizontal Wire Size: 10.5 gauge, 0.096158 inch.
- C. Framework: Framework strength and coating shall be in accordance with ASTM F 1043.
 1. Grade A Pipe, hot-dipped galvanized Schedule 40 pipe conforming to ASTM F 1043 Group 1A.

2. Grade B Pipe, Manufactured by cold rolling and radial frequency welding, the steel shall conform to ASTM F 1043 Group IC with a minimum yield strength of 50,000 PSI.. Exterior coatings shall be in accordance with ASTM F 1043.
3. "C" post, manufactured by cold forming shall conform to ASTM F 1043 Group II with minimum yield strength of 60, 000 PSI. "C" post size 3¼" x 2½" x .130 wall.
4. Wind loads: Post shall withstand 70 M.P.H. minimum wind load.
5. Manufacturers:
 - a. Gregory Galvanizing, Canton, OH.
 - b. Or approved equal.
6. Post Sizes, determined in accordance with previous approved practices Line, terminal and gate post shall not be less than 95% of the nominal weight conforming to (ASTM F 1043 Group 1A, 1C. and 11.)
 - a. "C" Post 3¼" x 2½" x 0.160 wall are acceptable "C" line post with flat attaching bars used to secure welded mesh to post. "C" post brackets spaced 15" o.c. also acceptable for attaching welded mesh to "C" line post. 4" diameter tubular post shall be used as terminal post, exceptions may apply to gate post.
7. Rail Size:
 - a. 1-5/8" diameter rails located at the top and bottom of the fence.
 - b. "C" rails 1.625 x 1.25 x 0.80" wall are acceptable for top and bottom rail locations.
 - c. Secure welded mesh to rails with 9 gauge tie wires

D. Fittings and Accessories

1. Post Tops: Pressed steel or malleable iron, designed as a weather tight enclosure for tubular post. Weather tight enclosures not required for "C" post.
2. Provide one cap for each exposed tubular post end, unless equal protection is afforded by combining post top and barbed wire supporting arm if used. Post caps not required for "C" post.
3. Preformed Power Twisted Ties: Fabric attachment to rails, 9 gauge ties for fabric sizes 10.5 gauge and larger. Ties shall be aluminized with a minimum coating of 0.40 oz. aluminum/ft² or galvanized.
4. Tie Spacing for top rails are at intervals not exceeding 24", (bottom rail tie spacing intervals not to exceed 12".
5. Line Post and Terminal Post Brackets: Spacing for line and terminal posts are at intervals not exceeding 15" See drawing for bracket locations.

2.3 VERTICAL PIVOT GATE SYSTEM

- A. Basis of Design: TYM-VP Vertical Pivot Gate System as manufactured by Tymetal Corp.
 1. Subject to compliance with requirements, equivalent products of alternative manufacturers will be considered for approval.
- B. Gate operator shall open and close gate panel to provide convenience and security, incorporating a soft start/stop feature. Model functions with most accessories including: radio controls, digital keypads, card readers, sensing loops, push button controls and

telephone entry systems. Operator is 24v DC powered with 120VAC (15 amp) supply, having up to 72 hours of back-up operation. Solid state coated APeX control board is housed in a NEMA 4x weatherproof electrical enclosure. Operator design is conducive to low maintenance, having a minimum amount of moving parts and no hydraulics or internal cables. To protect against catastrophic failure, the counter balance system shall be a multi-spring design. Installation should not require field welding.

1. Mechanical components:
 - a. Gear Motor: 1/3 horse power.
 - b. Duty cycle: continuous.
 - c. Frame: 2" square, 11 gauge steel tubing.
 - d. Cover: 18 gauge galvaneal steel and color coated; Doors: 14 gauge galvaneal steel and color coated (Cover and doors shall be same color as gate frame).
 - e. Three point door lock.
 - f. 24v built-in system brake when 120v or battery power is present.
 - g. Operator size: 68" long x 51" high x 30" wide.
 - h. High torque double reduction belt drive system.
2. Electrical components:
 - a. APeX Controller with integrated radio receiver, plug-in loop detector capability, surge protection, and easy to read labeling standard.
 - b. Open / Closing cycles: 10 – 12 seconds.
 - c. Solid state logic controls featuring 15 diagnostic L.E.D. indicators and auto-close timer (one second to 9 minutes).
 - d. Control circuitry: APeX control board in NEMA 4x weatherproof electrical enclosure. Sealed proximity switches ensure weather & moisture-proof integrity. Boards tested to -40 degrees F.
 - e. Built in panel amp meter to monitor operator balance.
 - f. Control wiring: 16 and 18 gauge single conductor, copper with electrolytic copper compression terminals, tin-plated for maximum corrosion prevention.
 - g. Built in cycle counter to assist with maintenance scheduling.
 - h. Obstruction sensor: Adjustable Instant Reverse Device (IRD) senses obstructions opening or closing.
 - i. 24v AC indicator light on front of operator indicates AC power is on.
 - j. Through beam photo eyes included.
3. The gate operator shall be UL 325 compliant for Class I, II, III, and IV.
4. Control device shall be key switch located inside the building.

C. Factory Inspection and Testing

1. Manufacturer shall test each operator at factory to assure smooth, quiet operation.
2. Manufacturer shall test all control inputs to ensure proper function.

D. Warranty:

1. Five (5) years from date of shipment on manufactured components and workmanship.
2. Accessories are covered by their manufacturer's warranty.

E. Gate System:

1. Gate Frame:
 - a. The gate frame shall be fabricated from 6063-T52 aluminum alloy tube. The frame members shall be fabricated from 2.50" square tube, weighing no less than 2.137 lb/lf.
 - b. The gate frame shall be welded. All corner joints shall be full penetration welds; others are full circle welds.
2. Mounting:
 - a. Mounting hardware is 304 stainless steel.
3. Obstruction Sensing Systems:
 - a. The inherent motor current sensors / Instant Reverse Device (IRD) are part of the gate operator system and may not be removed or bypassed.
 - B. The installing contractor shall be responsible to ensure that appropriate external secondary entrapment protection devices be installed for the specific site conditions to protect against all potential entrapment zones. Proper operation of these safety devices shall be verified and training as to the operation and maintenance of these devices for the users and owners shall be documented.

2.4 FENCE AND GATE MATERIALS

- A. Wire shall conform to ASTM A 853 Grade AISI 1006, having a minimum tensile strength of 70,000 PSI.
 1. After welding, hot-dip galvanize fabric with minimum 1.2 oz zinc/ft².
 2. Polymer Coating: ASTM F 668, Class 2b.
 - a. Color: As selected by Architect from manufacturer's full range, complying with ASTM F 934.
- B. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Tubing: ASTM A 500/A 500M, cold-formed steel tubing.
- D. Galvanizing: For components indicated to be galvanized and for which galvanized coating is unspecified, hot-dip galvanize to comply with ASTM A 123/A 123M. For hardware items, hot-dip galvanize to comply with ASTM A 153/A 153M.

2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

- B. Concrete: Normal-weight, air-entrained, ready-mix concrete complying with requirements in Section 033000 "Cast-in-Place Concrete" with a minimum 28-day compressive strength of 3000 psi, 3-inch slump, and 1-inch maximum aggregate size.
- C. Nonshrink Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M and specifically recommended by manufacturer for exterior applications.

2.6 GROUNDING MATERIALS

- A. Grounding Conductors: Bare, solid wire for No. 6 AWG and smaller; stranded wire for No. 4 AWG and larger.
 - 1. Material above Finished Grade: Copper.
 - 2. Material on or below Finished Grade: Copper.
 - 3. Bonding Jumpers: Braided copper tape, 1 inch wide, woven of No. 30 AWG bare copper wire, terminated with copper ferrules.
- B. Grounding Connectors and Grounding Rods: Comply with UL 467.
 - 1. Connectors for Below-Grade Use: Exothermic-welded type.
 - 2. Grounding Rods: Copper-clad steel.
 - a. Size: 5/8 by 96 inches.

2.7 GALVANIZED-STEEL FINISH

- A. Galvanized Finish: Clean welds, mechanical connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 FENCE INSTALLATION

- A. Install fences according to manufacturer's written instructions.
- B. Post Excavation: Drill or hand-excavate holes for posts 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 and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
 - a. Exposed Concrete: Extend 2 inches above grade. Finish and slope top surface to drain water away from post.
 - b. Concealed Concrete: Top 2 inches below grade or as indicated on Drawings to allow covering with surface material. Slope top surface of concrete to drain water away from post.
3. Posts Set in Concrete: Extend post to within 6 inches of specified excavation depth, but not closer than 3 inches to bottom of concrete.
4. Space posts uniformly.

3.3 GATE INSTALLATION

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

3.4 GATE OPERATOR INSTALLATION

- A. Install gate operators according to manufacturer's written instructions, aligned and true to fence line and grade.
- B. Excavation for Support Posts, Pedestals, and Concrete Bases: Hand-excavate holes for bases in firm, undisturbed soil to dimensions and depths and at locations as required by gate operator component manufacturer's written instructions and as indicated.
- C. Concrete Bases: Cast-in-place or precast concrete, depth not less than 36 inches, dimensioned and reinforced according to gate operator component manufacturer's written instructions and as indicated on Drawings.
- D. Comply with NFPA 70 and manufacturer's written instructions for grounding of electric-powered motors, controls, and other devices.

3.5 GROUNDING AND BONDING

- A. Fence Grounding: Install at maximum intervals of 750 feet except as follows:
 1. Gates and Other Fence Openings: Ground fence on each side of opening.
 - a. Bond metal gates to gate posts.
 2. Bond across openings, with and without gates, except at openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches below finished grade.
- B. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a maximum distance of 150 feet on each side of crossing.
- C. Fences Enclosing Electrical Power Distribution Equipment: Ground as required by IEEE C2 unless otherwise indicated.

- D. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.
- E. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.
- F. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
 - 1. Grounding-Resistance Tests: Subject completed grounding system to a megger test at each grounding location. Measure grounding resistance not less than two full days after last trace of precipitation, without soil having been moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural grounding resistance. Perform tests by two-point method according to IEEE 81.
 - 2. Excessive Grounding Resistance: If resistance to grounding exceeds specified value, notify Architect promptly. Include recommendations for reducing grounding resistance and a proposal to accomplish recommended work.
 - 3. Report: Prepare test reports of grounding resistance at each test location, certified by a testing agency. Include observations of weather and other phenomena that may affect test results.

3.7 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. Automatic Gate Operators: Energize circuits to electrical equipment and devices. Adjust operators, controls, safety devices, alarms, and limit switches.
 - 1. Hydraulic Operators: Purge operating system, adjust pressure and fluid levels, and check for leaks.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls, alarms, and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Lubricate hardware, gate operators, and other moving parts.

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3.8 DEMONSTRATION

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

END OF SECTION 32 31 14

SECTION 32 92 00 TURF AND GRASSES**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Bid Scope Manual, and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- B. Section Includes:

1. Seeding.
2. Sodding.
3. Lawn renovation.
4. Erosion-control material(s).

- C. Related Sections:

1. Division 31 Section "Site Clearing" for topsoil stripping and stockpiling.
2. Division 31 Section "Earth Moving" for excavation, filling and backfilling, and rough grading.

1.3 DEFINITIONS

- B. Finish Grade: Elevation of finished surface of planting soil.
- C. Manufactured Soil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- D. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.
- E. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill immediately beneath planting soil.
- F. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

1.4 SUBMITTALS

- B. Product Data: For each type of product indicated.
- C. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name and percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

1. Certification of each seed mixture for turfgrass sod, identifying source, including name and telephone number of supplier.
- D. Qualification Data: For qualified landscape Installer.
- E. Product Certificates: For soil amendments and fertilizers, from manufacturer.
- F. Material Test Reports: For existing surface soil and imported topsoil.
- G. Planting Schedule: Indicating anticipated planting dates for each type of planting.
- H. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of lawns during a calendar year. Submit before expiration of required initial maintenance periods.

1.5 QUALITY ASSURANCE

- B. Installer Qualifications: A qualified landscape installer whose work has resulted in successful lawn establishment.
 1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when planting is in progress.
- C. Soil-Testing Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
- D. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of topsoil.
 1. Report suitability of topsoil for lawn growth. State-recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory topsoil.

1.6 DELIVERY, STORAGE, AND HANDLING

- B. Seed: Deliver seed in original sealed, labeled, and undamaged containers.
- C. Sod: Harvest, deliver, store, and handle sod according to requirements in TPI's "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in its "Guideline Specifications to Turfgrass Sodding." Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage and drying.

1.7 PROJECT CONDITIONS

- B. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: March - May.
 2. Fall Planting: September - November.
- C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit.

1.8 MAINTENANCE SERVICE

- B. Initial Lawn Maintenance Service: Provide full maintenance by skilled employees of landscape installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable lawn is established, but for not less than the following periods:
1. Seeded Lawns: 60 days from date of Substantial Completion.
 - a. When initial maintenance period has not elapsed before end of planting season, or if lawn is not fully established, continue maintenance during next planting season.
 2. Sodded Lawns: 30 days from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SEED

- B. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.
- C. Seed Species: State-certified seed of grass species, as follows:
- D. Seed Species, except baseball outfield: Seed of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:
1. Full Sun: Bermudagrass (*Cynodon dactylon*).
 2. Full Sun: Kentucky bluegrass (*Poa pratensis*), a minimum of three cultivars.
 3. Sun and Partial Shade: Proportioned by weight as follows:
 - a. 50 percent Kentucky bluegrass (*Poa pratensis*).
 - b. 30 percent chewings red fescue (*Festuca rubra* variety).
 - c. 10 percent perennial ryegrass (*Lolium perenne*).
 - d. 10 percent redtop (*Agrostis alba*).
 4. Shade: Proportioned by weight as follows:
 - a. 50 percent chewings red fescue (*Festuca rubra* variety).
 - b. 35 percent rough bluegrass (*Poa trivialis*).
 - c. 15 percent redtop (*Agrostis alba*).

- E. Seed Species, baseball outfield: Seed of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:
1. Outfield without irrigation system: Proportioned by weight as follows:
 - a. 85 percent fescue.
 - b. 10 percent rye.
 - c. 5 percent bluegrass.
 2. Outfield with irrigation system: Proportioned by weight as follows:
 - a. 70 percent bluegrass.
 - b. 30 percent rye.

2.2 TURFGRASS SOD

- B. Turfgrass Sod: Number 1 Quality/Premium, including limitations on thatch, weeds, diseases, nematodes, and insects, complying with TPI's "Specifications for Turfgrass Sod Materials" in its "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.
- C. Turfgrass Species, except baseball infield: Sod of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:
1. Full Sun: Kentucky bluegrass (*Poa pratensis*), a minimum of three cultivars.
 2. Sun and Partial Shade: Proportioned by weight as follows:
 - a. 50 percent Kentucky bluegrass (*Poa pratensis*).
 - b. 30 percent chewings red fescue (*Festuca rubra* variety).
 - c. 10 percent perennial ryegrass (*Lolium perenne*).
 - d. 10 percent redtop (*Agrostis alba*).
 3. Shade: Proportioned by weight as follows:
 - a. 50 percent chewings red fescue (*Festuca rubra* variety).
 - b. 35 percent rough bluegrass (*Poa trivialis*).
 - c. 15 percent redtop (*Agrostis alba*).
- D. Turfgrass Species, baseball infield: Sod of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:
1. 100 percent bluegrass with no netting.

2.3 TOPSOIL

- B. Topsoil: ASTM D 5268, pH range of 5.5 to 7, a minimum of 4 percent organic material content; free of stones 1 inch (25 mm) or larger in any dimension and other extraneous materials harmful to plant growth.

1. Topsoil Source: Reuse surface soil stockpiled on-site. Verify suitability of stockpiled surface soil to produce topsoil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
 - a. Supplement with imported or manufactured topsoil from off-site sources when quantities are insufficient. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches (100 mm) deep; do not obtain from agricultural land, bogs or marshes.
2. Topsoil Source: Import 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 (100 mm) deep; do not obtain from agricultural land, bogs or marshes.
3. Topsoil Source: Amend existing in-place surface soil to produce topsoil. Verify suitability of surface soil to produce topsoil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
 - a. Surface soil may be supplemented with imported 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 (100 mm) deep; do not obtain from agricultural land, bogs or marshes.

2.4 INORGANIC SOIL AMENDMENTS

- B. Lime: ASTM C 602, agricultural limestone containing a minimum of 80 percent calcium carbonate equivalent and as follows:
 1. Class: T, with a minimum of 99 percent passing through No. 8 (2.36-mm) sieve and a minimum of 75 percent passing through No. 60 (0.25-mm) sieve.
 2. Class: O, with a minimum of 95 percent passing through No. 8 (2.36-mm) sieve and a minimum of 55 percent passing through No. 60 (0.25-mm) sieve.
 3. Provide lime in form of dolomitic limestone.
- C. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, with a minimum of 99 percent passing through No. 6 (3.35-mm) sieve and a maximum of 10 percent passing through No. 40 (0.425-mm) sieve.
- D. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- E. Aluminum Sulfate: Commercial grade, unadulterated.
- F. Perlite: Horticultural perlite, soil amendment grade.
- G. Agricultural Gypsum: Finely ground, containing a minimum of 90 percent calcium sulfate.
- H. Sand: Clean, washed, natural or manufactured, free of toxic materials.
- I. Diatomaceous Earth: Calcined, diatomaceous earth, 90 percent silica, with approximately 140 percent water absorption capacity by weight.
- J. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.5 ORGANIC SOIL AMENDMENTS

- B. 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 3/4-inch (19-mm) 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.
- C. Peat: Sphagnum peat moss, partially decomposed, finely divided or granular texture, with a pH range of 3.4 to 4.8.
- D. Peat: Finely divided or granular texture, with a pH range of 6 to 7.5, containing partially decomposed moss peat, native peat, or reed-sedge peat and having a water-absorbing capacity of 1100 to 2000 percent.
- E. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture, free of chips, stones, sticks, soil, or toxic materials.
 - 1. In lieu of decomposed wood derivatives, mix partially decomposed wood derivatives with ammonium nitrate at a minimum rate of 0.15 lb/cu. ft. (2.4 kg/cu. m) of loose sawdust or ground bark, or with ammonium sulfate at a minimum rate of 0.25 lb/cu. ft. (4 kg/cu. m) of loose sawdust or ground bark.
- F. 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.

2.6 PLANTING ACCESSORIES

- B. Selective Herbicides: EPA registered and approved, of type recommended by manufacturer for application.

2.7 FERTILIZER

- B. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of [1] [4] percent nitrogen and [10] [20] percent phosphoric acid.
- C. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
- D. 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: 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m) of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
 - 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

- E. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - 1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
 - 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

2.8 MULCHES

- B. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.
- C. Peat Mulch: Sphagnum peat moss, partially decomposed, finely divided or granular texture, with a pH range of 3.4 to 4.8.
- D. Peat Mulch: Finely divided or granular texture, with a pH range of 6 to 7.5, containing partially decomposed moss peat, native peat, or reed-sedge peat and having a water-absorbing capacity of 1100 to 2000 percent.
- E. 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 (25-mm) 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.
- F. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic; 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.
- G. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.
- H. Asphalt Emulsion: ASTM D 977, Grade SS-1; nontoxic and free of plant-growth or germination inhibitors.

2.9 EROSION-CONTROL MATERIALS

- B. 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 (150 mm) long.
- C. Erosion-Control Fiber Mesh: Biodegradable burlap or spun-coir mesh, a minimum of 0.92 lb/sq. yd. (0.5 kg/sq. m), with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches (150 mm) long.
- D. Erosion-Control Mats: Cellular, non-biodegradable slope-stabilization mats designed to isolate and contain small areas of soil over steeply sloped surface, of 4-inch (100 mm) nominal mat thickness. Include manufacturer's recommended anchorage system for slope conditions.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Invisible Structures, Inc.; Slopetame 2.
 - b. Presto Products Company; Geoweb.
 - c. Tenax Corporation - USA; Tenweb.

2.10 PLANTING SOIL MIX

- B. Planting Soil Mix: Topsoil mixed with the following soil amendments and fertilizers in the following quantities:
 1. Ratio of Loose Compost to Topsoil by Volume: 1:3.
 2. Ratio of Loose Peat to Topsoil by Volume: 1:3.
 3. Weight of Lime per 1000 Sq. Ft. (92.9 Sq. m): 50 lbs.
 4. Volume of Sand Plus 10 Percent Diatomaceous Earth per 1000 Sq. Ft. (92.9 Sq. m).
 5. Weight of Commercial Fertilizer per 1000 Sq. Ft. (92.9 Sq. m): 15 lbs.

PART 3 - EXECUTION

3.1 EXAMINATION

- B. Examine areas to receive lawns and grass for compliance with requirements and other conditions affecting performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- B. 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.
- C. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 LAWN PREPARATION

- B. Limit lawn subgrade preparation to areas to be planted.
- C. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 4 inches (100 mm). Remove stones larger than 1 inch (25 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply superphosphate fertilizer directly to subgrade before loosening.
 2. Thoroughly blend planting soil mix off-site before spreading or spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil mix.
 - 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 mix to a depth of 4 inches (100 mm) 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. Spread approximately 1/2 the thickness of planting soil mix over loosened subgrade. Mix thoroughly into top 2 inches (50 mm) of subgrade. Spread remainder of planting soil mix.
 - b. Reduce elevation of planting soil to allow for soil thickness of sod.
- D. Unchanged Subgrades: If lawns are 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 (150 mm)] [8 inches (200 mm)]. Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top [4 inches (100 mm)] [6 inches (150 mm)] of soil. Till soil to a homogeneous mixture of fine texture.
 - a. Apply superphosphate fertilizer directly to surface soil before loosening.
 3. Remove stones larger than 1 inch (25 mm) 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.
- E. 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 (13 mm) 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.
- F. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- G. Before planting, restore areas if eroded or otherwise disturbed after finish grading.

3.4 PREPARATION FOR EROSION-CONTROL MATERIALS

- B. Prepare area as specified in "Lawn Preparation" Article.
- C. For erosion-control mats, install planting mix in two lifts, with second lift equal to thickness of erosion-control mats. Install erosion-control mat and fasten as recommended by material manufacturer.
- D. Fill cells of erosion-control mat with planting mix and compact before planting.

- E. 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.
- F. 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

- B. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph (8 km/h). Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
 - 1. Do not use wet seed or seed that is moldy or otherwise damaged.
 - 2. 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. (1.4 to 1.8 kg/92.9 sq. m).
- D. Rake seed lightly into top 1/8 inch (3 mm) of soil, roll lightly, and water with fine spray.
- E. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets installed and stapled according to manufacturer's written instructions.
- F. Protect seeded areas with erosion-control mats where shown, installed and anchored 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 (42 kg/92.9 sq. m) to form a continuous blanket 1-1/2 inches (38 mm) in loose depth over seeded areas. Spread by hand, blower, or other suitable equipment.
 - 1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.
- H. Protect seeded areas from hot, dry weather or drying winds by applying compost mulch or peat mulch within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a depth of 3/16 inch (4.8 mm), and roll surface smooth.

3.6 SODDING

- B. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.
- C. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
 - 1. Lay sod across angle of slopes exceeding 1:3.

2. Anchor sod on slopes exceeding 1:6 with wood pegs or steel staples spaced as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.
- D. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches (38 mm) below sod.

3.7 LAWN RENOVATION

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

3.8 LAWN MAINTENANCE

- B. Maintain and establish lawn by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth lawn. Provide materials and installation the same as those used in the original installation.

1. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
- C. Watering: Provide and maintain temporary piping, hoses, and lawn-watering equipment to convey water from sources and to keep lawn uniformly moist to a depth of 4 inches (100 mm).
 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 lawn with fine spray at a minimum rate of 1 inch (25 mm) per week unless rainfall precipitation is adequate.
- D. Mow lawn as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:
 1. Mow grass to a height of 2 to 3 inches (50 to 75 mm).
- E. Lawn Postfertilization: Apply fertilizer after initial mowing and when grass is dry.
 1. Use fertilizer that will provide actual nitrogen of at least 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m) to lawn area.

3.9 SATISFACTORY LAWNS

- B. Lawn installations shall meet the following criteria as determined by Architect:
 1. Satisfactory Seeded Lawn: 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. (0.92 sq. m) and bare spots not exceeding 5 by 5 inches (125 by 125 mm).
 2. Satisfactory Sodded Lawn: At end of maintenance period, a healthy, well-rooted, even-colored, viable lawn has been established, free of weeds, open joints, bare areas, and surface irregularities.
- C. Use specified materials to reestablish lawns that do not comply with requirements and continue maintenance until lawns are satisfactory.

3.10 CLEANUP AND PROTECTION

- B. Promptly remove soil and debris, created by lawn work, from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- 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 lawn is established.
- D. Remove nondegradable erosion-control measures after grass establishment period.

END OF SECTION

SECTION 32 93 00 PLANTS**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Bid Scope Manual, and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- B. Section Includes:
 - 1. Trees.
 - 2. Shrubs.
 - 3. Ground cover.
 - 4. Plants.
 - 5. Tree stabilization.
- C. Related Sections:
 - 1. Division 31 Section "Site Clearing" for protection of existing trees and plantings, topsoil stripping and stockpiling, and site clearing.
 - 2. Division 31 Section "Earth Moving" for excavation, filling, and rough grading and for subsurface aggregate drainage and drainage backfill materials.
 - 3. Division 32 Section "Turf and Grasses" for lawn and meadow planting.

1.3 DEFINITIONS

- B. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- C. Balled and Burlapped Stock: Exterior plants dug with firm, natural balls of earth in which they are grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of tree or shrub required; wrapped, tied, rigidly supported, and drum laced as recommended by ANSI Z60.1.
- D. Balled and Potted Stock: Exterior plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of exterior plant required.
- E. Bare-Root Stock: Exterior plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for type and size of exterior plant required.
- F. Clump: Where three or more young trees were planted in a group and have grown together as a single tree having three or more main stems or trunks.
- G. Container-Grown Stock: Healthy, vigorous, well-rooted exterior plants grown in a container with well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball

shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of exterior plant required.

- H. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted exterior plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of exterior plant.
- I. Finish Grade: Elevation of finished surface of planting soil.
- J. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- K. Multi-Stem: Where three or more main stems arise from the ground from a single root crown or at a point right above the root crown.
- L. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.
- M. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.
- N. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

1.4 SUBMITTALS

- B. Product Data: For each type of product indicated.
- C. Qualification Data: For qualified landscape Installer.
- D. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:
 - 1. Manufacturer's certified analysis for standard products.
 - 2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- E. Material Test Reports: For existing surface soil and imported topsoil.
- F. Planting Schedule: Indicating anticipated planting dates for exterior plants.
- G. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of exterior plants during a calendar year. Submit before expiration of required maintenance periods.

1.5 QUALITY ASSURANCE

- B. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of exterior plants.

1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when planting is in progress.
 - C. Soil-Testing Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
 - D. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of topsoil.
 1. Report suitability of topsoil for plant growth. State-recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory topsoil.
 - E. Provide quality, size, genus, species, and variety of exterior plants indicated, complying with applicable requirements in ANSI Z60.1, "American Standard for Nursery Stock."
 1. Selection of exterior plants purchased under allowances will be made by Architect, who will tag plants at their place of growth before they are prepared for transplanting.
 - F. Tree and Shrub Measurements: Measure according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches (150 mm) above the ground for trees up to 4-inch (100-mm) caliper size, and 12 inches (300 mm) above the ground for larger sizes. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip-to-tip.
 - G. Observation: Architect may observe trees and shrubs either at place of growth or at site before planting for compliance with requirements for genus, species, variety, size, and quality. Architect retains right to observe trees and shrubs further for size and condition of balls and root systems, insects, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
 1. Notify Architect of sources of planting materials seven (7) days in advance of delivery to site.
 - H. Preinstallation Conference: Conduct conference at Project site.
- 1.6 DELIVERY, STORAGE, AND HANDLING**
- B. Deliver exterior plants freshly dug.
 1. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.
 - C. Do not prune trees and shrubs before delivery except as approved by Architect. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of exterior plants during delivery. Do not drop exterior plants during delivery and handling.

- D. Handle planting stock by root ball.
- E. Deliver exterior plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set exterior plants and trees in shade, protect from weather and mechanical damage, and keep roots moist.
 - 1. Heel-in bare-root stock. Soak roots that are in dry condition in water for two hours. Reject dried-out plants.
 - 2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
 - 3. Do not remove container-grown stock from containers before time of planting.
 - 4. Water root systems of exterior plants stored on-site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.

1.7 PROJECT CONDITIONS

- B. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.
 - 1. Spring Planting: March-May
 - 2. Fall Planting: September-Mid December
- C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed according to manufacturer's written instructions and warranty requirements.
- D. Coordination with Lawns: Plant trees and shrubs after finish grades are established and before planting lawns unless otherwise acceptable to Architect.
 - 1. When planting trees and shrubs after lawns, protect lawn areas and promptly repair damage caused by planting operations.

1.8 WARRANTY

- B. Special Warranty: Installer's standard form in which Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, abuse by Owner, or incidents that are beyond Contractor's control.
 - b. Structural failures including plantings falling or blowing over.
 - c. Faulty operation of tree stabilization.
 - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Warranty Periods from Date of Substantial Completion:
 - a. Trees and Shrubs: One year.

- b. Ground Cover and Plants: One year.
- 3. Include the following remedial actions as a minimum:
 - a. Remove dead exterior plants immediately. Replace immediately unless required to plant in the succeeding planting season.
 - b. Replace exterior plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
 - c. A limit of one replacement of each exterior plant will be required except for losses or replacements due to failure to comply with requirements.
 - d. Provide extended warranty for replaced plant materials; warranty period equal to original warranty period.

1.9 MAINTENANCE SERVICE

- B. Initial Maintenance Service for Trees and Shrubs: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below.
 - 1. Maintenance Period: 12 months from date of Substantial Completion.
- C. Initial Maintenance Service for Ground Cover and Plants: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below.
 - 1. Maintenance Period: 12 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TREE AND SHRUB MATERIAL

- B. General: Furnish nursery-grown trees and shrubs complying with ANSI Z60.1, with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
- C. Provide trees and shrubs of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of trees and shrubs required. Trees and shrubs of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.
- D. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1.
- E. Label each tree and shrub with securely attached, waterproof tag bearing legible designation of botanical and common name.
- F. Label at least one tree and one shrub of each variety and caliper with a securely attached, waterproof tag bearing legible designation of botanical and common name.

- G. If formal arrangements or consecutive order of trees or shrubs is shown, select stock for uniform height and spread, and number label to assure symmetry in planting.

2.2 SHADE AND FLOWERING TREES

- B. Shade Trees: Single-stem trees with straight trunk, well-balanced crown, and intact leader, of height and caliper indicated, complying with ANSI Z60.1 for type of trees required.
 - 1. Provide balled and burlapped trees.
 - 2. Branching Height: One-third to one-half of tree height.
- C. Small Upright Trees: Branched or pruned naturally according to species and type, with relationship of caliper, height, and branching according to ANSI Z60.1; stem form as follows:
 - 1. Stem Form: As noted on the plant schedule.
 - 2. Provide balled and burlapped trees.
- D. Small Spreading Trees: Branched or pruned naturally according to species and type, with relationship of caliper, height, and branching according to ANSI Z60.1; stem form as follows:
 - 1. Stem Form: As noted on the plant schedule.
 - 2. Provide balled and burlapped trees.

2.3 DECIDUOUS SHRUBS

- B. Form and Size: Shrubs with not less than the minimum number of canes required by and measured according to ANSI Z60.1 for type, shape, and height of shrub.
 - 1. Shrub sizes indicated are sizes after pruning.
 - 2. Provide balled and burlapped or container-grown shrubs.

2.4 CONIFEROUS EVERGREENS

- B. Form and Size: Normal-quality, well-balanced, coniferous evergreens, of type, height, spread, and shape required, complying with ANSI Z60.1.
- C. Form and Size: Specimen quality as described, symmetrically shaped coniferous evergreens.
 - 1. Shearing Designation: Semi-sheared or lightly sheared (LS).
 - 2. Provide balled and burlapped trees.

2.5 BROADLEAF EVERGREENS

- B. Form and Size: Normal-quality, well-balanced, broadleaf evergreens, of type, height, spread, and shape required, complying with ANSI Z60.1.

- C. Form and Size: Specimen quality as described, symmetrically shaped broadleaf evergreens.

1. Shearing Designation: Semi-sheared or lightly sheared (LS).
2. Provide balled and burlapped or container-grown trees as noted on the plant schedule.

2.6 GROUND COVER PLANTS

- B. Ground Cover: Provide ground cover of species indicated, established and well rooted in pots or similar containers, and complying with ANSI Z60.1 and the following requirements:

2.7 PLANTS

- B. Annuals and Biennials: Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems reaching to sides of the container to maintain a firm ball, but not with excessive root growth encircling the container. Provide only plants that are acclimated to outdoor conditions before delivery[and that are in bud but not yet in bloom].
- C. Perennials: Provide healthy, field-grown plants from a commercial nursery, of species and variety shown or listed, complying with requirements in ANSI Z60.1.
- D. Vines: Provide vines of species indicated complying with requirements in ANSI Z60.1 as follows:
 1. Two-year plants with heavy, well-branched tops, with not less than 3 runners 18 inches (450 mm) or more in length, and with a vigorous well-developed root system.
 2. Provide field-grown vines. Vines grown in pots or other containers of adequate size and acclimated to outside conditions will also be acceptable.

2.8 TOPSOIL

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

3. Topsoil Source: Amend existing in-place surface soil to produce topsoil. Verify suitability of surface soil to produce topsoil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
 - a. Surface soil may be supplemented with imported 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 (100 mm) deep; do not obtain from agricultural land, bogs or marshes.

2.9 INORGANIC SOIL AMENDMENTS

- B. Lime: ASTM C 602, agricultural limestone containing a minimum of 80 percent calcium carbonate equivalent and as follows:
 1. Class: T, with a minimum of 99 percent passing through No. 8 (2.36-mm) sieve and a minimum of 75 percent passing through No. 60 (0.25-mm) sieve.
 2. Class: O, with a minimum of 95 percent passing through No. 8 (2.36-mm) sieve and a minimum of 55 percent passing through No. 60 (0.25-mm) sieve.
 3. Provide lime in form of dolomitic limestone.
- C. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, with a minimum of 99 percent passing through No. 6 (3.35-mm) sieve and a maximum of 10 percent passing through No. 40 (0.425-mm) sieve.
- D. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- E. Aluminum Sulfate: Commercial grade, unadulterated.
- F. Perlite: Horticultural perlite, soil amendment grade.
- G. Agricultural Gypsum: Finely ground, containing a minimum of 90 percent calcium sulfate.
- H. Sand: Clean, washed, natural or manufactured, free of toxic materials.
- I. Diatomaceous Earth: Calcined, diatomaceous earth, 90 percent silica, with approximately 140 percent water absorption capacity by weight.
- J. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.10 ORGANIC SOIL AMENDMENTS

- B. 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 (13-mm) 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.

- C. Peat: Sphagnum peat moss, partially decomposed, finely divided or granular texture, with a pH range of 3.4 to 4.8.
- D. Peat: Finely divided or granular texture, with a pH range of 6 to 7.5, containing partially decomposed moss peat, native peat, or reed-sedge peat and having a water-absorbing capacity of 1100 to 2000 percent.
- E. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture, free of chips, stones, sticks, soil, or toxic materials.
 - 1. In lieu of decomposed wood derivatives, mix partially decomposed wood derivatives with ammonium nitrate at a minimum rate of 0.15 lb/cu. ft. (2.4 kg/cu. m) of loose sawdust or ground bark, or with ammonium sulfate at a minimum rate of 0.25 lb/cu. ft. (4 kg/cu. m) of loose sawdust or ground bark.
- F. 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.

2.11 FERTILIZER

- B. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 4 percent nitrogen and 10 percent phosphoric acid.
- C. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
- D. 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: 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m) of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
 - 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.
- E. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - 1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
 - 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

2.12 MULCHES

- B. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
 - 1. Type: Shredded hardwood.

2.13 TREE STABILIZATION MATERIALS**B. Stakes and Guys:**

1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, redwood, or pressure-preservative-treated softwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal (38-by-38-mm actual) by length indicated, pointed at one end.
2. Flexible Ties: Wide rubber or elastic bands or straps of length required to reach stakes or turnbuckles.
3. Guys and Tie Wires: ASTM A 641/A 641M, Class 1, galvanized-steel wire, 2-strand, twisted, 0.106 inch (2.7 mm) in diameter.
4. Hose Chafing Guards: Reinforced rubber or plastic hose at least 1/2 inch (13 mm) in diameter, black, cut to lengths required to protect tree trunks from damage.
5. Guy Cables: 5-strand, 3/16-inch- (4.8-mm-) diameter, galvanized-steel cable, with zinc-coated turnbuckles, a minimum of 3 inches (75 mm) long, with two 3/8-inch (10-mm) galvanized eyebolts.
6. Flags: Standard surveyor's plastic flagging tape, white, 6 inches (150 mm) long.

C. Root-Ball Stabilization Materials:

1. Upright Stakes and Horizontal Hold-Down: Rough-sawn, sound, new hardwood or softwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal (38-by-38-mm actual) by length indicated; stakes pointed at one end.
2. Wood Screws: ASME B18.6.1.

2.14 METAL TRELLIS SYSTEM

- B.** Provide metal trellis system wall mounted to the building in 4 locations per the drawings. Trellis shall form a grid pattern for the purposes of supporting climbing vines as per the planting plans. Attach trellis system to the building per manufacturers' instructions, recommendations and specifications. Provide all necessary accessories including mounting clips, anchors, fasteners, edge trim, spacers and post caps. Refer to architectural drawings for lengths and Heights of the trellis

1. Basis of Design: 'Greenscreen' 1-800-450-3494.
 - a. Trellis system to consist of rigid, three-dimensional welded wire grid panels fabricated of 24 gauge galvanized steel wire. Wire shall be welded at each intersection to form 2 x 2 inch face grid on the front and back panels. Metal components to be factory finished after fabrication.
 - b. Color to be Wrinkle Green.
2. Submittals:
 - a. Submit manufacturer's product data, standard details, and installation instructions.
 - b. Submit shop drawings showing sizes, critical dimensions and layout.
 - c. Submit color samples of product.

2.15 MISCELLANEOUS PRODUCTS

- B. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.
- C. Trunk-Wrap Tape: Two layers of crinkled paper cemented together with bituminous material, 4-inch- (100-mm-) wide minimum, with stretch factor of 33 percent.

2.16 PLANTING SOIL MIX

- B. Planting Soil Mix: Mix topsoil with the following soil amendments[and fertilizers] in the following quantities:
 - 1. Ratio of Loose Compost to Topsoil by Volume: 1:3.
 - 2. Ratio of Loose Peat to Topsoil by Volume: 1:3.
 - 3. Ratio of Loose Wood Derivatives to Topsoil by Volume: 1:3.
 - 4. Weight of Lime per 1000 Sq. Ft. (92.9 Sq. m): 20 pounds.
 - 5. Volume of Sand Plus 10 Percent Zeolites per 1000 Sq. Ft. (92.9 Sq. m): 20 per cent by volume.
 - 6. Weight of Bonemeal per 1000 Sq. Ft. (92.9 Sq. m): 20 pounds.
 - 7. Weight of Superphosphate per 1000 Sq. Ft. (92.9 Sq. m): 5 pounds.
 - 8. Weight of Commercial Fertilizer per 1000 Sq. Ft. (92.9 Sq. m): 20 pounds.
- C. Planter Soil Mix: 1 part topsoil, 1 part coarse sand, 1 part peat, and 3 lb (1.36 kg) of dolomitic limestone per cubic yard (cubic meter) of mix.

PART 3 - EXECUTION**3.1 EXAMINATION**

- B. Examine areas to receive exterior plants for compliance with requirements and conditions affecting installation and performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- B. Protect structures, utilities, sidewalks, pavements, and other facilities, and lawns and existing exterior plants from damage caused by planting operations.
- C. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- D. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before planting. Make minor adjustments as required.

- E. Lay out exterior plants at locations directed by Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.
- F. Trunk Wrapping: Inspect tree trunks for injury, improper pruning, and insect infestation; take corrective measures required before wrapping. Wrap trees of 2-inch (50-mm) caliper and larger with trunk-wrap tape. Start at base of trunk and spiral cover trunk to height of first branches. Overlap wrap, exposing half the width, and securely attach without causing girdling.
- G. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
 - 1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.
- H. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

3.3 PLANTING BED ESTABLISHMENT

- B. Loosen subgrade of planting beds to a minimum depth of 6 inches (150 mm). Remove stones larger than 1-1/2 inches (38 mm) 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. Spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil mix.
 - 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 mix to a depth of 4 inches (100 mm) but not less than required to meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
 - a. Spread approximately one-half the thickness of planting soil mix over loosened subgrade. Mix thoroughly into top 4 inches (100 mm) of subgrade. Spread remainder of planting soil mix.
- C. Finish Grading: Grade planting beds to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.
- D. Before planting, restore planting beds if eroded or otherwise disturbed after finish grading.

3.4 EXCAVATION FOR TREES AND SHRUBS

- B. Pits and Trenches: Excavate circular pits with sides sloped inward. Trim base leaving center area raised slightly to support root ball and assist in drainage. Do not further disturb base. Scarify sides of plant pit smeared or smoothed during excavation.
1. Excavate approximately three times as wide as ball diameter for balled and burlapped and container-grown stock.
 2. Excavate at least 12 inches (300 mm) wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
 3. If drain tile is shown or required under planted areas, excavate to top of porous backfill over tile.
- C. Subsoil removed from excavations may be used as backfill.
- D. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
1. Hardpan Layer: Drill 6-inch- (150-mm-) diameter holes, 24 inches (600 mm) apart, into free-draining strata or to a depth of 10 feet (3 m), whichever is less, and backfill with free-draining material.
- E. Drainage: Notify Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub pits.
- F. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.5 TREE AND SHRUB PLANTING

- B. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1.
- C. Set balled and burlapped stock plumb and in center of pit or trench with top of root ball 1 inch (25 mm) above adjacent finish grades.
1. Remove burlap and wire baskets from tops of root balls and partially from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 2. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.
- D. Set container-grown stock plumb and in center of pit or trench with top of root ball 1 inch (25 mm) above adjacent finish grades.
1. Carefully remove root ball from container without damaging root ball or plant.
 2. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.

- E. Organic Mulching: Apply 3-inch (75-mm) average thickness of organic mulch extending 12 inches (300 mm) beyond edge of planting pit or trench. Do not place mulch within 3 inches (75 mm) of trunks or stems.
- F. Inspect tree trunks for injury, improper pruning, and insect infestation; take corrective measures required before wrapping. Wrap trees of 2-inch (50-mm) caliper and larger with trunk-wrap tape. Start at base of trunk and spiral cover trunk to height of first branches. Overlap wrap, exposing half the width, and securely attach without causing girdling.
- G. Trunk Wrapping: Inspect tree trunks for injury, improper pruning, and insect infestation; take corrective measures required before wrapping. Wrap trees of 2-inch (50-mm) caliper and larger with trunk-wrap tape. Start at base of trunk and spiral cover trunk to height of first branches. Overlap wrap, exposing half the width, and securely attach without causing girdling.

3.6 TREE AND SHRUB PRUNING

- B. Remove only dead, dying, or broken branches. Do not prune for shape.
- C. Prune, thin, and shape trees and shrubs as directed by Architect.
- D. Prune, thin, and shape trees and shrubs according to standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured or dead branches from flowering trees. Prune shrubs to retain natural character.

3.7 TREE STABILIZATION

- B. Trunk Stabilization: Unless otherwise indicated, provide trunk stabilization as follows:
 - 1. Upright Staking and Tying: Stake trees of 2- through 5-inch (50- through 125-mm) caliper. Stake trees of less than 2-inch (50-mm) caliper only as required to prevent wind tip-out. Use a minimum of 2 stakes of length required to penetrate at least 18 inches (450 mm) below bottom of backfilled excavation and to extend at least 72 inches (1830 mm) or one third of trunk height above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.
 - 2. Use 2 stakes for trees up to 12 feet (3.6 m) high and 2-1/2 inches (63 mm) or less in caliper; 3 stakes for trees less than 14 feet (4.2 m) high and up to 4 inches (100 mm) in caliper. Space stakes equally around trees.
 - 3. Support trees with bands of flexible ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
 - 4. Support trees with two strands of tie wire encased in hose sections at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
- C. Guying and Staking: Guy and stake trees exceeding 14 feet (4.2 m) in height and more than 3 inches (75 mm) in caliper unless otherwise indicated. Securely attach no fewer than 3 guys to stakes 30 inches (760 mm) long, driven to grade.
 - 1. For trees more than 6 inches (150 mm) in caliper, anchor guys to pressure-preservative-treated deadmen 8 inches (200 mm) in diameter and 48 inches (1200 mm) long buried at least 36 inches (900 mm) below grade. Provide turnbuckle for each guy wire and tighten securely.

2. Support trees with bands of flexible ties at contact points with tree trunk and reaching to turnbuckle. Allow enough slack to avoid rigid restraint of tree.
 3. Support trees with strands of cable or multiple strands of tie wire encased in hose sections at contact points with tree trunk and reaching to turnbuckle. Allow enough slack to avoid rigid restraint of tree.
 4. Attach flags to each guy wire, 30 inches (760 mm) above finish grade.
 5. Paint turnbuckles with luminescent white paint.
- D. Root-Ball Stabilization: Unless otherwise indicated, provide at- or below-grade stabilization system to secure each new planting by the root ball.
1. Wood Hold-Down Method: Horizontal wood hold-down stake placed across top of root ball and screwed at each end to a vertical stake against side of root ball and driven into subsoil.
 - a. Provide stakes of length required to penetrate at least 18 inches (450 mm) below bottom of backfilled excavation. Saw stakes off at horizontal stake.
 - b. Install screws through horizontal hold-down and penetrating at least 1 inch (25 mm) into stakes. Predrill holes if necessary to prevent splitting wood.
 - c. Install second set of stakes on other side of root trunk for larger trees as indicated.

3.8 GROUND COVER AND PLANT PLANTING

- B. Set out and space ground cover and plants as indicated.
- C. Dig holes large enough to allow spreading of roots and backfill with planting soil.
- D. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- E. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- F. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.9 PLANTING BED MULCHING

- B. Mulch backfilled surfaces of planting beds and other areas indicated. Provide mulch ring around trees in lawn areas.
 1. Organic Mulch: Apply 2-inch (50-mm) average thickness of organic mulch, and finish level with adjacent finish grades. Do not place mulch against plant stems.

3.10 PLANT MAINTENANCE

- B. Tree and Shrub Maintenance: Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, restoring planting saucers, adjusting and repairing stakes and guy supports, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease. Restore or replace damaged tree wrappings.

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- C. Ground Cover and Plant Maintenance: Maintain and establish plantings by watering, weeding, fertilizing, mulching, and other operations as required to establish healthy, viable plantings.

3.11 CLEANUP AND PROTECTION

- B. During planting, keep adjacent paving and construction clean and work area in an orderly condition.
- C. Protect exterior plants from damage due to landscape operations, operations by other contractors and trades, and others. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

3.12 DISPOSAL

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

END OF SECTION

SECTION 33 11 13 FACILITY WATER DISTRIBUTION PIPING**PART 1 GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawing and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Section, apply to this section.

1.2 SUMMARY

- A. This section includes water-distribution piping and related components outside the building for water service, fire-service mains, and combined water service and fire-service mains.
- B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

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1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1) Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
 - 2) Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
 - 3) 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. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.
- D. Comply with FMB'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 "NSF-pw" on piping.
- 2) Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.5 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 Architect no fewer than seven days in advance of proposed interruption of service.
 - 2) Do not proceed with interruption of water-distribution service without Construction Manager's written permission.

1.6 COORDINATION

- A. Coordinate connection to water main with utility company.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

- A. Soft 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.
- B. Hard Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L, water tube, drawn temper.
 - 1) Copper, Solder-Joint Fittings: ASME B16.18, castp-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
- C. PE, Fire-Service Pipe: ASTM F 714, AWWA C906, or equivalent for PE water pipe; FMG approved, with minimum thickness equivalent to FMG Class 150 and Class 200.
 - 1) Molded PE Fittings: ASTM D 3350, PE resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.
- D. PVC, AWWA Pipe: AWWA Class 150 and 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 150 and Class 299, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.

- 3) PVC Molded Fittings: AWWA 907, Class 150, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
- 4) Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - a) Gaskets: AWWA C111, rubber
- 5) Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - a) Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.2 JOINING MATERIALS

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for commonly used joining materials.
- B. Brazing Filler Metals: AWS A5.8, BCuP Series.
- C. Bonding Adhesives for Fiberglass Piping: As recommended by fiberglass piping manufacturer.
- D. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

2.3 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:
 - 1) Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners and with ends of same sizes as piping to be joined.
 - a) Standard: AWWA C219

2.4 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.
 - 2) Manufacturers: Subject to compliance with requirements.
 - 3) Basis-of-Design Product: Subject to compliance with requirements, as indicated on drawings or a comparable product by one of the following:
 - a) American AVK Co.; Valves and Fittings Div.
 - b) American Cast Iron Pipe Co.; American Flow Control Div.
 - c) American Cast Iron Pipe Co.; Waterous Co. Subsidiary
 - a. Crane Co.; Crane Valve Group; Stockham Div.
 - b. East Jordan Iron Works, Inc.
 - c. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa)
 - d. McWane, Inc.; Kennedy Valve Div.
 - e. McWane, Inc.; M & H Valve Company Div.

- f. McWane, Inc.; Tyler Pipe Div.; Utilities Div.
 - g. Mueller Co.; Water Products Div.
 - h. NIBCO INC.
 - i. U.S. Pipe and Foundry Company
- 4) Nonrising-Stem, Metal-Seated Gate Valves:
 - a) Description: Gray- or ductile-iron body and bonnet; with cast-iron or bronze double-disc gate, bronze gate rings, bronze stem, and stem nut.
 - 1) Standard: AWWA C500.
 - 2) Minimum Pressure Rating: 200 psig.
 - 3) End Connections: Mechanical joint.
 - 4) Interior Coating: Complying with AWWA C550.
 - 5) Nonrising-Stem, Resilient-Seated Gate Valves:
 - a) Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
 - 1. Standard: AWWA C509.
 - 2. Minimum Pressure Rating: 200 psig.
 - 3. End Connections: Mechanical joint.
 - 4. Interior Coating: Complying with AWWA C550.
 - 6) Nonrising-Stem, High-Pressure, Resilient-Seated Gate Valves:
 - a) Description: Ductile-iron body and bonnet; with bronze or ductile-iron gate, resilient seats, bronze stem, and stem nut.
 - 1) Standard: AWWA C509.
 - 2) Minimum Pressure Rating: 250 psig.
 - 3) End Connections: Push on or mechanical joint.
 - 4) Interior Coating: Complying with AWWA C550.
 - 7) OS&Y, Rising-Stem, Metal-Seated Gate Valves:
 - a) Description: Cast- or ductile-iron body and bonnet, with cast-iron double disc, bronze disc and seat rings, and bronze stem.
 - (1) Standard: AWWA C500.
 - (2) Minimum Pressure Rating: 200 psig.
 - (3) End Connections: Flanged.
 - 8) OS&Y, Rising-Stem, Resilient-Seated Gate Valves:
 - a) Description: Cast- or ductile-iron body and bonnet, with bronze or gray- or ductile-iron gate, resilient seats, and bronze stem.
 - a. Standard: AWWA C509.
 - b. Minimum Pressure Rating: 200 psig.
 - c. End Connections: Flanged.
- C. UL/FMG, Cast-Iron Gate Valves:
- 1) Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work.
 - 2) Manufacturers: Subject to compliance with requirements.
 - 3) Basis-of-Design Product: Subject to compliance with requirements, provide as indicated on Drawings or a comparable product by one of the following:
 - a) American Cast Iron Pipe Co.; American Flow Control Div.
 - b) American Cast Iron Pipe Co.; Waterous Co. Subsidiary
 - c) Crane Co.; Crane Valve Group; Stockham Div.
 - d) McWane, Inc.; Clow Valve Co. Div. (Oskaloosa)

- e) McWane, Inc.; Kennedy Valve Div.
 - f) McWane, Inc.; M & H Valve Company Div.
 - g) Mueller Co.; Water Products Div.
 - h) NIBCO INC.
 - i) U.S. Pipe and Foundry Company
- 4) UL/FMG, Nonrising-Stem Gate Valves:
- a) Description: Iron body and bonnet with flange for indicator post, bronze seating material, and inside screw.
 - a. Standards: UL 262 and FMG approved.
 - b. Minimum Pressure Rating: 175 psig.
 - c. End Connections: Flanged.
- 5) OS&Y, Rising-Stem Gate Valves:
- a) Description: Iron body and bonnet and bronze seating material.
 - 1. Standards: UL 262 and FMG approved.
 - 2. Minimum Pressure Rating: 175 psig.
 - 3. End Connections: Flanged.

D. Bronze Gate Valves:

- 1) Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work.
- 2) Manufacturers: Subject to compliance with requirements.
- 3) Basis-of-Design Product: Subject to compliance with requirements, provide as indicated on Drawings or a comparable product by one of the following:
 - a) Crane Co.; Crane Valve Group; Crane Valves
 - b) Crane Co.; Crane Valve Group; Jenkins Valves
 - c) Crane Co.; Crane Valve Group; Stockham Div.
 - d) Hammond Valve
 - e) Milwaukee Valve Company
 - f) NIBCO INC.
 - g) Red-White Valve Corporation
- 4) OS&Y, Rising-Stem Gate Valves:
 - a) Description: Bronze body and bonnet and bronze stem.
 - 1. Standards: UL 262 and FMG approved.
 - 2. Minimum Pressure Rating: 175 psig.
 - 3. End Connections: Threaded.
- 5) Nonrising-Stem Gate Valves:
 - a) Description: Class 125, Type 1, bronze with solid wedge, threaded ends, and malleable-iron handwheel.
 - a. Standard: MSS SP-80.

2.5 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies:

- 1) Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work.
- 2) Manufacturers: Subject to compliance with requirements.

- 3) Basis-of-Design Product: Subject to compliance with requirements, provide as indicated on Drawings or a comparable product by one of the following:
 - a) American Cast Iron Pipe Co.; Waterous Co. Subsidiary
 - b) East Jordan Iron Works, Inc.
 - c) Flowserve
 - d) McWane, Inc.; Clow Valve Co. Div. (Oskaloosa)
 - e) McWane, Inc.; Kennedy Valve Div.
 - f) McWane, Inc.; M & H Valve Company Div.
 - g) Mueller Co.; Water Products Div.
 - h) U.S. Pipe and Foundry Company
- 4) Description: Sleeve and valve compatible with drilling machine.
 - a) Standard: MSS SP-60.
 - b) Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
 - c) Valve: AWWA, cast-iron, nonrising-stem, resilient-seated gate valve with one raised face flange mating tapping-sleeve flange.
- B. 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.
- C. Indicator Posts: UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

2.6 CORPORATION VALVES AND CURB VALVES

- A. Manufacturers:
 - 1) Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work.
 - 2) Manufacturers: Subject to compliance with requirements by one of the following:
 - a) Amcast Industrial Corporation; Lee Brass Co.
 - b) Ford Meter Box Company, Inc. (The); Pipe Products Div.
 - c) Jones, James Company.
 - d) Master Meter, Inc.
 - e) McDonald, A. Y. Mfg. Co.
 - f) Mueller Co.; Water Products Div.
 - g) Red Hed Manufacturing & Supply.
- B. Service-Saddle Assemblies: Comply with AWWA C800. Include saddle and valve compatible with tapping machine.
 - 1) Service Saddle: Copper alloy with seal and AWWA C800, threaded outlet for corporation valve.
 - 2) Corporation Valve: Bronze body and ground-key plug, with AWWA C800, threaded inlet and outlet matching service piping material.

- 3) Manifold: Copper fitting with two to four inlets as required, with ends matching corporation valves and outlet matching service piping material.
- C. Curb Valves: Comply with AWWA C800. Include bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.
- D. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately 3 inches (75 mm) in diameter.
- 1) Shutoff Rods: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.

2.7 WATER METERS

- A. Water meters will be furnished by utility company.

2.8 BACKFLOW PREVENTERS

- A. Double-Check, Backflow-Prevention Assemblies:

- 1) Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a) Ames Fire & Waterworks; a division of Watts Regulator Co.
 - b) Conbraco Industries, Inc.
 - c) FEBCO; SPX Valves & Controls
 - d) Flomatic Corporation
 - e) Watts Water Technologies, Inc.
 - f) Zurn Plumbing Products Group; Wilkins Water Control Products Div.
- 2) Standard: ASSE 1015.
- 3) Operation: Continuous-pressure applications.
- 4) Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved or steel with interior lining complying with AWWA C550 or that is FDA approved/stainless steel NPS 2-1/2 and larger.
- 5) End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
- 6) Accessories: Ball valves with threaded ends on inlet and outlet of NPS 2 (DN 50) and smaller; OS&Y gate valves with flanged ends on inlet and outlet of NPS 2-1/2 (DN 65) and larger with tamper switch.

2.9 WATER METER BOXES

- A. Description: Cast-iron body and cover for disc-type water meter, with lettering "WATER METER" in cover; and with slotted, open-bottom base section of length to fit over service piping.
- 1) Option: Base section may be cast-iron, PVC, clay, or other pipe.

- B. Description: Cast-iron body and double cover for disc-type water meter, with lettering "WATER METER" in top cover; and with separate inner cover; air space between covers; and slotted, open-bottom base section of length to fit over service piping.
- C. Description: Polymer-concrete body and cover for disc-type water meter, with lettering "WATER" in cover; and with slotted, open-bottom base section of length to fit over service piping. Include vertical and lateral design loadings of 15,000 lb minimum over 10 by 10 inches square.

2.10 CONCRETE VAULTS

- A. Description: Precast, reinforced-concrete vault, designed for A-16 load designation according to ASTM C 857 and made according to ASTM C 858.
 - 1) Ladder: ASTM A 36/A 36M, steel or polyethylene-encased steel steps.
 - 2) Manhole: ASTM A 48/A 48M Class No. 35A minimum tensile strength, gray-iron traffic frame and cover.
 - a) Dimension: 30-inch (610-mm) minimum diameter, unless otherwise indicated.
 - 3) Manhole: ASTM A 536, Grade 60-40-18, ductile-iron traffic frame and cover.
 - a) Dimension: 30-inch (610-mm) minimum diameter, unless otherwise indicated.
 - 4) Drain: ASME A112.6.3, cast-iron floor drain with outlet of size indicated. Include body anchor flange, light-duty cast-iron grate.

2.11 FIRE HYDRANTS

A. Dry-Barrel Fire Hydrants:

- 1) Available Manufacturers: Subject to compliance with requirements of local municipality, manufacturers offering products that may be incorporated into the Work.
- 2) Manufacturers: Subject to compliance with requirements of local municipality.
- 3) Basis-of-Design Product: Subject to compliance with requirements of local municipality, provide a comparable product by one of the following:
 - a) American AVK Co.; Valves & Fittings Div.
 - b) American Cast Iron Pipe Co.; American Flow Control Div.
 - c) American Cast Iron Pipe Co.; Waterous Co. Subsidiary
 - d) American Foundry Group, Inc.
 - e) East Jordan Iron Works, Inc.
 - f) McWane, Inc.; Clow Valve Co. Div. (Oskaloosa)
 - g) McWane, Inc.; Kennedy Valve Div.
 - h) McWane, Inc.; M & H Valve Company Div.
 - i) Mueller Co.; Water Products Div.
 - j) Troy Valve; a division of Penn-Troy Manufacturing, Inc.
 - k) U.S. Pipe and Foundry Company
- 4) Description: Freestanding, with one NPS 4-1/2 (DN 115) and two NPS 2-1/2 (DN 65) outlets, 5-1/4-inch (133-mm) main valve, drain valve, and NPS 6 (DN 150) mechanical-joint inlet. Include interior coating according to

AWWA C550. Hydrant shall have cast-iron body, compression-type valve opening against pressure and closing with pressure.

a) Standard: AWWA C502.

b) Pressure Rating: [150 psig (1035 kPa) minimum] [250 psig (1725 kPa)].

5) Description: Freestanding, with one NPS 4-1/2 (DN 115) and two NPS 2-1/2 (DN 65) outlets, 5-1/4-inch (133-mm) main valve, drain valve, and NPS 6 (DN 150) mechanical-joint inlet. Hydrant shall have cast-iron body, compression-type valve opening against pressure and closing with pressure.

a) Standards: UL 246, FMG approved.

b) Pressure Rating: [150 psig (1035 kPa) minimum] [250 psig (1725 kPa)].

c) Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.

d) Operating and Cap Nuts: Pentagon, 1-1/2 inches (38 mm) point to flat.

e) Direction of Opening: Open hydrant valve by turning operating nut to left or counterclockwise.

f) Exterior Finish: Color chosen by local Fire Department.

PART 3 EXECUTION

3.1 EARTHWORK

A. Refer to Division 31 Section "Earth Moving" 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, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

E. Underground water-service piping NPS 4 and NPS 6 shall be the following:

1) NPS 4 and NPS 6: NPS 6 PVC, AWWA Class 150 pipe; PVC, AWWA Class 150 molded fittings; and gasketed joints.

F. Water Meter Box Water-Service Piping NPS 3/4 to NPS 2 shall be same as underground water-service piping.

G. Underground Fire-Service-Main Piping NPS 4 to NPS 8 shall be the following:

1) PVC, AWWA Class 150 pipe listed for fire-protection service; PVC Class 150 fabricated or molded fittings; and gasketed joints.

2) PVC, AWWA Class 200 pipe listed for fire-protection service; PVC Class 200 fabricated fittings; and gasketed joints.

H. Underground Combined Water-Service and Fire-Service-Main Piping NPS 6 to NPS 10 shall be the following:

- 1) PVC, AWWA Class 150 or 200 pipe listed for fire-protection service; PVC fabricated or molded fittings of same class as pipe; and gasketed joints.

3.3 VALVE APPLICATIONS

- A. General Application: Use mechanical-joint-end valves for NPS 3 and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 and smaller installation.
- B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1) Underground Valves, NPS 3 (DN 80) and Larger: AWWA, cast-iron, nonrising-stem, resilient-seated gate valves with valve box.
 - 2) Underground Valves, NPS 4 (DN 100) and Larger, for Indicator Posts: UL/FMG, cast-iron, nonrising-stem gate valves with indicator post.
 - 3) Use the following for valves in vaults and aboveground:
 - a) Gate Valves, NPS 2 and Smaller: bronze, nonrising or rising stem.
 - b) Gate Valves, NPS 3 and Larger: AWWA, cast iron, OS&Y rising stem, metal seated.

3.4 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. See Division 22 Section "Common Work Results for Plumbing" for piping-system common requirements.

3.5 PIPING INSTALLATION

- A. Water-Main Connection: Arrange with utility company for tap of size and in location indicated in water main.
- B. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.
- C. Make connections 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. Comply with NFPA 24 for fire-service-main piping materials and installation.
- E. Bury piping with depth of cover over top at least 48 inches.
- F. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.

- 1) Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.

- G. Sleeves are specified in Division 22 Section "Common Work Results for Plumbing."
- H. Mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
- I. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

3.7 JOINT CONSTRUCTION

- A. See Division 22 Section "Common Work Results for Plumbing" for basic piping joint construction.
- B. Make pipe joints according to the following:
 - 1) 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.
 - 2) Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure. Refer to Division 22 Section "Common Work Results for Plumbing" for joining piping of dissimilar metals.

3.8 ANCHORAGE INSTALLATION

- A. Anchorage, General: Anchorages and restrained-joint types that may be used include the following:
 - 1) Concrete thrust blocks.
 - 2) Locking mechanical joints.
 - 3) Set-screw mechanical retainer glands.
 - 4) Bolted flanged joints.
 - 5) Heat-fused joints.
 - 6) Pipe clamps and tie rods.
- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
 - 1) Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
 - 2) Fire-Service-Main Piping: According to NFPA 24.

- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.9 VALVE INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
- B. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.
- C. MSS Valves: Install as component of connected piping system.
- D. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

3.10 WATER METER INSTALLATION

- A. Install water meters, piping, and specialties according to utility company's written instructions.

3.11 BACKFLOW PREVENTER INSTALLATION

- A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.
- B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.
- C. Do not install bypass piping around backflow preventers.
- D. Support NPS 2-1/2 and larger backflow preventers, valves, and piping near floor and on brick or concrete piers.

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 with top 2 inches above surface.

3.13 CONCRETE VAULT INSTALLATION

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

3.14 FIRE HYDRANT INSTALLATION

- A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.
- B. Wet-Barrel Fire Hydrants: Install with valve below frost line. Provide for drainage.
- C. AWWA Fire Hydrants: Comply with AWWA M17.
- D. UL/FMG Fire Hydrants: Comply with NFPA 24.

3.15 FIRE DEPARTMENT CONNECTION INSTALLATION

- A. Install protective pipe bollards on two sides of each fire department connection as shown on the drawings. Pipe bollards are shown on the drawings.

3.16 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.
 - 1) Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
- C. Prepare reports of testing activities.

3.17 IDENTIFICATION

- A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Division 31 Section "Earth Moving."
- B. Permanently attach equipment nameplate or marker indicating plastic water-service piping, on main electrical meter panel. See Division 22 Section "Common Work Results for Plumbing" for identifying devices.

3.18 CLEANING

- A. Clean and disinfect water-distribution piping as follows:
 - 1) Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
 - 2) Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
 - 3) Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
 - a) Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
 - b) Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
 - c) After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.

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- d) Submit water samples in sterile bottles to authorities having jurisdiction.
Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

END OF SECTION

SECTION 33 13 13 FACILITY SANITARY SEWERS**PART 1 GENERAL****1.1 SUMMARY****B. Section Includes:**

- 1) Pipe and fittings
- 2) Nonpressure and pressure couplings
- 3) Expansion joints
- 4) Cleanouts
- 5) Encasement for piping
- 6) Manholes

1.2 SUBMITTALS

- A. Product Data: For expansion joints.
- B. Shop Drawings: For manholes. Include plans, elevations, sections, details, and frames and covers.
- C. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from sewer system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.
- D. Product Certificates: For each type of cast-iron soil pipe and fitting, from manufacturer.
- E. Field quality-control reports.

PART 2 PRODUCTS**2.1 PVC PIPE AND FITTINGS****A. PVC Corrugated Sewer Piping:**

- 1) Pipe: ASTM F 949, PVC corrugated pipe with bell-and-spigot ends for gasketed joints.
- 2) Fittings: ASTM F 949, PVC molded or fabricated, socket type.
- 3) Gaskets: ASTM F 477, elastomeric seals.

B. PVC Type PSM Sewer Piping:

- 1) Pipe: ASTM D 3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
- 2) Fittings: ASTM D 3034, PVC with bell ends.

- 3) Gaskets: ASTM F 477, elastomeric seals.

2.2 NONPRESSURE-TYPE TRANSITION COUPLINGS

- A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground non-pressure 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 Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - 2) For Concrete Pipes: ASTM C 443, rubber.
 - 3) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - 4) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- A. Unshielded, Flexible Couplings:
- 1) Description: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
- B. 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.

2.3 CLEANOUTS

- A. Cast-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
- 1) Top-Loading Classification: Heavy Duty.
 - 2) Sewer Pipe Fitting and Riser to Cleanout: ASTM F 949, PVC.

2.4 ENCASEMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105.
- B. Material: High-density, cross-laminated polyethylene film of 0.004-inch minimum thickness.
- C. Form: Tube.

2.5 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 5-inch minimum thickness for walls and base riser section; with separate base slab or base section with integral floor.
- 5) Riser Sections: 5-inch minimum thickness, of length to provide depth indicated.
- 6) Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated; with 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: As shown in details.
- 10) Adjusting Rings: Interlocking HDPE rings, with level or sloped edge in thickness and diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
- 11) Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, with diameter matching manhole frame and cover, and with 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 5-inch- minimum-width flange and 26-inch- (660-mm-) diameter cover.
- 2) Material: ASTM A 536, Grade 60-40-18 ductile iron unless otherwise indicated.

2.6 CONCRETE

A. General: Cast-in-place concrete complying with 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 (27.6 MPa) 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: 4 percent.
- C. 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.

PART 3 EXECUTION

3.1 EARTHWORK

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

3.2 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewer 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 using 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. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
- F. Install gravity-flow, non-pressure, drainage piping according to the following:
 - 1) Install piping pitched down in direction of flow, at minimum slope of 1 percent unless otherwise indicated.

- G. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.3 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, non-pressure, drainage piping.
- B. Pipe couplings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
 - 1) Use non-pressure flexible couplings where required to join gravity-flow, non-pressure sewer piping unless otherwise indicated.
 - a) Unshielded flexible couplings for pipes of same or slightly different OD.
 - b) Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
 - c) Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

3.4 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. Install FRP manholes according to manufacturer's written instructions.
- D. Form continuous concrete channels and benches between inlets and outlet.
- 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.
- E. Install manhole-cover inserts in frame and immediately below cover.

3.5 CONCRETE PLACEMENT

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

3.6 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. 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, 24 by 24 by 6 inches deep. Set with tops 1 inch above surrounding grade.

- C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.7 CONNECTIONS

- A. Connect non-pressure, gravity-flow drainage piping to building's sanitary building drains specified in Division 22 Section "Sanitary Waste and Vent 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 by cutting opening into existing unit 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 or manhole 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 and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
- C. Connect to grease and/or interceptors specified in Division 22 Section "Sanitary Waste Interceptors."

3.8 IDENTIFICATION

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

3.9 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 report 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.
- 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 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) Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:
 - a) Fill sewer piping with water. Test with pressure of at least 10-foot head of water, and maintain such pressure without leakage for at least 15 minutes.
 - b) Close openings in system and fill with water.
 - c) Purge air and refill with water.
 - d) Disconnect water supply.
 - e) Test and inspect joints for leaks.
 - 6) Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
 - a) Option: Test plastic gravity sewer piping according to ASTM F 1417.
 - b) Option: Test concrete gravity sewer piping according to ASTM C 924.
 - 7) Manholes: Perform hydraulic test according to ASTM C 969.
- 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.

3.10 CLEANING

- A. Clean dirt and superfluous material from interior of piping. Flush with potable water.

END OF SECTION

SECTION 33 41 00 STORM UTILITY DRAINAGE PIPING**PART 1 GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- B. This Section includes gravity-flow, nonpressure storm drainage outside the building, with the following components:
 - 1) Special fittings for expansion and deflection
 - 2) Backwater valves
 - 3) Cleanouts
 - 4) Drains
 - 5) Corrosion-protection piping encasement
 - 6) Precast concrete and Cast-in-place concrete manholes

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- C. EPDM: Ethylene-propylene-diene-monomer rubber.
- D. FRP: Fiberglass-reinforced plastic.
- E. LLDPE: Linear low-density, polyethylene plastic.
- F. PE: Polyethylene plastic.
- G. PP: Polypropylene plastic.
- H. PVC: Polyvinyl chloride plastic.
- I. RTRF: Glass-fiber-reinforced, thermosetting-resin fitting.
- J. RTRP: Glass-fiber-reinforced, thermosetting-resin pipe.
- K. TPE: Thermoplastic elastomer.

1.4 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water (30 kPa). Pipe joints shall be at least silttight, unless otherwise indicated.

1.5 SUBMITTALS**A. Product Data:** For the following:

- 1) Special pipe fittings
- 2) Backwater valves
- 3) Drains
- 4) Channel drainage systems
- 5) 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.****1.6 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.

1.7 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 **Architect** and **Owner** no fewer than **two (2)** days in advance of proposed interruption of service.
- 2) Do not proceed with interruption of service without **Owner's** written permission.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

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

2.2 PIPING MATERIALS

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

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service and Extra-Heavy classes.
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
- C. Shielded, Stainless-Steel Couplings: CISPI 310, with ASTM A 666, Type 301, stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
- 1) Available Manufacturers:
 - a) ANACO.
 - b) Dallas Specialty & Mfg. Co.
 - c) Fernco Inc.
 - d) Ideal Div.; Stant Corp.
 - e) Mission Rubber Company; a division of MCP Industries, Inc.
 - f) Tyler Pipe; Soil Pipe Div.
 - 2) Couplings for NPS 1-1/2 to NPS 4 (DN 40 to DN 100): 2-1/8-inch- (54-mm-) wide shield with 2 bands.
 - 3) Couplings for NPS 5 and NPS 6 (DN 125 and DN 150): 3-inch- (76-mm-) wide shield with 4 bands.
 - 4) Couplings for NPS 8 and NPS 10 (DN 200 and DN 250): 4-inch- (102-mm-) wide shield with 4 bands.
- D. Heavy-Duty, Shielded, Stainless-Steel Couplings, NPS 10 (DN 250) and Smaller: With ASTM A 666, Type 301 or Type 304, stainless-steel shield; 2 or more stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.

- 1) Available Manufacturers:
 - a) ANACO
 - b) Clamp-All Corp.
 - c) Dallas Specialty & Mfg. Co.
 - d) Ideal Div.; Stant Corp.
 - e) Mission Rubber Company; a division of MCP Industries, Inc.
 - f) Tyler Pipe; Soil Pipe Div.
 - 2) Couplings for NPS 1-1/2 to NPS 4 (DN 40 to DN 100): 3 inches (76 mm).
 - 3) Couplings for NPS 5 to NPS 10 (DN 125 to DN 250): 4 inches (102 mm).
- E. Heavy-Duty, Shielded, Stainless-Steel Couplings, NPS 12 and NPS 15 (DN 300 and DN 375): With ASTM A 666, Type 301 or Type 304, stainless-steel shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
- 1) Available Manufacturers:
 - a) ANACO
 - b) Ideal Div.; Stant Corp.
 - c) Mission Rubber Company; a division of MCP Industries, Inc.
 - d) Tyler Pipe; Soil Pipe Div.
 - 2) Couplings: 5-1/2-inch- (140-mm-) wide shield with 6 bands.
- F. Heavy-Duty, Cast-Iron Couplings: ASTM A 48, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.
- 1) Available Manufacturers:
 - a) MG Piping Products Co.
 - 2) Couplings for NPS 1-1/2 to NPS 4 (DN 40 to DN 100): 2-1/8-inch- (54-mm-) wide housing with 2 bolts.
 - 3) Couplings for NPS 5 and NPS 6 (DN 125 and DN 150): 3-1/8-inch- (80-mm-) wide housing with 4 bolts.
 - 4) Couplings for NPS 8 and NPS 10 (DN 200 and DN 250): 4-inch- (102-mm-) wide housing with 4 bolts.
- G. Unshielded Couplings: ASTM C 1461, rigid, 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.
- 1) Available Manufacturers:
 - a) ANACO
 - 2) Couplings for NPS 1-1/2 to NPS 4 (DN 40 to DN 100): Sleeve with two bands.

2.5 DUCTILE-IRON CULVERT PIPE AND FITTINGS

- A. Pipe: ASTM A 716, for push-on joints.
- B. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.
- C. Compact Fittings: AWWA C153, for push-on joints.

D. Gaskets: AWWA C111, rubber.

2.6 DUCTILE-IRON PRESSURE PIPE AND FITTINGS

A. Pipe: AWWA C151, for push-on joints.

B. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.

C. Compact Fittings: AWWA C153, for push-on joints.

D. Gaskets: AWWA C111, rubber.

2.7 STEEL PIPE AND FITTINGS

A. Corrugated-Steel Pipe and Fittings: ASTM A 760/A 760M, Type I with fittings of similar form and construction as pipe.

1) Special-Joint Bands: Corrugated steel with O-ring seals.

2) Standard-Joint Bands: Corrugated steel.

3) Coating: Zinc.

2.8 ALUMINUM PIPE AND FITTINGS

A. Corrugated Aluminum Pipe and Fittings: ASTM B 745/B 745M, Type I with fittings of similar form and construction as pipe.

1) Special-Joint Bands: Corrugated steel with O-ring seals.

2) Standard-Joint Bands: Corrugated steel.

2.9 ABS PIPE AND FITTINGS

A. ABS Sewer Pipe and Fittings: ASTM D 2751, with bell-and-spigot ends for gasketed joints.

1) NPS 3 to NPS 6 (DN 80 to DN 150): SDR 35.

2) NPS 8 to NPS 12 (DN 200 to DN 300): SDR 42.

3) Gaskets: ASTM F 477, elastomeric seals.

2.10 PE PIPE AND FITTINGS

A. Corrugated PE Drainage Pipe and Fittings NPS 10 (DN 250) 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) Corrugated PE Pipe and Fittings NPS 12 to NPS 48 (DN 250 to DN 1200): AASHTO M 294M, Type S, with smooth waterway for coupling joints.

- 4) Silttight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings.
- 5) Soiltight Couplings: AASHTO M 294M, corrugated, matching pipe and fittings.
- B. Corrugated PE Pipe and Fittings NPS 56 and NPS 60 (DN 1400 and DN 1524): 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.

2.11 PVC PIPE AND FITTINGS

- A. PVC Pressure Pipe: AWWA C900, Class 150, for gasketed joints and using ASTM F 477, elastomeric seals.
 - 1) Fittings NPS 4 to NPS 8 (DN 100 to DN 200): PVC pressure fittings complying with AWWA C907, for gasketed joints and using ASTM F 477, elastomeric seals.
 - 2) Fittings NPS 10 (DN 250) and Larger: Ductile-iron, compact fittings complying with AWWA C153, for push-on joints and using AWWA C111, rubber gaskets.
- B. PVC Water-Service Pipe and Fittings: ASTM D 1785, Schedule 80 pipe, with plain ends for solvent-cemented joints with ASTM D 2466, Schedule 80, socket-type fittings.
- C. PVC Cellular-Core Pipe and Fittings: ASTM F 891, Sewer and Drain Series, PS 50 minimum stiffness pipe with ASTM D 3034, SDR 35, socket-type fittings for solvent-cemented joints.
- D. PVC Sewer Pipe and Fittings, NPS 15 (DN 375) and Smaller: ASTM D 3034, SDR 35, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.
- E. PVC Sewer Pipe and Fittings, NPS 18 (DN 450) and Larger: ASTM F 679, T-1 wall thickness, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.
- F. 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.

2.12 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 (ASTM C 443M), rubber.
 - 2) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - 3) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - 4) 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.
- 1) Available Manufacturers:
 - a) Dallas Specialty & Mfg. Co.
 - b) Fernco Inc.
 - c) Logan Clay Products Company (The).
 - d) Mission Rubber Company; a division of MCP Industries, Inc.
 - e) NDS Inc.
 - f) Plastic Oddities, Inc.
- 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.
- 1) Available Manufacturers:
 - a) Cascade Waterworks Mfg.
 - b) Dallas Specialty & Mfg. Co.
 - c) Mission Rubber Company; a division of MCP Industries, Inc.
- 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.
- 1) Available Manufacturers:
 - a) Fernco Inc.
 - b) Logan Clay Products Company (The)
 - c) Mission Rubber Company; a division of MCP Industries, Inc.
- 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.
- 1) Available Manufacturers:
 - a) ANACO.

2.14 SPECIAL PIPE FITTINGS

- A. Ductile-Iron Flexible Expansion Joints: Compound fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include 2 gasketed ball-joint sections and 1 or more gasketed sleeve sections, rated for 250-psig (1725-kPa) minimum working pressure and for offset and expansion indicated.
- 1) Available Manufacturers:
 - a) EBAA Iron Sales, Inc.
 - b) Romac Industries, Inc.
 - c) Star Pipe Products

- B. Ductile-Iron Deflection Fittings: Compound coupling fitting with ball joint, flexing section, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include rating for 250-psig (1725-kPa) minimum working pressure and for up to 15 degrees of deflection.

- 1) Available Manufacturers:
a) EBAA Iron Sales, Inc.

- C. Ductile-Iron Expansion Joints: Three-piece assembly of telescoping sleeve with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Include rating for 250-psig (1725-kPa) minimum working pressure and for expansion indicated.

- 1) Available Manufacturers:
a) Dresser, Inc.; DMD Div.
b) EBAA Iron Sales, Inc.
c) JCM Industries
d) Smith-Blair, Inc.

2.15 BACKWATER VALVES

- A. Gray-Iron Backwater Valves: ASME A112.14.1, gray-iron body and bolted cover, with bronze seat.

- 1) Available Manufacturers:
a) Josam Company
b) Smith, Jay R. Mfg. Co.
c) Wade Div.; Tyler Pipe
d) Watts Industries, Inc.
e) Watts Industries, Inc.; Enpoco, Inc. Div.
f) Zurn Industries, Inc.; Zurn Specification Drainage Operation

- 2) Horizontal Type: With swing check valve and hub-and-spigot ends.

- 3) Combination Horizontal and Manual Gate-Valve Type: With swing check valve, integral gate valve, and hub-and-spigot ends.

- 4) Terminal Type: With bronze seat, swing check valve, and hub inlet.

- B. PVC Backwater Valves: Horizontal type; with PVC body, PVC removable cover, and PVC swing check valve.

- 1) Available Manufacturers:
a) Canplas Inc.
b) IPS Corporation
c) NDS Inc.
d) Plastic Oddities, Inc.
e) Sioux Chief Manufacturing Company, Inc.
f) Zurn Industries, Inc.; Zurn Light Commercial Specialty Plumbing Products

2.16 CLEANOUTS

- A. Gray-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.

- 1) Available Manufacturers:
 - a) Josam Company
 - b) MIFAB Manufacturing, Inc.
 - c) Smith, Jay R. Mfg. Co.
 - d) Wade Div.; Tyler Pipe
 - e) Watts Industries, Inc.
 - f) Watts Industries, Inc.; Enpoco, Inc. Div.
 - g) Zurn Industries, Inc.; Zurn Specification Drainage Operation
 - 2) Top-Loading Classification(s): Heavy and Extra-heavy duty.
 - 3) Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.
- B. PVC Cleanouts: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.
- 1) Available Manufacturers:
 - a) Canplas Inc.
 - b) IPS Corporation
 - c) NDS Inc.
 - d) Plastic Oddities, Inc.
 - e) Sioux Chief Manufacturing Company, Inc.
 - f) Zurn Industries, Inc.; Zurn Light Commercial Specialty Plumbing Products

2.17 DRAINS

- A. Gray-Iron Area Drains: ASME A112.21.1M, round body with anchor flange and round secured grate. Include bottom outlet with inside calk or spigot connection, of sizes indicated.
- 1) Available Manufacturers:
 - a) Josam Company
 - b) MIFAB Manufacturing, Inc.
 - c) Smith, Jay R. Mfg. Co.
 - d) Wade Div.; Tyler Pipe
 - e) Watts Industries, Inc.
 - f) Watts Industries, Inc.; Enpoco, Inc. Div.
 - g) Zurn Industries, Inc.; Zurn Specification Drainage Operation
 - 2) Top-Loading Classification(s): Heavy duty.
- B. Gray-Iron Trench Drains: ASME A112.21.1M, 6-inch- (150-mm-) wide top surface, rectangular body with anchor flange or other anchoring device, and rectangular secured grate. Include units of total length indicated and number of bottom outlets with inside calk or spigot connections, of sizes indicated.
- 1) Available Manufacturers:
 - a) Josam Company
 - b) Smith, Jay R. Mfg. Co.
 - c) Wade Div.; Tyler Pipe
 - d) Watts Industries, Inc.
 - e) Watts Industries, Inc.; Enpoco, Inc. Div.
 - f) Zurn Industries, Inc.; Zurn Specification Drainage Operation

- 2) Top-Loading Classification(s): Heavy duty.

2.18 MANHOLES

- A. Standard Precast Concrete Manholes: ASTM C 478 (ASTM C 478M), precast, reinforced concrete, of depth indicated, with provision for sealant joints.
 - 1) Diameter: 48 inches (1200 mm) minimum, unless otherwise indicated.
 - 2) Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
 - 3) Base Section: 6-inch (150-mm) minimum thickness for floor slab and 4-inch (102-mm) minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
 - 4) Riser Sections: 4-inch (102-mm) 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 (ASTM C 990M), bitumen or butyl rubber.
 - 7) Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), 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 (13-mm) 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 (300- to 400-mm) intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches (1500 mm).
 - 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 (150- to 225-mm) total thickness, to match diameter of manhole frame and cover.
 - 11) Manhole Frames and Covers: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch- (102-mm-) minimum width flange and 26-inch- (660-mm-) 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 iron, unless otherwise indicated.
 - b) Protective Coating: Foundry-applied, SSPC-Paint 16, coal-tar, epoxy-polyamide paint; 10-mil (0.26-mm) minimum thickness applied to all surfaces, unless otherwise indicated.
- B. Designed Precast Concrete Manholes: ASTM C 913; designed according to ASTM C 890 for A-16 (ASSHTO HS20-44), heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for sealant joints.

- 1) Ballast: Increase thickness of one or more precast concrete sections or add concrete to manhole, as required to prevent flotation.
 - 2) Joint Sealant: ASTM C 990 (ASTM C 990M), bitumen or butyl rubber.
 - 3) Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), cast or fitted into manhole walls, for each pipe connection.
 - 4) Steps: Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) 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 (300- to 400-mm) intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches (1500 mm).
 - 5) Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
 - 6) Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, to match diameter of manhole frame and cover.
 - 7) Manhole Frames and Covers: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch- (102-mm-) minimum width flange and 26-inch- (660-mm-) 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 iron, unless otherwise indicated.
 - b) Protective Coating: Foundry-applied, SSPC-Paint 16, coal-tar, epoxy-polyamide paint; 10-mil (0.26-mm) minimum thickness applied to all surfaces, unless otherwise indicated.
- C. 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) Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), cast or fitted into manhole walls, for each pipe connection.
 - 3) Steps: Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) 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 (300- to 400-mm) intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches (1500 mm).
 - 4) Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
 - 5) Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, to match diameter of manhole frame and cover.
 - 6) Manhole Frames and Covers: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch- (102-mm-) minimum width flange and 26-

inch- (660-mm-) 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, unless otherwise indicated.
- b) Protective Coating: Foundry-applied, SSPC-Paint 16, coal-tar, epoxy-polyamide paint; 10-mil (0.26-mm) minimum thickness applied to all surfaces, unless otherwise indicated.

2.19 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: 4500 psi (27.6 MPa) 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 (420 MPa), deformed steel.
- C. Ballast and Pipe Supports: Portland cement design mix, 4500 psi (20.7 MPa) 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 (420 MPa), deformed steel.

2.20 CATCH BASINS

- A. Standard Precast Concrete Catch Basins: ASTM C 478 (ASTM C 478M), precast, reinforced concrete, of depth indicated, with provision for sealant joints.
 - 1) Base Section: 6-inch (150-mm) minimum thickness for floor slab and 4-inch (102-mm) minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
 - 2) Riser Sections: 4-inch (102-mm) minimum thickness, 48-inch (1220-mm) 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 (ASTM C 990M), 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 (150- to 229-mm) total thickness, that match 24-inch- (610-mm-) diameter frame and grate.
 - 7) Steps: Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) 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 (300- to 400-mm) intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 60 inches (1500 mm).
 - 8) Pipe Connectors: ASTM C 923 (ASTM C 923M), resilient, of size required, for each pipe connecting to base section.
- B. Designed Precast Concrete Catch Basins: ASTM C 913, precast, reinforced concrete; designed according to ASTM C 890 for A-16 (ASSHTO HS20-44), heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for sealant joints.
- 1) Joint Sealants: ASTM C 990 (ASTM C 990M), bitumen or butyl rubber.
 2. 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.
 3. Grade Rings: Include 2 or 3 reinforced-concrete rings, of 6- to 9-inch (150- to 229-mm) total thickness, that match 24-inch- (610-mm-) diameter frame and grate.
 4. Steps: Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) 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 (300- to 400-mm) intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 60 inches (1500 mm).
 5. Pipe Connectors: ASTM C 923 (ASTM C 923M), resilient, of size required, for each pipe connecting to base section.
- C. 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 (13-mm) 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 (300- to 400-mm) intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 60 inches (1500 mm).

- D. 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.
 - 4. Size: 24 by 24 inches (610 by 610 mm) minimum, unless otherwise indicated.
 - 5. Grate Free Area: Approximately 50 percent, unless otherwise indicated.
- E. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include 24-inch (610-mm) ID by 7- to 9-inch (178- to 229-mm) riser with 4-inch (102-mm) minimum width flange, and 26-inch- (660-mm-) diameter flat grate with small square or short-slotted drainage openings.
 - 6. Grate Free Area: Approximately 50 percent, unless otherwise indicated.

2.21 STORMWATER INLETS

- A. Curb Inlets: Made with vertical curb opening, of materials and dimensions according to utility standards.
- B. Gutter Inlets: Made with horizontal gutter opening, of materials and dimensions according to utility standards. Include heavy-duty frames and grates.
- C. Combination Inlets: Made with vertical curb and horizontal gutter openings, of materials and dimensions according to utility standards. Include heavy-duty frames and grates.
- D. Frames and Grates: Heavy-duty frames and grates according to utility standards.
- E. Curb Inlets: Vertical curb opening, of materials and dimensions indicated.
- F. Gutter Inlets: Horizontal gutter opening, of materials and dimensions indicated. Include heavy-duty frames and grates.
- G. Combination Inlets: Vertical curb and horizontal gutter openings, of materials and dimensions indicated. Include heavy-duty frames and grates.
- H. Frames and Grates: Dimensions, opening pattern, free area, and other attributes indicated.

2.23 PIPE OUTLETS

- L. Head Walls: Cast-in-place reinforced concrete, with apron and tapered sides.
- M. Riprap Basins: Broken, irregular size and shape, graded stone according to NSSGA's "Quarried Stone for Erosion and Sediment Control."
 - 1. Average Size: NSSGA No. R-3, screen opening 2 inches (51 mm).
 - 2. Average Size: NSSGA No. R-4, screen opening 3 inches (76 mm).
 - 3. Average Size: NSSGA No. R-5, screen opening 5 inches (127 mm).
- N. Filter Stone: According to NSSGA's "Quarried Stone for Erosion and Sediment Control," No. FS-2, No. 4 screen opening, average-size, graded stone.

- O. Energy Dissipaters: According to NSSGA's "Quarried Stone for Erosion and Sediment Control," No. A-1, 3-ton (2700-kg) average weight armor stone, unless otherwise indicated.

2.25 MISCELLANEOUS MATERIALS

- A. Paint: SSPC-Paint 16.
- B. PE Sheeting: ASTM D 4397, with at least 8-mil (0.2-mm) thickness.

PART 3 EXECUTION

3.1 EARTHWORK

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

3.2 PIPING APPLICATIONS

- A. Pipe couplings and special pipe 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.
 - a) Unshielded flexible or rigid couplings for same or minor difference OD pipes.
 - b) Unshielded, increaser/reducer-pattern, flexible or rigid couplings for pipes with different OD.
 - c) Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
- B. Special Pipe Fittings: Use for pipe expansion and deflection. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
- C. Gravity-Flow, Nonpressure Sewer Piping: Use the following pipe materials for each size range:
 - A. NPS 4 and NPS 6 (DN 100 and DN 150): PVC sewer pipe and fittings, solvent-cemented joints, or gaskets, and gasketed joints.

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.
- P. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.
- Q. Install gravity-flow, nonpressure drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow, at minimum slope of 1 percent, unless otherwise indicated.
 - 2. Install piping NPS 6 (DN 150) and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.
 - 3. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
 - 4. Install hubless cast-iron soil piping according to CISPI C310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
 - 5. Install ductile-iron culvert piping according to ASTM A 716.
 - 6. Install ductile-iron and special fittings according to AWWA C600 or AWWA M41.
 - 7. Install corrugated steel piping according to ASTM A 798/A 798M.
 - 8. Install corrugated aluminum piping according to ASTM B 788/B 788M.
 - 9. Install ABS sewer piping according to ASTM D 2321 and ASTM F 1668.
 - 12) Install PE corrugated sewer piping according to CPPA's "Recommended Installation Practices for Corrugated Polyethylene Pipe and Fittings."
 - 13. Install PVC cellular-core piping according to ASTM D 2321 and ASTM F 1668.
 - 14. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
 - 15. Install PVC profile gravity sewer piping according to ASTM D 2321 and ASTM F 1668.
 - 16. Install fiberglass sewer piping according to ASTM D 3839 and ASTM F 1668.
 - 17) Install nonreinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."
 - 18) Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

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:

17. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
18. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
- 2) Join hubless cast-iron soil piping according to CISPI C310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- 3) Join ductile-iron culvert piping according to AWWA C600 for push-on joints.
- 4) Join ductile-iron and special fittings according to AWWA C600 or AWWA M41.
- 5) Join corrugated steel sewer piping according to ASTM A 798/A 798M.
- 6) Join corrugated aluminum sewer piping according to ASTM B 788/B 788M.
- 7) Join ABS sewer piping according to ASTM D 2321 and ASTM D 2751 for elastomeric-seal joints.
- 8) Join corrugated PE piping according to CPPA 100 and the following:
 - a) Use silttight couplings for Type 1, silttight joints.
 - b) Use soiltight couplings for Type 2, soiltight joints.
- 9) Join PVC cellular-core piping according to ASTM D 2321 and ASTM F 891 for solvent-cement joints.
- 10) 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.
- 11) Join PVC profile gravity sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
- 12) Join fiberglass sewer piping according to ASTM D 3839 for elastomeric-seal joints.
- 13) Join nonreinforced-concrete sewer piping according to ASTM C 14 (ASTM C 14M) and ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints.
- 14) Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints.
- 15) Join dissimilar pipe materials with nonpressure-type flexible couplings.

3.5 BACKWATER VALVE INSTALLATION

- A. Install horizontal-type backwater valves in piping where indicated.
- B. Install combination horizontal and manual gate valve type in piping and in manholes where indicated.
- C. Install terminal-type backwater valves on end of piping and in manholes where indicated.

3.6 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.
 - 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.
 - 19. Use heavy-duty, top-loading classification cleanouts in vehicle-traffic service areas.
 - 20. Use extra-heavy-duty, top-loading classification cleanouts in roads areas.
- B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 inches (450 by 450 by 300 mm) deep. Set with tops 1 inch (25 mm) above surrounding earth grade.
- C. Set cleanout frames and covers in concrete pavement with tops flush with pavement surface.

3.7 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 areas.
- B. Embed drains in 4-inch (102-mm) 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.
- E. Assemble trench sections with flanged joints.
- F. Embed trench sections in 4-inch (102-mm) minimum concrete around bottom and sides.

3.8 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. Install PE sheeting on earth where cast-in-place-concrete manholes are to be built.
- E. Install FRP manholes according to manufacturer's written instructions.
- F. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches (76 mm) above finished surface elsewhere, unless otherwise indicated.

3.9 CATCH BASIN INSTALLATION

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

3.10 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.

3.11 CONCRETE PLACEMENT

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

3.12 DRAINAGE SYSTEM INSTALLATION

- A. Assemble and install components according to manufacturer's written instructions.
- B. Install with top surfaces of components, except piping, flush with finished surface.
- C. Assemble channel sections to form slope down toward drain outlets. Use sealants, adhesives, fasteners, and other materials recommended by system manufacturer.
- D. Embed channel sections and drainage specialties in 4-inch (102-mm) minimum concrete around bottom and sides.
- E. Fasten grates to channel sections if indicated.
- F. Assemble channel sections with flanged or interlocking joints.
- G. Embed channel sections in 4-inch (102-mm) minimum concrete around bottom and sides.

3.13 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Division 22 Section "Facility Storm Drainage Piping."
- B. Connect to sediment interceptors specified in Division 22 Section "Sanitary Waste Interceptors."

3.14 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- (203-mm-) 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 (915 mm) below final grade. Fill to within 12 inches (300 mm) 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."

3.15 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 warning tape or detectable warning tape over ferrous piping.
 - 2) Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.16 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (610 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 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 (ASTM C 924M).
- 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.

3.17 CLEANING

- A. Clean interior of piping of dirt and superfluous materials.

END OF SECTION

ADDENDUM ACKNOWLEDGEMENT FORM
SOLICITATION NO.: WSH13095

Instructions: Please acknowledge receipt of all addenda issued with this solicitation by completing this addendum acknowledgment form. Check the box next to each addendum received and sign below. Failure to acknowledge addenda may result in bid disqualification.

Acknowledgment: I hereby acknowledge receipt of the following addenda and have made the necessary revisions to my proposal, plans and/or specification, etc.

Addendum Numbers Received:

(Check the box next to each addendum received)

| | |
|---|--|
| <input type="checkbox"/> Addendum No. 1 | <input type="checkbox"/> Addendum No. 6 |
| <input type="checkbox"/> Addendum No. 2 | <input type="checkbox"/> Addendum No. 7 |
| <input type="checkbox"/> Addendum No. 3 | <input type="checkbox"/> Addendum No. 8 |
| <input type="checkbox"/> Addendum No. 4 | <input type="checkbox"/> Addendum No. 9 |
| <input type="checkbox"/> Addendum No. 5 | <input type="checkbox"/> Addendum No. 10 |

I understand that failure to confirm the receipt of addenda may be cause for rejection of this bid. I further understand that any verbal representation made or assumed to be made during any oral discussion held between Vendor's representatives and any state personnel is not binding. Only the information issued in writing and added to the specifications by an official addendum is binding.

Company

Authorized Signature

Date

NOTE: This addendum acknowledgment should be submitted with the bid to expedite document processing.
 Revised 6/8/2012