

SPECIFICATIONS

FOR

RIVER OF LIFE BAPTIST CHURCH

BRUNSWICK COUNTY, NORTH CAROLINA

SITE EXPANSION

PREPARED BY



712 Village Road SW, Suite 103
Shallotte, NC 28470
FIRM LICENSE NO. C-0459
PROJECT NO. 23.07008

RIVER OF LIFE BAPTIST CHURCH
SITE EXPANSION

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PART 1 - GENERAL**1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. Section Includes:

- 1. Demolition and removal of selected portions of building or structure.
 - 2. Demolition and removal of selected site elements.
 - 3. Salvage of existing items to be reused or recycled.

- B. Related Requirements:

- 1. Division 01 Section "Summary" for restrictions on the use of the premises, Owner-occupancy requirements, and phasing requirements.
 - 2. Division 1 Section "Temporary Facilities and Controls" for temporary construction and environmental-protection measures for selective demolition operations.
 - 3. Division 01 Section "Execution Requirements" for cutting and patching procedures.
 - 4. Division 31 Section "Site Clearing" for site clearing and removal of above- and below-grade improvements.

1.3 DEFINITIONS

- A. Demolish: Completely remove and legally dispose of off-site.
- B. Recycle: Recovery of demolition waste for subsequent processing in preparation for reuse.
- C. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- D. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, allow for further use, and deliver to Owner ready for reuse.

- E. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- F. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Timber, steel and other merchantable goods and materials removed incidental to demolition shall remain the property of the Owner unless otherwise directed
- C. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
 - 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 PROJECT CONDITIONS

- A. Owner may operate portions of the facility immediately adjacent to selective demolition operations. Conduct selective demolition so Owner's operations will not be disrupted.
 - 1. Comply with requirements specified in Division 1 Section "Summary."
- B. Conditions existing at time of inspection for bidding purposes will be maintained by Owner as far as practical.
- C. Notify Engineer of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Engineer and Owner. Hazardous materials will be removed by the Contractor by way of a Change Order or by the Owner under a separate contract. If the removal of hazardous materials results in a delay to the Contractor's schedule an appropriate adjustment will be made to the Contract Time by way of Change Order.

- A. Hazardous Materials: Hazardous materials may be present in buildings and structures to be demolished. If a report on the presence of hazardous materials is on file for review and use, the Contractor may examine report to become aware of locations where hazardous materials are present.
 - 1. Hazardous material remediation is specified elsewhere in the Contract Documents.
 - 2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
 - 3. Owner will provide material safety data sheets for suspected hazardous materials that are known to be present in buildings and structures to be selectively demolished because of building operations or processes performed there.
- B. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.
- C. Storage or sale of removed items or materials on-site is not permitted.

1.6 PREDEMOLITION MEETING

- A. Predemolition Conference: Conduct conference at Project site.
 - 1. Inspect and discuss condition of construction to be selectively demolished.
 - 2. Review structural load limitations of existing structure.
 - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review and finalize protection requirements.
 - 5. Review procedures for protection of adjacent structures.
 - 6. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 - 7. Review areas where existing construction is to remain and requires protection.
 - 8. Review items to be salvaged and returned to Owner.
 - 9. Review procedures for the disposal of hazardous waste.

1.7 SUBMITTALS

- A. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property for

environmental protection, dust control, and noise control. Indicate proposed locations and construction of barriers.

B. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

C. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.

D. Predemolition Photographs or Video: Submit before Work begins.

E. Warranties: Documentation indicated that any existing warranties remain in effect after completion of selective demolition.

1.8 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

B. Landfill Records: Provide receipt for the acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

C. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.9 QUALITY ASSURANCE

A. Hazardous Material Abatement Firm Qualifications: An experienced firm that has specialized in abatement work similar in material and extent to that indicated for this Project.

1.10 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with

materials so as not to void existing warranties. Notify warrantor before proceeding.

- B. Notify warrantor upon completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

2.2 SOIL MATERIALS

- A. Satisfactory Soils: Comply with requirements in Division 31 Section "Earth Moving."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that all existing utilities have been disconnected, capped and/or de-energized before starting selective demolition operations.
- B. Review any available record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.
- C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Engineer.
- A. Engage a professional engineer properly licensed to practice in the state of the project site to perform an engineering survey of condition of structure to determine whether removing any element might result in structural deficiency or

unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.

1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
 2. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.
- B. Survey of Existing Conditions: Record existing conditions by use of measured drawings, preconstruction photographs, preconstruction videotapes, and templates.
1. Inventory and record the condition of items to be removed and salvaged. Provide photographs and/or video of conditions that might be misconstrued as damage caused by salvage operations.
 2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
1. Comply with requirements for existing services/systems interruptions specified in Division 01 Section "Summary."
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
1. Arrange to shut off indicated utilities with utility companies.
 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.

- c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
- C. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- 1. Comply with requirements for access and protection specified in Division 01 Section "Temporary Facilities and Controls."
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
- 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of structures.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 - 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Division 01 Section "Temporary Facilities and Controls."
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or

collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Upon completion of all new work, completely remove any remaining existing construction. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

B. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner or indicated on Drawings.
5. Protect items from damage during transport and storage.

C. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Engineer, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, then remove concrete between saw cuts.
- B. Hazardous Materials: If hazardous materials are encountered during selective demolition, obtain the services of a professional abatement firm to develop and carry-out procedures for removal of hazardous materials.
- C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
- D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.
- E. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.
- F. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight.
1. Remove existing roof membrane, flashings, copings, and roof accessories.
 2. Remove existing roofing system down to substrate.

3.6 SITE RESTORATION

- A. Below-Grade Areas: Completely fill below-grade areas and voids resulting from demolition operations with satisfactory soil materials according to backfill requirements in Division 31 Section "Earth Moving."
- B. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades. Eliminate areas where water may collect in depressions.

3.7 REPAIRS

- A. Promptly repair damage to adjacent improvements caused by demolition operations.

3.8 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an approved landfill acceptable to authorities having jurisdiction.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.

3.9 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

PART 1 - GENERAL**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Modified General and Supplementary Conditions and Division 01 Specification Sections, 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.
3. Division 01 Section "Construction Waste Management and Disposal".
4. Division 02 Section "Demolition" for demolition of buildings, structures, and site improvements.
5. Division 02 Section "Selective Demolition" for partial demolition of buildings or structures.

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. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

- 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. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, as indicated on Drawings or as designated by the Engineer.
- E. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, as indicated on Drawings or as designated by the Engineer.
- F. 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.
- B. Timber, steel and other merchantable materials removed incidental to clearing and grubbing shall remain the property of the Owner unless otherwise directed.

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 plants designated to remain.
- B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

- B. Work on Adjoining Property: Work on adjoining property will be not permitted without the written consent of the property owner and the Engineer. This shall include, but not limited to temporary access to the Work, storage of materials and any ground disturbing activities.
- C. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises.
- D. Utility Locator Service: Notify appropriate utility locator services for area where Project is located a minimum of 72 hours prior to commencing site clearing activities.
- E. Do not commence site clearing operations until temporary erosion and sedimentation control and plant/tree protection measures are in place.
- F. 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.
- G. Do not direct vehicle or equipment exhaust towards protection zones.
- H. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.
- I. 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 Section "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. Wrap a 1-inch blue vinyl tie tape flag around each tree trunk at 54 inches above the ground.
- C. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

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 and requirements of authorities having jurisdiction.
- 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. Upon the establishment of permanent vegetative covers, 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 (including root structure) to avoid injury.
- B. Enclose the trunks of trees which are to remain adjacent to the work with substantial wooden boxes of such height as may be necessary to protect them from piled material, equipment or equipment operation. Use excavating machinery and cranes of suitable type and operate the equipment with care to prevent injury to remaining tree trunks, roots, branches and limbs.
- C. Do not cut branches, limbs, and roots except by permission of the Engineer. Cut smoothly and neatly without splitting or crushing. In case of cutting or

unavoidable injury to branches, limbs, and trunks of trees, neatly trim the cut or injured portions and cover with an application of grafting wax and tree healing paint as directed.

- D. Protect by suitable means all cultivated hedges, shrubs and plants that might be injured by the Contractor's operations. Promptly heel in any such trees or shrubbery necessary to be removed and replanted. Perform heeling in and replanting under the direction of a licensed and experienced nurseryman. Replant in their original position all removed shrubbery and trees after construction operations have been substantially completed and care for until growth is reestablished.
- E. Replace cultivated hedges, shrubs, and plants injured to such a degree as to affect their growth or diminish their beauty or usefulness, by items of kind and quality at least equal to the kind and quality existing at the start of the work.

3.4 EXISTING UTILITIES

- A. Locate, identify, and disconnect utilities indicated to be removed or abandoned in place.
- B. 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 Engineer not less than three (3) days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Engineer's written permission.
- C. Excavate for and remove underground utilities indicated to be removed.

3.5 CLEARING AND GRUBBING

- A. Clearing and grubbing shall consist of the removal and satisfactory disposal of all trees, brush, stumps, logs, grass, weeds, roots, decayed vegetable matter, posts, fences, stubs, rubbish and all other objectionable matter resting on or protruding through the original ground surface and occurring within the construction limits or right of way of any excavation, borrow area, or embankment.
- B. 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. Grind down stumps and remove roots, obstructions, and debris to a depth of 18 inches below exposed subgrade.
 3. Use only hand methods for grubbing within protection zones.
 4. Chip removed tree branches and stockpile in approved areas, if approved by Engineer, or dispose of off-site.
- C. The work of clearing shall only be performed within the limits established by the plans, specifications, or the Engineer.
- D. Clearing shall consist of the felling and cutting up, or the trimming of, trees and the satisfactory disposal of the trees and other vegetation together with the down timber, snags, brush and rubbish occurring within the areas to be cleared. Trees and other vegetation, except such individual trees, groups of trees, and vegetation, as may be indicated on the plans to be left standing, and all stumps, roots and brush in the areas to be cleared shall be cut off 6 inches above the original ground surface.
- E. Individual trees and groups of trees designated to be left standing within cleared areas shall be trimmed of all branches to such heights and in such manner as may be necessary to prevent interference with construction operations. All limbs and branches required to be trimmed shall be neatly cut close to the whole of the tree or to main branches, and the cuts thus made shall be painted with an approved tree wound paint. Individual trees, groups of trees, and other vegetation, to be left standing shall be thoroughly protected from damage incident to construction operations by the erection of barriers or by such other means as the circumstances require.
- F. The Engineer will designate all areas of growth or individual trees which are to be preserved due to their desirability for landscape or erosion control purposes. When the trees to be preserved are located within the construction limits, they will be shown on the plans or designated by the Engineer.
- G. Clearing operations shall be conducted so as to prevent damage by falling trees to trees left standing, to existing structures and installations, and to those under construction, and so as to provide for the safety of employees and others. When such damages occur, all damaged areas shall be repaired, removed or otherwise resolved utilizing generally accepted practices at the Contractor's expense.
- H. Grubbing shall consist of the removal and disposal of all stumps, roots and matted roots from all cleared areas, except as herein specified.
- I. In embankment areas, when the depth of embankment exceeds 42 inches in height sound stumps shall be cut off not more than 6 inches above the existing

ground level and not grubbed. Unsound or decayed stumps shall be removed to a depth of approximately 2 feet below the natural ground surface.

- J. 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.
- K. Clearing and grubbing operations shall be completed sufficiently in advance of grading operations as may be necessary to prevent any of the debris from the clearing and grubbing operations from interfering with the excavation or embankment operations. All work under this section shall be performed in a manner which will cause minimum soil erosion. The Contractor shall perform such erosion control work, temporary or permanent, as may be directed by the Engineer in order to satisfactorily minimize erosion resulting from clearing and grubbing operations.

3.6 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to a depth of 6 inches in a manner to prevent intermingling with underlying subsoil or other waste materials.
 - 1. Remove subsoil and non-soil 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 respreading 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 the 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.
- C. If items are shown on the plans to be fully or partially removed and replaced, those existing improvements shall be carefully disassembled and/or removed as necessary to permit construction, safely stored by the Contractor to prevent harm to the materials, then following construction, reassembled in the original location in a manner that matches the assembly prior to its removal.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Timber, steel and other merchantable goods and materials removed incidental to clearing and grubbing shall remain the property of individual property owners, unless otherwise directed.
- B. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off site.
- C. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.
- D. All combustible matter shall be deposited at locations approved by authorities having jurisdiction. Combustible matter may be burned (with written approval of authorities having jurisdiction) or may be disposed of as stated above.
- E. Debris shall not be burned unless written permission or permit is issued by the Fire Marshall or other entity having jurisdiction. The Contractor shall adhere to all limitations and conditions set forth in the permit.
- F. Burning shall be done at such time and in such a manner as to prevent fire from spreading and to prevent any damage to adjacent cover and shall further be subject to all requirements of agencies having jurisdiction pertaining to the burning. Disposal by burning shall be kept under constant attendance until all fires have burned out or have been extinguished.

END OF SECTION 311000

PART 1 - GENERAL**1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. Section Includes:

- 1. Preparing subgrades for buildings, structures, 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 and base courses for concrete walks, and pavements and asphalt paving.
- 5. Subsurface drainage backfill for walls and trenches.
- 6. Excavating and backfilling trenches for utilities and pits for buried utility structures.

- B. Related Sections:

- 1. Division 01 Sections "Construction Progress Documentation" and "Photographic Documentations" 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 03 Section "Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
- 4. Divisions 21, 22, 23, 26, 27, 28, and 33 Sections for installing underground mechanical and electrical utilities and buried mechanical and electrical structures.
- 5. Division 31 Section "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above and below-grade improvements and utilities.
- 6. Division 32 Section "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.
- 7. Division 32 Section "Plants" for finish grading in planting areas and tree and shrub pit excavation and planting.

1.3 SITE CONDITIONS

- A. Site Information: Unless otherwise indicated in the Contract Documents, no subsurface test results are available for this project. Test borings and other exploratory operations may be undertaken by the Contractor at their own expense, provided such operations are acceptable to the Owner and authorities having jurisdiction.
- B. The Contract Documents may contain a Geotechnical Report in the appendix of these documents. When that is the case, all recommendations contained in the Geotechnical Report shall be implemented by the Contractor as described in that document.
- C. Where boring logs and related information are included in the Geotechnical Report, this information depicts approximate subsurface conditions only at these specific locations and at the particular time designated on the logs. Subsurface conditions at other locations may differ from those reported at the boring locations. It is expressly understood that neither the Owner nor the Engineer will be responsible for interpretations or conclusions drawn from the boring data by the Contractor. The data are made available for the convenience of the Contractor. Additional test borings and other exploratory operations may be undertaken by the Contractor at his own expense provided such operations are acceptable to the Owner and authorities having jurisdiction.

1.4 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. Cohesionless Materials: Include poorly and well graded gravels (GP and GW) and poorly and well graded sands (SP and SW). Cohesionless soils are generally regarded as free draining.
- F. Cohesive Materials: Clayey gravels (GC), clayey sands (SC), lean clays (CL), fat clays (CH), silts (ML and MH), and organic (GM) and silty sands (SM) will be

considered cohesionless only when the fines have a plastic index of 0. Otherwise they will be considered cohesive.

- G. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- H. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated for footings, foundations, pipework and other construction as shown on the Drawings.
 - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices or changes in the Work as appropriate.
 - 2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
 - 3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.
- I. Fill: Soil materials used to raise existing grades.
- J. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. for bulk excavation or 3/4 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
 - 1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch- wide, maximum, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,700 lbf and stick-crowd force of not less than 18,400 lbf with extra-long reach boom; measured according to SAE J-1179.
 - 2. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 230-hp flywheel power and developing a minimum of 47,992-lbf breakout force with a general-purpose bare bucket; measured according to SAE J-732.
- K. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by a geotechnical testing agency, according to ASTM D 1586.

- L. Select Backfill: Backfill and fill material that is transported to the site from outside the project limits, and which meets the soil requirements specified herein as satisfactory materials. Material excavated in conjunction with the construction of this project cannot be considered as “select backfill” for payment purposes.
- M. 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.
- N. 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.
- O. 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.
- P. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.5 SUBMITTALS

- A. Product Data: For each type of the following manufactured products required:
 - 1. Geotextiles.
 - 2. Flowable Fill (Controlled low-strength material), including design mixture.
 - 3. Warning tapes.
- B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:
 - 1. Classification according to ASTM D 2487.
 - 2. Laboratory compaction curve according to ASTM D 698.
- C. Blasting plan approved by authorities having jurisdiction.
- D. Seismic survey report from seismic survey agency.
- E. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.

1.6 QUALITY ASSURANCE

- A. **Blasting:** Comply with applicable requirements in NFPA 495, "Explosive Materials Code," and prepare a blasting plan reporting the following:
 - 1. Types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
 - 2. Seismographic monitoring during blasting operations.
- B. **Seismic Survey Agency:** An independent testing agency, acceptable to authorities having jurisdiction, experienced in seismic surveys and blasting procedures shall be provided and paid for by the Contractor to perform the following services:
 - 1. Report types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
 - 2. Seismographic monitoring during blasting operations.
- C. **Geotechnical Testing Agency:** A geotechnical testing firm will be selected by the Owner to provide construction material testing services as required for the project.
- D. All work associated with this Section shall comply with latest edition of the North Carolina Department of Transportation, Standard Specifications for Roads and Structures where those requirements are more stringent than those specified herein.
- E. All work associated with this Section shall comply with the latest edition of the North Carolina Department of Environment and Natural Resources, Erosion and Sediment Control Planning and Design Manual.
- F. Comply with all pollution control rules, regulations, ordinances, and statutes which apply to any work performed under the Contract, including any air pollution control rules, regulations, ordinances and statutes, or any municipal regulations pertaining to air pollution.
- G. During the progress of the work, maintain the area of activity, including sweeping and sprinkling of streets as necessary, so as to minimize the creation and dispersion of dust. If the Engineer determines that it is necessary to use calcium chloride or more effective dust control, furnish and spread the material, as directed, and without additional compensation.

1.7 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
 - 1. Do not proceed with work on adjoining property until directed by Engineer.
- C. Utility Locator Service: Notify appropriate utility locator services for area where Project is located before beginning earth moving operations.
- D. Do not commence earth moving operations until tree 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.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Borrow material shall be selected to meet the requirements and conditions of the particular fill for which its use is intended. Sand clay soils shall be capable

of being readily shaped and compacted to the required densities, and shall be free of roots, trash, and other deleterious material. Unless specifically provided, no borrow shall be obtained within the limits of the project site without written approval. Borrow shall meet the same requirements as other onsite materials as specified herein.

- C. The Contractor shall place only borrow material that has been specifically identified as acceptable for this section, unless otherwise directed by the Engineer.
- D. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, CL, ML, and SM according to ASTM D 2487 or Groups A-1, A-2-4, A-2-5, and A-3 according to AASHTO M 145, or a combination of these groups; free of masonry, rock or boulders larger than 4 inches in any dimension, and free of metal, gypsum, lime, debris, waste, frozen materials, vegetation, and other deleterious matter, unless otherwise specified.
 - 1. Organically contaminated soils must be removed from the area of grading operations. At the discretion of the Engineer, topsoil within the area to be stripped shall be stockpiled in a convenient area, selected by the Engineer, for later use in planting areas. All topsoil shall be graded by the Engineer as suitable and shall be stockpiled separately as directed by the Engineer in the field.
 - 2. Soft or excessively yielding material shall be removed and replaced with inert controlled fill.
 - 3. All roots, organic matter, trash, debris, and other unsuitable materials that may find their way into otherwise acceptable fill material shall be removed during the dumping and spreading operations.
 - 4. Fill material shall have a minimum laboratory dry weight, ASTM D-698, of at least 100 pounds per cubic foot unless specifically exempted from this requirement by the Engineer.
- E. Unsatisfactory Soils: Soil Classification Groups GC, SC, OL, CH, MH, OH, and PT according to ASTM D 2487 and Groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7 according to AASHTO M 145, or a combination of these groups, unless otherwise specified.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- F. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- G. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least

95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.

- H. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- I. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
- J. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.
- K. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 4 sieve.
- L. Pipe Bedding: Narrowly graded washed crushed stone or crushed gravel meeting the requirements of ASTM D 448, aggregate grading size 57.
- M. Sand: ASTM C 33; fine aggregate.
- N. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GEOTEXTILES

- A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 - 1. Survivability: Class 2; AASHTO M 288.
 - 2. Grab Tensile Strength: 157 lbf; ASTM D 4632.
 - 3. Sewn Seam Strength: 142 lbf; ASTM D 4632.
 - 4. Tear Strength: 56 lbf; ASTM D 4533.
 - 5. Puncture Strength: 56 lbf; ASTM D 4833.
 - 6. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
 - 7. Permittivity: 0.2 per second, minimum; ASTM D 4491.
 - 8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

- B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Grab Tensile Strength: 247 lbf; ASTM D 4632.
3. Sewn Seam Strength: 222 lbf; ASTM D 4632.
4. Tear Strength: 90 lbf; ASTM D 4533.
5. Puncture Strength: 90 lbf; ASTM D 4833.
6. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
7. Permittivity: 0.02 per second, minimum; ASTM D 4491.
8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.3 FLOWABLE FILL (CONTROLLED LOW-STRENGTH MATERIAL)

- A. Flowable Fill (controlled low-strength material) shall meet the requirements of NCDOT Standard Specifications for Roads and Bridges, (latest revision). Flowable fill shall have a minimum 28-day compressive strength of 125 psi and shall be mixed such that cement content is 100 to 150 pounds per cubic yard, air content is less than 35 percent and slump is between 7 and 9 inches.

2.4 ACCESSORIES

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

5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Locate existing underground utilities in the area of work. If utilities are to remain in place, provide adequate means of protection during earthwork operations.
- B. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult the Engineer immediately for directions as to procedure. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to the satisfaction of utility companies.
- C. 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.
- D. Do not commence earth moving operations until temporary erosion and sedimentation control measures, as shown on the plans, as specified herein or as may be required by authorities having jurisdiction are in place.
- E. Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow, strip, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface. Shape the subgrade as indicated on the drawings by forking, furrowing, or plowing so that the first layer of new material placed thereon will be well bonded to it.
- F. After removal of all existing topsoil, debris, and other undesirable material, the areas which are to receive fill, which have been cut to the desired grade, or which are at the approximate required subgrade elevation without additional earthwork, should be proofrolled to locate any soft or yielding area. Proofrolling shall be done as described below.
- G. Any soft or excessively yielding material revealed by the proofrolling shall be removed and replaced with inert controlled fill. The Engineer shall be the sole judge of what constitutes soft or excessively yielding material.
- H. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 CUTTING CONCRETE OR ASPHALT SURFACE CONSTRUCTION

- A. All pavement cutting and repair shall be done in accordance with the requirements of authorities having jurisdiction. Cuts in concrete and asphaltic concrete shall be no larger than necessary to provide adequate working space for proper installation of pipe and appurtenances. Cutting shall be performed with a concrete saw in a manner which will provide a clean groove the complete thickness of the surface material along each side of the trench and along the perimeter of cuts for structures.
- B. Concrete and asphaltic concrete over trenches excavated for pipelines shall be removed so that a shoulder not less than 12 inches in width at any point is left between the cut edge of the surface and the top edge of the trench. Trench width at the bottom shall not be greater than at the top and no undercutting will be permitted. Cuts shall be made to and between straight or accurately marked curved lines which, unless otherwise required, shall be parallel to the center line of the trench.
- C. Pavement or other surfaces removed for connections to existing lines or structures shall not be of greater extent than necessary for the installation.
- D. Where the trench parallels the length of concrete walks and the trench location is all or partially under the walk, the entire walk shall be removed and replaced. Where the trench crosses drives, walks, curbs, or other surface construction, the surface construction shall be removed and replaced between existing joints or between saw cuts.

3.3 DEWATERING

- A. The Contractor shall provide and maintain adequate dewatering equipment to remove and dispose of all surface water and groundwater entering excavations, trenches, or other parts of the work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.
- B. All excavations for concrete structures or trenches that extend down to or below groundwater shall be dewatered by lowering and keeping the groundwater level beneath such excavations 12 inches or more below the bottom of the excavation.
- C. The Contractor is responsible for obtaining any required permits or permissions necessary for the disposal of groundwater that is removed. Any discharged groundwater shall be clean and free of sediment.

- D. The Contractor shall be responsible for the condition of any pipe or conduit which he may use for drainage purposes, and all such pipes or conduits shall be left clean and free of sediment.
- E. The Contractor shall take special care to prevent the siltation of streams and remove all organically contaminated sediment, saturated soil, and other undesirable material from existing watercourses.
- F. Prevent surface water and ground water from entering or accumulating in trenches and other excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area. Do not use excavated trenches as temporary drainage ditches. Divert water from these areas without causing damage to adjacent property.
- G. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

3.4 EXPLOSIVES

- A. Where blasting is permitted, it shall be done only by qualified personnel and in accordance with all requirements of authorities having jurisdiction. The Contractor shall be responsible for any damage done to adjacent structures, properties, or to persons, by reason of the blasting or other earthwork operations. The Contractor shall also be responsible for damage to other site improvements including, but not limited to embankments and cut areas, and sewer, water, gas or other underground lines which may result from blasting or earthwork operations. All such damage shall be repaired and made good by the Contractor in a timely manner.
- B. Suitable methods shall be employed to confine all materials lifted by blasting within the limits of the excavation or trench.
- C. All rock which cannot be handled and compacted as earth shall be kept separate from other excavated materials and shall not be mixed with backfill or embankment materials except as specified or directed.
- D. Perform blasting without weakening the bearing capacity of rock subgrade and with the least-practicable disturbance to rock to remain.
- E. Obtain written permission from authorities having jurisdiction before bringing explosives to Project site or using explosives on Project site.

3.5 EXCAVATION, GENERAL

- A. Perform all excavation work in compliance with applicable requirements of governing authorities having jurisdiction.

- B. Furnish, put in place, and maintain such sheeting, bracing, etc., as may be necessary to support the sides of the excavation to comply with the requirements of governing authorities having jurisdiction.
- C. Protect structures, utilities, sidewalks, pavements, and other facilities from damages caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- D. The use of mechanical equipment will not be permitted in locations where its operation would cause damage to trees, buildings, culverts, or other existing property, utilities, or structures above or below ground. In all such locations, hand excavating methods shall be used.
- E. Widening of cuts or flattening of cut slopes will not be required in rock or material which required ripping. When rock is unexpectedly encountered, any widening or flattening already begun shall be transitioned to leave the cut with a pleasing and safe appearance.
- F. Unclassified Excavation: Excavate to subgrade elevations regardless of the character, nature or composition 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 outside of concrete forms other than at footings.
 - b. 12 inches outside of concrete forms at footings.
 - c. 6 inches outside of minimum required dimensions of concrete cast against grade.
 - d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
 - e. 6 inches beneath bottom of concrete slabs-on-grade.
 - f. 6 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide.
- G. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth or rock. When rock is encountered within the limits of construction, the Contractor shall notify the Engineer prior to any removal. Upon the Engineer's authorization, the Contractor shall remove the rock. The Contractor shall not be paid for rock removed without prior approval from the Engineer.
 - 1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to

be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.

- a. Intermittent drilling; blasting, if permitted; ram hammering; or ripping of material not classified as rock excavation is earth excavation.
2. Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the following dimensions:
 - a. 24 inches outside of concrete forms other than at footings.
 - b. 12 inches outside of concrete forms at footings.
 - c. 6 inches outside of minimum required dimensions of concrete cast against grade.
 - d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
 - e. 6 inches beneath bottom of concrete slabs-on-grade.
 - f. 6 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide.

3.6 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
 2. Pile Foundations: Stop excavations 6 to 12 inches above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.
 3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.
- B. Excavations at Edges of Tree- and Plant-Protection Zones:
 1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

2. Cut and protect roots according to requirements in Division 01 Section "Temporary Tree and Plant Protection."

3.7 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate and shape the surface of areas under walks to indicated lines, grades, elevations, subgrades and cross sections, with the finish surface not more than 0 inches above or 1 inch below the required subgrade elevation, compacted as specified, and graded to prevent ponding of water after rains.
- B. Excavate and shape the surface of areas under pavement to indicated lines, grades, elevations, subgrades and cross sections, with the finish surface not more than 1/2 inch above or below the required subgrade elevation, compacted as specified, and graded to prevent ponding of water after rains. Include such operations as plowing, discing, and any moisture or aerating required to provide the optimum moisture content for compaction.
- C. Fill low areas resulting from removal of unsatisfactory soil materials, obstructions, and other deleterious materials, using satisfactory soil material.

3.8 EXCAVATION FOR UTILITY TRENCHES

- A. Perform all excavation of every description and of whatever substance encountered so that the pipe can be laid to the indicated gradients, lines, depths, and elevations shown on the drawings.
- B. Except where tunneling is indicated on the drawings, is specified, or is permitted by the Engineer, all trench excavation shall be open cut from the surface.
- C. No more trenches shall be opened in advance of pipe laying than is necessary to expedite the work. One block or 400 feet (whichever is the shorter) shall be the maximum length of open trench on any line under construction.
- D. Mechanical equipment used for trench excavation shall be of a type, design, and construction and shall be controlled, such that uniform trench widths and vertical sidewalls are obtained at least from an elevation one foot above the top of the installed pipe to the bottom of the trench, and that trench alignment is such that pipe when accurately laid to specified alignment will be centered in the trench with adequate clearance between the pipe and sidewalls of the trench. Undercutting the trench sidewall to obtain clearance will not be permitted.
- E. Where pipe grades or elevations are not definitely fixed by the contract drawings, trenches shall be excavated to a depth sufficient to provide a minimum depth of backfill cover over the top of the pipe. Cover depths may be

necessary on vertical curves or to provide necessary clearance beneath existing pipes, conduits, drains, drainage structures, or other obstructions encountered at normal pipe grades. Measurement of pipe cover depth shall be made vertically from the outside top of pipe to finished ground or pavement surface elevation except where future surface elevations are indicated on the drawings.

- F. Excavate trenches to uniform widths to provide a maximum trench width no greater than the pipe outside diameter plus 24 inches (12 inches on either side of pipe). Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated. Do not widen trenches by scraping or loosening materials from the sides.
- G. 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 to be bedded in earth excavated trenches, fine grade the bottoms of such trenches to allow firm bearing for the bottom of the pipe on undisturbed earth. Where any part of the trench has been excavated below the grade of the pipe, fill the part excavated below such grade with pipe bedding material and compact at the Contractor's expense.
 - 2. For pipes and conduit to be laid in embankments or other recently filled material, first place the fill material to the finish grade or to a height of at least one foot above the top of the pipe, whichever is the lesser. Take particular care to ensure maximum consolidation of material under the pipe location. Excavate the pipe trench as though in undisturbed material.
 - 3. For trench bottoms in poor soils excavate and remove unstable or unsuitable soil to a width and depth, as directed by the Engineer, and refill with a thoroughly compacted gravel bedding.
 - 4. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
- H. Trenches in Tree- and Plant-Protection Zones:
 - 1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
 - 2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
 - 3. Cut and protect roots according to requirements in Division 01 Section "Temporary Tree and Plant Protection."

- I. Where trench sheeting is left in place, such sheeting shall not be braced against the pipe, but shall be supported in a manner which will preclude concentrated loads or horizontal thrusts on the pipe. Cross braces installed above the pipe to support sheeting may be removed after pipe embedment has been completed.

3.9 SUBGRADE INSPECTION

- A. Notify Engineer when excavations have reached required subgrade.
- B. Subgrades for concrete structures and trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; free from mud and muck; and sufficiently stable to remain firm and intact under the feet of the workmen.
- C. If Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- D. Subgrades for concrete structures or trench bottoms, which are otherwise solid but which become mucky on top due to construction operations, shall be reinforced with one or more layers of crushed rock or gravel. The stabilizing material shall be spread and compacted to a depth of not less than 6 inches below the bottom of the structure or pipe. Not more than ½ inch depth of mud or muck shall be allowed to remain on stabilized trench bottoms when the pipe bedding material is placed thereon. The finished elevation of stabilized subgrades for concrete structures shall not be above subgrade elevations indicated on the drawings.
- E. Proof-roll subgrade below structures, slabs, pavements and other areas as directed by Engineer. Proofrolling shall be done with at least four (4) overlapping passes of a heavy-duty flat wheel vibratory roller, at least 20 tons, or by its approved equivalent.
- F. Do not proof-roll wet or saturated subgrades.
 1. Completely proof-roll subgrade in one direction (longest dimension of Project). Limit vehicle speed to 3 mph.
 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Engineer, and replace with compacted backfill or fill as directed.
- G. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer, without additional compensation.

3.10 UNAUTHORIZED EXCAVATION

- A. Unauthorized excavation consists of the removal of materials beyond indicated lines, grades, or elevations without the specific direction of the Engineer.
- B. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Additional concrete to fill unauthorized excavations shall be placed, by and at the expense of the Contractor, with concrete placed at the same time and monolithic with the concrete above.
- C. For pipe trenches and elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of the same classification, unless otherwise directed by the Engineer.

3.11 STORAGE OF SOIL MATERIALS

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

3.12 BACKFILL

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

3.13 UTILITY TRENCH BACKFILL

- A. Unless otherwise specified or indicated on the drawings, use suitable material for backfill which was removed in the course of making the construction

excavations. Do not use frozen material for the backfill and do not place backfill on frost, snow, ice or frozen or muddy material. Remove previously frozen material before new backfill is placed. Start backfilling as soon as practicable after the pipes have been laid, or the structures have been built and are structurally adequate to support the loads, including construction loads to which they will be subjected, and proceed until its completion.

- B. With the exception mentioned below in this paragraph, do not backfill trenches at pipe joints until after that section of the pipeline has successfully passed any specified tests required. Should the Contractor wish to minimize the maintenance of lights, and barricades, and the obstruction of traffic, he may, at his own risk, backfill the entire trench as soon as practicable after installation of pipe, and the related structures have acquired a suitable degree of strength. He shall, however, be responsible for removing and later replacing such backfill, at his own expense, should he be ordered to do so in order to locate and repair or replace leaking or defective joints or pipe.
- C. Do not drop large masses of backfill material into the trench in such a manner as to endanger the pipeline. Use a timber grillage to break the fall of material dropped from a height of more than 5 feet. Exclude pieces of bituminous pavement from the backfill unless their use is expressly permitted.
- D. Zone Around Pipe: Place bedding material to the level shown on the Drawings and work material carefully around the pipe to insure that all voids are filled, particularly in bell holes. For backfill up to a level of 2 feet over the top of the pipe, use only selected materials containing no rock, clods or organic materials. Place the backfill and compact thoroughly under the pipe haunches and up to the mid line of the pipe in layers not exceeding 6 inches in depth. Place each layer and tamp carefully and uniformly so as to eliminate the possibility of lateral displacement. Place and compact the remainder of the zone around the pipe and to a height of one foot above the pipe in layers not exceeding 6 inches and compact to a maximum density of at least 100 percent as determined by ASTM D698.
- E. Backfill voids with satisfactory soil while removing shoring and bracing.
- F. Tamping: Deposit and spread backfill materials in uniform, parallel layers not exceeding 12 inches thick before compaction. Tamp each layer before the next layer is placed to obtain a thoroughly compacted mass. Furnish and use, if necessary, an adequate number of power driven tampers, each weighing at least 20 pounds for this purpose. Take care that the material close to the bank, as well as in all other portions of the trench, is thoroughly compacted. When the trench width and the depth to which backfill has been placed are sufficient to make it feasible, and it can be done effectively and without damage to the pipe, backfill may, on approval of the Engineer, be compacted by the use of suitable rollers, tractors, or similarly powered equipment instead of by tamping. For compaction by tamping (or rolling), the rate at which backfilling material is

deposited in the trench shall not exceed that permitted by the facilities for its spreading, leveling and compacting as furnished by the Contractor.

- G. Follow the measures described herein to ensure the optimum moisture content of the backfill material prior to placement in the trench. Perform no compaction by tamping (or rolling) when the material is too wet either from rain or applied water to be compacted properly.
- H. Compact backfill in pipe trenches to the maximum density as shown on the drawings, or as specified herein.
- I. Flowable Fill (Controlled Low-Strength Material): Place initial backfill of flowable fill to a height of 12 inches over the pipe or conduit. Coordinate backfilling with utilities testing.
- J. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- K. Install warning tape directly above utilities as shown on the Drawings.

3.14 SOIL FILL

- A. After a stable, non-yielding surface has been established, the surface of the area to be filled shall be scarified with a disc or harrow to a depth of 4 to 6 inches. An initial 3-inch layer of fill material shall then be spread over the scarified surface and the entire area compacted as specified below.
- B. No fill shall be placed on any area until that area has been inspected and approved by the Engineer. Fill shall not be placed mud, frost, snow or ice. Fill materials shall be spread in uniform horizontal layers not exceeding 8 inches in uncompacted thickness. Alternating layers of cohesive and granular fill soils shall not be permitted. Spreading and compacting of fill material should be started at the lowest portion of the site. All fill must be placed in horizontal layers. Sloping fill planes will not be permitted. Fill material shall be distributed over the full width of the embankment, and in no case will deep ruts be allowed to form.
- C. Keyways shall be provided at the toe of each fill slope as shown on the drawings. As each layer of fill meets the natural grade of a slope, a bench, approximately 7 to 8 feet wide, shall be cut into the existing grade with each layer of newly placed fill. If rock is encountered at the face of the natural grade, the original ground shall be cut in vertical steps of 4 to 5 feet and a horizontal bench cut into the rock at the top of each vertical increment. A horizontal plateau, approximately 15 to 20 feet wide, should be provided in the existing slope at vertical intervals of roughly 25 feet. Subsurface drains shall be installed at the toe of the slope and wherever springs or excessive seepage are encountered. Drains should be led to the outside face of the embankment and

the water picked up and carried away in such a manner as to avoid softening the embankment or its toe, or producing erosion gullies.

- D. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use satisfactory soil material.
 - 2. Under walks and pavements, use satisfactory soil material.
 - 3. Under steps and ramps, use engineered fill.
 - 4. Under building slabs, use engineered fill.
 - 5. Under footings and foundations, use engineered fill.

3.15 SOIL MOISTURE CONTROL

- A. Before compaction begins, the fill shall be brought to a water content that will permit proper compaction. This may require aerating the material if it is too wet or the addition of water if it is too dry. If additional water is required, it should be uniformly distributed through the use of approved water wagons, and shall be thoroughly incorporated into the material by means of discs or other suitable mixing equipment. Care shall be taken to avoid trapping water within the fill.
- B. Where, in the opinion of the Engineer, proposed fill material is too wet to permit drying in a reasonable length of time, the Engineer may reject the material and it must be removed from the work area.
- C. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
 - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.
- D. Method "C" of the Standard Proctor test of moisture density relationship test, ASTM D 698 or AASHTO T99, shall be used to determine the maximum laboratory dry density and the optimum moisture content of the material which is to be used for fill.

3.16 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place satisfactory backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

- B. Place satisfactory backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure. Do not place backfill against or on structures until they have attained sufficient strength to support the loads (including construction loads) to which they will be subjected, without distortion, cracking, or other damage. Take care to prevent wedging action of backfill against structures.
- C. Make special leakage tests, if required, as soon as practicable after the structures are structurally adequate and other necessary work has been done. Use the best of the excavated materials in backfilling within 2 feet of the structure.
- D. When existing ground surface has a density less than that specified under the subsection entitled "COMPACTION" for the particular area classification, break up the ground surface, pulverize, moisture condition to the optimum moisture content, and compact to required depth and percentage of maximum density.
- E. After compaction, all fill will be tested in accordance with Method "C" of ASTM D-698, unless specified otherwise. Except as noted otherwise for the zone around pipe, provide not less than the following percentages of maximum density of soil material compacted at optimum moisture content, for the actual density of each layer of soil material-in-place:

UNPAVED AREAS	Compact Full Depth to 92%
DRIVES AND PARKING	Top 24" - 100%
TRENCH BACKFILL (PAVED AREAS)	Compact full depth to 100%
TRENCH BACKFILL (UNPAVED AREAS)	Compact full depth to 95%
ALL OTHER BACKFILL	Compact full depth to 95%

- F. The above compaction requirements are to be satisfied for all soil and weathered or soft rock fills. Weathered or soft rocks are those that can be broken down and disintegrated under normal compaction procedures and equipment.
- G. At the close of each day's work, or where work is to be interrupted for a period of time, the surface of the site shall be shaped to drain freely, and sealed. If after a prolonged rainfall, the surface of the area to be filled or cut is too wet to work properly, the unsuitable material shall be removed to expose workable soil. The wet material removed may be dried and reused. Construction traffic shall be controlled so as to prevent rutting of graded areas and to avoid over-rolling of any section.
- H. All cut areas shall be rolled and compacted to produce a compaction equal to that of the filled area. If soft or yielding material is encountered in cuts, or fills as a result of trapping water, over-rolling or improper control of construction traffic, and cannot be satisfactorily stabilized by moisture control, compaction or other means approved by the Engineer, the unstable material shall be

excavated to the depth required by the Engineer. The excavation shall then be filled with suitable compacted material in accordance with the requirements outlined above.

3.17 GRADING

- A. Elevations shown on the plans are finished ground unless otherwise noted. Grading shall be maintained in such a manner as to provide free surface drainage away from structures and throughout the site at all times without any ponding of water.
- B. 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.
- C. Provide ditches and swales to the cross sections and grades shown on the drawings. Cut ditch subgrades 4 inches below the grades shown and provide 4 inches of topsoil where the plans call for seeding or sodding of the ditch. Keep ditches and swales free of accumulations of debris or washed in material until final acceptance of work by the Engineer.
- D. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 - 1. Turf or Unpaved Areas: Plus or minus 1 inch.
 - 2. Walks: Plus or minus 1 inch.
 - 3. Pavements: Plus or minus 1/2 inch.
- E. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.18 SUBSURFACE DRAINAGE

- A. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches of filter material, placed in compacted layers 6 inches thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches.

1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698 with a minimum of two passes of a plate-type vibratory compactor.
- B. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches thick. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
 1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698 with a minimum of two passes of a plate-type vibratory compactor.
 2. Place and compact impervious fill over drainage backfill in 6-inch thick compacted layers to final subgrade.

3.19 BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place 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 base course to required crown elevations and cross-slope grades.
 4. Place base course 6 inches or less in compacted thickness in a single layer.
 5. Place base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 6. Compact base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.
- C. Pavement Shoulders: Place shoulders along edges of base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact simultaneously with each base layer to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.20 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 or less in compacted thickness in a single layer.
 3. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.21 FIELD QUALITY CONTROL

- A. The services of qualified soils testing personnel may be engaged by the Owner for the making of tests to determine the moisture-density relationships, relative densities, plastic and liquid limits and suitability of materials for compaction and for inspection and control of the site preparation, selection, placing and compaction of the fill. Such tests will be provided and paid for by the Owner, except that tests which reveal non-conformance with the Specifications and all succeeding tests for the same area, until conformance with the Specifications is established shall be at the expense of the Contractor. The Owner will be responsible for paying for only the successful tests. A copy of the testing personnel's daily field report including results of in-place density and moisture content tests should be forwarded to the Owner and the Engineer at the end of each working day.
- B. The Contractor shall cooperate fully with the testing personnel so as to permit proper inspection and control of the work without unnecessary delays.
- C. 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.

3.22 PROTECTION

- A. Do not operate tractors, bulldozers or other power operated equipment on paved surfaces if the treads or wheels of the equipment are so shaped as to cut or otherwise injure the surfaces.
- B. Restore all surfaces, including lawns, grassed, and planted areas that have been injured by the Contractor's operations, to a condition at least equal to that in which they were found immediately before the work was begun. Use suitable

materials and methods for such restoration. Maintain all restored plantings by cutting, trimming, fertilizing, etc., until acceptance. Restore existing property or structures as promptly as practicable and do not leave until the end of construction period.

- C. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- D. During construction and until final acceptance, the Contractor shall construct temporary or permanent earth berms along the outer edges of the top surface of the embankment, construct temporary ditches, shape the embankment surface to provide for the drainage of surface runoff along and throughout the length of the embankments, and use any other methods necessary to maintain the work covered by this section so that the work will not contribute to excessive soil erosion. The Contractor shall construct brush dikes, or install temporary or permanent slope drains or other drainage features to assist in controlling erosion.
- E. Slides and overbreaks which occur prior to final acceptance of the project due to natural causes shall be removed and disposed of by the Contractor as directed by the Engineer.
- F. Where slides or overbreaks occur due to negligence or carelessness on the part of the Contractor, the Contractor shall remove and dispose of the material at no cost to the Owner.
- G. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by Engineer; reshape and recompact.
- H. 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.
- I. All embankments shall be brought to the grade and cross section shown on the plans or established by the Engineer, prior to final inspection and acceptance by the Engineer.

3.23 MAINTENANCE

- A. The Contractor shall be responsible during construction and until final acceptance for the maintenance of all embankments, ground covers and other surfaces made under the Contract.
- B. The Contractor shall protect and maintain erosion and sedimentation controls during earth moving operations and shall remove said measures upon completion of earth moving operations and the satisfactory establishment of permanent or temporary ground covers.

3.24 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property unless otherwise required by the plans or special provisions or unless disposal within the project area is permitted by the Engineer.
- B. Concrete that is painted must be disposed of in accordance with requirements and regulations of the North Carolina Department of Environment and Natural Resources (NCDEQ) Solid Waste Section. Prior to disposal of painted concrete, the Contractor shall submit a written certification to NCDEQ that the paint on the concrete is not lead-based. Certification that paint on concrete is not lead-based paint is required prior to management as inert debris. Lead-based paint is defined by federal statute (Title X of the Housing and Community Development Act and the Toxic Substances Control Act, by reference). Concrete that is painted with lead-based paint, or paint that has not been certified to the satisfaction of the NCDEQ Solid Waste Section to be below the federal standard to be considered lead-based paint, must be disposed of at a properly permitted construction and demolition landfill or a permitted municipal solid waste landfill.
- C. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Engineer.
- D. The Contractor shall maintain the earth surfaces of all waste areas, both during the work and until the completion of all seeding and mulching or other erosion control measures specified, in a manner which will effectively control erosion and siltation.
- E. The following requirements shall also be applicable to all waste or disposal areas other than active public waste or disposal areas:
 - 1. Rock waste shall be shaped to contours which are comparable to and blend in with the adjacent topography where practical, and shall be covered with a minimum 6 inch thick layer of earth material either from the project waste or from borrow.

2. Earth waste shall be shaped to contours which are comparable to and blend in with the adjacent topography where practicable, but in no case will slopes steeper than 2:1 be permitted.
3. Construction debris, grubbed debris and all broken pavement and masonry shall be covered with a minimum 6-inch thick layer of earth waste material from the project or borrow. The completed waste area shall be shaped as required above for disposal of earth waste.
4. Seeding and mulching shall be performed over all earth or earth covered waste areas. The work of seeding and mulching shall be performed in accordance with other sections of these Contract Documents.
5. Where the Engineer has granted permission to dispose of waste and debris within the project, the Engineer will have the authority to establish whatever additional requirements may be necessary to insure the satisfactory appearance of the completed project.

END OF SECTION 312000

PART 1 - GENERAL**1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. The work covered by this section consists of the construction of a base composed of an approved aggregate material hauled to the site, placed on the site, compacted, and shaped to conform to the lines, grades, depths, and typical sections shown on the plans or established by the Engineer.
- B. Related Sections:
 - 1. Division 31 Section "Earth Moving".
 - 2. Division 32 Section "Bituminous Paving".
 - 3. Division 33 Section "Water Pipe and Appurtenances".
 - 4. Division 33 Section "Sanitary Sewer Pipe and Appurtenances".
 - 5. Division 33 Section "Storm Drainage Materials".

1.3 PERFORMANCE REQUIREMENTS

- A. The work under this section consists of furnishing all materials, labor, equipment, incidentals and services required for the complete installation of aggregate base course materials in the locations shown on the drawings and as specified herein.
- B. All work in connection with installing aggregate base course materials shall comply with all current requirements of authorities having jurisdiction. The Contractor is responsible for being familiar with and adhering to these requirements.
- C. The Contractor shall inspect the locations of the proposed work associated with this Section and shall familiarize themselves with the conditions under which the work will be performed, and with all necessary details and the suitability of their equipment and methods for the work required. The omission of any installation details which may not appear within the Contract Documents shall

not relieve the Contractor of full responsibility for completing the work as necessary.

- D. Construction shall be done in such a manner that will not interfere with the operation of any street, highway, railway, or other facility nor weaken or damage any embankment or structure. Barricades and lights shall be furnished and maintained to safeguard traffic and pedestrians as required by authorities having jurisdiction until such time as the operation has been completed.

1.4 SUBMITTALS

- A. Product Data and certificates: For all aggregate base course materials.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall utilize methods of handling, hauling, and placing which will minimize segregation and contamination of the aggregate used for the base course. If segregation occurs, the Engineer may require that changes be made in the Contractor's methods and may also require remixing of the aggregate to achieve the proper mixture. No additional compensation will be made for remixing, additional equipment, or other measures necessary to provide the coarse aggregate base course specified. Aggregate which becomes contaminated with foreign materials to the extent that the base course will not serve its intended use shall be removed and replaced by the Contractor at no additional expense to the Owner. The above requirements will be applicable regardless of the type of aggregate placed and regardless of prior acceptance.

1.6 COORDINATION

- A. For all work within the Department of Transportation right-of-way, the Contractor shall notify the appropriate office of the Department of Transportation at least 72 hours prior to beginning construction.

1.7 WARRANTY

- A. All materials shall be warranted to be free from defects in workmanship and materials for one (1) year following final acceptance by the Owner.

PART 2 - PRODUCTS

2.1 AGGREGATE BASE COURSE

- A. Aggregate base course materials shall consist of crushed stone or uncrushed gravel, or other similar material having hard, strong, durable particles free of adherent coatings meeting the requirements of the NCDOT Standard Specifications for Roads and Structures, latest edition for the project-specific use of the aggregate.
- B. The Contractor shall furnish aggregate base course material produced in accordance with the requirements indicated herein for Type A, aggregate unless otherwise specified in the special provisions.
- C. All aggregates shall be from approved sources. Sources will not be approved unless the material has satisfactory soundness and satisfactory resistance to abrasion. Satisfactory soundness will be considered to be a weighted average loss of not greater than 15 percent when subjected to five (5) alternations of the sodium sulfate soundness test in accordance with AASHTO T104. Satisfactory resistance to abrasion will be considered to be a percentage of wear of not greater than 55 percent when tested in accordance with AASHTO T96.
- D. Aggregates shall be handled in such a manner as to minimize segregation
- E. Sites for aggregate stockpiles shall be grubbed and cleaned prior to storing aggregates, and the ground surface shall be firm, smooth, and well drained. A cover of at least 3" of aggregate shall be maintained over the ground surface in order to avoid the inclusion of soil or foreign material. Stockpiles shall be built in such a manner as to minimize segregation. When it is necessary to operate trucks or other equipment on a stockpile in the process of building the stockpile, it shall be done in a manner approved by the Engineer.
- F. Stockpiles of different types or sizes of aggregates shall be spaced far enough apart, or else separated by suitable walls or partitions, to prevent the mixing of the aggregates.
- G. Any method of stockpiling aggregates which allows the stockpile to become contaminated with foreign matter or causes excessive degradation of the aggregate will not be permitted. Excessive degradation will be determined by sieve tests of samples taken from any portion of the stockpile over which equipment has been operated, and failure of such samples to meet all grading requirements for the aggregate will be considered cause for discontinuance of such stockpiling procedure.
- H. Gradation: All standard sizes of aggregates shall meet the gradation requirements when tested in accordance with AASHTO T27.

2.2 WATER

- A. Water, if used in construction, shall be potable water, free from oil and other deleterious matter.

PART 3 - EXECUTION

3.1 SUBGRADE PREPARATION

- A. The subgrade shall be dry and cleaned of all foreign substances prior to constructing the base course.
- B. The surface of the subgrade shall be prepared as specified in Section 312000 "Earth Moving" based on the specified use of the aggregate base course.

3.2 PLACEMENT OF STONE BASE

- A. The aggregate material shall be spread on the subgrade to a uniform loose depth and without segregation.
- B. Where the required compacted thickness of base is 10 inches or less the base material may be spread and compacted in one layer. Where the required compacted thickness of base is more than 10 inches, the base material shall be spread and compacted in two (2) or more approximately equal layers. The minimum compacted thickness of any one layer shall be approximately 4 inches.
- C. Each layer of material shall have been sampled, tested, compacted, and approved prior to placing succeeding layers of base material or pavement. Such tests will be provided and paid for by the Owner, except that tests which reveal non-conformance with the Specifications and all succeeding tests for the same area, until conformance with the Specifications is established shall be at the expense of the Contractor. The Owner will be responsible for paying for only the successful tests. The minimum compaction for each layer shall be 100% standard proctor.
- D. No base material shall be placed on frozen subgrade or base. Hauling equipment shall not be operated on subgrade or a previously completed layer of base material soft enough to rut or weave beneath the equipment.
- E. The maximum speed of trucks hauling or traveling over any part of the subgrade or base shall be five (5) miles per hour.

3.3 QUALITY CONTROL

A. Weather and Temperature Limitations:

1. Coarse aggregate base course shall not be placed during rainy weather or on wet or frozen subgrade.
2. Stabilized aggregate base courses shall not be constructed when the atmospheric temperature is below thirty-five (35) degrees F. when measured in the shade away from artificial heat.
3. Any areas of completed base course that are damaged by elements such as rain, sleet, snow, hail, or freeze/thaw conditions shall be reconditioned, reshaped, and compacted in accordance with the Drawings and these Specifications.

B. Tolerances:

1. After final shaping and compacting the base, the Engineer will check the surface of the base for conformance to grade and typical section and will determine the base thickness.
2. The thickness of the base shall be within a tolerance of $\pm 1/2$ -inch of the base thickness required by the plans.

C. Maintenance:

1. Where the base material is placed in a trench section, the Contractor shall provide adequate drainage through the shoulders to protect the subgrade and base until such time as shoulders are completed.
2. The Contractor shall maintain the surface of the base by watering, machining, and rolling or dragging when necessary to prevent damage to the base by weather or traffic.
1. Where the base or subgrade is damaged, repair the damaged area; reshape the base to required lines, grades and typical sections; and recompact the base to the required density at no cost to the Owner.

END OF SECTION 312230

PART 1 - GENERAL**1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. The work to be performed under this Specification shall consist of furnishing and installing all materials and equipment and performing all labor required to install rip rap and associated appurtenances as specified herein.
- B. Related Sections:
 - 1. Division 33 Section "Water Pipe and Appurtenances".
 - 2. Division 33 Section "Sanitary Sewer Pipe and Appurtenances".
 - 3. Division 33 Section "Storm Drainage Materials".

1.3 PERFORMANCE REQUIREMENTS

- A. The work under this section consists of furnishing all materials, labor, equipment, incidentals and services required for the complete installation of rip rap and geotextiles materials in the locations shown on the drawings and as specified herein.
- B. All work in connection with installing rip rap and associated geotextile materials shall comply with all current requirements of authorities having jurisdiction. The Contractor is responsible for being familiar with and adhering to these requirements.
- C. The Contractor shall inspect the locations of the proposed work associated with this Section and shall familiarize themselves with the conditions under which the work will be performed, and with all necessary details and the suitability of their equipment and methods for the work required. The omission of any installation details which may not appear within the Contract Documents shall not relieve the Contractor of full responsibility for completing the work as necessary.
- D. Construction shall be done in such a manner that will not interfere with the operation of any street, highway, railway, or other facility nor weaken or

damage any embankment or structure. Barricades and lights shall be furnished and maintained to safeguard traffic and pedestrians as required by authorities having jurisdiction until such time as the operation has been completed.

1.4 SUBMITTALS

- A. Product Data and certificates: For all rip rap and geotextile materials.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall coordinate material deliveries with the manufacturer/supplier. All materials shall be handled and stored in accordance with the manufacturer's recommendations using methods that will prevent damage to the materials.
- B. The Contractor shall load, transport, unload and store geotextiles so they are kept clean and free of damage. Label and store geotextiles in accordance with Section 7 of AASHTO M288. Geotextiles with defects, flaws, deterioration or damage will be rejected. Do not unwrap geotextiles until just before installation.

1.6 COORDINATION

- A. For all work within the Department of Transportation right-of-way, the Contractor shall notify the appropriate office of the Department of Transportation at least 72 hours prior to beginning construction.

1.7 WARRANTY

- A. All materials shall be warranted to be free from defects in workmanship and materials for one (1) year following final acceptance by the Owner.

PART 2 - PRODUCTS

2.1 GEOTEXTILES

- A. When indicated for use on the Drawings, geotextiles used in conjunction with the placement of rip rap shall possess the following properties.
 - 1. Elongation: ≥ 50 percent in accordance with ASTM D4632.
 - 2. Grab Strength: 205 pounds in accordance with ASTM D4632.
 - 3. Tear Strength: 80 pounds in accordance with ASTM D4533.
 - 4. Puncture Strength: 440 pounds in accordance with ASTM D6241.
 - 5. Permittivity: 0.20 sec-1 in accordance with ASTM D4491.

6. Apparent Opening Size: #60 in accordance with ASTM D4751.
 7. UV Stability (Retained Strength after 500 hours of exposure): 50 percent in accordance with ASTM D4355.
- B. When required, sew geotextiles together in accordance with Article X1.1.4 of AASHTO M288. Provide sewn seams with seam strengths meeting the required strengths of the geotextile specified herein.

2.2 RIP RAP

- A. Rip rap shall be field stone or rough unhewn quarry stone which is sound, tough, dense, resistant to the action of air and water and suitable in all other respects for the purpose intended. Where broken concrete from demolished structures or pavement is available, it may be used in place of stone provided that such use meets with the approval of the Engineer. However, the use of broken concrete that contains reinforcing steel will not be permitted.
- B. All stone shall meet the approval of the Engineer. While no specific gradation is required, there shall be equal distribution of the various sizes of the stone within the required size range. The size of an individual stone particle will be determined by measuring its long dimension.
- C. Stone or broken concrete for rip rap shall meet the table below for the class shown on the drawings.

ACCEPTANCE CRITERIA FOR RIP RAP AND STONE FOR EROSION CONTROL			
Class	Minimum	Midrange	Maximum
A	2	4	6
B	5	8	12
1	5	10	17
2	9	14	23

- D. No more than 5.0 percent of the material furnished shall be less than the minimum size specified nor no more than 10.0 percent of the material shall exceed the maximum size specified.

PART 3 - EXECUTION

3.1 SUBGRADE PREPARATION

- A. The Contractor shall prepare the subgrade such that the finished rip rap surface conforms to the lines, slopes and elevations indicated. The Contractor shall clear the subgrade of sticks, stones, debris and other materials that could puncture the overlying geotextile. The finished subgrade shall not vary from design grade by more than 2 inches at any location.

3.2 PLACEMENT OF GEOTEXTILE

- A. The Contractor shall place geotextile material only on subgrade approved by the Engineer in accordance with the recommendations of the material manufacturer.

3.3 PLACEMENT OF RIP RAP

- A. The Contractor shall proceed with placing the riprap immediately upon completion of geotextile installation.
- B. Rip rap shall be placed on the surface of slopes and at storm drainage pipes at the locations indicated on the plans. Rip rap shall be placed to a minimum depth of 1.5 times the midrange stone size for the class of rip rap specified, but in no case less than 6 inches.
- C. Rip rap shall be placed in such a manner as to produce a reasonably well-graded mass with the minimum practicable percentage of voids.
- D. Place to full course thickness in one operation in a manner to avoid displacing or puncturing geotextile. Rip rap shall not be dropped from a height greater than one foot above the geotextile.
- E. The Contractor may place the rip rap by mechanical methods, augmented by hand placing where necessary, provided that when the rip rap is completed it forms a uniformly graded, dense, neat layer of rip rap of the necessary depth.
- F. Unless otherwise indicated or directed by the Engineer, the rip rap shall be placed upon a slope which shall be no steeper than the angle of repose.

END OF SECTION 312271

PART 1 - GENERAL**1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. Section includes construction dewatering.
- B. Related Sections:
 - 1. Division 01 Sections "Construction Progress Documentation and Photographic 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

- A. 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. 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.
 - 2. Prevent surface water from entering excavations by grading, dikes, or other means.
 - 3. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
 - 4. Remove dewatering system when no longer required for construction.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning dewatering. Comply with hauling and disposal regulations of authorities having jurisdiction.
 - 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.

1.5 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 Engineer no fewer than three days in advance of proposed interruption of utility.
 - 2. Do not proceed with interruption of utility without Engineer'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]** **[referenced]** 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 Engineer 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 01 Section "Temporary Facilities and Controls" and 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 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 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 312319

SECTION 315000 EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes temporary excavation support and protection systems.
- B. Related Sections:
 - 1. Division 01 Sections "**Construction Progress Documentation and Photographic Documentation**" for recording preexisting conditions and excavation support and protection system progress.
 - 2. Division 01 Section "Temporary Facilities and Controls" for temporary utilities and support facilities.
 - 3. Division 31 Section "Dewatering" for dewatering system for excavations.

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. Delegated Design: Design excavation support and protection system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
 - 2. Prevent surface water from entering excavations by grading, dikes, or other means.
 - 3. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.
 - 4. Monitor vibrations, settlements, and movements.

1.4 SUBMITTALS

- A. Delegated-Design Submittal: For excavation support and protection 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.

B. Other Informational Submittals:

1. Photographs or Videotape: Show existing conditions of adjacent 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. Submit before Work begins.
2. Record Drawings: Identifying and locating capped utilities and other subsurface structural, electrical, or mechanical conditions.
 - a. Note locations and capping depth of wells and well points.

1.5 **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 Engineer no fewer than three days in advance of proposed interruption of utility.
 2. Do not proceed with interruption of utility without Engineer'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 the data.
1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection.
 2. The geotechnical report is **[included]** **[referenced]** 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; 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 Engineer if changes in elevations or positions 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 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 are 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 PILES AND LAGGING

- A. Install steel soldier piles before starting excavation. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement. Space soldier piles 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 piles as excavation proceeds. Trim excavation as required to install lagging. Fill voids behind lagging with soil, and compact.
- C. Install wales horizontally at locations indicated on Drawings and secure to soldier piles.

3.3 SHEET PILING

- A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock to form a continuous barrier. Accurately place the piling, using templates and guide frames unless otherwise recommended in writing by the sheet piling manufacturer. 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, install, grout, and tension tiebacks. 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 soil 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 Engineer.
 - 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 overlaying construction and abandon remainder.
 - 2. Fill voids immediately with approved backfill compacted to density specified in Division 31 Section "Earth Moving."
 - 3. Repair or replace, as approved by Engineer, 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 315000

PART 1 - GENERAL**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Modified General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. All work and materials required under this section of the specifications shall conform to the applicable sections of the latest edition of the North Carolina Department of Transportation Division of Highways Standard Specifications for Roads and Structures and the North Carolina Department of Transportation Pavement Construction Section Superpave Hot Mix Asphalt / Quality Management System.

1.2 SUMMARY

- A. Section Includes:
 - 1. Cold milling of existing hot-mix asphalt pavement.
 - 2. Hot-mix asphalt patching.
 - 3. Hot-mix asphalt paving.
 - 4. Hot-mix asphalt paving overlay.
 - 5. Asphalt surface treatments.
 - 6. Pavement-marking paint.
 - 7. Traffic-calming devices.
- B. Related Sections:
 - 1. Division 02 Sections "Demolition" and/or "Selective Demolition" for demolition, removal, and recycling of existing asphalt pavements.
 - 2. Division 31 Section "Earth Moving" for aggregate subbase and base courses and for aggregate pavement shoulders.
 - 3. Division 32 Sections for other paving installed as part of crosswalks in asphalt pavement areas.
 - 4. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants and fillers at paving terminations.

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. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.
- C. Samples: For each paving fabric, 12 by 12 inches minimum.
- D. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:
 - 1. Each paving fabric, 12 by 12 inches minimum.
 - 2. Each type and color of preformed traffic-calming device.
 - 3. Each pattern and color of imprinted asphalt.
- E. Material Certificates: For each paving material, from manufacturer.
- F. Material Test Reports: For each paving material.
- G. The Contractor shall furnish copies of certified weight tickets for all asphalt placed on the project. The original of all tickets, including any voided tickets or tickets for rejecting mixture, shall become the property of the Engineer.

1.5 QUALITY ASSURANCE

- A. All aspects of the work, including, but limited to materials, equipment, application and installation procedures, quality control, and environmental conditions necessary for application/installation of materials shall be in accordance with the latest edition of the Superpave Hot Mix Asphalt/Quality Management System of the North Carolina Department of Transportation Pavement Construction Section.
- B. Quality control and quality assurance are provided for through use of the Quality Management System, as discussed in Section 1 of the latest edition

Superpave Hot Mix Asphalt/Quality Management System of the North Carolina Department of Transportation Pavement Construction Section.

- C. All hot mix asphalt must be provided by a Certified Asphalt Plant, as covered in Section 5.3 of the latest edition Superpave Hot Mix Asphalt/Quality Management System of the North Carolina Department of Transportation Pavement Construction Section.
- D. Asphalt plant equipment and operations shall meet the Specifications set forth in Section 5 and 6 of the latest edition of the Superpave Hot Mix Asphalt/Quality Management System of the North Carolina Department of Transportation Pavement Construction Section.
- E. Delivery and Acceptance of Asphalt Materials must conform to Section 2.40.10 of the latest edition of the Superpave Hot Mix Asphalt/Quality Management System of the North Carolina Department of Transportation Pavement Construction Section.
- F. The Engineer reserves the right to sample and test any shipment and to reject any material not meeting the requirements of the specifications.
- G. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the North Carolina Department of Transportation for all asphalt paving work.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Transportation of Bituminous Mixture: Asphalt Mixtures shall be hauled in accordance with Section 6.9 of the latest edition of the Superpave Hot Mix Asphalt/Quality Management System of the North Carolina Department of Transportation Pavement Construction Section.
- B. Deliver paint and pavement-marking materials to Project site in original containers and packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.
- C. Store paint and 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: Apply asphalt materials only when the environmental conditions for the specific material to be applied are in accordance with Section 9 of the latest edition of the Superpave Hot Mix

Asphalt/Quality Management System of the North Carolina Department of Transportation Pavement Construction Section.

- B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces in environmental conditions recommended by the manufacturer.

PART 2 - PRODUCTS

2.1 AGGREGATES

- A. All aggregates utilized in bituminous pavement mixtures shall be in accordance with Section 2.5 of the latest edition of the Superpave Hot Mix Asphalt/Quality Management System of the North Carolina Department of Transportation Pavement Construction Section with the exception of paragraph 2.5.2.D.

2.2 ASPHALT MATERIALS

- A. All asphalt materials utilized on the project shall be in accordance with the requirements of the latest edition of the Superpave Hot Mix Asphalt/Quality Management System of the North Carolina Department of Transportation Pavement Construction Section.
- B. Water: Potable.

2.3 PAVEMENT MARKINGS

- A. The following are minimum requirements and shall govern except all local, state and/or federal highway or transportation department standard specifications shall govern when their requirements are in excess thereof.
- B. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M 248, Type F, and colors complying with the latest revision of FS TT-P-1952.
 - 1. Color: As indicated.

2.4 WHEEL STOPS

- A. Wheel Stops: Precast, air-entrained concrete, 2,500-psi minimum compressive strength, 4-1/2 inches high by 9 inches wide by 72 inches long. Provide chamfered corners, drainage slots on underside, and holes for anchoring to substrate.
 - 1. Dowels: Galvanized steel, 3/4-inch diameter, 10-inch minimum length.

2.5 PRE-FORMED TRAFFIC-CALMING DEVICES

- A. Speed Bumps, Humps, and Cushions: Solid, integrally colored, 100 percent postconsumer or commingled postconsumer and postindustrial recycled **plastic**; UV stabilized. Provide holes for anchoring to substrate.
1. Size: Modular bumps 2 inches high by 10 inches wide by 72 inches long, with overall length as dimensioned on Drawings.
 2. Size: Modular assemblies 4 inches high by 14 feet in overall width, with overall length as dimensioned on Drawings.
 3. Mounting Hardware: Galvanized-steel hardware as standard with device manufacturer.
 4. Adhesive: As recommended by device manufacturer.

2.6 COMPOSITION OF MIXTURES

- A. The asphalt mix formula shall be in accordance with Section 4.6 of the latest edition of the Superpave Hot Mix Asphalt/Quality Management System of the North Carolina Department of Transportation Pavement Construction Section.
- B. The job mix formula for each mixture will establish a single percentage of aggregate passing each required sieve size, a single percentage of asphalt cement to be added to the aggregate, and a single temperature at which the mixture is to be discharged from the plant and shall be within the design limits specified for the particular type of bituminous mixture.
- C. The job mix formula for each mixture shall be in effect until modified in writing by the Engineer.
- D. All mixtures furnished for the work shall conform to the job mix formula within the tolerance ranges specified for the particular mix involved as specified herein.
- E. Should a change in sources of aggregate materials be made, a new job mix formula will be required before the new mixture is produced.
- F. When unsatisfactory results or other conditions make it necessary, the Engineer may establish a new job mix formula.
- G. Bituminous Base Course, Type B 25.0B: The bituminous base course mixture shall conform to Table 2 in Section 4.6 of the latest edition of the Superpave Hot Mix Asphalt/Quality Management System of the North Carolina Department of Transportation Pavement Construction Section.
- H. Bituminous Intermediate Course, Type I 19.0B: The bituminous intermediate course mixture shall conform to Table 2 in Section 4.6 of the latest edition of the

Superpave Hot Mix Asphalt/Quality Management System of the North Carolina Department of Transportation Pavement Construction Section.

- I. Bituminous Surface Course (SF 9.5A and S 9.5B): The bituminous surface course mixture shall conform to Table 2 in Section 4.6 of the latest edition of the Superpave Hot Mix Asphalt/Quality Management System of the North Carolina Department of Transportation Pavement Construction Section.
- J. Tack Coat: Tack Coat shall conform to Section 9.31 of the latest edition of the Superpave Hot Mix Asphalt/Quality Management System of the North Carolina Department of Transportation Pavement Construction System.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to begin paving.
- B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 - 1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph.
 - 2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
 - 3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Engineer, and replace with compacted backfill or fill as directed.
- C. Proceed with paving only after unsatisfactory conditions have been corrected.
- D. 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 asphalt.

3.2 COLD MILLING

- A. The equipment utilized in milling of existing asphalt pavements shall be in accordance with Section 8.7 of the latest edition of the Superpave Hot Mix Asphalt/Quality Management System of the North Carolina Department of Transportation Pavement Construction System.

- B. Additional equipment necessary to satisfactorily remove the pavement in the area of manholes, water valves, curb and gutter, and other obstructions shall be provided.
- C. The pavement removal operations shall be conducted to effectively minimize the amount of dust being emitted in accordance with local, State, and Federal air pollution control laws and regulations. The operation shall be planned and conducted so that it is safe for persons and property adjacent to the work including the traveling public.
- D. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.
- E. The existing pavement shall be milled in a manner which will restore the pavement surface to a uniform longitudinal profile and cross section at the locations and in accordance with typical sections shown on the plans. Where indicated in the plans, removal shall be to a specified depth and shall produce a specified cross slope.
- F. The Contractor may elect to make multiple cuts to achieve the required depth of cut or cross slope required by the plans.
- G. The longitudinal profile of the milled surface shall be established by a mobile string line on the side of the cut nearest the centerline of the road. The cross slope of the milled surface shall be established by an automatic cross slope control mechanism or by a second skid sensing device located on the outside edge of the cut. The Engineer may waive the requirement for automatic grade and cross slope controls where conditions warrant.
- H. The milling equipment shall be operated in such a manner as to prevent damage to the underlying pavement structure, utilities, drainage facilities, curb and gutter, paved surfaces outside the milled area, and any other appurtenances. The milled pavement surface shall be reasonably smooth and free of excessive scarification marks or other damage as determined by the Engineer. Any leveling or patching required as a result of negligence by the Contractor shall be repaired with hot bituminous plant mix at no cost to the Owner and in a manner acceptable to the Engineer. The Contractor shall coordinate the adjustment of manholes, meter boxes and valves boxes with the milling operation.
- I. The Engineer may require remilling any area where surface laminations or defects resulting from the Contractor's operations cause a non-uniform surface to occur.
- J. The milled pavement surface shall be thoroughly cleaned of all loose aggregate particles, dust and other objectionable material by the use of power brooms, power blowers, power vacuums or other means.

3.3 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 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. The surface preparation necessary for asphalt patching shall be done in accordance with Section 3.5 below.
- C. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseal concrete pieces firmly.
 - 1. Pump hot undersealing asphalt under rocking slab until slab is stabilized or, if necessary, crack slab into pieces and roll to reseal pieces firmly.
 - 2. 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.
- D. Tack Coat: Tack coat shall be applied in accordance with Section 9.3 of the latest edition of the Superpave Hot Mix Asphalt/Quality Management System of the North Carolina Department of Transportation Pavement Construction Section.
- E. Patching: Fill excavated pavements with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.
- F. Traffic Markings: The Contractor shall repair and restripe any traffic markings that were damaged, removed or covered during construction. All work shall be done in accordance with the requirements described elsewhere in this section.
- G. Existing Utilities: All existing manhole and valve covers shall be raised by the Contractor as necessary prior to paving so that the tops of the covers are flush with the final surface. The cost of this work shall be included in the unit bid prices for other related work and no additional payment shall be made.

3.4 REPAIRS

- A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.
 - 1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.

- B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch.
 - 1. Clean cracks and joints in existing hot-mix asphalt pavement.
 - 2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.
 - 3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

3.5 SURFACE PREPARATION

- A. Preparation of Subgrade: The work covered under this section of this specification shall be performed in strict accordance with Section 500 of the latest edition of the North Carolina Department of Transportation Division of Highways Standard Specifications for Roads and Structures.
- B. Application of Aggregate Base Course: The work covered under this section of this specification shall be performed in strict accordance with Section 520 of the latest edition of the North Carolina Department of Transportation Division of Highways Standard Specifications for Roads and Structures.
- C. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
- D. 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.
- E. Prime Coat: Prime coat shall be applied in accordance with Section 9.2 of the latest edition of the Superpave Hot Mix Asphalt/Quality Management System of the North Carolina Department of Transportation Pavement Construction Section.
- F. Tack Coat: The work covered under this section of this specification shall be performed in strict accordance with Section 605 of the latest edition of the North Carolina Department of Transportation Division of Highways Standard Specifications for Roads and Structures and Section 9.3 of the latest edition of the Superpave Hot Mix Asphalt/Quality Management System of the North Carolina Department of Transportation Pavement Construction Section.

3.6 HOT-MIX ASPHALT PLACING

- A. Asphalt Mixtures shall be hauled in accordance with Section 6.9 of the latest edition of the Superpave Hot Mix Asphalt/Quality Management System.
- B. Bituminous Plant Mix - General: The work covered under this section of this specification shall be performed in strict accordance with Section 610 and Section 620 of the latest edition of the North Carolina Department of Transportation Division of Highways Standard Specifications for Roads and Structures and Sections 2 through 6 and Section 9 of the Superpave Hot Mix Asphalt / Quality Management System of the North Carolina Department of Transportation Pavement Construction Section. For pavement repairs, see Section 654 of the latest edition of the North Carolina Department of Transportation Division of Highways Standard Specifications for Roads and Structures.
- C. Base Course, Type B 25.0B; Intermediate Course (I 19.0B); Surface Courses (SF 9.5A and S 9.5B): All hot mix placement and compaction operations shall conform to Section 9.4 of the latest edition of the Superpave Hot Mix Asphalt/Quality Management System of the North Carolina Department of Transportation Pavement Construction Section.
- D. Spreading and Finishing: Spreading and finishing of asphalt pavements shall be done in accordance with Section 9.5 of the latest edition of the Superpave Hot Mix Asphalt/Quality Management System of the North Carolina Department of Transportation Pavement Construction Section.
- E. Compaction: Compaction of asphalt pavements shall be done in accordance with Section 9.7 of the Superpave Hot Mix Asphalt/Quality Management System of the North Carolina Department of Transportation Pavement Construction Section.
- F. Joints:
 - 1. Transverse Joints: Transverse joints are to be constructed in accordance with Section 9.9 of the Superpave Hot Mix Asphalt/Quality Management System of the North Carolina Department of Transportation Pavement Construction Section.
 - 2. Longitudinal Joints: Longitudinal are to be constructed in accordance with Section 9.10 of the latest edition of the Superpave Hot Mix Asphalt/Quality Management System of the North Carolina Department of Transportation Pavement Construction Section.
- G. Weather and Seasonal Limitations: Placement of asphalt is limited in accordance with Section 9.4.3 of the latest edition of the Superpave Hot Mix Asphalt/Quality Management System of the North Carolina Department of Transportation Pavement Construction Section.

3.7 ASPHALT CURBS

- A. Construct hot-mix asphalt curbs over compacted pavement surfaces. Apply a light tack coat unless pavement surface is still tacky and free from dust. Spread mix at minimum temperature of 250 degrees F.
 - 1. Asphalt Mix: Same as pavement surface-course mix.
- B. Place hot-mix asphalt to curb cross section indicated or, if not indicated, to local standard shapes, by machine or by hand in wood or metal forms. Tamp hand-placed materials and screed to smooth finish. Remove forms after hot-mix asphalt has cooled.

3.8 ASPHALT TRAFFIC-CALMING DEVICES

- A. Construct hot-mix asphalt speed bumps, humps, cushions, and tables over compacted pavement surfaces. Apply a tack coat unless pavement surface is still tacky and free from dust. Spread mix at minimum temperature of 250 degrees F.
 - 1. Tack Coat Application: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.
 - 2. Asphalt Mix: Same as pavement surface-course mix.
 - 3. Before installation, mill pavement that will be in contact with bottom of traffic-calming device. Mill to a depth of 1 inch from top of pavement to a clean, rough profile.
- B. Place hot-mix asphalt to cross section indicated, by machine or by hand in wood or metal forms. Tamp hand-placed materials and screed to smooth finish. Remove forms after hot-mix asphalt has cooled.

3.9 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Engineer.
- B. Paint shall only be applied when the atmospheric, surface, and material conditions are in accordance with the manufacturer's requirements.
- C. Contractor must insure that pavement surface to be painted shall be clean and dry before application. All surface contamination such as oil, grease, dirt, foreign matter, or other deleterious materials will be removed by the Contractor prior to application of paint.

- D. Paint shall be applied with mechanical equipment to produce uniform straight edges in strict compliance with the manufacturer's instructions. Paint shall be applied in two (2) coats at the manufacturer's recommended rates.

3.10 WHEEL STOPS

- A. Install wheel stops in bed of adhesive as recommended by manufacturer.
- B. Securely attach wheel stops to pavement with not less than two galvanized-steel dowels embedded at one-quarter to one-third points. Securely install dowels into pavement and bond to wheel stop. Recess head of dowel beneath top of wheel stop.

3.11 PRE-FORMED TRAFFIC-CALMING DEVICES

- A. Install pre-formed speed bumps, humps, and/or cushions in bed of adhesive as recommended by manufacturer for heavy traffic.
- B. Securely attach preformed speed bumps, humps, and/or cushions to pavement with hardware spaced as recommended by manufacturer for heavy traffic. Recess head of hardware beneath top surface.

3.12 FIELD QUALITY CONTROL

- A. The Owner will engage a qualified testing agency to perform tests and inspections and shall bear the responsibility for paying all costs associated with passing tests. The Contractor shall bear all costs in making all necessary repairs to make work satisfactory after a failed test and shall pay all costs associated with failed tests.
- B. Sampling and testing shall be in accordance with Section 7 of the latest edition of the Superpave Hot Mix Asphalt/Quality Management System of the North Carolina Department of Transportation Pavement Construction Section.
- C. Mat cross-slope and thickness shall be tested according to Section 10.1.8 of the latest edition of the Superpave Hot Mix Asphalt/Quality Management System of the North Carolina Department of Transportation Pavement Construction Section.
- D. Surface texture shall conform to Section 10.1.9 of the Superpave Hot Mix Asphalt/Quality Management System of the North Carolina Department of Transportation Pavement Construction Section. Smoothness shall conform to Section 10.2. Areas found to reveal non-conformance corrected by the Contractor by removal of the defective work and replacement with new material unless other corrective measures are permitted by the Engineer. The work and

materials required in the correction of defective work shall be provided by the Contractor at no cost.

- E. The Contractor shall repaint and restripe any traffic markings that were damaged, removed or covered during construction. All work shall be done in accordance with NCDOT requirements and specifications. The cost of this work shall be included in the unit bid prices for other related work and no additional payment shall be made.
- F. All existing manhole and valve covers shall be raised by the Contractor as necessary prior to paving so that the tops of the covers are flush with the final surface. The cost of this work shall be included in the unit bid prices for other related work and no additional payment shall be made.
- G. Replace and compact hot-mix asphalt where core tests were taken.
- H. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.13 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.
 - 1. The milled material shall become the property of the Contractor. All milled material shall be disposed of by the Contractor in an EPA-approved landfill, except where the milled material is used in the work or recycled. Do not allow milled materials to accumulate on-site.

END OF SECTION 321216

PART 1 - GENERAL**1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. Section Includes:

- 1. Driveways.
- 2. Roadways.
- 3. Parking lots.
- 4. Curbs and gutters.
- 5. Walks.

- B. Related Sections:

- 1. Division 03 Section "Cast-in-Place Concrete" for general building applications of concrete.
- 2. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.

1.3 DEFINITIONS

- A. 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

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.
- C. Other Action Submittals:

1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- D. Material Certificates: For the following, from manufacturer:
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.
- E. Material Test Reports: For each of the following:
1. Aggregates.
 2. Portland Cement: The Contractor shall submit a copy of mill test reports on all cement delivered to the job 7 days prior to use of the cement.
 3. Fly Ash: Complete chemical and physical analysis of each carload of fly ash shall be submitted to the Engineer ten (10) days prior to use of each carload delivered.
- F. Submit records of all concrete pours showing exact location of pour, date of pour, quantity of pour, and class of concrete poured to the Engineer each month. Temperature at time of pour should also be recorded.

1.5 QUALITY ASSURANCE

- A. All Portland cement concrete paving shall be in accordance with the appropriate sections of the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition) Division 7 and associated referenced sections, standards and drawings.
- B. If the average strength of the laboratory control cylinders shows the concrete to be below the specified design strength, the aggregate proportions and water content may be changed by the Engineer, who, in addition to such changes, may require core tests. Tests confirming concrete strengths on hardened concrete which was poured without testing shall be paid for by the Contractor.

1.6 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for public and emergency uses, as well as other construction activities.

PART 2 - PRODUCTS

2.1 FORMS

- A. Form Materials: shall be in accordance with the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition) Section 700-5.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

- A. Steel reinforcement utilized in all concrete paving shall be in accordance with the appropriate paragraphs of the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition) Section 1070.

2.3 CONCRETE MATERIALS

- A. Cementitious Material: All cementitious materials utilized in the Work shall be in accordance with the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition). All cementitious materials, shall be of same type, brand, and source throughout Project:
 - 1. Portland Cement: shall be fresh stock of an approved standard brand meeting the requirements of ASTM C 150, white portland cement Type II meeting the requirements of the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition) Section 1024-1.
 - 2. Fly Ash: shall be in accordance with the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition) Section 1024-5.
 - 3. Ground Granulated Blast-Furnace Slag: shall be in accordance with the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition) Section 1024-6.
 - 4. Coarse Aggregate: shall be in accordance with the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition) Section 1014-2.
 - 5. Fine Aggregate: shall be in accordance with the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition) Section 1014-1.

- B. Water: shall be potable and in accordance with the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition) Section 1024-4.
- C. Air-Entraining Admixture: shall be in accordance with the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition) Section 1024-3.
- D. Chemical Admixtures: shall be in accordance with the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition) Section 1024-3.

2.4 CURING MATERIALS

- A. All curing agents for concrete paving shall be in accordance with the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition) Section 1026.

2.5 RELATED MATERIALS

- A. Joint Materials: shall be appropriately selected in accordance with the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition) Section 1028.
- B. Adhesive and Epoxy Bonding Agents: shall be in accordance with the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition) Section 1081.

2.6 PAVEMENT MARKINGS

- A. Pavement-Markings: shall be in accordance with the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition) Section 1087.

2.7 PAVEMENT MARKERS

- A. Pavement-Markers: shall be in accordance with the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition) Section 1086.

2.8 WHEEL STOPS

- A. Wheel Stops: Precast, air-entrained concrete, 2,500-psi minimum compressive strength, 4-1/2 inches high by 9 inches wide by 72 inches long. Provide

chamfered corners, drainage slots on underside, and holes for anchoring to substrate.

1. Dowels: Galvanized steel, 3/4-inch diameter, 10-inch minimum length.

2.9 PRE-FORMED TRAFFIC-CALMING DEVICES

- A. Speed Bumps, Humps, and Cushions: Solid, integrally colored, 100 percent postconsumer or commingled postconsumer and postindustrial recycled plastic; UV stabilized. Provide holes for anchoring to substrate.
 1. Size: Modular bumps 2 inches high by 10 inches wide by 72 inches long, with overall length as dimensioned on Drawings.
 2. Size: Modular assemblies 4 inches high by 14 feet in overall width, with overall length as dimensioned on Drawings.
 3. Mounting Hardware: Galvanized-steel hardware as standard with device manufacturer.
 4. Adhesive: As recommended by device manufacturer.

2.10 CONCRETE MIXTURE

- A. The concrete mix design utilized for all concrete paving shall be in accordance with the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition) Section 1000-3.

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 paving to identify soft pockets and areas of excess yielding. Proof-rolling shall be in accordance with the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition) Sections 260-1 through 260-3.
- C. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Division 31 Section "Earth Moving."
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.
- B. Before placing concrete, all equipment for mixing and transporting and placing concrete shall be cleaned, all debris and ice removed from spaces to be occupied by the concrete, forms thoroughly cleaned of soil, ice, or other coatings which will prevent proper bond, reinforcement shall be securely tied in place and expansion joint material, anchors, and other embedded items shall be securely positioned. Hardened concrete and foreign materials shall be removed from the conveying equipment.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Form Installation, Use and Removal: shall be in accordance with the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition) Section 700-5.
- 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 the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition) Sections 425-1 through 425-5 for fabricating, placing, and supporting reinforcement.

3.5 JOINTS

- A. General: Joint construction shall comply with the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition) Section 700-11.
- B. Form construction, isolation, and contraction joints and tool edges 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 paving, place transverse joints to align with previously placed joints unless otherwise indicated.
 - 2. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
 - 3. Provide tie bars at sides of paving strips where indicated.

- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
1. Locate expansion joints at intervals of 50 feet unless otherwise indicated.
 2. Extend joint fillers full width and depth of joint.
 3. Terminate joint filler not less than 1/2 inch or more than 1 inch 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. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 3/8-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.6 INSPECTION

- A. Before placing concrete, the formwork installation and reinforcing steel must be complete. Notify Engineer upon completion of installation of all forms and reinforcing in ample time to permit inspection of the work. Subbase is subject to testing as directed by the Engineer. Place concrete immediately after approval of subbase, formwork and reinforcement.

3.7 CONCRETE PLACEMENT

- A. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- B. 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.
- C. Place concrete in accordance with the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition) Section 700-5.
- D. Concrete shall be handled from the mixer to the place of final deposit as rapidly as practical by methods which will prevent separation or loss of ingredients and in a manner which will assure that the required quality concrete is obtained. Conveying equipment shall be of size and design to insure a continuous flow of concrete at the delivery end.

- E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
- F. Batch tickets for each load of concrete shall be submitted to the Engineer. The following information shall be provided on each batch ticket:
 - 1. Design mix designation.
 - 2. Exact time cement, water and aggregate were discharged into the mix.
 - 3. Compressive strength of mix.
 - 4. Amount of water added to the mix.
- G. Concrete shall be deposited and spread in a continuous operation such that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, construction joints shall be located at points as provided for in the drawings or as approved. Placing shall be carried on at such a rate that the concrete which is being integrated with fresh concrete is still plastic. Deposit concrete as nearly as possible to its final location to avoid segregation due to rehandling or flowing. Do not subject concrete to any procedure which will cause segregation. Do not push or drag concrete into place or use vibrators to move concrete into place.
- H. Maintain equipment in proper operating condition, with drums cleaned before charging of each batch. Schedule delivery of trucks in order to prevent delay of placing after mixing.
- I. Concrete shall not be allowed to "freefall" a distance greater than 3 feet.
- J. Do not use concrete which has become non-plastic and unworkable or does not meet the required quality control limits, or which has become contaminated by foreign material. Remove rejected concrete from the project site and dispose of in an acceptable location.
- K. Consolidate concrete in accordance with the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition) Section 700-6.
- L. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
 - 1. When air temperature has fallen to or is expected to fall below 40 degrees F within five (5) days after the concrete is placed, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 55 degrees F and not more than 80 degrees F 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 design mixtures.
 4. Cover top with insulating blankets. Blankets shall remain in place for a minimum period of five days.
 5. In addition to laboratory-cured test specimens, additional concrete test specimens shall be cured under the same field conditions that the concrete in the field represented by these cylinders is cured and high thermometers shall be placed on the surface of slab to record daily temperatures during curing period.
- M. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
1. An approved admixture designed to retard the rate of set shall be used for all concrete placed when temperatures exceed 75 degrees F. Set retarding admixtures shall conform to ASTM C-494, Type D, water reducing and retarding.
 2. Provide wind breaks around the perimeter of the area where concrete is being placed.
 3. Cool ingredients before mixing to maintain concrete temperature below 90 degrees F at time of placement. Fresh concrete with temperatures 90 degrees F. or above shall be discarded off site. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water.
 4. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 5. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.8 CONCRETE FINISHING

- A. Finish concrete surfaces in accordance with the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition) Section 710-6.

3.9 JOINT SEALING

- A. General: Joint sealing shall be performed in accordance with the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition) Section 700-12.

3.10 DETECTABLE WARNINGS

- A. Blockouts: Form blockouts in concrete for installation of approved detectable paving units.
 - 1. Tolerance for Opening Size: Plus 1/4 inch, no minus.
- B. Stamped Detectable Warnings: Install approved stamped detectable warnings as part of a continuous concrete paving placement and according to stamp-mat manufacturer's written instructions.
 - 1. Before using stamp mats, verify that the vent holes are unobstructed.
 - 2. Apply liquid release agent to the concrete surface and the stamp mat.
 - 3. Stamping: While initially finished concrete is plastic, accurately align and place stamp mats in sequence. Uniformly load, gently vibrate, and press mats into concrete to produce imprint pattern on concrete surface. Load and tamp mats directly perpendicular to the stamp-mat surface to prevent distortion in shape of domes. Press and tamp until mortar begins to come through all of the vent holes. Gently remove stamp mats.
 - 4. Trimming: After 24 hours, cut off the tips of mortar formed by the vent holes.
 - 5. Remove residual release agent according to manufacturer's written instructions, but no fewer than three days after stamping concrete. High-pressure-wash surface and joint patterns, taking care not to damage stamped concrete. Control, collect, and legally dispose of runoff.

3.11 CONCRETE PROTECTION AND CURING

- A. Concrete Protection: shall comply with the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition) Section 700-8.
- B. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures, and maintain without drying at a relatively constant temperature for the period of time necessary for hydration of the cement and proper hardening of the concrete.
- C. Concrete Curing: shall comply with the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition) Section 700-9.
- D. Curing for concrete paving surfaces during periods when the outside air temperature does not exceed 60 degrees F. shall be provided by applying a membrane-forming curing compound to concrete surfaces as soon as the final troweling or floating operation has been completed. Application shall be in accordance with the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition) Section 700-9. Do not

use membrane curing compounds on surfaces which are to be covered with a coating material applied directly to the concrete or with any other cover or finish material which shall be bonded to the concrete.

- E. Curing for all pavement surfaces during periods when the outside air temperature will exceed 60 degrees F. shall be provided by covering the entire surface with burlap. Application shall be in accordance with the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition) Section 700-9. Immediately following the placement of the burlap, the entire surface shall be maintained continuously wet for a period of 7 days. Do not permit surfaces to dry at any period during the required curing period.
- F. During the curing period, protect concrete from damaging mechanical disturbances, including load stresses, shocks, excessive vibration and from change caused by subsequent construction operations.

3.12 PAVING TOLERANCES

- A. Tolerances for pavement thickness shall comply with the appropriate portions of the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition) Sections 700-15 and 710-9.
- B. Tolerances for surface smoothness shall comply with the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition) Section 710-7.

3.13 PAVEMENT MARKINGS

- A. The application of pavement markings shall comply with the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition) Section 1205.
- B. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Engineer.
- C. Allow concrete paving to cure for a minimum of 28 days and be dry before starting pavement marking.
 - 1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to concrete surface. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.

3.14 PAVEMENT MARKERS

- A. The installation of pavement markers shall comply with the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition) Section 1250.
- B. Do not install pavement-markers until layout, colors, and placement have been verified with Engineer.
- C. Allow concrete paving to cure for a minimum of 28 days and be dry before starting pavement marking.

3.15 WHEEL STOPS

- A. Install wheel stops in bed of adhesive applied as recommended by manufacturer.
- B. Securely attach wheel stops to paving with not less than two galvanized steel dowels located at one-quarter to one-third points. Install dowels in drilled holes in the paving and bond dowels to wheel stop. Recess head of dowel beneath top of wheel stop.

3.16 PREFORMED TRAFFIC-CALMING DEVICES

- A. Install preformed speed bumps, humps, and/or cushions in bed of adhesive applied as recommended by manufacturer for heavy traffic.
- B. Securely attach preformed speed bumps, humps, and/or cushions to paving with hardware spaced as recommended by manufacturer for heavy traffic. Recess head of hardware beneath top surface.

3.17 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections as required.

3.18 REPAIRS AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Engineer. Make edges of cuts perpendicular to the concrete surfaces.
- B. Repair and patch defective areas immediately after removal of forms as directed by the Engineer. Dampen all concrete surfaces in contact with

patching concrete, and brush with a neat cement grout coating or concrete bonding agent. Place patching concrete before grout takes its initial set. Mix patching concrete of the same materials to provide concrete of the same type or class as the original adjacent concrete. Place, compact, and finish as required to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.

- C. Drill test cores where directed by Engineer, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with approved non-shrink grout compatible with the pavement concrete.
- D. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- E. Protect concrete paving from environmental factors in accordance with the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition) Section 700-8.
- F. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

3.19 TESTING AND QUALITY CONTROL

- A. The Owner shall employ a concrete testing laboratory to provide all laboratory testing services on the project and a concrete technician to perform all quality control tests on concrete and materials used to batch concrete. The testing agency employed shall meet the requirement of "Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction", (ASTM E-329).
- B. Such tests will be provided and paid for by the Owner, except that tests which reveal non-conformance with the Specifications and all succeeding tests for the same area, until conformance with the Specifications is established shall be at the expense of the Contractor. The Owner will be responsible for paying for only the successful tests.
- C. The Contractor shall provide and maintain adequate facilities on the project for the testing laboratory to locate the required testing equipment and for safe storage area for test cylinders. The general contractor shall provide at his own expense all casual labor needed to assist the concrete technician in obtaining samples of concrete and concrete materials and moving and transporting cylinders and materials which are being tested.

- D. Acceptance testing for concrete pavement shall comply with the North Carolina Department of Transportation Standard Specifications for Road and Structures (latest edition) Sections 700-15.

END OF SECTION 321313

PART 1 - GENERAL**1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. This section covers the furnishing of all labor, equipment and materials necessary for the proper restoration of existing surfaces disturbed or damaged as a result of construction operations which are not specifically scheduled or specified for topsoil and seeding, paving, landscaping or other surfacing.
- B. In general, the types of replacement included in this section are seeding along pipelines, concrete sidewalks, driveways, roadways, ditches, lawns and landscaped areas, and curb and gutter.
- C. Any damage to existing structures shall be repaired using materials and workmanship equal to, or better than, those of the original construction.

1.3 DEFINITIONS

- A. CABC – Crushed aggregate base course.
- B. NCDOT – North Carolina Department of Transportation.
- C. PSI – Pounds per square inch.

1.4 SUBMITTALS

- A. All submittals shall be in accordance with the requirements of the pertinent specification sections referenced herein.
- B. An appropriate concrete mix design shall be submitted for all concrete sidewalks, driveways, roadways, and curb and gutter restored as part of this project.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 SEEDING DISTURBED AREAS

- A. All ground surfaces disturbed by construction activity, which are not classified as lawns, landscaped areas, or pavement areas, but would be classified as open fields, shall be raked smooth and seeded in accordance with the appropriate paragraph(s) within Section 329200 entitled Turf and Grasses. Large rocks, clumps of earth and excessive spoil material shall be removed from the area prior to seeding.
- B. Shoulders of all roads shall be restored as specified for lawns and landscaped areas.
- C. Wooded areas not classified as lawns shall be restored to as near their original condition as possible.

3.2 CONCRETE SIDEWALKS

- A. Concrete walks removed in connection with, or damaged as a result of, construction operations under the Contract shall be replaced with new construction. Such walks shall be constructed of 4,000 PSI concrete on a thoroughly compacted subgrade, shall have a vertical thickness, unless otherwise noted, of not less than 4 inches or the thickness of the replaced walk where greater than 4 inches.
- B. Walks shall be float finished, edged with an edging tool, and grooved at intermediate intervals not in excess of the width of the walk, uniform throughout the length of the walk in any one direction.

3.3 DRIVEWAYS

- A. Unless otherwise noted, unpaved driveways shall be surfaced with not less than 4 inches of CABC, topped with 4 inches of stone, gravel, or other materials equal to that found in the original driveway. Driveways shall be left in a condition better than their original condition.
- B. Concrete drives shall be replaced with 4,000 PSI concrete and shall have equal thickness and reinforcing steel to that of the original drive. Prior to placing the concrete a 6-inch aggregate base course shall be placed in the drive area.
- C. Unless otherwise noted, bituminous or asphaltic concrete drives shall be restored to original base and asphalt thicknesses or a minimum of 6 inches of

aggregate base course and a 2-inch surface course, whichever is greater. Base material shall be compacted in 3-inch lifts and Type SF 9.5A or S 9.5B asphalt compacted in 2-inch lifts to match existing pavement section. All work shall be in accordance with the appropriate paragraph(s) of Section 321216 entitled Bituminous Paving.

3.4 ROADWAY REPLACEMENT

- A. Bituminous or Asphaltic pavements shall include all areas paved with blacktop, built up pavements or oil and stone, tar and stone and similar pavements constructed with a bituminous or asphalt and stone materials.
- B. Immediately upon completion of installation of underground piping and structures, the trench shall be backfilled and the roadway shall be repaired. Provide materials as specified in the Contract Drawings. If, in the opinion of the Engineer, the area adjacent to the excavation has not been damaged to the extent that the base course need to be replaced, restoration may consist of a surface course of sufficient thickness to meet the existing pavement.
- C. Unless otherwise noted, bituminous or asphaltic concrete roadways shall be restored to original base and asphalt thicknesses or a minimum of 6 inches of aggregate base course and a 2-inch surface course, whichever is greater. Base material shall be compacted in 3-inch lifts and Type SF 9.5A or S 9.5B asphalt compacted in 2-inch lifts to match existing pavement section. All work shall be in accordance with the appropriate paragraph(s) of Section 321216 entitled Bituminous Paving.
- D. Portland cement concrete roadways shall be replaced with 4,000 PSI concrete and shall have equal thickness and reinforcing steel as the original roadway. An aggregate base course with a thickness of 6 inches shall be placed prior to the placing of concrete.
- E. Differential settlement of restored pavements shall be corrected immediately.
- F. The Contractor shall repair and restripe any traffic markings that were damaged, removed or covered during construction. All work shall be done in accordance with NCDOT requirements and specifications.
- G. All existing manhole and valve covers shall be raised, as required, by the Contractor prior to paving. The cost of this work shall be included in the unit bid prices for other related work and no additional payment shall be made.

3.5 DITCHES

- A. Ditches shall be regraded to the original grade and line. The surface of all ditches shall be returned to the same condition as found before commencing work.

3.6 LAWNS AND LANDSCAPED AREAS

- A. Lawns and landscaped areas shall be regraded and replaced as follows:
 - 1. Grading shall be to the grade existing before construction of the work under this Contract.
 - 2. Lawn replacement shall be in accordance with the appropriate paragraph(s) within Section 329200 entitled Turf and Grasses. Topsoiled areas shall be replaced with topsoil of equal quality and quantity.
- B. Landscaped areas shall be replaced with shrubs, hedges, ornamental trees, flowers, or other items to original condition.

3.7 CURB AND GUTTER

- A. Curb and gutter removed with or damaged as a result of construction operations, injured or disturbed by the Contractor, his agents, or employees, shall be replaced with new construction to a condition similar and equal to that existing before damage was incurred. 4,000 PSI concrete shall be used in curb and gutter replacement.
- B. All work associated with curb and gutter replacement shall be in accordance with Section 846-3 of the NCDOT Standard Specifications for Roads and Structures (latest edition). Horizontal and vertical alignment of the curb and gutter shall match that of the existing to the greatest extent practical, unless directed otherwise by the Engineer.

3.8 DAMAGE TO STRUCTURES

- A. Any damage to existing structures shall be repaired of materials and workmanship equal to those of original construction. Extensively damaged structures, where the structural stability has been affected or which cannot be repaired in a suitable fashion shall be replaced entirely. Replacement shall not commence until approval of the plan of replacement has been given by the Engineer. Replacement costs shall be responsibility of the Contractor.

END OF SECTION 322905

PART 1 - GENERAL**1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. This section covers the furnishing of all labor, equipment and materials necessary for the establishment of vegetation in all areas of the site disturbed by construction operations and all earth surfaces of embankments including rough and fine grading, topsoil if required, fertilizer, lime, seeding and mulching. The Contractor shall adapt his operations to variations in weather or soil conditions as necessary for the successful establishment and growth of the grasses or legumes.
- B. 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

- A. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.
- B. Finish Grade: Elevation of finished surface of planting soil.
- C. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- D. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- E. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. These include insects, mites, grubs,

mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

- F. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- G. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.
- H. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- I. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.4 SUBMITTALS

- A. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
 - 1. Evidence of State certification of each seed mixture for turfgrass sod and plugs. Include identification of nursery source and name and telephone number of supplier.
- B. Product Certificates: For soil amendments and fertilizers, from manufacturer.
- C. Certificates of Inspection as required by law or governing authorities to accompany shipments.
- D. Source of mulch for approval and five (5) gallon bucketful physical sample.
- E. Proposed planting schedule, indicating dates for all work during normal seasons for such work. Once accepted, revise dates only as approved in writing, after documentation of reasons for delays.
- F. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of turf and grasses during a calendar year. Submit before expiration of required initial maintenance periods.

1.5 QUALITY ASSURANCE

- A. No material substitutions will be permitted without the prior written approval of the Engineer.
- B. All materials shall be applied in strict accordance with manufacturer's written instructions.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Products shall be packed and shipped in a manner which will not damage them.
- B. Damaged products shall be rejected upon delivery and promptly removed from the site.
- C. Products which must be stored prior to installation shall be protected from damage and theft.
- D. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable. During handling and storing, the seed shall be cared for in such a manner that it will be protected from damage by heat, moisture, rodents, or other causes.
- E. Bulk Materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 - 3. Accompany each delivery of bulk fertilizers, lime, and soil amendments with appropriate certificates.

1.7 PROJECT CONDITIONS

- A. Schedule and coordinate work with all trades involved.
- B. Verify that the areas of work have been properly contoured and brought to final grade prior to beginning work.
- C. Consult record drawings and installers to determine actual underground utility and drainage system locations in the vicinity of this work. Damage to known or unrecorded utilities will be repaired at the Contractor's expense.

- D. Notify the Engineer of any unforeseen conditions which will affect plant installation or growth.
- E. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of planting completion.
 - 1. Optimum Spring Planting: April 1 – May 1.
 - 2. Optimum Fall Planting: September 1 – October 1.
- F. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

1.8 MAINTENANCE SERVICE

- A. Initial Turf Maintenance Service: Provide full maintenance by skilled employees. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until Final Acceptance of the project by the Owner.
- B. Initial Meadow Maintenance Service: Provide full maintenance by skilled employees. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until Final Acceptance of the project by the Owner.
- C. Continuing Maintenance Requirements: Throughout the warranty period of the Work, excluding conditions of vandalism, theft, accident, acts of God and Owner's negligent maintenance, Contractor shall be responsible for making any and all necessary repairs to planted areas which may include or may result from, the lack of fully established growth of turfs and grasses and/or soil erosion from project areas. In such instances, Contractor shall be responsible for restoring these areas to originally accepted conditions as well as full establishment of turfs and grasses or other groundcovers in the area. The Contractor shall also be responsible for any damages to adjacent areas impacted by the lack of proper turf and grass establishment.

PART 2 - PRODUCTS

2.1 FERTILIZERS

- A. The quality of fertilizer and all operations in connection with the furnishing of this material shall comply with the requirements of the North Carolina Fertilizer Law and regulations adopted by the North Carolina Board of Agriculture.

- B. For all areas to be seeded which are not classified as lawns, but would be classified as open fields, fertilizer shall be free-flowing, ready mixed 10-10-10 grade commercial fertilizer. Upon written approval of the Engineer a different grade of fertilizer may be used, provided the rate of application is adjusted to provide the same amounts of plant food.
- C. For all areas to be seeded which are classified as lawns, fertilizer shall be as follows:
 - 1. Fertilizer tablets: Agriform Planting Tablets 20-10-5 as manufactured by Scotts-Sierra Horticultural Products, or equal, may be used at installer's option.
 - 2. Encapsulated fertilizer: Osmocote 19-6-12 as manufactured by Scotts-Miracle Gro, or equal, may be used at installer's option.
- D. During handling and storing, the fertilizer shall be cared for in such a manner that it will be protected against hardening, caking, or loss of plant food values. Any hardened or caked fertilizer shall be pulverized to its original conditions before being used.

2.2 LIME

- A. Lime: The quality of lime and all operations in connection with the furnishing of this material shall comply with the requirements of ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
 - 1. Class: O, with a minimum of 95 percent passing through No. 8 sieve and a minimum of 55 percent passing through No. 60 sieve.
 - 2. Provide lime in the form of free-flowing ground dolomitic limestone.
- B. During the handling and storing, the lime shall be cared for in such a manner that it will be protected against hardening and caking. Any hardened or caked lime shall be pulverized to its original condition before being used.

2.3 SEED

- A. Grass seed shall be fresh, clean, dry, new-crop seed complying with the requirements of the North Carolina Seed Law and regulations adopted by the North Carolina Board of Agriculture.
- B. Seed shall have been approved by the North Carolina Department of Agriculture or any agency approved by the Engineer before being sown, and no seed will be accepted with a date of test more than nine (9) months prior to the date of sowing. Such testing however, will not relieve the Contractor from responsibility for furnishing and sowing seed that meets these specifications at

the time of sowing. When a low percentage of germination causes the quality of the seed to fall below the minimum pure live seed specified, the Contractor may elect, subject to the approval of the Engineer, to increase the rate of seeding sufficiently to obtain the minimum pure live seed contents specified, provided that such an increase in seeding does not cause the quantity of noxious weed seed per square yard to exceed the quantity that would be allowable at the regular rate of seed.

- C. During handling and storing, the seed shall be cared for in such a manner that it will be protected from damage by heat, moisture, rodents, or other causes.
- D. Seed shall be entirely free from bulblets or seed of Johnson Grass, Nutgrass, Sandbur, Wild Onion, Wild Garlic, and Bermuda Grass. The specifications for restricted noxious weed seed refers to the number per pound, singly or collectively, of Blessed Thistle, Wild Radish, Canada Thistle, Corncockle, Field Bindweed, Quackgrass, Dodders, Dock, Horsenettle, Bracted Plantain, Buckhorn or Wild Mustard; but in no case shall the number of Blessed Thistle or Wild Radish exceed 27 seeds of each per pound. No tolerance on weed seed will be allowed.
- E. Seed Purity: All seed species shall consist of seed with not less than a 95 percent germination rate, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:

2.4 MULCH

- A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, threshed straw of wheat, rye, or oats which is free of noxious weeds or other species which would grow and be detrimental to the specified grass.
- B. Wood Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 10 percent (± 2 percent); organic matter 99.4 percent (± 0.2 percent); ash content 0.6 percent (± 0.2 percent) water holding capacity of 1050 grams water/100 grams dry fiber. and a pH range of 4.5 to 6.5.

2.5 TACKIFIER

- A. Tackifier shall consist of an asphalt emulsion in accordance with ASTM D 977, Grade SS-1; shall be nontoxic and free of plant-growth or germination inhibitors.

2.6 WATER

- A. Water shall be clean, clear water free from any objectionable or harmful chemical qualities or organisms and shall be furnished by the Contractor.

2.7 EROSION-CONTROL MATERIALS

- A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches long.
- B. Erosion-Control Mats: Cellular, non-biodegradable slope-stabilization mats designed to isolate and contain small areas of soil over steeply sloped surface. Include manufacturer's recommended anchorage system for slope conditions.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PROTECTION OF EXISTING STRUCTURES, UTILITIES, TREES AND VEGETATION

- A. Protect existing structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings indicated to remain in place against unnecessary cutting, breaking or skinning of roots, skinning and bruising of bark, and smothering of trees by stockpiling construction materials or excavated materials, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide wood or metal stakes 48 inches in height, set on eight (8) to 10 foot

centers, connected by 2-inch minimum brightly colored flagging tape or fabric fencing to protect trees and vegetation to remain. Set perimeter of protection at the drip line of trees to remain unless approved otherwise by the Engineer.

- B. Provide protection for roots over 1-1/2 inch in diameter cut during construction operations. Coat cut faces with an emulsified asphalt, or other acceptable coating, formulated for use on damaged plant tissues. Temporarily cover exposed roots with wet burlap to prevent roots from drying out and cover with earth as soon as possible.
- C. The Contractor shall not remove or damage trees and shrubs which are outside the Clearing Limits established by the Owner or those within the Clearing Limits designated to remain.
- D. Repair trees scheduled to remain and damaged by construction operations in a manner acceptable to the Engineer. Repair damaged trees promptly to prevent progressive deterioration caused by damage.
- E. Replace trees scheduled to remain and damaged beyond repair by construction operations, as determined by the Engineer, with trees of similar size and species. Repair and replacement of trees scheduled to remain and damaged by construction operations or lack of adequate protection during construction operations shall be at the Contractor's expense.
- F. Protect adjacent and adjoining areas from hydroseeding, hydromulching, and tackifier overspray.
- G. Protect grade stakes set by others until directed to remove them.

3.3 GRADING

- A. Rough grading shall be done as soon as all excavation required in the area has been backfilled. The necessary earthwork shall be accomplished to bring the existing ground to the desired finish elevations as shown on the Contract Drawings or otherwise directed.
- B. Fine grading shall consist of shaping the final contours for drainage and removing all large rock, clumps of earth, roots and waste construction materials. It shall also include thorough loosening of the soil to a depth of 6" by plowing, disking, harrowing or other approved methods until the area is acceptable as suitable for subsequent landscaping operations. The work of landscaping shall be performed on a section by section basis immediately upon completion of earthwork.
- C. Upon failure or neglect on the part of the Contractor to coordinate his grading with seeding and mulching operations and diligently pursue the control of erosion and siltation, the Engineer may suspend the Contractor's grading

operations until such time as the work is coordinated in a manner acceptable to the Engineer.

3.4 SECURING AND PLACING TOPSOIL

- A. Topsoil shall be secured from areas from which topsoil has not been previously removed, either by erosion or mechanical methods. Topsoil shall not be removed to a depth in excess of the depth approved by the Engineer.
- B. The area or areas from which topsoil is secured shall possess such uniformity of soil depth, color, texture, drainage and other characteristics as to offer assurance that, when removed the product, will be homogeneous in nature and will conform to the requirements of these specifications.
- C. All areas from which topsoil is to be secured, shall be cleaned of all sticks, boards, stones, lime, cement, ashes, cinders, slag, concrete, bitumen or its residue and any other effuse which will hinder or prevent growth.
- D. In securing topsoil from a designated pit, or elsewhere, should strata or seams of material occur which do not come under the requirements for topsoil, such material shall be removed from the topsoil or if required by the Engineer, the pit shall be abandoned.
- E. Before placing or depositing topsoil upon any areas, all improvement within the area shall be completed, unless otherwise approved by the Engineer. The areas in which topsoil is to be placed or incorporated shall be prepared before securing topsoil for use.
- F. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.5 SEEDBED PREPARATION

- A. The Contractor shall cut and satisfactorily dispose of weeds or other unacceptable growth on the areas to be seeded. Uneven and rough areas outside of the graded section, such as crop rows, farm contours, ditches and ditch spoil banks, fence line and hedgerow soil accumulations, and other minor irregularities which cannot be obliterated by normal seedbed preparation operations, shall be shaped and smoothed as directed by the Engineer to provide for more effective seeding and for ease of subsequent mowing operations.
- B. The soil shall then be scarified or otherwise loosened to a depth of not less than 6 inches except as otherwise provided below or otherwise directed by the Engineer. Clods shall be broken and the top 2 to 3 inches of soil shall be

worked into an acceptable seedbed by the use of soil pulverizers, drags, or harrows; or by other methods approved by the Engineer.

- C. On 2:1 slopes a seedbed preparation will be required that is the same depth as that required on flatter areas, although the degree of smoothness may be reduced from that required on the flatter areas if so permitted by the Engineer.
- D. On cut slopes that are steeper than 2:1, both the depth of preparation and the degree of smoothness of the seedbed may be reduced as permitted by the Engineer, but in all cases the slope surface shall be scarified, grooved, trenched, or punctured so as to provide pockets, ridges, or trenches in which the seeding materials can lodge.
- E. On cut slopes that are either 2:1 or steeper, the Engineer may permit the preparation of a partial or complete seedbed during the grading of the slope. If at the time of seeding and mulching operations such preparation is still in a condition acceptable to the Engineer, additional seedbed preparation may be reduced or eliminated.
- F. The preparation of seedbeds shall not be done when the soil is frozen, extremely wet, or when the Engineer determines that it is in an otherwise unfavorable working condition.
- G. Limestone may be applied at the rate described below as a part of the seedbed preparation, provided it is immediately worked into the soil. If not so applied, limestone and fertilizer shall be applied as described below.

3.6 APPLICATION OF LIMESTONE, FERTILIZER, SEED, AND MULCH (GENERAL)

- A. Equipment to be used for the application, covering or compaction of limestone, fertilizer, and seed shall have been approved by the Engineer before being used on the project. Approval may be revoked at any time if equipment is not maintained in satisfactory working condition, or if the equipment operation damages the seed.
- B. Limestone, fertilizer, seed and mulch shall be applied within 24 hours after completion of seedbed preparation unless otherwise permitted by the Engineer, but no limestone or fertilizer shall be distributed and no seed shall be sown when the Engineer determines that weather and soil conditions are unfavorable for such operations.

3.7 FERTILIZATION AND LIMING

- A. Following seedbed preparation, fertilizer shall be applied to all areas to be seeded so as to achieve the application rates shown below. Fertilizer shall be

spread evenly over the seedbed and shall be lightly harrowed, raked, or otherwise incorporated into the soil for a depth of ½ inch.

- B. Fertilizer need not be incorporated in the soil as specified above when mixed with seed in water and applied with power sprayer equipment. The seed shall not remain in water containing fertilizer for more than 30 minutes when a hydraulic seeder is used.
- C. Agricultural limestone shall be thoroughly mixed into the soil according to the rates indicated below. The specified rate of limestone application may be reduced by the Engineer if pH tests indicate this to be desirable. It is the responsibility of the Contractor to obtain such tests and submit the results to the Engineer for adjustment in rates.
- D. In the absence of a soil test, the following rates of application of fertilizer and lime shall be to all areas to be seeded which are not classified as lawns, but would be classified as open fields:
 - 1. Lime: 4,000 pounds per acre
 - 2. Fertilizer: 1,000 pounds per acre
- E. For all areas to be seeded which are classified as lawns, fertilizer and lime shall be applied at the following rates:
 - 1. Lime: 92 pounds per 1,000 square feet
 - 2. Fertilizer: 23 pounds per 1,000 square feet
- F. When adverse seeding conditions are encountered due to steepness of slope, height of slope, or soil conditions, the Engineer may direct or permit that modifications be made in the above requirements which pertain to incorporating limestone into the seedbed; covering limestone, seed, and fertilizer; and compacting the seedbed. Such modifications may include but not be limited to the following:
 - 1. The incorporation of limestone into the seedbed may be omitted on:
 - a. Cut slopes steeper than 2:1;
 - b. On 2:1 cut slopes when a seedbed has been prepared during the excavation of the cut and is still in an acceptable condition; or
 - c. on areas of slopes where the surface of the area is too rocky to permit the incorporation of the limestone.
- G. It shall be the responsibility of the Contractor to make an additional application of maintenance fertilizer in the amount of 650 pounds per acre (15 pounds per 1,000 square feet) following the initial establishment of groundcover. This application shall occur when vegetation is three (3) inches in height or 45 days after initial seeding, whichever comes first.

3.8 **SEEDING**

- A. Seeding shall commence as soon as preparation of the seedbed has been completed. Do not broadcast or drop seed when wind velocity exceeds 5 mph or until the surface is suitable for working and is in proper condition. Seed mixtures may be sown together provided they are kept in a thoroughly mixed condition during the seeding operation.
- B. All disturbed areas shall be seeded unless specifically indicated to receive other types of plantings or groundcovers.
- C. Seed may be uniformly sown over the seedbed by a mechanical method suitable for the slopes and size of the areas to be seeded. Broadcast type seeders, windmill hand seeder or approved mechanical power drawn seed drills may be utilized.
 - 1. Do not use wet seed or seed that is moldy or otherwise damaged.
 - 2. Do not seed against existing trees.
- D. For all areas to be seeded which are not classified as lawns, but would be classified as open fields, seed species and application rates shall be as follows:
 - 1. Spring/Summer (Normally April 1 to August 31):
 - a. 100 pounds of Ky-31 tall fescue per acre.
 - 2. Fall and Winter (Normally September 1 to March 31):
 - a. 85 pounds of Ky-31 tall fescue and 15 pounds of rye grain per acre.
 - 3. On cut and fill slopes having 2:1 or steeper slopes, add 15 pounds of sudangrass to the planned seeding in summer seeding or 25 pounds of rye cereal per acre in fall and winter seeding, if seeded September to February.
 - 4. These seeding rates are prescribed for all sites with less than 50 percent ground cover and for sites with more than 50 percent ground cover where complete seeding is necessary to establish effective erosion control vegetative cover. On sites having 50 to 80 percent ground cover where complete seeding is not necessary to establish vegetative cover, reduce the seeding rate at least one-half the normal rate.
- E. For all areas to be seeded which are classified as lawns, seed species and application rates shall be as follows:
 - 1. "Rebel" turf type fescue.....3 pounds per 1,000 square feet
 - 2. "Falcon" turf type fescue 3 pounds per 1,000 square feet
 - Total Mix 6 pounds per 1,000 square feet**

- F. Care shall be taken to adjust the seeder for seeding at the proper rate before seeding operations are started and to maintain their adjustment during seeding. Seed in hoppers shall be agitated to prevent segregation of the various seeds in the mixture.
- G. Immediately after application, harrow, drag, rake, or otherwise work seedbed so as to cover the seed with a layer of soil. The depth of covering shall be as directed by the Engineer. If two kinds of seed are to be used which require different depths of covering, they shall be sown separately.
- H. When a combination seed and fertilizer drill is used, fertilizer may be drilled in with the seed after limestone has been applied and worked into the soil. If two kinds of seed are being used which require different depths of cover, the seed requiring the lighter cover may be sown broadcast or with a special attachment to the drill, or drilled lightly following the initial drilling operation.
 - 1. The rates of application of limestone, fertilizer, and seed on slopes 2:1 or steeper or on rocky surfaces may be reduced or eliminated.
 - 2. Compaction after seeding may be reduced or eliminated on slopes 2:1 or steeper, on rocky surfaces, or on other areas where soil conditions would make compaction undesirable.
- I. Protect seeded areas with erosion-control mats where shown on Drawings; install and anchor according to manufacturer's written instructions.

3.9 MULCHING

- A. All seeded areas shall be uniformly mulched in a continuous blanket immediately after seeding. The mulch shall be applied so as to permit some sunlight to penetrate and the air to circulate and at the same time, shade the grounds, reduce erosion and conserve soil moisture. Approximately 25 percent of the ground shall be visible through the mulch blanket.
- B. To achieve the coverage described above, it will be necessary to apply straw mulch to seeded areas at a rate of approximately 4,000 pounds per acre (92 pounds per 1,000 square feet) or wood fiber mulch at a rate of 1,600 pounds per acre (37 pounds per 1,000 square feet).
- C. Mulch shall be uniformly spread by hand or by approved mechanical spreaders or blowers which will provide an acceptable application as described above.
- D. Before mulch is applied on cut or fill slopes which are 3:1 or flatter, and ditch slopes, the Contractor shall remove and dispose of all exposed stones in excess of 3 inches in diameter and all roots or other debris which will prevent proper contact of the mulch with the soil.

- E. Care shall be exercised to prevent displacement of soil or seed or other damage to the seeded area during the mulching operations.
- F. The Contractor shall take sufficient precautions to prevent mulch from entering drainage structures through displacement by wind, water, or other causes and shall promptly remove any blockage to drainage facilities which may occur.

3.10 TACKIFIER

- A. Emulsified asphalt or organic tackifier shall be sprayed uniformly on mulch as it is ejected from blower or immediately thereafter. Tackifier shall be applied evenly over area creating uniform appearance. Application rates and method of application will vary with conditions, be approved by the Engineer, and shall be applied in sufficient amount to assure that the mulch is properly held in place. Where the binding material is not applied directly with the mulch it shall be applied immediately following the mulch operation.
- B. The Contractor shall cover/protect structures, poles, fences and other appurtenances if mulch binder is applied in such a way that it may come in contact with or discolor those structures or appurtenances. Mulch and binder shall be applied by suitable blowing equipment at closely controlled application rates in a manner acceptable to the Engineer.
- C. Asphalt shall not be used in freezing weather.

3.11 HYDROSEEDING

- A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseeding applications. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
 - 1. Mix slurry with fiber-mulch tackifier in accordance with manufacturer's recommendations.
 - 2. Fiber mulch shall be mixed into the slurry such that the application rate of the fiber mulch is 1,500 to 2,000 pounds per acre.
 - 3. Apply slurry uniformly to all areas to be seeded in a one-step process in accordance with the application rates described herein.
- B. When a hydraulic seeder is used for application of seed and fertilizer, the seed shall not remain in water containing fertilizer for more than 30 minutes prior to application unless otherwise permitted by the Engineer.

3.12 EROSION CONTROL MATERIALS

- A. Install all erosion control materials in accordance with manufacturer's recommendations and as shown on Drawings.

3.13 TURF RENOVATION

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

3.14 TURF MAINTENANCE

- A. The Contractor shall keep all seeded areas in good condition, reseeding and mowing if and when necessary as directed by the Engineer, until a good lawn is established over the entire area seeded and shall maintain these areas in an approved condition until final acceptance of the Contract.

- B. Grassed areas will be accepted when a 95 percent cover by permanent grasses is obtained and weeds are not dominant. On slopes, the Contractor shall provide against washouts by an approved method. Any washouts which occur shall be regraded and reseeded until a good sod is established.
- C. Areas of damage or failure due to any cause shall be corrected by repair or by being completely redone as may be directed by the Engineer. Areas of damage or failure resulting either from negligence on the part of the Contractor in performing subsequent construction operations or from not taking adequate precautions to control erosion and siltation as required throughout the various sections of the specifications shall be repaired by the Contractor as directed by the Engineer at no cost to the Owner.

3.15 CLEANUP AND PROTECTION

- A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.
- C. Remove nondegradable erosion-control measures after grass establishment period.

END OF SECTION 329200

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. This section covers the furnishing of all labor, equipment and materials necessary for the installation of all trees, shrubs, ground covers, herbaceous plants and bulbs. Also included is the sodding of lawn areas.
- B. Section Includes:
 - 1. Plants.
 - 2. Planting soils.
 - 3. Tree stabilization.
 - 4. Landscape edgings.
 - 5. Tree grates.
- C. Related Sections:
 - 1. Division 01 Section "Temporary Tree and Plant Protection" for protecting, trimming, pruning, repairing, and replacing existing trees to remain that interfere with, or are affected by, execution of the Work.
 - 2. Division 31 Section "Site Clearing" for protection of existing trees and plantings, topsoil stripping and stockpiling, and site clearing.
 - 3. Division 31 Section "Earth Moving" for excavation, filling, and rough grading and for subsurface aggregate drainage and drainage backfill materials.
 - 4. Division 32 Section "Turf and Grasses" for turf planting, hydroseeding, and erosion-control materials.

1.3 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with ball size not less than sizes indicated; wrapped

with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.

- C. Balled and Potted Stock: 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 plant required.
- D. Bare-Root Stock: 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 plant required.
- E. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a 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 plant required.
- F. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.
- G. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted 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 plant.
- H. Finish Grade: Elevation of finished surface of planting soil.
- I. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- J. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- K. Pests: Living organisms that occur where they are not desired, or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- L. Planting Area: Areas to be planted.
- M. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified

with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

- N. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.
- O. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.
- P. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.
- Q. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- R. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- S. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated, including soils.
 - 1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
 - 2. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to the Project.
- B. Samples for Verification: For each of the following:
 - 1. Source of mulch for approval and five (5) gallon bucketful physical sample.
- C. Qualification Data: For qualified landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.
- D. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:
 - 1. Certificates of Inspection as required by law or governing authorities to accompany shipments.

2. Vendor certified analysis for soil amendments, fertilizer materials, and grass seed.
 3. Evidence of State certification for sod.
 4. Certificates indicating nursery source of each plant.
- E. Material Test Reports: Soil analysis report for existing soil and proposed supply of soil, if needed. Also indicate location of source.
- F. Proposed planting schedule, indicating dates for each type of landscape work during normal seasons for such work. Once accepted, revise dates only as approved in writing, after documentation of reasons for delays.
- G. Maintenance Instructions: Written instructions for the Owner's maintenance of landscaping. Include initial, 12-month, and long-term maintenance recommendations. Submit prior to acceptance of landscaping.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: In addition to the requirements in Division 01 Section "Quality Requirements", the landscape installer shall have at least five (5) years of satisfactory experience in successful establishment of plants including at least two (2) completed jobs of dollar value and scope similar to this work.
1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
 2. Installer's Field Supervision: Installer to shall maintain an experienced full-time supervisor on Project site when work is in progress.
 3. Chemical Applicator: Applicator must be properly trained to use all chemicals and must be licensed to purchase and use restricted chemicals, if any.
- B. Soil-Testing Laboratory Qualifications: An independent or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
- C. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of the soil.
1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.
 2. The soil-testing laboratory shall oversee soil sampling; with depth, location, and number of samples to be taken per instructions from Engineer. A minimum of three (3) representative samples shall be taken

from varied locations for each soil to be used or amended for planting purposes.

3. Report suitability of tested soil for plant growth.
 - a. Based upon the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1,000 sq. ft. or volume per cu. yd. for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
 - b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.
- D. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1. Tagging of plants prior to digging at the nursery is recommended.
- E. Substitutions will be permitted only with the prior written approval of the Engineer and may be granted if the installer can demonstrate that plants of a specific type, size or quality are not available within a 200-mile radius of the site.
- F. The landscape installer should be familiar with the quality of materials available from suppliers in order to minimize the likelihood that unacceptable products will be rejected.
- G. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.
 1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
 2. Other Plants: Measure with stems, petioles, and foliage in their normal position.
- H. Plant Material Observation: Engineer may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Engineer retains right to observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, 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 Engineer of sources of planting materials seven (7) days in advance of delivery to site.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. All products shall be packed and shipped in a manner which will not damage them.
- B. Damaged products shall be rejected upon delivery and promptly removed from the site.
- C. Products which must be stored prior to installation shall be protected from damage and theft.
- D. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable.
- E. Bulk Materials:
 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 3. Accompany each delivery of bulk fertilizers, lime, and soil amendments with appropriate certificates.
- F. Deliver bare-root stock plants freshly dug. 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.
- G. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, 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 plants during shipping and delivery. Do not drop plants during delivery and handling.
- H. Handle planting stock by root ball.
- I. Store bulbs, corms, and tubers in a dry place at 60 to 65 degrees F until planting.

- J. Time delivery of sod so that it will be placed within 36 hours after harvesting. Protect sod against drying and breaking of rolled strips.
- K. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or 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 plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly-wet condition.

1.7 PROJECT CONDITIONS

- A. Schedule and coordinate work with all trades involved.
- B. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.
- C. Consult Record Drawings and installers to determine actual underground utility and drainage system locations in the vicinity of this work. Damage to known or unrecorded utilities will be repaired at the Contractor's expense.
- D. Interruption of Existing Services or Utilities: Do not interrupt services or utilities to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary services or utilities according to requirements indicated:
 - 1. Notify Engineer no fewer than three (3) days in advance of proposed interruption of each service or utility.
 - 2. Do not proceed with interruption of services or utilities without Engineer's written permission.
- E. Notify the Engineer immediately of any unforeseen conditions which will affect plant installation or growth.
- F. Test internal drainage of soils at representative planting locations by digging a hole 12 inches deep and approximately 12 inches in diameter, then filling the

hole with water. If the water drains away within 24 hours, the drainage should be adequate.

- G. The results of the soil tests may indicate recommendations which will affect the type and analysis of soil amendments.
- H. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.
- I. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.
 - 1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.8 WARRANTY

- A. Following the date of acceptance by the Owner, plants shall be warranted for one (1) year excluding conditions of vandalism, theft, accident, acts of God and Owner's negligent maintenance.
- B. Replace each unacceptable plant as soon as season requirements permit.
- C. Only one (1) replacement per plant will be required, except for losses due to failure to comply with specifications.
- D. Provide extended warranty for period equal to original warranty period, for replaced plant material.

1.9 MAINTENANCE SERVICE

- A. Maintenance Service: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until Final Acceptance of the project by the Owner.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

- A. General: Furnish only nursery-grown plants under climatic conditions similar to the location of this project, for at least one growing season prior to this work which are true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule or Plant Legend shown on Drawings and complying with ANSI Z60.1 and any more stringent requirements which may be stated herein or on the Drawings.
- B. Furnish only plants with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
 - 1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots will be rejected.
 - 2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.
 - 3. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Engineer, with a proportionate increase in size of roots or balls, but use of such plants shall not increase the contract price.
- C. 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. Root flare shall be visible before planting.
- D. Labeling: Label at least 10 percent of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant as shown on Drawings.
- E. If formal arrangements or consecutive order of plants is shown on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.
- F. Bulbs: Bulb quality will be approved by the Engineer prior to planting. Bulb quality will be judged by the following characteristics:
 - 1. Firm and free from deep blemishes, cuts or soft spots.
 - 2. Heavy for their size.

3. Have a solid and firm basal plate.
- G. Annuals, Biennials, and Perennials: 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.
 - H. Plant Quantity: The greater quantity shall take precedence if discrepancies occur between the quantities designated on the materials list and those indicated on the drawings.
 - I. Nomenclature shall conform to "Hortus III".

2.2 INORGANIC SOIL AMENDMENTS

- A. Lime: The quality of lime and all operations in connection with the furnishing of this material shall comply with the requirements of ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
 1. Class: O, with a minimum of 95 percent passing through No. 8 sieve and a minimum of 55 percent passing through No. 60 sieve.
 2. Provide lime in the form of free-flowing ground dolomitic limestone.
- B. During the handling and storing, the lime shall be cared for in such a manner that it will be protected against hardening and caking. Any hardened or caked lime shall be pulverized to its original condition before being used.

2.3 ORGANIC SOIL AMENDMENTS

- A. Sawdust: Well-rotted sawdust, free of chips, stones, sticks, soil or toxic substances and with 7.5 lbs. nitrogen uniformly mixed into each cubic yard.
- B. Manure: Well-rotted, unleached, stable or cattle manure not less than 8 months or more than 2 years old, containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.
- C. Commercial Bagged Manure Such as "Black Cow", "Baa Baa Doo", or equal.

2.4 FERTILIZERS

- A. The quality of fertilizer and all operations in connection with the furnishing of this material shall comply with the requirements of the North Carolina Fertilizer Law and regulations adopted by the North Carolina Board of Agriculture.

- B. Planting Tablets: Tightly compressed chip type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.
 - 1. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.
 - 2. Manufacturer: Agriform Planting Tablets as manufactured by Scotts-Sierra Horticultural Products, or equal, may be used at installer's option.
- C. Encapsulated Fertilizers: Fertilizer made up of nutrient granules embedded in a synthetic resin which dissolves slowly, releasing the nutrients over an extended period of time. It is also called a slow-release fertilizer.
 - 1. Nutrient Composition: 19 percent nitrogen, 6 percent phosphorous, and 12 percent potassium, by weight plus micronutrients.
 - 2. Manufacturer: Osmocote as manufactured by Scotts-Miracle Gro, or equal, may be used at installer's option.
- D. During handling and storing, the fertilizer shall be cared for in such a manner that it will be protected against hardening, caking, or loss of plant food values. Any hardened or caked fertilizer shall be pulverized to its original conditions before being used.

2.5 PLANTING SOILS

- A. Planting Soil: Existing, native surface topsoil formed under natural conditions with the duff layer retained during excavation process and stockpiled on-site. Verify suitability of native surface topsoil to produce viable planting soil. Clean soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
 - 1. Supplement with another specified planting soil when quantities are insufficient.
 - 2. Mix existing, native surface topsoil with soil amendments of the type and quantity directed by the Engineer to produce planting soil:
- B. Planting Soil: Existing, in-place surface soil. Verify suitability of existing surface soil to produce viable planting soil. Remove stones, roots, plants, sod, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth. Mix surface soil with soil amendments of the type and quantity directed by the Engineer to produce planting soil:
- C. Planting Soil: Imported topsoil or manufactured topsoil from off-site sources. Obtain topsoil displaced from naturally well-drained construction or mining sites

where topsoil occurs at least 4 inches deep; do not obtain from bogs, or marshes.

1. Additional Properties of Imported Topsoil or Manufactured Topsoil: Screened and free of stones 1 inch or larger in any dimension; free of roots, plants, sod, clods, clay lumps, pockets of coarse sand, paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials harmful to plant growth; free of obnoxious weeds and invasive plants including quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and brome grass; not infested with nematodes; grubs; or other pests, pest eggs, or other undesirable organisms and disease-causing plant pathogens; friable and with sufficient structure to give good tilth and aeration. Continuous, air-filled pore space content on a volume/volume basis shall be at least 15 percent when moisture is present at field capacity. Soil shall have a field capacity of at least 15 percent on a dry weight basis.
2. Top soil shall not be delivered in a muddy or frozen condition.

2.6 MULCHES

A. Mulch Materials for Plants

1. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
 - a. Type: Shredded hardwood.
 - b. Size Range: 3 inches maximum, 1/2 inch minimum.
 - c. Color: Natural.

- B. Mulch materials for seeded areas shall be as described in Division 32, "Turf and Grasses".

2.7 WATER

- A. Water shall be clean, clear water free from any objectionable or harmful chemical qualities or organisms and shall be furnished by the Contractor.

2.8 WEED-CONTROL BARRIERS

- A. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. minimum, composed of fibers formed into a stable network so that fibers

retain their relative position. Fabric shall be inert to biological degradation and resist naturally-encountered chemicals, alkalis, and acids.

- B. Composite Fabric: Woven, needle-punched polypropylene substrate bonded to a nonwoven polypropylene fabric, 4.8 oz./sq. yd.

2.9 PESTICIDES

- A. General: Pesticide registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

2.10 TREE STABILIZATION MATERIALS

- A. Stakes and Guys:
 - 1. Upright and Guy Stakes: Rough-sawn, sound, new lumber, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by 8'-0" length, pointed at one end.
 - 2. Flexible Ties: Wide rubber or elastic bands or straps of length required to reach stakes or compression springs.
 - 3. Guys and Tie Wires: ASTM A 641, Class 1, galvanized-steel wire, two-strand, twisted, 12-gauge minimum.
 - 4. Tree-Tie Webbing: UV-resistant polypropylene or nylon webbing with brass grommets.
 - 5. Guy Cables: Five-strand, 3/16-inch-diameter, galvanized-steel cable, with zinc-coated compression springs, a minimum of 3 inches long, with two 3/8-inch galvanized eyebolts.
 - 6. Flags: Standard surveyor's plastic flagging tape, white, 6 inches long.
- B. Root-Ball Stabilization Materials:
 - 1. Upright Stakes and Horizontal Hold-Down: Rough-sawn, sound, new lumber, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by lengths necessary for proper support; stakes pointed at one end.
 - 2. Wood Screws: ASME B18.6.1.

3. Battens or Blocks and Struts: Rough-sawn, sound, new lumber, free of knots, holes, cross grain, and other defects, 2-by-4-inch nominal by lengths necessary for proper support.
4. Straps: Adjustable steel or plastic package banding straps.
5. Padding: Burlap.

2.11 MISCELLANEOUS PRODUCTS

- A. Wood Pressure-Preservative Treatment: AWPA C2, with waterborne preservative for soil and freshwater use, acceptable to authorities having jurisdiction, and containing no arsenic; including ammoniacal copper arsenate, ammoniacal copper zinc arsenate, and chromated copper arsenate.
- B. Root Barrier: Black, molded, modular panels manufactured with 50 percent recycled polyethylene plastic with ultraviolet inhibitors, 85 mils thick, with vertical root deflecting ribs protruding 3/4 inch out from panel, and each panel 18 inches wide.
- C. 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.
- D. Burlap: Non-synthetic, biodegradable.
- E. Planter Drainage Gravel: Washed, sound crushed stone or gravel complying with ASTM D 448 for Size No. 8.
- F. Planter Filter Fabric Nonwoven geotextile manufactured for separation applications and made of polypropylene, polyolefin, or polyester fibers or combination of them.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.
 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.

3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Engineer and replace with new planting soil.

3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Lay out individual tree and shrub locations with stakes or flags. Flag outlines of planting beds and secure landscape architect's approval prior to beginning soil preparation. Make adjustments as directed.
- D. 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.
- E. 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 AREA ESTABLISHMENT

- A. Loosen and excavate subgrade of all planting areas to a minimum depth of 12 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply [superphosphate] <Insert type> fertilizer directly to subgrade before loosening.
 2. Spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.
 - a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
 - b. Mix lime with dry soil before mixing fertilizer.
 3. Spread planting soil to a depth of 8 inches 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 over loosened subgrade. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil.
- B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.
- C. Before planting, obtain Engineer's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.
- D. Application of Mycorrhizal Fungi: At time directed by Engineer, broadcast dry product uniformly over prepared soil at application rate indicated on Drawings.

3.4 EXCAVATION FOR TREES AND SHRUBS

- A. Planting Pits and Trenches: Excavate circular planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are not acceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
1. Excavate approximately three times as wide as ball diameter for balled and burlapped, balled and potted, container-grown, or fabric bag-grown stock.
 2. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
 3. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
 4. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.

5. Maintain required angles of repose of adjacent materials as shown on the Drawings. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
 6. Maintain supervision of excavations during working hours.
 7. Keep excavations covered or otherwise protected overnight and after working hours.
 8. If drain tile is shown on Drawings or required under planting areas, excavate to top of porous backfill over tile.
- B. Subsoil and topsoil removed from excavations may not be used as planting soil.
- C. Obstructions: Notify Engineer if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
1. Hardpan Layer: Drill 6-inch-diameter holes, 24 inches apart, into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.
- D. Drainage: Notify Engineer if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.
- E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.5 TREE, SHRUB, AND VINE PLANTING

- A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.
- B. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. Set balled and burlapped stock plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades.
1. Use planting soil for backfill.
 2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and 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.
 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.

4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
 5. Continue backfilling process. Water again after placing and tamping final layer of soil.
- D. Set balled and potted or container-grown stock plumb and in center of planting pit or trench with root flare **1 inch** above adjacent finish grades.
1. Use planting soil for backfill.
 2. Carefully remove root ball from container without damaging root ball or plant.
 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
 5. Continue backfilling process. Water again after placing and tamping final layer of soil.
- E. Set fabric bag-grown stock plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades.
1. Use planting soil for backfill.
 2. Carefully remove root ball from fabric bag without damaging root ball or plant. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
 5. Continue backfilling process. Water again after placing and tamping final layer of soil.
- F. Set and support bare-root stock in center of planting pit or trench with root flare 1 inch above adjacent finish grade.
1. Use planting soil for backfill.

2. Spread roots without tangling or turning toward surface, and carefully work backfill around roots by hand. Puddle with water until backfill layers are completely saturated. Plumb before backfilling, and maintain plumb while working backfill around roots and placing layers above roots.
 3. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside soil-covered roots about 1 inch from root tips; do not place tablets in bottom of the hole or touching the roots.
 4. Continue backfilling process. Water again after placing and tamping final layer of soil.
- G. When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.6 MECHANIZED TREE SPADE PLANTING

- A. Trees shall be planted with an approved mechanized tree spade at the designated locations. Do not use tree spade to move trees larger than the maximum size allowed for a similar field-grown, balled-and-burlapped root-ball diameter according to ANSI Z60.1, or larger than the manufacturer's maximum size recommendation for the tree spade being used, whichever is smaller.
- B. When extracting the tree, center the trunk within the tree spade and move tree with a solid ball of earth.
- C. Cut exposed roots cleanly during transplanting operations.
- D. Use the same tree spade to excavate the planting hole as was used to extract and transport the tree.
- E. Plant trees as shown on Drawings, following procedures in "Tree, Shrub, and Vine Planting" Article.
- F. Where possible, orient the tree in the same direction as in its original location.

3.7 TREE, SHRUB, AND VINE PRUNING

- A. Remove only dead, dying, or broken branches. Do not prune for shape.
- B. Prune, thin, and shape trees, shrubs, and vines as directed by Engineer.
- C. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise

indicated by Engineer, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

- D. Do not apply pruning paint to wounds.

3.8 TREE STABILIZATION

- A. 14 feet in height and more than 3 inches in caliper unless otherwise indicated. Securely attach no fewer than three guys to stakes 30 inches long, driven to grade.

- 1. Site-Fabricated Staking-and-Guying Method:

- a. For trees more than 6 inches in caliper, anchor guys to wood deadmen buried at least 36 inches below grade. Provide turnbuckle or compression spring for each guy wire and tighten securely.
 - b. Support trees with bands of flexible ties at contact points with tree trunk and reaching to turnbuckle or compression spring. Allow enough slack to avoid rigid restraint of tree.
 - c. Support trees with strands of cable or multiple strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points with tree trunk and reaching to turnbuckle or compression spring. Allow enough slack to avoid rigid restraint of tree.
 - d. Attach flags to each guy wire, 30 inches above finish grade.
 - e. Paint turnbuckles and compression springs with luminescent white paint.

- 2. Proprietary Staking and Guying Device: Install staking and guying system sized and positioned as recommended by manufacturer unless otherwise indicated and according to manufacturer's written instructions.

- B. Root-Ball Stabilization: Install at- or below-grade stabilization system to secure each new planting by the root ball unless otherwise indicated.

- 1. Wood Hold-Down Method: Place vertical stakes against side of root ball and drive them into subsoil; place horizontal wood hold-down stake across top of root ball and screw at each end to one of the vertical stakes.

- a. Install stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation. Saw stakes off at horizontal stake.
 - b. Install screws through horizontal hold-down and penetrating at least 1 inch 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.

2. Proprietary Root-Ball Stabilization Device: Install root-ball stabilization system sized and positioned as recommended by manufacturer unless otherwise indicated and according to manufacturer's written instructions.
- C. Palm Bracing: Install bracing system at three or more places equally spaced around perimeter of trunk to secure each palm until established unless otherwise indicated.
1. Site-Fabricated Palm-Bracing Method:
 - a. Place battens over padding and secure battens in place around trunk perimeter with at least two straps, tightened to prevent displacement. Ensure that straps do not contact trunk.
 - b. Place diagonal braces and cut to length. Secure upper ends of diagonal braces with galvanized nails into battens or into nail-attached blocks on battens. Do not drive nails, screws, or other securing devices into palm trunk; do not penetrate palm trunk in any fashion. Secure lower ends of diagonal braces with stakes driven into ground to prevent outward slippage of braces.
 2. Proprietary Palm-Bracing Device: Install palm-bracing system sized and positioned as recommended by manufacturer unless otherwise indicated and according to manufacturer's written instructions.

3.9 GROUND COVER AND PLANT PLANTING

- A. Dig holes large enough to allow spreading of roots.
- B. For rooted cutting plants supplied in flats, plant each in a manner that will minimally disturb the root system but to a depth not less than two nodes.
- C. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- D. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- E. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.10 PLANTING AREA MULCHING

- A. Install weed-control barriers before mulching according to manufacturer's written instructions. Completely cover area to be mulched, overlapping edges a minimum of 12 inches and secure seams with galvanized pins.

- B. Mulch backfilled surfaces of planting areas and other areas indicated.
 - 1. Trees and Tree-like Shrubs in Turf Areas: Apply organic or mineral mulch ring of 2-inch average thickness, with 36 inch radius around trunks or stems. Do not place mulch within 6 inches of trunks or stems.
 - 2. Organic Mulch in Planting Areas: Apply 3 inch average thickness of organic mulch over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 6 inches of trunks or stems.

3.11 PLANT MAINTENANCE

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.
- B. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.12 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
 - 1. Use herbicides to eradicate vegetation before tilling plant seed and sod beds.
 - 2. Use herbicides to control emerging weeds in shrub and ground cover beds and around trees.
- B. Pre-Emergent Herbicides (Selective and Non-Selective): Apply to tree, shrub, and ground-cover areas in accordance with manufacturer's written recommendations. Do not apply to seeded areas.
- C. Post-Emergent Herbicides (Selective and Non-Selective):

1. Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.
2. In buffer planting areas apply a minimum of three (3) applications of approved herbicide at two (2) week intervals.
3. Protect adjacent property and vegetation to remain.

3.13 CLEANUP AND PROTECTION

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.
- B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- C. After installation and before Final Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

3.14 DISPOSAL

- A. 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 329300

PART 1 - GENERAL**1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping joining materials.
 - 2. Transition fittings.
 - 3. Sleeves.
 - 4. Identification devices.
 - 5. Grout.
 - 6. Flowable fill.
 - 7. Piped utility demolition.
 - 8. Piping system common requirements.
 - 9. Equipment installation common requirements.
 - 10. Painting.
 - 11. Concrete bases.
 - 12. Metal supports and anchorages.

1.3 DEFINITIONS

- A. Exposed Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.
- B. Concealed Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- C. ABS: Acrylonitrile-butadiene-styrene plastic.
- D. CPVC: Chlorinated polyvinyl chloride plastic.
- E. PE: Polyethylene plastic.
- F. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Dielectric fittings.
 - 2. Identification devices.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel."
- B. Steel Piping Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

- A. As required, coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- B. Coordinate installation of identifying devices after completing covering and painting if devices are applied to surfaces.
- C. Coordinate size and location of concrete bases. Formwork, reinforcement, and concrete requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 IDENTIFICATION DEVICES

- A. General: Products specified are for applications referenced in other Division 33 Sections. If more than single type is specified for listed applications, selection is Installer's option.
- B. Equipment Nameplates: Metal permanently fastened to equipment with data engraved or stamped.
 - 1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and essential data.
 - 2. Location: Accessible and visible.
- C. Stencils: Standard stencils prepared with letter sizes complying with recommendations in ASME A13.1. Minimum letter height is 1-1/4 inches for ducts, and 3/4 inch for access door signs and similar operational instructions.
 - 1. Material: Brass.
 - 2. Stencil Paint: Exterior, oil-based, alkyd-gloss black enamel, unless otherwise indicated. Paint may be in pressurized spray-can form.
 - 3. Identification Paint: Exterior, oil-based, alkyd enamel in colors according to ASME A13.1, unless otherwise indicated.
- D. Snap-on Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid, snap-on type. Include color-coding according to ASME A13.1, unless otherwise indicated.
- E. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted, color-coded, pressure-sensitive-vinyl type with permanent adhesive.
- F. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers, extending 360 degrees around pipe at each location.
- G. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers, at least three times letter height and of length required for label.
- H. Lettering: Manufacturer's standard preprinted captions as selected by Engineer.
- I. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.

1. Arrows: Either integrally with piping system service lettering to accommodate both directions of flow, or as separate unit on each pipe marker to indicate direction of flow.
- J. Plastic Tape: Manufacturer's standard color-coded, pressure-sensitive, self-adhesive vinyl tape, at least 3 mils thick.
1. Width: 1-1/2 inches on pipes with OD, including insulation, less than 6 inches; 2-1/2 inches for larger pipes.
 2. Color: Comply with ASME A13.1, unless otherwise indicated.
- K. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch sequenced numbers. Include 5/32-inch hole for fastener.
1. Material: 0.032-inch thick, polished brass or aluminum.
 2. Material: 0.0375-inch thick stainless steel.
 3. Material: 3/32-inch thick plastic laminate with 2 black surfaces and a white inner layer.
 4. Material: Valve manufacturer's standard solid plastic.
 5. Size: 1-1/2 inches in diameter, unless otherwise indicated.
 6. Shape: As indicated for each piping system.
- L. Valve Tag Fasteners: Brass, wire-link or beaded chain; or brass S-hooks.
- M. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
1. Engraving: Engraver's standard letter style, of sizes and with terms to match equipment identification.
 2. Thickness: 1/16 inch, for units up to 20 sq. in. or 8 inches in length, and 1/8 inch for larger units.
 3. Fasteners: Self-tapping, stainless-steel screws or contact-type permanent adhesive.
- N. Plastic Equipment Markers: Manufacturer's standard laminated plastic, in the following color codes:
1. Green: Cooling equipment and components.
 2. Yellow: Heating equipment and components.
 3. Brown: Energy reclamation equipment and components.
 4. Blue: Equipment and components that do not meet criteria above.
 5. Hazardous Equipment: Use colors and designs recommended by ASME A13.1.

6. Terminology: Match schedules as closely as possible. Include the following:
 - a. Name and plan number.
 - b. Equipment service.
 - c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
 7. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.
- O. Plasticized Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with mat finish suitable for writing.
1. Size: 3-1/4 by 5-5/8 inches.
 2. Fasteners: Brass grommets and wire.
 3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
- P. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in piped utility identification with corresponding designations indicated. Use numbers, letters, and terms indicated for proper identification, operation, and maintenance of piped utility systems and equipment.
1. Multiple Systems: Identify individual system number and service if multiple systems of same name are indicated.

2.2 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
1. Characteristics: Post hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 2. Design Mix: 5000-psi, 28-day compressive strength.
 3. Packaging: Premixed and factory packaged.

2.3 FLOWABLE FILL

- A. Description: Low-strength-concrete, flowable-slurry mix.
1. Cement: ASTM C 150, Type I, portland.
 2. Density: 115- to 145-lb/cu. ft.

3. Aggregates: ASTM C 33, natural sand, fine and crushed gravel or stone, coarse.
4. Aggregates: ASTM C 33, natural sand, fine.
5. Admixture: ASTM C 618, fly-ash mineral.
6. Water: Comply with ASTM C 94.
7. Strength: 100 to 200 psig at 28 days.

PART 3 - EXECUTION

3.1 PIPED UTILITY DEMOLITION

- A. Refer to Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove piped utility systems, equipment, and components indicated to be removed.
 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 2. Piping to Be Abandoned in Place: Drain piping. Fill abandoned piping with flowable fill, and cap or plug piping with same or compatible piping material.
 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make operational.
 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 3. Install dielectric fittings at connections of dissimilar metal pipes.

3.3 EQUIPMENT INSTALLATION

- A. Install equipment level and plumb, unless otherwise indicated.
- B. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference with other installations. Extend grease fittings to an accessible location.
- C. Install equipment to allow right of way to piping systems installed at required slope.

3.4 PAINTING

- A. Painting of piped utility systems, equipment, and components is specified in Division 09 painting Sections.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.5 IDENTIFICATION

- A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.
 - 1. Stenciled Markers: According to ASME A13.1.
 - 2. Plastic markers, with application systems. Install on insulation segment if required for hot noninsulated piping.
 - 3. Locate pipe markers on exposed piping according to the following:
 - a. Near each valve and control device.
 - b. Near each branch, excluding short takeoffs for equipment and terminal units. Mark each pipe at branch if flow pattern is not obvious.
 - c. Near locations where pipes pass through walls or floors or enter inaccessible enclosures.
 - d. At manholes and similar access points that permit view of concealed piping.
 - e. Near major equipment items and other points of origination and termination.
- B. Equipment: Install engraved plastic-laminate sign or equipment marker on or near each major item of equipment.
 - 1. Lettering Size: Minimum 1/4 inch high for name of unit if viewing distance is less than 24 inches, 1/2 inch high for distances up to 72 inches, and

- proportionately larger lettering for greater distances. Provide secondary lettering two-thirds to three-fourths of size of principal lettering.
2. Text of Signs: Provide name of identified unit. Include text to distinguish among multiple units, inform user of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
- C. Adjusting: Relocate identifying devices that become visually blocked by work of this or other Divisions.

3.6 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of base.
 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 7. Use 3000-psi 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "[**Cast-in-Place Concrete**] [**Miscellaneous Cast-in-Place Concrete**]"

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor piped utility materials and equipment.
- B. Field Welding: Comply with AWS D1.1.

3.8 GROUTING

- A. Mix and install grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors.

- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 330500

PART 1 - GENERAL**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Modified General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Where specific standards are referenced within this document, the most current specification and/or latest revision shall apply.

1.2 SUMMARY

- A. Section includes:
 - 1. Pipe and fittings.
 - 2. Valves and appurtenances.
 - 3. Fire hydrants.
 - 4. Manhole sections and appurtenances.
 - 5. Transition couplings

1.3 SCOPE OF WORK

- A. Furnish all labor, equipment, materials and incidentals necessary to install and complete installation of potable water lines and appurtenances in accordance with the plans. All pipe and appurtenance material shall be of the type and class specified herein.
- B. All pipeline and appurtenance excavation, bedding, pipe laying, jointing and coupling of pipe joints and backfilling shall be completed as described herein.

1.4 DEFINITIONS

- A. ANSI – American National Standards Institute
- B. API – American Petroleum Institute

- C. ASTM – American Society for Testing and Materials
- D. AWWA – American Water Works Association
- E. DIP – Ductile Iron Pipe
- F. HDD – Horizontal Directional Drilling
- G. HDPE – High Density Polyethylene
- H. LB – Pound
- I. MSS – Manufacturer’s Standardization Society
- J. NFPA – National Fire Protection Association
- K. NSF – National Sanitation Foundation
- L. PE – Polyethylene
- M. PPM – Parts Per Million
- N. PSI – Pounds per Square Inch
- O. PVC – Polyvinyl Chloride

1.5 SUBMITTALS

- A. All submittals shall be in accordance with the requirements of Division 1 of these specifications.
- B. Shop drawings or submittals shall be required for the following:
 - 1. All sizes and types of pipe.
 - 2. All pipe fittings, valves, hydrants, and appurtenances.
 - 3. All manholes and vaults
 - 4. All transition couplings.
 - 5. Wiring Diagrams: Power, signal, and control wiring for alarms.
- C. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.

- D. Operation and Maintenance Data: For specialties valves and appurtenances to include in emergency, operation, and maintenance manuals.

1.6 DELIVERY, STORAGE AND HANDLING

- A. The Contractor shall coordinate material deliveries with the manufacturer/supplier. All materials shall be handled and stored in accordance with the manufacturer's recommendations using methods that will prevent damage to the materials.
- B. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
 - 1. Ensure that valves are dry and internally protected against rust and corrosion.
 - 2. Protect valves against damage to threaded ends and flange faces.
 - 3. Set valves in best position for handling. Set valves closed to prevent rattling.
 - 4. Protect pipe from vehicle exhaust by covering pipe materials with tarps.
- C. The Contractor shall unload pipe so as to avoid deformation or other injury thereto. Pipe shall not be placed within pipe of a large size and shall not be rolled or dragged over gravel or rock during handling. If any defective material is discovered after installation, it shall be removed and replaced with sound pipe or shall be repaired by the Contractor in an approved manner and at his own expense.
- D. The Contractor shall store all pipe and appurtenances on sills above storm drainage level and deliver for laying after the trench is excavated. Do not store any plastic materials in direct sunlight. All plastic materials shall be supported to prevent sagging and bending. All plastic materials shall also be covered with tarps if exposed to the elements for extended periods of time.
- E. Protect pipe, pipe fittings, and seals from dirt and damage.
- F. Handle all materials in accordance with the manufacturer's written instructions.
- G. When any material is damaged during transporting, unloading, handling or storing, the undamaged portions may be used as needed, or, if damaged sufficiently, the Engineer will reject the material as being unfit for installation.

1.7 PROJECT CONDITIONS

- A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following

conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:

1. Notify Engineer and utility Owner no fewer than 72 hours in advance of proposed interruption of service.
2. Do not proceed with interruption of water-distribution service without utility Owner's written permission.

1.8 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with all requirements of utility Owner supplying water including the tapping of water mains and backflow prevention.
2. Comply with all 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. All piping materials shall bear label, stamp, or other markings of specified testing agency.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

E. NSF Compliance:

1. As applicable, comply with NSF 14 for plastic potable-water-service piping, including marking "NSF-pw" on piping.
2. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.9 COORDINATION

A. Coordinate any connections to the existing water distribution system with utility Owner.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS

- A. All materials shall be first quality with smooth interior and exterior surfaces, free from cracks, blisters, honeycombs, and other imperfections, and true to theoretical shapes and forms throughout. All materials shall be subject to the inspection of the Engineer at the plant, trench, or other point of delivery, for the purpose of culling and rejecting material which does not conform to the requirements of these specifications. Such material shall be marked by the Engineer, and the Contractor shall remove it from the project site upon notice being received of its rejection.
- B. As particular specifications are cited, the designation shall be construed to refer to the latest revision under the same specification number, or to superseding specifications under a new number, except provisions in revised specifications which are clearly inapplicable.

2.2 DUCTILE-IRON PIPE (DIP)

- A. Ductile Iron Pipe shall be manufactured in accordance with AWWA C151. All Ductile Iron Pipe shall be Class 350 unless otherwise specified and shall be lined with a cement mortar lining not less than 1/16" thick conforming to AWWA C104. Pipe wall thickness for all Ductile Iron Pipe shall conform to "Thickness Design for Ductile Iron Pipe," AWWA C150. The standard laying condition shall be type 2 according to AWWA C150/C151 unless specified otherwise. The exterior of all Ductile Iron Pipe shall have a protective coating of a coal tar or asphaltic material a minimum of 1 mil thickness conforming to AWWA C151. Ductile Iron Pipe larger than 12" in diameter that are to be field cut shall be gauged full length. Flanged Ductile Iron Pipe and any Ductile Iron Pipe that is to be coated in the field shall have a shop applied primer compatible with the field installed coating system.
- B. Slip-Joint Ductile Iron Pipe:
 - 1. Bells of "slip" joint pipe shall be contoured to receive a bulb-shaped circular rubber gasket, and plain ends shall have a slight taper to facilitate installation. The gasket and associated lubricant shall be furnished by the pipe manufacturer and shall be manufactured in accordance with ANSI Specification A21.11.
 - 2. The jointing shall be done by guiding the plain end into the bell until contact is made with the gasket and by exerting a sufficient compressive force to drive the joint home until plain end makes full contact with the base of the bell. No joint may exceed a maximum deflection of 11 inches in an 18-foot joint of pipe (3 degrees).

C. Mechanical-Joint Ductile Iron Pipe:

1. All mechanical joint pipe shall be manufactured in accordance with AWWA C111. Pipe shall be manufactured in accordance with AWWA C151, and the pipe thickness shall be Class 350 as determined by AWWA C150 unless otherwise noted.
2. All bolts shall be tightened by means of torque wrenches in such a manner that the follower shall be brought up toward the pipe evenly. If effective sealing is not obtained by tightening the bolts to the specified torques, the joint shall be disassembled and reassembled after thorough cleaning.
3. Bolts for mechanical joints shall be high grade steel, low alloy type, with tee or hex head and American Standard threads. Mechanical joint gland shall be gray iron and shall utilize a plain rubber gasket.

D. Flanged-Joint Ductile Iron Pipe:

1. Flanged pipe shall be factory assembled by threading plain end pipe, screwing on the flange(s) and machine tightening.
2. Where required, flanges shall be tapped for stud bolts. Flanges shall be accurately faced at right angles to the pipe axis and shall be drilled smooth and true, and covered with coal tar pipe varnish or otherwise protected against corrosion of flange faces. Flange faces shall be cleaned to bare metal with wire brushed before installation of pipe.
3. Ductile iron flanged joint pipe shall have a thickness of Class 53 minimum and shall conform to AWWA C110 and AWWA C115. All pipe shall have Class 125 flanges conforming to AWWA C110 unless otherwise specified.
4. Flanged joints shall be made up with through bolts of the required size. Bolts in exposed locations shall be zinc plated. Bolts in submerged locations shall be stainless steel. All bolts shall have good and sound, well-fitting threads, so that the nuts may be turned freely by hand.
5. Flanged joints shall be made up using only full face gaskets with a minimum thickness of 1/8-inch. Ring gaskets are not acceptable. Gasket material shall be rubber or approved equal as recommended by the Manufacturer.
6. Connecting flanges shall be in proper alignment and no external force shall be used to bring them together.
7. Field installed flanges shall be EBAA Series 1000 E-Z flange or equal for all instances where normal operating pressures are less than 200 psi. Restraint set screws must be tightened by use of a torque wrench per the manufacturer's instructions.

E. Restrained Push-on Joint Ductile Iron Pipe

1. Restrained joints shall be manufactured in accordance with ANSI/AWWA C111/A21.11.
2. Restrained push joints (positive locking segments) shall be American "Flex-Ring," or "Lok-Ring"; Clow "Super-Lock"; U.S. Pipe "TR Flex"; or pre-approved equal. Use of setscrews bearing on the pipe wall will not be acceptable.
3. Restrained push joints (gaskets with stainless steel gripping segments) shall be U.S. Pipe "Field Lok 350 Gasket," or American "Fast Grip" or pre-approved equal
4. Restrained push joints (locking wedge type) shall be EBAA Iron "Megalug" Series 1700, Tyton "TR Flex Gripper Ring," or American "Field Flex Ring," or pre-approved equal.

F. Restrained Mechanical Joint Ductile Iron Pipe

1. Restrained mechanical joints shall be manufactured in accordance with ANSI/AWWA C111/A21.11.
2. Restrained mechanical joints (factory prepared spigot) shall be American "MJ coupled Joints," or U.S. Pipe "Bolt-Lok" or "Mech-Lok" Or pre-approved equal
3. Restrained mechanical joints (field cut spigot) shall be manufactured in accordance with AWWA C151 and shall be EBAA Iron "Megalug" Series 1100, Star Pipe Products "StarGrip", or pre-approved equal.

2.3 POLYVINYL CHLORIDE PIPE (PVC)

- A. All materials shall be first quality with smooth interior and exterior surfaces, free from cracks, blisters, honeycombs, and other imperfections, and true to theoretical shapes and forms throughout. All materials shall be subject to the inspection of the Engineer at the plant, trench, or other point of delivery, for the purpose of culling and rejecting material which does not conform to the requirements of these specifications. Such material shall be marked by the Engineer, and the Contractor shall remove it from the project site upon notice being received of its rejection.
- B. As specific specifications are cited, the designation shall be construed to refer to the latest revision under the same specification number, or to superseding specifications under a new number, except provisions in revised specifications which are clearly inapplicable.

- C. PVC pipe 4 inches in diameter and larger shall be manufactured in accordance with AWWA C900 and shall have a minimum dimension ratio (DR) of 18 unless specified otherwise. All Pressure Rated PVC Pipe 3 inches diameter and smaller shall be manufactured in accordance with ASTM D2241 and have a standard dimension ratio (SDR) of 13.5 unless otherwise specified. The exterior of all PVC Pipe shall bear a stamp which shows the AWWA certification, SDR, size and NSF seal.
1. All PVC pipes 4-inches and larger in diameter shall have slip or "push-on" joints which are manufactured in accordance with AWWA C900. All PVC pipes 3-inches and smaller in diameter shall have slip or "push-on" joints which are manufactured in accordance with AWWA C151. All pipes shall have a bell with integral rubber gasket.
 2. Bells of "slip" joint pipe shall be contoured to receive a bulb shaped circular rubber gasket, and plain ends shall have a slight taper to facilitate installation. The lubricant used in making up the joints shall be furnished by the pipe manufacturer and shall be NSF approved. The jointing shall be done by guiding the plain end into the bell until contact is made with the gasket and by exerting a sufficient compressive force to drive the joint home until the assembly mark on the pipe barrel is flush with the end of the bell. No joint may exceed a maximum deflection of 11 inches in an 18-foot joint of pipe (3 degrees).

2.4 HIGH DENSITY POLYETHYLENE PIPE (HDPE)

- A. High-density polyethylene pipe may be used in the horizontal directional drilling of water distribution piping as indicated on the project drawings. Piping shall be extruded from a polyethylene compound and shall conform to the following requirements:
1. The polyethylene resin shall meet or exceed the requirements of ASTM D3350 for PE 3408 material with a cell classification of 335434C or better.
 2. The polyethylene compound shall be suitably protected against degradation by ultraviolet light by means of carbon black, well dispersed by precompounding in a concentration not less than 2 percent.
 3. The maximum allowable hoop stress shall be 800 PSI at 73.4 degrees Fahrenheit.
 4. The pipe manufacturer shall be listed with the Plastic Pipe Institute as meeting the recipe and mixing requirements of the resin manufacturer for the resin used to manufacture the pipe in this project.
 5. The pipe and bends shall have a minimum standard dimension ratio (SDR) wall thickness as specified by the Engineer.

6. Joining shall be performed by thermal butt-fusion in accordance with the manufacturer's recommendations.

2.5 FITTINGS

- A. All fittings for any type of water piping shall be ductile iron mechanical joint type in accordance with AWWA C153 (ductile iron, compact type) for 3 inch through 24 inch diameter fittings and AWWA C110 (ductile iron, full body type) for pipe diameters larger than 24 inches. Where flanged pipe is used ductile iron fittings shall be flanged in accordance with AWWA C153 or C110 where applicable for exposed piping. All flanges shall be Class 125 unless otherwise noted.
- B. All fittings shall be lined with cement mortar not less than 1/16-inch thick in conformance with AWWA C104 and suitable for a minimum of 250 PSI working pressure unless otherwise specified.
- C. All mechanical joints shall be manufactured in accordance with AWWA C111. The Contractor shall provide suitable 3-inch plugs with stainless steel threaded nipples and sleeves for connection of fittings for PVC pipe 2 inches in diameter and smaller.
- D. Restraint devices for mechanical joint pipe for nominal pipe sizes 3-inch through 48-inch shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C110/A21.10. The devices shall have a working pressure rating of 350 psi for 3 through 16-inch and 250 psi for 18 through 48-inch. Ratings are for water pressure and must include a minimum safety factor of 2 to 1 in all sizes.

2.6 GASKETS

- A. All rubber gaskets for DIP and PVC pipe and fittings shall be in accordance with AWWA C111. All gaskets shall be a product of the pipe manufacturer, made specifically for the pipe being installed, and shall match the shape and configuration of the joint.

2.7 WATER SERVICE PIPE AND APPURTENANCES

- A. All water service piping shall be constructed of Type "K" flexible copper tubing in accordance with ASTM B 88 or SDR 9 HDPE as described above.
- B. All fittings utilized for copper tubing shall be pressure-seal (compression-type) fittings.
- C. Corporation stops shall be constructed of brass.

- D. Meter boxes shall be of round style and made of Polyvinyl Chloride Plastic with a minimum wall thickness of 0.375 inches. Meter box shall be sized to accept a 5/8-inch water meter and shall have a minimum inside diameter of 18 inches with a 30-inch depth. Meter box shall have a non-locking cast iron lid.
- E. The inlet and outlet pipes that pass through the box wall shall be brass and shall be locked in place with brass hex nuts on straight external pipe threads. The inlet and outlet of these nipples shall have external tapered pipe threads and shall be protected by Polyethylene Cap Plugs. An In-Line quarter turn shut off valve with internal tapered pipe thread inlet and water meter coupling outlet shall be used upstream of the water meter. The valves shall be soft seating with a padlock wing. The valves internal components shall be removable from the top of the valve body. An In-Line Dual Check Valve with independent acting checks shall be used downstream of the water meter. The check valve shall have a meter coupling inlet and shall be contained inside the box. The internal parts of the check valve shall be removable without disconnecting the check valve the outlet piping. All brass materials used in contact with the water shall have a minimum copper content of 80 percent and a maximum zinc content of 10 percent.

2.8 GATE VALVES

- A. All gate valves shall be designed for a minimum working pressure of 250 PSI unless otherwise specified. Valves shall have a clear waterway equal to the full nominal diameter of the pipe. Valves shall be opened by turning counterclockwise. Each valve shall have the initials or name of the maker, pressure rating and year of manufacture cast on the body. Prior to shipment from the factory, each valve shall be tested by hydraulic pressure equal to twice the specified working pressure. Valves shall be operated by handwheel for above ground installations or 2-inch square operating nut for below ground installations. Valves shall have an arrow cast in the metal indicating the direction of opening.
- B. All valves to be installed underground (buried) shall be of the non-rising stem type and shall have mechanical joint connections.
- C. All valves installed above ground or in structures shall have rising stems with outside stem and yoke and 18-inch diameter minimum hand wheel and shall have flanged ends with Class 125 flanges unless others noted.
- D. Valves 1-1/2-inches and Smaller:
 - 1. Valves 1-1/2 inches and smaller in diameter shall be full port, quarter turn ball valves suitable for underground installation.
 - 2. Valves shall have a forged brass body, adjustable packing, and threaded ends conforming to NPT standards.
 - 3. Valves shall be manufactured in accordance with MSS-SP-110.

E. Resilient Seated Wedge Valves:

1. Gate valves 2 inches through 16 inches in diameter size shall be of ductile iron body, resilient seated wedge type meeting the requirements set forth in AWWA C-509. All valves shall be from one manufacturer and parts interchangeable.
2. Gate valves shall have body, bonnet and gate manufactured of ductile iron conforming to ASTM A-536. The shell thickness of all components shall conform to the thicknesses in Table 2, Section 4.4 of AWWA C-509. The valve body and bonnet shall be coated on both the interior and exterior surfaces with a fusion bonded epoxy paint conforming to AWWA C-550.
3. The gate shall be fully covered with a rubber cover over all exterior and interior ferrous surfaces. The rubber shall be securely bonded to the gate body, including the part which houses the stem nut. The gate and rubber coat shall conform to ASTM D429.
4. Valve stems shall be cast bronze or copper alloy. The stuffing box shall use "O"-ring seal type with two rings located above the thrust collar. The rings shall be replaceable with the valve fully open and under pressure.
5. Valves larger than 12 inches in diameter shall be designed for horizontal installation with beveled gear boxes with reduction gears to reduce the number of turns required to operate valve.

2.9 BUTTERFLY VALVES (20" and Larger Valves)

- A. Valve shall be designed, manufactured, and tested in accordance with AWWA C504, latest revision, and include the following design features. Valve shall be rated and tested for absolute, zero leakage shut-off.
- B. Valve body shall be ductile iron per ASTM A536 Grade 65-45-12. Flanged end valves shall be faced and drilled per ANSI B16.1, Class 125, or as specified by purchaser. Mechanical joint ends shall be per ANSI A21.11 and include mechanical joint end accessories. Valve body shall include a stainless steel seat ring that is mechanically retained without use of clamping devices, adjusting segments, or other hardware being in the waterway.
- C. Valve disc shall be solid type ductile iron without any external vanes, ribs, etc., to obstruct flow. Resilient seat shall be located on edge of disc, offset from the shaft, and seal against mating stainless steel body seat with 360 degree uninterrupted contact. The resilient seal shall be locked to the disc by three separate means of retention, and be field-adjustable, if necessary, with no tools other than a standard socket wrench. Replacement of seat in field shall be possible without valve disassembly. The disc shall be connected to the offset stainless steel shaft by locked taper wedge keys and stainless steel retaining nuts on the back side

of the disc. Taper keys shall be heat treated 416 Stainless Steel for added strength. Shaft shall be stub type for valves 30 inches and larger in diameter; one piece for valves 24 inches in diameter and smaller. The valve shall be equipped with adjustable thruster for centering the disc on valves 30 inches and larger in diameter, if required.

- D. Shaft shall have nylon sleeve or woven Teflon fibreglassed backed sleeve for bearing surfaces. Bearings shall be self-lubricating.
- E. Valve body shall be primed with manufacturer's standard primer.
- F. Butterfly valves shall be manufactured by Val-Matic, DeZurik, Pratt, Mueller, or pre-approved equal.

2.10 VALVE BOXES

- A. All valve boxes shall be cast iron and shall conform to ASTM A48 and AWWA M44. Valve boxes shall be of the adjustable screw type (based on depth of burial) with a base to fit the valve yoke with a removable cover with the word "WATER" cast thereon.

2.11 FIRE HYDRANTS

- A. Fire hydrants shall comply with all of the applicable requirements of the AWWA C502, latest revision, for dry-barrel fire hydrants and with these specifications. Hydrants shall be of the traffic model type incorporating a break-away flange arrangement which will permit the upper section of the hydrant barrel to separate from the lower section upon impact. Each hydrant shall include an automatic system designed to lubricate the entire length of the threaded part of the valve stem each time the hydrant is operated. It shall be further equipped with "O"-ring seals to insure that threads on the valve stem do not come into contact with water at any time.
- B. Hydrants shall open counterclockwise with 4-1/2-inch diameter compression base valve opening against pressure and be capable of withstanding 250 PSI working pressures and 500 PSI hydrostatic test pressures, unless otherwise specified. The pentagonal operating nut shall be 1-1/2 inches from the point to the flat. Hydrants shall be equipped with one (1) 4-1/2-inch or 5-1/4 inch diameter pumper nozzle as selected by Owner and two (2) 2-1/2-inch diameter hose nozzles, all with National Standard Threads per Appendix A of AWWA C502, and chained nozzle caps. Nozzles shall be reverse threaded into the fire hydrant barrel.
- C. Unless otherwise indicated on the plans, all hydrants shall have 6-inch diameter mechanical joint bottom connections, 4-1/2-inch diameter valve openings and a bury to the bottom of the ditch plus the main line diameter. All hydrants shall be

painted the manufacturer's standard red unless otherwise specified. Following installation and testing all hydrants shall be painted with two (2) 6-mil coats of epoxy paint.

- D. All iron parts within fire hydrants shall be ductile iron.
- E. The bury length (distance from ground line to insert of the hydrant inlet) shall be 4'-0" unless ground conditions shown on plans warrant a deeper bury.
- F. The hydrant main valve shall be 4-1/2 inches minimum in diameter and shall be of the full compression design, opening against and closing with pressure. The valve seat ring shall thread into a bronze sub-seat, and all gaskets sealing the seat ring shall be a bronze-to-bronze surface.
- G. Drain valves shall be all bronze and allow complete draining of all residual water in the hydrant barrel.
- H. All bolting and fasteners below ground shall be stainless steel.
- I. The operating machine shall utilize two (2) "O"-ring seals between the revolving nut and bronze-sheathed upper section of the valve rod. The top of the rod shall also be fitted with a travel stop nut to limit downward travel of the rod. All-weather grease shall be used to provide permanent lubrication. A thermoplastic thrust washer shall be used to reduce friction in the thrust collar while opening the hydrant.
- J. The hydrant inlet shall be mechanical joint. Joint restraint, if specified, shall be accomplished for mechanical joint by use of mechanical joint gripper glands.

2.12 RESTRAINED JOINT FLANGED COUPLING ADAPTERS

- A. Restrained flange adapters shall be installed only where specified on the plans or approved in writing by the Engineer. Flange adapters shall be made of ductile iron conforming to ASTM A536 and have flange bolt circles that are compatible with ANSI/AWWA C110/A21.10.
- B. Restraint for the flange adapter shall consist of a plurality of individual actuated gripping wedges to maximize restraint capability. Torque limiting actuating screws shall be used to insure proper initial set of gripping wedges.
- C. The flange adapter shall be capable of deflection during assembly, or permit lengths of pipe to be field cut, to allow a minimum of 0.6" gap between the end of the pipe and the mating flange without affecting the integrity of the seal.
- D. The flange adapter shall have a minimum pressure rating of 290 psi.

2.13 COMBINATION AIR RELIEF/VACUUM VALVES

- A. Air relief valves shall be hydro-mechanical devices which will automatically permit the discharge of surge air when filling the pipeline, relieve the vacuum when draining the pipeline and also release to atmosphere small amounts of accumulated air within the water distribution piping system. Once the air purge or vacuum has been exhausted, the valve shall seat tightly to prevent water leakage.
- B. All valves shall have cast iron bodies and be manufactured in accordance with AWWA C512. All valve bodies shall be one (1) integral casting or two (2) valve bodies flange bolted together containing an air and vacuum valve and separate pressure valve mechanism.
- C. All air relief valves shall be rated for a minimum working pressure of 300 PSI and subjected to a minimum hydrostatic test pressure of 450 PSI unless specified different.

2.14 TAPPING SLEEVES AND VALVES

- A. Tapping sleeves shall consist of two piece split ductile iron, jointed by bolts manufactured of high strength cast iron and incorporating a longitudinal compound rubber gasket. The sleeves shall include split end gasket and two piece mechanical joint glands suitable for the class of pipe around which sleeves are to be placed. Glands will be joined by steel bolts and fastened to the bell openings of the sleeves to form totally enclosed rubber water tight seals around the periphery of the pipe and along the longitudinal joints.
- B. The sleeves shall have flanged outlets which will accommodate the tapping valves. Valves will be identical to resilient wedge gate valves elsewhere specified with inlet and outlet ends adaptable to the tapping machine and to provide mechanical joint connections to discharge pipes.

2.15 AIR-CUSHIONED SWING CHECK VALVES

- A. The valve shall have a heavy duty body shall be constructed of high-strength cast iron conforming to ASTM A126 Class B with integral flanges, faced and drilled per ANSI B16.1 Class 125 and be suitable for horizontal or vertical installation.
- B. All check valves shall be manufactured in accordance with the latest revision of AWWA C508.
- C. The valve body shall be the full waterway type, designed to provide a net flow area not less than the nominal inlet pipe size when swung open no more than 25 degrees. The body seat ring shall be replaceable and shall be constructed of

stainless steel only. The stainless steel ring shall be mechanically retained by means of roll pins or stainless steel cap screws.

- D. The valve disc shall be constructed of cast iron per ASTM A126 Class B and be attached to the disc arm by means of a single center pin permitting 360-degree articulation. The disc shall present a convex surface to the direction of flow to compensate for oscillation.
- E. The disc arm shall be ductile iron or steel, suspended from and keyed to an austenitic stainless steel shaft which is completely above the waterway and supported at each end by heavy bronze bushings. The shaft shall rotate freely without the need for external lubrication. The shaft shall be sealed where it passes through the body by means of a stuffing box and adjustable packing. Simple O-ring shaft seals are not acceptable. Hinge shafts shall be constructed of 316 stainless steel
- F. The valve shall be supplied with an outside lever and adjustable counterweight to initiate valve closure. Final closure shall be dampened by means of a single, side-mounted bronze air-cushion assembly directly mounted to the valve body on machined pads. The amount of cushioning shall be easily adjustable without the need for pre-charged air chambers. Commercial air cylinders, which pivot and/or are attached with fabricated brackets, are not acceptable.
- G. The valve shall be GA Industries, Inc. Figure 250-DS, equivalent Ross Valve or approval equal.

2.16 ALTITUDE CONTROL VALVES

- A. Altitude control valves shall be hydraulically operated, pilot actuated diaphragm type globe or angle valve designed for ground level control of water in an elevated storage tank and reservoirs. The valve operates on a differential in pressure between the height of the water in the reservoir and an adjustable spring loaded pilot control. The valve is to be non-throttling and will remain in the full open position until the shut-off point is reached.
- B. The valve shall be constructed with a cast iron body (ASTM A126) with stainless steel stem or shaft and spring, bronze seat (ring) and upper stem bushing, nylon reinforced diaphragms, bronze valve control pilots with stainless steel and Buna-N internal parts. It shall be designed for an internal working pressure of 175 PSI and maximum differential pressure across the diaphragm of basic valve and pilots is not to exceed 300 PSI.
- C. The installation shall be designed for either one-way flow or two-way flow as indicated on the Contract drawings.
 - 1. One-way flow: The valve will be used where pressure on the inlet side of the valve is greater than the pressure created by the maximum reservoir or

tank head. The valve's sole function is to fill an elevated tank or reservoir to a desired level.

2. Two-way flow: The valve will be used when pressure on the inlet side is variable. When inlet pressure falls below reservoir pressure the valve opens, allowing reverse flow from the reservoir and thus maintaining fluid pressure within the water distribution system.
3. The altitude control valve(s) shall be of the size and type indicated on the Contract drawings and as manufactured by GA Industries, Ross Valve or approved equal.

2.17 PRESSURE-REDUCING VALVES

A. Construction: Pressure Reducing Valves larger than 2-inches in diameter shall consist of a main valve assembly and a pilot system, completely assembled tested as unit and ready for field installation.

1. Main valve body shall be globe style, constructed of high-strength cast iron conforming to ASTM A126 Class B with integral flanges, faced and drilled per ANSI B16.1 Class 125. The valve shall be "full-ported" with a flow area through the valve no less than the area of its nominal pipe size and have an integral bottom pad or feet to permit support directly beneath the body.
2. The main valve shall operate on the differential piston principle such that the area on the underside of the piston is no less than the pipe area and the area on the upper surface is greater than that of the underside. There shall be no diaphragms or springs in the main valve.
3. The valve piston shall be fully guided on its outside diameter and all guiding and sealing surfaces shall be bronze. To minimize the consequences of throttling, throttling shall be by long, stationary vee-ports located downstream of the seat and not by the seat itself. Sawtooth attachments or other add-on devices are not permitted.
4. The valve shall be fully capable of operating in any position without the need of springs and shall not incorporate stems, stem guides or spokes in the waterway. A visual position indicator shall be provided.
5. The main valve shall be serviceable in the line through a single flanged cover which provides easy access to all internal components.

B. Pilot System:

1. Provide a system of pilots and controls to enable the valve to perform the function listed below. All controls and control piping shall be non-corrosive and suitable for the working pressure.
 2. System shall include a normally open, direct-acting, diaphragm operated, spring loaded bronze pressure reducing pilot. Pilot shall be easily field-adjustable from near zero to a minimum of 10 percent above the factory setting. Controls shall include adjustable closing speed control, y-strainer and pilot isolating valves.
- C. Function: The valve shall function to reduce a higher, fluctuating inlet pressure to a lower, steady outlet pressure regardless of variations in demand.
- D. The valve shall be GA Industries Figure 4500-D, Ross Valve equivalent or approved equal.

2.18 MANHOLE SECTIONS AND APPURTENANCES

- A. Precast concrete manhole bases, risers and cones shall conform to ASTM C478, latest revision, for precast reinforced concrete manhole sections. Tapered sections and transition sections, where required, shall be of eccentric cone design, having the same wall thickness and reinforcement as the cylindrical ring sections. Flat slab tops shall be required for very shallow manholes and where shown or specified.
- B. Minimum compressive strength of concrete shall be 4,000 PSI at 28 days and shall comply with ACI 318, ACI 350. The maximum permissible absorption shall be 6.0%. All cement used in the mixture shall be in accordance with ASTM C 150, Type II. Fine aggregate shall be sand, while coarse aggregate shall be crushed gravel, both in accordance with ASTM C 33. All water utilized in the concrete mix shall be potable water. Bases and risers shall be reinforced with a single cage of steel placed within the center third of the wall. Welded wire fabric shall be in accordance with ASTM A 185. Steel reinforcing bars shall be grade 60 deformed steel in accordance with ASTM A 615. The tongue or the groove of the joint shall contain one (1) line of circumferential reinforcement equal in area to that in the barrel of the manhole riser. The minimum cross-sectional area of steel per linear foot shall be 0.12 square inches. Precast manhole sections shall fit together readily.
- C. The quality of materials, the process of manufacture, and the finished manhole sections shall be subject to inspection and approval by the Engineer. The manhole sections shall be perpendicular to their longitudinal axis, within the limits listed in ASTM C478.
- D. Manhole Frames and Covers

1. Frames and covers shall be cast iron of superior quality, tough and even texture. Castings shall be gray iron conforming to ASTM A 48, size as indicated, free from blow holes, porosity, hard spots, shrinkage distortion, or other defects, and well cleaned. The bearing surface between frame and cover shall be machined to prevent rocking and rattling.
 2. The standard manhole casting shall be designed for heavy duty use with a 190 pound frame and 125 pound cover. All frames and covers shall comply with AASHTO HS20 loading requirements. The minimum opening within the interior of the frame shall be 24-inches. The frame shall have a 4-inch minimum width flange with the cover being 26 inches in diameter and shall include an indented top design with lettering cast into the cover, using the wording "WATER". Acceptable products include John Bouchard & Sons JBS 1155, U.S. Foundry USF 669 ring and KL cover, or an approved equal.
 3. Special waterproof manhole frame and covers shall be installed only at those locations indicated on the contract drawings. Watertight rings and lids shall be John Bouchard & Sons JBS 1155, U.S. Foundry 669-KL-BWTL with a 125-pound cover or approved equal. Ring shall have a flat type gasket and cover shall be bolted down with a minimum of four (4) bolts.
 4. After the manhole has been set in its final position, set the manhole frame to the required elevation using no more than 12 inches of precast concrete grade rings, or bricks sealing all joints between cone, adjusting rings, and manhole frame. When grade rings or bricks are used, grout with non-shrink grout. Where manholes are constructed in paved areas, the top surface of the frame and cover shall be tilted so as to conform to the exact slope, crown and grade of the existing surrounding pavement. Manhole frames which are placed above final grade will have frames attached to manhole cone section by means of 5/8-inch diameter stainless steel anchors and washers. One anchor bolt shall be provided per hole.
 5. When flat slab tops are utilized, frames shall be cast into the top for access into manholes.
- E. Brick for manholes and other structures shall conform to applicable requirements of ASTM C62, latest revision, Grade SW.

2.19 TRANSITION COUPLINGS

A. New Water System Construction

1. Transition couplings shall not be permitted in the construction of new water systems, except as necessary when joining dissimilar pipe materials required for horizontal directional drilling or where necessary clearances between water line and sewer or storm drainage piping cannot be achieved.

B. Rehabilitation of Existing Water Systems

1. In general, during the rehabilitation of existing water lines, the use of appropriate transition couplings shall be permitted as approved by the Engineer.
2. When the rehabilitation of an existing water line requires the use of a transition coupling, the use of such couplings shall be as approved by the Engineer. When the nominal diameter of the pipe does not change, an approved transition coupling may be used, as necessary. In these cases, a ductile iron, mechanical joint, solid sleeve shall be used to joint these materials. The solid sleeve shall be as specified above for fittings and shall be the long body-type. The appropriate gaskets shall be selected based on the outside diameter(s) of the material(s) being jointed. All gaskets shall be as specified above. In all cases, the gap between the pipe sections being jointed shall not exceed 0.25 inches.
3. Where the nominal diameter of an existing water line changes as part of a rehabilitation project, an appropriate ductile iron, mechanical joint reducer, as specified above for fittings, shall be used to joint these materials. The appropriate gaskets shall be selected based on the outside diameter(s) of the material(s) being jointed. All gaskets shall be as specified above.

PART 3 - EXECUTION

3.1 EARTHWORK

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

3.2 PIPING AND VALVE APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications:
 1. Do not use flanged pipe, fittings, or valves or unions for underground (buried) piping. Fittings and valves for underground (buried) piping shall be mechanical joint.
 2. Flanged pipe, fittings and valves and unions shall be used on aboveground piping and piping in vaults.
 3. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used as specified, unless otherwise indicated.

3.3 PIPING INSTALLATION

A. Existing Utilities and Separation Requirements:

1. The Contractor shall be required to excavate to determine the precise location of utilities or other underground obstructions which are shown on the Plans and/or marked by the utility Owners. Such location and excavation shall be at least 500 feet ahead of construction, unless otherwise noted.
2. All utility Owners shall be notified prior to excavation as required by the 1985 Underground Damage Prevention Act. Utility Owners who are members of OneCall may be notified by calling 811 (toll free) before any excavation or drilling. The Contractor will be fully responsible for damage to any utilities if the Owners have not been properly notified as required by the Underground Damage Prevention Act. All damage to such structures and pipelines and all damage to property or persons resulting from damage to such structures and pipelines shall be borne by the Contractor and shall be completely repaired within a reasonable time. No claim shall be made against the Owner for damage or delay of the work on account of the proximity of, or the leakage from, such structures and pipelines. Where high pressure gas lines are to be crossed, they shall be uncovered by hand excavation methods before other excavation near them is started.
3. Utility Owners may, at their option, have representatives present to supervise excavation in the vicinity of their utilities. The cost of such supervision, if any, shall be borne by the Contractor.
4. Conflicts with underground utilities may necessitate changes in alignment and/or grade of this construction. All such changes will be approved by the Engineer before construction proceeds.
5. When underground obstructions not shown on the Plans are encountered, the Contractor shall promptly report the conflict to the Engineer and shall not proceed with construction until the conflict is resolved.
6. All water lines shall have a minimum 18 inches of vertical separation from storm sewer.
7. Water lines shall be laid at least 10 feet laterally from existing or proposed sanitary sewers, unless local conditions or barriers prevent a 10-foot lateral separation--in which case:
 - a. The water line is laid in a separate trench, with the elevation of the bottom of the water line at least 18 inches above the top of the sanitary sewer; or
 - b. The water line is laid in the same trench as the sanitary sewer with the water line located at one side on a bench of undisturbed earth, and

with the elevation of the bottom of the water line at least 18 inches above the top of the sanitary sewer.

8. Whenever it is necessary for a water line to cross over a sanitary sewer, the water main shall be laid at such an elevation that the bottom of the water line is at least 24 inches above the top of the sanitary sewer, unless local conditions or barriers prevent an 24 inch vertical separation--in which case both the water line and the sanitary sewer shall be constructed of ferrous materials and with joints that are equivalent to water line standards for a distance of 10 feet on each side of the point of crossing.
 9. Whenever it is necessary for a water line to cross under a sanitary sewer, both the water line and the sanitary sewer shall be constructed of ferrous materials and with joints equivalent to water line standards for a distance of 10 feet on each side of the point of crossing. A section of water line pipe shall be centered at the point of crossing.
- B. All piping is to be installed in strict accordance with the manufacturer's recommendations, AWWA C600 and AWWA M41 (for ductile iron pipe and appurtenances), AWWA C605 and AWWA M23 (for PVC pipe and appurtenances) and the contract material specifications. Installation manuals from various material suppliers will be furnished to the Engineer for his review and approval prior to installation of any materials. The Engineer may augment any manufacturer's installation recommendations if, in his opinion, it will best serve the interest of the Owner.
 - C. All piping shall be laid with a minimum of 36 inches of soil cover over the top of the pipe.
 - D. Proper tools, implements and facilities satisfactory to the Engineer shall be provided and used for the safe and convenient prosecution of pipe laying. All pipe, fittings, valves, and other materials used in the laying of pipe will be lowered into the trench piece by piece by means of suitable equipment in such a manner to prevent damage to the pipe, materials, to the protective coating on the pipe materials, and to provide a safe working condition to all personnel in the trench. Each piece of pipe being lowered into the trench shall be clean and free of defects. It shall be laid on the prepared foundations, as specified elsewhere to produce a straight line on a uniform grade, each pipe being laid so as to form a smooth and straight inside flow line.
 - E. Pipe shall be removed at any time if broken, injured or displaced in the process of laying same, or of backfilling the trench.
 - F. When cutting short lengths of pipe, a pipe cutter, as approved by the Engineer, will be used and care will be taken to make the cut at right angles to the center line of the pipe or on the exact skew as shown on the plans. In the case of push-on

pipe, the cut ends shall be tapered with a portable grinder or coarse file to match the manufactured taper.

- G. All pipe joints shall be constructed in strict accordance with the pipe manufacturer's specifications and materials and any deviation must have prior approval of the Engineer.
- H. The maximum deflection per joint of flexible joint pipe shall be that deflection recommended by the manufacturer. However, at no time will a deflection greater than 3 degrees (11 inches in an 18'-0" pipe section) be allowed.
- I. Detectable warning tape and copper tracer wire shall be installed over all piping.
- J. Exposed Piping:
 - 1. All exposed piping to be installed inside tanks, wetwells, vaults and buildings shall be installed as shown on the Drawings and field painted as described below. All exposed pipe shall be ductile iron utilizing flanged joints unless otherwise noted.
 - 2. All exposed ductile iron pipe, fittings and valves shall be field painted in accordance with Section 099000. Color of paint shall be as selected by the Owner.
- K. Horizontal Directional Drilling of HDPE Water Pipe:
 - 1. The Contractor may install HDPE water piping by means of horizontal directional drilling where shown on the Drawings. The Contractor shall assemble, support, and pretest the pipeline prior to installation in the directional drill tunnel.
 - 2. Horizontal directional drilling shall consist of the drilling of a small diameter pilot hole from one end of the alignment to the other, followed by enlarging the hole diameter for the pipeline insertion. The exact method and techniques for completing the directionally drilled installation will be determined by the Contractor, subject to the requirements of these specifications.
 - 3. The Contractor shall prepare and submit a plan to the Engineer describing the insertion of the HDPE pipe into the opened bore hole. The plan shall include pullback procedure, ballasting, use of rollers, side booms and side rollers, coating protection, internal cleaning, internal gauging, hydrostatic tests, dewatering, and purging.
 - 4. The required piping shall be assembled in a manner that does not obstruct adjacent roadways or public activities. The Contractor shall erect temporary fencing around the entry and exit pipe staging areas.

5. Each length of pipe shall be inspected and cleaned as necessary to be free of debris immediately prior to joining.
6. Pipes shall be joined to one another by means of thermal butt-fusion. Polyethylene pipe lengths to be joined by thermal butt-fusion shall be of the same type, grade, and class of polyethylene compound and supplied from the same raw material supplier.
7. Mechanical connections of the polyethylene pipe to auxiliary equipment shall be through flanged connections which shall consist of the following:
 - a. A polyethylene "sub end" shall be thermally butt-fused to the ends of the pipe.
 - b. Provide ASTM A240, Type 304 stainless steel backing flange, Class 125, ANSI B16.1 standard, and gaskets as required by the manufacturer.
 - c. Stainless steel bolts and nuts of sufficient length to show a minimum of three complete threads when the joint is made and tightened to the manufacturer's standard. Retorque the nuts after 4 hours.
 - d. Butt-fusion of pipes shall be performed in accordance with the manufacturer's recommendation as to equipment and technique. Butt-fusion jointing shall be 100 percent efficient offering a joint weld strength equal to or greater than the tensile strength of the pipe.
8. Pipe installed by the directional drilled method must be located in plan as shown on the drawings, and must be no shallower than shown on the drawings unless otherwise approved. The Contractor shall plot the actual horizontal and vertical alignment of the pilot bore at intervals not exceeding 30 feet. The "Record Drawing" plan and profile shall be updated as the pilot bore is advanced. The Contractor shall at all times provide and maintain instrumentation that will accurately locate the pilot hole and measure drilling fluid flow and pressure. The Contractor shall grant the Engineer access to all data and readout pertaining to the position of the bore head and the fluid pressure and flows.
9. When requested, the Contractor shall provide explanations of this position monitoring and steering equipment. The Contractor shall employ experienced personnel to operate the directional drilling equipment and, in particular, the position monitoring and steering equipment. No information pertaining to the position or inclination of the pilot hole bores shall be withheld from the Engineer.
10. Each exit point shall be located as shown with an over-length tolerance of 10 feet for directional drills of 1,000 linear feet or less and 40 feet for directional drills of greater than 1,000 linear feet and an alignment tolerance

of 5 feet left/right with due consideration of the position of the other exit points and the required permanent easement. The alignment of each pilot bore must be approved by the Engineer before pipe can be pulled. If the pilot bore fails to conform to the above tolerances, the Engineer may, at his option, require a new pilot boring to be made.

11. After the pipe is in place, cleaning pigs shall be used to remove residual water and debris. After the cleaning operation, the Contractor shall provide and run a sizing pig to check for anomalies in the form of buckles, dents, excessive out-of-roundness, and any other deformations. The sizing pig run shall be considered acceptable if the survey results indicate that there are no sharp anomalies (e.g. dents, buckles, gouges, and internal obstructions) greater than 2 percent of the nominal pipe diameter, or excessive ovality greater than 5 percent of the nominal pipe diameter. For gauging purposes, dent locations are those defined above which occur within a span of 5 feet or less. Pipe ovality shall be measured as the percent difference between the maximum and minimum pipe diameters. For gauging purposes, ovality locations are those defined above which exceed a span of 5 feet.
12. Reaming: Reaming operations shall be conducted to enlarge the pilot bore after acceptance of the pilot bore. The number and size of such reaming operations shall be conducted at the discretion of the Contractor.
13. Pulling Loads: The maximum allowable pull exerted on the HDPE pipelines shall be measured continuously and limited to the maximum allowed by the pipe manufacturer so that the pipe or joints are not over stressed.
14. Torsion and Stresses: A swivel shall be used to connect the pipeline to the drill pipe to prevent torsional stresses from occurring in the pipe.
15. The lead end of the pipe shall be closed during the pullback operation.
16. Pipeline Support: The pipelines shall be adequately supported by rollers and side booms and monitored during installation so as to prevent over stressing or buckling during pullback operation. Such support/rollers shall be spaced at a maximum of 60 feet on centers, and the rollers to be comprised of a non-abrasive material arranged in a manner to provide support to the bottom and bottom quarter points of the pipeline allowing for free movement of the pipeline during pullback. Surface damage shall be repaired by the Contractor before pulling operations resume.
17. The Contractor shall at all times handle the HDPE pipe in a manner that does not over stress the pipe. Vertical and horizontal curves shall be limited so that wall stresses do not exceed 50 percent of yield stress for flexural bending of the HDPE pipe. If the pipe is buckled or otherwise damaged, the damaged section shall be removed and replaced by the Contractor at

his expense. The Contractor shall take appropriate steps during pullback to ensure that the HDPE pipe will be installed without damage.

18. During drilling, reaming, or pullback operations, the Contractor shall make adequate provisions for handling the drilling fluids, or cuttings at the entry and exit pits. To the greatest extent practical, these fluids must not be discharged into the waterway. When the Contractor's provisions for storage of the fluids or cuttings on site are exceeded, these materials shall be hauled away to a suitable legal disposal site. The Contractor shall conduct his directional drilling operation in such a manner that drilling fluids are not forced through the subbottom into the waterway. After completion of the directional drilling work, the entry and exit pit locations shall be restored to original conditions. The Contractor shall comply with all permit provisions.
19. Pits constructed at the entry or exit point area shall be so constructed to completely contain the drill fluid and prevent its escape to the beach or waterway.
20. The Contractor shall utilize drilling tools and procedures which will minimize the discharge of any drill fluids. The Contractor shall comply with all mitigation measures listed in the required permits and elsewhere in these specifications.
21. To the extent practical, the Contractor shall maintain a closed loop drilling fluid system.
22. The Contractor shall minimize drilling fluid disposal quantities by utilizing a drilling fluid cleaning system which allows the returned fluids to be reused.
23. As part of the installation plan specified herein before, the Contractor shall submit a drilling fluid plan which details types of drilling fluids, cleaning and recycling equipment, estimated flow rates, and procedures for minimizing drilling fluid escape.
24. All drilling operations shall be performed by supervisors and personnel experienced in horizontal directional drilling. All required support, including drilling tool suppliers, survey systems, mud cleaning, mud disposal, and other required support systems used during this operation shall be provided by the Contractor.
25. A smoothly drilled pilot hole shall follow the design of the pipe profile and alignment described on the construction drawings.
26. The position of the drill string shall be monitored by the Contractor with the downhole survey instruments. Contractor shall compute the position in the X, Y, and Z axis relative to ground surface from downhole survey data a minimum of once per length of each drilling pipe (approximately 31 foot interval). Deviations from the acceptable tolerances described in the

specifications shall be documented and immediately brought to the attention of the Engineer for discussion and/or approval. The profile and alignment defined on the construction drawings for the bore holes define the minimum depth and radius of curvature. The Contractor shall maintain and provide to the Engineer, upon request, the data generated by the downhole survey tools in a form suitable for independent calculation of the pilot hole profile.

27. Between the water's edge and the entry or exit point the Contractor shall provide and use a separate steering system employing a ground survey grid system, such as "TRU-TRACKER" or equal wherever possible. The exit point shall fall within a rectangle 10 wide and 40 feet long centered on the planned exit point.
28. During the entire operation, waste and leftover drilling fluids from the pits and cuttings shall be dewatered and disposed of in accordance with all permits and regulatory agencies requirements. Remaining water shall be cleaned by Contractor to meet permit requirements.
29. Technical criteria for bentonite shall be as given in API Spec. 13A, Specification for Oil Well Drilling Fluids Material for fresh water drilling fluids. Any modification to the basic drilling fluid involving additives must describe the type of material to be used and be included on Contractor's drilling plan presented to the Engineer. The Owner retains the right to sample and monitor the waste drilling mud, cuttings, and water.
30. The horizontal directional drilling operation is to be operated in a manner to eliminate the discharge of water, drilling mud and cuttings to the adjacent creek or land areas involved during the construction process. The Contractor shall provide equipment and procedures to maximize the recirculation or reuse of drilling mud to minimize waste. All excavated pits used in the drilling operation shall be lined by Contractor with heavy-duty plastic sheeting with sealed joints to prevent the migration of drilling fluids and/or ground water.
31. The Contractor shall visit the site and must be aware of all structures and site limitations at the directional drill crossing and provide the Engineer with a drilling plan outlining procedures to prevent drilling fluid from adversely affecting the surrounding area.
32. The general work areas on the entry and exit sides of the crossing shall be enclosed by a berm to contain unplanned spills or discharge.
33. Waste cuttings and drilling mud shall be processed through a solids control plant comprised as a minimum of sumps, pumps, tanks, desalter/desander, centrifuges, material handlers, and haulers all in a quantity sufficient to perform the cleaning/separating operation without interference with the

drilling program. The cuttings and excess drilling fluids shall be dewatered by the Contractor to the extent necessary for disposal in offsite landfills. Water from the dewatering process shall be treated by the Contractor to meet permit requirements and disposed of legally. The cuttings and water for disposal are subject to being sampled and tested. The construction site and adjacent areas will be checked frequently for signs of unplanned leaks or seeps.

34. Equipment (graders, shovels, etc.) and materials (such as groundsheets, hay bales, booms, and absorbent pads) for cleanup and contingencies shall be provided in sufficient quantities by the Contractor and maintained at all sites for use in the event of inadvertent leaks, seeps, or spills.
35. Waste drilling mud and cuttings shall be dewatered, dried, and stock piled such that it can be loaded by a front end loader, transferred to a truck and hauled offsite to a suitable legal disposal site. The maximum allowed water content of these solids is 50 percent of weight.
36. Due to a limited storage space at the worksites, dewatering and disposal work shall be concurrent with drilling operations. Treatment of water shall satisfy regulatory agencies before it is discharged.

3.4 THRUST BLOCK INSTALLATION

- A. All plugs, caps, tees, bends, and other fittings shall be provided with adequate thrust blocks. Thrust blocks shall be constructed to the minimum dimensions shown on the drawings or as directed by the Engineer. Thrust blocks shall be made of ready mix concrete having a compressive strength of 28 days of 3,000 PSI and shall bear directly against the undisturbed trench wall. Where possible, the concrete shall be so placed that the fitting joints will be accessible for repair. All bolts and pipe joints shall be protected against contact with thrust block concrete by the installation of a 20 mil polyethylene film placed between the fittings and the concrete. Where any section of a main is provided with concrete thrust blocks, the hydrostatic pressure test shall not be made until three days after installation of the concrete thrust blocks unless otherwise approved by the Engineer. Where trench conditions are, in the opinion of the Engineer, unsuitable for thrust blocks, the Contractor shall provide steel tie rods and socket clamps to adequately anchor the piping. All tie rods and clamps shall be given a bituminous protective coating or shall be galvanized.
- B. Concrete for thrust blocks shall consist of a ready mix of Portland Cement, fine and coarse aggregate, and water to produce concrete with a minimum compressive strength at 28 days of not less than 3,000 PSI when tested in accordance with ASTM C39. Sakrete or any similar material will not be permitted under any circumstances.

3.5 VALVE INSTALLATION

- A. All valves shall be installed in accordance with the manufacturer's instructions. Before setting each valve, the Contractor shall make sure the interior is clean and test opening and closing. Valves shall be set with stems plumb, unless horizontal installation is called for on the plans, and at the exact locations shown. Trench backfill shall be tamped thoroughly for a distance of 3'-0" on each side of valves boxes.

3.6 VALVE BOX INSTALLATION

- A. All valve boxes shall be installed in accordance with the manufacturer's instructions. A valve box shall be installed over each underground valve. All boxes shall be installed in accordance with the manufacturer's instructions and set plumb with their top flush with finished grade.

3.7 FIRE HYDRANT INSTALLATION

- A. All fire hydrants shall be installed in accordance with the manufacturer's instructions. Fire hydrants shall be located as shown. Each hydrant shall be connected to the main with a 6-inch branch line having at least as much cover as the distribution main. Hydrants shall be set plumb with the pumper nozzle facing the roadway and with the center of the lowest outlet not less than 18 inches above the finished grade. Hydrants shall be rodded to the 6-inch branch tee. Unless otherwise specified, the backfill around hydrants shall be thoroughly compacted to the final grade immediately after installation in order to put the hydrant into service as soon as practicable. Not less than nine (9) cubic feet of clean crushed stone shall be placed around the base of the hydrant to insure drainage of the hydrant barrel. A 12" x 12" x 6" solid concrete block or pad shall be set under the fire hydrant foot for a solid bottom.

3.8 AIR RELIEF VALVE INSTALLATION

- A. All air relief valves shall be installed in accordance with the manufacturer's recommendations at locations shown and in accordance with details provided on the Project Plans.
- B. All air relief valve shall be installed in a precast concrete manhole as shown in detail on the plans. Manhole sections shall be set plumb and on a firm foundation. Each joint between sections and all wall openings shall be sealed inside and out with a 2:1 sand-cement mortar and made watertight. When so directed, the Contractor shall install a flat slab top, precast with a standard frame and cover. Flat slab tops shall be traffic bearing unless noted otherwise.

3.9 CONNECTIONS TO EXISTING WATER SYSTEMS

- A. Connections to existing water distribution systems will be allowed when proper precautions are taken to protect the existing system. The Contractor shall be responsible for determining and utilizing all measures required by the water utility Owner in tapping existing water mains. The Contractor shall also make appropriate arrangements with the water utility Owner based on the size and location of the tap indicated on the drawings.
- B. If the proposed water extension does not begin at an existing valve, a new tapping sleeve and valve of the size specified shall be installed at the required location as specified. All tapping sleeves and valves shall be installed in accordance with MSS SP-60. Alternately, if water service interruption is acceptable to the Owner, a valve may be installed at the appropriate location in the existing water piping.
- C. The Contractor shall be responsible for installing all backflow prevention devices or other “jumpers” as may be required by the Plans or the water utility Owner at the point of connection with the existing water system. For extensions of the existing system, the valve isolating the new system from the existing system will not be opened until all other water system construction has been completed, satisfactorily passed all testing in compliance with these specifications, and been certified by the Engineer unless specifically authorized by the water utility Owner.

3.10 INSTALLING NEW WATER SERVICE LINES

- A. For extensions of the existing water system, all buildable lots adjacent to the extension shall have a water service line provided unless otherwise directed. Additional service lines may be installed by the Contractor as directed and authorized by the Engineer.
- B. All water service connections and their associated appurtenances shall conform to the latest revision of AWWA C800.
- C. In general, service lines shall be constructed from the public water system to a point located at the edge of the public right-of-way or the water easement. Domestic service lines shall consist of a ¾- inch (for a single service) or 1-inch diameter pipe (for a double service), as listed in the Bid Schedule and/or shown on the Plans.
- D. The standard water service connection shall be Type “K” flexible copper tubing unless shown otherwise on the drawings, and shall connect to the main at a brass corporation stop tapped into the main line.
- E. The Owner-maintained portion of each water service line shall have a minimum of 3 feet of cover.

- F. The meter box unit shall be a complete unit with all pipe nipples, valves, yoke, and bottom installed and connected prior to delivery.

3.11 REINSTATING EXISTING WATER SERVICE LINES

- A. Where existing water mains are being rehabilitated, water service lines shall be constructed for each property that is occupied by a business or dwelling if it is currently served by the system being rehabilitated.
- B. The Contractor shall be responsible to locate and connect all existing water service lines to the new main. In the event a service is missed during construction, the Contractor shall return to the site and perform all work necessary to reinstate the connection. The Contractor will be compensated in accordance with the original contract unit pricing; however, re-mobilization to the site will not be paid for.

3.12 JOINT CONSTRUCTION

- A. Make pipe joints in accordance with the following requirements:
 - 1. Gasketed joints for ductile-iron water piping shall be made in accordance with AWWA C600 and AWWA M41.
 - 2. Gasketed joints for PVC piping shall be made using jointing materials in accordance with AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D2774 or ASTM D3139 and pipe manufacturer's written instructions.
 - 3. Pressure-sealed joints for copper tubing shall be made using proprietary crimping tool and procedure recommended by copper, pressure-seal-fitting manufacturer.

3.13 FIELD QUALITY CONTROL

- A. Testing:
 - 1. After the pipeline has been satisfactorily constructed, complete with the required fire hydrants, services, and all other appurtenances, and the trench sufficiently backfilled, the newly constructed pipeline and valved sections shall be subjected to hydrostatic pressure tests in strict accordance with AWWA C600 (for ductile iron pipe and appurtenances), AWWA C605 (for PVC pipe and appurtenances), and the contract material specifications. Valves shall be closed or line plugged at both ends of each completed section of the pipeline slowly filled with potable water. At no time shall more than 4,000 linear feet of main be tested. As the main is being filled with

water in preparation of the tests, all air shall be expelled from the pipe. The main shall be subjected to a maximum hydrostatic pressure of 200 pounds per square inch (at the lowest point of the line section under test) and minimum 150 psi at the high point of the test section for a period of two (2) hours. In no case shall the test pressure exceed the rated working pressure of any joints, restraints, valves, or fittings. Pressure shall be applied to the main by means of a hand pump for small lines or by use of a gasoline pump or fire engine for larger lines.

2. The Contractor shall be responsible for paying any costs that may be associated with the water utilized in the flushing, testing and sterilization process in accordance with the requirements of the authorities having jurisdiction. Any costs associated with paying for this water shall be incorporated into the unit price for water line installation.
3. Air removal: Before applying the specified test pressure, air shall be expelled completely from the section of piping under test. If permanent air vents are not located at all high points, corporation cocks shall be installed at these points to expel the air as the line is filled with water. After the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of a successful pressure test, the corporation cocks shall be removed and the pipe plugged.
4. Examination: Any exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damage or defective pipe, fittings, valves, hydrants, or joints that are discovered following the pressure test shall be repaired or replaced with reliable material, and the test shall be repeated until satisfactory results are obtained.
5. Testing of all services, their appurtenances and all valves (regardless of type) shall conform to the appropriate AWWA standard.
6. The test allowance shall be determined at 15-minute intervals by means of volumetric measurement of the water added during the test until the rate has stabilized at the constant value for three consecutive 15-minute periods.
7. Test allowance is defined as the quantity of water to be supplied into the newly laid pipe, or any valved section thereof, necessary to maintain the specified test pressure after the pipe has been filled with water and the air expelled. Allowable leaking within the new water line shall be determined using the following equation:

$$L = \frac{SDP^{0.5}}{148,000}$$

Where: L = testing allowance (makeup water), in gallons per hour
S = length of pipe tested, in feet
D = nominal diameter of the pipe, in inches

P = average test pressure during the hydrostatic test, in pounds per square inch (gauge)

8. The allowable leakage for various pipe sizes and test pressures is graphically represented below:

ALLOWABLE MAKEUP WATER PER 1,000 FEET OF PIPELINE (Gallons/Hour)														
TEST PRESSURE (P.S.I.)	PIPE DIAMETER													
	2	3	4	6	8	10	12	14	16	18	20	24	30	36
100	0.14	0.20	0.27	0.41	0.54	0.68	0.81	0.95	1.08	1.22	1.35	1.62	2.03	2.43
125	0.15	0.23	0.30	0.45	0.60	0.76	0.91	1.06	1.21	1.36	1.51	1.81	2.27	2.72
150	0.17	0.25	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49	1.66	1.99	2.48	2.98
175	0.18	0.27	0.36	0.54	0.72	0.89	1.07	1.25	1.43	1.61	1.79	2.15	2.68	3.22
200	0.19	0.29	0.38	0.57	0.76	0.96	1.15	1.34	1.53	1.72	1.91	2.29	2.87	3.44
225	0.20	0.30	0.41	0.61	0.81	1.01	1.22	1.42	1.62	1.82	2.03	2.43	3.04	3.65
250	0.21	0.32	0.43	0.64	0.85	1.07	1.28	1.50	1.71	1.92	2.14	2.56	3.21	3.85
275	0.22	0.34	0.45	0.67	0.90	1.12	1.34	1.57	1.79	2.02	2.24	2.69	3.36	4.03
300	0.23	0.35	0.47	0.70	0.94	1.17	1.40	1.64	1.87	2.11	2.34	2.81	3.51	4.21

9. No leakage will be allowed under the above tests for piping in buildings and structures.
10. Cracked or defective pipe, joints, fittings, valves, or hydrants discovered in consequence of this test shall be removed and replaced with sound materials, and the test shall be repeated until the test results are satisfactory. Precautions shall be taken to remove or otherwise protect equipment in, or attached to, pipe to prevent damage or injury thereto.
11. Tests of insulated and concealed piping shall be made before the piping is covered or concealed. No leakage will be allowed under the above tests for piping under or in buildings.
12. The Contractor shall notify the Engineer when the work is ready for testing with all testing done in the presence of the Engineer. All labor, equipment, water and materials, including meters and gauges shall be furnished by the Contractor at his own expense.
13. When hydrants are in the test section, the test shall be made against the main valve in the hydrant.

B. Sterilization:

1. After the pressure-leakage test is completed and before the use of water is permitted from any portion of newly constructed water line which will hold or carry potable water, it shall be flushed, cleaned and chlorinated in the presence of and as directed by the Engineer or his Representative.
2. Pipelines may, at the option of the Contractor, be chlorinated in sections isolated by means of gate valves or other approved means.
3. Each unit of the completed water line shall be sterilized as specified below as prescribed by AWWA C651 "continuous feed" method. The unit to be sterilized shall be thoroughly flushed with water until all entrained dirt and mud have been removed before introducing the chlorinating material. The chlorinating material shall provide a chlorine dosage of not less than 50 PPM and shall be introduced into the water line in an approved manner. The retention time shall be at least 24 hours and shall produce not less than 25 PPM of chlorine at the extreme end of the line at the end of the retention period. All valves on the lines being sterilized shall be opened and closed several times during the contact period.
4. Following chlorination, all treated water shall be thoroughly flushed from the pipe until the replacement water shall, upon test, both chemically and bacteriologically, be proven equal to the water quality served to the public from the existing water supply system, and be approved by authorities having jurisdiction. The Contractor shall be responsible for taking the necessary precautions, such as dechlorination, to ensure that the flushing does not harm the environment and complies with all appropriate regulatory requirements. The Contractor shall pay for all bacteriological testing costs. Bacteriological tests shall be performed by a State Approved Laboratory.
5. During the flushing period, each fire hydrant on the line shall be opened and closed several times to remove potential concentrations of chlorinated water. The Contractor shall arrange for the collection of water samples in properly sterilized containers for bacterial examination and shall coordinate the testing of collected samples. The requirements of AWWA C651 shall dictate the number and locations of samples to be collected and tested based on the length and configuration of the constructed system. No water samples shall be collected from a fire hydrant. All cost for testing shall be included in the unit price for water line installation. Prior to acceptance of the water system improvements, two (2) complete, consecutive sets of samples, collected at least 16 hours apart, must pass the required bacteriological testing or the sterilization process repeated until these results are achieved. Test results shall be provided to the Engineer by the authorized testing agency/firm immediately upon completion of the testing procedure.

6. Final connections to existing mains shall be made where indicated on the drawings or as directed after satisfactory samples have been obtained.

END OF SECTION 332660

PART 1 - GENERAL**1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe and fittings.
 - 2. Nonpressure transition couplings.
 - 3. Pressure pipe couplings.
 - 4. Expansion joints and deflection fittings.
 - 5. Drains.
 - 6. Encasement for piping.
 - 7. Manholes.
 - 8. Channel drainage systems.
 - 9. Catch basins.
 - 10. Stormwater inlets.
 - 11. Stormwater detention structures.
 - 12. Pipe outlets.
 - 13. Stormwater disposal systems.

1.3 DEFINITIONS

- A. AASHTO: American Association of State Highway and Transportation Officials
- B. CMP: Corrugated Metal Pipe.
- C. FRP: Fiberglass-reinforced plastic.
- D. HDPE: High Density Polyethylene.
- E. NCDOT: North Carolina Department of Transportation.
- F. RCP: Reinforced Concrete Pipe.

1.4 SUBMITTALS

- A. Shop Drawings: The Contractor shall submit at least six (6) copies of shop drawings to the Engineer, including dimensional drawings, materials of construction, catalogue cut sheets, and other pertinent information.

1.5 QUALITY ASSURANCE

- A. All materials shall be manufactured by suppliers with at least five (5) years of experience in the manufacture of similar materials.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. All materials shall be delivered, stored and handled in strict accordance with the manufacturer's recommendations, and in a manner which preserves the structural integrity of the materials.
- B. Do not store plastic materials in direct sunlight.
- C. Protect pipe, pipe fittings, and seals from dirt and damage.
- D. Handle concrete drainage structures according to manufacturer's written rigging instructions.

1.7 WARRANTY

- A. All materials and equipment shall be warranted to be free from defects in workmanship and materials for one (1) year after Owner's acceptance.

1.8 PROJECT CONDITIONS

- A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Engineer no fewer than three days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of service without Engineer's written permission.

PART 2 - PRODUCTS

2.1 CORRUGATED STEEL PIPE AND FITTINGS

- A. Corrugated-Steel Pipe and Fittings: AASHTO M-36, Type 2, except as modified by NCDOT 1032-3 corrugated steel with rerolled ends.
- B. Pipe shall be furnished with manufacturer's "hugger type" coupling bands. The use of dimple bands will not be allowed.
- C. All corrugated metal pipe shall have 2-2/3-inches by 1/2 inch corrugations.
- D. Pipe 18-inches and smaller in diameter shall be 16 gauge.
- E. Pipes 21-inches through 30-inches in diameter shall be 14 gauge.
- F. Pipes 36-inches through 48-inches in diameter shall be 12 gauge.
- G. Pipes 48-inches and larger in diameter shall be 10 gauge.
- H. When shown on the drawings, pipes shall be furnished with full or partial bituminous coatings and/or paved in accordance with NCDOT 1032-4. Bituminous coatings, where required by the drawings, shall consist of asphalt cement having a minimum thickness of 0.04-inches measured at the crest of the corrugations. Paved inverts in corrugated metal pipe, where required by the drawings, shall consist of asphalt cement applied on the inside of the pipe for one quarter of its circumference (bottom of pipe when installed). The pavement shall have a minimum thickness of 0.50 inches tapering to 0.1 inches at the sides.

2.2 CORRUGATED ALUMIUM ALLOY PIPE AND FITTINGS

- A. Corrugated-Steel Pipe and Fittings: AASHTO M196, Type 2, and NCDOT 1032-2 aluminized corrugated steel with rerolled ends.
- B. Pipe shall be furnished with manufacturer's "hugger type" coupling bands. The use of dimple bands will not be allowed.
- C. Pipes 24-inches and smaller in diameter shall be 16 gauge.
- D. Pipes 30 inches through 42-inches in diameter shall be 14 gauge.
- E. Pipes larger than 42-inches in diameter shall be 12 gauge.

2.3 HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS

- A. Corrugated HDPE Pipe and Fittings (12-inch to 60-inch): AASHTO M294, Type S, with smooth interior wall, with watertight joints.
- B. Pipe and fittings shall be made of virgin polyethylene compounds that comply with the cell classification 435400C, as defined and described in ASTM D3350, except that carbon black content should not exceed 4%. The 12-inch through 24-inch virgin pipe material shall comply with the notched constant ligament-stress (NCLS) test as specified in Sections 9.5 of AASHTO M294.

2.4 CONCRETE PIPE AND FITTINGS

- A. Reinforced Concrete Pipe: ASTM C-76, Class III, with Wall Type B, and AASHTO M170, except as modified by NCDOT 1032-9, paragraph B.
- B. All pipe shall have interior surfaces free from roughness, projection, indentations, offset or irregularities of any kind.
- C. Joint material for reinforced concrete pipe shall be either "O" ring type joints utilizing a rubber "O" ring, or bell and spigot type utilizing a mastic joint material as provided by the pipe manufacturer.

2.5 MANHOLES

- A. Standard precast concrete manholes sections shall conform to the latest revision of ASTM C 478. Tapered section and transition sections, where required, shall be of eccentric cone design, having the same wall thickness and reinforcement as the cylindrical ring sections. Flat slab tops shall be required for very shallow manholes where shown or specified. Flat slab tops shall ONLY be utilized when/where approved for use by the Engineer. All manholes shall be constructed to the sizes, shapes and dimensions and at the locations shown on the plans. Unless otherwise shown on the plans, manhole diameters, wall thicknesses and bottom thicknesses shall be as follows:

Pipe Size (inches)	Diameter (feet)	Wall Thickness (inches)	Bottom Thickness (inches)
8 through 18	4	5	6
21 through 36	5	5	8
39 through 54	6	6	8
Larger than 54	8	8	8

- B. The minimum wall thickness of all manhole riser sections shall be as shown in the table above. Cone sections shall have a minimum wall thickness of 8 inches at their top. Suitable openings for inlet and outlet pipes shall be cast into

the base section for standard connections and into the riser section for drop connections. These openings shall be circular, accurately located and appropriately sized for each manhole.

- C. When indicated on the drawings, precast concrete base sections shall be provided with extended base sections or increased bottom thickness to provide ballast to prevent flotation. When necessary, this ballast shall be provided as shown on the drawings and incorporated into the manhole base section as a monolithic pour.
- D. Minimum compressive strength of concrete shall be 4,000 psi at 28 days and shall comply with ACI 318, and ACI 350. The maximum permissible absorption shall be 6.0 percent. All cement used in the mixture shall be in accordance with ASTM C 150, Type II. Fine aggregate shall be sand, while coarse aggregate shall be crushed gravel, both in accordance with ASTM C 33. All water utilized in the concrete mix shall be potable water. Risers shall be reinforced with a single cage of steel placed within the center third of the wall. Welded wire fabric shall be in accordance with ASTM A 185. Steel reinforcing bars shall be grade 60 deformed steel in accordance with ASTM A 615. The tongue or the groove of the joint shall contain one (1) line of circumferential reinforcement equal in area to that in the barrel of the manhole riser. The minimum cross sectional area of steel per linear foot shall be 0.12 square inches. Precast manhole sections shall fit together readily.
- E. The quality of materials, the process of manufacture, and the finished manhole sections shall be subject to inspection and approval by the Engineer and his Construction Field Representative. The manhole sections shall be perpendicular to their longitudinal axis within the limits listed in ASTM C 478.
- F. Joint Sealing Materials: Joints shall be sealed by two (2) butyl rubber seals. Each seal shall be as described below:
 - 1. Butyl Seals shall consist of a plastic or paper-backed butyl rubber rope no less than 1 inch cross section. When manholes are larger than 4 feet diameter or have a larger than normal space between the joints, the length and or diameter of the rope shall be increased as required to achieve a seal. Butyl rubber material shall conform to Federal Specification SS-S210A, AASHTO M-198, Type B - Butyl Rubber and as follows: maximum of 1 percent volatile matter and suitable for application temperatures between 10 and 100 degrees F. Butyl rubber shall be applied to clean, dry surfaces only. Use of 2 independent wraps of Butyl Rubber qualifies for the requirement of two seals.
 - 2. Internal O-Ring Gaskets and Internal Rubber Gaskets shall not be used.

G. Manhole Steps

1. Steps shall be a copolymer polypropylene plastic reinforced with a ½ inch diameter, grade 60 bar and have serrated tread and tall end lugs. Step pull out strength shall be a minimum of 2,000 pounds when tested according to ASTM C-497.
2. Steps shall be required in all structures with a depth greater than four (4) feet. Steps shall be vertically aligned and uniformly spaced for the entire depth of the structure. Steps shall be located in the structures along the vertical face of the eccentric cone and so as to land upon a bench.
3. Steps shall be vertically spaced between twelve (12) and sixteen (16) inches on center. Step width shall be a minimum of twelve (12) inches. Steps shall protrude from the wall of the structure a minimum of five (5) inches and a maximum of seven (7).
4. Secure steps to the wall with a compression fit in tapered holes. Steps shall not be vibrated or driven into freshly cast concrete. Steps shall not be grouted in place.

H. Precast Grade Rings and Brick

1. Precast reinforced concrete grade rings or brick shall be used to adjust ring and covers to finished grade. No more than 12 vertical inches of grade rings or brick will be allowed per manhole. Grade rings shall conform to ASTM C478 and shall be no less than 6 inches and no more than 9 inches in height with a diameter matching that of the frame and cover.
2. All brick used shall be solid and shall be made from Concrete, Clay, or Shale, and shall be of standard building size.

2.6 **CONCRETE**

- A. General: Cast-in-place concrete according to ACI 318, ACI 350/350R, and the following:
 1. Cement: ASTM C 150, Type II.
 2. Fine Aggregate: ASTM C 33, sand.
 3. Coarse Aggregate: ASTM C 33, crushed gravel.
 4. Water: Potable.
- B. Portland Cement Design Mix: 4,000 psi minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185, steel, welded wire fabric, plain.
 2. Reinforcing Bars: ASTM A 615, Grade 60 deformed steel.
- C. Ballast and Pipe Supports: Portland cement design mix, 3,000 psi minimum, with 0.58 maximum water/cementitious materials ratio.
1. Reinforcing Fabric: ASTM A 185, steel, welded wire fabric, plain.
 2. Reinforcing Bars: ASTM A 615, Grade 60 deformed steel.

2.7 PRECAST CONCRETE BOXES

- A. All rectangular drainage structures shall meet the requirements of NCDOT Standard Specifications for Roads and Structures (latest edition) articles 840-1 through 840-3 as well as NCDOT Standard Detail 840.45. No waffle boxes shall be allowed. All pipe openings in precast structures must be cast or cored.
- B. Curb inlet catch basins shall conform to NCDOT Standard Details 840.02 and 840.04.
- C. Drop inlets shall conform to NCDOT Standard Detail 840.14.
- D. Junction boxes shall conform to NCDOT Standard Detail 840.31
- E. Manhole Steps
1. Steps shall be a copolymer polypropylene plastic reinforced with a ½ inch diameter, grade 60 bar and have serrated tread and tall end lugs. Step pull out strength shall be a minimum of 2,000 pounds when tested according to ASTM C-497.
 2. Steps shall be required in all structures with a depth greater than four (4) feet. Steps shall be vertically aligned and uniformly spaced for the entire depth of the structure. Steps shall be located in the structures along the vertical face of the structure.
 3. Steps shall be vertically spaced between twelve (12) and sixteen (16) inches on center. Step width shall be a minimum of twelve (12) inches. Steps shall protrude from the wall of the structure a minimum of five (5) inches and a maximum of seven (7).
 4. Secure steps to the wall with a compression fit in tapered holes. Steps shall not be vibrated or driven into freshly cast concrete. Steps shall not be grouted in place.

F. Precast Grade Rings and Brick

1. Precast reinforced concrete grade rings or brick shall be used to adjust frames and covers to finished grade. No more than 12 vertical inches of grade rings or brick will be allowed per structure. Grade rings shall conform to ASTM C478 and shall be no less than 6 inches and no more than 9 inches in height with a diameter matching that of the frame and cover.
2. All brick used shall be solid and shall be made from Concrete, Clay, or Shale, and shall be of standard building size.

2.8 FRAMES, GRATES AND HOODS

- A. All metal castings and grating shall meet the requirements of NCDOT Standard Specifications for Roads and Structures (latest edition) articles 1074-7 and 1074-9.
- B. All metal castings shall be sound and free from warp, holes and other defects that impair their strength or appearance. Exposed surfaces shall have a smooth finish and sharp, well defined lines and arises. Machined joints, where required, shall be milled to a close fit. Provide all necessary lugs and brackets so that work can be assembled in a neat, substantial manner.
- C. Frames, grates and hoods for curb inlets shall conform to NCDOT Standard Detail 840.03.
- D. Frames and grates for drop inlets shall conform to NCDOT Standard Detail 840.16.
- E. Frames and covers for junction boxes shall conform to NCDOT Standard Detail 840.54. Include indented top design with lettering cast into cover, using wording "STORM SEWER."

2.9 AGGREGATE FOR UNDERDRAINS

- A. Aggregate for underdrains shall be washed stone, standard size number 67 per North Carolina Department of Transportation specifications, Section 1005.

PART 3 - EXECUTION

3.1 EARTHWORK

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

3.2 PREPARATION OF PIPE FOUNDATION

- A. Lines and Grades: The pipe foundation shall be prepared to be uniformly firm and shall be true to the lines and grades as shown on the plans. Any deviation or field adjustments will require the approval of the Engineer. When a Construction Field Representative is present on the site and is so requested by the Contractor, he shall check the position of grades and lines; but the Contractor shall be responsible for the finished drain line being laid to exact and proper line and grade.
- B. Pipe Foundation:
 - 1. Whenever the nature of the ground will permit, the excavation at the bottom of the trench shall have the shape and dimensions of the outside lower third of the circumference of the pipe, care being taken to secure a firm bearing support uniformly throughout the length of the pipe. A space shall be excavated under and around each bell to sufficient depth to relieve it of any load and to allow ample space for filling and finishing the joint. The pipe, when thus bedded firmly, shall be on the exact grade. In case the bed shaped in the bottom of the trench is too low, the pipe shall be completely removed from position, and earth of suitable quality shall be placed and thoroughly tamped to prepare a new foundation for the pipe.
 - 2. In no case shall the pipe be brought to grade by blocking up under the barrel or bell of same, but a new and uniform support must be provided for the full length of the pipe. Where rock or boulders are encountered in the bottom of the trench, the same shall be removed to such depth that no part of the pipe, when laid to grade, will be closer to the rock or boulders than 6". A suitably tamped and shaped foundation of suitable earth shall be placed to bring the bottom of the trench to proper subgrade over rock or boulders.
 - 3. Where the foundation material is found to be of poor supporting value, the Engineer may make minor adjustment in the location of the pipe to provide a more suitable foundation. Where this is not practical, the foundation

shall be conditioned by removing the existing foundation material by undercutting to the depth as directed by the Engineer, within the limits established on the plans, and backfilling with either a suitable local material secured from unclassified excavation or borrow excavation at the nearest accessible location along the project, or foundation conditioning material consisting of crushed stone or gravel or a combination of sand and crushed stone or gravel approved by the Engineer as being suitable for the purpose intended. The selection of the type of backfill material to be used for foundation conditioning will be made by the Engineer.

- C. Water in Trenches: The Contractor shall remove all water which may be encountered or which may accumulate in the trenches by pumping or bailing and no pipes shall be laid until the water has been removed from the trench. The Contractor will not be permitted to drain water through the storm drain within a period of 24 hours after the pipe has been laid, and the open end of the pipe in the trench shall be kept closed with a tight fitting plug to prevent washing of dirt or debris into the line. Water so removed from the trench must be disposed of in such manner as not to cause injury to work completed or in progress.
- D. Special Foundations: Whenever the bottom of the trench shall be of such nature as to provide unsatisfactory foundation for the pipe, the Engineer will require the pipe to be laid on timber or concrete cradle foundations. Such foundations whether of single plank, plank cradle, plank cradle supported on piles, or poured concrete cradle, shall be placed by the Contractor and compensation will be allowed the Contractor for the materials so used.

3.3 PIPING INSTALLATION

- A. General: All piping is to be installed in strict accordance with the manufacturer's recommendations. Installation manuals from various material suppliers shall be furnished to the Engineer for his review and approval prior to installation of any material. The Engineer may augment any manufacturer's installation recommendations, if in his opinion it will best serve the interest of the Owner.
- B. Laying Pipe:
 - 1. No pipe shall be laid except in the presence of the Engineer or his Construction Field Representative or without special permission from the Engineer. Proper tools, implements, and facilities satisfactory to the Engineer shall be provided and used for the safe and convenient prosecution of pipe laying. All pipe, fittings, valves, and other materials used in the laying of pipe will be lowered into the trench piece by piece by means of suitable equipment in such a manner to prevent damage to the pipe materials, to the protective coating on the pipe materials, and to

provide a safe working condition to all personnel in the trench. Each piece of pipe being lowered into the trench shall be carefully given a final inspection to see that it is clean, sound and free of defects. It shall be laid on the prepared foundation to produce a straight line on a uniform grade, each pipe being laid as to form a close abutted joint with a preceding pipe, so as to form a smooth and straight inside flow line. Each pipe will be tested for its exact position after it is in its final position. The pipes shall be fitted together in order to insure sufficient space for joint gaskets, and other jointing material. Pipe shall be removed at any time if broken, injured or displaced in the process of laying same, or of backfilling the trench.

2. When cutting short lengths of pipe, a pipe cutter as approved by the Engineer will be used, and care will be taken to make the cut at right angles to the center line of the pipe, or on the exact skew as shown on the plans. In the case of push on pipe, the cut ends shall be tapered with a portable grinder or coarse file to match the manufactured taper.
3. When coupling bands for annular or helical corrugated metal pipe are used, the pipe sections shall be joined and fully bolted so that the circumferential and longitudinal strength will be sufficient to preserve the alignment, prevent separation of the sections, and to prevent infiltration of backfill material.

3.4 CONCRETE STRUCTURE INSTALLATION

- A. Drainage structures shall be built to the lines, grades and dimensions as shown on the plans. The Contractor shall adjust the final grades in the field as necessary to provide positive drainage to the structures or to match final pavement or grade elevation.
- B. Excavations for drainage structures shall be made with care so as not to disturb the surrounding areas more than necessary. All excavations shall be maintained water free until completion of the drainage structure, including backfilling. The Contractor shall provide adequate pumping capacity as required.
- C. Where the foundation material is found to be of poor supporting value, the existing foundation material shall be removed by undercutting to the depth directed by the Engineer and backfilled with suitable material secured from locations along the project or from a borrow pit. The backfill placed in the undercut area shall be compacted to a degree satisfactory to the Engineer.
- D. Precast concrete sections shall be lifted from the side of the excavation to the bottom of the trench with equipment and support slings capable of safely handling the weight of the concrete pieces. The structure shall be set plumb and adjusted to the final finished surface grade with brick and mortar.

- E. For cast-in-place structures the Contractor shall use care in placing rebar and concrete. Unless otherwise approved, the bottom slabs shall be poured separate from the walls. A minimum of seven (7) days cure time shall be provided between completion of pouring the bottom and the walls.
- F. Pipe openings shall be exactly aligned to that of the pipe(s) entering and/or leaving the structure. The pipe lines shall be placed in the structure openings, properly aligned, and set to grade.
- G. When existing drainage structures are constructed of concrete brick, only new, sound brick shall be used to modify those structures. Mortar mix shall be mixed on site using an approved mortar mix consisting of Portland Cement (Type S), and clean sand. Following the modification of existing drainage boxes, both the interior and exterior shall be plastered with a minimum ½-inch thick coat of Portland Cement and sand mixture.

3.5 CONCRETE PLACEMENT

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

3.6 FITTINGS AND CONNECTIONS

- A. Where fittings enter masonry, they shall be placed as the work is built up, thoroughly bonded, and accurately spaced and aligned.
- B. Pipe connections shall be cut off flush with the inside wall of the drainage structure and grouted as necessary to make smooth and uniform surfaces on the inside of the structure.
- C. Metal frames for grates and covers shall be set in full mortar beds or secured by methods approved by the Engineer.
- D. Pipe collars and pipe plugs shall be constructed in accordance with the details shown on the plans or as directed by the Engineer.

3.7 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

- A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
 - 1. Close open ends of piping with at least 8-inch thick, concrete bulkheads.
- B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:

1. Remove manhole or structure and close open ends of remaining piping.
 2. Remove top of manhole or structure down to at least 36 inches below final grade. Fill to within 36 inches of top with CABC. Fill to top with compacted earth fill.
- C. Backfill to grade according to Division 31 Section "Earth Moving."

3.8 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Upon completion, installed lines shall show a full circle of light when "Lamped" between drainage structures. This test shall be performed by the Engineer.
- B. Other tests may be required by the Engineer, such as exfiltration. In this event the results shall meet the minimum standards that the manufacturer states are obtainable.
- C. The Contractor shall demonstrate to the Owner and Engineer that all drainage structures operate as intended and designed. All drainage structures shall be field tested by the Contractor in the presence of the Engineer prior to final acceptance.
- D. Replace defective piping and structures using new materials, and repeat inspections until defects are within allowances specified.
- E. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

3.9 CLEANING

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

END OF SECTION 334100